CAPITAL BUDGETING

by

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ABSTRACT

Capital budgeting is a form of systematic planning of expenditure in order to achieve sound investment programs which fulfill management's trusteeship obligations; the care and effective use of those funds entrusted to them by their shareholders and investors.

Capital budgeting is the technique of administering a capital management program. It includes many areas beginning with the creative search for profitable opportunities and ending with retirement and disposal of assets. Between these two decisions lie a host of others all of which are the subject of this thesis: long and short range capital plans, measurement of project worth, screening and selection of alternate proposals.

The study has been developed through four major areas: demand, supply, and cost of capital, and evaluation of capital expenditure proposals. This comprises a well defined concept of capital budgeting about which much has already been written. In addition to drawing this material together, Capital

Budgeting seeks to evaluate the concept as a tool of practical business. How valuable is this approach to practicing management? While it seems logical to expect that much use would be made of the concept of capital budgeting; in fact, business has found some limitations in its use, particularly with the return on investment criterion. In fact, substantially less use of this approach is being made than might have been expected in view of the enthusiastic promotion it has received in the accounting literature of recent years.

Capital budgeting procedures are no panacea for management's problems, nor are they a substitute for good judgment. All factors influencing a decision cannot be reduced to quantitative formulae and any reliance on such seemingly meaningful arithmetic manipulations to the exclusion of the exercise of sound judgment will lead to serious problems. In particular the return on investment criterion as an aid to measurement and evaluation of capital expenditure decisions has an important and valuable contribution to make, but must be viewed in the perspective of the total of all factors to be

considered. Those who claim that such a criterion can embrace all factors, that is, meet the test of all-inclusiveness, are misled and cannot but be disillusioned at the shortcomings of such an attempted evaluation.

TABLE OF CONTENTS

INTRODUCTION

> Capital budgeting is an exercise in economics. It is that kind of systematic programming required for sound investment of stockholders' money. Planning and control of capital expenditure is the basic management function because management is employed to administer stockholders' funds and to maximize their earning power. In a broad sense, therefore, production, marketing, personnel and accounting can be viewed as subsidiary problems to administering management's trusteeship over capital.
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> Until recently, little attention has been paid to capital budgeting, per se, especially by economists, and there exists a wide gulf of unknown water between economic theory of investment and management's decision to spend.[1]

Capital expenditure is the basic ingredient of capital budgeting. This term as used in this study will include items which do not fall within the accountant's definition of capital. For purposes of evaluation one must think of capital expenditure in an economic sense. The essential criterion is the rate of turnover into cash. In practice some items of a minute nature

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1 Joel Dean, Capital Budgeting, (New York, Columbia University Press, 1951), pp. 1-3.

must be excluded from consideration regardless of their rate of turnover into cash. Most of the items classified as "Current Assets" on a standard balance sheet will also be excluded. Although involving a cash outlay, their turnover period is usually short enough and control over that turnover sufficient enough to make them adjustable in a reasonably short time. It is the major expenditure which ties up capital inflexibly for long periods that merits consideration for capital budgeting.

> Wise capital budget decisions are of the utmost importance to both the nation and the company making them; to the nation because they give it a modern, efficient, and complete industrial plant; to the company because they help it keep its place in our dynamic economy.[2]

This inquiry includes the four major areas of consideration that normally comprise the construction of a capital budget. The first of these is the demand for capital, involving a survey of the need for capital expenditure and a survey of profitable opportunities for invest-

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2 J. A. Griswold, "More For Your Capital Dollar", Controller, October, 1957, p. 480.

ment. This is the phase that is usually regarded as "preparing the budget" in many companies. In fact, as we shall see, this is only the first phase and a fairly small part of the total requirements of a capital budget.

If the need is present, the next logical consideration is the source of funds to fill that need, i.e. the supply of capital. This consideration can be easily broken down into two major parts. How much of the needed supply can be generated from within the company? It must be noted that this supply is cash and may differ from the company's profit. The second part is how much of the supply can or should be obtained from outside financing. The decision must be made whether outside financing is to be considered at all. If money is to be raised from outside sources what form of financing will be used; debt financing or equity financing?

To answer the questions of supply through internal or external financing, the cost of capital must be examined. Current market conditions and the cost of the various forms of outside

financing must be analyzed to determine the practicability of the proposed financing. The cost of capital also introduces a question of the timing of investments which must be interrelated to the need or demand for capital.

If it is possible to obtain all the information needed pertaining to the demand, supply and cost of capital, how shall a decision be reached, that is, a capital budget constructed? Some form or standard of evaluation is required. Possible standards will form the final or fourth section of this paper. There are several forms of quantitative measurement that have been proposed and used. These will be discussed in Chapter VI and VII. Some expenditure proposals do not lend themselves to quantitative evaluation however, and as a result the task of deciding among alternatives becomes a very difficult one for the administrator. The final element of the measurement phase, the establishment of a scale or priority of investments (with the attendant factors of rationing of capital and rejection of proposals that cannot be justified)

results from the comparison of the individually evaluated proposals.

