

## Note on Costs

### Cost Objects

Management accountants define costs with respect to a **cost object**. Products, departments, divisions, or units of output are typical cost objects, but in general a cost object can be anything for which managers wish to measure costs.

### Direct and Indirect Costs

Costs that relate directly to a cost object are **direct costs**. Costs that do not relate directly are **indirect costs**. A cost object could be a surgical patient requiring an overnight stay, a direct cost could be the cost of the anesthesia, and an indirect cost could be the wages paid to the hospital's housekeeping staff. Indirect costs pose difficulties because they cannot be directly traced to a cost object. Without patients, for example, there would be no need to employ a housekeeping staff. The patients, therefore, cause the costs associated with housekeeping, but it is conceptually and practically infeasible to trace those costs to an individual patient. Nonetheless, there are many decisions for which it is necessary for managers to allocate these costs to cost objects. I will discuss **cost allocation** methods later in the note.

### Cost Behaviors

Management accountants also classify costs in terms of their cost behavior. The typical designations are **variable costs** or **fixed costs**. Fixed costs do not change as volume changes; variable costs do. A fixed cost for a hospital, for example, could be the depreciation on the facility. Regardless of the number of patients serviced, the depreciation is the same. A variable cost could be the cost of the food for patients requiring an overnight stay. Feeding an extra patient produces incremental food preparation costs.

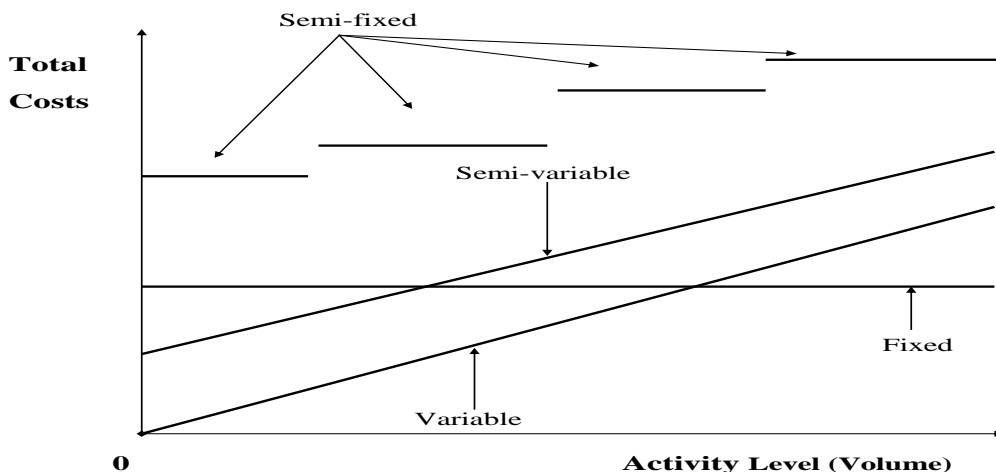
Cost behaviors are valid only over a **relevant range** of activity. Suppose the hospital has reached its capacity for patients. The hospital would have to incur costs to increase its capacity. Thus the facility cost is fixed with respect to the volume of patients up to the facility's capacity. Beyond that, the facility cost has a variable component.

It is also important to note that over a longer time frame, all fixed costs are variable because the organization can change its capacity. In contrast to the previous example, suppose that the hospital is always below capacity. In the short run, the facility cost is fixed. In the longer run, however, the hospital's management can choose to move to a smaller facility with less depreciation.

In practice, costs are usually neither purely fixed nor purely variable, but rather a mixture of the two. Some costs are **step-function**, or **semi-fixed** costs, fixed over a range, then increasing discontinuously once a threshold of volume is reached. For example, one nurse may be able to provide coverage for as many as five patients, but a second nurse is necessary if coverage is needed for a sixth patient. The resource in this case (nurses) is not divisible: one cannot hire 1/5<sup>th</sup> of a nurse. Other costs are **semi-variable**, entailing a charge even if the volume of activity is 0, and then behaving as a variable cost as volume increases. Utilities are typically semi-variable costs, with a fixed monthly service charge and usage rates for the amount of the resource consumed. Though other cost patterns are, of course, possible, the fixed, variable, semi-fixed, or semi-variable designations are broad enough to approximate most cost behaviors for decision-making purposes.

The following figure illustrates the four main cost-behavior patterns

### COST BEHAVIOR PATTERNS



#### Cost-Volume Profit Analysis

The concepts of fixed and variable cost are useful in understanding the relationship between an organization's cost structure, volume, and profit. In particular, organizations often need to understand the volume of revenue-generating activity necessary to cover fixed costs, or the **breakeven point**.

