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EXPENDITURES.

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DISSERTATION

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

By

Richard Stanley Roberts, B.B.A., M.B.A.

* * * * * *

The Ohio State University
1966

Approved by

[Signature]
Adviser
Department of Accounting
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VITA

August 12, 1937  Born - Dayton, Ohio

1960 . . . .  B.B.A., University of Cincinnati, Cincinnati, Ohio

1960-1961 . .  Graduate Assistant, Department of Accounting, The Ohio State University, Columbus, Ohio

1961 . . . .  M.B.A., The Ohio State University

1963-1964 . .  Instructor in Accounting, The Ohio State University, Columbus, Ohio

1964-1966 . .  Assistant Professor of Accounting, University of Akron, Akron, Ohio

FIELDS OF STUDY

Major Field: Accounting


Studies in Economics: Professors Paul G. Craig, Clifford L. James, Robert D. Patton, and Alva M. Tuttle

Studies in Mathematics: Professors Leroy F. Meyers, Roy F. Reeves, Jesse M. Shapiro, and Jack P. Tull
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CHAPTER I

THE PROBLEM

Industrial research spending has rapidly increased in size and importance in our technologically oriented economy. Future economic benefits are expected from research investments, yet the majority of industrial research outlays are expensed as incurred. The inconsistency between corporate research planning and accounting has been excused because of the apparent lack of a satisfactory basis for amortizing research costs over the periods benefited. The problem considered in this dissertation is how industrial research expenditures should be matched with revenues in determining periodic net income. The purpose is to provide a useful research expense recognition method that is consistent with accounting theory.

Background of the Problem

Importance of research

The economic growth rate in the United States is among the highest of the industrialized countries of the world. One reason is that the United States devotes a comparatively high percentage of its national income to research endeavors. Research outlays have grown ten to fifteen percent annually since 1910, while the gross national
product has increased approximately three to four percent per year in the same period.\(^1\) Research has increased from less than one percent of gross national product at the end of World War II to more than three percent at present.\(^2\)

Total expenditures for research and development in the United States were less than one billion dollars in 1941, approximately five billion dollars in 1953, and currently exceed twenty billion dollars per year.\(^3\) In all manufacturing concerns performing research, funds for company-financed research expenditures increased from an average of 0.9% of net sales in 1953 to 1.9% in 1961.\(^4\)

**Present research accounting**

A large percentage of industrial research outlays is expensed as incurred. The alternative is to capitalize research expenditures as assets, subsequently amortizing the capitalized amounts over a reasonable time period. Studies of corporate annual reports show that less

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\(^3\)Lazarcik, loc. cit.; National Science Foundation, *op. cit.*, p. 4; and "Industry Keeps Pace as R & D Outlays Soar," *Business Week* (July 17, 1965), p. 72.

than five percent of the surveyed companies capitalize research and development expenditures.\(^5\)

Executives in a company considering research projects generally make plans based on several future periods. The expected costs are weighed against the amount and timing of anticipated benefits in deciding whether or not to institute a particular project. Benefits expected in the period of expenditure are often negligible due to the time lag between outlays and benefits. Many profitable projects would not be undertaken if costs were weighed against the benefits anticipated in the period of research disbursement.

Accounting for research outlays seems to be uniform since most firms expense such charges immediately. Whether or not accounting uniformity is desirable, accounting that conflicts with economic facts is undesirable. Expensing research costs as incurred is proper only if all benefits emanating from research efforts are received in the period of outlay. However, the plans on which research investments are based generally include significant benefits in periods subsequent to the time spending occurs. Therefore, an inconsistency exists between the research projects that companies undertake and the present

\(^5\)American Institute of Certified Public Accountants, *Accounting Trends and Techniques in Published Corporate Annual Reports* (New York: American Institute of Certified Public Accountants, annual editions); e.g., 1964, pp. 75-78; 1963, pp. 78-80; 1962, pp. 76-79; 1954, pp. 89-93; 1953, pp. 100-03; and 1952, pp. 86-90.
accounting for expenditures to implement such investment programs.

**Reasons for present accounting**

**Conservatism.** Conservatism means that provision should be made for all losses, but gains should not be anticipated. This idea developed at a time when businessmen might have been tempted to overstate assets and earnings to impress creditors. A general feeling developed that understatement of assets and earnings was conservative and commendable, whereas overstatement of these items was dishonest and reprehensible.

Conservatism reflects a state of mind rather than a rational basis of measurement. It is the antithesis of the matching principle since it overstates the costs to be matched with revenues in one period, resulting in an understatement of costs to be charged to subsequent periods. As Paton said so well, conservatism is the most objectionable and obstructive tradition in accounting because there is no virtue in either understatement or overstatement. Conservatism cannot be defended logically and should not be used as justification for misstating the costs to be matched with revenues in computing net income. Therefore, it is not a legitimate reason for expensing research outlays as incurred.

**Tax laws.** The Federal tax rules concerning research spending were indefinite prior to the enactment of the 1954 Internal Revenue Code, and the Internal Revenue Service generally recognized a

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taxpayer's established accounting practices. Section 174 (a) of the Internal Revenue Code of 1954 permits a taxpayer to deduct research as a current expense of the year in which the charge is paid or incurred. According to Code Section 174 (b), a taxpayer who has not adopted the current expense method may elect to defer research project expenditures if the period of amortization is not less than sixty months.7

The Internal Revenue Code does not require that the research accounting procedure employed for tax purposes be used for financial accounting statements. In fact, Revenue Ruling 58-78 allows a taxpayer to deduct research expenditures as a current expense under provisions of Section 174 (a) regardless of the method employed for financial accounting purposes.8

It is sometimes assumed that the same expenses should be shown for financial accounting reports as are reported to taxing authorities. Tax rules and accounting principles need not coincide because their purposes and objectives are quite different. Tax allocation should be employed in financial statements, to apply properly the matching principle, whenever material timing differences arise between amounts reported for tax and financial accounting purposes. However, the tax laws do not provide a reasonable excuse for expensing research expenditures as incurred.


Lack of an amortization basis. The third reason given for expensing research outlays immediately is the opinion that there is not an objective basis on which to capitalize research expenditures and amortize them over succeeding accounting periods. In contrast, prepaid expenses often have definite periods of usefulness to which their costs can be allocated. The lives of tangible, long-lived assets can be estimated by considering physical composition, location, extent of maintenance, degree of asset utilization, and technical obsolescence. Even though imprecise, estimates are made in these situations because it is recognized that the costs will be useful to the company subsequent to the period incurred.

Research spending presents more difficult problems. The period of usefulness is not stated in a contract and there are no physical attributes for which obsolescence can be estimated. The success of research projects depends on the future, which is difficult to predict reliably. Expensing research costs as incurred is generally recognized as improper. Unfortunately, very little effort has been expended by the accounting profession to determine a satisfactory capitalization and amortization basis for research outlays.

Hypothesis, Objective, and Organization

The dissertation hypothesis is that the expectations employed by management in planning research investments provide sufficient objective evidence for the capitalization and eventual amortization of industrial research expenditures. The objective is to develop
general criteria appropriate for determining the asset and expense components of research outlays.

**Dissertation organization**

The principles underlying proper accounting for research expenditures are the subject matter of chapter two. Asset definition and valuation are explained from the viewpoint of service-potentials. Cost is the primary basis of current accounting due to the practical difficulties associated with the service-potential concept, and some of these implementation problems are briefly stated. The meaning and importance of matching is considered, as well as how costs are charged to expense to satisfy the matching principle. An example is presented to demonstrate asset valuation and the matching of costs with revenues.

**Research investments.** Research investment planning, quite similar to capital budgeting, is discussed in the third chapter. Corporate managers are influenced by competition and company goals in determining their overall research policies. The likelihood of success and other uncertainty factors must be considered in estimating future benefits. Scientific planning and an evaluation of the profitability of research proposals are essential in reaching sound decisions concerning research investments.

The fourth chapter contains information relative to personal visitations to six selected companies. This field study was performed to determine the planning actually employed in the selected firms as well as to assess the availability of research cost and benefit
information. A summary of the field research findings is presented, the more detailed results of the visits appearing in the Appendix.

