DIFFERENTIAL COST ACCOUNTING

DISSERATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of the Ohio State University

By

Paul LeMoyne Noble, B.S.C., M.B.A.
The Ohio State University

1952

Approved by:

Herman C. Miller
Adviser
Table of Contents

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  Introduction</td>
<td>2</td>
</tr>
<tr>
<td>2  The Economic Background of Differential Costs</td>
<td>27</td>
</tr>
<tr>
<td>3  The Relationship of Differential Cost to Price</td>
<td>47</td>
</tr>
<tr>
<td>4  A Critique of Present Methods of Factory</td>
<td>72</td>
</tr>
<tr>
<td>Overhead Accounting and Control</td>
<td></td>
</tr>
<tr>
<td>5  Adapting Accounting Techniques to the</td>
<td>92</td>
</tr>
<tr>
<td>Differential Cost Approach</td>
<td></td>
</tr>
<tr>
<td>6  Non-manufacturing Uses of Differential</td>
<td>152</td>
</tr>
<tr>
<td>Cost Accounting</td>
<td></td>
</tr>
<tr>
<td>Conclusions</td>
<td>170</td>
</tr>
<tr>
<td>Appendix A</td>
<td>173</td>
</tr>
<tr>
<td>Appendix B</td>
<td>193</td>
</tr>
<tr>
<td>Bibliography</td>
<td>196</td>
</tr>
<tr>
<td>Autobiography</td>
<td>207</td>
</tr>
</tbody>
</table>

$921002$
Any treatment or discussion of the history of cost accounting will readily point out and emphasize the relative recency of the development of the art. It is usually recognized that accounting is a young field in comparison to the older professions of law and medicine, but general financial accounting was well on its way toward establishment and recognition as a profession before much attention was given to cost accounting. It is generally recognized that the modern age of accounting in this country had its roots in the huge industrial and railroad expansion which followed the Civil War. This expansion caused the growth of complex business structures resulting from combinations and mergers which, in turn, gave rise to the need for proper and adequate accounting. Furthermore, this spectacular expansion, particularly that of the railroads, was financed to a considerable extent by capital from Great Britain where the need for proper accounting methods had already gained recognition. British investors, seeking to protect their investments, insisted upon an accounting for their American ventures; and thus many accounting and auditing techniques were imported to this country.
By 1887 the public accounting profession had developed to the point where a professional society was successfully formed, the American Association of Public Accountants. Cost accounting at this time was just receiving the first signs of attention. Although some pioneers had installed factory cost systems as early as 1857, it was not until the decade of the 1890's that serious study was first directed to costing. It was not until 1919 that the National Association of Cost Accountants was formed, thirty-two years after the formation of the American Association of Public Accountants.

In a body of knowledge so recently conceived, one would hardly expect to find a clearly outlined set of fundamental principles universally accepted through years of testing and proven by successfully withstanding attack. On the contrary, one would expect that the early years in the development of a field of learning would be years of trial and error and of searching for fundamental truths. It is a period in which many hypotheses are advanced only

1 "Mr. John W. Francis, in 1857, took charge of the accounts of Bement & Dougherty, then well-known as manufacturers of machine tools and whose plant later became a part of the Niles, Bement, Pond Co., properties. In this position, in addition to his regular duties, Mr. Francis undertook the task of designing and installing a factory cost-system." T. Edward Ross, Pioneers of Organized Public Accountancy in Pennsylvania, 1942, pp. 9, 10.

to fall under the test of time and usefulness, while other concepts must await full development pending the proper background of circumstances.

Such have been the early years in the development of the art of cost accounting, and it was in this setting that differential costs had their beginnings. All of these early years might be described as the pioneer stage of cost accounting, but Dr. Raymond P. Marple, Assistant Secretary of the National Association of Cost Accountants, conceives of three distinct stages through which cost accounting thinking has passed in these early years of its development: first, what he terms the inventory valuation and profit measurement stage; secondly, the cost control stage; and he feels that we are just entering upon the third, or cost analysis stage. The concept of differential costs was discussed in the very earliest years of the development of cost accounting, but the time and circumstances were not ripe for its full development and use. It was not until recently, when we entered upon the cost analysis stage, that a full appreciation of the significance of differential costs could be developed. Dr. Marple states it this way: "...during the early development of modern

1 Letter from Dr. Raymond P. Marple, dated July 23, 1951, addressed to the author, reproduced in full in Appendix B.

cost accounting—what I call the first stage or the inventory valuation and profit measurement stage—the need for separate classification and treatment of fixed and variable costs was not appreciated or developed. It was not until we were well along in the second stage—the cost control stage—that the development of flexible budget techniques forced recognition of the essential difference between fixed and variable costs. But it is the third stage, which we are just entering—the cost analysis stage—which has brought home to a few cost accountants the way in which this essential difference in the two types of costs can be utilized to provide better cost information, not only for management policy determination, but for all purposes for which costs are used."

Thus, the concept of differential cost is not new—it received mention in the earliest years of cost accounting, but only recently have we begun to focus serious attention upon the practical application of differential cost techniques to managerial problems.

The first suggestion of the wide application of differential costing appeared in an article by Jonathan Harris in January, 1936. In this article he proposed the

1 Ibid, Dr. Marple letter, Appendix B.
elimination of fixed charges from inventories, which is an approach to inventory valuation based upon the differential cost principle. A storm of protesting letters followed this proposal and were published in succeeding issues of the Bulletin of The National Association of Cost Accountants. However, the concept persisted and in succeeding years it gained much momentum. In the last several years it has been the subject of a growing number of articles in the N.A.C.A. Bulletin and has been discussed at regional and national cost conferences.

It is the objective of this dissertation to test the validity and reliability of the differential cost approach, both from the theoretical and from the practical point of view. Economists have already intensively studied the theoretical aspects of the concept. The present study will review this theoretical background in an effort to relate it to problems of accounting control as well as test it in the light of practical observations. After thus establishing the theoretical basis for differential costs, attention will be turned to the practical problems of incorporating differential costs in the accounts, reports and in accounting standards.

The theoretical aspects of the problem will be drawn largely from the field of economics. For practical grounding, the problem was discussed with executives representing ¹ cf. post, pp. 120 ff.
ten industrial firms throughout Ohio. Several of these firms were chosen because it was known that they were interested in, or experimenting with, differential costs. The remainder were chosen because of their willingness to cooperate in the discussion of problems of accounting, costing and pricing. An abstract of these discussions is presented as Appendix A of this dissertation.

Before proceeding further, it would be well to define differential costs. Actually, differential costs have wide applicability in many types of situations. One of the most common of these pertains to the production of a firm in terms of units of product, and it is in these terms that differential costs are usually defined. Blocker says, "differential costs are the increase or decrease in total costs that results from producing and distributing additional or fewer units of product."¹ Thus assume a firm is now producing 50,000 units of product, which is something less than its full capacity, at a total cost of $100,000, or an average total cost of $2 per unit. Obviously some of the $100,000 is fixed cost—that is, cost which does not necessarily change with changes in production volume, while other costs included in the total are variable costs or those costs which are increased and decreased almost solely as the result of changes in

production volume. Let us further assume that of the $100,000 total cost incurred, $30,000 may be classified as fixed while the other $70,000, or $1.40 per unit, are variable costs. Given these existing conditions, it is now proposed to produce an additional 10,000 units of product, or 60,000 in all; and a question is raised as to the cost of these 10,000 units. We shall assume that no change will occur in the fixed costs, and that a variable cost of $1.40 will be incurred for each of the additional 10,000 units, as was incurred for each of the previous 50,000 units. One approach would calculate the cost of the 10,000 units as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed costs of the firm</td>
<td>$30,000</td>
</tr>
<tr>
<td>Variable costs (60,000 units @ $1.40 ea.)</td>
<td>$44,000</td>
</tr>
<tr>
<td>Total cost of 60,000 units</td>
<td>$114,000</td>
</tr>
<tr>
<td>Unit cost ($114,000 ÷ 60,000)</td>
<td>$ 1.90</td>
</tr>
<tr>
<td>Cost of 10,000 units (10,000 @ $1.90)</td>
<td>$ 19,000</td>
</tr>
</tbody>
</table>

This calculation and approach to cost determination is referred to as the average total cost calculation, because it would average all the costs over all the units, making no differentiation for the 10,000 new units as distinguished from the 50,000 previous units being produced.

The differential cost approach would calculate the
cost of producing these 10,000 units as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Present cost of producing 50,000 units</td>
<td>$100,000</td>
</tr>
<tr>
<td>Cost of producing 60,000 units (see previous calculation above)</td>
<td>114,000</td>
</tr>
<tr>
<td>Additional cost involved in producing the added 10,000 units</td>
<td>14,000</td>
</tr>
<tr>
<td>Unit cost of each of the added 10,000 units</td>
<td>1.40</td>
</tr>
</tbody>
</table>

According to the differential cost approach, each added unit costs $1.40, while according to the average total cost approach, each of the 10,000 units costs $1.90.

There are several aspects of this simple definition and illustration which require further emphasis. It should be noted that differential costs are best understood in comparison to total average costs; not only is this true in defining differential costs, but it is also true in the application of the differential cost technique to the solution of practical problems. The average total cost approach would insist upon spreading all costs equally to all units, while the differential cost approach would assign to any particular unit, or group of units, only those costs arising directly as a result of the production of those units.

These two approaches are not necessarily contradictory; one is not necessarily right and the other wrong, but they do represent two different views of a set of
circumstances. In the field of general financial reporting, it is becoming more and more recognized that there is not just one method of reporting, but rather that the form and content of a financial report depends largely upon the use which is to be made of it. The time is coming when cost accountants must recognize the same principle—namely, that there is not just one method of calculating a cost, but the way in which a cost is calculated should depend largely upon the use to be made of it. One of the executives with whom this problem was discussed expressed this view rather emphatically. He said that in recent years he has adopted a policy wherein he refused to submit cost calculations for others in his organization until he knows the purpose for which the information is requested.

Thus both total costs and differential costs may have their uses, but in the past the emphasis has, by far, been placed upon total costs with less attention being given to differential costs. It is one of the objectives of this study to examine the relative significance and importance which has been assigned to the two approaches and to determine whether the placing of the emphasis should be reversed.

It is further pointed out that the above definition and illustration are greatly over-simplified. In the first place, it apparently assumes that the so-called variable
cost remains exactly constant at all levels of production; that regardless of whether we are producing the first or the thousandth or the sixty-thousandth unit, the variable cost is $1.40. Practical conditions do not react in this simplified way; although it is called variable cost, conditions usually are such that savings will be effected in variable costs at certain volume levels, while inefficiencies will prevail at other volume levels. Accordingly, it may be somewhat inaccurate to use the $1.40 figure at all levels of production, but this simplification does not destroy the validity of the illustration. Whether the added cost of an additional unit of production is $1.40 or $1.38 or $1.42 or even $2.00, it is this added cost which constitutes the differential cost. These fluctuations in variable cost will also be the subject of further investigation and analysis in this study.

Another over-simplification is found in the apparent ease with which the total cost was classified into its fixed and variable elements, and the ignoring altogether of a semi-variable element. The use of the classification in the illustration is valid, but the actual segregation of costs into these categories in practical circumstances sometimes pose rather perplexing difficulties. This problem, as well as the problem of a semi-variable type of cost, will also be examined in further detail.
The illustration further assumes the existence of unused or idle plant capacity. This is one of the more common situations in which differential costs have been used, but it is by no means the only situation. The differential cost of units of product may be calculated at any volume level, even when operating at full or maximum capacity. At such levels of operation, it may be found that the differential cost of added units become exorbitant because of inefficiencies which enter into the productive process; or the point will eventually be reached where, in order to produce an added unit, additional plant facilities must be acquired. Thus, the amount of the differential costs may vary widely, depending upon the given circumstances of the situation. The significant point is that the approach can be applied at any level of operation and is not limited to analyses of unused capacity, although this is a common application of the technique.

Up to this point, the discussion has been entirely in terms of the differential cost of added units of production. As stated earlier, this is one of the more common uses of the differential cost technique; and most writers have discussed differential costs almost solely in these terms. While this is one area in which differential costs can have great value, it is certainly not the only situation in which differential costs can be useful. On the contrary, there is hardly a managerial decision in which
differential costs cannot be of use and indeed may be the very basis for managerial policy determination.

Several examples will help to demonstrate the wide variety of circumstances in which the differential approach can be utilized. The possibility of plant expansion has already been mentioned. In a sense this might be classified as simply the problem of added units of production, but the circumstances are sufficiently distinct as to warrant separate consideration.

If, when discussing the building of a new plant, we are thinking of the creation of an entirely new firm, we may find that the differential, or variable cost, and the total cost are exactly the same. The distinction between differential cost and total cost arises when we have some existing fixed costs which may be spread over greater activity without increasing them in amount. Thus, the added or differential cost is less than the total cost. If an entirely new firm is created where there are no previously existing fixed costs, then the differential cost and the total cost of the new firm will be identical.

Economists have stated this same concept in another way—namely, that in the long run all costs are variable. In other words, speaking in terms of extremely long periods of time, we may think of firms coming and firms going, the creation of firms and the discontinuance of
firms. It is only when we "slow down" our perspective that we can begin to examine what goes on during the life of a particular firm. It is then that periodic fluctuations in volume levels take on significance and present pressing problems for objective study.

The distinction, then, between differential costs and average total costs exists only in the short-run. Thus, when we refer to differential cost applied to the problem of the creation of additional plant facilities, we are referring to the addition to the existing plant through the creation of a new wing, a new building, or a branch or subsidiary plant.

Under such conditions there are existing costs which will not require extension in the operation of the new plant--fixed costs which will remain essentially the same. In this circumstance, the number of variable costs or differential costs will be much greater than in the case of increased utilization of existing plant facilities. In the latter situation, such costs as machinery depreciation, building depreciation, factory supervision and real estate taxes are all fixed costs which would not increase with additional output. In the event of constructing additional plant facilities, all of these costs become variable. Additional depreciation costs would be incurred for both machinery and building, the services of additional factory
foremen and department heads would be acquired, new real estate taxes would be levied on the new building, and many other costs which are fixed with a given plant size would now become variable. However, not all costs would increase. Many costs which were incurred before the plant expansion would continue with little change; for example, the cost of salaries paid to the president and other key executives and the expenses of the board of directors would not necessarily change. In other words the additional plant facility might be operated with the same executive force, at the same cost, as had previously been required. The same sales force might be utilized in the sale of the new output with many fixed costs remaining essentially constant. Thus, an average total cost calculation of the operations of the added facility, based upon a full allocation of all of the fixed costs, would be quite a different figure than the differential cost.

This use of the differential cost technique is a variation of the basic problem of an increase or decrease in units of production. There are many such variations in problems which are fundamentally concerned with increased or decreased production in which the differential cost approach has great significance. Such problems as adding or discontinuing a product or line of products, accepting a defense contract, opening a new territory or
discontinuing an old one, adopting a new channel of distribution such as a mail-order house—these are all variations of the fundamental question of expanding or contracting production and sales. In every instance two calculations could be made, one an average total cost calculation, the other a differential cost calculation, as demonstrated in the earlier illustration.

In addition to questions involving variations in volume, the differential cost approach has value in a wide variety of other matters calling for managerial decisions. As an illustration, let us assume that the sales department reports that it could get a much higher price for the product if it provided a one-year guarantee—that the customers are requesting it and would be willing to pay a higher price in order to obtain it. We will assume that the increase in selling price has been determined, and for the moment shall not concern ourselves with that problem. The question confronting us is the cost of providing the guarantee, which can then be compared with the added revenue which will be forthcoming. The plan will involve estimating the number of returns of product to the factory for repair during the first year after sale. For this purpose the company will set up a new "repair department" within the present building.

Once again there are the same two approaches which
may be taken in the calculation of the cost of this service, as will be obvious from the illustration presented in Figure 1 on the following page.

Columns one and two reflect the traditional total cost calculation in which a portion of all overhead costs are allocated to the element being costed. This traditional approach places a cost of $32,000 on the guarantee proposal. Column three, however, shows the total cost of the plant operation before the adoption of the plan and by comparing columns one and three, it is observed that the total cost of operating the plant has increased by only $21,000 as a result of creating and operating the repair department. This is the differential cost. Column five explains the difference of $11,000 in the two cost calculations. Which of these cost calculations carries the most merit? Which should be emphasized most by the cost accountant and relied upon by management in deciding whether or not to embark upon the guarantee plan? Should one approach be emphasized more than the other, or are they of equal importance? These are questions which this study will investigate and try to answer.

This illustration pertaining to the product guarantee is intended to exemplify those circumstances wherein differential cost is of significance, aside from situations pertaining to changes in units sold. Actually there are
### Differences

<table>
<thead>
<tr>
<th>(1) Budgeted Cost of Plant Operations After Adoption of Guarantee Plan</th>
<th>(2) Portion of Total Cost Allocated to Repair Department</th>
<th>(3) Plant Costs Before Adoption of Guarantee Plan</th>
<th>(4) Difference Between Plant Costs Before and After Adoption of Plan</th>
<th>(5) Differences Between Total Cost and Differential Cost Calculation Col.2 - Col.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct material (x units)</td>
<td>$100,000</td>
<td>-0-</td>
<td>$100,000</td>
<td>-0-</td>
</tr>
<tr>
<td>Direct labor (x units)</td>
<td>100,000</td>
<td>-0-</td>
<td>100,000</td>
<td>-0-</td>
</tr>
<tr>
<td>Factory overhead:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salaries:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plant Supervisor</td>
<td>15,000</td>
<td>$3,000</td>
<td>15,000</td>
<td>-0-</td>
</tr>
<tr>
<td>Departmental Foremen</td>
<td>20,000</td>
<td>5,000</td>
<td>15,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Indirect Labor</td>
<td>40,000</td>
<td>6,000</td>
<td>35,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Building depreciation</td>
<td>50,000</td>
<td>5,000</td>
<td>50,000</td>
<td>-0-</td>
</tr>
<tr>
<td>Machinery depreciation</td>
<td>50,000</td>
<td>5,000</td>
<td>45,000</td>
<td>5,000</td>
</tr>
<tr>
<td>Taxes</td>
<td>10,000</td>
<td>2,000</td>
<td>10,000</td>
<td>-0-</td>
</tr>
<tr>
<td>Supplies</td>
<td>10,000</td>
<td>1,000</td>
<td>9,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Repair parts</td>
<td>5,000</td>
<td>5,000</td>
<td>-0-</td>
<td>5,000</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>$400,000</strong></td>
<td><strong>$32,000</strong></td>
<td><strong>$379,000</strong></td>
<td><strong>$21,000</strong></td>
</tr>
</tbody>
</table>

Figure 1. Comparison of average total cost and differential cost calculation of a specific proposal to provide a product guarantee.
many such decisions which confront management, all of which may be approached from the differential cost point of view. Such problems as producing a part or service previously purchased, or discontinuing the production of a part or service; providing additional services to customers, or discontinuing such services; embarking upon an advertising campaign or other promotional scheme; providing a service or facility for employees or other employee promotional schemes—all these and many other matters for managerial policy determination require cost calculations. Each offers an opportunity for either the total or the differential cost approach, or both.

It is significant that so many managerial decisions provide an opportunity for development and use of differential costs; however, most of the literature on differential cost accounting overlooks or ignores these many uses.

Writers have been prone to discuss differential costs strictly in terms of increases or decreases in the units of production, with little or no mention of the wealth of other areas in which the analysis may be beneficial.\(^1\) Indeed, it is difficult to visualize an important managerial decision without a differential cost aspect.

It is probably true, as previously stated, that the most common use of differential costs is in connection with changes in volume. Hence, this particular application

\(^1\) cf. ante., Blocker, p. 7.
of the technique will be used largely throughout this dissertation when it is necessary to refer to examples and illustrations; but it should be kept in mind that the approach is equally applicable in a wide variety of managerial policy circumstances.

Through the early years of the development of cost accounting, a variety of cost concepts has been developed with little uniformity of terminology. Some of these concepts and the terms used to describe them deal with essentially the same idea as differential costs, and others bear an important relationship to differential costs. It will be fruitful to examine some of these in order to sharply define their use.

**Variable cost** is a term we have already used in this discussion. In a very broad sense, variable cost may be the same as differential cost—that is, we think of differential costs as those costs which will vary with changes in production; therefore, they are variable. In a specific sense and as commonly used, variable costs are usually thought of as those costs which vary almost exactly proportionately to production at all volume levels. Thus, material cost may be two dollars per unit at all volume levels; hence, it is strictly a variable cost. There are other costs of this nature such as direct labor, power and certain types of supplies, which vary in direct pro-
portion to production. These are the costs which are
generally denoted by the term variable costs. Such a
classification would strictly exclude any cost which does
not consistently vary with production, such as foremen
salaries, heat and light and other costs which are some­
times termed semi-variable.

Differential cost, while it would include all of the
variable costs, might also include semi-variable costs
if additions to semi-variable costs were incurred as a
result of the differential action. For example, it may be
proposed to produce an added 10,000 units of product; but
in order to do so, additional help must be provided in the
payroll department where the present work load has already
reached an absolute maximum. The cost of the added payroll
clerk would be included as a part of the differential cost
of added production, but is not what is normally considered
as variable cost since cost of the payroll department does
not vary directly in proportion to production.

The term variable has occasionally been used to denote
exactly the opposite concept of that referred to here—
namely, the costs which we have been calling fixed. If one
thinks of the way in which costs behave in relation to one
unit, then it may be observed that the unit cost of such
items as real estate taxes will vary with the number of
units produced. In other words if taxes in a particular
period amount to $1,000 and two units are produced, the unit
cost of taxes is $500; whereas if 10 units are produced,
the unit cost is $100. Thus, this cost varies with pro-
duction and is termed a variable cost.

The term fixed cost has been used here to denote a
cost which remains fixed in total at varying output levels,
such as real estate taxes. However, this term has also
been used occasionally to convey an opposite meaning.
Direct material cost, for example, may be $2 per unit for
every unit which is produced; therefore, it is fixed in
per unit amount.

Throughout this dissertation the term "variable" will
be used to denote those costs which vary in total amount
as production varies, and the term "fixed cost" will be
used to refer to those costs which do not change in total
amount as production varies. Between those costs which are
purely variable and those which are completely fixed, there
are costs which are frequently referred to as semi-variable
or semi-fixed. The illustration given of the cost of pay-
roll is an example. In recent years, and for reasons which
will be developed later, there has been a tendency to in-
clude these semi-variable costs in the term "fixed."¹ In
a sense then, the term fixed includes, broadly, two types
of costs—the semi-variable and the completely fixed. The
latter are then sometimes referred to as "sunk costs,"

¹ Lawrence, F.C. and Humphreys, E.N., Marginal Costing,
"shut-down costs," "inescapeable costs" or "stand-by costs." All these terms refer to an identical concept—namely, those costs which exist in the same amount, regardless of the level of production, such as building depreciation, top executives' salaries, real estate taxes and insurance.

**Direct cost** is another term which has been used in this general area of cost thinking. However, the term has not achieved altogether consistent usage. Some writers have used the term to imply the same meaning as "variable cost" as it is used herein. Quite recently, frequent reference has been made to the "direct costing of inventories." Those using the term in this connection have usually referred to a very loose and somewhat arbitrary division of costs between differential and fixed. This problem is discussed in further detail in Chapter V.1

The term **marginal cost** is probably as nearly synonymous with differential cost as any of these terms. This is the term used by economists to express essentially the same concept as that which has been defined herein as differential cost. One slight difference in the two terms may lie in the fact that economists, in using the term "marginal cost", usually think in terms of increments of one unit. Differential costs, on the other hand, may apply to any increment, one unit or 10,000 units, as the

1 cf. post., p. 120.
particular situation may be. It is not uncommon today to find accountants who use the term "marginal cost" interchangeably with differential cost.