CHAPTER I

A CAPITAL MANAGEMENT PROGRAM

Capital budgeting and the methodology surrounding it is a subject that has come into fashion in recent years. It has received a great deal of theoretical treatment and has acquired as a result, an aura of mysticism that obscures its value to the practical businessman. Capital budgeting is concerned with designing a systematic program for investing funds. It is ordinarily thought of as pertaining to durable plant but embraces much more. It can and should be considered when planning a long term advertising program, building a marketing organization, setting up a management training program and a good many other investment decisions. In many cases the circumstances do not lend themselves to quantitative expression. Capital budgeting, although applied, is much less objective than in the case of measurable committments where returns can be expressed quantitatively.

One should not be misled into thinking that the tools and theories related to capital budgeting are new. General Motors and Dupont formalized the Return on Investment concept as a basic ingredient of capital budgeting thirty-five years ago. What is relatively new is the emphasis being placed on these tools as a general management aid to investment decisions.

In his article "Measuring the Productivity of Capital"[3], Joel Dean defines ten components of a capital management program which summarize the scope of the whole problem. In this discussion items 2, 3, 4, and 5 will be emphasized but they must be considered in the perspective of a total program.

1. Creative search for profitable opportunities.

   The first stage is conception of the underlying profit-making idea which is to be embodied in the capital facility. Turning up profitable opportunities for investing company's capital is in part a

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3 Joel Dean, "Measuring the Productivity of Capital", Harvard Business Review, January, 1954, p. 122.

by-product of good management. But this cannot be depended upon to provide the plethora of enticing capital proposals that constitute the raw material for good management of capital expenditures. Inadvertant opportunities should be supplemented by an active program of seeking out and investigating such opportunities.

2. Long range capital plans. To provide consistent bench marks for proposals originating in all parts of the organization, it is necessary to have some kind of plan sketched out for the future. Individual proposals should conform to this broad planning.

3. Short range capital budget. Listing of a project in a yearly capital budget indicates only that it is approved as being worthy of detailed study for that year.

4. Measurement of project worth. This is the stage where evaluation criteria are applied to justify the project by financial

and economic analysis of its investment worth to the company.

5. Screening and selection. The individual project must be compared with other rival projects in the light of cash available, cost of capital, and the attractiveness of alternative investments.

6. Control of authorized outlays. This phase involves a system of control and comparison to the authorized budget.

7. Post mortems. Reassessment and reappraisal of both cost and earnings should be carried out after the project has been placed in operation.

8. Retirement and disposal. Management's responsibility for a project ends only when the asset has been disposed of and a suitable future course of action planned.

9. Forms and procedures. Paper work, although a nuisance, is necessary to a smooth operation.

10. Economics of capital budgeting. Wise decisions in this vitally important field of management can only be made if those responsible keep themselves as up-to-date as possible in current economic thinking. Furthermore the accuracy of the answers are only as accurate as the facts on which they are based.

CHAPTER II

THE DEMAND FOR CAPITAL

In order to determine the demand for capital the potential needs of a company must first be surveyed. This is the usual starting point for compiling a capital budget. At periodic intervals a company will canvass all its departments or divisions for expenditure proposals. This is most often done once a year but may be done for much longer periods with reassessments and reviews being made at shorter intervals. In requesting proposals management may define general limits or specify the character of investment that will be considered most favourably but usually few limitations are imposed, the selection or elimination process being deferred until a later stage.

At this point a conflict of purpose often emerges. It revolves around the term "need". Some expenditures may have a subjective need but the amount cannot be justified on the basis of

quantitative evaluation. It is often said that such an expenditure is justified on the basis of making the department or the person in question more effective. Effectiveness becomes very difficult to measure. The consideration of effectiveness often occurs in connection with service equipment or training plans which may involve substantial expenditures.

Immediately it may be seen that this process of capital budgeting cannot be reduced to mechanics. It must contain a substantial element of judgment. This aspect will be referred to in more detail later in the discussion of measurement and evaluation. Many companies take the position that once a major unit has been approved the auxiliary or service equipment for the project is all automatically approved provided the expenditures are within the total amount allocated for the project. In fact, it would appear that some dividing line must be established if the budget committee is not to be burdened with minute items affecting very little the capital budget as a whole.

There is another aspect to the term

"need". This is best referred to by substituting the term "demand". Demand for capital will arise in two areas. One is in the nature of expansion or replacement of major units of a company's enterprise. An example of this kind of demand would be the addition of a new production line to a manufacturer's existing plant. Another area is that of investment of funds in projects not directly connected with the business of the company; for example, long term investment of funds in a land and industrial development by a company primarily engaged in the generation and sale of electricity. In these cases the evaluation of demand can become far more objective and quantitative standards can be more rigidly applied. Application of these standards will be dealt with further in Chapters V, VI, and VII.

