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You Should Have Seen that Volume Variance Coming!

By Kenneth Snead, Ph.D.; David Stott, Ph.D., CPA; and Andy Garcia, Ph.D., CPA

EXECUTIVE SUMMARY

It can be difficult to estimate volume variances, but knowing what to look for and how to manage all the pieces will help you plan for the long term.

To deliver goods and services, most enterprises find they increasingly need to capture, effectively manage, and report capacity costs. These are some of the greatest challenges facing managers and accountants today. In manufacturing contexts, capacity costs are related to the production process and typically are fixed manufacturing overhead costs, such as depreciation, rent, or salaries. Firms providing services also incur capacity costs, which often take the form of IT investments, depreciation, rent, or staff salaries. In this article, we use a manufacturing context because Generally Accepted Accounting Principles (GAAP) and the Internal Revenue Service (IRS) require companies to attach capacity costs to products.

Manufacturing companies typically report two measures related to capacity costs: the fixed overhead volume variance and fixed overhead spending variance. We will consider only the volume variance. Although there is an expressed management need for details related to the costs of unused capacity, these costs typically reside as those misapplied fixed manufacturing overhead costs a company captures and reports as a fixed manufacturing overhead volume variance.[1]

Unfortunately, as traditionally computed and reported, the volume variance falls far short of enabling managers to correctly identify the causes generating this variance. Without an accurate assessment of the causes, it is unlikely that the subsequent managerial reactions to and the financial accounting treatment of the variance will be appropriate. Quite often, however, companies could have anticipated much of the fixed manufacturing overhead volume variance. Specifically, the influences of seasonality, growth, and intended nonuse of capacity on the volume variance can be determined easily prior to the onset of the reporting period. Further, under certain conditions, the volume variance impact of seasonality and growth will reverse over time.

A company can accomplish all of this by merely simultaneously considering capacity-based measures that are likely to have been identified already. So you should have seen that volume variance coming, and some of it may disappear on its own! We will discuss, by way of an example, the portions of the volume variance that should be anticipated easily, as well as the managerial and financial accounting reporting impacts of this knowledge.

Example

To illustrate, imagine your firm needs to increase the capacity of available machine hours (MH) because of a growing market for its products. Accordingly, an economic analysis is conducted to identify the most appropriate approach to acquire this capacity. While the analysis would involve many factors, clearly it would include two key ones:

1. An estimate of the increasing number of MH annually over some appropriate multiyear time horizon because of the expanding market.
2. For each approach, the number of MH the company realistically could deliver annually while making reasonable allowances for downtime and other operational inefficiencies.

Table 1 addresses the first factor and contains estimates for the annually increasing need for MH capacity over a four-year time horizon. This need for MH begins at a level of 47,300 for the first year, and it increases annually to a level of 56,008 in the fourth year.

Based on the annual MH requirements in Table 1 and a comparative analysis of approaches available to meet this need, assume the chosen approach to provide additional MH of capacity has the following attributes:

- ◆ It realistically provides 60,000 MH per year, if needed. This measure incorporates reasonable allowances for operational inefficiencies and addresses the second factor.
- ◆ Required annual fixed manufacturing overhead costs for this approach amount to $4.8 million, which includes annual charges for depreciation, incremental salaries required for production oversight, and so on. While this approach requires incremental variable manufacturing overhead as well, we focus the article on the treatment of the incremental fixed manufacturing overhead costs.

Table 1: Annual Estimates for Machine Hour (MH) Needs

Year	Estimated Annual MH Needed
1	47,300 MH
2	52,504
3	54,380
4	56,008
Total	210,192 MH

Both Table 1 and these attributes imply that the firm has intentionally decided to acquire MH capacity that is likely to remain idle during the upcoming four-year period. This decision includes the desire to provide a capacity cushion or buffer for either backup needs or for meeting customers' emergency demands. Another reason could be to acquire capacity proactively in anticipation of increasing customer demand over time.[2] While we assume the latter scenario will be the primary catalyst for this capacity acquisition, we also note that capacity is a fairly indivisible resource that the company must acquire in bundles. Thus, the capacity acquisition decision must also consider the most economically appropriate bundle size to purchase. This appropriate bundle size may be of such magnitude as to also contribute to providing capacity that is likely to remain idle.