**Incremental cost** is a term which has had some usage in the field of public utility accounting to express the differential cost concept as it applies to units of output.

The term **opportunity cost** expresses an idea quite different from differential cost, but brief mention might be appropriate in a summary of cost concepts. This notion views the cost of any particular thing in light of what was foregone in order to produce it. In other words, the cost of any commodity amounts to the best alternative use to which the factors of production, consumed in its manufacture, could have been assigned. Thus, if the best alternative use to which a given set of productive factors could be used is in the production of consumer's goods and these same factors are put to the production of machinery, then the cost of the consumer's goods is the amount of the machinery which could otherwise be produced.

Attention to this cost concept has come almost entirely from economists, where it has received considerable attention. It has some rather interesting implications pertaining to accounting, but has received little attention from accountants. An examination of the opportunity cost aspects of accounting would provide fertile ground for
further examination.

A number of other terms which have a close relationship to differential costs should be mentioned. The term "out-of-pocket costs" is often mentioned. Sometimes it has been used to refer to variable costs—that is, those costs which vary directly with production at all volume levels. At other times the term has been used to refer to outlays for a specific proposal, and in this sense corresponds to differential cost. Although descriptive, the term has not been used consistently.

The term average total cost was used earlier to mean a unit cost calculation which includes all variable costs incurred in the unit's manufacture as well as a proportionate share of all semi-variable and fixed costs. Another term used to describe this concept is full cost. These are distinguished from unit differential costs, which refer only to those costs incurred directly because of the manufacture and sale of the unit.

As we shall see later, differential cost is meaningful primarily in relationship to differential revenue. By this is meant the gross addition to total revenue which results from a particular action. With respect to a particular action then, there is the differential cost incurred and the differential revenue realized; and by subtracting the cost from the revenue, there would remain
the net amount contributed by this action to the coverage of fixed cost and the provision of net profit. This contribution may be referred to as differential profit.
Chapter 2
The Economic Background of Differential Costs

It would be difficult to determine specifically who originated the differential cost concept. Certainly the concept is an old one in economics where it is more generally known as "marginal costs." Economists usually trace the marginal concept to the Austrian school of economics, but most economists contend that men have been thinking in terms of margins ever since the beginning of time. The Austrians, however, are responsible for the term "margin" and were credited with consolidating thought with respect to margins.\(^1\) The development of the concept as a tool of economics resulted from the work of many economists in succeeding years; but the one who probably contributed most to relating marginal economics to practical business problems was J. Maurice Clark in his book, entitled *Studies on the Economics of Overhead Costs.*\(^2\)

The term "differential cost" is used almost exclusively in the field of accounting, and the concept was probably developed by accountants independent of the marginal cost concept in economics. This is not


surprising in view of the observation that men have always thought in terms of margins.

Nevertheless accountants have much to learn from economists in this field, for economists have given much study and development to the concept, while by comparison it is only recently that accountants have begun to give attention to the marginal idea. It might be fair to say that the marginal idea has become one of the most important concepts in economic theory. In economic analysis, it is one of the most important tools.

The marginal concept has been important in the analysis of utility or satisfaction derived from economic goods, and has received much attention in this connection. However, the marginal concept, as applied to costs and revenue, is at the very core of the economist's analysis of the complex functionings of business enterprises and markets. Yet many cost accountants and most cost accounting textbooks, in dealing with the same problems and complexities, have given it but slight attention.

To the economist, decisions to produce more or fewer units of product, to expand productive facilities, to open new territories—in fact, almost all business decisions in the short run depend upon the relationship of marginal cost to marginal revenue. More specifically if the marginal cost, or added cost, of producing an additional unit of
product is less than the marginal or added revenue which will result from the production, then it will obviously be to the advantage of the firm to proceed with the production of the unit. For example, if the added cost of producing another unit of product is $1.40, whereas this unit will add $1.80 to total revenue, the firm will gain 40¢ by producing the unit regardless of the average total cost.

"Once the firm, under competitive conditions, obtains a price per unit in excess of the variable cost per unit, any further expansion of output is profitable as long as the additional cost per unit is less than the additional receipts per unit. When the two additional sums are equal profits are at a maximum, or, under adverse conditions, losses are at a minimum. Up to that point expansion of output adds more to receipts than to costs and hence, contributes to profit or to the reduction of any loss. The equality, then, of marginal costs and marginal receipts when output is varied by one-unit changes indicates a precise point of equilibrium for the firm. This means that, under the assumed conditions, the firm cannot improve its profit-position by altering output."

profit" since each unit of product up to this point adds something to the total firm profit, whereas the next unit beyond this point would incur a cost greater than its revenue and therefore detract from total firm profit.

Referring to the illustration in Chapter 1, it will be recalled that the differential or marginal cost of producing the additional units was $1.40. The total cost calculation results in a cost of $1.90 each. If the proposed selling price of the additional units is $1.80, it can readily be seen that it is a matter of some importance as to which of these cost figures should guide the firm in arriving at a decision with respect to producing the added units. Most cost accountants have emphasized the total cost figure of $1.90, with attention being given to the differential or marginal cost of $1.40; while economists, in the short run at least, would regard the $1.40 as the only significant figure. It is true that in the long run, economists would give consideration to total cost — this will be given further consideration later. In the short run, however, economists would contend that total cost is of relatively little significance in making decisions and solving the day-by-day problems of business.

1 cf. ante, p. 9.
2 James, op. cit., p. 193.
3 cf. post, p. 43.
As long as marginal cost is less than marginal revenue, the desire to maximize profits will lead a firm to proceed with the production and sale of the added unit. But as this production proceeds in accordance with these maxims, a point is reached where inefficiencies start to develop; and as a result marginal cost per unit will increase. Regardless of these inefficiencies, it will still be desirable to produce the added units as long as marginal cost is less than marginal revenue. This will continue to be desirable up to the point where marginal cost exactly equals marginal revenue. Thus, in the previous illustration, the next unit of product may require a differential outlay of $1.50 and the next $1.60 and the next $1.75. Yet, as long as the selling price remains at $1.80, it is beneficial to produce the added units. But if the next unit requires a differential outlay of $1.85, with the selling price remaining at $1.80, then it would obviously be foolhardy to produce this unit. Economists have expressed this basic axiom in terms of a formula—namely, that mc=mr (marginal cost in the short run must always equal marginal revenue).

Economists have placed this emphasis upon margins because they believe that fundamentally people think in terms of margins, and this point of view can be supported by observations from every walk of life. In view of this, it is understandable that accountants and management are
Increasingly recognizing the importance of the concept in business decisions.

Although economists usually illustrate the application of $mc=mr$ by reference to units of product, the concept is basic to many situations involving managerial decisions. In fact, it is clearly logical that any act contemplated by management is desirable so long as the differential cost of the act is less than the differential revenue to be derived therefrom. Thus, the type of analysis involved in $mc=mr$ is applicable to the many different examples outlined in Chapter 1, where differential cost analysis is appropriate. The question of adding a new product line, opening a new territory, building a branch plant, adding a new wing, or even embarking upon an advertising campaign—in each instance the decision hinges upon whether or not the added revenue from the proposed action will be greater than its differential cost.

For illustration, reference is made to the illustration in Chapter 1, wherein it was proposed to offer a one-year guarantee on the product and at the same time increase the price. It was stated at that time that we would not concern ourselves with the amount of the price increase, for at that time we were concerned with showing

1 cf. ante., pp. 8, 13, 16, 19.
2 cf. ante., p. 18.
the way in which differential cost was calculated as distinguished from total cost. It will be recalled that in this particular case, it was determined that the differential cost of the proposal was determined to be $21,000, while the total cost was calculated at $32,000. To continue the illustration, let us assume that the sales department reports that the guarantee will provide an increase sales revenue of $30,000.¹

If the cost accountant calculates the cost in accordance with the total cost approach—namely, $32,000—it would seem as though a $2,000 loss would result from the proposal. The differential cost approach, however, proves that the only real cost incurred in the guarantee is $21,000; and if this will result in $30,000 of added revenue, then the firm profit will be $9,000 greater. The essential consideration in making management decisions is the relationship of differential or marginal cost and differential or marginal revenue. It is in this setting that the real significance of differential costs can be understood.

It is quite obvious that differential costs have meaning only in relation to differential revenue. How, then, can the latter be calculated? The discussion has

¹For purposes of simplicity, the increase in sales revenue is assumed to result solely from increased selling price, although the proposal might also create differential revenue from increased volume, or a decrease in volume might offset the increase in revenue from the increased selling price.
dealt at great length with the calculation of the differential cost, but how can the $30,000 of added revenue be determined in the preceding illustration? While recognizing the importance of this aspect of the problem, no attempt will be made in this dissertation to solve the practical problems which are involved. This is clearly a problem of market analysis and market research, and much study and development is being carried on today in this area. No attempt shall be made here to infringe upon what is rapidly becoming a highly specialized field of market surveys. Here it will merely be assumed that, in one way or another, differential revenue can be estimated; that, in the example cited, after diligent consideration and study, $30,000 was the best possible estimate of the revenue to be added from the proposed course of action. To those who might be skeptical of such estimates, it is pointed out that management must and does make these estimates before entering upon any course of action. The way of estimating may be crude or it may be refined; it may consist of nothing more than the president's best hunch, but nevertheless, there is an estimate, and it is compared with differential cost before a course of action is decided upon. Undoubtedly, the more study and effort which goes into the determination

of differential revenue, the more reliable it will be; but this is entirely a matter for the market analyst.

Although the practical aspects of estimating revenues must be left to the market researchers, the economist has contributed much toward an understanding of the theoretical aspects of revenue behavior. An understanding of these theoretical aspects is essential to the full appreciation of the importance and uses of differential costs.

Broadly speaking, there are two ways in which the revenue of firms may react to changes in volume. The first of these is that situation wherein changes in the volume of output of any one firm will have no effect whatever upon the selling price of that output. This does not necessarily imply that all of the conditions of the economic concept of "perfect competition" must be met; it is just one of many conditions found in the more competitive industries. Mr. Howard Greer described this type of market as peculiar to the "primary industries", meaning those industries dealing with raw materials close to their natural source, as distinguished from "secondary industries" which fabricate the raw materials into an end product. These classifications merely use different terminology for what the economist describes as first, a competitive market,

1 Greer, Howard C., in an unpublished address before the Columbus Chapter of the National Association of Cost Accountants, April 28, 1952, entitled "Accounting Aspects of Business Policy Determination."
and secondly, a market of monopolistic competition. In the primary or competitive industries, the individual firm has no control over price, there is great homogeneity of product, and the volume of output of one firm has no effect upon selling price. Mr. Greer thinks in terms of the primary industries because these conditions are more likely to be found there. Examples are to be found in the great commodity markets, in the production of oil, timber, minerals, etc., and even in the basic refinement of these raw materials. The products of each firm fall into several classes, and beyond that are not distinguishable from the product of any other firm in the industry. The price of these products are determined in centralized markets under conditions which tend toward perfect competition. No one individual firm has control over price. Figure 2 on the following page is illustrative of this type of market situation, with each unit being disposed of at $1.25 per unit regardless of the level of output.

With each increment of output the differential revenue remains the same, since this firm's output has no effect upon the total market. It will be noted that under these assumed conditions the firm would continue to produce and sell to a point a little beyond 120,000 units, for up to this point differential cost is less than differential revenue; but beyond this point the differential cost
<table>
<thead>
<tr>
<th>Production</th>
<th>Sales Revenue @ $1.25 Per Unit</th>
<th>Total Cost</th>
<th>Differential Revenue</th>
<th>Differential Cost</th>
<th>Unit Differential Cost</th>
<th>Total Average Unit Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>-o-</td>
<td>$40,000</td>
<td>-o-</td>
<td>-o-</td>
<td>-o-</td>
<td>-o-</td>
</tr>
<tr>
<td>10,000</td>
<td>$ 12,500</td>
<td>48,000</td>
<td>$12,500</td>
<td>8,000</td>
<td>$.80</td>
<td>$4,8000</td>
</tr>
<tr>
<td>20,000</td>
<td>25,000</td>
<td>55,000</td>
<td>12,500</td>
<td>7,000</td>
<td>$.70</td>
<td>2,7500</td>
</tr>
<tr>
<td>30,000</td>
<td>37,500</td>
<td>61,000</td>
<td>12,500</td>
<td>6,000</td>
<td>$.60</td>
<td>2,0333</td>
</tr>
<tr>
<td>40,000</td>
<td>50,000</td>
<td>68,000</td>
<td>12,500</td>
<td>7,000</td>
<td>$.70</td>
<td>1,7000</td>
</tr>
<tr>
<td>50,000</td>
<td>62,500</td>
<td>75,000</td>
<td>12,500</td>
<td>7,000</td>
<td>$.70</td>
<td>1,5000</td>
</tr>
<tr>
<td>60,000</td>
<td>75,000</td>
<td>82,000</td>
<td>12,500</td>
<td>7,000</td>
<td>$.70</td>
<td>1,3667</td>
</tr>
<tr>
<td>70,000</td>
<td>87,500</td>
<td>90,000</td>
<td>12,500</td>
<td>8,000</td>
<td>$.80</td>
<td>1,2855</td>
</tr>
<tr>
<td>80,000</td>
<td>100,000</td>
<td>99,000</td>
<td>12,500</td>
<td>9,000</td>
<td>$.90</td>
<td>1,2375</td>
</tr>
<tr>
<td>90,000</td>
<td>112,500</td>
<td>109,000</td>
<td>12,500</td>
<td>10,000</td>
<td>1.00</td>
<td>1,2111</td>
</tr>
<tr>
<td>100,000</td>
<td>125,000</td>
<td>120,000</td>
<td>12,500</td>
<td>11,000</td>
<td>1.10</td>
<td>1,2000</td>
</tr>
<tr>
<td>110,000</td>
<td>137,500</td>
<td>131,000</td>
<td>12,500</td>
<td>11,000</td>
<td>1.10</td>
<td>1,1909</td>
</tr>
<tr>
<td>120,000</td>
<td>150,000</td>
<td>143,000</td>
<td>12,500</td>
<td>12,000</td>
<td>1.20</td>
<td>1,1917</td>
</tr>
<tr>
<td>130,000</td>
<td>162,500</td>
<td>156,000</td>
<td>12,500</td>
<td>13,000</td>
<td>1.30</td>
<td>1,2000</td>
</tr>
</tbody>
</table>

Figure 2. Example of changing output and changing costs with constant revenue per unit of product.
($13,000) is more than differential revenue ($12,500).

The second type of market—that which economists term monopolistic competition—is what Mr. Greer described as typical of secondary industries, the main feature being that here the firm has some control over the selling price of its product. Economists have gone on to describe this type of market as one in which the product of each firm is different from that of any other firm in the industry. This differentiation may be slight, such as insignificant variations in style or size or color, or the difference may only be in wrapping (example, bread, cigarettes, etc.) or in a trademark or label. Nevertheless, the difference is sufficient that customers build up a preference for a particular brand and are willing to insist upon this brand within a certain range of price fluctuations. Economists express this situation as one in which there is a separate "demand curve" for the product of each firm in the industry, rather than one "demand curve" applicable to the entire industry. In other words, the firm may raise or lower the price of its particular product with corresponding fluctuations in the demand for its product. Figure 3, on the following page, is illustrative.

It is observed that in order to increase sales from 600,000 to 700,000 units, it is necessary to reduce the unit selling price from 93¢ to 92¢. Thus, the added or
<table>
<thead>
<tr>
<th>Sales and Production Units</th>
<th>Selling Price Necessary To Dispose Of Production</th>
<th>Sales Revenue At Indicated Price</th>
<th>Total Cost</th>
<th>Differential Revenue</th>
<th>Differential Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>600,000</td>
<td>$.93</td>
<td>$558,000</td>
<td>$558,000</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>700,000</td>
<td>.92</td>
<td>644,000</td>
<td>567,000</td>
<td>$86,000</td>
<td>$ 9,000</td>
</tr>
<tr>
<td>800,000</td>
<td>.90</td>
<td>720,000</td>
<td>600,000</td>
<td>76,000</td>
<td>33,000</td>
</tr>
<tr>
<td>900,000</td>
<td>.88</td>
<td>792,000</td>
<td>657,000</td>
<td>72,000</td>
<td>57,000</td>
</tr>
<tr>
<td>1,000,000</td>
<td>.86</td>
<td>860,000</td>
<td>720,000</td>
<td>68,000</td>
<td>63,000</td>
</tr>
<tr>
<td>1,100,000</td>
<td>.82</td>
<td>902,000</td>
<td>795,000</td>
<td>42,000</td>
<td>75,000</td>
</tr>
<tr>
<td>1,200,000</td>
<td>.78</td>
<td>936,000</td>
<td>936,000</td>
<td>34,000</td>
<td>122,500</td>
</tr>
</tbody>
</table>

Figure 3. Example of changing output and costs with changing revenue per unit of product.
differential revenue is increased not by 100,000 X 93c, nor even 100,000 X 92c, but the increase is as follows:

\[
\begin{align*}
100,000 \text{ units} \times 92c &= 92,000 \\
\text{Less 600,000 units reduced 1c} &= 6,000 \\
\text{Net increase in revenue} &= 86,000
\end{align*}
\]

Although proposals for changes in volume must now consider a new unit selling price, the application of the rule of mc=mr is just as valid here as in the previous type of market. Specifically, this firm would produce slightly more than 1,000,000 units, but would not go to 1,100,000. Up to the 1,000,000 unit level, the differential cost of each increment is less than the differential revenue, but the cost of producing the next 100,000 units ($75,000) is considerably more than the addition to revenue ($42,000).

A further possibility exists with respect to this monopolistic competition type of market—namely, that it may be possible to maintain the existing market, with its existing level of output and existing selling price, and to sell the new output in a new and separate market without affecting the old market. In Figure 3 it is seen that the firm will stop producing at the 1,000,000 unit level since the next 100,000 units would reduce overall selling price to eighty-two cents and the increase in total revenue would be only $42,000, whereas the added cost of
these units would be $75,000. But what would the situation be if the firm could maintain the sale of the existing 1,000,000 units at eighty-six cents and, by entering a new market, dispose of another 100,000 units at eighty-two cents? Total revenue from the 1,100,000 units would consist of 1,000,000 at eighty-six cents or $860,000 and 100,000 units at eighty-four cents or $84,000 or total revenue of $944,000. All of the revenue from the added output comprises differential revenue, or $84,000, while differential cost remains the same—namely, $75,000; and under these circumstances since mc is less than mr, it would now be beneficial to increase production to the 1,100,000 level.

This type of analysis is not new to economists.\(^1\) Furthermore, there is ample evidence that management uses this technique whenever the opportunity is present. Many examples can be cited of areas in which this technique may be applied. A new territory may be opened up in a neighboring state or sale of the additional product at a reduced price may be accomplished through a mail-order house. In either of these instances the additional product will probably be marketed under a different brand name so that it will not be directly related to the marketing of the old product.

\(^1\) Dean, *op. cit.*, p. 512.
Another variation of this same procedure is found in the bidding on governmental or defense contracts to produce and sell a product at a price lower than that of the product sold in the civilian market. Another procedure has been to enter the foreign market at a reduced price, this being so completely separated from the domestic market that it will have no effect upon the latter. One of the executives interviewed in this study made the observation that his firm has entered the foreign market at a consistent price reduction of 10% below selling price in this country. All of these methods are a means of tapping additional markets, without disturbing conditions in the existing markets or maximizing the excess of differential revenue over differential cost. From the viewpoint of the economist, this creates a new product in a new market, with a demand curve distinct from that of the old product.

There is one further consideration with respect to entering new markets at lowered prices to obtain a differential revenue advantage. In discussions with one executive, he was quick to point out that competitors may look upon such action as "price cutting" and retaliatory action may lead eventually to price wars. This serves to emphasize that budgeting or estimating differential revenue is not an easy task. Careful and complete market analyses must be conducted, considering the total effect
of the proposed action, including the reaction of competitors.

Up to this point, all of the discussion in this chapter has pertained to the economists' analysis of marginal or differential cost and their application to accounting problems. What of the economists' total cost? So far, little or no mention has been made of this. Is total cost of little significance in economic analysis? Quite to the contrary, total cost has an important role in economic analysis, but its significance is found mainly in the economists' long run concept.

Economic analysis has placed much emphasis upon the distinction between the short run and the long run. Economists have recognized that in the study and understanding of economic phenomena this distinction must be observed, that certain things are true in the short run while others are true in the long run.

Total cost, in relation to prices and managerial decisions, has significance to the economist primarily in the long run; it is of lesser significance in the day-to-day decisions with respect to production and sales. As has been demonstrated, these problems are marginal cost problems; and these are considered economically as short run concepts.

In the long run, economists recognize that total
revenue must be sufficient to cover total cost. If this were not true in the long run, firms would seek other more profitable outlets for their capital investments and leave the industry in which revenue is not sufficient to cover cost. The threat of this would force prices to rise in the industry to a point sufficient to attract and maintain sufficient capital. This in essence is the role of total cost in economic analysis. But in their day-to-day decisions, management cannot leave the industry one day, if prices aren't right, and go back in the next day. The costs of productive facilities as well as other fixed costs have been "sunk" in the firm. The most that management can do in its day-to-day operations is to make certain that added or differential outlays are at least covered by revenue, and also to maximize the extent to which this revenue exceeds differential cost.

Economists have made much of the distinction between long run and short run, while accountants seldom make any such distinction. The accounting method for determination of costs and profits in the past has corresponded very closely to the economists long run concept. The accountant in computing income has usually taken into consideration the long run life of the enterprise as a basis for his costing. Many costs, entering into inventory values for the balance sheet and for the income statement, have been
computed as though the accountant were standing at some distance viewing the entire life of the firm. Examples are found in the depreciation of facilities for long periods of time, and the proration of fixed costs over all units of production so as to compute a long run average total cost figure.

Accountants have been long run minded even to the point of ignoring the existence of the economic concept of the short run. Management is supplied by the accountant with long run average total cost figures for the solution of short run day-to-day problems. As has been pointed out, differential cost accounting or what might be termed short-run accounting, offers the solution to these day-to-day problems.

What is needed is a general recognition, in practice as well as theory, of a short run and a long run accounting concept in much the same way that this distinction exists in economics. Accountants readily recognize that they are dealing with economic problems and economic matters, and it would therefore seem logical to assume that the two fields would be dealing with essentially the same concepts. In many instances, however, this is not true. Economists could benefit from the accountants' practical insight into many matters. On the other hand, economists have made thorough study of important matters which have escaped
the attention of accountants, such as this distinction between the long run and short run. A much closer study by each group of the work of the other would certainly prove to be mutually beneficial.
Chapter 3

The Relationship of Differential Cost to Price

Those who object to the use of differential unit costs usually do so on the basis of the assertion that a knowledge of average total costs is vital for proper price setting. They claim that unit total cost must be considered in price setting in order to insure the avoidance of loss.

This is an interesting view for a number of reasons. First, it is interesting because some business executives support the view while others just as strongly deny that average total cost per unit has anything to do with price setting. Secondly, it is interesting because it is related to very extensive studies which economists have made in this area of price determination.

First, a brief summary of the economists' thinking on this subject. From a purely theoretical point of view, it has been shown that in the short run, price is determined by the operation of the forces of supply and demand. Many factors may influence supply and demand; but in the final analysis, these are theoretically the determinants. With price in the short run being determined independently of cost, a firm then strives to equate marginal cost and marginal revenue in the manner described in Chapter 2. It should be noted that marginal cost does not determine price. Price is independently established by the functioning
of supply and demand, and then the firm makes its decision to produce or not to produce on the basis of marginal cost and marginal revenue.

