Overhead Allocations in Highly Automated Production Processes

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Abstract

The capital intensive nature of automated production processes has increased the proportion of total production costs which are classified as overhead. The increasing importance of overhead costs makes their treatment a central issue in the determination of product cost. This article examines current methods of changing overhead costs to product and suggests possible improvements in the current process.

Introduction - The Nature of Overhead Costs

The treatment of overhead costs in manufacturing processes has become a central cost accounting issue in recent years. Overhead, as a percentage of total costs, has been increasing as companies develop more highly automated production processes. This move towards a more capital intensive production process has made many companies' current allocation methods inappropriate.

Overhead, broadly defined, is all manufacturing costs other than the costs separately identified as direct material and direct labor. Overhead consists of things such as indirect materials, indirect labor, and labor related costs such as fringe benefits and overtime premium. It also consists of such major cost items as supervision, depreciation of manufacturing plant and equipment, utilities and maintenance. Consequently, overhead is made up of a mix of variable, fixed, and semivariable costs. Due to the increasingly capital-intensive nature of automated production processes, Lammert (p.33) maintains that overhead costs have become increasingly fixed.

Overhead allocation is the process by which these plantwide, indirect costs are assigned to various intermediate cost objectives (divisions, departments, etc.) and finally to the products produced. Allocation is necessary because overhead cannot be directly associated with corresponding units of output. The objective of the allocation process is to assign overhead to production in a manner that best reflects the cause and effect between the costs incurred and output obtained. A secondary consideration is the cost of making the allocation. Overhead is typically assigned to production by an allocation rate based on some directly measurable factor common to the different types of units produced, such as direct labor cost or machine hours. The assumption made is that the relative amount of this factor used in the production of a product indicates that product's proportionate share of overhead cost. According to Usary (p.325), this correlation needs to be as close as possible to provide relevant, decision-useful information for management and investors. Management relies on this cost information in evaluating the efficiency or effectiveness of divisions, departments, and individual managers, as well as the profitability of certain product lines. The impact of the allocation process on inventory valuation and cost of goods sold directly affects reported profitability and resulting investment decisions.

As companies develop increasingly capital intensive production processes through automa-

tion, the nature of their overhead costs change. Not only do the components making up overhead change, but also overhead as a whole becomes more important as it makes up a greater percentage of total product costs. This change in the nature of overhead creates a situation in which traditional allocation methods no longer reflect the relationship between overhead and product costs.

Overhead often appears to be an "invisible" part of the finished product. The direct materials in a product are evidenced by material requisitions. Direct labor is evidenced by time tickets. There is no such evidence directly relating overhead to a product or job, and yet, as Usary, (p.324) demonstrates, it very often is a majority of the cost. Average unit overhead costs can fluctuate considerably as production volume changes, because of the mixed components of overhead. The variable portion of overhead attributable to a product, such as factory supplies and labor fringe benefits, changes with the volume of production. The fixed portions, such as rent, remain constant. Semivariable costs, such as electricity, are composed of fixed and variable components. Electricity used for lighting tends to be a fixed cost, while that used in running production machines is variable. These diverse cost relationships make the selection of a meaningful allocation rate a difficult one.

Present Methods of Dealing with Overhead

Since it is impossible to trace the items of factory overhead directly to a specific job or product (which would be theoretically preferable), an arbitrary allocation must be made. Since overhead must be allocated as product is produced, a predetermined factory overhead rate is normally established based on estimated overhead cost and activity levels. This rate is established by dividing the estimated overhead for the period by an allocation base. The base selected should be closely related to the overhead costs being applied and be directly measurable with respect to product or other cost objectives. Theoretically, it should be the cost driver. A base should also be chosen that minimizes clerical cost and effort relative to the benefits or accuracy attained.

Some common bases used today are physical output, direct materials cost, machine hours, direct labor cost, and direct labor hours. The physical output base is the simplest method of applying overhead. The overhead per unit is computed by dividing the estimated overhead by the estimated units of production. This method is adequate only when one type of product is produced. A direct materials base is applicable if there is a correlation between direct materials cost and factory overhead. According to Usary (p.327), this rate is seldom used because in most cases this correlation does not exist. A product with higher priced materials, using a similar manufacturing process, would be charged with more than its share of overhead. A machine hours base may be the most appropriate in a highly automated production process. A rate per machine hour is computed by dividing the estimated factory overhead by estimated machine hours. This method is considered most reasonable when overhead cost is made up predominantly by facility-related costs, such a depreciation, maintenance, and utilities. A major difficulty with this method is that it usually requires additional clerical effort to accumulate machine hour information. The direct labor cost and direct labor hour bases are perhaps the most common bases used today. These rates, found by dividing estimated overhead by estimated direct labor costs or hours, are often inappropriate.