Acquiring the incremental capacity with the previous approach has annual (inter-year) volume variance implications from two general components:

1. The Anticipated Nonuse component, under which a company acquires excess capacity with no predeter-

mined intention to use it for either a backup or cushion or simply because it was a part of the economically optimal bundle size; and

2. The Anticipated Growth component, under which a company acquires capacity that it did not need in its early years but, as a result of the expanding market, will need in its later years.

Acknowledging that you need to deal with volume variances more often than annually, the discussion now moves to include another important factor that has implications for quarterly (intra-year) volume variances—seasonality. Here we assume that you will seasonally distribute machine hours during the year, anticipating quarters two and three to be the higher-use quarters. This assumption introduces Anticipated Seasonality as another component of quarterly volume variances.

Breakdown of Measures

Table 2 reports measures that are relevant for expected MH usage by quarter for each of the four years. Note that the pattern of these measures is consistent with our assumptions. We will discuss each column heading and corresponding MH measure from right to left with regard to the information for year one (the shaded area of the table).

- The PC column represents the practical capacity of MH that realistically can be available if the company needs it. Note that the four-quarter total for this measure for year one (and all other years) is 60,000 MH. In year one, the company has distributed this measure evenly across the four quarters as it has for all other years.
- The NC column represents normal capacity of MH use and merely distributes the previously reported four-year total need for 210,192 MH evenly across all years and quarters. Thus, the share of this four-year need for year one is 52,548 MH, as it is for all years. In year one, the company distributed this measure evenly across four quarters as it has for all other years.
- The EAC column represents the expected annual capacity of MH use and distributes each year's anticipated MH need evenly across the four quarters. Thus, for year one this total is the previously specified 47,300 MH. In year one, the company distributed this measure evenly across the four quarters as it has for the annually increasing use of machine hours.
- The EQC column represents the expected quarterly capacity MH use. Note that the four-quarter total of this measure for year one is 47,300 MH. Further, distributing these 47,300 MH across the four quarters is consistent with seasonality-related assumptions that quarters two and three will require heavier utilization.

Table 2: MH Measures of Inter-Year Growth Coupled with Intra-Year Seasonality

Qtr/Year	EQC	EAC	NC	PC
Q1	11,000	11,825	13,137	15,000
Q2	12,500	11,825	13,137	15,000
Q3	13,800	11,825	13,137	15,000
Q4	10,000	11,825	13,137	15,000
Total Y1	47,300	47,300	52,548	60,000
Q1	12,210	13,126	13,137	15,000
Q2	13,875	13,126	13,137	15,000
Q3	15,000	13,126	13,137	15,000
Q4	11,419	13,126	13,137	15,000
Total Y2	52,504	52,504	52,548	60,000
Q1	12,821	13,595	13,137	15,000
Q2	14,569	13,595	13,137	15,000
Q3	15,000	13,595	13,137	15,000
Q4	11,990	13,595	13,137	15,000
Total Y3	54,380	54,380	52,548	60,000
Q1	13,206	14,002	13,137	15,000
Q2	15,000	14,002	13,137	15,000
Q3	15,000	14,002	13,137	15,000
Q4	12,802	14,002	13,137	15,000
Total Y4	56,008	56,008	52,548	60,000
Total Y1–Y4	210,192	210,192	210,192	240,000

EQC – Expected Quarterly Capacity
EAC – Expected Annual Capacity
NC – Normal Capacity
PC – Practical Capacity

Conspicuously absent from Table 2 are measures representing the actual use of machine hours. This intentional omission amplifies the point that the expected relationships among EQC, EAC, NC, and PC have significant volume variance implications that you should anticipate before you actually use the capacity. Specifically, the difference in MH between PC and EQC (PC – EQC) drives the total quarterly volume variance these capacity measures imply. You can partition this total variance into the Anticipated Seasonality component using the difference in MH between EAC and EQC (EAC – EQC), the Anticipated Growth component using the difference in MH between NC and EAC (NC – EAC), and the Anticipated Nonuse component using the difference in MH between NC and EAC (NC – EAC). Of course, this partitioning of the total volume variance and its dollarization depends on the approach to compute the fixed manufacturing overhead rate.