All this is first established as the theoretical functioning of price determination, but economists have been quick to emphasize that in practice, price determination usually does not work in this manner. Many economists have concluded that in practice, prices are determined largely by the calculation of an average total unit cost to which is added a mark-up for profit. Professor Clifford L. James makes mention of this approach to price setting in his textbook and analyzes the problem further in his course in Intermediate Economic Analysis. John Due expresses this viewpoint when he says: "The need for a feasible approach to pricing in a multiple-product situation, plus the desire to avoid the price instability which the existence of common costs creates, and the desire—ever present in oligopoly—to lessen uncertainty and attain more closely the maximum joint-profit price level have resulted in the development in many industries of a technique of price-setting which employs average cost rather than


2 From lectures by Professor Clifford L. James in *Economics 602, Intermediate Economic Analysis*, Ohio State University, Winter Quarter, 1950.
marginal cost. Essentially, this method involves the use as the basis for price-setting of an estimated average-cost figure, which includes a share of common cost allocated to the various products on some selected basis.  

Although many economists have concurred in this explanation of price determination, two English economists are usually credited with first developing this thesis. R. L. Hall and C. J. Hitch, writing in 1939, said: "The purpose of this paper is to examine, in the light of the interviews, the way in which businessmen decide what price to charge for their products and what output to produce. It casts doubt on the general applicability of the conventional analysis of price and output policy in terms of marginal cost and marginal revenue and suggests a mode of entrepreneurial behaviour which current economic doctrine tends to ignore. This is the basing of price upon what we shall call the 'full cost' principle, to be explained in detail below."

More recently a study was conducted by The National Bureau of Economic Research regarding the practical methods of determining price. It recognized that price setting was extremely complex, and it devoted much time to a discussion of varying practices in different firms. However,


the general feeling seemed to be that most practices were a variation of the total-cost-plus-a-mark-up technique. This study concluded that one of the primary reasons that executives did not think in terms of margins was because they could not determine margins—not only marginal costs but more particularly marginal revenue was not known. It was contended that businessmen were not familiar with either their marginal cost or marginal revenue figures.¹

A number of the firms studied in this dissertation confirmed the view that prices were based upon average total unit costs. One officer asserted that the only justification for the existence of the cost department was to supply information to the sales department for price setting purposes. When asked what kind of cost information he presented to the sales department, he replied "total unit costs".

An official in another company explained that in their firm, costs were calculated only every six months. This was a firm that manufactured about fifty different items in a coordinated line, and the cost calculation was full, historical allocation of total costs to all products in the line. Suspecting that such an infrequent cost calculation could hardly be of use for cost control purposes, a question was asked as to the purpose of this semi-annual

cost calculation. This answer was an unequivocal "for price setting purposes."

The experiences of these firms would seem to support the views of the economists quoted above. However, this viewpoint was not by any means found to be unanimous. In fact, just the opposite attitude prevailed with some executives. They felt that average total unit cost had no particular relation to selling prices. Their views of price determination corresponded roughly to the theoretical propositions outlined above—that price was determined independent of total unit cost in the short-run, and that the decision to enter or not to enter the market at the established price was essentially a matter of differential cost in relation to differential revenue.

One of the strong supporters of this point of view is Mr. Howard C. Greer. He developed this subject extensively in a talk given before the Columbus Chapter of the National Association of Cost Accountants on April 28, 1952. He made the assertion that it is a complete fallacy to think that costs should or do determine selling price. Mr. Greer would insist that price in the market is determined independent of cost.

Logic and reasonableness would appear to support Mr. Greer's view. What is there in a cost accountant's total cost figure which would determine the value of a product
in terms of the amount which a consumer would be willing to pay for it? There are first, the direct costs of producing the particular unit—materials, productive labor, etc. If these were the only costs to be considered, would the consumers' willingness to pay follow in proportion to these costs? We are all familiar with examples of products which obviously have small material and labor cost, but which demand a sizable price due to their novelty or other peculiar circumstances.

The arbitrary proration of indirect costs adds further difficulty in determining a total cost figure. There are admittedly a variety of bases upon which many indirect overhead costs may be allocated to products. Is it reasonable for management to think that selling price should logically conform to the arbitrary method by which the cost accountant chooses to prorate these costs? Is the degree of desire on the part of a consumer affected by cost allocations? Revenue from all products combined should, it is true, cover total indirect and fixed costs of the firm. Yet one particular product in the group may have great saleability and hence command a high price, while another may have only slight saleability and hence command a lower price. Yet, in spite of these facts, a logical treatment of indirect cost might allocate identical amounts to each product.
It does not seem reasonable to expect that consumers would necessarily pay a price based upon an arbitrary cost calculation or any cost for that matter. Price does not guarantee cost recovery except perhaps in that instance where the seller is in a monopoly position. If there is no other source of supply for the product, it is conceivable that the monopolist could dictate a price and maintain it, adjusting his output to the point on the demand curve which corresponds to this price.

Further understanding of this perplexing problem may be gained by raising a question as to what a total cost figure indicates with respect to price. Suppose that the cost accountant makes a complete allocation of all costs to products, and on this basis certain products show net losses. Refer, for example, to the illustration used in Chapter 1 wherein a total unit cost calculation resulted in a cost of $1.90 per unit, with a selling price of $1.80. What should now be done with respect to such a loss product? Assuming that all possibilities of cost reduction have been exhausted, is the solution to be found in discontinuing this product? It will be recalled that in the above illustration, the units which had a total cost of $1.90 had a differential cost of only $1.40. Since the units are contributing something to the coverage of the firm's fixed cost, the firm would obviously lose 40¢ per unit by discontinuing this production and sale. Clearly cf. ante., p. 8.
the answer here is to be found in the differential approach. It is not the total cost which throws any light on the situation; but rather, since the differential cost of producing the product is slightly less than the revenue which it adds to the total, then the production and sale of the product is contributing 40¢ to covering the firm's pool of fixed costs. In such a circumstance, the firm is better off by continuing the production and sale of the product than if it were to discontinue it.

For completeness it should be pointed out that in a circumstance of this kind another possibility exists. It may be found that the productive facilities which are being devoted to the "loss" product could better be devoted to some other product. This would be governed by a determination of whether an alternative product would contribute more to the covering of the fixed pool of costs than is the present product. In other words, is the excess of the differential revenue over the differential cost of the alternative product greater than it is in the case of the product currently being produced?

This discussion, although it utilizes the marginal cost approach, is really a problem of opportunity or alternative costs which was discussed briefly in Chapter 1. It is a problem which exists in any instance where

\[1\text{ cf. ante, p. 24.}\]
where maximum capacity is being utilized; management is constantly faced with the question: could these facilities be devoted to a more profitable use? This was brought out in a discussion with one executive who cited an example of a product, the selling price of which did not cover total cost (he had no specific knowledge of differential cost). However, the production of this product was tying up facilities and using valuable space which could better be devoted to other uses. This was in a period of high plant activity, thus space was at a premium and a question of best alternative use of plant facilities was pressing.

If a plant is producing at less than full capacity and idle facilities exist, the problem of alternatives becomes one of choice of products to utilize the idle facilities. That product which will produce the greatest differential profit should be added to production to contribute what it can to the coverage of the fixed costs of the firm.

Even in these circumstances, however, another kind of alternative still presents itself—that is, the alternative of selling the firm or liquidation and dissolution. It is a question of the best disposition of the assets of the firm—should they be used to produce product A and B, or one and not the other if facilities are not sufficient for both; or should the facilities be sold and the firm
dissolved? The alternative is always present that the best alternative disposition of the firm's productive facilities is to sell them.

In summary then, it may be said that loss based upon total cost is not conclusive evidence that the production of a product should be discontinued. Rather, if the product is providing some differential profit, its continued production is desirable subject to the best alternative use of the facilities now devoted to its manufacture.

Returning to the illustration in which a total cost allocation to products resulted in a loss for certain products, it has been shown that discontinuance of the production of the "loss" products is primarily a matter of differential cost and not total cost per unit. Investigating further, they readily admitted that they recognized that it was desirable to continue to produce the article for what it would contribute to the coverage of fixed overhead. Although this was recognized in principle, in most instances these executives had no accurate knowledge of how far selling price could fall before it would no longer contribute something to the coverage of the firm's pool of fixed costs. One executive "guessed" that he could decrease selling price below total cost by "about 15% of his total overhead costs." Others knew that they might still produce and sell with selling price below
There would appear to be another possible approach in that situation in which a total cost allocation to products has been made and has resulted in loss for certain products. If it is not desirable to discontinue the manufacture and sale of the product, then why not increase the selling price? As was pointed out above, there is ample evidence in some firms that price determined by total cost is being used quite successfully. The executive of one firm, upon questioning, estimated that in 85% of his products, selling price determined upon the basis of average total cost plus a mark-up is the final selling price. In only 15% of the cases is further adjustment necessary as he stated, "to meet competition."

If one has such control over his selling price so as to raise and lower it at will, it is quite obvious that the market is something less than purely competitive. Some degree of monopoly must exist in order to be able to raise the selling price when arbitrary total cost allocations indicate a "loss". In more competitive markets the producer has no such opportunity to manipulate his selling price.

In summary, it has been pointed out that first, average total cost calculations are highly arbitrary and cannot consistently form a basis for consumer values as
expressed in a competitively determined price. Only the arbitrary cost calculation of a monopolist could become the basis for a price and then maintain it. Secondly, products which show "losses" based upon total cost allocations should not necessarily be discontinued. Here is a differential cost matter.

These observations appear to lead to the conclusion that average total unit cost calculations have little value in a competitive market, but that as a smaller degree of competition exists, more use can be made of average total costs. Inversely there is a direct relationship between the degree of competition which exists and the importance of differential costs in executive policy determination.

This hypothesis appears to be the answer to the seeming paradox which exists between the points of view expressed earlier: (1) price is determined largely by average total unit costs; (2) price is determined independent of total cost, but the decision to enter or not to enter the market rests upon differential cost and differential revenue. Those who support the second position are apparently basing their observations upon more competitive types of industries, where average total costs have been of less significance. Economists, on the other hand, do stress the lack of competition in industry and
have placed considerable emphasis upon monopolistic elements wherever they have been found. If the above hypothesis is true, that total unit costs are of value where competition is slight, then it is understandable that economists should observe their use in studying monopolistic situations.

Since this postulate appeared so valid in theory, it was the subject of questioning and further examination in the firms visited; and in each instance the facts bore out the truth of the theory in a very clear manner.

In each of the firms, the executive being interviewed was asked whether he considered that he was faced with keen competition in his business. In all but one instance, the answer was in the affirmative but with varying degrees of emphasis.

In the one firm which admitted that it had no really close competitors, there was without a doubt the most resistance to the idea of differential costs. First, the executives had practically no notion of the meaning of differential costs or marginal costs. Upon development of the idea, they seemed mildly interested but insisted that their average total cost calculations were of paramount importance. This was the firm which developed actual, historical average total unit costs of each product every six months. This semi-annual calculation followed the usual pattern, with elaborate schemes for apportioning
all fixed and indirect costs to products. These execu-
tives were convinced that they were doing an unusually
good job of making these prorations, and this was responsi-
sible for their ability to develop correct prices. Fur-
thermore, they felt that these careful total cost calcu-
lations were largely responsible for the fact that they
had quite successfully "avoided inviting competition."They felt that they were producing the product very effi-
ciently and that careful average total cost calculations,
plus a "modest" mark-up for profit, would yield a selling
price which was fair and which would be difficult for a
competitor to meet. In their opinion, as a result of this
policy, they had been quite successful in discouraging
competition.

Another instance similar to this was observed some
years ago,¹ not in connection with this present study.
This took place in a company which manufactured basically
a single, highly specialized product in several sizes and
varieties. In this instance the company auditors, in
conjunction with their year-end audit, were asked to make
a calculation of the cost of manufacture and sale of each
variety and size of product produced. The usual pro-
cedures for cost calculation were employed, with fixed costs

¹ Based upon observations of the author during several
years of public accounting practice as a staff member of
the firm of Haskins & Sells, Certified Public Accountants,
Cleveland, Ohio.
prorated upon what appeared to the auditors to be the best basis available. To these total cost calculations was added a mark-up for profit, and this became without exception the list price for the following year. This firm can be described as very successful, but the top executive of the firm admitted they had practically no competition. They were, at that time, the only manufacturer of this particular product. It was marketed over a wide area comprising a large number of states. In other areas this firm licensed its patented processes to another concern for the manufacture and distribution of the product.

The support of the basic hypothesis—that there is a direct relationship between the degree of competition and the importance of differential cost information—was just as clearly demonstrated at the opposite extreme, where a high degree of competition exists.

Mr. Greer's experience comes largely from industries which are highly competitive—the meat packing industry and the railroad industry (competing with motor trucks). From both fields he cited numerous examples of the application of the differential cost technique. In the meat packing industry he was with one of the smaller companies, competing with the meat packing giants—Swift, Armour, etc.—for a small share of the market. Although the railroads are not competitive in the sense of being in direct
competition with each other and freight rates are under the control of the Interstate Commerce Commission, yet the railroad with which Mr. Greer was connected felt very keenly the competition for freight traffic from the motor trucking industry. The executives constantly had to consider the pressure from motor trucking rates and service. So Mr. Greer's whole outlook is one of keen competition and correspondingly one of differential cost analysis. In 1944, addressing the 25th Annual International Cost Conference in Chicago, Mr. Greer said: "When the cost accountant can talk as glibly about the marginal cost of any given job or lot of product as he now does about scientific methods of overhead allocation, he can help to solve one of the problems which will be most pressing in the postwar era."  

Other business executives faced with keen competition were most appreciative of differential costs. The sharp clash between the differential approach and the traditional total cost approach was clearly outlined in one of the firms which handled a low priced, highly competitive specialty item. This product is marketed through drug stores where it is usually displayed beside the products of its competitors. The executive interviewed in this firm

was not an accounting executive, but was associated with the production of the product. Nevertheless, he had a clear appreciation of the need for differential cost information. He had long felt the shortcomings of the traditional total cost information which was supplied to him by the cost accounting department, and is now in the process of experimenting with the differential cost approach. He reports that the approach is already providing much valuable cost information for effective control and guidance of the business.

Between these extremes, admitted monopoly on the one hand and keen competition on the other, are the other firms studied which might be classified at varying degrees in between. Even in these cases where the distinction between competition and monopoly was not quite so marked, the extent or degree of competition seemed to follow closely the firms' interest in and reliance upon differential costs.

Some of the firms studies were engaged in the manufacture of heavy, high unit value, industrial machinery. From all appearances they seemed to be in much the same position with respect to conditions of production, sales, competition, etc. Upon closer analysis, it developed that two of these firms were vitally interested in differential costs, while in a third there was only mild interest in the
subject. Further inquiry developed the fact that the business of the first two was highly competitive. The price charged for their products was strictly a competitive price and bore no particular relationship to total unit costs. The third firm was the one in which the statement was made that price was determined as total cost plus a percentage. The price so determined remained unchanged in 85% of the cases. In the remaining 15% of the products, some variation in selling price was necessary in order "to meet competition". This would seem to indicate that in the other 85% of the cases, competition was not strong enough to force fluctuation in price from the one based upon an arbitrary total cost.

There was one interesting feature in these companies, all producing heavy industrial machinery, which may account for the greater degree of competition in the first two than in the third. Sales in the first two were largely a "one-time" proposition. There was little repeat business resulting from customer goodwill, etc. In the third company, however, repeat business was an important factor. The product was such that frequent repairs were required and machines wore out rather rapidly. Consequently the firm had succeeded in building up a large customer following. Companies which had for years bought their machinery from this same firm depended upon it for service and replace-
ments. There were other manufacturers of the same kind of machinery, but their competition was slight. Fundamentally it was a condition of monopolistic competition resulting almost solely from a "repeat-business" type of industry.

All of the cases studied seem to point toward correlation between the degree of competition and the appreciation and use of differential costs. Conversely it may be said that where monopolistic tendencies are present, there is less use or comprehension of differential costs and greater emphasis upon total unit costs.

This theory and the observation of its practical applications are entirely consistent with the ideas advanced in Chapter 2. There it was developed that average total unit costs were an exemplification of the economists long run. Now it is shown that average total unit costs are highly regarded as a guide to price setting where there is a lack of keen competition. These two views are perfectly compatible. A firm in a monopolistic position might take a short run view toward price setting, utilizing the principles of mc=mr to the fullest extent and thereby greatly enhance his short run profits. However, it appears that monopolists prefer to take a long run view, trying to arrive at a price which they think approximates the price which in the long run must just cover total cost and provide a "modest" margin of profits. Hence total unit cost, which only has meaning in the
long run, is relied upon where competition is lacking as a guide to the "proper" price. He contends that if he can determine this long run price which will cover costs plus a reasonable profit and no more, he will effectively discourage the entrance of competition. In other words the monopolist is concerned about price being too high and looks to total long run cost as a preventive of this.

On the other hand wherever keen competition exists, the firms never need worry about setting price too high for fear of inviting competition. The competition exists, and from the standpoint of price and production planning the problem is a short run problem. As stated in Chapter 2, in the short run, average total unit cost has little meaning for policy decisions. The effective guide is differential cost.

In view of this background, why is it then that economists have the impression that businessmen, in general, do not think in terms of differential cost? Is it because business, in general, is monopolistic? We have concluded that the monopolist tends to ignore differential cost and place emphasis upon average total unit costs. Are most business concerns monopolistic, thus explaining the economists impression that businessmen think in terms of total cost? The facts do not support this contention. It is true that there are some instances in which varying degrees
of monopoly do exist. However, in the great majority of companies, competition is real and makes itself felt. This was apparent not only in the companies included in the present study, but was also observed in a variety of companies with which the author came in contact during several years in public accounting practice.

Obviously there is no clear-cut line of distinction between what is referred to here as monopoly and competition. Actually, most business concerns would probably be classified technically in that type of market which economists refer to as "monopolistic competition." However, within this overall group there are widely varying degrees to which competition is felt, and there are many more firms which tend toward high degrees of competition than toward high degrees of monopoly. Consequently there are more firms interested in the differential cost approach than firms which are not. This was definitely borne out in the firms included in this study.

There was the case cited above of the production executive of one firm who not only thought in terms of differential cost, but who was so insistent upon this type of information that he even embarked upon a study of the technique himself. This executive cited numerous examples of instances arising every day in which he applied the marginal approach.
Another executive in a firm manufacturing heavy industrial equipment, made the statement that he "doesn't see how any company can ever make any decision without a knowledge of differential costs."

Other examples of this attitude might be cited. What, then, explains the economists' opinion that business executives do not think in terms of margins? If this attitude is not the outgrowth of a general prevalence of monopolistic conditions, then what can be the cause?

There are a number of factors which would seem to explain this attitude. First, of course, there are that minority of instances in which the operations tend more toward monopoly and where it has been demonstrated executives do become total cost minded. Economists have been greatly interested in the incidence of monopoly in our economy and have studied it intently. If the theory advanced in this chapter is valid, then it is true that economists have observed the use of average total unit costs in their studies of monopoly.

A second factor which has contributed to the economists' attitude is found in a condition which Mr. Greer has stressed. Even where conditions of keen competition exist, business executives in discussions between themselves will decry the marginal approach. In luncheon meetings, trade association meetings, trade publications, etc.,

1 Greer, Howard C., in lectures presented in Accounting 860, Accounting Aspects of Business Policy Determination, Spring Quarter, 1950, Ohio State University.
differential costs are frequently scorned, while the attributes of total costing are acclaimed as a basis for price determination. The latter, they say, will provide a fair price and yet permit each member of the industry to cover his cost and allow a reasonable profit. According to Mr. Greer, all of this talk is intended for "the other fellow"; and the moment an individual executive is in the privacy of his own firm, his thoughts turn to marginal thinking.

Mr. Greer says, "As a matter of fact, there seems to be a conspiracy between accountants and managers not to talk openly about this subject. An appreciation that costs may be lowered by increasing volume is thought to lead to that horrible abomination, "price-cutting." Cost accountants dare not mention the devil for fear he may appear. I hope there will be less time devoted to public speeches urging manufacturers to figure in all their costs to be sure their prices are high enough, and that there will be more honest studies of the actual savings which may be obtained through increased volume."

If these observations are valid, then this would be a further explanation of the impression which economists have received. In other words, business executives have helped to convey the impression to economists that average total unit costs are the guide to executive action, while

1 Greer, op. cit., Cost Requirements, p. 120.
there seems to be evidence and support that this is not true, if their acts are to serve as criteria.

Another important factor which lends much to the economists' conclusion that executives do not think in terms of margins is the fact that until recent years most cost accountants ignored this approach to costing. In other words, the facts would seem to support the contention that top management in a competitive market has turned to the differential approach in spite of, rather than because of, information supplied by cost accountants. It may be that the economists' charge of refusal to think in terms of margins should be directed to cost accountants rather than to top executives. There is much evidence that top executives do think in terms of margins, but one need not go far into cost accounting literature to gain an appreciation of the predominance of the total cost viewpoint.

Cost accounting thinking and literature has been directed toward the long run point of view—that which is characteristic of financial accounting—and cost accountants have resisted change. It is quite understandable that economists turning to cost accounting literature in an effort to discover the businessman's approach to costing, would conclude that business uses the total unit cost approach.

Cost accountants in past years have overlooked an
opportunity for rendering a real service to management in the development and use of the marginal approach. All too often the cost accountant became so bound up with clerical details and administrative procedures that his vision of important fundamentals and basic relationships was cut off altogether. When his cost calculations and reports seemed foreign to management, he was prone to talk about the education of top management to an understanding of the work of the cost accountant. It is now time for the cost accountant to raise his sights, to cut himself free from the details of costing and look about him to learn what the economist, the top executive and others are thinking.
Chapter 4

A Critique of Present Methods of Factory Overhead Accounting and Control

The title of this chapter limits the discussion to the accounting for and control of factory overhead, with no mention of direct materials and direct labor. Present methods of accounting for material and labor are well adapted to the differential cost approach. Practically all of the problems arising in a discussion of differential costs versus total costs are in the area of accounting for overhead.

Accounting for material and labor may involve extensive clerical procedures, but they are relatively simple to understand. Accounting for them is not complex because the occurrences of these costs is straightforward and simple. If a unit of product is produced, the cost is incurred; if no production takes place, there is no cost. There are, of course, some complicating exceptions. Scrap and spoiled material develop, and there is idle labor time; but even these problems have been treated and classified traditionally as a part of factory overhead rather than problems of accounting for material and labor.

Material and labor cost control have also been relatively simple. Because these costs behave fundamentally in a direct relation to units of production, their control,
based upon production, has not been complex.

By comparison, the accounting for and control of factory overhead costs is much more complicated. This is true because factory overhead consists of many different kinds of costs which behave differently in relation to the production of units of product. Certain factory overhead costs are exactly like material and direct labor in that they vary directly with production. Other factory overhead costs remain the same in total amount regardless of the level of output. Still other factory overhead costs increase in a step-like fashion as production increases.

The initial classification of costs which is usually made, however, fails to take into account these fundamental differences in factory overhead costs. Practically all elementary accounting textbooks, or cost accounting texts, classify factory costs of production as (1) direct material, (2) direct labor, (3) factory overhead or manufacturing expenses. In the short run at least, there is some question about the value of a classification of this sort from the standpoint of cost behavior. To classify is "to arrange in a class or classes,"¹ and a class is "a number of objects, facts or events having common essential properties."² In accordance with these definitions, the above

² Ibid., p. 227.
would hardly qualify as a classification. It is merely a listing of costs: (1) material, (2) labor, (3) all other costs. The first two are hardly classes since they consist essentially of one cost, not a number. The third is not a class since, although it includes a number of costs, they do not have "common essential properties" regarding the behavior of costs. It is this fact which has caused the complexities in present methods of accounting for factory overhead.