Proposed accounting. The proposed accounting for research expenditures is contained in chapter five. The basis for recognizing research expenses is presented, including a procedure for amortizing capitalized research costs. Changes in expectations requiring adjustments to previously recorded amounts are briefly discussed.
CHAPTER II

UNDERLYING ACCOUNTING PRINCIPLES

Asset Definition and Valuation

Nearly sixty years ago, Sprague said that assets are the embodiment of services previously given and are a storage of services to be received.\(^1\) Approximately two decades later, Canning alleged that there must be some anticipated, identifiable, separable services to be had by an enterprise as a matter of legal or equitable right for an object to be an asset; thus, an asset is any future service in money, or convertible into money, in which an enterprise has a beneficial interest legally or equitably secured.\(^2\)

Service-potentials

Paton and Littleton contributed the service-potential idea and insisted that any kind of cost may contribute to the asset total; it is not money or price that is significant in the accounts, but service-potentialities which bring other service-potentialities into the

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enterprise when an exchange occurs. Vatter stated that assets are economic in nature and are embodiments of future wants satisfactions that take the form of service-potentials which may be exchanged, transformed, or stored.

In the 1957 revision of the American Accounting Association's statement of accounting standards, it was asserted that assets are aggregates of service-potentials available for, or beneficial to, expected business operations. Sprouse and Moonitz described assets as representing future economic benefits; most assets are capable of providing a limited amount of services so that the asset status expires as the economic services are used.

All of these descriptions emphasize asset services. The fact that monetary amounts are involved is a valuation problem. Service is the important element due to the anticipation of receiving future economic benefits as a result of having rights to the assets. In summary, the assets of an enterprise represent valuable service-

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potentials (expected economic benefits) for which equitable interests were acquired by the enterprise.

Assets and expenses must be differentiated before financial condition and operating results can be properly determined. The distinguishing characteristic of assets is the ability to render future services. Objects that are expected to provide future benefits are assets, whereas those items not expected to benefit future periods are expenses. Assets are charges awaiting future revenues, while expenses are charges against present revenues. There is general agreement on these theoretical differences between assets and expenses, but disagreement arises in the difficult process of implementation.

**Asset valuation**

The worth of an asset is the value of the goods, services, or other satisfactions that result from its use or possession in the future. It may be described as the value of all future net receipts arising from utilization of the asset, discounted to the present at a rate reflecting risk and interest.

Fair market value is an indication of worth at the time an asset is acquired. The selling price of an asset approximates its fair market value when there are numerous, knowledgeable buyers and sellers acting in good faith. Price paid (cost) is assumed to be an equitable representation of asset value at acquisition when an exchange occurs in a free market. Cost may not be a reasonable indication of asset worth when something less than the ideal free market situation exists.
In such cases, an estimate of fair market value should be employed as asset acquisition value.

Subsequent to acquisition, the current (replacement) cost of an asset is superior to historical (acquisition) cost as a measure of the present value of its expected future benefits. Current (replacement) cost is the cost of acquiring currently the inputs that were used by the enterprise in obtaining the asset.\(^7\) Current market price may be employed, whenever available, as an indication of current cost. If a current market price is not determinable, the original valuation may be adjusted by index numbers designed to measure price movements of similar items, or an independent appraisal may be obtained.\(^8\)

**Implementation problems.** Reliable market values are not always available. The form or usefulness of the asset may have substantially changed so that market price is a reflection of the worth of a different item. The market prices of infrequently traded assets may not be reliable indications of asset value.

Adjusting the original asset valuation by price indexes or appraisals, mentioned above, has not yet been widely accepted by the accounting profession. Another alternative would be to estimate the future receipts as a result of using the asset and discount such amounts to the present. Assuming that the amounts to be received in the future were reasonably known or determinable, disagreement could

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\(^8\)Sprouse and Moonitz, *op. cit.*, p. 27.
develop over the proper discount rate to be employed in the computations.

Historical cost is used almost exclusively in current accounting. Overcoming the implementation problems associated with departures from this basis is far beyond the scope of the present discussion. For purposes of this dissertation, historical cost is assumed to be a valid basis for recognizing asset value in the period of acquisition and in subsequent periods, and asset amortization is based on historical cost.

Matching

Matching means associating revenue deductions (cost expirations) with revenues. That is, matching means trying to mate related economic data, costs (efforts) and revenues (accomplishments). There must be some basis to indicate that these economic data belong together.

Revenue and cost are not independent. One must be chosen as the controlling factor and assigned to an accounting period, and then the other can be allocated to the period based on its relationship to the controlling factor. Since revenue estimations are frequently more precise than measurements of cost expirations, accountants have generally chosen to assign revenues first and then attempt to match costs with revenues.9

Matching is one of the most important and fundamental principles in accounting for profit-seeking enterprises. The result of matching

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costs and revenues is periodic net income. The primary objective of business operation is to earn a profit, and periodic earnings reflect the extent of progress toward this objective. An accurate matching of costs and revenues is particularly vital for earnings computations to be meaningful and because the matching of unrelated data is likely to result in misrepresentation.\textsuperscript{10}

Although the "true" earnings of an enterprise cannot be known until that firm ceases to exist, a periodic estimation of earnings is necessary for many purposes. Management must decide whether to continue present policies or pursue alternative courses of action. Owners are interested in the relative success of the company to determine the size of their desired ownership investment. Creditors need to know the relative safety of their interests and the likelihood that earnings will be sufficient to enable repayment of corporate obligations. The usefulness of earnings measurements for these and other purposes depends upon the care with which matching has been accomplished.

**Homogeneity of costs**

Ideally, all costs incurred should be related to definite goods or services. Accomplishment and effort could be measured in units of output if such a concept could be implemented. Accountants must use time periods for earnings computations whenever continued activity prevents an appropriate assignment of costs to items of product. Time

periods are a convenience or a substitute, but the fundamental concept is to match the efforts related or attributable to the revenues realized.\textsuperscript{11}

All costs incurred prudently and in good faith are essentially homogeneous in their significance to an enterprise, and all such costs contribute to the asset total prior to their absorption as revenue charges.\textsuperscript{12} There is no need to distinguish, for example, between costs incurred for merchandise or for selling or administrative purposes. The principles are the same for all costs, although some cost expirations are easier to measure or apportion than others.\textsuperscript{13}

The inability to measure expenses accurately does not nullify the matching principle, but accountants have made little effort to measure the future benefits of certain costs. As a result, some costs are arbitrarily assigned as expenses of the period incurred rather than being deferred until benefits are obtained. To apply properly the matching principle, an effort must be made to determine accurately periodic cost expirations. Some measurements may be matters of judgment and interpretation, but they must nevertheless be attempted

\textsuperscript{11}Paton and Littleton, \textit{op. cit.}, p. 15.

\textsuperscript{12}\textit{Ibid.}, p. 33.

because of the reliance placed upon corporate financial statements.

**Expense recognition**

The 1948 revision of the American Accounting Association's statement of accounting concepts suggests that expenses should be recognized in a period when there is a direct or indirect association with periodic revenues or when there is a measurable expiration of asset value even though not associated with current period revenues.\(^{14}\) Costs related to the current revenues are expenses of the current period, those associated with prior revenues should be charged against prior periods' earnings, and costs pertaining to future revenues must be carried forward as assets.

The matching principle necessitates finding an association between costs and revenues. All costs are incurred as an essential part of the revenue operation, but revenue may not always emerge from such expenditures. Some costs are more closely associated with revenues than others, and the ideal of finding a cause and effect relationship is not always attainable.

**Associating expired costs with revenues.** Certain costs, such as direct materials or direct labor, can be closely identified with specific results. There tends to be a cause and effect relationship between the efforts (costs) and accomplishments (revenues). When goods are sold or services are rendered to customers, such direct costs should be allocated against the revenues resulting from the transaction.

\(^{14}\)American Accounting Association, *op. cit.*, p. 15.
Other costs cannot be directly associated with specific results, but can be associated with a group of results. Examples include factory overhead and some selling and administrative expenditures. These costs do not seem to have a causal relationship with any specific revenue, but are incurred in the process of manufacturing and selling goods and services. Such charges should be apportioned between assets and expenses on a reasonable basis. This may be accomplished by comparing the costs with the expected benefits (revenues minus other expenses) and apportioning the costs to the periods benefited.

**Lack of future benefits.** Some costs gradually lose their ability to produce future benefits even though no current benefits are realized. A cost should not be carried as an asset when it is not expected to benefit the future. There may have been an indirect happening to account for the loss of value, or the loss may be due to changes in general business expectations or in the anticipations for the particular item with which the costs were associated.