Returning to the survey of a company's demand for capital, the next step is usually a marshalling of all the individual needs and the construction of a budget proposal. In order that this may be done, individual proposals will have to be prepared in sufficient detail to arrive at

a tentative total cost and length of time to construct or complete.

CHAPTER III

THE SUPPLY OF CAPITAL

Once the demand for capital is known, the next consideration must be from what source the funds can be obtained or if they can be obtained at all. There are two main sources that may be considered. These are usually called internal and external sources.

By internal sources, it is meant those funds generated by the company in the course of its business activity. It is commonly stated that these funds arise out of depreciation and retained earnings. This statement is misleading because depreciation is not a cash expenditure and no funds are involved in the depreciation charge. A more accurate view of internal supply of funds will result if the cash flow is examined. The funds generated by a business are the cash residue after all cash disbursements are deducted from all cash revenues received in the course of

a period of operation.[4] A secondary internal source arises from the sale of assets such as property or securities. Temporary funds can also be made available through the reduction of working capital. However, this is not a true generation of funds, as working capital merely represents liquid assets which may be put to use as short term investment or retained as cash (the most liquid asset) for the purpose of the day to day operations of the business.

The net funds available from internal sources, are that portion of the total cash generated that is not disbursed in the form of cash dividends to the shareholders. The amount available from this source will depend on three factors: 1) the ability of the business to generate cash, 2) existing committments for use of cash, such as sinking fund requirements, 3) and the dividend policy.[5] Many companies finance all expansion by restricting dividends and plowing back all available funds, not other-

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4 See Appendix B for an example illustrating this view.

5 See Appendix B for example.

wise committed, into expansion and investment.

This practice has made possible much of the growth and rapid progress of many of our industries during the last fifty years. However, the practice might not be justified, as it denies the shareholder (owner) the basic right of making his own decision as to the merit of a particular investment. Management and the Board of Directors are charged with the responsibility of trusteeship of the funds invested in the enterprise. They have an obligation to use these funds wisely and to ensure that a return, equaling the cost of money for that undertaking, is earned for the shareholders. The use to which that return is put is not within management's or the directorate's responsibility. This decision should be left to the shareholders. One way of accomplishing this is to disburse earnings in the form of dividends to the shareholders. These shareholders may then decide to what use the funds shall be put. Management and the directorate would then be required to substantiate their case for expansion through reinvestment, in the same

manner as is necessary for the solicitation of external funds for investment.

S.P. Dobrovolsky[6] points out that a practice of paying out a higher proportion of earnings in the form of dividends would reduce the funds available for investment. One reason for this is that the recipients may choose to spend some of these funds for current purposes, rather than saving them for reinvestment. A second argument is that under present tax law, dividends are subject to income tax, thus reducing the funds available for reinvestment through a forced contribution to the government. The second argument is of significance. To make the proposal outlined above of practical merit would require a change in existing tax legislation. However in theory there is little defence for the first argument even if the facts of it are acknowleged. If a shareholder wishes to spend the returns from his investment instead of reinvesting them, it should be his unquestionable right to do so. It is not for management or the directorate to say what

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6 S.P. Dobrovolsky, "Economics of Corporate Internal and External Financing", Journal of Finance, March, 1958, pp. 35-46.

is the better choice for the shareholder. They may advise but the decision should remain with the rightful owner of the funds.

If the owner of the funds does, in fact, spend the dividend for current consumptions instead of reinvesting, there is no reason to conclude that the total funds available for investment are decreased. The funds expended enter the money stream and are returned to the potential savings of another sector of the economy. The funds available for investment must be viewed as a part of the total money supply and not as a separate pool of funds.

It is recognized and acknowledged that our modern business society involves large diversified ownership; absentee owners who appear to have little interest in taking part in the conduct of affairs that affect their investment. However, it may be suggested that if the freedom of choice of investment were returned to its rightful holder, the owner (shareholder) would become a more aware, and a more significant influence in the disposition of corporate savings.

On the other hand, William C. Hood presents a conclusive analysis on the merits of financing through business saving, that is, through the funds resulting from retained earnings and provision for depreciation.[7] He acknowledges that the provision of funds for capital expansion from retained earnings results in a circumvention of the capital market but points out that this is not undesirable, nor does it produce a misallocation of funds. In the first place, in many cases, projects "are only partly financed in this way, the balance of funds required being obtained from new issues in the capital market".[8] Hence these projects are appraised by the investors at large. In the second place, projects financed wholly from retained earnings receive a market test through the workings of the economy at large of which the capital market is a part. The ultimate test of any undertaking is its profitability and without profits the firm will not survive long.