It is true that some overhead accounting techniques have recognized the existence of different kinds of costs in the factory overhead category. The flexible budget and the break-even chart are two examples of techniques which do recognize the distinction between fixed, semi-variable and variable factory overhead costs. However, many of the present methods of accounting for overhead ignore this fundamental distinction; in fact, the routine methods of setting standards, accounting and reporting of overhead make little distinction between fixed and variable elements. It is these routine methods of accounting for factory overhead which will be examined here.

Essentially there are two approaches to the accounting for factory overhead: one is the purely historical approach; the other is concerned with the budgeting of overhead costs through the use of standard overhead rates.
or predetermined burden rates.

In either approach, the final result is to reduce total factory overhead to an amount per unit of output. Where production is not complex—where only one kind of product is being produced—output may be measured in terms of units of product. Where, on the other hand, many products are being manufactured, output is usually measured in terms of some factor common to all units of product. Very frequently the common factor used is direct labor hours, so that in either budgeting or in the historical accounting for factory overhead the net result is to reduce total factory overhead to a rate per direct labor hour.

In the historical accounting for actual factory overhead, this rate per hour is calculated by dividing total actual factory overhead cost for the period by the actual direct labor hours for the period. Thus, if the actual total factory overhead in a period amounts to $2,000 and the firm operated a total of 4,000 direct labor hours, the factory overhead rate per hour would be 50¢ ($2,000 ÷ 4,000 hours).

There are essentially two criticisms which are raised with respect to this procedure. The first objects to the treatment of fixed and variable costs as one entity when, as a matter of fact, they are fundamentally different in nature. This is discussed by Lawrence & Humphreys:
"The costs and expenses of a business resolve themselves into two constants:--

(1) The Direct or Marginal Cost per article--assumed now to be £2--which can be designated M.

(2) The sum total of the Establishment or Fixed Charges of a period...which may be designated F.

"These two constants are independent of each other, no fixed relationship existing between them.

"In an endeavor to introduce them into an equation in order to arrive at something that is often called 'total' cost or 'all in' cost, or by some such term, many people have been led astray.

"But there is another element that is, for shorter or longer periods, a fixed quantity--the selling price of the article; subject no doubt to varying discounts, but the basic price is, during its currency, a fixed quantity, S.

"Now, S and M are of the same dimensions--pounds sterling per article--and therefore subject to the elementary laws of mathematics. They can be subtracted to give a deficit or surplus, or divided into one another to give a ratio. On the other hand, M and F, or S and F, are not so related, and that is the bugbear of the Accountant.

"Why should it be?

"It certainly need not be, if the clear distinction is kept between the different natures of M and F."
M is a constant ratio;
F is a constant quantity;
and once that simple fundamental fact is thoroughly grasped, all that follows will be clear, and, so far as Costing and Cost Accounting are concerned, the many pitfalls and complications encountered can be altogether avoided.¹

There is a second criticism which is raised in connection with calculating a rate of factory overhead per unit of output. The illustration referred to earlier calculated a factory overhead rate of 50¢ per direct labor hour. From a strictly historical viewpoint, this may not be objectionable; it may be correct to observe that in the past, total factory overhead did average 50¢ for each hour which was worked. The objection arises in the implication that this 50¢ is a variable cost and that for each direct labor hour that the plant operates, a cost of 50¢ will result. This implication may or may not arise in a historical calculation of an overhead rate, but it is certainly present when overhead rates are calculated for budgets and standards; and it is in this connection that the greatest criticism arises.

In order to calculate a standard or budgeted overhead rate, some assumption must first be made with respect to the units of output (either products or direct labor

hours). This is necessary in order to know the denominator of the equation—the amount by which total factory overhead cost will be divided in order to arrive at a rate. It is also necessary to know the level of output so as to permit the budgeting of the total factory overhead itself. Since the total is different at each level of output, some particular level must be assumed in order to make the calculation.

The level of output which is most commonly assumed is that of "normal" or "standard" capacity. Thus, if normal capacity for the plant is 4,000 direct labor hours and the standard cost of total factory overhead for the output level is $2,000, then by division, the standard rate of factory overhead is 50¢ per direct labor hour. This is now used as a budgeted figure, with the implication that for each hour that the plant will operate, a factory overhead cost of 50¢ will be incurred. This technique has made a variable cost of total factory overhead which, as a matter of fact, consists of both variable and fixed elements. To the extent that there is variable cost in the 50¢, the figure has validity and usefulness; but to the extent that the 50¢ contains a fixed element, it may be misleading.

Dr. Raymond P. Marple, Assistant Secretary of the National Association of Cost Accountants emphasized the seriousness of this when he said: "It is possible, even
probable in my thinking that when the history of costing theory is written some years in the future, the concept of normal capacity and normal burden rates will be pointed to as the influences which have been most responsible for retarding the development of cost accounting. By using normal burden rates, fixed costs are converted into variable costs. 

Other writers in recent years have joined in the criticism of normal burden rates and have pointed to some of the more specific objections in connection with their use. One of the primary objections is found in the volume variances which arise as a result of treating total overhead as a variable cost. In the preceding illustration, the standard overhead rate was based upon a normal operating volume of 4,000 direct labor hours and an overhead rate of 50¢ per hour. If, in the ensuing period, a volume of other than 4,000 hours is maintained, a volume variance results. This is calculated as simply 50¢ multiplied by the number of hours of variance from normal. If 3,600 hours are actually worked, there is an unfavorable volume or idle capacity variance of 400 hours (4,000 normal hours minus 3,600 hours actual), amounting to $200 (400 hours x 50¢). If greater than 4,000 hours are worked, a variance is calculated in the same way, but it becomes a favorable or

1 From a letter by Dr. Raymond P. Marple, addressed to the author and dated July 23, 1951, reproduced in Appendix B.
credit variance. This volume variance is now carried to the income statement in the period concerned with the effect that if production varies to any considerable extent, net income may be seriously distorted.

Jonathan N. Harris, C.P.A., writing in the January, 1936 issue of the Bulletin of The National Association of Cost Accountants, was one of the first to criticize this procedure seriously. Since that time, a number of others have added their dissent to the observations of Mr. Harris. One of these is Mr. I. Wayne Keller, Assistant Controller of The Armstrong Cork Company of Lancaster, Pennsylvania. In an address before the Midwest Cost Conference of the National Association of Cost Accountants meeting in Indianapolis, Mr. Keller presented the illustration shown in Figure 4 on the following page.

This example illustrates the way in which changes in production, accompanied by the use of a standard total overhead rate, may completely alter the net profit picture. The sales were the same in the first two quarters of the year, and it may be assumed that costs and expenses remained the same. Yet, the net profit in the second period is reduced by $10,000, solely the result of decreased production of 20,000 units. With a factory overhead rate of 50¢ per unit, the 20,000 unit variance equals $10,000 unfavorable volume variance. In the third quarter, sales'
**Basic data:**

<table>
<thead>
<tr>
<th>Standard costs (per unit)</th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material and labor</td>
<td>$600,000</td>
<td>$600,000</td>
<td>$560,000</td>
<td>$540,000</td>
<td>$2,300,000</td>
</tr>
<tr>
<td>Factory overhead</td>
<td>$450,000</td>
<td>$450,000</td>
<td>$420,000</td>
<td>$405,000</td>
<td>$1,725,000</td>
</tr>
<tr>
<td>Total</td>
<td>$150,000</td>
<td>$150,000</td>
<td>$140,000</td>
<td>$135,000</td>
<td>$575,000</td>
</tr>
</tbody>
</table>

**Units produced**

<table>
<thead>
<tr>
<th>Units produced</th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$600,000</td>
<td>$600,000</td>
<td>$560,000</td>
<td>$540,000</td>
<td>$2,300,000</td>
<td></td>
</tr>
</tbody>
</table>

**Units sold**

<table>
<thead>
<tr>
<th>Units sold</th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$300,000</td>
<td>$280,000</td>
<td>$300,000</td>
<td>$280,000</td>
<td>$270,000</td>
<td>$1,150,000</td>
</tr>
</tbody>
</table>

**Sales**

<table>
<thead>
<tr>
<th>Sales</th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$600,000</td>
<td>$600,000</td>
<td>$560,000</td>
<td>$540,000</td>
<td>$2,300,000</td>
<td></td>
</tr>
</tbody>
</table>

**Standard cost of sales**

<table>
<thead>
<tr>
<th>Standard cost of sales</th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$450,000</td>
<td>$450,000</td>
<td>$420,000</td>
<td>$405,000</td>
<td>$1,725,000</td>
<td></td>
</tr>
</tbody>
</table>

**Standard gross profit**

<table>
<thead>
<tr>
<th>Standard gross profit</th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$150,000</td>
<td>$150,000</td>
<td>$140,000</td>
<td>$135,000</td>
<td>$575,000</td>
<td></td>
</tr>
</tbody>
</table>

**Less: idle capacity variance**

<table>
<thead>
<tr>
<th>Less: idle capacity variance</th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$150,000</td>
<td>$140,000</td>
<td>$140,000</td>
<td>$160,000</td>
<td>$590,000</td>
<td></td>
</tr>
</tbody>
</table>

**Actual gross profit**

<table>
<thead>
<tr>
<th>Actual gross profit</th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$90,000</td>
<td>$90,000</td>
<td>$90,000</td>
<td>$90,000</td>
<td>$360,000</td>
<td></td>
</tr>
</tbody>
</table>

**Selling and administrative expenses**

<table>
<thead>
<tr>
<th>Selling and administrative expenses</th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$60,000</td>
<td>$50,000</td>
<td>$50,000</td>
<td>$70,000</td>
<td>$230,000</td>
<td></td>
</tr>
</tbody>
</table>

**Net profit**

<table>
<thead>
<tr>
<th>Net profit</th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td>$0</td>
<td></td>
</tr>
</tbody>
</table>

*Note: Factory overhead based upon normal capacity of 1,200,000 units and $600,000 of cost. Assume no expected seasonal variance in production and sales.*

*Assume no price or efficiency variances.*

Figure 4. Comparative Income Statement with Varying Units of Production

decline as compared with the second period but net profits remain the same, the result of the fact that production was back to normal, and therefore no volume variance occurs. In the fourth quarter, when sales reach an all-time low, net profit stands at an all-time high due to the fact that production is high. Since 50,000 units in excess of normal are produced, a credit variance exists of $25,000 (50,000 units x 50¢ per unit).

Such unnatural fluctuations in profits are difficult for management to understand and difficult to explain to the board of directors. Management, and most people for that matter, think of net profits first in relation to sales. If costs and expenses remain the same, net profits should represent changing sales.

The effect of this procedure is well illustrated by one writer as follows: "Due to the relatively high overhead rate, the comparability of profits to sales volumes in different periods was heavily influenced by the level of factory activity. In a postwar period, when materials had become available, the factory was engaged in a program to rebuild the supply of parts and to manufacture new parts for new product lines. The large amount of overhead absorbed in the inventory increase resulted in unusual profits. The comparison of sales volume and profits of this period to later periods did not make sense to operating management."
Had the inventory decreased substantially in succeeding periods, comparisons would have been even more disproportionate, since cost of sales in this later period would have included fixed expenses of the previous period carried forward as inventory, in addition to fixed expenses of the later period of lower volume, charged off as unabsorbed overhead."¹

Another writer prepares an illustration essentially like that presented in Figure 4, and says: "Here is a case where there were identical sales figures for the two succeeding months, yet the operating profit shown is three times as large in one month as in the other. The difference is of course accounted for by the fact that production was at a high rate in January, so that factory burden was over-absorbed and the lower production rate in February resulted in an under-absorbed burden. The question arises, what is the correct profit? Should we say that the rate of factory production in a month should be allowed to influence profit regardless of the rate of sales in the same month?"²

The existence of this volume or idle capacity variance


is purely the result of the attempt to make fixed overhead variable. The overhead rate (50¢ in the above examples) is applied to units of production as though it were variable. Then, since it is not entirely variable, when volume does not equal what is considered normal, some disposition must be made of the under-applied or over-applied variance. If overhead were entirely variable, the procedure would be logical and justified.

Some other questions may be raised regarding the meaningfulness of the variances resulting from the use of normal or standard overhead rates. Usually three overhead variances are developed which are intended to explain deviations from standard overhead. One of these variances we have already examined--the volume or idle capacity variance. The other two are the production efficiency variance and the budget variance.

These three variances are developed and illustrated in nearly every cost accounting textbook and have been used in various N.A.C.A. publications. Terminology, however, may vary. The terminology used here is taken from Blocker's Cost Accounting. The National Association of Cost Accountants in a Research Series Monograph on standard costs says: "There are three factors which can cause overhead variances--namely, production volume, production..."
These are exactly the same as the idle capacity variance, the production efficiency variance and the budget variance.

An example of the way in which these variances are calculated will be helpful in their discussion. Assume the following basic data:

1. Standard overhead for the budget period $2,000
2. Standard units of production for the budget period 400 units
3. Standard labor hours for the budget period 4,000 hours
4. Standard labor hours required for production of one unit (3:2) 10 hours

With these assumed conditions, the standard rate per direct labor hour is determined by the methods discussed earlier:

\[
\frac{2,000}{4,000 \text{ hours}} = 50\text{¢ per direct labor hour}
\]

and now, since it requires ten hours to produce a unit of product at 50¢ per hour, there would be standard factory overhead of $500 in each unit produced. At least this would be true if all factory overhead were variable.

Continuing, assume the following conditions with respect to actual operations during the budget period:

5. Actual overhead for the period $1,990
6. Actual units produced during the period 350
7. Actual labor hours for the period 3800

At the end of the period, the total overhead variance would be calculated as follows:

- Actual factory overhead $1,990
- Standard overhead (350 units @ $5) 1,750
- Total overhead variance $240

The total overhead variance of $240 may now be divided into its three causes as follows:

1. **Idle capacity variance** (which has already been discussed):

   - Budgeted hours of plant operation for the period = 4,000 hrs.
   - Actual hours of plant operation for the period = 3,800 hrs.
   - Unused hours = 200 hrs.
   - Cost of unused hours, 200 @ 50¢ = $100.00

2. **Production efficiency variance**:

   - Actual hours required to produce 350 units = 3,800 hrs.
   - Standard hours required to produce 350 units (350 x 10 hrs.) = 3,500 hrs.
   - Excessive hours required for production = 300 hrs.
   - Cost of operating the plant 300 excessive hrs. (300 x 50¢) = $150.00
3. **Budget variance**:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Budgeted overhead for the period</td>
<td>$2,000</td>
</tr>
<tr>
<td>Actual overhead for the period</td>
<td>$1,990</td>
</tr>
<tr>
<td>Saving in reduced overhead</td>
<td>$10.00</td>
</tr>
<tr>
<td>Total variance per above</td>
<td>$240.00</td>
</tr>
</tbody>
</table>

The idle capacity variance, as we have already seen, would be more valid if all factory overhead were variable; and the objection which is raised results from the existence of a fixed element in overhead. Essentially this same criticism may be levied against the production efficiency variance. This variance would lead management to chastise the labor force for having operated the plant too many hours for what it produced. But clearly this cost is only the variable cost of the excess hours of work—the portion of the 50¢ per hour which is variable. The other portion—the fixed—is a cost anyway and has no relation to excessive hours of operation. This whole subject will be developed in greater detail in Chapter 5, but a little illustration may be given. Assume for example that of the $2,000 budgeted overhead for the period, $1,000 is fixed for any level of output and that the variable element amounts to 25¢ per direct labor hour. If this were the case, the cost of the 300 excessive hours would be $75 (300 hours × 25¢). In other words the overhead cost of production inefficiencies is only the variable cost, while the rate includes
both fixed and variable.

While the idle capacity and the production efficiency variances seem to be based upon the false assumption that all overhead costs are variable, in contrast the budget variance seems to imply that the overhead is entirely fixed. When production was budgeted at 400 units and 4,000 hours, overhead was budgeted at $2,000. The calculation of the budget variance does not take into consideration the fact that the operations were far below this anticipated level—production units down to 350 from anticipated 400, and hours down to 3,800 from anticipated 4,000. Since a portion of overhead is variable, decreased productive activity means some decrease in cost; but this is not recognized in the budget variance computation. With such a decline in volume, it might be assumed that the total overhead cost should have properly declined much below $1,990 and accordingly, this might represent a very unfavorable variance. But the actual calculation takes none of these factors into account, treats overhead costs as purely fixed and reports a $10 favorable variance regardless of what has happened to volume.

All of these questions regarding the traditional treatment of normal overhead rates lead one plant controller to observe: "we have completely dispensed with the use of the traditional overhead variance accounts."
There is still another phase of present methods of overhead accounting which gives rise to some questions of logic. Reference is made to the arbitrary allocations of fixed cost which must be made in order to arrive at the portion applicable to each unit. There are many costs which have only a very indirect relationship to units of specific product; and these costs are arbitrarily allocated, then arbitrarily re-allocated and then re-allocated again before they are finally reduced to a per-unit basis. Examples of such costs are personnel manager's salary, past service cost of pension plans, the plant infirmary, the cost of a house organ or supporting a company baseball team. Not only do all these costs remain the same within wide ranges of productive activity, but they are only remotely identified with widely varying types of products. Most common procedure is to allocate these costs first to departments---productive as well as service---on some selected basis. Service department costs are then reallocated to productive departments on some selected basis. Finally, overhead costs of productive departments are allocated to units of product, again on some arbitrary basis such as machine hours, labor hours, labor cost, etc.

One writer cites an example of the lack of correlation between these arbitrary cost calculations and anything relating to product value. He says: "I am reminded
of such a situation which occurred only recently. Two competing manufacturers of women's apparel turned out a skirt which was nearly identical because of similarity in design and because both used the same fabric with a highly stylized print. Manufacturer A's selling price was $4.75 while Manufacturer B's price was $3.75. Naturally, A's selling price became $3.75 promptly, despite the fact that, according to his cost sheet, he was making no profit at this price. It then happened that one of B's cost sheets became available to A. The management was amazed to see that B appeared to have a comfortable margin at $3.75.

"How was this possible? The companies had very similar establishments in the same district and their annual gross sales were nearly the same. Comparison of the cost sheets revealed that the difference in direct labor and material was negligible but that drastically different rates were being used for indirect cost allocation. It was this which made it appear that virtually the same skirt was being produced at two different costs."¹

Most of the techniques discussed in this chapter are a result of an effort on the part of cost accountants to

calculate average total costs per unit, including in each unit a proportionate part of the firm's fixed cost. This total cost seems important so that it may be compared with unit selling price, and a net profit per unit may be calculated. But of this net profit per unit, Lawrence & Humphreys say: "no one unit ever makes a profit. Net profit is made only from total activity of manufacturing and distribution during a period, and the units made and sold contribute their quota to a pool from which the profit finally emerges."¹

It may appear logical to make these total cost allocations to product; but if these techniques are not conveying information to management in a clear and understandable manner, they are not achieving their full usefulness.

¹ Lawrence & Humphreys, op. cit., Marginal Costing, P. 4.
Chapter 5

Adapting Accounting Techniques to the Differential Cost Approach

Thus far the discussion has dealt primarily with the theoretical background for differential costs and objections to present costing procedures. It is the objective of this chapter to develop specific ways and means of incorporating differential costs in the accounts, budgets, reports and other accounting techniques.

As with all cost accounting, the problem resolves itself into two phases. One of these is concerned with the use of cost data for special cost studies; the other has to do with the routine accounting and reporting of costs in regularly established procedures. Cost accountants have always worked in both of these areas. The introduction of differential costs does not alter this setting but merely provides the cost accountant with a new tool with which to approach these problems.

Differential costs were first applied to the solution of special cost problems and have had more attention in this application. Textbook treatment of differential costs is almost solely in this area. Only in very recent years has there been any discussion of the application of differential cost techniques to routine accounting and reporting, and there is comparatively little written on
this phase of the problem. Since there has been more experience with the application of differential costs to special cost studies, this area will be examined first.

By special cost studies are meant the preparation of cost estimates or other cost data for specific proposals or problems confronting the firm. This was discussed in Chapter 1 when the advantages of the differential approach in this situation were outlined. Examples were cited and several detailed illustrations given. It will be recalled that, broadly speaking, there were two types of situations involving estimates of differential cost and differential revenue. First, there are proposals directly concerned with changes in unit output of production, accompanied by changes in revenue. Examples of this are found in opening or discontinuing a new territory, adding or discontinuing a product line, acceptance of a defense contract, etc.

Secondly, there are special cost studies initiated with respect to proposals which may involve only a revenue change or only a volume change or neither one. Examples of this would include projected plans for the adoption of a product guarantee, the manufacture of a part hitherto purchased, the design and construction of a machine in our own shop as opposed to outside purchase, or the provision of some service or benefit for employees. The distinction between these two broad classes of special cost problems is
important because the major attention has been applied to the differential costs of changes in units of output and revenue.

One application of the differential cost technique has been in the so-called "break-even" chart. This is a means of presenting graphically the relationship of costs and profits to changes in volume. The device has been in use for many years, one of the earliest proponents being C. E. Knoeppel, an early industrial management counselor and disciple of Frederick W. Taylor and Henry L. Gantt. Knoeppel claims to have originated the idea of the break-even chart in the year 1909, although he called it the Knoeppel "Profitgraph". Since that time there has been little change in the basic concept of the break-even chart, but it has grown in popularity.

In its simplest form, the break-even chart consists of two plotted lines, as in Figure 5 on the following page. One line—B, D, C—represents total cost of production, selling and administration at each volume level; the other line—0, D, A—represents total revenue at each level of output. The revenue line—0, D, A—starts at zero since there is no revenue when there are no sales. The total cost line, on the other hand, starts at a point

1 Knoeppel, C.E., Profit Engineering, New York: McGraw-Hill, 1933, p. IX.
Figure 5. Simple break-even chart.
of no production but of those fixed or sunk or shut-down costs incurred even when there is no production. In this illustration this point is at $2,000. D is the volume at which the revenue exactly equals cost—the break-even point. At all volume levels greater than D the revenue line exceeds the cost line, the difference representing profit. At all volume levels less than D, cost exceeds revenue and loss results.

Further refinements in the break-even chart have been concerned primarily with greater detailed description of what makes up total cost at the varying levels of output (Figure 6).

The break-even chart has been a valuable adjunct to accounting for differential costs. Although it has served other purposes, one of the most beneficial has probably been the fact that it has greatly advanced an understanding of the differential cost principle. The chart has gained widespread popularity and has therefore conveyed to many cost accountants some notion of the relationship of costs and profits to volume.

In addition, the chart can be useful in gaining a broad estimate of the effect of broad changes in volume and may be of considerable value as a guide in gaining an overall perspective of the operations of the firm.

However, beyond these broad generalizations, the use-
Figure 6. Detailed break-even chart.
fulness of the chart becomes somewhat limited. William L. Fill says:

"The break-even chart is just a summary report. Its simplicity enhances its ability to communicate the relation of sales less variable and fixed costs at different levels of operation quite forcefully to financial analysts outside the company and to the management group within the company. In such a function, its use to convey the information in the master budget is undisputed. However, the preparation of a break-even chart requires many estimates and conjectures which may add up to minor inaccuracies in the chart which will be misleading if the chart is used to measure costs and sales at any particular level of output. Especially is the break-even chart unreliable when output approaches the break-even point--almost invariably the break-even point will begin to shift as it is neared. The chart, then, has uses as a summary report and portrays the general facts of the company as the landscape would be in an oil painting. To abuse the report by using it as a detailed aerial photograph to direct actual movements of the management forces is to court disaster."

Although the break-even chart serves a very useful purpose, it would be of little help in the preparation of detailed cost studies for most concerns. Its primary disadvantage is over-simplification and lack of realism for detailed purposes.

