Activity-Based Costing: Multiple Lot Size Effect

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Abstract

This paper illustrates how overhead cost allocations may vary between traditional volume-based cost accounting and ABC. The illustration is then expanded to show how product costs determined by ABC can also vary depending upon the lot sizing method. The illustration is then used to explain how a costing table can be utilized to obtain accurate per unit costs when a product is produced in multiple lot sizes.

Introduction

In order to obtain better cost measurements for pricing and other decisions in a manufacturing environment, many companies have switched from traditional volume-based costing to activity-based costing (ABC) (Journal of Accountancy, 1994). However, management accountants need to be aware that when companies utilize multiple lot sizes the per unit costs measured under ABC can still vary depending upon the size of the production batch. This cost variation effect may be overlooked by some companies because much of the literature concerning ABC assumes a constant lot size and has not addressed this issue.

The Illustration

A computer keyboard assembly process is used to show how overhead cost allocations may vary between traditional volume-based cost accounting and ABC. The illustration is then expanded to show how product costs determined by ABC can vary depending upon the lot sizing method. The illustration is further used to explain how a costing table can be utilized to obtain accurate per unit costs when a product is produced in multiple lot sizes.

Traditional Volume Based Cost Accounting

Traditionally, many firms have allocated overhead costs to products by utilizing a single plant-wide volume-based application rate that depends upon some identifiable measure of activity. This is accomplished by aggregating all overhead costs into one overhead cost pool and then allocating these costs to products proportional to their direct labor hour (DLH) or direct labor cost (DLC) content.

Table 1 shows the calculations necessary to determine the annual overhead rate per DLH. The annual overhead cost for this manufacturing section is expected to be $390,000. These costs include engineering changes, scrap/rework/ warranty, service-center costs such as industrial engineering, maintenance, data processing, inventory and capacity holding costs, technology and utilities. This total budgeted overhead cost is divided by the total expected DLHs, for the same period, resulting in an allocation rate of $20 per DLH ($390,000 / 19,500 = $20).

The total costs per unit is the sum of the direct costs (labor and material) and overhead

Table 1
Calculation of Overhead Allocation Rate per Direct Labor Hour

Annual budgeted overhead	$390,000.00
Divided by annual DLH's	/19,500
Overhead per DLH	$20.00

charges. Direct labor costs are $20.775 to assemble a keyboard (1.95 hours per assembly times $10.65385 per direct labor hour). Material charges are $25.50 per unit. Overhead charges, calculated using the $20 per DLH overhead rate, are $39.00 (1.95 times $20). The total cost per keyboard assembly is the sum of the foregoing charges, namely $85.28

Because this traditional cost accounting method assumes that all overhead resources are used at the same rate by all products, there are many who believe that the amount of overhead cost allocated frequently is inaccurate (Horngren, et. al., 1994). The assumption usually is inaccurate because, for example, some products, relative to others, require more or less engineering support, setup time, or data processing time, etc. When the cost system, either one used by an accounting department or one embedded within an MRPII system, allocates overhead this way, the result is distorted costs. Frequently found distortions are that low-volume and specialty products are under costed and high-volume and standard products are over costed (Cooper and Kaplan, 1988; Pare, 1993).

Possible consequences of relying on these inaccurate and biased costs are biased and suboptimal decisions. Examples would include product pricing and mix, labor-technology mix, product and process cost control, investment in overhead resources (e.g., technology) decisions.

Activity-based Costing

Rather than utilizing a single cost pool and allocation base, activity-based costing (ABC) disaggregates overhead resources into a series of cost pools and several allocation bases. The key being to select cost pools such that all of the overhead resources in the cost pool are consumed by the products using that cost pool in a similar manner.

The first step in utilizing an ABC system is to identify all the work activities that are performed to make products (e.g., purchasing, materials movement, setup, engineering support, maintenance, quality control). For each activity, all of the resources (e.g., software engineers, electricity, inspectors) used to perform the activity are identified and the cost of these resources are assigned to the activity's cost pool. The second step is to find a good base to allocate each particular activity's cost to the products that use the activity. For example, materials handling costs might be allocated on the basis of the number of requisitions received by the storeroom. Once the allocation base is identified, the expected (or budgeted) cost of the activity is divided by the practical or theoretical (in some companies this could be expected or budgeted) activity level of the allocation base.

To illustrate how ABC works, we will continue to use our keyboard assembly example. Table 2 shows that the keyboard assembly passes through five activities. Four activities are batch-level (setups, warehouse storage, production control, material movement) and one is a facility-sustaining activity (e.g., plant maintenance).

The company's cost accounting system, which previously had only one overhead cost pool, must now identify the overhead resources that are used by each of the newly created five activity cost pools. Then, for each activity cost pool, an appropriate cost driver must be identified. If at all possible, there should be a causal relationship between the cost driver and the activity cost pool. For example, setup overhead cost is caused by and relative to the number of setups; production control cost is caused by and relative to the number of shop orders issued. Overhead charges for facility-sustaining activities will be charged at $20 per unit or $10.25641 per DLH.

