COST ASSIGNMENT METHODS --
Accounting for Manufacturing Overhead

OVERVIEW

In the note on fixed and variable costs, we examined the structure of costs in organizations. In any period of time, some costs vary with the level of business activity (sales and/or production volume) while others do not. Knowledge of whether a cost behaves in one of those ways or the other is critical to a manager’s ability to predict the way costs will change based on any action the organization takes.

In this note, we turn our attention to the kind of information that the organization’s cost accounting system provides for managers. Cost accounting systems are, unfortunately, not primarily focused on whether costs are fixed or variable. Instead, they are focused on providing information for financial reports. This focus on external financial reporting means that cost accounting systems are occupied with tracing costs to the balance sheet (basically, the inventory accounts) and the income statement (basically, cost of goods sold). Thus, this note will discuss the inventory “holding pens” for production costs as they pass through an organization (raw materials inventory, work-in-process inventory, and finished goods inventory) on their way to becoming cost of goods sold. It will also examine the ways in which cost accounting systems collect and assign costs of material, labor, and overhead to production units. The latter issue, how overhead is divided up and then associated with units made during a period, will be a central focus of much of the note.

The Flow of Costs Through Inventories

The expenditures made to support the manufacturing process must be recorded by the accounting system as assets until the goods produced by that manufacturing process are sold. There are three basic inventory classes that the cost accounting system uses for this purpose. The first one holds the assets that are inputs to the production process, purchased materials. This inventory is generally called **raw materials inventory**, even though the purchased materials may not actually be in the "raw" form. For example, a company that assembles personal computers would consider such devices as hard disk drives units to be raw materials, even though they are another manufacturer's completed good.

The second inventory type is the one that consists of the goods currently in the process of manufacturing. This inventory is called **work-in-process inventory**. Work-in-process inventory (also called WIP, pronounced "whip") contains the total of all costs so far assigned to goods under production. Since this is the inventory that accumulates costs, it is where the cost accounting system does all of its work. The third category of inventory holds the output of production, completed goods. This type is generally called **finished goods inventory**. The results of the work of the cost accounting system are reflected in the value of the finished goods inventory account. Once a unit of production is included in finished goods, the cost accounting system has finished accumulating and assigning costs to it even though additional costs for storage, financing, insurance, etc. continue to pile up. These post-production costs are simply added to overhead.

Many companies produce an internal report that summarizes the flow of costs through these three inventories and into the expense account, cost of goods sold. The report is called a **Cost of Goods Manufactured and Sold Statement**. An example appears in exhibit 1. This statement nicely summarizes the job of the cost accounting system at the aggregate level. In essence, the cost accounting system provides the detail behind the assignment of costs in this statement. That is, while the statement shows that $174,000 of overhead cost were recorded during the period, the system provides the
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Exhibit 1 Cost of Goods Manufactured and Sold

Framingham Framis, Inc.
Cost of Goods Manufactured and Sold
for the Month ended March 31, 1997

I. Materials
   Raw materials inventory, March 1 $30,000
   Purchases 210,000
   = Materials available for production 240,000
   Less raw materials inventory, Mar 31 (32,500)
   = Cost of materials issued to production $207,500

II. Work-in-process
   Direct labor cost for March 100,000
   Overhead applied during March 174,000
   = Cost of March Production 481,500
   Add WIP inventory, March 1 150,000
   = Total cost in production during March 631,500
   Less WIP inventory, March 31 (230,000)
   = Cost of goods finished in March 401,500

III. Finished Goods
   Add finished goods inventory, March 1 68,000
   = Cost of goods available for sale in March 469,500
   Less finished goods inventory, March 31 (56,500)
   = Cost of goods sold during March $413,000

connections between those dollars and the specific goods produced during the period. Note that each section of the statement shows the total costs during the period that flowed into the associated inventory account (e.g., $210,000 of purchases were added to raw materials inventory) and the total costs that flowed out of each inventory account (e.g., goods assigned a value of $413,000 were sold and their cost was removed from finished goods inventory).
Collecting and Assigning Costs

The statement above is an after-the-fact description of where costs were at the end of a period. However, the cost accounting system works on a real-time, as-you-go basis. As production progresses, material, labor, and overhead costs are added to production records. The production process may take the goods through several departments or may employ the addition of parts made elsewhere in the factory. Such information must all be captured by the system. The main point is that, as production takes place, the associated material, labor, and overhead costs from each department must be recorded as part of the product’s cost.