Fixed Manufacturing Overhead Rate

This issue involves selecting some measure of capacity over which to average estimated annual capacity costs used as the denominator for the fixed manufacturing overhead rate. Interestingly, most of the potential capacity measures considered for this purpose are the PC, NC, and EAC measures. Many people suggest that you should use PC for internal reporting purposes to avoid impounding idle capacity costs in this rate of application and ultimately into the product cost.[3] Thus, in our discussion, we will presume PC will be used for this fixed manufacturing overhead rate computation, yielding an annual rate of $80 per MH ($4.8 million/60,000 MH), given the previously specified expansion capacity cost. Even so, we need to simultaneously consider knowledge of all three capacity measures (PC, NC, and EAC) to accurately identify all causes of the volume variance that will result from using this $80 rate (see Table 3).

Table 3 presents the dollar volume variance implications of the MH measures pattern in Table 2. As with Table 2, the prospect that actual results may differ from expectations does not influence the information in Table 3. Stated differently, if all estimates related to capacity utilization for the next four years were error-free, Table 3 contains the volume variance dollars that will surface even under these perfect conditions of estimation accuracy. Thus, this assumption of estimation accuracy implies that the actual MH for each quarter and year will correspond exactly to the EQC and EAC measures, respectively. Further, the total fixed manufacturing overhead cost actually incurred each year will be $4.8 million, or $1.2 million per quarter.

Table 3 merely uses the measures in Table 2 in conjunction with the $80/MH rate of application of fixed manufacturing overhead costs to monetize all volume variance implications for each time period. We will discuss each column heading and corresponding dollar contents from left to right in the context of quarter one of year one, which appears in the shaded area of Table 3.

- Column 1, Total Volume Variance, is simply the total underapplied fixed manufacturing overhead that a company would report for a given time period. For quarter one of year one, the $320,000 is the difference between the $1.2 million of fixed manufacturing and the $880,000 of fixed manufacturing overhead that the company would apply based on using 11,000 MH at the $80/MH application rate. A mathematically equivalent approach to this computation is simply to apply the $80/MH rate to the difference between the PC and EQC measures.
- Column 2, Anticipated Seasonality Component, represents the portion of the Total Volume Variance caused by the interim-year seasonal distribution of MH. To compute the $66,000 for quarter one of year one, apply the $80/MH rate to the difference between the EAC and EQC measures.
- Column 3, Anticipated Growth Component, represents the portion of the Total Volume Variance that the increasing use of MH causes over the four-year time frame because of anticipated market growth. For quarter one of year one, apply the $80/MH rate to the difference between the NC and EAC measures, which is $104,960.
- Column 4, Anticipated Nonuse Component, represents the portion of the Total Volume Variance caused by nonuse of the practical capacity of MH available. For quarter one of year one, apply the $80/MH rate to the difference between the PC and NC measures, which is $149,040.

Table 3: Dollar Volume Variances and Components Implied by Table 2 (Assumed Overhead Rate is $80/MH based on PC)