Table 2
Establishing Cost Pools and Batch Drivers

Batch Drivers	Expected Expenses	Facility-Sustaining Activities	Expected Expenses
		Total overhead costs	$ 390,000.00
Setups		less batch related overhead	$ 190,000.00
Annual setup cost	$ 35,000.00	Facility-sustaining overhead	$ 200,000.00
Number of setups	1,165	Direct labor hours	19,500
Cost per setup	$ 30.04	Facility-sustaining overhead per DLH	10.25641
		Facility-sustaining overhead per unit	$ 20.00
Warehouse			
Total Warehouse Cost	$ 40,000.00		
Square footage in warehouse	20,000		
WH cost per square foot	$ 2.00		
KB space per unit	0.50		
KB cost per unit storage	$ 1.00		
Production Control			
Annual production plan expense	$ 80,000.00		
Shop orders issued	682		
Cost per shop order	$ 117.30		
Material Movement			
Annual cost of material movement	$ 35,000.00		
Material movements	875		
Cost per movement	$ 40.00		

Table 3 shows for four lot sizes the annual overhead costs for assembling the keyboard. If one lot size is used in the assembly operation, the overhead costs as measured by the ABC system will be more accurate than the costs reported by the traditional volume based system because ABC measures the consumption of overhead resources more closely with how these resources are actually consumed by (embedded in) the product. Instead of using only volume-based drivers, as does the traditional system, ABC recognizes that many overhead resources are consumed proportional to each batch of product. Therefore, various overhead resources are associated with different batches and utilize different batch measures (e.g., purchase orders, setups, material moves, etc.).

When only one lot size is used in manufacturing the keyboard the information in Table 3 is more accurate, it can be used to improve the quality of decisions such as technology investment, make-buy, product pricing and mix and cost improvement.

Users of ABC need to be aware that, although the product cost information derived from an ABC system is more accurate than cost information derived from a traditional volume-based system, the per unit cost of the product as measured by the ABC system can vary significantly depending upon the lot size utilized in calculating the product costs. For example, Table 3 shows the unit product cost varies considerably with the lot size used in making the calculations. If the product is produced in varying lot sizes the costs in Table 3 may not be accurate. This is important because, in many companies using MRPII scheduling, lot sizing for a product varies among shop orders(Thiesen, 1974; Sherrard, et. al, 1991; Vollmann, et. al, 1992). Therefore, whether traditional volume-base costing or ABC is used, product costing and management decisions can be improved by paying more attention

Table 3
Annual and Per Unit Costs using Activity Based Costing
Multiple Lot-Sizes KB450 Keyboard Assembly

	Lot Size			
Batch overhead charges	Annual Demand 10,000 Units			
	10	100	200	2000
Setup cost ($30.04 per batch)				
Number of batches per year	1000	100	50	5
Annual cost (4 setups per batch)	$ 120,160.00	$ 12,016.00	$ 6,008.00	$ 600.80
Warehouse Cost ($1.00 per unit)	$ 5.00	$ 50.00	$ 100.00	$ 1,000.00
Production control expense				
Cost per shop order = $117.30	$ 117,300.00	$ 11,730.00	$ 5,865.00	$ 586.50
Material moving expense				
Cost per move = $40.00				
Number of moves per batch = 5	$ 200,000.00	$ 20,000.00	$ 10,000.00	$ 1,000.00
Facility-sustaining overhead	$ 200,000.00	$ 200,000.00	$ 200,000.00	$ 200,000.00
Total overhead charges	$ 637,465.00	$ 243,796.00	$ 221,973.00	$ 203,187.30
Cost per unit (ABC Method)	$ 63.75	$ 24.38	$ 22.20	$ 20.32
Percentage of cost for 2,000 lot size	314%	120%	109%	100%

to lot sizing assumptions and decisions.

ABC using a Multiple Lot-sizing Cost Table

The per unit cost measured by the ABC method is dependent upon the lot-sizing assumption used in the manufacture of the keyboard. Between the smallest and the largest lot size shown in Table 3, the per unit cost varies by over two hundred per cent. In order to obtain constant accurate per unit costs, the shop order must be for a fixed (unvarying) lot size. However, many MRPII firms use a lot sizing technique that varies with each shop order. Under these methods the lot size is dependent on gross requirements, inventory on hand, and inventory carrying costs.

Therefore, when asked to bid on keyboard orders, the lot size must be taken into consideration. To do otherwise will result in prices that are either too high or too low. In the case of the latter, bids will be won that afford low to nonexistent profit margins. In the former case, bids will be lost that would have been very desirable.

Companies wishing to use multiple lot sizes should use a table that relates product, lot size and unit cost. The table, similar to the one shown in Table 4, relates unit cost to the size of the customer order. The table can be expanded to include additional products and lot sizes. If the profit margin is added to the unit cost, the table can be easily converted to a unit pricing table.

Summary

Accurate overhead charges combined with direct labor and material costs result in better pricing and other decisions. Generally, it has been shown that activity-based costing (ABC) allocates overhead more accurately than does the

Table 4	
Costing Table	
Lot Size	KB450
10	$ 63.75
100	$ 24.40
200	$ 22.20
2000	$ 20.32

traditional volume-based allocation method. However, in order to make better costing and pricing decision in an ABC environment, the size of the shop order should also be taken into consideration. Per unit cost variation between small and large lot sizes can be very large. Thus, failure to consider lot sizing when using ABC may result in errors as large as those produced under the traditional volume-based method of cost allocation.

When an MRPII system is using one of the multiple lot sizing algorithms a costing table should be prepared to produce accurate cost and pricing estimates. Such a table will show the cost discounts from larger orders and/or production runs. MRPII computer programs that incorporate ABC product costing should be changed to indicate the different cost figures produced by varying lot sizes. It is not enough to simply use ABC assuming fixed lot sizes.

Suggestions for Future Research

Most manufacturing firms use one of two methods to convert from the traditional accounting method of overhead allocation to activity-based costing. Some firms use a stand alone ABC software package with linkages to their MRPII scheduling system. Others purchase an MRPII software package that incorporates ABC accounting. Additional research needs to discern if the MRPII software designers correctly accommodate, if at all, the multiple lot sizing feature of MRPII. Also manufacturers who use stand alone ABC software should be examined to discern if the linkage between their ABC and MRP software makes allowance for the multiple lot sizing feature of MRPII.

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