According to Deakin (p.18) direct labor cost and direct labor hour bases come from allocation principles developed during the early Industrial Revolution, when there was a completely different production environment. Due to a much higher degree of labor intensity, direct labor costs were a larger percentage of total costs. Labor based allocation methods were designed to control these costs. During this time, overhead was comparatively low and, because it largely consisted of employee fringes and payroll taxes, was largely a function of the number of workers and time worked. Most of these labor-related

overhead components varied with the amount of direct labor utilized. Today, as companies shift from labor based production processes to automated processes, many are still using labor based allocations methods. These methods are often still used because they are so easy to implement. Labor hour and cost information is readily available in the financial accounting system. The use of these methods has continued even though overhead has become less dependent on the number of laborers or time worked. Direct laborers are now less involved in the production process. Their roles have become more of a supervisory one. They are increasingly merely tending to and monitoring the real cost driver - the machines.

Overhead in Capital - Intensive Processes

Capital intensive production processes have developed and are developing because of several factors. First, the continued escalation of labor costs has made investment in labor saving equipment more easily justifiable. These higher labor costs have often been overstated by the usage of labor-based allocation methods, which may lead an uninformed user to view allocated overhead as an additional cost per labor hour. According to Jonez(p.28), many companies with highly automated production processes are producing products with direct labor making up less than four percent of total costs. Advances in technology have also made robotics and the computer more extensively applicable in production processes. Lee(p.34) maintains that this trend is expected to continue as most industry experts believe that the ideal factory of the future would be one implementing computer integrated manufacturing. In a computer integrated manufacturing (CIM) system, the whole production process, from designing, to engineering, to manufacturing, would be linked together by computer and be totally automated. A CIM system, with no human participation in the production process, has yet to materialize. However, it illustrates the trend toward reduced labor involvement in production. Many companies today employ a scaled-down version of CIM called Flexible Manufacturing Systems (FMS). A FMS is a group of machines which can be reprogrammed to switch from one product type to another. A FMS process consists of robots and computer-controlled material handling systems which link various, separate, computer-programmed machine tools. Companies are applying this new technology in their search for a more flexible, efficient way to produce a higher quality product.

In automated processes of this type, fixed overhead costs have become much more significant in relation to total costs, while direct labor costs have declined in importance. In processes of this type, the major costs and investment precede the production process in the development of systems and software, and the acquisition of the equipment. As machines replace workers, direct materials and energy to operate the equipment become virtually the only variable costs, as those related to labor disappear. Wages shift from hourly rates to salaries, as information workers, such as design engineers and system analysts replace the traditional blue collar workers. Also, Hein(p.116) maintains that those "traditional" blue collar workers that are still present in the factory often have a large portion of their wages fixed due to union wage agreements. This shift towards higher fixed costs comes at a time when rapidly changing product and process technologies are causing shorter product life cycles. This puts more strain on the cost accounting system, which must properly charge a diverse product mix with a meaningful share of an increasingly large fixed overhead cost. The higher fixed portion of overhead makes the allocation process more difficult. Typical allocation processes, when using a variable base such as labor hours or machine hours, make the assumption that the cost being allocated is variable. This assumption can lead to unit costs that consist primarily of allocated fixed costs, often based on irrelevant allocation bases.

An irrelevant allocation base would be one in which there was no causal relationship between the base and overhead. As mentioned earlier many companies continue to use labor based allocation methods. If there is no causal rela-

tionship between direct labor and overhead, unit costs are derived which do not reflect the realities of the production process. This distortion is compounded in a highly automated production process, one in which direct labor is low relative to overhead, because allocation rates are so high. Deakin(p.20) found that it is common in these situations to find overhead rates in excess of $150 per direct labor hour. Single allocations bases also, by the fact that they are single, make the faulty assumption that overhead is driven by a single variable. In actually, overhead, with its many components, is driven by many variables.

Alternative Solutions to the Problem of Overhead Allocation

The problems associated with the present method of overhead allocation can thus be summarized as follows: 1) The widespread use of labor-based allocation methods is not appropriate due to the lack of causal connection between direct labor cost and overhead costs; 2) Overhead costs are now a greater portion of total manufacturing costs, making allocation a central issue in arriving at total unit manufacturing costs; 3) Overhead costs have increasingly become fixed, while overhead allocations methods assume a variable relationship between overhead and associated production volume. In short, traditional overhead accounting methods have ceased to reflect the realities of the present production process and in many instances have become dysfunctional as a basis for providing decision-useful cost information.