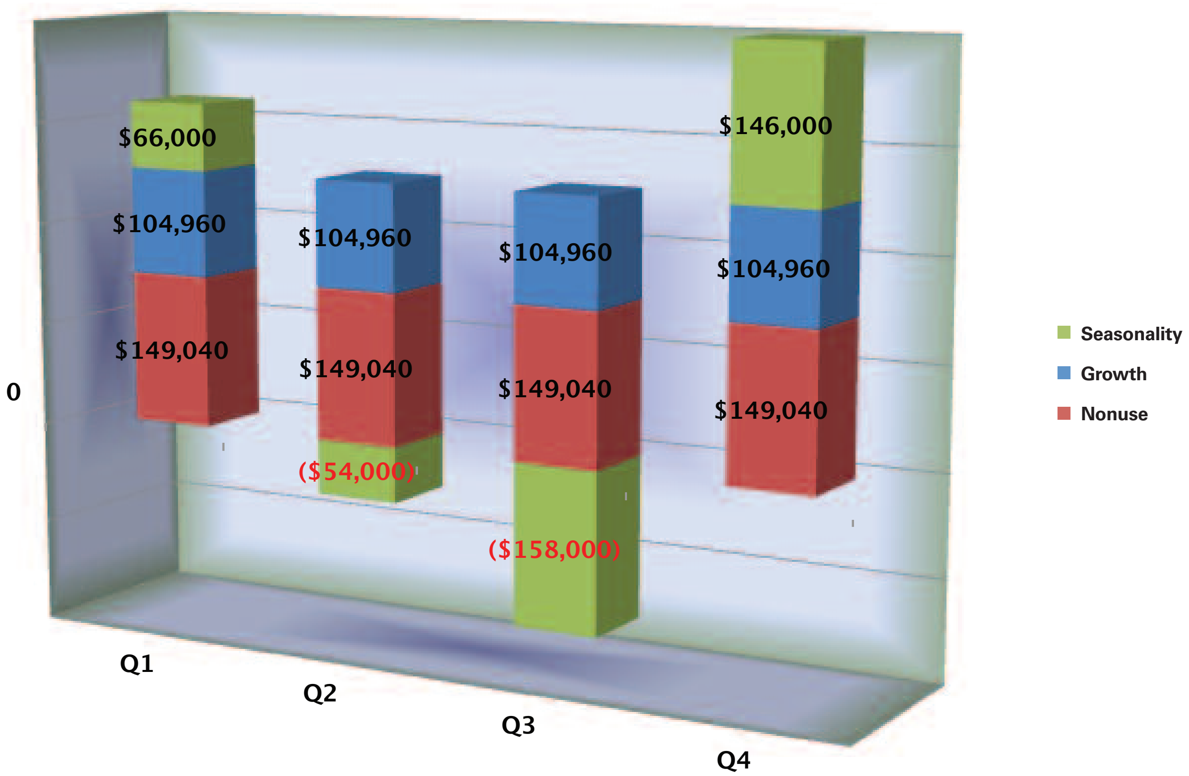
	Total Volume Variance (1)	Anticipated Seasonality Component (2)	Anticipated Growth Component (3)	Anticipated Nonuse Component (4)
Qtr/Year	**PC - EQC**	**EAC - EQC**	**NC - EAC**	**PC - NC**
Q1	$320,000	$66,000	$104,960	$149,040
Q2	200,000	-54,000	104,960	149,040
Q3	96,000	-158,000	104,960	149,040
Q4	400,000	146,000	104,960	149,040
Total Y1	$1,016,000	$0	$419,840	$596,160
Q1	$223,200	$73,280	$880	$149,040
Q2	90,000	-59,920	880	149,040
Q3	0	-149,920	880	149,040
Q4	286,480	136,560	880	149,040
Total Y2	$599,680	$0	$3,520	$596,160
Q1	$174,320	$61,920	-$36,640	$149,040
Q2	34,480	-77,920	-36,640	149,040
Q3	0	-112,400	-36,640	149,040
Q4	240,800	128,400	-36,640	149,040
Total Y3	$449,600	$0	-$146,560	$596,160
Q1	$143,520	$63,680	-$69,200	$149,040
Q2	0	-79,840	-69,200	149,040
Q3	0	-79,840	-69,200	149,040
Q4	175,840	96,000	-69,200	149,040
Total Y4	$319,360	$0	-$276,800	$596,160
Total Y1-Y4	$2,384,640	$0	$0	$2,384,640

EQC – Expected Quarterly Capacity
EAC – Expected Annual Capacity
NC – Normal Capacity
PC – Practical Capacity

Note: Positive/negative values represent under/overapplied.

In essence, Table 3 merely reports each period's expected volume variance that a company can partition among the three components and causes of anticipated seasonality, anticipated growth, and anticipated nonuse. Figure 1 illustrates these three components for each quarter in year one. For example, the expected volume variance for quarter one of year one will include three components: $66,000 due to seasonality, $104,960 due to growth, and $149,040 due to nonuse. Further, note that the seasonality component of the volume variance fluctuates from positive (underapplied) to negative (overapplied).