Traditional methods of allocation are predicated on a few basic criteria. The primary criterion is that the method that is used must result in the assignment of all of the factory costs in a given period into the products produced in the factory during that period. That is, total product costs in a period must be identical to total production costs in that period. The second criterion is that the resulting assignments do not materially distort reported aggregate inventory balances or aggregate cost of goods sold. These criteria are not very demanding.

While the same approach is used to track material, labor, and overhead costs to products, the practice of determining which costs of manufacturing overhead are appropriate for inclusion in product’s cost is more problematical than that for material and labor. Generally Accepted Accounting Principles provide very little guidance as to how overhead should be associated with production work. The only real guiding criterion is that each unit produced during a period should bear its “fair share” of product costs. What is fair from one perspective may not be from another. Practices can vary greatly from company to company depending on the way costs are accumulated in the organization. Generally, however, as long as the method for assigning overhead is systematic and consistent, it is acceptable for financial reporting purposes. (Recall that the only issue in financial reporting is whether the aggregate values for inventories and cost of good sold is reasonable, not the individual unit values.)
Sometimes overhead can be unambiguously associated to one and only one product or product line. In that case the overhead cost can be recorded directly to the product. This is usually not the case. However, it is often the case that specific resource use can be associated with the work process used to produce many product units.

As we draw our focus wider than the product unit, we can find cost objects for which overhead costs are direct. Often, machinery depreciation and supervisory labor costs are uniquely associated with a production department. Also, production departments are sometimes associated with individual product lines. Thus, that association of those costs to product lines may be quite clear. In that case, the assignment of those particular overhead costs only to units in that product line or only to units produced in that department is generally viewed as a desirable approach. Thus, in factories where these associations are present (and there are many such factories), it is not unusual to see overhead allocated within each production department rather than across the factory as a whole.

Some overhead costs are not specific to production departments or to product lines. In fact, some production-related costs, like the cost of running the payroll function related to issuing paychecks to factory personnel, may not even be incurred in the factory at all. Since a centralized payroll function is used for purposes of efficiency, it is quite likely that the specific costs of payroll processing due to factory payroll will never be known with certainty. They are mixed-up with and indistinguishable from payroll processing costs for other factories as well as the sales and administrative side of the organization. Thus, the great majority of manufacturing overhead is associated with products through another means -- the use of some allocation formula.

One or more quantifiable traits of a product are used to compute a proportion of the overhead cost that will be associated with it. The quantifiable feature (or features) of production used to achieve this allocation is said to be the overhead allocation basis (or bases). For the sake of discussion, we will use an example where direct labor hours for each product, as a percentage of total direct labor hours recorded, is used as an allocation basis for all overhead in the
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factory. This is probably the simplest (and still the most popular) method of allocating overhead.

The traditional approach to allocating overhead through departments requires two steps. First, the total "shared" overhead is determined. Second, this total is divided by the total allocation basis measurement to find an average overhead cost per basis "unit," the overhead allocation rate.

If only one rate is computed for a whole factory, it is called a single, plant-wide rate. Occasionally, when it is believed that significant overhead numbers are uniquely associated with a particular production department or process, these rates are computed for each production area. The result is several departmental overhead rates. In this case, overhead from outside the production departments (including general services like plant building depreciation and plant management salaries) is first divided up among the producing departments based on one or more formulas and added to the "within-department" overhead. Second, these new departmental overhead totals are used to determine an overhead rate for the department which is then applied to all units worked on in the department.

There is a particular logic employed to determine the relationship between the production of goods and the consumption of resources. The first line of reasoning is the idea that costs should be associated based on actual services rendered. To the extent that overhead costs are unique to a department or product line, it is easy to decide which department the costs should go with. The second line of reasoning is to associate overhead costs with product lines or departments based on an equitable share of facilities provided. That is, although the depreciation of a factory building cannot be associated directly with any of the three production departments in the factory, it can be divided among those departments based on the relative share of the physical building space used by each of the departments.

Once a cost accounting system is in place, it performs calculations using overhead costs rather blindly. There is seldom discussion or reflection about where the overhead costs came from or about how closely associated those
costs were with the cost object to which they were being assigned. Nonetheless, it cannot be taken for granted that overhead costs occur in the same way the system attaches them to work that is done.  

Overhead costs are the great source of complexity in costing of goods and services. By definition, overhead costs are all those factory costs other than direct materials and direct labor. They are costs related to resources used in production that are, at least in some sense, shared by more than one cost object. They can relate to shared resources in two basic ways. First, the resources consumed to support production may comprise a fixed cost. That is, the costs may represent the resources required to provide production capacity (like depreciation on the factory building or the salary of the plant manager). Second, although the overhead costs may indeed vary with the level of production just as direct costs do, they are indirect in relation to units of production. That is, as production volume increases, so do some maintenance costs. However, no particular bit of maintenance can be traced directly to specific production units. Nonetheless, GAAP reporting requires that all of these factory costs be included in accounting for inventory and cost of goods sold. Therefore, the cost accounting system must have some mechanism for associating them with units of production. Traditionally, when the cost accounting system is designed, there is an attempt to keep overhead "close to" the work it is used for. Thus, many factories use departmental overhead accounting. That is, they first allocate overhead to different working departments and then create an overhead rate within each of those departments.