A problem sometimes arises concerning the proper handling of a cost that expires in this manner. It should be charged against current period revenues to the extent it applied to the current period and the remainder should be shown as a correction of prior periods' earnings. As a practical matter, the current period is often charged with the
entire expired cost due to inconclusive evidence concerning the periods
to which the cost applied.

Illustration of Asset Valuation and Matching

Machinery investment

The value of a machine at the time of acquisition is the
equivalent cash price at that moment. The equivalent cash price
includes the invoice cost as well as insurance during transit, freight,
installation, costs of breaking-in the machine, etc. The equivalent
cash price should be reduced by all available discounts, and should
exclude interest or carrying charges connected with a deferred payment.

The cost of work performed by the company acquiring the
machine, such as installation or break-in, should be added to the
cost of the machinery. This includes direct labor, direct materials,
and overhead allocated on a reasonable basis. In other words, asset
cost includes all expenditures which are reasonable and necessary to
get the asset in a position and condition for the intended use.

Purchase of machinery. The management of a company contem-
plating the purchase of a machine, as of the first day of Year 1,
expects the machine to benefit operations as shown in Table 1. The
benefits are the additional revenues less the additional expenses
other than the initial machine cost. The additional revenues and
expenses are not expected to have a constant relationship throughout
the asset's life due to sales price fluctuations and changes in
production costs. Salvage value is assumed to be zero at the end of
the useful life of the machine, as the cost of dismantling and selling the parts is expected to approximate the sales value of those parts. If

TABLE 1

ANTICIPATED MACHINERY BENEFITS

<table>
<thead>
<tr>
<th></th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Additional revenues</td>
<td>$2000</td>
<td>$2500</td>
<td>$3600</td>
<td>$3200</td>
<td>$11300</td>
</tr>
<tr>
<td>Additional expenses, other than the initial machine cost</td>
<td>$1500</td>
<td>$1700</td>
<td>$2400</td>
<td>$2200</td>
<td>$7800</td>
</tr>
<tr>
<td>Benefits, before considering the initial machine cost</td>
<td>$500</td>
<td>$800</td>
<td>$1200</td>
<td>$1000</td>
<td>$3500</td>
</tr>
</tbody>
</table>

this were not the case, salvage value would be considered an additional benefit (to the extent it exceeded the removal and selling costs) of the period of salvage.

It is expected that operations will be benefited by a total of $3500 over the four-year machine life. Management should not pay that much for the asset since the company would earn nothing if the actual results turned out as anticipated. Additional earnings would emerge only if the price paid were less than $3500. The amount that corporate management is willing to invest depends on its aspirations concerning the earnings rate on such endeavors. The firm should pay no more than the present value of the benefits, with the desired earnings rate employed as a discount factor in the present value computations.
Corporate management considered the amount and timing of the expected benefits, as well as the investment risks involved, in determining the maximum amount to pay for the machine. The executives decided to purchase the asset, which could be acquired for less than they were willing to invest, and incurred the following expenditures:

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invoice price of machine</td>
<td>$2400</td>
</tr>
<tr>
<td>Financing charge due to deferring cash payment</td>
<td>120</td>
</tr>
<tr>
<td>Freight and insurance during transit</td>
<td>105</td>
</tr>
<tr>
<td>Installation, performed by purchaser:</td>
<td></td>
</tr>
<tr>
<td>Direct labor, direct materials</td>
<td>180</td>
</tr>
<tr>
<td>Overhead allocation</td>
<td>120</td>
</tr>
</tbody>
</table>

The cost of the machine includes all of the above items except the financing charge due to deferring the cash payment, so the initial asset valuation is $2805.

The anticipated earnings rate on the investment can be found by using the present value of the expected benefits. The present value of the benefits depends upon whether the benefits accrue at the beginning or end of the year or evenly throughout the year. It is assumed in this illustration that the benefits accrue continuously throughout the year. An appropriate present value table should be examined to determine the apparent interest (discount) rate by equating the present value of the benefits with the machine cost. The present value of the benefits equals cost when a rate of 10% compounded continuously is employed as a discount factor, as shown in Table 2.

Various rates can be employed, on a trial and error basis, until the
rate is found such that the present value of the expected benefits is closer to the investment cost than for any other rate. The anticipated

TABLE 2
PRESENT VALUE OF MACHINERY BENEFITS

<table>
<thead>
<tr>
<th>Year</th>
<th>Benefits</th>
<th>Present value of 1 at 10% earned continuously throughout the year</th>
<th>Present value of benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$ 500</td>
<td>.9516</td>
<td>$ 476</td>
</tr>
<tr>
<td>2</td>
<td>800</td>
<td>.8611</td>
<td>689</td>
</tr>
<tr>
<td>3</td>
<td>1200</td>
<td>.7791</td>
<td>935</td>
</tr>
<tr>
<td>4</td>
<td>1000</td>
<td>.7050</td>
<td>705</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$ 2805</td>
</tr>
</tbody>
</table>

\[ aJ. C. Gregory's continuous interest table for determining rate of return by discounting performance which occurs uniformly over individual years, in Erwin E. Nemmers, Managerial Economics (New York: John Wiley & Sons, Inc., 1962), pp. 394-408. \]

earnings rate is useful in implementing the matching principle.

Machinery utilization. The remaining economic benefits diminish as the machine is utilized until no further benefits are anticipated. The fact that the asset loses its usefulness over a period of time must be recognized in the accounts. The benefits expected from the machine, as estimated at the time of acquisition, provide sufficient objective evidence concerning the pattern of expense recognition (asset amortization). The allocation of the asset's cost to expense should be based on its anticipated benefits (additional revenues minus
additional expenses other than the initial cost) in order to apply properly the matching principle.

In reaching the investment decision, management recognized that the benefits were being earned over a period of time and employed the desired earnings rate to determine the maximum amount to pay for the asset. The recognition of machinery utilization should also consider the time factor and the implicit interest rate on the investment.

If the actual benefits approximately equal the expected benefits, the anticipated earnings rate previously determined would provide the basis for computations. The asset value should be reduced by the present value (as of the asset acquisition date) of the benefits used up in the period. The effect on earnings is the difference between the benefits and the present value of the benefits as of the date of asset acquisition. The net income from the machinery investment is shown in Table 3.

A slight change must be made when the actual results, or the expected results for subsequent periods, differ from the original expectations. Using the best available information regarding anticipated benefits, a discount factor is found so that the present value of those benefits is equal to the asset cost. This interest (discount) rate is employed, rather than the implicit rate found earlier, in determining the expense to be recognized. If this occurs after expenses have been recorded for one or more accounting periods,
the expenses reported in prior periods should be adjusted to their proper amounts as determined by present estimates.

TABLE 3

NET INCOME FROM MACHINERY INVESTMENT

<table>
<thead>
<tr>
<th>Benefits received</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 500</td>
<td>$ 800</td>
<td>$ 1200</td>
<td>$ 1000</td>
<td></td>
<td>$ 3500</td>
</tr>
</tbody>
</table>

Costs matched with the benefits (present value of the benefits at asset acquisition date)

| 476 | 689 | 935 | 705 | 2805 |

Net income on investment

| 24  | 111 | 265 | 295 | 695  |

Arbitrariness versus objectivity

The basis employed in allocating the cost of a long-lived asset to expense should consider the benefits anticipated in the investment planning and the actual benefits resulting from the investment. The original plans provide objective evidence of managerial expectations concerning the benefits to be derived, so cost should be matched with revenue according to the schedule of expected and actual benefits. This method was employed in the machinery utilization illustration.

Other allocation methods are often used in current accounting practice as a substitute for this method. Common substitutes include an equal expense per period (straight-line), a declining expense per period (sum-of-the-years-digits or double-declining-balance), or a constant expense per unit produced (production). All of these
allocation methods are arbitrary since they are not based on the plans of management concerning anticipated benefits. Also, they all ignore the time value of money and the fact that benefits are usually received over an extended period. Although these methods are easy to implement, they are a poor substitute for a method which tries to match expired costs with revenues on the basis of expected benefits and the timing of those benefits. Such substitute methods should be discouraged and additional effort made to implement more correct methods of recognizing the expired portion of long-lived assets.
CHAPTER III

RESEARCH INVESTMENT PLANNING

Research investment planning and capital budgeting involve the application of scientific techniques and an evaluation of individual project profitability. Management tries to determine the ratio of expected returns to expected costs for alternative uses of given resources.¹

The planning methods connected with research investments or capital budgeting are often called scientific because they involve a careful study of the projects to be selected to satisfy corporate objectives. However, the projects do not always turn out as expected. Prediction lies at the heart of any executive judgment about a proposed investment, but the investment plans are only as good as the care taken in the estimates.² Even though estimates are determined from the best available information, changes in economic conditions can quickly invalidate such efforts. The use of scientific methods does not insure


infallibility but should, logically, produce better results than haphazard planning.