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7 William C. Hood, Financing of Economic Activity in Canada, Royal Commission on Canada's Economic Prospects, pp. 267-274.

8 Ibid., p. 23.

The important question is this: "does the use of business saving by the savers themselves necessarily increase the possibility of misallocation of resources?"[9] Rather, to discourage retention of earnings by these savers, particularly in the case of small firms, would produce a greater misallocation of funds because the very existence of these firms is dependant on profits and if profitable, they must be meeting the ultimate test of the economy as a whole. To deny this test is to deny the right of these firms to exist at all.

Another argument is that, in fact, the market (the investors) do not subject investment proposals to any greater critical analysis than do the companies themselves. Hence the judgment of the semi-informed investor is a no better evaluation than the evaluation of the firm proposing the investment and cannot be said to result in a better allocation of funds.[10]

Thirdly, the proportion of non-institutional holders of corporate securities is exceed-

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9 Ibid., p. 271.
10 Ibid., p. 272.

ingly small and the decisions as to allocation of funds are thus in large part, merely inter-company decisions. Through external financing one is merely placing the appraisal decision in another institutional hand.[11]

Therefore, while it may be said that, in theory, retention of earnings for expansion is not justified, the practical effect of such an argument has little merit. There is no conclusive evidence to suggest that the multiplicity of decision resulting from the appraisal by the capital market of investment proposals would result in any better allocation or utilization of funds.[12]

Having considered internal sources of capital and some of the factors surrounding their use, the next consideration will be the forms of external financing.

There are two ways to accomplish external financing: through increased equity or by long or short term debt financing. To finance through equity offerings involves going to

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11 Ibid., p. 273.
12 Ibid., p. 267-274.

the present shareholders and/or prospective investors with an offering of common or preferred shares. By long term debt financing is meant the raising of funds through bond or debenture issues. The form of financing chosen will depend on many factors. The most important of these in assessing the profitability of a proposed undertaking, is the cost of capital. Before examining the cost of capital, it must be recognized that, although this will be a very important factor, and in most instances a measurable one, there are several other factors which may influence a decision as to the type of external financing. For example, it might be determined that a common stock offering might be the best form considering cost of capital, condition of the market, present capitalization structure, etc. On the other hand, if the organization is at present closely held and controlled, there may be a great reluctance to let any portion of share control and ownership pass to other hands. In such circumstances the firm may well decide

to use a form of financing that is less desirable from the standpoint of objective considerations but which satisfies better some subjective considerations.

CHAPTER IV

THE COST OF CAPITAL

Before examining the cost of capital's relationship to the forms of financing and the capital budget picture as a whole, we should first consider what is meant by this term "cost of capital".

The compensation for the use of money is usually called interest. Interest is revenue to the lender and cost to the borrower. It is paid on the principal amount borrowed (capital), hence our phrase "cost of capital". The rate of interest is based on both the amount of money and the length of time involved. For this purpose the principle of compound interest has been developed. A brief look at the money market will indicate that there are many rates of interest in use. There is an interest rate, a time period, and a method of repayment to suit almost any lender's or borrower's requirements.

Why are there different rates of interest? It is generally regarded that the interest rate is made up of several components. The first of these is the amount of money, and the second is the length of time before repayment is made. The third factor is what is usually called "risk".

The variation in the interest rate will usually be in proportion to the amount of money and the length of time involved. The risk factor is a subjective assessment of the probability that the future repayment will occur at the time and in the amount promised.

This can be more readily seen if one looks at some examples. Interest rates on government bonds are generally low because the backing of all the resources of the government reduces the risk to a very negligible proportion. The interest rate on mortgages will be higher as the risk of default is greater. Another comparison is that between bonds and common stocks. The prospect of dividends on common shares is less certain than the payment of the interest on the bonds; hence the yield is generally higher than

that for bonds. The yield will also vary with a great number of other factors including the nature of the industry itself, the calibre of management and its history; but basically it is a function of time, linking present value with future expectations through the compound interest principle.

The cost of capital will be a very important determinant in the acceptability of the proposed use of that capital. When considering internal sources of capital, the cost becomes a highly theoretical concept. In a practical sense the company has the funds and it costs them nothing in the way of a cash outlay to reinvest or "plow-back". However, over the long term there is some evidence to suggest that a heavy emphasis on plow-back will depress the price of the company's stock in the market and thereby increase the company's cost of capital for further issues of stock.[13] In a theoretical sense there is a cost of plowed-back earnings. This cost is the amount that such funds as are plowed-back could earn if invested elsewhere.

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13 S.P. Dobrovolsky, op. cit., p. 38.