In the first place, plant activity is stated entirely in terms of units of product, and then only one kind of unit of product. This would be of significance in a plant which manufactured only one kind and one size of unit of product. One such plant was visited in this

study. This firm manufactured one product only, consisting of three simple parts, two of which it manufactured, the third of which it purchased. In such circumstances, changes in volume usually follow simple progressions and can be plotted simply. However, for plants manufacturing a complex group of products, it is impossible to plot units of product in a meaningful progression.

In an effort to correct this difficulty for plants which manufacture several products or a "mix" of products, the horizontal axis, or the volume scale, might be stated in terms of a volume factor which is common to all units produced. Such a common factor might be direct labor hours or total plant machine hours, etc. These may be stated in terms of hours or may be converted into terms of plant capacity stated as a percentage. Thus, the chart would reflect total cost and revenue at each level of total plant hours within the meaning of this term.

Even this approach, however, would not be entirely satisfactory, particularly where products differ widely in costs and methods of production and where the operations performed in various departments differ widely. Under such circumstances, in order to arrive at total cost at a particular level of plant operating hours, it would be necessary to assume a certain "mix" of products. With 100,000 man hours, an unlimited number of combinations
of different products could be manufactured, each with a
different cost and revenue total. Therefore, the con-
struction of the break-even chart would be dependent upon
the particular mix of products which is assumed, and it
would be useful only as long as that particular mix was
maintained. The chart, under these circumstances, would
have little usefulness for most special cost studies.

For example, in one of the firms studied, a proposal
was under consideration which involved the manufacture of
a new product in only one of the plant's many departments.
This particular department had some idle capacity, so the
plan was to manufacture a simple product which required
only the facilities of this one department. This action
would, of course, completely alter the existing pattern of
product "mix" in a break-even chart prepared for this
company.

In essence the break-even chart would have usefulness
in special cost studies only where it was proposed to
make shifts in volume which exactly corresponded to volume
fluctuations assumed when first preparing the chart. It
would have little usefulness where volume consists of a
"mix" of products, or in the case of special proposals
which are not concerned with changes in volume.

Other serious shortcomings of the break-even chart
are mentioned by W. L. Fill, "Other assumptions involved
in computing the sales to be plotted at various levels of production are that prices are fixed, that there is but one product or that the sales 'mix' does not change and that if prices do change the percent of sales in excess of variable costs remains constant. These assumptions should be given serious consideration in the preparation and review of a break-even chart and if not true, a new chart may have to be prepared. "\(^1\)

Since we have concluded that the break-even chart is useful only for very broad approximations, it might seem pointless to argue about refinements with respect to the behavior of either the revenue or cost curve. Nevertheless, to enable the preparation of accurate cost studies, it is important to have as full an understanding as possible of the specific behavior of these elements. For this reason, closer scrutiny of the cost and revenue lines are in order.

The question being raised with respect to the behavior of revenue pertains to the distinction between the various types of markets which was discussed in Chapter 2. \(^2\) The revenue lines depicted in Figures 5 and 6 are typical of most break-even charts—namely, they are perfectly straight lines. This implies that revenue varies exactly

\(^1\) Ibid, Fill, "Break-Even Chart", p. 203.

\(^2\) *cf. ante.*, pp. 35 ff.
proportionately to output at all volume levels; or in other words, the product can be sold at the same price per unit regardless of the number of units sold. This is the condition which exists in the type of market which tends toward the economists' concept of pure competition. The individual firm has no control over selling price and can sell all of its output at the established market price. Although this pricing condition does exist in many firms, it is far from typical in many types of industries.

In monopolistic competition the firm has some control over price, and usually it reaches a point where added volume can be sold only by reducing the price. In these circumstances the revenue curve is not a straight line, but eventually would tend to become more horizontal as more and more units are sold.

Another over-simplification in the break-even chart is found in the assumption that the total cost line is straight. There is first the possibility of periodic "steps" in total cost resulting from what is commonly termed semi-variable cost. However, we shall ignore this possibility for the moment, since we shall deal with it at greater length later. Even if we ignore these "steps", it is still doubtful whether the total cost line would be perfectly straight. Economists have always depicted the total cost curve of a firm as a curved line, resulting
from the principle of non-proportional returns. In other words as volume increases, a point is reached where inefficiencies begin to occur; and costs will rise more rapidly than volume.

If these two lines—total revenue and total cost—did not curve but rose steadily in exactly the manner depicted in Figures 5 and 6, it would appear that a firm could increase its profits without limit by merely increasing its output. This is unrealistic.

Figure 7 shows a break-even chart in which the two main lines—the revenue line and the total cost line—are drawn to conform with the principles discussed above. Total revenue—0,A—does not go on increasing forever at the same rate but tends to flatten out as output becomes great. Total cost—B,C—likewise curves upward as inefficiencies cause total costs to rise more rapidly than does output. If carried to an extreme, point Y is eventually reached where total cost once again exceeds total revenue. M,N—the greatest distance between total cost and total revenue—represents the level of maximum profit.

The same principles may be observed in the following data from which Figure 7 was plotted:
If the total cost and revenue lines were perfectly straight, then the differential cost would be the same for each increment of output and so would the differential revenue. On the contrary, in this example, differential cost is increasing at an increasing rate and differential revenue is decreasing at a decreasing rate, resulting in the curved line shown in Figure 7.

It might be argued that these refinements are too theoretical and are unnecessary for practical uses. Devine says: "a number of studies designed to test the constant variable cost assumption have shown that for many concerns over the range of normal output this assumption is justified."¹

It is probably true that for the broad approximations of the break-even chart, perfect variability may be a simplifying assumption; although it was evidenced in

Figure 7. Break-even chart showing decreasing total revenue and increasing total cost
several firms that this change in the rate of variability is a very real factor. Even if it is not important for the break-even chart, it is important in detailed cost studies. Devine says that the variability assumption is valid "over the range of normal output." Experience shows however that much of the time the firm is operating at something other than "normal" output, and many cost studies are undertaken with respect to sub-normal or above-normal output levels. This was particularly evidenced in the heavy machinery firms which were visited—they described themselves as a "feast or famine" industry. The concept of normal was of little significance for them. An executive in one firm estimated that four years ago they were operating at about 60% of "normal capacity," while today he would estimate the figure at around 130% of capacity. This was not an isolated case; similar experiences were reported in other firms.

Not only did this demonstrate that the concept of "normal" capacity has limited usefulness, but the same executive confirmed the declining efficiency and the increasing costs at these upper reaches of output. In his words he "picked up a lot of fat" at these upper levels of output which could be trimmed when output was reduced.

It is evident that a consideration of the changing variability of costs and revenues should be considered in
a break-even chart, and it is certain that these are important in special cost studies.

In an effort to provide more detailed information than is available in the break-even chart, the flexible budget has been developed (see Figure 8). The flexible budget shows essentially the same information in detailed dollar and cents form as does the break-even chart in graphic form. Although this form of the flexible budget has served many useful purposes, when it is prepared in this summary fashion for the total firm it is subject to essentially the same limitations as the break-even chart. It is somewhat more detailed; and by a breakdown of the semi-fixed expenses, it provides a clearer view of the "steps" in total costs than does the break-even chart. Yet this budget for purposes of calculating differential costs is limited essentially to changes in units of production, whether stated in terms of units or man-hours or machine-hours. In cases where a single product is manufactured or where production is not complex, this type of flexible budget might be sufficient. In firms producing a mixture of products, a particular "mix" would have to be assumed in preparing the costs at the various volume levels of the budget. In this event the budget is not of much value in studying costs, except for proposals which conform to the assumptions underlying the budget itself.
<table>
<thead>
<tr>
<th>Volume</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
<th>110%</th>
<th>120%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed costs:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td>$200,000</td>
<td>$200,000</td>
<td>$200,000</td>
<td>$200,000</td>
<td>$200,000</td>
<td>$200,000</td>
<td>$200,000</td>
</tr>
<tr>
<td>Selling</td>
<td>120,000</td>
<td>120,000</td>
<td>120,000</td>
<td>120,000</td>
<td>120,000</td>
<td>120,000</td>
<td>120,000</td>
</tr>
<tr>
<td>Administrative</td>
<td>80,000</td>
<td>80,000</td>
<td>80,000</td>
<td>80,000</td>
<td>80,000</td>
<td>80,000</td>
<td>80,000</td>
</tr>
<tr>
<td>Total fixed</td>
<td>$400,000</td>
<td>$400,000</td>
<td>$400,000</td>
<td>$400,000</td>
<td>$400,000</td>
<td>$400,000</td>
<td>$400,000</td>
</tr>
<tr>
<td>Semifixed costs:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Supervisory</td>
<td>$25,000</td>
<td>$25,000</td>
<td>$29,000</td>
<td>$42,000</td>
<td>$46,000</td>
<td>$46,000</td>
<td>$46,000</td>
</tr>
<tr>
<td>Light and heat</td>
<td>5,000</td>
<td>5,000</td>
<td>6,000</td>
<td>8,000</td>
<td>9,000</td>
<td>9,000</td>
<td>9,000</td>
</tr>
<tr>
<td>Total</td>
<td>$30,000</td>
<td>$30,000</td>
<td>$35,000</td>
<td>$50,000</td>
<td>$55,000</td>
<td>$55,000</td>
<td>$55,000</td>
</tr>
<tr>
<td>Selling</td>
<td>$10,000</td>
<td>$10,000</td>
<td>$13,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>Administrative</td>
<td>$5,000</td>
<td>$5,000</td>
<td>$7,000</td>
<td>$10,000</td>
<td>$12,000</td>
<td>$12,000</td>
<td>$12,000</td>
</tr>
<tr>
<td>Total</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$20,000</td>
<td>$25,000</td>
<td>$27,000</td>
<td>$27,000</td>
<td>$27,000</td>
</tr>
<tr>
<td>Variable costs:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials</td>
<td>$33,000</td>
<td>$35,000</td>
<td>$40,000</td>
<td>$45,000</td>
<td>$50,000</td>
<td>$55,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>Labor</td>
<td>54,000</td>
<td>56,000</td>
<td>61,000</td>
<td>72,000</td>
<td>80,000</td>
<td>90,000</td>
<td>100,000</td>
</tr>
<tr>
<td>Repairs</td>
<td>2,000</td>
<td>3,000</td>
<td>7,000</td>
<td>22,000</td>
<td>60,000</td>
<td>75,000</td>
<td>109,000</td>
</tr>
<tr>
<td>Power</td>
<td>1,000</td>
<td>1,000</td>
<td>2,000</td>
<td>3,000</td>
<td>4,000</td>
<td>4,000</td>
<td>4,000</td>
</tr>
<tr>
<td>Total</td>
<td>$90,000</td>
<td>$95,000</td>
<td>$116,000</td>
<td>$150,000</td>
<td>$197,000</td>
<td>$282,000</td>
<td>$389,000</td>
</tr>
<tr>
<td>Selling</td>
<td>$14,000</td>
<td>$15,000</td>
<td>$16,000</td>
<td>$17,000</td>
<td>$19,000</td>
<td>$22,000</td>
<td>$27,000</td>
</tr>
<tr>
<td>Administrative</td>
<td>$4,000</td>
<td>$5,000</td>
<td>$6,000</td>
<td>$7,000</td>
<td>$9,000</td>
<td>$12,000</td>
<td>$17,000</td>
</tr>
<tr>
<td>Total</td>
<td>$18,000</td>
<td>$20,000</td>
<td>$22,000</td>
<td>$24,000</td>
<td>$31,000</td>
<td>$44,000</td>
<td>$44,000</td>
</tr>
<tr>
<td>Total variable</td>
<td>$133,000</td>
<td>$122,000</td>
<td>$115,000</td>
<td>$123,000</td>
<td>$125,000</td>
<td>$129,000</td>
<td>$151,000</td>
</tr>
<tr>
<td>Total costs</td>
<td>$350,000</td>
<td>$357,000</td>
<td>$350,000</td>
<td>$357,000</td>
<td>$360,000</td>
<td>$364,000</td>
<td>$364,000</td>
</tr>
<tr>
<td>Number of units</td>
<td>650,000</td>
<td>700,000</td>
<td>800,000</td>
<td>900,000</td>
<td>1,000,000</td>
<td>1,100,000</td>
<td>1,200,000</td>
</tr>
<tr>
<td>Average cost</td>
<td>$0.93</td>
<td>$0.81</td>
<td>$0.75</td>
<td>$0.73</td>
<td>$0.72</td>
<td>$0.74</td>
<td>$0.78</td>
</tr>
</tbody>
</table>

Figure 8. Flexible Budget

In plants which have a complex of operations and products, it becomes necessary to understand the behavior of costs in each operation. By operation is meant the performance of a function for costing purposes. Usually such functions are termed cost centers or costing departments or just simply departments. However such a departmental organization for costing purposes does not necessarily conform to departmental organization for administrative purposes. The objective here is to divide the total plant into centers wherein a single function is being performed. Detailed budgets can then be prepared for costs of operating this one function at various volume levels. Now when a specific proposal is made, it will first be analyzed in terms of functions or departments involved. Then turning to the cost budget for each of these departments, prepared in terms of activity level, the differential cost of adopting the proposal can readily and accurately be determined.

It was pointed out that the type of flexible budget prepared for the plant in total was valid and useful only if the plant were manufacturing essentially a single product, or had only a single process. The proposal here is to make each department in a complex plant just like a small firm which manufactures a single product in a simple operation. If all of the products passing through a department do not have the same operations performed on them,
then the cost centers have not been carefully enough defined, and two or more costing departments may be needed.

Once a careful determination of departments for costing purposes has been achieved, a careful study of the operations and costs of each department must be made.

First, a careful listing of each cost or an account classification should be prepared for each department showing each variable and semi-variable cost pertaining to the department. Fixed costs may be excluded.

Since our objective is to provide a basis for differential cost calculations and since fixed costs have no part in differential cost studies, they will not be included in the departmental budget. A separate budget of fixed costs should be prepared, and the budgeted figures compared with actual figures for proper control purposes. By no means can fixed costs be ignored; in fact, they constitute an important area for accounting and managerial scrutiny. However by the very definition of differential costs, the fixed costs are excluded.

The budget of fixed costs might be prepared first on a plant-wide basis, and for differential cost purposes this would suffice. Determination of fixed costs on a departmental basis is likely to involve many arbitrary allocations which may raise some questions as to the reliability of the results. This was discussed at the
close of Chapter 4. If total cost information is desired for any purpose, fixed costs may be allocated to departments and then to products. However such a procedure is not a part of a system of differential costs.

One of the firms included in this study was in the process of developing this type of budget. The express objective of the project was to make possible the preparation of detailed cost studies of each plant operation under varying levels of activity.

The plant was first departmentalized on a "cost accumulation" basis—that is the plant was broken-down into cost activity centers, each constituting a department. A chart of accounts was then prepared in which the costs of each department were listed and classified as either variable or semi-variable. A simple example, adapted from this company's chart of accounts, included as variable expenses in one department:

**Account 801 Machine Direct Labor**

Cost of machine operators will be charged to this account for the entire time that they are available at the machine for the purpose of operating the machine.

**Account 802 Manufacturing Supplies**

This account will be charged for the cost of all operating supplies used in the
operation of this department. Includes lubricating oils, greases, and other supplies used in operations.

**Account 803 Waste and Spoilage**

Charges to this account will originate in the Accounting Department and will represent the total cost of spoiled work. Also includes any cost involved in salvaging defective work.

**Account 804 Electric Power**

Charge with the consumption of electric power as reflected by meter readings.

**Account 805 Fuel**

Charge with the consumption of gas as reflected by meter readings.

**Account 806 Repairs**

Labor and materials used in repairing equipment assigned to this department.

Semi-variable expenses are those which change in a step-like fashion as productive volume changes. A semi-variable expense will remain the same in total over a given range of volume; then at a particular point, as volume increases, it will "jump" in amount to a new level. At this point it again remains the same over a given range of volume. Figure 9 reflects a common way of presenting,
Figure 9. Typical behavior of a semi-variable cost
graphically, the behavior of a semi-variable expense.

Examples of semi-variable expenses adapted from the illustration mentioned above, included:

**Account 810 Indirect Labor--Foremen and Floorboys**
Charge with salaries and wages paid foremen and floorboys.

**Account 811 Indirect Labor--Janitor**
Charge with salaries and wages paid for sweeping, cleaning and janitor service.

**Account 812 Departmental Mechanics**
Includes salaries of all mechanics assigned to and carried on this department's payroll.

These are but a few examples of the types of variable and semi-variable expenses included in a chart of accounts for one department.

The next step in the preparation of the budget for this department is the determination of a unit of measurement. Since we are dealing entirely with variable expenses (either wholly variable or semi-variable) we must now have a unit to measure the work being performed or volume of activity in the department.

If the department processes only one kind of product, then units of output would constitute a perfect measure of activity. However where work is being performed on units of varying size and complexity, the number of units produced
would not constitute a satisfactory measure of the level of output. In such instances some other common unit of measure must be found. This should not be difficult since each department is performing essentially a single type of operation. Thus a satisfactory unit of measure may be found in direct labor hours within the department or in machine hours or direct labor cost. That unit should be chosen which most properly measures the level of output of the department.

The procedure for establishing budgeted amounts for each cost will now follow the well established routines for budgeting. Particularly in the case of the variable costs, no new problems would arise. Budgets here would be based upon past experience and standardized performance, adjusted to reasonable expectations of actual future performance and stated in terms of a dollar amount per unit of measure. Thus budgeted direct labor cost may amount to $3.15 per machine operating hour, and repairs are budgeted at $.10 per machine operating hour, and waste and spoilage at $.07 per machine operating hour, etc.

The important factor to be remembered in budgeting the semi-variable expenses is that a budgeted figure must be determined for each "plateau" in the upward progression of the cost (see Figure 9). This involves two principal tasks--first, determining the volume levels at which the
"step" occurs and secondly, determining the amount of the cost at each "step".

An illustration of how the semi-variable cost budget may be prepared is shown in Figure 10 on the following page. This was adapted from the procedures being developed by the company which was referred to earlier in this connection.

This company sets up what they call a "Budget Rate Development Sheet" for each expense in each department. The most important part of the sheet is the rate itself shown at the bottom of the page. However the computations followed in arriving at the rates are given in the upper part of the sheet so as to formalize the calculations and form a permanent record of them.

The sheet presented in Figure 10 illustrates the calculation of the cost rate for foremen and floorboys (Account 810).

It should be noted in this illustration that the first factor determined was the output levels at which the semi-variable cost "jumped." These levels in this case are first stated in terms of shifts, for it is with the change in the number of shifts that the cost changes. These levels are then converted into terms of machine operating hours (Moh), the unit of measurement in this department. The basis for this conversion is presented
Department: Injection molding  
Account Number: 810

Account description: Foremen and Floorboys' salaries

The foremen and floorboys' salaries in this department should be as follows, by level of activity:

<table>
<thead>
<tr>
<th>Number of Shifts /Wk.</th>
<th>Number of Machines</th>
<th>Total Foremen</th>
<th>Total Floormen</th>
<th>Max. Std. moh.</th>
<th>Semi-fixed cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5</td>
<td>1-2</td>
<td>1</td>
<td>0</td>
<td>340</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>3-4</td>
<td>1</td>
<td>1</td>
<td>680</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>3-4</td>
<td>2</td>
<td>2</td>
<td>1,360</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>3-4</td>
<td>3</td>
<td>3</td>
<td>2,040</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>3-4</td>
<td>4</td>
<td>4</td>
<td>2,870</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>4-5</td>
<td>4</td>
<td>4</td>
<td>3,588</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
<td>5-6</td>
<td>4</td>
<td>5</td>
<td>4,306</td>
</tr>
</tbody>
</table>

2. 1 shift 1 machine 5-day wk. = (365 - 104 Sat. & Sun. - 6 Hols.) ÷ 12 Mo. x 8 hrs. = 170 hrs.

3 shift 1 machine 7-day wk. = (365 - 6 Hols) ÷ 12 Mo. x 24 hrs. = 717.6 hrs.

<table>
<thead>
<tr>
<th>Level</th>
<th>Activity</th>
<th>Budget Hours</th>
<th>Budget Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Up to 340</td>
<td>340 - 680</td>
<td>$309.40</td>
</tr>
<tr>
<td>2</td>
<td>680 to 1360</td>
<td>1360 - 2040</td>
<td>$567.80</td>
</tr>
<tr>
<td>3</td>
<td>1360 to 3588</td>
<td>2040 - 3588</td>
<td>$1,152.60</td>
</tr>
<tr>
<td>4</td>
<td>Over</td>
<td>3588</td>
<td>$1,737.40</td>
</tr>
</tbody>
</table>

1st Foremen Monthly Cost: 170 x 1.82 = $309.40
2nd & 3rd Foremen Monthly Cost: 170 x 1.87 = 317.90
4th Foreman Monthly Cost: 170 x 1.854 = 315.80
1st & 5th Floormen Monthly Cost: 170 x 1.52 = 258.40
2nd & 3rd Floormen Monthly Cost: 170 x 1.57 = 266.90
4th Floorman Monthly Cost: 170 x 1.554 = 265.18

Date

<table>
<thead>
<tr>
<th>Accepted</th>
<th>Approved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit of Measure</td>
<td>Std. Std. Std. Std. Std. Std.</td>
</tr>
<tr>
<td>Semifixed</td>
<td>moh. moh. moh. moh. moh. moh.</td>
</tr>
<tr>
<td>Activity</td>
<td>Up to 340</td>
</tr>
<tr>
<td>Budget Level</td>
<td>1360</td>
</tr>
<tr>
<td>Budget Rate</td>
<td>$309.40</td>
</tr>
</tbody>
</table>

moh = machine operating hours

Figure 10. Budget rate development sheet.
in Section 2 of the sheet.

After stating each of the changing levels of activity in terms of the unit of measurement, the cost for each level is calculated. Section 3 sets forth the cost of foremen and floorboys for each shift. These costs are then applied to the number of foremen and floormen required for each activity level to arrive at the cost for each level.

These cost determinations are then carried to the summary at the bottom of the page, the final objective of the budget sheet. Here then is an exact determination of the cost of this semi-variable expense at each possible output level. There is no need for an unrealistic assumption of a "normal" operating level which must be made where fixed costs are included. The only consideration is of variable costs which can be determined directly, positively and realistically at any activity level. It should be noted that this same "Budget Rate Development Sheet" is used for formalizing the calculation of the rate of variable cost, and at the bottom of the page space is provided for showing this rate. Of course this rate is uniform at all levels of activity, so there is no necessity for a columnar spread to develop costs by various outputs as were needed in the case of semi-variable costs. Only two items of information are needed in the case of the variable cost; the
unit of measure and the rate.

The type of budget illustrated for foremen and floorboys is duplicated for each variable and semi-variable cost at all activity levels for each cost in each department of the plant. The firm is then in an excellent position to exercise rigid control over all costs at any level of output. Furthermore such a budget plan provides every item of information necessary for a complete, accurate determination of the differential cost of any proposal which might be made. Whether the proposal is in terms of units presently produced or in terms of entirely new units, whether it affects the entire plant or only one department—whatever the proposal, a quick and accurate differential cost determination can be made. For example, if the proposal requires operating the molding department for six-hundred machine hours when the department is now operating only 300 hours, it is quickly apparent that the total foremen and floorboys' costs will increase from $309.40 to $567.80, or a differential cost of $258.40. A similar calculation for each cost in each department of the plant will quickly produce the total differential cost applicable to the proposal. A comparison of this differential cost with the differential revenue involved will reveal whether the proposal is profitable—that is, whether it will add marginal profit toward the coverage of the
firm's pool of fixed costs.

So far we have been dealing with the specific determination of differential costs for purposes of special cost studies. More recently a few forward-thinking cost accountants have raised the question of applying the principles of differential costs to the regular costing of all units and to routine accounting and reporting.