The procedures which should be employed in capital budgeting or in research investment planning include the following: continuous searching for investment opportunities, forecasting the supply and cost of investment funds, estimating each project's cash flows or other benefits, choosing among competing projects, and postauditing committed investments. All of these steps are important, but the last four will be relatively unproductive unless management continually searches for investment opportunities that are consistent with corporate objectives. Executives must plan capital investments carefully so that the company's economic position receives the maximum possible enhancement from such expenditures.

Reasons for Research Expenditures

Perhaps the underlying motivation for research and development activity in industrial companies is the competitive situation in which those companies operate. Although the competitive factor is more important in research-oriented industries, research must generally be performed to maintain a corporation's market position. An increasing proportion of personnel and financial resources must be devoted to

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research efforts for a firm to move ahead of competition or to provide growth opportunities.

Corporate executives should undertake research projects only if long-run company profits are expected to increase as a result of such investments. Some research projects may not provide a satisfactory investment return. If the firm is to maximize profits, however, the overall research program must recover the amount invested and generate a rate of return higher than the firm's cost of obtaining investment funds.

One way to enhance long-run profitability is to lead in the introduction of new products. The profit margin for new products is typically at its peak in the growth period following introduction and often starts declining when competition enters the market. Sooner or later, the market for every product degenerates into profitless price competition or the product is pre-empted by a substitute. Thus, the lure of monopoly profits in the initial stages of product life cycles is an important stimulus for research investments.

The most profitable industries and companies, and the ones with the best growth records, are often those which have exhibited outstanding performance in research and development activity. A study of fifty large industrial companies in the period following World War II

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confirmed these relationships.⁶ A similar study of four hundred corporations in the post-war period showed that the high-growth companies were predominantly research-oriented.⁷

**Company goals**

Executives are concerned with competitive research efforts and desire to maximize long-run profits while maintaining corporate liquidity, but research decisions involve basic ideas concerning company goals and objectives. The factors that influence managerial decisions on research spending may be separated into six categories: company resources, immediate needs, aspirations concerning growth, the nature of products or processes, management attitudes, and various environmental factors.⁸

An evaluation of company resources includes consideration of the quantity and quality of creative and supporting technical personnel, research ideas worth pursuing, capital for exploitation of research

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results, the present and desired financial condition and structure of
the firm, and the effect of research on sales volume, cost savings, and
profits. Immediate company needs which might influence research
decisions include production problems to be solved and customer
preferences to be satisfied.

Expansion or growth factors include the desired rate of company
growth relative to the economy, the percentage of market to be held,
marketing objectives by product line, sales share in major markets, and
the desirability of balancing short-range and long-range goals. The
nature of products or processes is evaluated by considering the degree
of dependence on scientific information, the quality-price market in
which the company operates, and the profit-volume ratio desired.

Management attitudes play a very important role in determining
company goals and in evaluating research proposals. These encompass
such factors as the type of business to pursue, the image the executives
want the public to see in the corporation, and the desirability of
customer satisfaction. Additional considerations include management's
outlook on information output, product leadership, personnel
development, and public responsibility, and managerial attitudes
concerning the degree of diversification, flexibility, or market
stability desired. Environmental factors include the business
prospects and directions for the industry, the nature of competition,
resource availability, and governmental policies affecting research.

Effect of Uncertainty

Research investments are based on anticipations of future benefits. Such advantages are uncertain due to the relative likelihood of successful research projects in a company. It is necessary to consider the plausibility of success in estimating the anticipated benefits from individual research projects before the profitability of those projects can be correctly determined.

Likelihood of success

The likelihood of success in research projects tends to diminish as a science or an art becomes more fully developed. Enterprises conducting research would have difficulty producing successful research results if their efforts were restricted to the field of endeavor in which the company was currently engaged. However, most firms are interested in expanding into related fields rather than merely refining present products or processes or trying to maintain the status quo. The general tendency for success in research projects to decline in likelihood is at least partially offset by the tendency to expand into related, less developed, areas.

The failure rate tends to be much higher for basic research than for development projects. Management of New Products, op. cit., p. 14.
States increased more than one billion dollars (or approximately 240 percent) from 1953 to 1961, but their relative importance is about the same since basic research outlays are eight to ten percent of total research spending. Basic research projects are often devoted to efforts which will not result in measurable future benefits unless further research is undertaken. The uncertainty of basic research must be carefully considered by corporate management.

Long-range research projects generally are more uncertain than shorter ones. Further, the probability of commercial success tends to be lower than the general average in some industries (e.g., metal fabricators, consumer packaged goods), while the likelihood of success is much higher in others (e.g., raw material processors, electrical machinery). Thus, the type of project and industry has a substantial effect on the likelihood of success in research endeavors.

The experience of a company is an important determinant of research success. Research personnel develop skills over a period of time, and efforts expended in prior periods can increase the possibility of success by providing insight into problem areas. Corporate management can greatly improve its effectiveness by carefully studying past decisions and the overall decision-making process.


\[12^\text{Management of New Products, loc. cit.}\]
Chance cannot be completely eliminated from research investments, but it can be controlled.\(^{13}\) The likelihood of success increases when management is able to make informed research decisions. The use of scientific techniques is an invaluable aid in this regard, and recent publications have directed attention to some of the scientific techniques available to research managers.\(^{14}\) Independent organizations are offering help to management so that the chances of research failure may be lessened. One novel approach is a mathematical model, based on an analysis of product behavior, which gives readings on the possible success of new products at several stages of development.\(^{15}\) Corporate managers should use any feasible technique that may increase the likelihood of research project success in their company.

**Ascertaining future benefits**

The future benefits of research projects are sometimes very difficult to determine. One reason for this difficulty is the lack of


repetitive research conditions. Similar projects are very rare, and even similar projects may have vastly different possibilities due to their individual characteristics. Often, research projects in a particular company over a period of time can be separated into a few groups so that general trends and experiences are evident for a particular research project classification.

Another reason that future benefits are difficult to estimate is that years may pass before success or failure is readily apparent. Some products introduced in recent years by Du Pont are based upon the research started by Wallace Corruthers in 1927, and even today it is very difficult to estimate the market and profit potential of this research.\(^{16}\)

The estimation difficulties are lessened when development projects, as opposed to basic research, are undertaken. As stated above, basic research comprises only about one tenth of total research spending. Quinn stated that over ninety percent of the research and development work done in most companies is devoted to solving technical problems which can yield known commercial applications.\(^{17}\) Many projects undertaken by industrial concerns are devoted to specific product or process development whose benefits might be reasonably estimated, but it is often difficult to estimate the benefits of product or process improvement projects.

\(^{16}\)Quinn, *op. cit.*, p. 13.

The type of product being developed is also important in determining possible future benefits. Certain products tend to have shorter life cycles than others. The closer a company is to consumer goods and the market place, the shorter the life cycle of its products is likely to be; conversely, longer cycles are common for products closer to basic industry or producers' goods. Product life cycles are becoming measurably shorter in research-oriented industries, and almost all product life cycles are being reduced by accelerating research and technology, changing markets, mass media, and mass distribution.

Uncertainty must be recognized at the time future benefits are estimated. There are many ways to allow for uncertainty, including the use of informal judgment, modification of return estimates, modification of life expectancies, or the use of probabilities applied to the estimates for individual years. The use of probabilities is preferable in a mathematical sense and is discussed briefly below, but such measures are seldom available. Therefore, managers need to determine the benefits that can reasonably be anticipated by using their judgment or by modifying return estimates or the life expectancies of projects.