When considering external sources of financing, cost of capital becomes a very real, actual, cash commitment. The cost of capital in the case of an equity issue is that rate of return demanded by the investors to induce them to release the funds. For example, if the investors are requiring a ten percent return and the company's dividend is currently three dollars per share, the highest price an investor will pay will be thirty dollars per share. Furthermore, there will be no point in going to the market with an equity issue if the proposed investment of the funds raised by such an issue will not yield more than the ten percent stated.

If the payout through dividends is less than 100% of earnings, which it normally is, the minimum acceptable yield from the investment will have to be even greater. For example if the dividend payout is sixty percent of net earnings, the minimum acceptable yield to make the investment proposal worthwhile will have to be greater than sixteen and two thirds percent.

The cost of capital in the case of a bond or debenture issue is the effective yield

of the bond at the time of sale. This should not be confused with the coupon rate, as the sale price may not be the same as the face value of the bond. The cost of bond or debenture capital is the coupon rate of the issue plus any amortization of discount or minus any amortization of premium.

It has been found that the cost of debt financing is usually less than equity financing. Therefore, presumably the earnings of a project could be less under the former and still be acceptable from the firm's point of view, other factors being equal.[14]

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14 D. Bodenham, "On the Problem of Capital Budgeting", Journal of Finance, December, 1959, p. 476.

CHAPTER V

MEASUREMENT AND EVALUATION

Having compiled information and obtained the needed data on demand, supply and cost of capital, the interrelationship of these three must then be considered to arrive at a decision as to the merits of the proposed capital expenditure. Here the subjective and objective criteria available will be applied to test the acceptability of the expenditure proposal and, if approval is given, establish a plan for execution of the project.

There are three standards that are most often applied to the problem of measurement and evaluation. They are postponability, payback, and profitability or rate of return on investment. Each of them will be discussed in turn, and later an attempt to assess their use in terms of actual application will be made.

In order to have a yardstick against which to evaluate the various approaches to

measurement of capital expenditure proposals, some criteria will be enumerated. The requirements of a good yardstick for measuring investment proposals, are suggested by Joel Dean in his article, "Profitability Indices for Capital Investment":[15]

1. Accuracy - measures productivity of capital correctly.
2. Inclusiveness - summarizes project merits in a single figure.
3. Realism - looks only at what happens to what is important - cash.
4. Versatility - makes different types of projects comparable.
5. Parimutuelity - reflects correctly the betting odds on getting the estimated earnings.
6. Simplicity - makes calculation easy.
7. Screenability - lines up with objective screening standards.

A word of caution should be interjected here. Capital investment is a clear-cut yes or no proposition on which management can and will be judged. However, there is a tendency to re-

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15 Joel Dean, "Profitability Indices for Capital Investment", Controller, February, 1958, p. 126.

gard seemingly meaningful arithmetic calculations as the sole criterion to be used in arriving at a decision. These formulae must be considered suspect if management is not balancing the calculations with liberal measures of judgment. Not all factors are measurable and there is no substitute for good judgment.

Two major areas for capital commitments are replacement and expansion. Under the category of replacement might be considered three sub-divisions: the replacement of old, worn out assets; the replacement of old but sound assets with newer ones which will produce more efficiently and with savings in cost; and the replacement of existing assets with new ones for the purpose of improving product or service. In the first instance there presumably is no alternative for the expenditure unless the operation is to be discontinued. This involves some judgment and very likely little in the way of formal assessment of return on investment. In the broad sense of course, it must be determined whether it is more

profitable to stay in the business or invest these funds elsewhere. In this broad sense an evaluation should be made.

When considering a new asset for purposes of cost savings and increased efficiency when the existing asset is not worn out, a quantitative evaluation of profitability should be made as a major factor in arriving at the decision.

In the third category, where the desire to improve product or service is the prime consideration, the decision will have to be based primarily on judgment. A quantitative evaluation can only be useful in this instance to indicate the extent to which the new operation will be as profitable as the former one.

When considering the category of expansion, judgment again must weigh heavily in the final decision. A new item may not be profitable in itself when measured by a formula, but may be necessary in the total operation, or may contribute to the profitability of the total operation. On the other hand, a very profitable undertaking may

be inconsistent with the aims and objectives of the company. As a result, it may be seen that in matters of expansion many factors besides the arithmetic calculations must be taken into consideration and the decision contains a substantial element of judgment. Reliance on a formula alone can be very misleading.

Therefore, although the requirements of a good yardstick previously enumerated are very useful, it will not be possible to find any yardstick which will meet all requirements to the fullest extent that may be desirable. The yardstick selected must meet as many of the requirements as possible. In this way a more informed and precise evaluation is made possible.

CHAPTER VI

POSTPONABILITY AND PAYBACK AS MEASUREMENT CRITERIA

The degree of necessity of the proposed project is one measure of an investment proposal. By this is meant, the extent to which a project cannot be postponed to later years. This yardstick is a useful device in capital budgeting. Some investments must be made just to remain in business, or to satisfy government regulatory bodies. If such is the case, clearly the investment must be made regardless of the economics of the proposal. Nevertheless caution must be used in applying this criterion.