The reasoning is essentially this: a firm is already producing 100,000 units of product. It is decided now to produce an additional 10,000 units. The differential cost approach would argue that the only costs applicable to the 10,000 units are those additional costs incurred directly as a result of producing these units. Why isn't it valid then to reason that the costs applicable to any unit, be it the first or the 100,009th, are only those costs which can be directly identified as having been incurred as a result of producing that unit? In other words, this plan would charge units of production with only the variable costs and exclude from cost of units manufactured any and all fixed costs. This production, charged with only the variable costs, would be carried through to the balance sheet and the income statement in this manner. Accordingly, the plan has been referred to occasionally as "the elimination of fixed costs from inventory," or the "direct costing plan."
In addition to the underlying differential cost concept there is one further theoretical aspect of this proposal which should receive some consideration. We have already attempted to establish the theoretical justification for identifying only differential costs with units of product for managerial decision purposes. However if all fixed costs are completely eliminated from all production, what disposition is to be made of fixed charges? Those advocating this approach find the answer in carrying all fixed charges directly to the income statement in the period in which incurred.

Not only do the advocates of this plan find theoretical justification for it, but they see in this approach an answer to the difficulties which arise in presenting idle capacity variances in the income statement as outlined first by Jonathan Harris and summarized here in Chapter 4.

Figure 11 presents the same basic data that was used in Figure 4. In Figure 4 however the old approach was used, wherein fixed overhead costs were spread over units of product by means of a predetermined or standard overhead rate. The determination of such a rate necessitated the use of some sort of normal capacity. Then when

1 Harris, op. cit., pp. 501-2.
2 cf. ante., p. 81.
Basic data:

<table>
<thead>
<tr>
<th>Standard cost: (per unit)</th>
<th>(Note: Fixed factory overhead, at any production level, amounts to $420,000 per year or $105,000 per quarter.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct material and labor $1.00</td>
<td></td>
</tr>
<tr>
<td>Variable factory expense .15</td>
<td></td>
</tr>
<tr>
<td>Total standard differential cost $1.15</td>
<td></td>
</tr>
<tr>
<td>Sales price per unit $2.00</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>First Quarter</th>
<th>Second Quarter</th>
<th>Third Quarter</th>
<th>Fourth Quarter</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units produced</td>
<td>300,000</td>
<td>280,000</td>
<td>300,000</td>
<td>350,000</td>
<td>1,230,000</td>
</tr>
<tr>
<td>Units sold</td>
<td>300,000</td>
<td>300,000</td>
<td>280,000</td>
<td>270,000</td>
<td>1,150,000</td>
</tr>
<tr>
<td>Sales</td>
<td>$600,000</td>
<td>$600,000</td>
<td>$560,000</td>
<td>$540,000</td>
<td>$2,300,000</td>
</tr>
<tr>
<td>Standard differential cost of sales</td>
<td>345,000</td>
<td>345,000</td>
<td>322,000</td>
<td>310,500</td>
<td>1,322,500</td>
</tr>
<tr>
<td>Standard margin</td>
<td>$255,000</td>
<td>$255,000</td>
<td>$238,000</td>
<td>$229,500</td>
<td>$977,500</td>
</tr>
<tr>
<td>Variances*</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
<td>-0-</td>
</tr>
<tr>
<td>Actual margin</td>
<td>$255,000</td>
<td>$255,000</td>
<td>$238,000</td>
<td>$229,500</td>
<td>$977,500</td>
</tr>
<tr>
<td>Selling and administrative expenses</td>
<td>$90,000</td>
<td>$90,000</td>
<td>$90,000</td>
<td>$90,000</td>
<td>$360,000</td>
</tr>
<tr>
<td>Fixed factory expenses</td>
<td>105,000</td>
<td>105,000</td>
<td>105,000</td>
<td>105,000</td>
<td>420,000</td>
</tr>
<tr>
<td>Total</td>
<td>$195,000</td>
<td>$195,000</td>
<td>$195,000</td>
<td>$195,000</td>
<td>$780,000</td>
</tr>
<tr>
<td>Net profit</td>
<td>$60,000</td>
<td>$60,000</td>
<td>$43,000</td>
<td>$34,500</td>
<td>$197,500</td>
</tr>
</tbody>
</table>

*there were assumed to be no price or efficiency variances, and there is no idle capacity variance with this treatment of fixed factory overhead.

Figure 11. Differential cost approach to the income statement with varying units of production. (To be compared with Figure 4, page 81).

(Adapted from an unpublished paper presented by I. Wayne Keller, Assistant Controller of The Armstrong Cork Co., before the Midwest Cost Conference, National Association of Cost Accountants, Indianapolis, Indiana, April 4, 1952.)
production varied from this normal, some unused overhead cost (idle capacity variance) resulted which was thrown into the income statement and which distorted month to month comparisons. In Figure 11 the fixed portion of overhead cost has been eliminated from cost of units produced or sold and is carried directly to the income statement. This amounts to $105,000 every quarter whether any production takes place or not. The balance of the overhead cost is the variable, which behaves with respect to units produced in essentially the same manner as direct labor and material cost. If production takes place, the cost is incurred and taken into the inventory value; if no production occurs, neither does the cost and there is no problem of unused capacity. Since sales are the same in the first two quarters, net profit for the two periods is the same regardless of the fact that production in the second quarter had declined. With sales declining in the third and fourth quarters profits decline, even though production is on the increase. This is quite a different picture than that presented in Figure 4 covering the same data.

The proponents of this treatment of handling fixed overhead costs feel that they have theoretical justification for this approach. One writer says: "According to the marginal approach, fixed costs cannot be considered costs
of manufacturing units of product because of their nature; and, therefore, they should not be applied to these units. In the first place, there are the shut-down costs such as depreciation, certain taxes, rentals, certain insurance and salaries, etc., which will continue to be incurred if no production at all takes place. Therefore, if they are the costs of not producing goods, how can they logically also be called costs of producing goods when production actually does take place. These costs are not affected by any decision to resume production, and the assumption of the accountant that they are being 'converted' into the form of produced units, when he applies them to these units, is inconsistent and disregards the inherent nature of these costs. These shut-down costs and all other fixed costs accrue strictly on a time basis and the services purchased when these costs are incurred are being consumed with every passing second. Once this second has passed, the services consumed are irrevocably lost, whether or not the company has benefited therefrom.  

The proponents of this differential costing for the income statement make much of the fact that these fixed costs are time costs and attempt to justify the procedure accordingly. However it should be pointed out that the

---

procedure since it eliminates fixed costs from cost of production will result in greatly reduced inventory values in the balance sheet. Some writers have attempted to minimize this aspect of the plan, pointing to the effect which LIFO has already had upon inventory values. The point is not this so much as it is a question of the use which is to be made of the statements. More and more accountants are recognizing the fact that the way in which statements are prepared must depend to some extent upon the use which is to be made of them. This is the answer to the question of the effect of the differential approach to inventory valuation. The differential technique has merit from the standpoint of most managerial decisions, and the under-valuation of the inventory would probably be of little consequence from the managerial point of view. Adjustment would have to be made in considering the working capital position. However the value to be gained from the improved income statement for managerial purposes might outweigh the disadvantages. From the viewpoint of the stockholders, creditors and particularly the banker who may be extending short-term credit, a different report should probably be prepared which would give more careful consideration to inventory values. To the stockholder who essentially has a long-run point of view, spreading of total costs, including fixed, to all units of production
may be more advantageous. However it has been conceded from the outset that differential costs were a tool for management's use in viewing the short-run, and it is in this sense that the differential income statement is justified.

Further logic and advantages of the differential income statement can be seen where the statement is prepared comparatively by products. Figure 12 on the following page is illustrative. The only costs which are identified with products are the differential costs, those costs directly applicable to the particular products. They are the costs which would not have been incurred if the product had not been produced. The statement deducts these direct costs from the revenue which they produced, the remainder if any being that product's contribution to the coverage of fixed costs and a profit.

Chapter 4 outlined the difficulties which arise in attempting to allocate fixed costs to product and questioned the reliability of the results. Figure 12 merely eliminates all these difficulties and provides a statement which may be more meaningful. If the fixed costs in Figure 12 were allocated to products on some arbitrary basis, it is conceivable that product C might result in a loss since its differential margin of profit is lower than in the case of the other products. Whether or not this product would
<table>
<thead>
<tr>
<th>Description</th>
<th>Total</th>
<th>Product A</th>
<th>Product B</th>
<th>Product C</th>
<th>Product D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$600,000</td>
<td>$50,000</td>
<td>$200,000</td>
<td>$225,000</td>
<td>$125,000</td>
</tr>
</tbody>
</table>
| Differential cost of goods sold  
(material, direct labor and all other directly variable costs) | $345,000 | 24,500    | 98,000    | 157,500   | 65,000    |
| Contribution to the coverage of fixed costs                               | $255,000 | 25,500    | 102,000   | 67,500    | 60,000    |
| Rate of contribution based on sales                                        | 51%     | 51%       | 30%       | 48%       |
| Selling and Administrative expenses                                        | $90,000 |
| Fixed factory overhead                                                     | $105,000 |
| Total                                                                      | $195,000 |
| Net profit                                                                | $60,000  |

Figure 12. Comparative differential cost income statement by products.
result in a loss, and how much that loss would be, would depend entirely upon what arbitrary bases were chosen for making the allocations. Furthermore as was noted in Chapter 3, if the product is marketed competitively, some questions might be raised as to the usefulness of the profit or loss figure resulting from such a calculation. Since selling price cannot be adjusted, the most significant aspect about product C is that it is covering its out-of-pocket costs and providing $67,500 toward the coverage of the pool of fixed costs and profit. The greater the degree of monopoly which exists in marketing product C, the more value which may be found in the total cost allocation.

In using the differential income statement classified by products, management will undoubtedly develop some "rule-of-thumb" with respect to the ratio of differential margin of profit to sales for each product and in total. However assuming conditions of competition, there would be no control over this ratio; and management could not be assured a net profit merely by maintaining a particular ratio for given products. Net profit is the result of a pooling and cannot be provided by any one unit or product or product class.

In this discussion of the presentation of the differential income statement, one complicating factor has thus
far been ignored: what treatment is given to the semi-variable costs in this type of statement? In the preceding discussion, costs were simply referred to as variable or fixed--variable deducted directly from revenue by classes of sales, and fixed deducted below in total only. Where in all this are the semi-variable or semi-fixed costs, those which progress in a step-like fashion as volume increases?

It is these semi-variable costs which gave us difficulty in applying differential costs to special cost studies; and it is the semi-variable costs which present the difficulty now in applying differentials to the costing and reporting of total production and sales. If all costs could be classified as either strictly variable or strictly fixed, the situation would be greatly simplified. But unfortunately this is not the case. Quite to the contrary, over wide ranges of production many costs are semi-variable.

There appear to be several possible approaches to treatment of semi-variable costs when applied to the costing of total operations. One approach would treat them as entirely fixed, showing them in total only. Another approach would show them entirely as variable and deduct them as differential costs by revenue classes. A third possibility would be to show some of them as fixed and others as
variable, depending upon the degree of variability of each.

Most of the few writers who have discussed this subject think in terms of the first approach. They would treat as variable only those costs which are purely variable—those which vary directly in proportion to output at all levels of output. Semi-variable costs are classed as fixed, in fact no distinction is made between the two in the income statement. One writer, for example, says: "There is one more definition of semi-variable cost which is in use today. I refer to those costs which are subject to variation in steps at certain levels of production between zero and maximum for any individual plant. Such a representation may be accurate; but practically speaking the operations of a going concern do not vary over all possible levels of productive activity between the absolute minimum and the absolute maximum, especially within any one fiscal period. The executive and the accountant are generally concerned with the actual range of productivity expected and experienced. Within this range most semi-variable costs such as supervision and service department costs tend to be fixed. I admit that they are subject to variation when we consider all possible levels of productivity, but within those surroundings in which the executive and the accountant work and make their decisions—the actual range of productivity experienced—semi-variable costs act
Another author prepares a differential income statement in the exact manner of that in Figure 12 but shows a breakdown of the costs included in "fixed factory overhead." It includes "salaries, rents, wages (caretakers, et. cetera), rates, heating and lighting, accountancy charges, insurance, postage, miscellaneous, maintenance, and depreciation." Obviously, many semi-variable costs are included in this classification.

To include all semi-variable costs as fixed would be the most simple procedure. Particularly where production is complex and a variety of products are being manufactured, some difficulties may be encountered in identifying semi-variable costs with products. Consequently it would be the simple approach to exclude such costs from product costs and include them as fixed costs, in total only.

An accounting system designed to produce this type of information would likewise be less complex. Accounts for semi-variable costs would be kept on a departmental basis; but beyond this, no further disposition of the cost to products would be made. The directly variable costs would be allocated to product on a per-unit or per-pound, or per-direct-labor or per-machine-hour basis. Since these costs

1 Sapega, ibid., p. 19.
2 Lawrence & Humphreys, op. cit., p. 55.
are strictly variable no problems would arise in assigning
them to product, either on an actual, historical basis or
upon the basis of a standard or pre-determined rate.

The simplicity of operation of this plan is one of
the most important points in its favor. If there is no
need to identify semi-variable costs by products or in
terms of other plant activity, then certainly it should
not be done; and according to Mr. Sapega\(^1\), there is no need.
However a number of the executives interviewed expressed
a different opinion, and evidenced a desire for methods of
assigning the semi-variable costs to products.

A point in Mr. Sapega's discussion is probably the
clue to the difficulty here. He says that the reason that
semi-variable costs should be treated as purely fixed is
that, within reasonable expectations, there is little
fluctuation in levels of production, and accordingly
little change in the so-called semi-variable costs. It
has been observed earlier in this discussion that within
narrow ranges of volume fluctuations, there would be little
change in these costs.

It appears then that where a firm experienced little
fluctuation in productive volume, treatment of semi-variable
costs as purely fixed would be justified as well as practi­
cal. But differential costs have their greatest usefulness
\(^1\) *Cf. ante.*, p. 130.
in connection with problems of fluctuation volume; and as one executive stated, it doesn't take much change in volume before changes in semi-variable costs make themselves felt.

Referring to Figure 12, product B had a differential cost of $98,000. If this represented the sale of 49,000 units and if all of the costs are strictly variable costs, then each unit has a strictly variable cost of $2 per unit. Now if the firm never fluctuates only within very narrow limits, it may not be necessary to know anything further about B except the variable cost of $2 per unit. But if the production of product B should expand moderately, it is reasonable to expect that an added payroll clerk should have to be hired or an extra mechanic would be added to service machinery, or somewhere in the plant some semi-variable cost would step up.

Where such fluctuations in volume occur, it is clear that costs other than the strictly variable should be identified with products. It was seen earlier in this chapter that carefully prepared budgets of semi-variable costs will provide the information necessary to prepare special cost studies with respect to specific proposals affecting particular products. But how can semi-variable costs be identified with product as a regular accounting routine?
Assume that products A, B, C and D are all processed in one month in department M in a type of operation which can be measured in terms of direct labor hours. Assume further that the department can be operated up to 160 hours per month with one foreman at a cost of $400, but operation of between 160 and 320 hours requires two foremen at a cost of $800. When the general combined output of all products increases beyond the 160 hours, which product should be charged with the added $400 cost? If the total cost is divided by the hours expended on all products, it is clear that at the 161-hour level we would have one rate; while at the 320-hour level there would be an entirely different rate. If a predetermined or budgeted figure for foremanship cost per hour is to be determined, it is obvious that some assumption must be made as to level of output—probably "normal" capacity—and the difficulties growing out of this concept are well known.

The answer to this problem was suggested by a technique in the system which was being developed in one of the plants visited. The effect of the technique was to combine all of the semi-variable costs into one class—in effect average them together—so that when taken together they would no longer progress in a step-like fashion; but the steps would be smoothed out, and in total a purely variable cost would result. In other words if only one semi-variable
When a cost is considered, it presents the difficulty of a step-like progression; but when many semi-variable costs are totaled together, the steps will be smoothed out.

Figure 13, on the following page, shows budgeted amounts of individual semi-variable costs over a wide range of production. Individually they appear in the traditional step-like fashion. The unit prices of the individual semi-variable costs fluctuate widely as the output may change and the cost does not. For example, the semi-variable unit cost of cost A fluctuates from a low of 27 cents at one level to 40 cents at another level. The unit price of cost E is completely doubled at the 1,000 unit level as compared with the 2,000 unit level of output. However by totaling all of the semi-variable costs and taking an average at each level, the fluctuations in unit price are smoothed out. In the illustration the unit price fluctuates from $1.17 to $1.26; but by making certain refinements in the calculation, the average might remain even more constant. A greater number of semi-variable costs are probably found in most departments, bringing more numbers into the average; and the budgeted figures may be set up at closer intervals than was done in Figure 13. The average of the unit prices developed in Figure 13—approximately $1.20 per unit—would be a close approximation of the variability of all semi-variable costs combined.
<table>
<thead>
<tr>
<th>Semi-variable cost</th>
<th>Units (or Hours or some other base)</th>
<th>1,000</th>
<th>1,500</th>
<th>2,000</th>
<th>2,500</th>
<th>3,000</th>
<th>3,500</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>$</td>
<td>400</td>
<td>400</td>
<td>800</td>
<td>800</td>
<td>$1,200</td>
<td>$1,200</td>
</tr>
<tr>
<td>B</td>
<td>$</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>150</td>
<td>150</td>
<td>200</td>
</tr>
<tr>
<td>C</td>
<td>$</td>
<td>200</td>
<td>400</td>
<td>400</td>
<td>800</td>
<td>800</td>
<td>1,200</td>
</tr>
<tr>
<td>D</td>
<td>$</td>
<td>300</td>
<td>600</td>
<td>600</td>
<td>900</td>
<td>900</td>
<td>1,200</td>
</tr>
<tr>
<td>E</td>
<td>$</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>F</td>
<td>$</td>
<td>200</td>
<td>200</td>
<td>400</td>
<td>400</td>
<td>400</td>
<td>400</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$</td>
<td>$1,200</td>
<td>$1,750</td>
<td>$2,350</td>
<td>$3,150</td>
<td>$3,550</td>
<td>$4,300</td>
</tr>
<tr>
<td><strong>Total semi-variable unit cost</strong></td>
<td>$1.20</td>
<td>$1.17</td>
<td>$1.18</td>
<td>$1.26</td>
<td>$1.18</td>
<td>$1.23</td>
<td></td>
</tr>
</tbody>
</table>

Figure 13. Budgeted semi-variable costs at various output levels.
Another way of calculating an average semi-variable cost figure is by use of a scattergram. This technique is illustrated in Figure 14 on the following page. The total costs, exclusive of raw materials, of operating a department are plotted graphically as represented by the dots on the chart. Then by the statistical method of least squares, a line is plotted which is in effect the average of the points representing total cost. This line--AB in Figure 14--is projected to the Y axis. The point at which it meets the Y axis would represent the purely fixed or shut-down costs of the firm. In other words in Figure 11 if units produced are zero, the total cost line stands at $2,000. This would then represent the fixed cost of the firm. By subtracting the fixed costs, so-determined, from the total cost at each output level, the balance would represent the variable and semi-variable costs.

At this point, two procedures are available. The strictly variable costs such as direct labor could now be subtracted. This would leave a balance representing only the semi-variable cost. Figure 15, on page 139, illustrates how this might be done. First, the AD line is drawn horizontally from the Y axis at the point at which it is bisected by the total cost line, AB. This area below line AD represents the fixed cost of the firm. Next, the purely variable cost is plotted above the fixed
Figure 14. Scattergram used to determine rate of variability of semi-variable costs.
Figure 15. Plotting fixed and variable costs in order to calculate semi-variable costs.
cost line. This was assumed to be 25¢ per unit in Figure 15, and the total of this variable cost above the fixed is represented by line AC. Now the remaining difference in the area BAC represents the combined semi-variable cost at any given level of output. This difference can now be measured and resolved in terms of cost per unit for purposes of further accounting application.

An alternative approach might be used, provided that direct labor hours are used as a basis for measuring activity in the department. Since cost of direct labor is measured in terms of hours, if other variable and semi-variable costs can also be measured in terms of hours there would be no particular need for separating the two; and one total expense rate could be developed to include both variable and semi-variable expenses. In this case the X axis on the scattergram would be stated in terms of direct labor hours, and the total costs plotted would be for the various activity levels in terms of direct labor hours. The fixed cost line would be projected in the same manner; and the remaining area would represent the total variable and semi-variable cost, all in terms of direct labor hours. This total can then be measured and resolved into terms of cost per direct labor hour.

All of this is designed to provide a rate which will represent the average cost of the combined semi-variable
expenses at any and all volume levels. This averaging technique seems justified, particularly where we are thinking in terms of fairly important changes in volume. Under such circumstances, semi-variable costs become fundamentally variable; and the average is the only practical means for handling them.

It should be emphasized that this average semi-variable cost rate does not repeat the errors of the average factory overhead figure which caused so much difficulty. In order to calculate the factory overhead rate (which included fixed as well as semi-variable) some volume level had to be assumed—usually normal capacity. Then the rate had little validity for other volume levels and led to the many other difficulties outlined in Chapter 4.

The average semi-variable cost rate is not thus dependent upon a volume assumption. It is valid at every volume level if the average has been worked out carefully. Thus in Figure 10, the average is approximately $1.20 per unit of product, and this may be applied at any volume level.

The use of the concept is limited to the framework of the assumptions upon which it is based. For example if one unit of output is added in a department, semi-variable costs will not necessarily go up by $1.26; but if 500 units are added, semi-variable cost will tend to
go up by approximately $600 (500 x $1.20). This is an average, and some fluctuation may be expected. Furthermore, not all semi-variable costs can be expected to increase; but while some increase and others remain constant, the average fluctuation will amount to $600.

In summary then, in preparing a differential type of income statement (Figure 12), semi-variable costs may all be classified as fixed. This would be the more simple approach and is justified if only very minor fluctuations in volume occur. Where more noticeable changes in volume are common, the changes in the semi-variable costs become of greater importance and should be included in differential cost. This may be done on the basis of an average rate per unit (hour, etc.) for all semi-variable costs within a department.

Most of the preceding discussion of an average semi-variable rate was in terms of budgeted figures and costs. It should be pointed out that the technique has equal applicability in the treatment of actual historical semi-variable costs. Actual semi-variable costs may be totaled at the end of the period and divided by units produced in order to arrive at the average semi-variable cost per unit (hour, etc.). This rate may then be applied to production to arrive at a differential cost of goods manufactured for purposes of inventory valuation and differential cost of
sales for purposes of the income statement.

Although the technique may be used in historical cost determinations, its real value lies in the determination of standards, budgeting and planning. By carefully budgeting each semi-variable cost in accordance with the methods outlined earlier in this chapter, the scattergram can then be prepared upon the basis of budgeted figures; and the semi-variable rate per unit (hour, etc.) becomes a standard rate. This standard rate would have two distinct advantages and uses. First, it can be applied to production to arrive at standard differential cost of sales which can then be compared with actual costs, and variances may be investigated. Secondly, the rate may be used as a quick means of providing management with cost estimates for particular proposals regarding expansion or contraction of volume.

Earlier in this chapter, there was a discussion of the use of detailed budgets of semi-variable costs for purposes of special differential cost studies. Now, by computing average semi-variable departmental expense rates, it is possible to provide a quick means of arriving at a rough approximation of the differential cost of particular proposals. Thus if the average semi-variable expense rate in a particular department is $1.20 per hour and it is proposed to operate the department an added 1000 hours,
it would be safe to estimate that the differential semi-variable cost of the proposal would be $1,200. Reference to specific budgets for each of the semi-variable costs within the department might disclose that the figure should be slightly more or slightly less, but the average rate will suffice as a quick, handy guide to proposed actions.