Figure 1: Volume Variance Components Year 1 – by Quarter



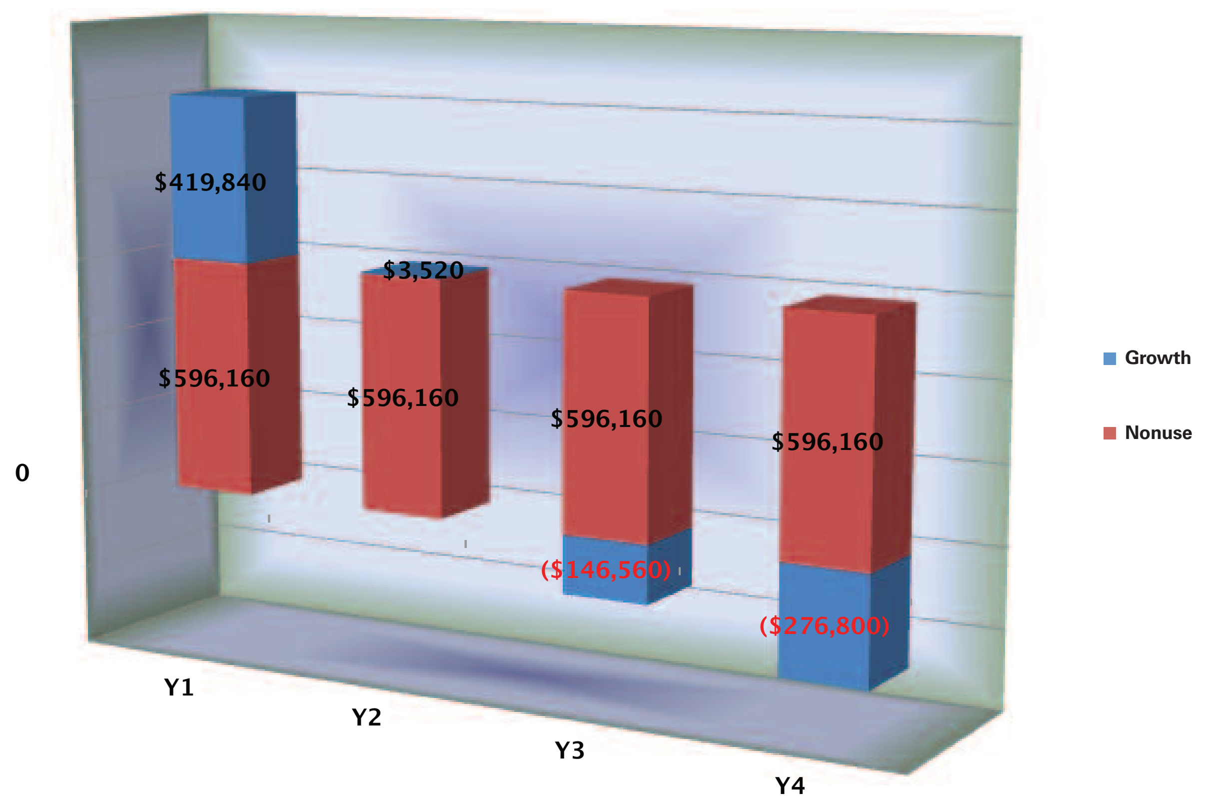
To manage capacity effectively, you need to be aware of all three components and underlying causes.[4] Figure 2 illustrates the volume variance components for each of the four years. It reveals that the expected volume variance for year one will include only two components: $419,840 due to growth and $596,160 due to nonuse. Note that the growth component of the volume variance fluctuates from positive (underapplied) to negative (overapplied). Also noteworthy is the absence of the seasonality component from the annual variances in Figure 2, which we will explain.

In addition to Table 3 revealing the simultaneous components of the volume variance that the company should anticipate, it also reveals that two of the three components are temporary. Note that in column 2 of Table 3, seasonality caused the quarterly volume variances that were offset by the end of each year via a netting of this component's underapplied and overapplied fixed manufacturing overhead over the four quarters.

Also temporary, but over a longer time frame, is the volume variance because of growth. Column 3 reveals that this component will dissipate by the end of the four-year time frame over which NC normalizes the increasing MH usage. This is accomplished by offsetting the growth volume variance dollars via a netting of underapplied and overapplied fixed manufacturing overhead over the four years.

These temporary components of the volume variance appear in Figure 3. The left graph illustrates how seasonality for all four quarters of year one sums to zero. Thus, this component's combined underapplied dollars from quarters one and four are exactly offset by the combined overapplied dollars from quarters two and three. Similarly, the growth graph illustrates how this component's annual volume variance dollars sum to zero over the entire four-year period. As expected, the one permanent component of the volume variance, nonuse, is that portion representing MH capacity that

Figure 2: Volume Variance Components by Year



has no specific predetermined use (see column 4 of Table 3).

At this point we hope to have convinced you of the following:

1. You can anticipate much of the volume variance;
2. By considering available capacity measures simultaneously, you will be able to identify components of the variance; and
3. Some of these components will net to zero over time.