There is a serious defect to this measurement - it fails to apply any quantitative measure of productivity. By productivity is meant the effect on earnings. Suppose, for example, the machine shop of a manufacturing company were destroyed by fire. It would appear that replacement of this asset would not be postponable. The

need is of the highest priority. Yet it might be found if a profitability yardstick were applied, that over-all profits might be enhanced if this work were subcontracted. Clearly caution is in order before accepting projects too blindly on a necessity basis.

The chief weaknesses of postponability as a criterion are:

a) that it does not consider alternatives
b) it does not measure earning power
c) it does not provide a basis for ranking proposals in any order of priority.

Payback is the term applied to the yardstick that is unquestionably the most widely used criterion for measuring investment proposals. Payback means the number of years required for the earnings of a project to pay back the original outlay. It is probable that the very extensive use of this measure is a result of a great deal of short term debt financing. Under short term financing conditions, it is almost essential that the earnings from a project be sufficient to pay back the funds borrowed to finance it, unless

refinancing is planned. This approach has become almost a by-word in capital expenditure proposals.

Payback, like postponability, is also a useful tool in capital budgeting decisions. It is superior to postponability in that it does consider earnings of a project. Its primary use should be as a coarse screen to select high profit projects for further consideration and to reject quickly those projects that show so little promise as to merit no further consideration. It can also be used in appraising projects with a high degree of risk and where the possibility of capital deterioration or wastage is high. Since payback weighs early year earnings heavily and distance earnings not at all, it contains a built in hedge against technological obsolescence, and the possibility of a short economic life.

Payback does have some very serious limitations as a yardstick for investment decisions. It is a cash concept and as a result it fails to measure or reflect all the dimensions of profitability which are relevant.

Firstly, payback tends to overemphasize the importance of liquidity as a goal. No firm can ignore liquidity but long term profits need not necessarily be subordinated to it. Secondly, payback ignores probable economic life. It gives no consideration to earnings of a project after the original outlay has been repaid. At the end of the payback period the project has still produced no net earnings. It is the earnings from this point on that really determine the benefit of the project.

Payback is neither sensitive enough nor sufficiently inclusive to be employed as the sole criterion for capital budgeting decisions.

CHAPTER VII

THE RETURN ON INVESTMENT CONCEPT

The phrase "return on investment" is used to include a wide variety of basically similar approaches to the problem of measurement but which differ considerably in certain respects. Basically the concept is that of profitability, that is, additional return as a result of additional investment.

The methods used in a return on investment concept either determins what the rate of return for an individual project would be, or alternatively, establish a minimum standard to ensure that a satisfactory return is earned on all projects. A variety of different names are used such as, Interest Rate of Return, the Investors Method, the Discounted Cash Flow, the Profitability Index, Capitalized Cost, Present Worth Method, and Annual Costs. The general term "discount methods" may be applied to them all for purposes of general consideration.

Basically the study of this concept is a study of why people borrow and lend money. Those who have accumulated savings which they cannot or do not wish to use at the present time are the potential lenders. The potential borrowers are those who could make profitable use of funds which they have not got at their disposal. The compensation paid by borrower to lender for use of the lender's money is called "interest", and is the foundation of the rate of return concept of measurement.

When appraising a capital expenditure proposal, future benefits from it are assessed, according to a discount method in terms of the cash generated by the project each year. Therefore, one can see that the rate of return concept for a capital expenditure is fundamentally the same as the yield on an investment concept.

There are two basic approaches. The first is to discount all future cash receipts to their present value at the rate of return (interest) which would make the sum of their present values equal to the capital expenditure. The second

approach is to discount the future cash receipts back at a minimum acceptable rate of return. If the sum of their present values exceeds the capital expenditure the rate of return is acceptable.

Therefore, we can establish a general definition:

> The rate of return (under discount methods) is equivalent to the maximum rate of interest at which money could be borrowed to finance a project, and paid back as it becomes available through earnings, so that the debt is liquidated by the end of the economic life of the project.
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> Alternatively it is the maximum rate of interest which, when used to discount all future cash receipts, would make their present worth equal to the capital expenditure which generated them.[16]

A sound method of determining rate of return on capital investment should take into consideration the following:

1. cost of a project, earnings from it, and the length of its useful life
2. recognize that a sum of money received at some future date is worth less than

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16 C.G. Edge, The Appraisal of Capital Expenditure, p. 11.

that same sum today

3. be able to translate a future sum into its equivalent today.

The discount methods that meet these tests provide a sound objective method of evaluation for the financial factors pertinent to an investment decision. As mentioned previously other factors will often play a large part in the final decision. The return on investment method should not be used alone, but should be one segment of the whole set of factors contributing to making a sound decision.