The following example will further illustrate the use of standard variable expense rates in special cost studies. Assume that a firm produces five products, identified as A, B, C, D and E. These products are manufactured in one process (department) in which all activity can be measured in terms of direct labor hours. Standards for the five products have been established as shown in Figure 16. Since all of the activity in the department can be measured in terms of direct labor hours, all variable, semi-variable and direct labor costs are combined into one rate ($3) per direct labor hour, as discussed on page 140.

Proposed increases or decreases in production of any units can readily be calculated in terms of differential cost and compared with differential revenue. Assume that present selling prices and volume are as follows:
<table>
<thead>
<tr>
<th>Product</th>
<th>Present Unit Selling Price</th>
<th>Present Volume (Units)</th>
<th>Present Total Sales Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$35</td>
<td>5,000</td>
<td>$175,000</td>
</tr>
<tr>
<td>B</td>
<td>$29</td>
<td>8,000</td>
<td>232,000</td>
</tr>
<tr>
<td>C</td>
<td>$20</td>
<td>6,000</td>
<td>120,000</td>
</tr>
<tr>
<td>D</td>
<td>$30</td>
<td>5,000</td>
<td>150,000</td>
</tr>
<tr>
<td>E</td>
<td>$19</td>
<td>3,000</td>
<td>57,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>$734,000</strong></td>
</tr>
</tbody>
</table>

Proposal #1. It is now proposed to reduce the selling price of product A in order to secure an increase in volume. Careful market surveys indicate that if the unit selling price of product A were reduced to $32 per unit, a total of 7,000 units could be sold. The Controller is asked to prepare a report on the profitableness of this proposal.

Differential revenue:

- Proposed revenue (7,000 units @ $32) $224,000
- Present revenue (5,000 units @ $35) 175,000

Differential revenue $49,000

Differential cost: 2,000 units @ $23 46,000

Differential profit resulting from the proposal $3,000

Proposal #2. It is noted that the above proposal would involve added production of 2,000 units; and since each unit of A requires 6 hours of productive time, the total proposal would require an additional 12,000 hours. Assume that the
<table>
<thead>
<tr>
<th>Standard Cost Per Unit of Measure</th>
<th>Products</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material</td>
<td></td>
<td>5</td>
<td>7</td>
<td>8</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Variable and semi-variable expense</td>
<td>Hour</td>
<td>6</td>
<td>4</td>
<td>2</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

Figure 16. Standard Differential Costs By Units of Product.
plant is already producing at top capacity, and in order to increase production of A, a decrease must be made in the production of some other units. Figure 17 shows the calculation of the effect of a reduction of 12,000 hours in each of the other four products produced. It is clear from this calculation that a reduction of 12,000 hours in the production of any of these four products would result in a greater decrease in differential profit than the increase which would result from the added units of Product A. The smallest reduction in total differential profit would occur in product D; but even in this case, the firm would lose $4,500 of differential profit and gain only $3,000. Accordingly the proposal for an increase in the production of product A should be abandoned.

Proposal #3. Another type of proposal might involve the abandonment of one product line and replacement by another product line. Under present circumstances the various products are contributing to the coverage of fixed costs as shown in column 6 of Figure 18.

From this it is apparent that products D and E are making the smallest contribution toward coverage of the firm's fixed costs--namely $15,000. However, the contribution of product D is only $3 per unit while product E is $5 per unit. Since product D requires eight direct labor hours per unit, a total of 40,000 direct labor hours
<table>
<thead>
<tr>
<th>Product</th>
<th>Standard Hours Per Unit</th>
<th>Units Produced In 12,000 Hours</th>
<th>Unit Selling Price</th>
<th>Unit Differential Cost</th>
<th>Differential Profit Per Unit Col.3-Col.4</th>
<th>Decrease In Total Differential Profit Col.2 x Col.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>4</td>
<td>3,000</td>
<td>$29</td>
<td>$19</td>
<td>$10</td>
<td>$30,000</td>
</tr>
<tr>
<td>C</td>
<td>2</td>
<td>6,000</td>
<td>20</td>
<td>14</td>
<td>6</td>
<td>36,000</td>
</tr>
<tr>
<td>D</td>
<td>8</td>
<td>1,500</td>
<td>30</td>
<td>27</td>
<td>3</td>
<td>4,500</td>
</tr>
<tr>
<td>E</td>
<td>4</td>
<td>3,000</td>
<td>19</td>
<td>14</td>
<td>5</td>
<td>15,000</td>
</tr>
</tbody>
</table>

Figure 17. Calculation of the effect upon differential profit of a decrease of 12,000 hours in the production of each of four products.
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Unit Selling Price</td>
<td>Initial Standard Differential Cost</td>
<td>Present Volume</td>
<td>Present Total Sales Revenue (1x3)</td>
<td>Present Total Differential Cost (2x3)</td>
<td>Total Differential Profit (4-5)</td>
<td>Unit Differential Profit (1-2)</td>
</tr>
<tr>
<td>A</td>
<td>$35</td>
<td>$23</td>
<td>5,000</td>
<td>$175,000</td>
<td>$115,000</td>
<td>$60,000</td>
<td>$12</td>
</tr>
<tr>
<td>B</td>
<td>29</td>
<td>19</td>
<td>8,000</td>
<td>232,000</td>
<td>152,000</td>
<td>80,000</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>20</td>
<td>14</td>
<td>6,000</td>
<td>120,000</td>
<td>84,000</td>
<td>36,000</td>
<td>6</td>
</tr>
<tr>
<td>D</td>
<td>30</td>
<td>27</td>
<td>5,000</td>
<td>150,000</td>
<td>135,000</td>
<td>15,000</td>
<td>3</td>
</tr>
<tr>
<td>E</td>
<td>19</td>
<td>14</td>
<td>3,000</td>
<td>57,000</td>
<td>42,000</td>
<td>15,000</td>
<td>5</td>
</tr>
</tbody>
</table>

Figure 18. Calculation of contribution to coverage of firms fixed costs (differential profit).
are devoted to its production (8 hrs. x 5,000 units). E requires only four hours per unit or a total of 12,000 direct labor hours (4 hrs. x 3,000 units).

Accordingly it is proposed that product X be substituted for product D. A careful market survey is conducted, and it is determined that a maximum of 15,000 units of X can be sold at a selling price of $28 each. Engineering estimates determine that the standard cost of producing a unit of X would be as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material, 20 lbs. @ $1</td>
<td>$20</td>
</tr>
<tr>
<td>Variable and semi-variable expense, 2 hrs. @ $3</td>
<td>$6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$26</strong></td>
</tr>
</tbody>
</table>

This provides a differential profit of only $2 per unit—$1 less per unit than was provided by product D. However since 15,000 units of X can be sold, total differential profit will amount to $30,000 (15,000 units x $2). Since production and sale of product D is providing differential profit of only $15,000, it would be beneficial to discontinue product D and adopt product X.

Furthermore the discontinuance of product D will release 40,000 direct labor hours, while product X, requiring only two hours per unit, will utilize only 30,000 direct labor hours, leaving 10,000 hours of capacity available for other uses.

There is one further aspect about the scattergram
technique described earlier. The total cost lines in the scattergrams in Figure 14 and 15 were represented as straight lines, whereas it was pointed out earlier that economists conceive of the total cost line as curved (Figure 7). This raises a question as to whether or not, in preparing the scattergram, a curve might not result from the joining of the plotted total cost points, due to the principle of non-proportional returns. This question was raised with the controller in the only firm found to be using this scattergram technique. He was plotting actual, historical, total costs; and his experience to date had been limited to a rather narrow range of volume. Therefore he had attempted only the plotting of a straight line. Statistical techniques are available, however, to test a series of data to see whether it is best fitted for a curve or a straight line. If the plotted points conform best to a curve, further statistical techniques are available to describe this curve mathematically. This in effect would give us a semi-variable expense rate which would not be absolutely constant, but which would increase in rate when the point was reached where inefficiencies develop.


2 Ibid, Chapters 15 and 16.
Chapter 6

Non-manufacturing Uses of Differential Cost Accounting

The discussion in the preceding chapters was chiefly confined to the manufacturing enterprise. While the differential cost approach is of great value in this area of costing, it is of equal value in other areas of business and commercial activities. Several of the more important of the non-manufacturing uses will be discussed in order to demonstrate the wide applicability of the differential cost technique. Lawrence and Humphreys say: "The benefits of marginal costing, however, can be enjoyed by any commercial enterprise, by the wholesaler and even by the retailer, and are as necessary to them as to the manufacturer."

The differential technique can be of great assistance in the field of distribution cost accounting. In discussions of distribution costing, it is usually observed that this field has not had the attention that has been given manufacturing costs. This was well supported by the companies visited in this study. Very few of the companies in the group had pursued distribution costing to any great extent. One company had a rather complete system of distribution costing; several others had a knowledge of major items of distribution costs, while others had done practically no work in this area.

1 Lawrence & Humphreys, op. cit., p. 9.
There are undoubtedly a number of factors which have contributed to the reluctance of cost accountants to develop this field. It is well recognized as an important area for cost analysis and control, but it is also recognized that it is a complex field of accounting. In manufacturing cost accounting, there is usually one final objective—costs by units of product. It is true that costs are accumulated by object and by departments, and that cost control is affected on this basis. However it is also true that departmental costs are an intermediary step toward the final objective of product costs. In distribution costing however, there may be many cost objectives. Distribution costs by products may be one objective, costs by territories may be another, costs by salesmen, costs by order size, costs by channels of distribution, costs by customers or classes of customers—all of these may be the objective of a distribution cost accounting system. Each objective requires separate study and cost procedures.

In addition to these complexities, there is the fact that selling and administrative expenses include a large fixed element. A failure to understand the nature of fixed costs and unrefined accounting techniques for handling them may be factors which have retarded the development of distribution cost accounting.

Although some cost accountants have recognized the
advantage of differentials in distribution costing, the usual approach is a total cost approach. That is in any cost allocation, all costs are allocated, fixed, semi-variable and variable.

First, selling and administrative expenses are classified by functions such as warehousing, sales promotion, direct selling, travel expenses, order filling, delivery, credit and collection, and billing and accounts receivable. These functions, for accounting purposes, correspond roughly to the departmental classifications used in manufacturing cost accounting. Such classifications are absolutely necessary in order to establish the cost of functions or services being performed. In manufacturing accounting, these service costs are then distributed to the products benefited or the territories benefited or the customer class benefited or to whatever the objective of the classification may be. Essentially then, manufacturing cost accounting and distribution cost accounting are fundamentally alike.

In classifying costs by functions as when classifying them by departments, some functional costs are variable, some semi-variable and others are fixed. The importance of this mixed nature of functional costs has been overlooked in distribution cost accounting. In many instances the entire functional cost has been treated as though it
were variable. In other words, the same difficulties are found here as were found in manufacturing accounting, where departmental overhead rates were developed including variable, semi-variable and fixed factory overhead.

Figure 19, on the following page, is typical of the way in which functional costs are allocated in distribution cost analyses. The warehousing and packaging function for example would include some purely variable costs, such as packing containers and supplies. It would include some semi-variable costs such as workmen's salaries. It would include some fixed or sunk costs such as building depreciation, taxes and insurance. Nevertheless this cost is stated as $.03 per unit handled and allocated to territories accordingly.

The final result of this procedure is to carry all fixed costs of the firm to the three territories on some arbitrary base. When no better base is available, costs are prorated on the basis of the value of sales in each territory, as in the case of administrative expenses.

In regard to such cost techniques, Carl Devine has said: "While the need for distribution cost control is unquestioned, some accountants have undoubtedly become over-enthusiastic about the possibilities of such procedures. Does the fact that the New England Division operates at a loss mean that the division should be
<table>
<thead>
<tr>
<th>Cost</th>
<th>Basis of cost distribution</th>
<th>Unit of distribution</th>
<th>Number</th>
<th>Cost</th>
<th>Total Cost</th>
<th>West Virginia Units</th>
<th>Cost</th>
<th>Virginia Units</th>
<th>Cost</th>
<th>Maryland Units</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warehousing and packaging</td>
<td></td>
<td>Hundred weight</td>
<td>102,000</td>
<td>$0.03</td>
<td>$3,060</td>
<td>40,000</td>
<td>$1,200</td>
<td>36,000</td>
<td>$1,080</td>
<td>26,000</td>
<td>$2,780</td>
</tr>
<tr>
<td>Sales salaries</td>
<td></td>
<td>Number of calls</td>
<td>4,000</td>
<td>2.00</td>
<td>8,000</td>
<td>1,800</td>
<td>3,600</td>
<td>1,200</td>
<td>2,400</td>
<td>1,000</td>
<td>2,000</td>
</tr>
<tr>
<td>Salesmen's traveling</td>
<td></td>
<td>Miles</td>
<td>50,000</td>
<td>0.06</td>
<td>3,000</td>
<td>20,000</td>
<td>1,200</td>
<td>15,000</td>
<td>900</td>
<td>15,000</td>
<td>900</td>
</tr>
<tr>
<td>Sales office expense</td>
<td></td>
<td>Number of calls</td>
<td>4,000</td>
<td>0.20</td>
<td>800</td>
<td>1,800</td>
<td>360</td>
<td>1,200</td>
<td>240</td>
<td>1,000</td>
<td>200</td>
</tr>
<tr>
<td>Direct mail advertising</td>
<td></td>
<td>Units mailed</td>
<td>40,000</td>
<td>0.15</td>
<td>6,000</td>
<td>15,000</td>
<td>2,250</td>
<td>15,000</td>
<td>2,250</td>
<td>10,000</td>
<td>1,500</td>
</tr>
<tr>
<td>Invoicing and billing</td>
<td></td>
<td>Lines invoiced</td>
<td>15,000</td>
<td>0.02</td>
<td>300</td>
<td>6,000</td>
<td>120</td>
<td>5,000</td>
<td>100</td>
<td>4,000</td>
<td>80</td>
</tr>
<tr>
<td>Collection</td>
<td></td>
<td>Remittances handled</td>
<td>2,000</td>
<td>0.05</td>
<td>100</td>
<td>1,000</td>
<td>50</td>
<td>700</td>
<td>35</td>
<td>300</td>
<td>15</td>
</tr>
<tr>
<td>General administration</td>
<td></td>
<td>Sales</td>
<td></td>
<td></td>
<td>3,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total selling and administrative expense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>$24,260</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 19. Allocation of total distribution and administrative expense to territories

(Adapted from Devine, Cost Accounting & Analysis, p. 544. New York: Macmillan Company, 1950.)
abandoned? If product A exhibits chronic losses, should the product be discontinued? Does the apportionment of central warehousing costs to sales territories aid in the control of such costs? In each case the answer is certainly in the negative. In view of these obvious limitations, it is not surprising that many businessmen, economists, and accountants have been discouraged with the results of systems which call for intricate assignments of fixed costs. New tools must be forged and added to those already in existence.  

An elaboration of the need for new tools can be drawn from Figure 19. Assume that sales in Virginia amounted to $30,000 and that total cost of sales in this territory amounted to $23,000. This would provide a gross profit of $7,000 and a net loss of $1,005 in this territory after deducting the distribution and administrative expenses of $8,005. Just what is the significance of the $1,005 loss? In the first place, since some of the bases for allocating costs to this territory were purely arbitrary, the final figure is arbitrary. Furthermore does the loss figure indicate that this territory should be dropped? Here again the answer is not found in this total cost allocation. The question is one of differential costs. If the revenue from the Virginia territory is sufficient

to cover the differential costs applicable to that territory, then it is contributing something toward the coverage of the firm's pool of fixed costs and profit. But this vital information is not revealed by the type of cost calculation shown in Figure 19.

The differential approach would assign to territories (or whatever cost analysis is being made) only the direct costs incurred in connection with that territory, or stating it differently—those costs which would not be incurred if the territory were discontinued. Such a treatment of distribution costs, along with the differential treatment of manufacturing costs, would result in the type of statement shown in Figure 20 on the following page.

The accounting for and calculation of differential costs of distribution will follow essentially the same procedures as differential cost accounting for manufacturing. Cost accounts would be set up for each variable cost for each function, just as was done by departments for manufacturing costs. Fixed costs would be excluded from functional classifications. The same problem would be faced here with semi-variable costs as was found in manufacturing, and the same alternative treatments are available. All semi-variable costs might be included with the fixed. This is the simple procedure and would find justification
Income Statement for the month ended

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Territory #1</th>
<th>Territory #2</th>
<th>Territory #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales</td>
<td>$100,000</td>
<td>$50,000</td>
<td>$30,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>Differential cost of sales</td>
<td>$40,000</td>
<td>$21,000</td>
<td>$11,000</td>
<td>$8,000</td>
</tr>
<tr>
<td>Production margin</td>
<td>$60,000</td>
<td>$29,000</td>
<td>$19,000</td>
<td>$12,000</td>
</tr>
<tr>
<td>Differential cost of distribution</td>
<td>$16,000</td>
<td>$6,000</td>
<td>$6,000</td>
<td>$4,000</td>
</tr>
<tr>
<td>Selling margin</td>
<td>$44,000</td>
<td>$23,000</td>
<td>$13,000</td>
<td>$8,000</td>
</tr>
</tbody>
</table>

Fixed expenses

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed factory expenses</td>
<td>$20,000</td>
</tr>
<tr>
<td>Fixed selling expenses</td>
<td>$10,000</td>
</tr>
<tr>
<td>Fixed administrative expenses</td>
<td>$8,000</td>
</tr>
<tr>
<td>Total fixed expenses</td>
<td>$38,000</td>
</tr>
</tbody>
</table>

Net profit $6,000

Figure 20. Income statement prepared to show differential cost of sales and differential distribution costs.
where volume changes are slight. Where wider fluctuations in volume occur, a semi-variable expense rate should be developed in accordance with the techniques outlined in Chapter 5. The variable expenses and the semi-variable expenses, stated as a rate per unit of functional service performed, would serve as a basis for the determination of the variable cost of the function by products, territories, customers, etc.

Although cost accounting textbooks have discussed standards for distribution costs, there seems to be little evidence of the practical applications of distribution standards in practice. Such standards as have been developed in textbooks have been based upon total cost. Since total cost includes the fixed, some assumption must be made with respect to volume level—usually "normal" capacity. Thus in the illustration used in Figure 19, Devine develops a standard cost figure of $.03 per unit for warehousing and packaging costs by assuming that 102,000 units is normal capacity and that $3,060 is the standard cost for that capacity. The difficulty to which such reasoning leads was fully developed in Chapter 4 and will not be re-stated again. On the other hand, unit standard rates developed for variable and semi-variable distribution

1 There is no formal evidence to be cited in support of this contention, but it is based upon impressions received in the companies visited in connection with this study as well as in other companies with which the author is familiar.
costs are not only theoretically justified, but they would be useful for control purposes.

Another excellent example of the use of the differential cost technique is found in the case of department store accounting. In fact differential costs have probably received more attention in this area than in either manufacturing or distribution cost accounting. The primary objective of cost allocations in a department store is to arrive at costs by departments. Prior to 1934, these cost allocations had been total costs. In other words, included in the cost of a particular department was not only the direct costs incurred by that department, but a full share of such store-wide fixed costs as rent or building depreciation, executive salaries, insurance, taxes, etc. In one department store visited, where this type of plan was still in use, they had arbitrarily determined that 26% of the total "building occupancy" cost should be allocated to first floor departments (it was a six-story building). This cost was then further sub-divided between the first floor departments on the basis of the relative floor space occupied by each.

The Standard Expense Accounting Manual for Department Stores and Specialty Stores says: "...the Net Profit Plan ¹ Referred to by the industry as the "Net Profit Plan" since it arrives at a net profit for each department.
charges them (departments) with expense, over which they have no direct control and by methods of distribution which are not always true measures of departmental participation or benefit." An example is cited to show the inequities which may develop where executives' salaries are allocated to departments on the basis of sales volume: "two departments have been doing $100,000 a year volume. It seems entirely fair that each should have an equal amount of the indirect expense. However, one year, one department begins to slip in sales volume. The general manager, publicity man, merchandise manager, buyer, controller—all give a tremendous amount of time and thought to the department, but still its volume moves down to $50,000. The other department increases its volume to $150,000 without anyone paying much attention to it. At the end of the year, this department has prorated three times as much expenses as the $50,000 department, in spite of the fact that more time and expense went into the management of the $50,000 department."

Because of these disadvantages of the "Net Profit Plan", Mr. Carlos B. Clark of the J. L. Hudson Company, Detroit, in 1934 introduced what he called the "Contribution


2 Controllers' Congress, ibid, p. 127.
Plan" for accounting for departmental operations. Un- doubtedly this plan was original with Mr. Clark, illustrating once again that persons in all walks of life do think fundamentally in terms of margins, for this is merely the differential cost approach by another name.

The "Contribution Plan" identifies with departments only those costs which are incurred directly as a result of operating that department. These are the costs which would not be incurred if the department were discontinued: clerical salaries, wrapping and other supplies, advertising and publicity for the department, etc. When these costs are deducted from the sales of the department, the difference represents that department's "contribution" to the coverage of the fixed overhead costs of the store and the provision of a net profit. Just as it was observed previously that no one unit ever made a profit, here it might be observed that no one department in a department store ever made a profit. All that a department can do is cover its direct costs and contribute something to the "pool" from which a net profit may emerge.

There is hardly a commercial enterprise where the differential cost technique would not be of value and importance. Another example of its use is in the contracting business,

or any other business in which revenue is secured by means of sealed bids.

In submitting such bids, a contractor may figure a total cost of the proposed job—that is, one which includes an allocation of all fixed costs such as equipment depreciation, executive and administrative salaries, etc. On the other hand, he knows that if he has productive facilities standing idle he will be wise to accept the job for something less than total cost. He may not calculate the figure and label it as such, but somewhere in his thinking he must realize that differential cost must constitute the lower limit below which his bid must not fall. Any bid above differential cost will provide something toward the coverage of fixed costs which would not otherwise have been provided.

The upper limit of the bid will be determined largely by what the contractor thinks his competitor will bid, and some knowledge of this may be gained by attempting to determine the competitor's costs. Mr. Howard Greer discussed the possibilities of estimating a competitor's costs and indicated that this technique had real practicability. If a contractor were aware of his own differential and total cost and had a good notion as to his competitor's differential and total costs, he would be in the most

1 Greer, *cf. ante.*, p. 35 (footnote).
favorable position to submit a bid. Undoubtedly many contractors have this information in mind, even if it is not formalized by use of specific terminology and resolved into written calculations. Cost accountants can render a real service to management in all lines of business by resolving these concepts into formalized calculations and reports.

The discussion of differential costing should not be concluded without raising a question as to the effects of this technique upon the calculation of net income for purposes of federal income taxation. In a manufacturing concern if all fixed costs are carried directly to the income statement rather than included in inventory values, it is obvious that inventory values are reduced and reported net profits are altered accordingly. Whether this method of reporting profits will be accepted by the Commissioner of Internal Revenue for tax purposes is doubtful. The assistant controller of one firm, which is in the process of installing a differential cost system, writes that the company's tax advisors are working on the matter of whether or not to ask for the Commissioner's acceptance of the plan, but so far no decision has been reached.  

Although the eventual outcome of this matter cannot
be predicted, certain observations can be made with respect to the tax aspects of differential costing.

First, even if differential cost valuation of inventories is not acceptable for income tax purposes, there is no reason why the differential approach cannot be used for internal reporting purposes and separate inventory valuations calculated for tax purposes. The executive referred to above says in this regard: "We feel that the advantages of direct costing for internal purposes are such that we will definitely use it internally even though we will make separate calculations for tax purposes. If we do make these separate calculations, we will also use the figures for the valuation of inventory in our published financial statements. We feel that this could be done with a minimum of extra effort and would provide us with most of the advantages of direct costing. However, our preference is to go the whole way; and we hope that our tax advisors and public accountants will be able to work out acceptable procedures for doing this."¹

It is further observed that while the differential costing of manufacturing inventories might reduce reported income in the first year that a company adopted the plan, thereafter there would be no effect upon reported income if inventories and costs remained the same in each taxable year. But usually they do change, and changes in costs...