Although certain factors affecting research projects are more

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19Ibid.

difficult to estimate than others, Seiler found that 70% of research managers felt they could reasonably estimate the revenue from sale of a product resulting from successful research, 75% thought they could approximate the probability of market success, and 83% believed they could adequately forecast the cost of a research project.21 Thus, management can generally make a satisfactory estimate of the future benefits expected from a research project. A few companies already employ gradations of certainty (e.g., very good, good, fair, poor, very poor or 1, 2, 3, 4, 5) in analyzing research project proposals.22

**Use of probabilities and mathematical expectations.** It would be preferable to determine the expected benefits by employing probabilities (e.g., 80%, 65%, 40%, etc.), but such estimates of degree of certainty are seldom available. Management could establish them by using the educated guesses of knowledgeable researchers and managers. These estimates would necessarily be subjective interpretations due to the lack of objective evidence about the future.

The mathematical expectation of future benefits is the product of the probability of success and the expected benefits if successful. The probability employed in a particular year reflects the degree of certainty concerning the anticipations for that period. The probabilities used in the computations might be different for various years in the life of the project due to changes in degree of certainty for the

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21 Seiler, *op. cit.*, pp. 177-78.

periods involved. Thus, the best available estimates for each year are employed in the determination of anticipated benefits for that year.

Mathematical expectations are a refinement of the informal judgment employed in the determination of future benefits. The use of probability measures may become more widespread in the future as research and development decision-making becomes increasingly scientific.

Scientific Planning Techniques

Companies have been spending an increasing share of their funds on research and development activities. Firms cannot undertake all proposed research projects due to the limited supply of financial resources for investment in such endeavors. Research investment planning entails an orderly selection of alternative uses for corporate funds which satisfy company objectives and enable the pursuit of long-run profit maximization.

An initial screening process should be undertaken to verify that a proposed research project complies with company goals. A project passing the initial screening should be subjected to a detailed analysis of technical, financial, and economic matters. The company must have the technical resources to undertake the project or be able to hire outsiders who have such abilities. An evaluation of the estimates in the proposal should be made to confirm that the expected

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cost is reasonably stated and that financial resources are available to implement the project.

An economic analysis should be made of all proposals conforming to the preliminary requirements to determine which projects are profitable. The proposals should be ranked in order of profitability so that management is aware of the relative desirability of the proposals. Projects are sometimes undertaken to satisfy legal requirements, to enable the company to keep pace with competition, or because management believes that a project will provide future benefits even though it cannot be deemed profitable. However, caution must be exercised lest undue importance is attached to a project because an executive thinks it has high priority and must be undertaken regardless of its profitability.

**Profitability determination**

There are numerous ways to compute project profitability. The simple rate of return involves a determination of the proceeds per dollar of outlay and is found by dividing average investment returns by the investment cost. The average rate of return is computed by dividing the expected average net operating advantage by the average amount invested for the period. A serious deficiency of each of these two profitability measures is that the timing of the expected returns is completely ignored. These methods lead to the conclusion that a project earning nothing for four years and $500 the fifth and last year is equal in profitability to a project involving the same investment
but earning $100 each year for a five-year period. Because of the time value of money, an amount earned in a short period subsequent to the investment is worth more than the same amount earned over an extended period. Thus, these two measures are not accurate profitability determinants.

Another profitability measure often employed is the payback period, which is the length of time for a project to return the initial investment. A project costing $1000 and returning $300 per year has a payback period of 3 1/3 years, as does a project costing the same amount but earning $100 each of the first two years and $600 per year thereafter. The payback method incorrectly considers the time when the initial investment is recovered and completely ignores returns subsequent to the point where investment benefits equal investment cost. This measure must be considered unacceptable when employed as the only profitability index, but it may be useful in choosing between projects which are otherwise equally profitable.

Executives often use subjective judgment in deciding particular courses of action. Subjective judgment enters into many managerial decisions and its influence in business cannot be denied. Nevertheless, an attempt to determine profitability in an objective manner is essential for any decision made on the basis of contributing to the company's aim of long-run profit maximization.

Present value, investment yield. The present value of net cash flows is a valid measure of profitability which management can employ in research project selection. This measure is also called discounted
cash flow, the internal rate of return, or the time adjusted rate of return. The present value is found by estimating the net cash flows for each period in the life of a project and discounting them to the present by using an assumed interest rate as a discount factor. If the present value equals zero, the project is expected to earn the rate of interest employed as the discount rate. The actual rate of earnings is higher than the discount rate if the present value is positive, while the effective interest rate is lower if the present value is a negative amount.

The minimum acceptable (cut-off) rate of return might be employed as the discount factor to find the present value of the investment. A better measure of profitability can be found by employing the firm's cost of capital as the discount rate. A positive present value would then indicate that the actual earnings rate on the investment exceeded the cost of capital, so that the company would be financially better off if the investment were undertaken. A further refinement of this concept is to use a rate somewhat higher than the actual cost of capital to provide for investments that produce little or no earnings and to compensate for the risks of individual projects, which are generally greater than the average hazards of the enterprise as a whole. ²⁴

The advantages of the present value method are that it is economically realistic because it confines the analysis to cash flows

²⁴Joel Dean, "Controls for Capital Expenditures," op. cit., pp. 11-12.
and does not rely upon arbitrary definitions of investment or earnings, it concentrates on the whole life of a project and not just a portion of the life, and it properly considers the timing of all necessary outlays and inflows of the research project. However, the present value method does have a disadvantage since the projects whose present values are positive cannot be ranked according to profitability. The reason is that the computation produces a dollar amount by which the present value of the cash inflows exceed (when the present value is positive) the present value of the cash outflows. The magnitude of this dollar figure is not an adequate profitability measure since the relative costs of the proposals are ignored (e.g., two projects having the same positive present value are equally profitable only if they require the same amount and timing of investment).

The investment yield (return on investment) may be employed to compensate for the weakness in the present value method. It is the rate of return that, used as a discount factor, makes the present value of the estimated cash flows exactly zero. This can be accomplished by employing different rates from present value tables on a trial and error basis. The investment yield is the rate of interest to be earned on the investment if the actual results turn out as anticipated. The investment yields, as percentages, can and should be used to rank projects on their relative profitability.

Measures currently employed. Research investment planning and capital budgeting should be approached from the standpoint of obtaining the best possible estimates of cash flows and profitability. In a study of capital-expenditure decisions in forty-eight companies in 1959, Istvan reported that half of the firms used the simple rate of return as their primary profitability measure while only a minor portion employed the present value of net cash flows as their chief criterion; further, two thirds of the firms used the payback period and simple rate of return as primary or supplementary measures but only one third employed the present value method in these capacities. In a similar study of research investment planning in approximately 120 companies in 1964, Seiler found that about half the firms used rate of return as a primary or supplementary measure, a third used the payback period, and about twenty percent employed present value analysis in evaluating project profitability.

As stated above, the present value of net cash flows and the investment yield provide management with valid profitability determinants and a means by which projects can be ranked according to desirability. It is asserted that the present value and investment yield measures should be used for investment projects selected for profitability even though these methods are not widely employed in present practice.


27 Seiler, op. cit., p. 176.
CHAPTER IV

AVAILABLE RESEARCH INFORMATION

Field research was conducted to assess the availability of research cost and benefit information. Another objective of the field study was to determine the type of research planning and analysis employed by the companies visited.

Field Research Methodology

The field research was limited to one firm in each of several industries so that a variety of research programs and experiences could be studied. Several people helped compile a list of corporations in nearby communities that had research information available and whose executives were willing to spend a few hours discussing such data. Due to the confidential nature of some research information, the executives of the contacted corporations were told that the firms would remain anonymous. Six companies, each with sales exceeding fifty million dollars per year, were finally selected for the personal visitations.

The six companies visited do not constitute a random sample. On the contrary, firms were selected for visitations because of the willingness of the executives to discuss their research programs. Although the discussions seemed to provide several different viewpoints,
the field research findings should not be construed to mean that other corporations employ identical procedures or have the same research characteristics.

Facts investigated

No pre-set pattern of questioning was employed on the visits. An attempt was made to discuss a wide variety of matters relative to the research effort so that an evaluation of each research situation might be made. Certain facts were, however, elicited at some time during the conversation with the corporate executives (some were research executives, others were members of top management in financial or accounting areas).

The determination of the overall research budget was discussed, as well as the related question of the relationship between research spending and total sales in recent years. The executives were asked the approximate length of research projects and of product life cycles, as well as for comments on any noticeable changes in these factors. The purchase of other companies for additions to product lines and the sale of development ideas to other enterprises were briefly discussed.