Where Overhead Costs Come From

In order to determine actual overhead for a prior period or to estimate overhead for a future period, we must start by identifying what the nature of the expenditure was. That is, what resource was the money spent for? Traditionally, cost accountants identify three broad categories of overhead expenditure: indirect materials, indirect labor, and general factory overhead.
Indirect materials are real materials, but ones that we cannot trace or do not care to trace directly to individual products. Thus, they would include the cleaning materials used to wash and sanitize a frozen food preparation and packaging line (not traceable) or the adhesives used to affix the manufacturing company's nameplate onto each finished CD player (traceable, but not traced due to lack of materiality). Likewise, indirect labor is real labor. It is labor other than that used to actually make the product. It is labor used to support the manufacturing effort. Examples include supervisory labor, maintenance labor, and labor employed to move materials into and out of inventory.

General factory overhead may or may not be real, if we can say that depreciation is not a real expenditure. Given the nature of our definitions, general factory overhead must be all costs in the factory other than direct materials, direct labor, indirect materials, and indirect labor. That leaves quite a bit of resource expenditures to be covered by the term. For example, this category of overhead would include all depreciation costs for plant and equipment, the costs of heat and power, rent, property taxes, insurance, telephones, factory administrative salaries, and the cost of the annual New Year's party.

**Single Plant-wide Overhead Rates or Multiple Department Overhead Rates?**

If a factory produces one or a few product lines and if these different lines consume resources in an undifferentiated way, it does not make much sense to chop the overhead up into a variety of departments for final assignment to units of production. Under such circumstances, all overhead can be aggregated into one general total and distributed to products according to a uniform rate. This is called a single, plant-wide overhead rate.

When there is reason to believe that different products differ in the degree to which overhead supports their production, it might make sense to segregate overhead costs into groups based on that differential consumption. The only sensible reason to further divide up overhead is that that extra separation
provides useful information. This is not always the case. (Even when it is, some companies still do not make the extra effort.)

Each subgroup of total overhead when it is divided up this way is called an **overhead pool**. In concept, at least, all of the costs in a single overhead pool are related to production in the same way. That is, they all share the same logical allocation base.

In the traditional view of multiple overhead pools, costs are associated with departments. That is, each product-making department in the factory is matched with its "direct" costs. The first stage of allocation is to take the costs for the other areas in the factory and redistribute them to production departments. The second stage of allocation is to take the computed production department totals and calculate an overhead application rate to spread those totals over the work done in the production departments. These second stage rates can be based on estimates or recorded costs. They also follow the same general form as the plant-wide overhead rate computation.

Note that the final "total" overhead to be allocated out of each department can vary greatly based on the methods used to put the support department overhead costs into the production work done in the production departments. Often, these calculations can appear to be very refined. However, finer detail is not necessarily more useful information. Remember the phrase GIGO -- garbage in, garbage out. If the allocation bases are not really related to the reasons costs are incurred, finer chopping just wastes effort and produces finer misinformation!

Regardless of whether a factory uses multiple department overhead rates or a single rate for the whole plant, the final methods used to calculate the rate are the same. The rate can be based on estimated overhead (this is called normal costing) or on recorded overhead (this is called actual costing). The final rate is then calculated according to a formula of the general form:

**Overhead application rate = [total factory overhead]/ [total base activity]**
The base activity is often a very simple and easily determinable measure, like direct labor hours, direct labor cost, machine hours, material weight, or material cost.

**The Normal and Actual Measures of Overhead Cost**

In accounting terminology, overhead costs recorded after the fact is said to be the "actual cost" of production. Here, "actual" is a label, indicating the way the assigned overhead was computed. The accounting term "actual" simply means "computed after the fact based on recorded costs." It does not indicate that this is the absolutely true cost.

An alternative approach to computing the cost of production is the "normal" costing approach. Normal costing is a method of using estimates to compute overhead associated with a product rather than waiting for final actual overhead costs and final counts of the allocation base activity. Normal costing has two advantages over actual costing (as well as one major disadvantage). First, normal costing avoids the wait for data until after the overhead costs are recorded. Under normal costing, the cost can be computed as soon as the last unit is complete. The second advantage is that it averages the effects of overhead costs and levels of activity over the year.