Total sales revenue can be expressed as:

$$\text{Sales Revenue} = \# \text{ of Units} \times \text{Price/Unit.}$$

An organization's total variable costs can be expressed as:

$$\text{Total Variable Costs} = \# \text{ of Units} \times \text{Variable Cost/Unit,}$$

implying that total costs, a sum of fixed and variable costs, are

$$\text{Total Costs} = \text{Total Fixed Costs} + \# \text{ of Units} \times \text{Variable Cost/Unit.}$$

Total profits are

$$\text{Total Profits} = \text{Sales Revenue} - \text{Total Costs,}$$

which, after making substitutions for the earlier expressions for Sales Revenue and Total Costs, is

$$\text{Total Profits} = \# \text{ of Units} \times \text{Price/Unit} - (\text{Fixed Costs} + \# \text{ of Units} \times \text{Variable Cost/Unit}),$$

which, after more rearrangement, is

$$\text{Total Profits} = \# \text{ of Units} \times (\text{Price/Unit} - \text{Variable Cost/Unit}) - \text{Fixed Costs.} \quad (1)$$

The quantity  $\text{Price/Unit} - \text{Variable Cost/Unit}$ , which is the price minus the variable cost per unit, is known as the **contribution margin per unit**. This allows a final substitution:

$$\text{Total Profits} = \text{Total Contribution Margin} - \text{Fixed Costs.} \quad (2)$$

Contribution margin is an important concept in financial decision making, indicating the marginal impact on profits of an additional unit of sales. It is useful in a variety of contexts. It follows from equation (1) that the breakeven volume can be expressed as:

$$\text{Breakeven volume} = \text{Fixed Costs}/(\text{Contribution Margin Per Unit}) \quad (3)$$

It also possible to use the basic breakeven equation to determine the volume necessary to attain a profit target:

$$\text{Profit Target Volume} = (\text{Fixed Costs} + \text{Profit Target})/(\text{Contribution Margin Per Unit}) \quad (4)$$

The idea is that the profit target is tantamount to an incremental fixed cost that the organization must recover.

Example:

ABC Corp manufactures widgets. Fixed costs are 150. The selling price is \$1.20, and variable costs are \$0.90/unit. What is the breakeven volume? How many units must ABC sell to realize profits of \$6?

Answer:

$$\begin{aligned} \text{Breakeven volume} &= \text{Fixed Costs}/\text{Contribution Margin Per Unit} \\ &= \$150/(\$1.20/\text{unit} - \$0.90/\text{unit}) = \$150/\$0.30/\text{unit} = 500 \text{ units} \\ \text{Profit Target volume} &= (\$150 + \$6)/(\$1.20/\text{unit} - \$0.90/\text{unit}) = \$156/\$0.30/\text{unit} = 520 \text{ units} \end{aligned}$$

Practice Problem:

Daisy Day Care is a day care center for toddlers. Daisy charges \$600/month. Fixed costs are \$2,100/month for the day care worker and \$2,400/month for rent. Variable costs are \$100/month per child for food and \$50/month per child for craft & play supplies. What is the breakeven number of children? Why would your answer change if federal regulations imposed a limit of 8 children per daycare worker?

### Cost Allocation

Cost allocation refers to the method of assigning indirect costs, typically called **overhead**, to individual cost objects. In some cases, cost allocation is inappropriate. There are many purposes and decision contexts, however, for which it is entirely reasonable or even necessary to allocate all indirect costs.. This is known as **full-cost accounting**. Many contracts, for example, are cost-plus contract in which the price or reimbursement is related to the cost of the product or service. In this case, an organization must allocate all indirect costs allowed under the contract. Even if not operating under a cost-plus contract, an organization may need to implement full-cost accounting to price its products or services efficiently.

Though cost allocation has its origins in manufacturing companies, service organizations encounter analogous problems. I now introduce an example to illustrate the basic ideas underlying modern cost allocation.

XYZ Corporation manufactures two products, A and B, on a single production line. Their total monthly costs are:

	<u>COST</u>
Direct labor	\$ 180,000
Direct material	\$ 170,000

Equipment/building lease	\$ 225,000
Set-up/Materials handling labor	<u>\$ 135,000</u>
TOTAL	\$ 710,000

Direct labor is the cost of the labor used on the production line. Direct material is the cost of the materials used in production. The equipment/building lease includes the cost of utilities. The set-up/materials handling labor refers to the costs incurred every time XYZ has to set up a production run for one of the products. This time-consuming process entails shutting down the production line, moving raw materials around the plant, and retooling the equipment on the line. The total costs to be assigned or allocated are \$710,000.