Most examinations of this problem have tended to focus on the problem of selecting a more meaningful allocation base for overhead allocation. In some manufacturing situations where inventory carrying costs are a major portion of overhead costs, the use of direct materials as an allocation base is appropriate. Jonez and Wright (p.27) have suggested using the number of part numbers as the basis for allocating material-related overhead to product. This method is based on a study indicating that materials-related overhead is more related to the number of items carried in stock than to the frequency of use of a particular item. They argue that this method of allocation will produce a strong incentive to standardize product components and thereby minimize materials-related overhead.

Because of the increasingly capital intensive nature of most production processes, the use of machine hours or some other measurement of equipment utilization is a frequent suggestion as an alternative to direct labor. (see for example Lammert (p.35) Allocation based on machine hours is administratively difficult because machine utilization is normally not recorded elsewhere in a firm's accounting system, as are direct labor costs and direct labor hours. There are also some conceptual problems such as whether to use actual utilization time or total time set up or "committed" to a particular job. However, because of the strong causal connection between equipment utilization and capital-related overhead costs, machine hours and similar utilization-related allocation bases remain attractive.

The proponents of alternatives to the use of labor-based allocation systems usually also propose the establishment of multiple overhead cost pools utilizing different allocation bases. For example, Jonez and Wright (p.29) propose the establishment of a materials-related pool allocated on the basis of part numbers utilized and a non-materials-related pool allocated on another base such as direct labor hours. Another possible approach is to associate costs with specialized manufacturing "cells" in which most cost elements are directly traceable to produce. Since the output of these cells would be homogeneous units of product, any allocations necessary could be made a units-of-production basis. According to Lammert (p.35) the result should be a simplified cost accumulation process that produces unit cost and productivity information that is timely and of greater decision-usefulness.

While all or some combination of the above alternatives will improve the process of overhead allocation, the basic nature of the allocation process remains the same. Overhead allocated to

product cost is treated as a variable element of cost. The allocation process thus fails to reflect the increasingly fixed nature of manufacturing overhead and, as a result, the increasingly fixed nature of manufacturing costs.

Processes with a high percentage of manufacturing costs in the form of fixed costs are characterized by large capital bases which are "sunk" in nature. Because variable manufacturing costs are relatively low and unit contribution margins are high, profit planning emphasizes expansion of sales volume and utilization of fixed capacity. Unit costs are deemphasized relative to quality and market share considerations. Traditional absorption costing methods, by treating fixed overhead as a product cost, mask the highly fixed nature of manufacturing costs in the above situation and tend to produce management decisions that fail to recognize the true nature of the costs involved.

An alternative method of accounting for manufacturing costs known as direct or variable costing specifically distinguishes between fixed and variable costs and treats only variable manufacturing costs as product costs. All fixed costs are treated as period costs, effectively recognizing them as an expense associated with the decision to operate the facility rather than a cost related to the decision to produce a given unit of product. In a process with a high level of fixed cost, direct costing methods offer a better representation of the firm's actual manufacturing cost situation. Their use would greatly simplify the manufacturing unit cost accumulation process by eliminating the requirement for allocating fixed overhead. Only variable overhead, which typically would be direct materials or direct labor related, would need to be allocated. Lammert (p.37) maintains that the result should be a cost accounting system that could be increasingly integrated into the manufacturing process rather than operated as a separate function within the organization.

In some cases, variable costing would require additional cost classification to separate mixed costs into fixed and variable components. Present regulations presently place some restrictions on these methods of use in financial reporting and for tax. However, Schiff (p.36) demonstrates that variable costing is used for financial reporting purposes by many corporations and is permitted in some form under current rules.

Conclusion

Robert A. Bonsack, a consultant for Arthur D. Little, Inc. has been quoted by Teresko (p.22) as observing that, "The measure of a good cost accounting system is the degree to which it reflects what is going on physically on the factory floor." The penalty for use of systems which fail to meet this test is management information which produces faulty decisions. As demonstrated above, cost accounting methods used to account for overhead costs have not changed to reflect the evolution of the manufacturing environment. Due to the increasingly fixed nature of production costs, variable costing should be adopted in most automated environments as an alternative to traditional absorption cost techniques. The accounting profession should clarify its somewhat opaque position on variable costing by strongly supporting use of this method. This change, together with the use of improved allocation bases for the variable overhead costs still remaining to be allocated should be major contributions to the problem of accounting for overhead in an automated manufacturing environment.

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