Much of the conversation related to the problem of project selection. The executives were asked if company goals were very important in research project selection and if the researchers were permitted to work on projects seemingly unrelated to present corporate endeavors. Another area of questioning involved the use of economic evaluations in project selection. The executives of firms requiring
benefit estimates were asked if there had been an effort to find the relationship between the expected and actual benefits of research projects. Related discussion dealt with problems encountered in predicting research benefits and in analyzing basic research projects. The executives were asked about the frequency of project abandonment and whether such decisions are based on technical or economic matters.

Summary of Field Research Findings

The answers to selected questions emanating from discussion with the executives interviewed in the field research study appear in Table 4 on the following two pages. More detailed findings of the research situation in each of the six companies visited appear in the Appendix.

Although the research budget in each firm is developed in a slightly different way, all six companies essentially base the research budget on the past year's research expenditure plus allowances related to sales increases. This agrees with another study of research decision-making which found a definite correlation between research and development spending and sales.\(^1\) The increased budget allowances, however, are not necessarily limited to the proportionate increase in sales. As a result, the trend of research spending as a percentage of sales in the six surveyed corporations ranged from little or no increase in one to a substantial increase in the relationship in another company.

<table>
<thead>
<tr>
<th>Question</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the research budget based on the past year plus allowances related to sales increases?</td>
<td>A: yes, B: yes, C: yes, D: yes, E: yes, F: yes</td>
</tr>
<tr>
<td>What is the approximate trend of research spending as a percent of sales in recent years?</td>
<td>A: very slight increase, B: gradual increase, C: slight increase, D: substantial increase, E: steady increase, F: little or no increase</td>
</tr>
<tr>
<td>How long are most research projects?</td>
<td>A: 2-4 years, B: 1-2 years, C: 1-2 years, D: some less than six months; other 1-2 years, E: 4-6 years, F: 7-8 years; some over 15 years</td>
</tr>
<tr>
<td>Approximately how long are the product life cycles?</td>
<td>A: some 5-6 years; others 15-20 years, B: 7-8 years, C: 5-6 years, D: 15 years or longer, E: 7-8 years for some; others much longer, F: 15-25 years</td>
</tr>
<tr>
<td>Does the company restrict research projects to those closely related to current product lines?</td>
<td>A</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>What economic considerations are employed in project selection?</th>
<th>none due to defensive research</th>
<th>none due to defensive research; consultant recommends present value</th>
<th>payback period, relation of sales to net income</th>
<th>just began using present value</th>
<th>investment return by years, payback period; plan to use present value</th>
<th>margin between price and production costs</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>What is the main type of research project?</th>
<th>product improvement</th>
<th>new product development</th>
<th>product improvement</th>
<th>new product development</th>
<th>new product development</th>
<th>product improvement</th>
</tr>
</thead>
</table>

| Is project abandonment based on technical or economic considerations? | technical | economic; decision often emotional | technical and economic | technical; just began considering economic | technical and economic | technical |

TABLE 4 (CONTINUED)
Research projects are sometimes finished in less than six months in one firm, while those in another occasionally extend over fifteen or more years. Most research projects, however, are completed within six years in all but one firm, and they are normally finished within two years in half the companies. Some product life cycles are approximately five to eight years while other products remain useful for fifteen years or longer. Many executives stated that the life cycles of their products have been decreasing in recent years due to the increased pace of technological change.

Some of the companies have purchased other enterprises in an effort to expand their product lines, but the general feeling of the executives was that this approach had not been as fruitful as the products resulting from corporate research activities. A few of the corporations sell development ideas to outsiders when the company does not want to pursue any further certain research endeavors, but this does not occur very often.

**Project selection**

Company goals and the desire of management to restrict research efforts to those projects closely related to current product lines are a major influence on the type of research project selected in three corporations. Although the executives of the other three firms are concerned with trying to fulfill company aims, they are much less restrictive on project selection. The latter three companies, to varying degrees, encourage their researchers to develop ideas which
might result in the expansion of the corporation into new endeavors. However, the executives of all six surveyed companies stated that top management would closely evaluate the facts before approving research projects which might lead to products having characteristics vastly different from the present products with regard to such factors as a change from producer to consumer goods, or vice versa, or a change in marketing or distribution channels or policies.

Four of the surveyed corporations employ some type of economic evaluation in project selection. Two of these have changed methods in the recent past, and further changes are expected by most executives interviewed. The economic evaluations employed include present value analysis, the payback period, investment return by years, analysis of the margin between price and production costs, and the relation of sales to net income. The two firms which do not presently require a formal evaluation on an economic basis are primarily concerned with defensive research to keep pace with competition. These latter two companies tend to follow rather than lead in the introduction of product changes or new product ideas. One of them recently employed a management consultant to study its research decision-making process, and he strongly recommended the use of economic criteria. Management in the other company is not quite ready to admit that such factors should be considered, but further complications in the next two or three years may cause a change in their attitude.

Competition in some products results in decreases in unit selling prices when additional firms enter the market, but about half
the executives felt that their products were competing on a quality rather than a price basis. Nevertheless, management in companies projecting research benefits must consider the possibility that sales prices might decline in future periods.

New product development projects receive the most attention in three corporations, and product improvement projects are emphasized in the other three firms. None of the six companies have performed a sizeable amount of basic research in the past and none plan much change in emphasis in the near future. Most of the companies consider technical factors when deciding whether or not to abandon research projects, and three consider both technical and economic matters. None of the corporations have abandoned very many research projects in the recent past.

Need for further research

The relationship between expected and actual research results needs much more attention than has been devoted to this subject in the past. Many executives assume that the benefit projections are reasonable but do not have an objective basis for such conclusions. It is entirely possible that factors other than those presently being considered in the estimation process are partially responsible for the research results.

Efforts should be expended to improve the research decision-making process. Many companies have research investment committees consisting of top research and management executives, but the work
appears to be very loosely organized. Occasionally, research decisions are due to the opinions of one or two influential individuals rather than the feelings of a majority of the committee members. Even more important, some decisions are made without regard to the facts and estimates which are available to the committee. It is not likely that all research decisions will be correct, but the possibility of making the proper decision in the circumstances would logically be enhanced if all available data were carefully considered before a decision was reached.

Very little time has been devoted to postauditing research projects and auditing the research function. Brief studies which have been undertaken by the corporations visited suggest that many improvements might be made in analyzing research proposals and in increasing the efficiency of the research effort. Further research should be performed to demonstrate the benefits available to management in studying past research projects and in periodically reviewing the research function.

Research Cost and Benefit Information

The field study provided an opportunity to determine whether or not information concerning the cost and expected benefits of research
projects is available, as well as an indication of the general reliability of benefit estimates.

**Research project cost**

The cost of individual research projects is now available, or could readily be determined, in all six companies visited. Wages and supplies comprise the largest portion of research cost in the firms included in the field research. Most executives reported that their company has (or would have) very little difficulty allocating overhead to the projects. Some corporations do not require overhead allocations at present, preferring to have such charges shown separately from the direct costs incurred on research projects.

The determination of basic research project cost might prove difficult in some cases. Most companies visited do not require the submission of basic research project proposals. Research administrators permit researchers to spend a small portion of their time in, hopefully, a productive manner on basic research endeavors. Many executives expressed general displeasure at the past results of basic research efforts and thought that additional controls might be instituted in the future with respect to basic research projects. Basic research ideas that progress very far generally must be approved through the
proposal process, so the cost of the more expensive basic research endeavors could be readily determined.

**Expected benefits**

Three of the six firms now require benefit estimates at the time of project proposal, and one other company is starting to implement a proposal process which includes estimates of research benefits. The remaining two enterprises are primarily engaged in trying to keep pace with competition through defensive research efforts and do not require formal estimates of research benefits.

Research benefit estimation is often rather difficult for product improvement projects because estimates are required to show the effect on future sales if research designed to improve the product is not undertaken. Executives expressed the opinion that the longer the time between the initiation of research projects and their eventual application, the more difficult the benefit projections become. The most difficult situation encountered in the firms visited was the effort to estimate the future benefits of a product improvement project whose results would not be incorporated into the product until five, ten, or even fifteen years later, depending on the rapidity of technological innovations. Although the estimation of the amount and timing of benefits would be very difficult at the time of research project proposal, benefit estimation would not prove particularly troublesome
if undertaken immediately prior to the employment of the product improvements.