Other relevant facts for costing are:

	<u>Product A</u>	<u>Product B</u>	<u>Total</u>
# Units manufactured	10,000	20,000	30,000
Direct labor dollars	\$ 60,000	\$ 120,000	\$ 180,000
Material dollars	\$ 50,000	\$ 120,000	\$ 170,000
Machine hours	375	375	750
# of set-ups	15	5	

Cost allocation for any type of organization has four steps:

- Assign direct costs
- Create indirect **cost pool(s)**
- Select allocation bases(s) for cost pool(s)
- Allocate indirect costs

Regardless of the method of allocating the indirect costs to the two products, the direct costs will always be the same: \$60,000 + \$50,000 = \$110,000 for A and \$120,000 + \$120,000 = \$240,000 for B.

I will compute two sets of production costs per unit: traditional (single pool) costing with labor dollar allocation, and **activity based** (multiple pool) **costing**.

Traditional (single pool) with labor dollar allocation

In the traditional method of cost allocation, there is a single overhead cost pool. In this problem, it is the sum of the equipment/building lease cost and the set-up/materials handling labor, or \$225,000 + \$135,000 = \$360,000. I will assign the pool based on the relative proportion of total labor dollars consumed by the products. Total overhead is 360,000 and total labor dollars are 180,000, implying that the overhead **burden rate** is \$360,000/180,000 = \$2/labor dollar. In other words, each product will be charged \$2 of overhead for every \$1 of direct labor. The \$2/labor dollar burden rate is comprised of a burden rate for lease costs of \$225,000/180,000 = \$1.25/labor dollar and a burden rate for set-up costs of \$135,000/180,000 = \$0.75/labor dollar.

	<u>SINGLE POOL</u>			<u>ACTIVITY</u>		
	<u>LABOR DOLLAR</u>			<u>BASED COSTING</u>		
	A	B	TOTAL	A	B	TOTAL
Labor	60,000	120,000	180,000	60,000	120,000	180,000
Material	50,000	120,000	170,000	50,000	120,000	170,000
Equip/building lease	75,000	150,000	225,000	112,500	112,500	225,000
Set-up/mat'l handling	<u>45,000</u>	<u>90,000</u>	<u>135,000</u>	<u>101,250</u>	<u>33,750</u>	<u>135,000</u>
TOTAL COST	230,000	480,000	710,000	323,750	386,250	710,000

# OF UNITS	10,000	20,000	10,000	20,000
COST/UNIT	23.00	24.00	32.38	19.31

As illustrated in Table 1, under traditional (single pool), labor dollar costing, \$120,000 of the total overhead costs of \$360,000 are allocated to Product A and \$240,000 are allocated to Product B. I computed the \$150,000 allocation of *Equip/building lease* to B in the following way:  $120,000 \text{ labor\$} \times \$1.25/\text{labor\$} = \$150,000$ . The fully allocated costs are \$23/unit and \$24/unit respectively.

#### Activity based (two pool) costing

Activity based (multiple pool) costing is a more nuanced approach. Rather than allocating all overhead costs based on a single cost driver, one decomposes overhead costs into multiple pools and identifies a different cost driver for each pool. The basic idea is that products may consume different types of overhead resources at different rates. Requiring a single **cost driver** for all costs obscures this distinction.

The two cost pools in this example are the lease costs of \$225,000 and the set-up costs of \$135,000. The cost driver for leases is the number of machine hours used and for set-up costs is the number of set-ups. The presumption is that machine hours and set-up costs are the “activities” that create the overhead costs. By linking the overhead costs more closely to the activities that drive them, one obtains more accurate product costs.

The burden rate for leases is  $\$225,000/750 \text{ machines hours} = \$300/\text{machine hour}$ . The burden rate for set-ups is  $\$135,000/20 \text{ set-ups} = \$6,750/\text{set-up}$ . I computed the set-up overhead to A in the following manner:  $15 \text{ set-ups} \times \$6,750/\text{set-up} = \$101,250$ .

The costs per unit are \$32.38/unit for A and \$19.31/unit for B. Though the product costs were almost the same under traditional costing, A is approximately 70% more expensive under activity based costing. The reason is that while A generated only 1/3 of the direct labor dollars, it generated 1/2 of the machines hours and 3/4 of the set-ups. As a result, its allocation of overhead increases from 33% under traditional costing to almost 60% under activity based costing.