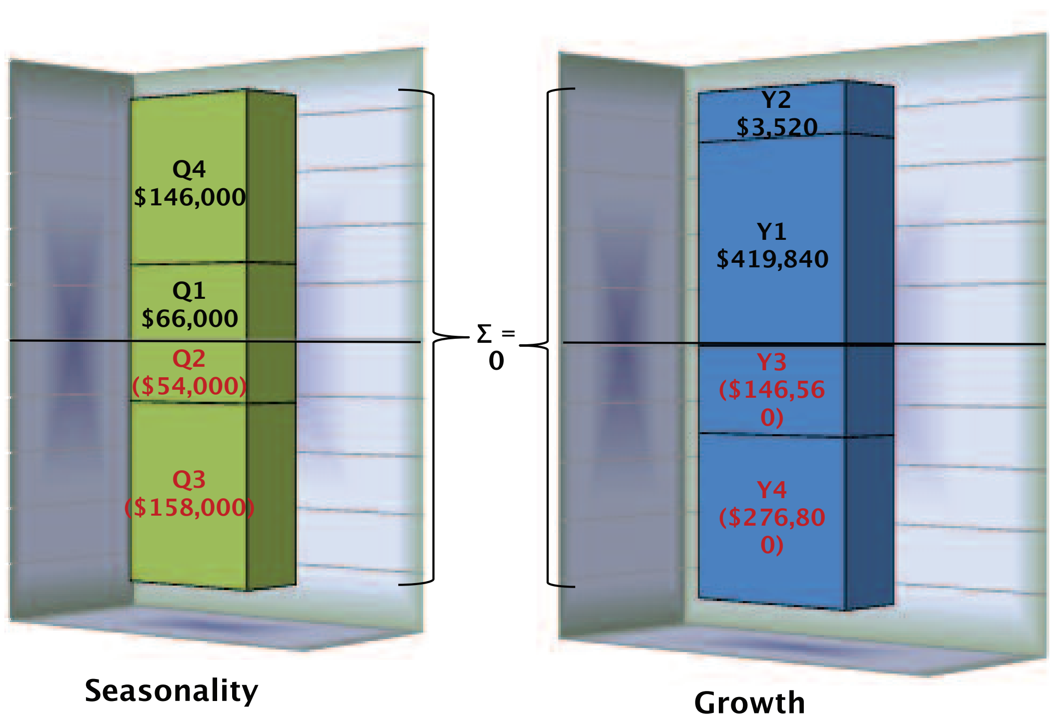
As you likely know, these three items have very important and interesting implications for managerial accounting reporting processes.

Managerial Accounting Reporting Implications

Let us return to our assumption that all the estimates for quarter one of year one are perfect. This implies no reported volume variances, right? Wrong! As Table 3 reveals, you should expect a $320,000 unfavorable volume variance to emerge for this period. Further, knowledge of all components of this variance would reveal that two components, representing well over one-half of the variance, will net to zero over time. So any time and energy that management invests to either investigate the perceived problem or reestimate already perfect estimates is not only wasted but also could lead to dangerous costing modifications and decisions.

For example, in Table 3, quarter one of year one reveals that $170,960 of the total $320,000 variance will be offset—the $66,000 due to seasonality will be offset within the year, and the $104,960 due to growth will be offset over the four-year period. Formally reporting these components of the volume variance as both *anticipated* and *temporary* should preclude you from panicked responses potentially leading to irrational reactions in

Figure 3: Volume Variance Temporary Components: Seasonality and Growth



the areas of product costing and pricing, planning, decision making, and performance evaluation.

Conversely, keep in mind the extent of the volume variance not expected to be offset. The $149,040 of the variance in the example is that portion of the fair-share allocation of capacity cost for quarter one of year one for which there is no specific predetermined plan for use over the four-year normalized time frame. Again, this separate reporting highlights and reminds us of those capacity costs we already expect to be misapplied permanently, hopefully reducing the possibility of erroneous responses. This type of capacity costs partitioning is consistent with C.J. McNair and Richard Vangermeersch's theme of the categories in their capacity deployment discussion.[5]

Table 3 best illustrates the need for this suggested partitioning of the traditional form of the volume variance by considering information for quarter three of year two, quarter three of year three, and quarters two and three of year four. Note that for these quarters you should plan to use all of the PC of 15,000 MH, yielding a reported total volume variance of zero. While this zero variance is ultimately a result of the anticipated MH use for these periods reaching the 15,000 MH level the PC provides, full utilization of capacity provides an offset or recovery from previously reported volume variances because of seasonality within the year (column 2) and growth across the four-year time horizon (column 3). Thus, the aggregating nature of the total volume variance masks the individual impacts of the seasonality, growth, and nonuse components.