¹ Ibid., Private letter to author, dated July 7, 1952.
and inventories would have the effect of shifting some expense from one taxable year to another and reported net profit might thus be reduced in one year; but it would be offset by a corresponding increase in the following year. An example will illustrate this. Assume that inventories are unusually large at the close of a particular year. Under present methods of accounting a portion of the firm's fixed costs would be carried forward as a part of this inventory value. If the inventory were priced at only the differential cost, all of the fixed factory overhead would be charged against income and net profits reduced accordingly. In the following year however, the situation would be reversed. Under present accounting methods the higher opening inventory value in the second year would have the effect of reducing profits in this year, as opposed to the differential plan where the reduced value of the opening inventory would cause the net profit to be greater. Thus the use of the differential plan might shift profits from one year to another but in offsetting amounts.

In the first year of adoption of the differential cost plan, the reported net profit would be reduced because of the decreased value placed upon the closing inventory. Even the effect of this might be offset by re-valuing the opening inventory in the first year so as to exclude the fixed factory overhead. If the amount of the
reduction in the opening inventory corresponded with the amount of the reduction in the ending inventory, there would be no change in net profit even in the first year, but a charge would have to be made against retained income for the decrease in the value of the opening inventory.

There is one further observation. The Internal Revenue Code and the Regulations are not entirely clear on the treatment of a firm's overhead costs with respect to inventories. The Commissioner has always accepted inventory values which include a proper allocation of overhead costs such as depreciation, taxes, rent, etc. On the other hand, Section 23 of the Code provides for the deduction of certain expenses—rent, depreciation, taxes, etc.—and specifically states that these should be deducted in the year in which incurred. It would appear, therefore, that with respect to those items of fixed factory overhead which are listed in Section 23, full deduction could be made in the year in which incurred. This would provide at least a partial differential costing of inventories.

One of the most important factors stressed in the Regulations is that the method used for valuation of inventories should be consistent from year to year. This fact, along with the fact that the differential plan would not greatly alter reported net profits, would lead to the hope that the Commissioner would grant permission to use
differential costs for inventory values. At the very least, it would be hoped that new companies could start off with it.
Conclusions

Many techniques developed in the past several decades for accounting for fixed costs have been unrealistic from the standpoint of planning, budgeting and control of a business enterprise. They are unrealistic because they combine fixed and variable costs in one category and then treat the whole as essentially variable. They are unrealistic because they develop cost information in a manner which does not always conform to the way in which management thinks.

Spreading of fixed costs to products, territories and other classifications may have value from a historical viewpoint as an indication of the long range recovery of total cost. But executives who are confronted with keen competition, and thus have no control over their selling price, tend to think in terms of differential costs; and many of the present techniques of accounting for fixed costs do not provide such information. In the past, many methods of accounting were oriented to a long run viewpoint, whereas many managerial problems require short run analysis. It was found that firms in the more competitive industries were turning to differential costs as one factor in the solution of short run managerial problems.

Cost accounting, for the short run, should recognize
from the very outset the basic distinction between variable costs and fixed costs. All ensuing cost accounting techniques should be built around this fundamental distinction. So-called semi-variable costs may be treated as either variable or fixed depending upon the degree of volume fluctuations experienced.

A system of differential cost accounting is based upon this fundamental distinction between fixed and variable costs; it conforms with management's concept of costs and profits, and is founded upon fundamental concepts of economics.
Ten industrial and commercial firms throughout Ohio were visited during the course of this study. In these visits, discussions were held with controllers, treasurers, cost accountants and other company officials regarding many accounting matters, but regarding differential costs in particular. Three of the firms were chosen because it was known that they were interested in differential costs; the others were chosen in an effort to have some diversification and on the basis of the cooperation which was extended.

In each firm an attempt was made to gain some understanding of the products and productive operations. In many firms extensive tours were made through the plant. In the three firms which had done some work with differential costs, their accounting methods were studied in more detail; and many observations made in these companies were incorporated in Chapter 5. In all firms differential costing was discussed and reactions to this technique were studied.

Special attention was given to the way in which cost accounting information was being used by the various firms—its role in managerial policy determination and its relation to price determination. An effort was made in each instance to gain an understanding of the extent of
competition which existed in the various companies. This was integrated with the price determination policies of the companies in an effort to understand the role of differential costs in price setting. Much of this material became the basis for Chapter 3.

Since much of the information obtained from these plant visits was incorporated in this dissertation, a brief abstract is presented herewith of the main points observed in each firm. Since much of the information was of a highly confidential nature, none of the firms will be identified.

In addition to the firms visited, a wealth of information was obtained from visits with Mr. Howard C. Greer, from his lectures in Accounting 860, Accounting Aspects of Business Policy Determination at The Ohio State University, and from his writings. Also from Mr. Greer were obtained numerous illustrations of the application of differential costs, examples of the way in which management uses cost information, and ideas on the way in which prices are determined.
Company A

This company is located in a town of about 20,000 population and employs between 500 and 600 people in the manufacture of a coordinated line of small household products. The products are very high quality; and by the admission of one company executive, very little competition exists. The product is marketed through higher class department stores, hardware stores and mail-order houses. Since there is no competing line, the product appears on store shelves alone.

The executives interviewed in this company had no knowledge of differential costing and were reluctant to see much value in this approach. They had no regular cost accounting system but semi-annually made a cost analysis by products. The sole purpose of this analysis was to provide a means of price setting; and as such, it appeared imperative that a full allocation of all fixed costs be made to products. The lack of competition for this company's products was attributed largely to the careful selling prices which were worked out on the basis of total cost calculations.
Company B

This company is located in a northern Ohio city and employs about 350 people in the manufacture of toothbrushes. There are only three major manufacturers of toothbrushes in the country, but competition is keen among these. Each manufactures a number of toothbrushes in various price ranges, and usually they are marketed in drugstores where the toothbrushes of each manufacturer are displayed side by side. There is just about one toothbrush per person sold annually in the United States, and efforts to increase this ratio have so far been unsuccessful. Competition is entirely for a share in the existing market.

The executives of this firm were keenly aware of the fact that they had little control over selling prices. When a new style toothbrush was developed, a trial selling price was stipulated; but several adjustments would usually be made before a relatively permanent selling price could be found. Either the selling price would be altered or the quality of the brush changed in order to meet competition.

The executive who was interviewed in this company had a real appreciation for differential costing, although he had not worked out all of the details of a complete differential cost system. The regular costing of units of production was in terms of total cost on a process basis.
However this executive had established a very complete budgetary system of variable and semi-variable costs for each department in the plant. Each semi-variable cost for each department was budgeted in terms of volume levels. This budgetary system was useful not only for cost control purposes, but had been extremely useful in differential cost studies. The executive interviewed related a number of instances in which differential costing had been the basis for executive decision.

A number of unusual types of fixed costs were found in this company. Because of the small number of firms in this field, there was no regularly manufactured machinery for toothbrush-making. The machines which this firm used were designed, tooled and built in the company's own machine shops. Then in order to provide mechanics to service and repair these machines, the company had to set up an extensive mechanic training program. The cost of training a mechanic was so great that the firm treated mechanics' salaries as a fixed expense. No matter how much volume declined, these mechanics were retained for they could not be replaced if volume increased again. This factor had contributed to the firm's realization of the need for differential costs.
This company is engaged in the manufacture of a light industrial machine. Although there is a considerable amount of competition in the sale of the machine which this company manufactures, the company holds patents on a number of devices which have given it a distinct advantage in the field. The basic core of the machine may be manufactured to stock, but the last stages in the manufacture of the machine are usually made to customers' specifications.

Since each machine is somewhat different than all others, a question was raised as to the method by which selling price was determined. The answer was "cost plus". When an order was received, a cost estimate was made in accordance with the particular specifications of that order. To this was added a mark-up to arrive at selling price. The executive in this firm said that "occasionally" a selling price, so determined, had to be altered to meet competition, but this was quite infrequent.

The firm used a combination of process and job-order costs, but both on a total cost basis. The executives expressed no knowledge of differential costs and little interest in the subject.
Company D

This company is an old and mature organization. It was the manufacturer of one of the earliest steam-powered road builders. In its early history, it also manufactured farm machinery—tractors, threshers, etc. In recent years however this line has been abandoned, and concentration has centered on diesel and gas-powered road-building machinery.

The field in which this company is engaged was described as highly competitive. There was a minimum of repeat business, and each sale was usually made only after the purchaser had carefully considered the products of competitors.

Being a very old concern this company had reached the point where many of its buildings had to be abandoned for heavy manufacturing purposes, making these facilities available for light manufacturing and storage.

This situation may have been partially responsible for the fact that the Controller in this company was keenly aware of the value of the differential cost technique. He said that he did not see how any decision was ever reached without a knowledge of differential costs.

One of the most outstanding features observed in this company was the fact that it manufactured, with its own
facilities, nearly every item that went into its completed product. Very few parts were purchased from outside firms. Accordingly there was a wide diversification of activities within this plant. Many different parts are cast in the foundry and hammered in the forge. It makes its own patterns and molds, welds plate, bores and bends plate, stamps and presses, makes gears and hydraulic lifts. In addition, it makes huge steel and fibre brushes and many other attachments and accessories for its equipment.

The Controller of this plant recognized that the decision to manufacture rather than buy these parts was largely a matter of differential costs. However he recognized that his present accounting system was inadequate for differential cost purposes.

This accounting system was essentially a typical total cost standard system. Standard costs had been set up for each department, including such fixed costs as depreciation, taxes and insurance. The Controller had the desire to eliminate these fixed costs from his standard calculations, but felt that if he did so the inventory figures thus calculated would not be accepted by the Commissioner of Internal Revenue for tax purposes, nor by the company auditors for published statement purposes. Furthermore he felt that he did not have adequate accounting staff to calculate two cost figures, one including an apportionment
of fixed overhead and another excluding fixed overhead. As a result of these feelings, he had adopted certain arbitrary procedures which he felt were providing a rough approximation of differential costs. Although this was only a rough calculation, he had developed a ratio between selling price and this "differential cost" which served as an important guide to the relative profitability of products.
Company E

This company manufactures a heavy industrial machine of great unit value. The company is situated in a very small town and employs at present about 700 people. Present operations however are at an extremely high point of activity—the Controller estimated that they were operating at about 130% of "normal" capacity. He was quick to emphasize that this greatly exceeded the point of optimum efficiency and that total costs rose rapidly at this level of operation—evidence for the curved cost line.

This Controller emphasized the "feast or famine" nature of this industry. Sales in the past four years had been as follows:

- 1949: $3 million
- 1950: $6 million
- 1951: $9 million
- 1952 (anticipated): $12 million

While some of this growth came as a result of plant expansion, most of it was managed with existing plant facilities. In 1948 the plant was operating at about 60% of capacity, according to the Controller's estimate.

The effect of competition in this industry is entirely dependent upon whether they are in the "feast" or "famine" stage. Prices are based upon cost estimates. For many years this was done by a cost estimator who made the cost
calculations mentally. More recently he has begun recording his cost calculations in a more formal fashion. This is a total factory cost calculation. Departmental overhead rates based upon labor are used to allocate fixed costs to jobs. To this cost an attempt is made to add about 35% to cover selling and administrative expenses and a profit. Whether or not this 35% mark-up can be maintained depends upon what stage of the cycle the industry is in. During the feast stage, the 35% is generally maintained. During 1948 (60% capacity), they bid jobs with mark-ups as low as 20% over factory cost. This 20% had not resulted from any differential cost calculation but resulted merely from the drive of competition. Nevertheless the Controller expressed sincere interest in differential costing and recognized its value, particularly in periods of "famine".
This firm is the manufacturer of a diversified line of heavy industrial machinery. However the product is such that it wears out rather rapidly, and therefore there is a considerable "repeat" business and a very extensive business in the sale of repair parts.

The cost system in this firm was essentially job order cost, with the use of standards. In the discussion with the chief cost accountant there was great emphasis upon total costs, great emphasis upon "normal capacity" and great emphasis upon the use of cost information in price setting. This executive maintained that one of the prime functions of the cost accounting department was the preparation of cost information for price determination. He estimated that in about 85% of the cases, total cost plus a mark-up constituted the final selling price. In the other 15% of the cases, some adjustment is made in this calculated selling price "to meet competition." At times a "bottom bid" figure has been calculated, but there are no routine methods for arriving at this. In those circumstances where a "bottom bid" figure was calculated, it amounted essentially to a differential cost calculation.
Company G

This was essentially a distributing company employing about 70 people. It is a relatively new company which purchases a common household product in bulk form, packages it in various size containers, and markets it in grocery stores throughout the United States. It is a most highly competitive product.

The company had practically no system of manufacturing cost accounting, since its "manufacturing" consists simply of one packaging operation. They did have however a rather highly developed system of distribution cost accounting since their operations were primarily marketing.

The objective of the distribution costing was to arrive at costs and profits by territories. A very interesting system of "sales potentials" had been developed for each territory, based upon a related, determinable factor in each district. At the outset total costs, including "home office" expense, had been allocated to territories. More recently this procedure has been abandoned with the realization that it contributed nothing toward the control of costs in the territory, and that it contributed nothing toward an understanding of the profitableness of the territory. The only costs now identified by territories are those actually incurred in the territorial offices. This
is not strictly a differential cost system, since some home office expenses may be purely variable with activity in the territories. Nevertheless the scheme is an approach toward a differential cost plan and was initiated in an effort to gain the advantages of differential costing.
This plant is a subsidiary of one of the large glass corporations and manufactures one product only. The plant employs 1,400 people in the routine, mass production of this one product, although the parent company employs about 25,000.

With production of only one product, the cost accounting was relatively simple. Most direct labor was on a piece-rate basis, simplifying the control of labor cost. Breakage amounted to a considerable cost, and this was reported and controlled on a "pieces broken" basis. A system of standards was provided which allocated total factory overhead to products in the usual manner. Although no formalized system of differential costs was in use, the plant's financial officer had prepared budgets of total plant operating costs at various levels of output—essentially a flexible budget. This was a relatively simple procedure since the plant was tooled to produce only the one item.

The flexible budget and other cost procedures in this firm were designed almost entirely for cost control purposes. There was no mention of costs in relation to price setting. When asked about price determination, this executive was quick to recognize the oligopolistic nature of
the glass industry and the fact that once a price structure was developed, each firm in the industry was quite careful to not disturb it.

The glass item being mass-produced by this firm was produced by only two other firms in the country. When the item was first produced by only one plant, total cost had probably influenced price. When the second and third firms entered the field, some slight adjustments had been made in price but nothing drastic. Since that time the selling price had remained stable, and it would undoubtedly remain stable as long as costs did not change.

The executive was asked whether drastically reduced demand might bring on price competition. His answer was an emphatic "no". He emphasized that although there were no collusive activities in the glass industry, the few firms in the industry had "learned to live together."
This was a medium-sized department store located in Columbus, Ohio. All of the discussion centered around the two accounting plans outlined in the Standard Expense Accounting Manual for Department Stores and Specialty Stores, published by the Controllers' Congress of the National Retail Dry Goods Association. This company used essentially the Net Profit Plan which allocated a full share of the store fixed overhead cost to each sales department. The Controller of the store was only vaguely familiar with the "Contribution Plan", but the plan was discussed and compared with the "Net Profit Plan".

The Controller admitted that probably the main reason for their use of the "Net Profit Plan" was because they "had always done it that way", and top management was familiar with this method of reporting.

Although the "Net Profit Plan" was in use for reporting to top management, the Controller did point out that for purposes of reporting to department managers, a different plan was used. These reports included sales, cost of sales and then only two items of expense: clerical salaries and advertising. This method of reporting was standard throughout the store; and although it is not a complete "Contribution Plan", it is an attempt to achieve
essentially the same result—a department's contribution to the coverage of the store's fixed cost and profit.
This was the only firm visited which had what might be described as a complete differential cost system. The system had been installed over a period of about eight months by G. Charter Harrison, management consultant.

The company manufactures large diesel engines and compressors for industrial uses. This is another "feast or famine" industry; and the need for differential costing was well outlined by the Controller, not only for special cost studies but for routine costing as well.

The system first eliminated all fixed costs from unit production costs and thus eliminated the idle capacity variances. This was the first characteristic of the system which was mentioned by the Controller, with the implication that it was one of the most important features. He stated that they had, at one time, calculated so-called total cost figures, but that they had little real meaning. Everyone who used the total cost figures with any regularity developed their own formulas, which they applied to the total cost to try to reduce it to something meaningful.

After the elimination of fixed overhead, a standard variable overhead rate was developed by the scattergram method—plotting total costs at varying levels of output, then projecting a line which is an average of the plotted points. In this particular plant the operations performed
on various products were sufficiently similar that one standard variable expense rate was developed for the entire plant on a per hour basis.

This standard variable expense rate was not incorporated in the general ledger accounts. The latter were carried at actual amounts, and the actual amounts were compared with standard by means of a work sheet comparison. The actual was then expressed as a percentage of standard, providing a ratio analysis of actual performance. Thus no variance accounts whatever appeared in the general ledger.

In addition to providing a standard measure of performance, the standard variable expense rate was used to determine standard variable costs (differential costs) of each product, present production as well as proposed, thus determining each product's contribution to the coverage of the firm's fixed costs.
Appendix B

NATIONAL ASSOCIATION OF COST ACCOUNTANTS

505 Park Avenue New York 22, N. Y.

Telephone Plaza 9-3444

Arthur B. Gunnarson, Secretary
Raymond P. Marple, Assistant Secretary
John L. Doran, Assistant Secretary

July 23, 1951

Mr. Paul L. Noble
The Ohio State University
College of Commerce and Administration
Columbus 10, Ohio

Dear Mr. Noble:

I have your letter of July 17, and I want to congratulate you on the subject you have selected for your doctoral dissertation. It seems to me that we have reached that stage in the evolution from full allocation costing to marginal costing where there is a real opportunity for someone to make a really major contribution to accounting literature. I hope you will not limit your study to the utilization of marginal costing for managerial policy determination, because the job which needs doing is the application of the marginal approach to all costing, including inventory valuation and profit measurement.

Perhaps a little of my thinking on this subject may be of interest to you. It is possible, even probable in my thinking, that when the history of costing theory is written some years in the future the concept of normal capacity and normal burden rates will be pointed to as the influence which has been most responsible for retarding the development of cost accounting. By using normal burden rates fixed costs are converted into variable costs. Accordingly, during the early development of modern cost accounting - what I call the first stage or the inventory valuation and profit measurement stage - the need for separate classification and treatment of fixed and variable costs
was not appreciated or developed. It was not until we were well along in the second stage - the cost control stage - that the development of flexible budget techniques forced recognition of the essential difference between fixed and variable costs. But it is the third stage, which we are just entering - the cost analysis stage - which has brought home to a few cost accountants the way in which this essential difference in the two types of costs can be utilized to provide better cost information not only for management policy determination, but for all purposes for which costs are used.

I am not going to attempt in this letter to give you a bibliography in marginal costing - I am referring your letter to Don Mackenzie of the Headquarters staff for that purpose. However, I would like to outline as briefly as possible the development in the literature of what is called "The Direct Cost Plan," because it is through an understanding of this plan that you get an appreciation of how the marginal approach can be applied to all costing.

In January, 1936, Jonathan Harris of Dewey and Almy of Boston wrote an article for the N.A.C.A. Bulletin entitled "What Did We Earn Last Month" in which he proposed the elimination of fixed costs from inventory values. A few issues later we published in the Bulletin a number of letters from members taking violent exception to Mr. Harris' proposal. However, the idea would not die. The July 1, 1937 Bulletin had an article on the same subject by Clem N. Kohl, and the idea was discussed at the 1937 conference by Professor Howard Cooper. In the intervening years several other articles on the subject have appeared, probably the best of which is the article on "Selling Overhead to Inventory" by Philip Kramer in the Bulletin for January 15, 1947.

In the meantime the idea had been developed independently in England and was presented in an article in a 1940 issue of the English "Cost Accountant." As in this country, this first article was followed by a number of letters to the editor disagreeing with the idea. However, the concept has apparently taken hold faster in England than in this country and visiting accountants from England are surprised that so little has been done with marginal costing in this country. A book entitled "Marginal Costing" by Lawrence and Humphreys was published in England in 1947.
Recently at the N.A.C.A. Annual Conference in Chicago, Charles Headlee, Controller of Westinghouse made some comments on the direct cost plan, which is marginal costing applied to inventory valuation, which helps to bring this story up to date. The two pages from his talk which bear on this matter are enclosed.

Perhaps it was the discussions in the N.A.C.A. Committee on Research regarding the contributions vs. the full allocation approach to the treatment of nonmanufacturing costs which cause me to realize the possibilities in the application of the marginal cost approach to all purposes for which costs are used. You will find considerable bearing on this matter in the report issued May, 1951, under the title "Assignment of Non-Manufacturing Costs for Managerial Decisions."

This letter is too long. Mr. Mackenzie will write you as to specific references. Should you be in New York in the near future, I would enjoy discussing this subject with you.

With kindest regards,

Very truly yours,

/s/
Ray Marple
Assistant Secretary
Technical Service

RPM: ja
BIBLIOGRAPHY

Books


Dean, Joel, Managerial Economics, New York: Prentice-Hall, Inc., (1951), Chaps. 1, 2, 3, 5, 7, 8, 9.


Due, John F., Intermediate Economic Analysis, Revised Ed., Chicago: Richard D. Irwin, Inc., (1950), Chaps. 8, 9, 10, 12, 12.

Frey, A. W., Manufacturers' Product, Package and Price Policies, New York: Ronald Press Co., (1940), Chap. II.


Heckert, J. Brooks, Business Budgeting and Control, New
James, Clifford L., Economics Basic Problems and Analysis, New York: Prentice-Hall, Inc., (1951), Part III.


Lawrence, F. C., and Humphreys, E. N., Marginal Costing, London: MacDonald & Evans, (1947).


Periodicals


Garner, L. W., "Battling the Overhead," The Controller, (June, 1952), 263-266.


Harris, Jonathan N., "Direct Costs as an Aid to Sales Management," The Controller, (October, 1948), 499.

Harris, Jonathan N., "What Did We Earn Last Month?," N.A.C.A. Bulletin, (January, 1936), 501-527.


Hilton, J. L., "What is the Use of a Total Cost?," The Cost Accountant, (December, 1949).


"Why Should We Allocate Overhead?", N.A.C.A. Bulletin, (September, 1950), 84-88, Workshop.


Other


Harrison, G. Charter, Why Most Profit Statements Are Wrong!--New Wine in Old Bottles, Privately printed, (1937).


National Association of Cost Accountants, Budgeting, Outline for Use in Program of Discussion Forums, Sessions I, II and VI.


"Should Orders Even Be Taken Below Normal Cost?", N.A.C.A. Yearbook, 1926, (Discussion), 258-263.

Autobiography

I, Paul LeMoyne Noble, was born in Cleveland, Ohio, October 29, 1921. I received my secondary school education in the public schools of the city of Cleveland, Ohio. My undergraduate training was obtained at The Ohio University, Athens, Ohio, from which I received the degree Bachelor of Science in Commerce in 1942. I completed an advanced course in Personnel Psychology at The University of California in 1943 as a part of the Army Specialized Training Program. From The Ohio State University, I received the degree Master of Business Administration in 1949. I became a Certified Public Accountant in the State of Ohio in 1950. I was appointed a Graduate Assistant in the Department of Accounting at The Ohio State University in January, 1947, and Instructor in Accounting in October, 1947. I held this latter position while completing the requirements for the degree Doctor of Philosophy.