Benefit reliability. The executives interviewed in the field research study stated that very little effort has been made to test the reliability of expected benefits by comparison with actual results. Some companies have not been estimating the advantages very long and therefore don't have much basis for comparison. Managers in other firms have difficulty determining actual benefits since much of their research is concerned with product improvements rather than new product development. The executives in one firm recently attempted to test the reliability of their projected benefits but had to abandon the study after considerable effort. Their corporate files yielded some benefit estimates for the past few years, but almost all of the projects involved new product developments whose actual benefits have not yet materialized to an extent to make a valid comparison with the expected results.

All firms visited have had projects whose results were wholly unexpected. It seems to be the very nature of research efforts to have such occurrences occasionally. The majority of the project results in the selected firms, however, were reasonably predictable. Although none of the corporations have made detailed studies to show the relationship between expected and actual research benefits, executives in those firms employing benefit projections were almost unanimous in believing that such evaluations would confirm a close relationship between anticipated and realized results. The only ones
expressing a contrary opinion were from a company in which the researchers generated benefit estimates. The executives in that firm believe that such research benefit projections tend to have an upward bias due to the researchers' natural enthusiasm for their own projects.

Many executives said that measures were being taken in their organizations to obtain additional information on research results. Research administrators expressed the desire to improve their estimation processes and plan to study expected and actual research results within the next few years. The reliability of research benefit estimates should increase in the future as further attention is devoted to this important subject.
CHAPTER V

PROPOSED RESEARCH ACCOUNTING

Accounting for most expenditures depends on the availability of objective, verifiable evidence. A corporation's accounting system should provide an objective measure of the cost of research and development projects. Research project cost includes wages, supplies, and other direct costs, as well as indirect charges and overhead allocations. Allocation of indirect or overhead charges among projects should not prove troublesome in most firms, as research overhead allocation is similar to the general problem of overhead allocation in industry.

The relationship between expected and actual results of previous research efforts, when available, can be used as a rough guide to the reliability of research benefit projections. The accountant should discuss the research ideas with research and other corporate executives in formulating his opinion on the reasonableness of the research plans. The uncertainties associated with research investments in the company and industry must also be considered. The research plans of management provide objective, verifiable evidence for accounting for research expenditures. The accountant should employ these plans, as well as
his professional judgment, in determining the proper handling of a particular research expenditure.

Research Expense Recognition

Research costs should be capitalized as assets whenever research benefits are reasonably anticipated, but should be expensed in the absence of reasonable expectations of future advantages. As discussed in the second chapter, assets are equitable interests which are expected to provide future benefits, whereas expenses are items not expected to benefit future periods.

Basic research project costs should be expensed as incurred. Similarly, the costs of other research projects should be written off as soon as it is determined that the efforts will not be fruitful. These costs should be expensed due to the absence of a reasonable anticipation of economic benefits in the foreseeable future.

The costs of successful projects concerning product or process research, development, or improvement should be capitalized. Expensing such outlays immediately violates the matching principle, which stipulates that an attempt must be made to mate the costs incurred with the revenues realized as a result of those costs. Research costs should be deferred to the future as assets whenever future revenues are reasonably anticipated.

These recommendations are intended to be general guides to action. Problems related to capitalizing or expensing the costs of some research projects may be difficult to solve. Such situations
require very careful attention, but the decision should be based on the best available evidence concerning the presence or absence of future economic benefits.

**Amortizing capitalized research**

The benefits expected from research projects provide sufficient objective evidence for determining the pattern of expense recognition (asset amortization) at dates subsequent to the initial expenditure. Capitalized research costs should be amortized by considering the amount and timing of the anticipated benefits. The allocation of cost to expense must be based on the expected benefits to implement properly the matching principle.

The research investment plans of management contain the expected future benefits of each research project. The investment yield should be determined for each project by finding the rate of return which makes the present value of the research expenditures equal to the present value of the expected benefits. The research expense to be recognized in a period (the portion of cost to be amortized) is the present value (as of the research expenditure date) of the benefits expected to be received during that period. The investment yield should be employed as the discount factor in present value computations. The research cost to be deferred to the future as an asset is the present value (as of the research expenditure date) of the benefits expected in subsequent periods. The anticipated benefits provide a basis for
amortizing capitalized research expenditures consistent with managerial expectations and producing a good matching of costs with revenues.

The benefit estimates employed in amortizing capitalized research costs should be realistic. Research proposals sometimes include optimistic or pessimistic estimates, but the amortization process should be based on the benefits which are expected to occur. Adjustments may be necessary to make the expectations realistic if researchers generate the estimates, since they might unknowingly permit their enthusiasm to influence benefit projections.

The ideal of revising anticipated benefits periodically is not widely employed at present. The expected benefits which appear in the research proposal should be used as the basis for calculations unless better estimates of anticipated benefits become available. A revision of expected benefits just prior to the time research benefits commence would be very worthwhile in obtaining the best possible matching of costs and revenues. Increased attention to benefit estimation may result in more frequent revisions of such projections in the future.

Changes in expectations

The cost of a research project, capitalized on the expectation of future benefits, should be written off as a correction of prior periods' earnings if it is later ascertained that future benefits will not likely be realized. Similarly, the cost of a research project expensed due to the absence of a reasonable anticipation of economic benefits should be capitalized as an asset if it is subsequently found
that the research project will probably provide economic advantages in future periods.

The actual benefits realized, or the expected benefits in subsequent periods, may differ from the original benefit expectations. In such cases, the revised information is the best available objective evidence for expense recognition and a revised investment yield should therefore be calculated. The investment yield to be employed as the discount factor in present value computations should always be such that the present value of the net cash flows currently anticipated is equal to zero. The charges for prior periods should be adjusted to what they would have been according to the revised investment yield calculations whenever anticipated or actual results change after expenses have been recognized.

These changed expectations cause increases or decreases in retained earnings. A related problem, however, is how such adjustments of prior periods' earnings should be disclosed on financial statements. These corrections may currently be shown on either the income or retained earnings statement. Permitting such a choice is not in the best interests of sound accounting, but the satisfactory solution of this difficulty is much beyond the scope of the present discussion. For purposes of this dissertation, corrections of prior periods' earnings should be shown on the income statement if the all-inclusive
earnings concept is employed or on the statement of retained earnings if the firm reports income following the current operating concept.

Conclusion

The inconsistency between research investment planning and accounting has been excused because of the apparent lack of a satisfactory basis for amortizing research costs over the periods benefited. The theoretical considerations underlying research accounting have been presented, as well as the managerial efforts related to the selection of sound research investments and the availability of research cost and benefit information in six selected companies. The research accounting proposal was based on these theoretical and practical considerations.

The expectations employed by management in planning research investments provide sufficient objective evidence for the capitalization of industrial research expenditures. Future benefit anticipations, contained in research proposals and subsequently revised to reflect current expectations, provide an objective and logical basis on which to amortize capitalized research costs.

There is no valid reason for the current inconsistency between research investment planning and accounting for industrial research expenditures. Responsible accountants must act to remove this and other inconsistencies from current accounting practice. Failure to act may lead to a complete lack of confidence in corporate financial statements.
APPENDIX

FIELD RESEARCH FINDINGS

Company A

The research budget in this corporation is based on a summari-
ization of the costs of research project proposals. Top management
reduces the budget if it is too high relative to past research
expenditures and the expected increases in sales revenue. Research
spending in the past few years has been increasing very slightly as
a percent of sales.

The executives feel that some research is mandatory, so
researchers are assigned work on the best available research projects.
Much of the research performed is defensive, as the firm attempts to
produce better products than those of competitors. There is a very
definite attempt to restrict research to the product lines in which the
company wants to compete.

The research executives in Company A have made very few attempts
to forecast expected research benefits because it is "too difficult." Many research projects are directed to product improvement, so that
benefit estimates depend on forecasts of sales with and without the
improvements. However, such sales projections are not presently made
by Company A.
An executive committee evaluates research projects semiannually to determine progress, but the evaluation is primarily technical. Projects may be abandoned if the company is not presently able to produce such a product or the executives do not want to expand the firm's facilities or product lines for the item. Due to the belief that some research is mandatory and the fact that a majority of research time is spent on product improvement projects, the corporate executives do not intend to employ an economic evaluation basis to research project selection in the foreseeable future.