The issues we have brought up in this article also present interesting implications and challenges for financial accounting reporting processes.

Financial Accounting Implications

While we strongly recommended using PC as the denominator for the fixed manufacturing overhead rate, GAAP requires using NC as the denominator for the fixed manufacturing overhead rate for external reporting purposes.[6] Accordingly, the rate that would result from using NC would be $91.35/MH ($4.8 million/52,548 MH). The increase in this rate from the $80/MH rate using PC is simply the result of impounding the $596,160 annual capacity costs associated with nonuse into the rate (see column 4 of Table 3). Given that the products will now absorb these nonuse capacity costs, their financial accounting treatment will be consistent with that for all product costs: The company will expense these costs when it sells the products and include them in the asset inventory prior to sale.

As a result, only two temporary components—seasonality and growth—will remain as part of this reported variance. Recall that we consider these components temporary because they will both net to zero over time. The only difference between them is the required period of time for them to net to zero. The seasonality component of the volume variance will ultimately be offset within the year, while the growth component will ultimately be offset over four years. While the dollar amounts for these two components will increase as compared to their original amounts in columns 2 and 3 of Table 3 (due to the increased rate of $91.35/MH), we argue to consider both a deferral for financial accounting reporting purposes. Thus, a company defers the growth component for years one and two until the later years since it incurs these costs with the knowledge that they will be recovered in future periods.

In fact, if the company did not include the needed capacity in later years in the initial capacity acquisition, it would not have realized the economic benefits associated with market expansion during these later years. Accordingly, a company should not expense the costs associated with this capacity in the early years but treat them as some sort of deferral that will eventually be offset when the market and MH use expand sufficiently.

This is somewhat analogous to the process employed by the units of production method of depreciation and in this situation can likely be accomplished with procedures similar to a standard implemented by the Financial Accounting Standards Board (FASB) regarding accounting for income taxes.[7] This standard handles timing differences for transactions affecting taxable income in periods different than periods in which they enter into the determination of pretax income. Consistent with this standard, it seems reasonable to use a noncurrent deferred capacity cost asset account to house that portion of the volume variance that anticipated growth causes until fully dissipated. Similarly, you could use a current deferred capacity cost asset account to store the Anticipated Seasonality component of the volume variance it expects to be offset within the upcoming year. The recommendation for deferring these short-term costs is likely to be more palatable than deferring the longer-term costs because it would not cross sacred annual boundaries of financial reporting.

Anticipate Volume Variance Components

Several causes potentially contribute to the fixed manufacturing overhead volume variance. Yet a company can anticipate many of these causes given the likely existence of capacity measures known in advance of the reporting period. Specifically, when a company considers the capacity acquisition, it develops knowledge of EQC and EAC measures that the budgeting process certainly requires. A company couples this knowledge with estimates akin to both NC and PC measures associated with the capacity acquisition being considered. These measures provide the necessary insight for both anticipating and isolating the effects of many potential causes of this variance. The simultaneous consideration of these measures permits a partitioning of the reported volume variance into anticipating the potential causes related to seasonality, growth, and nonuse. This partitioning is important, as failure to do so may result in irrational and erroneous managerial responses to and inappropriate financial accounting treatment of this variance.

We hope this article will heighten awareness and interest for others to relate these issues to their specific capacity utilization situation. Although the assumptions in the example may not generalize exactly to the myriad potential situations possible, the basic notion remains that a company should anticipate certain components of the volume variance. While we used a manufacturing example, these notions should generalize to capacity utilization issues in nonmanufacturing contexts as well. ■

Ken Snead, Ph.D., is a professor of accounting in the College of Business at Bowling Green State University. You can reach Ken at (419) 372-8160 or ksnead@bgsu.edu.

David Stott, Ph.D., CPA, is an associate professor of accounting in the College of Business at Bowling Green State University. You can reach David at (419) 372-2709 or dstott@bgsu.edu.

Andy Garcia, Ph.D., CPA, is an associate professor of accounting in the College of Business at Bowling Green State University. You can reach Andy at (419) 372-7812 or garcia@bgsu.edu.

Endnotes

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7 FASB, ASC 740-10-25, "Recognition," (previously SFAS No. 109).