Another consideration that must be emphasized is that the cost of a project, the earnings from it, and the length of its useful life are often very inaccurate or uncertain estimates at the time the proposal is being considered. As a result, even though a very precise method of evaluation may be applied, the resultant quantitative answer may be significantly inaccurate. This, it will be seen, may be a major shortcoming of the return on investment criterion of measurement.

CHAPTER VIII

THE PRACTICAL APPLICATION OF DISCOUNT METHODS

The principles linking present capital expenditures to future economic benefits have been discussed. The purpose of this section is to illustrate some practical applications of these principles. As mentioned previously there are several variants of the discount approach, all of them using compound interest formulae. All of these methods, however, yield virtually equivalent results. Some of the methods use continuous interest tables, others assume interest is calculated at the end of each year; some assume costs and income are incurred at the beginning, during, or at the end of a year. Some methods, when using minimum rates of return, convert capital costs to equivalent annual costs, others convert annual costs to capital costs. The various formulae also tend to become more complex as more factors are incorporated in them.

As previously defined, there are two basic approaches to this problem. The first is the use of a minimum rate of return to ensure that the proposed investment yields a rate of return above the minimum. The examples which follow will illustrate this approach by the "annual cost" method. The alternative approach is to calculate the rate of return of a proposal which can then be compared to an accepted minimum rate of return. Examples 14-17 which follow illustrate this method.

The annual cost method is well suited for evaluation of those projects such as cost reduction, replacement, and alternatives in equipment. The rate of return method is better suited to projects such as expansion projects, where risk is a larger factor. The rate of return for these projects can be compared to a minimum rate of return, and the safety margin between the two more clearly seen. The evaluation of the adequacy of the safety margin, it must be noted, requires judgment, and the mere existence of a margin of safety is insufficient evidence on which to base

a decision.

A relatively simple approach is used in all the examples which follow,[17] in order to illustrate the techniques involved. The assumptions used are as follows:

1. Minimum rate of return will be assumed at 17%. A table for use with this percentage is given. (This minimum rate of 17% has no particular significance other than the fact that it is arbitrarily assumed to be the minimum acceptable rate of return for the proposals involved in the examples.)

2. Costs and income incurred during a year will be assumed to occur at the end of the year. Normally this does not produce any significant inaccuracy.

3. Capital expenditures are assumed to occur at the beginning of the year.

4. All calculations are on a "before-tax" basis. Appendix B illustrates the application of these formulae with examples on an "after-tax" basis.

5. Formulae:

   P = present worth of a future sum of money

   S = future value of a sum of money

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17 C.G. Edge, The Appraisal of Capital Expenditure, pp. 27-47.

R = annual cost at the end of each year

i = rate of interest or rate of return on investment

n = number of years

a) Present Worth Factor:

$$P = \frac{S}{(1 + i)^n}$$

(This formula is used to find the present worth of a single sum of money.)

b) Sinking Fund Factor:

$$R = S \left[\frac{i}{(1 + i)^n - 1} \right]$$

(This formula is used with salvage values to convert them to equivalent annual costs.)

c) Capital Recovery Factor:

$$R = P \left[\frac{i\,(1 + i)^n}{(1 + i)^n - 1} \right]$$

(This formula is used to convert a capital expenditure today to the equivalent series of equal annual costs based on the economic life of the asset.)

INTEREST TABLE FOR 17% RATE OF RETURN

n Years	PRESENT WORTH FACTORS (F) $\left[\frac{1}{(1+i)^n}\right]$	SINKING FUND FACTORS (F_{sf}) $\left[\frac{i}{(1+i)^n - 1}\right]$	CAPITAL RECOVERY FACTORS (F_{cr}) $\left[\frac{i\ (1+i)^n}{(1+i)^n - 1}\right]$
1	0.8547	1.0000	1.1700
2	0.7305	0.4608	0.6308
3	0.6244	0.2826	0.4526
4	0.5337	0.1945	0.3646
5	0.4561	0.1426	0.3126
6	0.3898	0.1086	0.2786
7	0.3332	0.0849	0.2549
8	0.2848	0.0677	0.2377
9	0.2434	0.0547	0.2247
10	0.2080	0.0447	0.2146
11	0.1778	0.0368	0.2068
12	0.1520	0.0305	0.2005
13	0.1299	0.0254	0.1954
14	0.1110	0.0212	0.1912
15	0.0949	0.0178	0.1878
16	0.0811	0.0150	0.1850
17	0.0693	0.0127	0.1827
18	0.0592	0.0107	0.1807
19	0.0506	0.0091	0.1791
20	0.0433	0.0077	0.1777
21	0.0370	0.0065	0.1765
22	0.0316	0.0056	0.1755
23	0.0270	0.0047	0.1747
24	0.0231	0.0040	0.1740
25	0.0197	0.0034	0.1734
26	0.0169	0.0029	0.1729
27	0.0144	0.0025	0.1725
28	0.0123	0.0021	0.1721
29	0.0105	0.0018	0.1718
30	0.0090	0.0015	0.1715

F - Used to calculate present value of single payments "n" years from present.