Most research projects last from two to four years. The product life cycles vary greatly, some products being useful only five or six years and others fifteen to twenty years. The company has done very little basic research, being content to follow rather than lead in product innovations. A sizeable amount of research has been conducted under government contract, and this is expected to continue. A minor portion of the ideas developed under these contractual arrangements have been helpful in their commercial products. Other companies have been acquired as a means of expansion, but the results have not generally turned out as well as anticipated. Management intends to be more restrictive on acquisition policies in the future.

Company B

Past spending plus allowances for increases, related in general to expected sales and net income, provide the basis for establishing the research budget in Company B. Research expenditures have been
gradually increasing as a percentage of sales in the recent past. Executives in the firm seem overly concerned with the size of net income and the market price of their stock. Large research projects proposed near the end of a fiscal year are sometimes deferred until the subsequent year due to the unfavorable effect on net income and the desirability of the company stock as an investment.

An executive committee makes decisions on research spending and project selection, but the committee seems to be very loosely organized. A project may be undertaken simply because an influential committee member likes the idea. As a result, many research decisions are emotional rather than factual ones. The executives make a very definite attempt to define the product line rather narrowly and to exclude projects which don't fit into the firm's plans.

A majority of the research projects are defensive, being concerned with trying to keep pace with competition. There has been very little attempt to estimate possible benefits as the executives believe that many of the projects are necessary to maintain the corporation's competitive position. Most projects are concerned with new products, but the company has done very little basic research. A majority of the basic research conducted was in connection with governmental contract projects and the information proved helpful in their commercial research efforts. Most projects are rather short, lasting between one and two years. The product life cycles are generally not more than seven or eight years. Projects have been
abandoned if management thinks they will not prove beneficial, but again the decision is an emotional one.

A management consultant recently studied the research program of Company B. The consultant recommended that the executives employ economic evaluations (including present value analysis) in their research decisions. He also recommended that a person be hired to evaluate research proposals for the executive team rather than proceeding haphazardly as at present. The inadvisability of the present decision-making process was clearly pointed out in the report. Due to rapid changes in technology in the field, the consultant also recommended that the firm expand its interest in basic research efforts. The executives thought that further efficiencies might be obtained by hiring a consultant to evaluate their research program, but many of them believe that their judgment is superior to economic evaluations. Although the recommendations of the consultant are being considered, implementation is proceeding very slowly.

Company C

The overall research budget in Company C is related to sales after providing for increases, particularly for expanding product lines. Total research spending has increased slightly as a percent of sales in the past few years. Top management decides how the research budget should be apportioned to the various divisions within the corporation. A research executive committee evaluates project proposals in deciding which projects to undertake.
Researchers, with the advice of other departments, develop cost, sales, and net income forecasts for the projects for a period ranging from five to ten years. The executive committee studies the proposals, generally selecting projects with a satisfactory payback period and a good relationship between sales and net income for the first few years. The committee considers most of the factors that present value analysis employs, but does not use this profitability measure as such. One reason is that many projects are concerned with product improvements so that benefits are very hard to estimate. A more important reason is that the executive committee tends to distrust the estimates of the researchers since there is a natural tendency for them to overestimate expected research benefits.

The firm has not been successful in attempting to determine the relationship between actual and expected research results. However, the prevailing feeling is that the overestimate of benefits is much less than ten percent in most cases. The executives of Company C are looking for better economic evaluation measures, but believe that research decisions must rely on the judgment of the executive committee due to the uncertainties involved. The committee reviews research projects at least once every two months and may decide to abandon a project if a researcher thinks it will not turn out as expected in a technical manner or if management believes that additional costs will make the project economically unfeasible.

Most projects are relatively short, lasting one to two years. The product life cycles are also relatively short at five or six years.
The sale price per unit tends to decline after two or three years when additional competition enters the market. The company has done a limited amount of basic research in the past. Decisions on basic research are about the same as for other research proposals, although the researchers are not greatly limited in their efforts. The corporation is not very restrictive on the type of research project undertaken so long as it fits the general scheme of products, which is rather widely defined. The executives seem willing to expand into new areas of endeavor if such undertakings appear reasonably profitable.

Company D

The Company D research budget is based on past expenditures plus rather sizeable allowances for increases indirectly related to sales projections. As a result, total research spending in the recent past has increased substantially as a percent of sales. The selection of projects within a product area has been left primarily to the discretion of the division head, although subject to the approval of an executive committee. Similarly, project abandonment was based on technical matters as decided by the division head.

A detailed analysis was made when top management began to have misgivings about the research program. This study showed that numerous projects should not have been undertaken. A personnel shakeup resulted and research decisions are now made by committee action. The committee requires estimates of cost, sales, and net income for a ten to fifteen year period. The committee is employing the present value approach as
an economic indicator for research projects, most of which are concerned with new product development. Quarterly reports are prepared, including a technical appraisal as well as a cost analysis, to decide which projects should be continued and which ones abandoned.

Some research projects are extremely short (less than six months), but most last from one to two years. The product life cycles tend to be lengthy, being fifteen years or longer for some products. Most of the competition is on a quality rather than a price basis. Due to the expansion of the company as a result of research, many of the present products were not in existence five years ago. The executives attempt to limit research projects to the present fields of endeavor, defining these rather broadly. Company D has not performed much basic research in the past, but the committee anticipates analyzing basic research proposals in the same way as other research projects. Some executives doubt that this will work due to the greater uncertainties connected with basic research.

Company E

The research budget in this company is based on man-hours and an executive committee decides if it is acceptable based on the past year plus allowances for increases related to sales and net income projections. Total research expenditures in Company E have been steadily increasing as a percent of sales.

Research project proposals include estimates of cost, sales, net income, and return on capital invested for a ten-year period.
Proposals are evaluated by considering the investment return by years, the payback period, and the expected contribution to long-run profit maximization. Optimistic, realistic, and pessimistic estimates are usually presented. Actual calculations are generally based on the realistic figures, but the executive committee may reject a project whose pessimistic indications are too low. Most of the projects are concerned with new product development. The corporation is not very restrictive on the type of projects researched.

Projects are reviewed quarterly, the estimates being revised as needed. Projects are abandoned for technical or economic reasons. If the company doesn't want to get into a product line but has done some meaningful development work, the ideas might be sold to another firm. Company E changed over to the present evaluation basis a few years ago, and the executives do not yet have enough information to test the reliability of their estimation process. They believe, though, that the estimates provided by marketing and production have been reasonably reliable. In addition to the present evaluation bases, the executive committee plans to add present value analysis in the near future.

Research projects tend to be lengthy due to numerous tests that must be conducted. Many projects last four to six years or more. The product life cycles vary, some being seven or eight years and others much longer. The prices of many products tend to taper off after three to five years when competition becomes more severe. Due to the variety of tests that must be performed and the resulting length of research projects, PERT is employed in research project control.
The company has done some basic research which has been quite successful in terms of patents and ideas, but not in terms of profits. Additional measures to increase the profitability of basic research expenditures are being studied. In the past, management allowed researchers to spend a small portion of their time on basic research projects and exerted very little control over such activity. Some executives believe that a very minor portion of a researcher's time should be spent in this fashion, so that anyone intending to devote many hours to a basic research project should first submit a proposal.

Company F

The corporate research budget is based on man-hours and a committee reduces it if it is too high in relation to previous years. Allowances for increases from the prior year are based on expected sales increases. Research expenditures have been fairly steady as a percent of sales in Company F, showing little or no increase.

The sales department determines the demand and price of a product contained in a proposed research project, as well as the anticipated influence on related products. The production department is responsible for forecasting costs. Research projects are selected if the margin between price and production cost is sufficient in the opinion of the executive committee. Many projects are product improvement oriented with particular emphasis on quality improvement.

The executive committee reviews projects monthly. The decision to abandon a project is seldom based on costs, but may be due to
feasibility in a technical sense. The executives place definite restrictions on the type of research being conducted so that efforts are limited to product lines in which the corporation wants to compete. Management does not plan to use economic evaluations other than margin analysis in project selection.

Research projects tend to be quite lengthy. Seven or eight years are often spent on research projects, and some concerned with new products have lasted fifteen years or more. Part of the reason for the length of the product improvement projects is that the researchers perform work that will be needed in the future but no one knows when the data will be required. The product life cycles are commonly fifteen to twenty-five years long. Company F has grown some by licensing their patent rights to others and by acquisition. The executives feel that patents are important in the industry but that know-how is more important. Thus, competitors cannot seem to catch up to the industry leaders simply by spending more research funds.
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