Under the normal costing method, an overhead rate is calculated using estimates. This number is known as the **predetermined overhead rate**.

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PDOR = \frac{\text{Total estimated annual OH}}{\text{Total estimated annual DLH}}
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Once a production run is done, the amount of **basis activity** (e.g., direct labor hours) used is determined. Multiplying this number times the predetermined overhead rate finds the overhead amount to be associated with the work. This is called **applied overhead** to distinguish it from "actual" overhead. Under normal costing, the computed

The fact that the normal cost differs from the so-called actual cost is not really a cause for concern. There are three reasons why this could happen. First, there could be an effect due to differing overhead costs over the year. For example, costs for heat and grounds maintenance could be higher in winter. Second, there could be some seasonality to production activity levels. Perhaps
there is more work done in the April to September time period. If so, there are proportionately higher number of direct labor hours during those months. At a given monthly overhead cost, the "actual" costs per hour would be lower in the busy months. Both the higher costs for certain months and the higher activity levels for other months are averaged over the year under normal costing. Thus, normal costs can differ from actual costs because they average out the overhead costs for the year and apply them "smoothly" throughout the year. This is considered an advantage of the normal costing approach.

The third reason for the difference, of course, is that the estimates could be wrong! In fact, it would be surprising if the estimates were not off by some amount. How perfectly can we expect managers to predict the future? The difference over the year may not be all that important, however. This is something that has to be determined. This is the single major disadvantage of the normal method.

From the perspective of financial reporting, the final numbers in cost of goods sold and inventories must reflect total actual costs for the year. To the extent that the total of applied overhead using normal costing is larger than the total recorded overhead, it is said that the company has overapplied overhead. Conversely, if the actual total is larger than the applied total, underapplied overhead is the name given to the difference.

**The Cost Driver approach -- ABC**

The primary ways of associating overhead with jobs or processes are direct identification or some proportional (i.e., formula-based) allocation. Furthermore, there is typically a fundamental decision inherent in the costing system as to whether there will be one or many overhead rates calculated for the factory. Many organizations still rely on a single, plant-wide rate for applying overhead in the entire factory. This approach has often been derided as a "thick, peanut-butter spread."

We must be careful not to confuse the impact of these different methods with increased accuracy. To the degree that the allocation bases are poor
analogs of the way in which organizational work gives rise to overhead costs, the precision of the allocation method is wasted.

It should be clear at this point that the costs determined by traditional cost accounting systems are the result of a large number of estimations and occasionally debatable judgments. This can be the source of potentially serious management problems. No matter how "rough" or unrepresentative the cost numbers provided by the cost accounting system are, in most organizations it is difficult to deny the legitimacy of figures that come out of those systems. This is especially true when they are given official-sounding labels like as "actual unit cost." Over the last twenty-five years or so, there has developed a realization that costs calculated through traditional methods frequently do not give an appropriate picture of the resources that have really been dedicated to the provision of a service or consumed by the production of a unit of product. This is a problem, because when we are concerned with management decisions, it is a "resource use" measure of cost that we need to know.

One prominent accounting researcher who deals with the role accounting plays in affecting behavior in organizations claims that the only reason managers want to know a cost is to change it. If this is correct, then it would help to have a reliable way of deciding what resources are consumed by production so that we can know (1) what is the cost now and (2) what the is the effect of our attempt to change the cost. In recent years, companies, consultants, and researchers have put a great deal of effort into trying to find better ways of doing just that. The focus of their efforts has been on overhead allocation. The goal they seek is finding out what makes overhead costs rise or fall.

**Cost Drivers:**

**What Makes Costs Go Up or Down?**

When companies choose overhead allocation bases, they are interested in finding measurable aspects of production that reflect what makes costs go up and down. The primary distinction brought to bear on this question in the traditional view is the difference between fixed and variable costs. Variable costs
rise and fall with short-term changes in the volume of production activity. Fixed
costs do not, but presumably even they go up and down with the long-term
trends in the volume of activity. That is, if production volume keeps rising, the
company may have to buy more machinery or build an addition onto the factory.
Hence, overhead from factory depreciation costs will go up.

To the extent that a company's separation of costs into fixed and variable
categories is based on careful analysis of total overhead cost data, the fixed-
variable distinction can be quite useful. A good approximation of how costs rise
and fall with production activity (variable cost) would reveal at least one
component of cost that reflected cause-effect relationships. Such an analysis
would still leave unanswered the question of what "caused" the fixed overhead.
Most fixed costs are the results of planned decisions about capabilities and
capacities, so it is the inputs to these decisions that are, in some sense, the real
causes of fixed cost increases and decreases.

In recent years, the realization that there are things done in factories other
than strict production volume that make costs go up or down has led to a search
for underlying cost drivers. In the cost literature, there is some confusion about
what a cost driver is. In our discussion, we will reserve that term for the
capabilities, capacities, and activities that cause costs to rise or fall. That is, a
cost driver is a cause, and it is defined conceptually. All costs are variable in the
long term. A cost driver is the dimension along which a cost varies in the long
term.

In terms of the mechanics of calculation, activity-based costing (ABC) is
not much different from the methods of the past. It is still based on overhead
pools and the allocation of overhead from these pools using some allocation
base. What is different about it is: (1) the way the cost pools are defined and (2)
the way that cost objects for those cost pools are specified.

Traditional systems take costs from pools defined by cost collection
points, like service departments. ABC systems start from the perspective of cost
drivers: increases in which activities make total costs higher? Having identified a
discrete number of such drivers, ABC systems build cost pools by classifying
costs based on the driver that causes them. That is, overhead costs are grouped into separate pools. Each pool is related to a single major cause. This is a critically important part of designing an ABC system. If the drivers are mis-specified or the cost pools are poorly constructed, the final cost figures provided by the system will be meaningless. Since the new cost pools cut across departments, they are not easy to construct.

It is typical for an ABC system to show that more complex products, ones with more interruptions in processing, and ones with comparatively lower volumes of production than others in the plant are more costly than the traditional model shows. Cost management researchers have identified a list of symptoms exhibited by organizations whose cost accounting systems misrepresent their cost structures enough so that an ABC system is likely to provide a significant improvement in cost information. Many of these symptoms have to do with the fact that the cost information leads managers to expect one result, while events lead to conflicting results. For example:

1. Customers do not react as expected to price changes. They do not rush in when prices are lowered, or, perhaps, they do not reduce demand when price increases take place. This kind of reaction is most likely to occur when the existing cost accounting makes managers believe that a product consumes much less or much more resources than it really does.

2. Competitors seem to put most of their efforts into attacks on the company’s low gross margin items, perhaps even selling at prices below the company’s recorded costs. Conversely, competitors do not compete against products that the company’s cost accounting system shows to have high gross margins. Why would competitors fight for low profits and ignore high ones? They would not! Therefore, they must believe that the margins are just the opposite. Maybe they are right and the company’s cost accounting system is wrong.

3. Expected costs and gross margins (i.e., budget expectations) do not come out as the company would expect. Perhaps the product mix shifts to high
margin items, but profits do not increase. Perhaps production volume shifts to a greater percentage of lower-cost items, but total costs do not reflect such a shift. Again, the cost accounting system is likely to be providing misleading information.

Even when none of the above outcomes is noticed, there are structural signals which indicate an ABC system may be helpful. The basic question is, do different products use resources differently? Are some products high users (per unit) of direct labor or machine hours while others are not? Do some products use special equipment which is known to be more expensive (or less expensive) than average?

SUMMARY

In the pursuit of unit product costs, cost accounting systems gather the costs associated with doing the work that produces products and divide them up among the units. The focus of costing activity is following a specified batch of goods through production, recording the cost of direct material, direct labor, and overhead as work is done. When the total costs for the period are known, they can be divided by some common measure of the work done and then translated into cost of production for each unit of each product type. The result is called the unit product cost.

In order to simplify gathering the overhead costs that go with a job, many systems employ an idealized version of overhead costs -- normal or standard costs. Normal costing implies that overhead will be applied to jobs based on the estimated overhead costs for the year and the estimated "basis" activity related to overhead. Of course, since estimates are used, there is bound to be some difference at the end of the year between the total overhead applied to all jobs and the actual amount of overhead recorded for the factory. This over- or underapplied overhead has to be reflected in the books. Generally, this is done by adding or subtracting it from cost of goods sold. This adjustment is probably the biggest negative factor in choosing to use normal costing, and it is not all that serious.
These are questions that call for management analysis and action, not financial reporting. A substantial number of companies are devising and using ABC systems. A substantial number are employing some ABC ideas in their costing systems, but not changing as radically. Some companies have started to design ABC systems, but have stopped after they have done the analysis, choosing instead to take the implied actions (this is becoming known as Activity Based Management -- ABM). All of these companies, however, are interested in using their new-found knowledge of costs to improve management analysis and action. Once an activity-based cost analysis is complete, managers are in a position to ask (and answer) the basic questions of strategic cost planning: What activities consume resources? Do those activities create value? Can they be accomplished through a more efficient alternative? Are they necessary, or are they waste?