F_{sf} - Used to calculate series of "n" annual payments which will accumulate a given sum at the end of "n" years (Sinking Fund Factors often used to convert salvage values into equivalent annual payments).

F_{cr} - Used to calculate series of "n" annual payments which will be yielded by a given sum invested now (capital recovery factors often used to convert capital cost into equivalent annual costs).

ANNUAL COST METHOD

CHOICE OF ALTERNATIVE EQUIPMENT:

Example 1 Comparison of two alternatives with different investments and useful economic lives. Operating costs assumed to be the same in each case.

Problem A steel storage tank costing $10,000 lasts 5 years. A stainless steel one, costing $25,000, lasts 20 years. Which is preferable?

Principle Use the capital recovery factor to convert capital costs into annual costs. It is assumed that the steel tank can be replaced every five years for $10,000.

Solution Annual cost of Steel Tank $= 10,000 \times 0.3126 = \$3,126$

Annual cost of Stainless Steel Tank $= 25,000 \times 0.1777 = \$4,444$

Since the steel tank yields lower annual costs, choose the steel tank.

Example 2 Comparison of two alternatives with different investments and lives, and also different maintenance costs.

Problem A steel tank costs $10,000, lasts 5 years, maintenance costs are $1,600 a year.
Stainless steel tank costs $25,000, lasts 20 years, maintenance costs are $100 a year.

Principle Convert the capital costs to annual costs. Add them to the annual operating costs and find the proposal which has the lowest total cost.

Solution

Steel Tank -

Annual Cost	10,000 × 0.3126 =	$3,126
Maintenance Costs		1,600
Total Annual Cost		$4,726

Stainless Steel Tank

Annual Cost	25,000×0.1777 =	$4,444
Maintenance Costs		100
Total Annual Cost		$4,544

Therefore, choose the Stainless Steel Tank.

Example 3 Comparison of alternatives with different investments and lives, operating costs and salvage values.

Problem Estimated salvage value of steel tank after 5 years is $1,000 and stainless steel tank, after 20 years, is $2,000.

	Steel Tank	S.S. Tank
Capital Cost	$10,000	$25,000
Life-years	5	20
Maintenance costs per year	1,600	100
Salvage value	1,000	2,000

Principle — Convert the salvage values, using sinking fund factors, to the equivalent annual amount. It would, in fact, be a negative cost and deducted from the other costs.

Solution

	Steel	Stainless
Capital-Annual Cost	$3,126	$4,444
Maintenance	1,600	100
Salvage Value:		
1,000 × 0.1426	(143)	
2,000 × 0.0077		(15)
Total Annual Cost	$4,583	$4,529

Therefore, choose the Stainless Steel Tank.

Example 4 — Sometimes it is desirable to estimate the effect of higher maintenance costs on the length of life of an asset.

Problem — A steel tank costs $10,000 and lasts 5 years. Is it worthwhile to extend its life by 3 years by painting it annually at a cost of $300?

Principle — Use the capital recovery factor to find which alternative has the lowest annual cost.

Solution

Steel tank lasting five years
Annual cost of capital — 10,000 × 0.3126 = $3,126

Steel tank lasting eight years
Annual cost of capital — 10,000 × 0.2377 = $2,377
Maintenance costs per year — 300
Total Annual Cost — $2,677

Therefore paint tank and replace every eight years.

Example 5 Also, one can determine how much more capital one could spend to get a desired effect.

Problem If a steel tank lasts 5 years and costs $10,000, how much could one spend for a tank lasting 20 years?

Principle Find the annual cost for the five year tank and then find the equivalent capital for a 20 year life.

Solution

Annual cost of 5 year tank	10,000 ×	0.3126 =	$3,126
Capital Recovery Factor - 20 years		0.1777	
Therefore capital cost if life 20 years		$\frac{3,126}{0.1777}$ =	$17,591

Therefore a 20 year tank should not cost more than $17,591 to be better than a $10,000 tank lasting five years.

Example 6 Sometimes there are periodic costs such as an overhaul of a tractor every three years.

Problem What is the average annual cost of a tractor costing $30,000 with a 9 year life and salvage value of $2,000. Also, an overhaul costing $3,000 is needed every three years. No overhaul is assumed at the end of the ninth year.

Principle If the overhauls occur at the end of every three years, the sinking fund formula would be used to convert them into the equivalent annual costs. However, an adjustment may be needed to this result. This is because it would be unusual for an overhaul to take place just prior to the vehicle being sold. Therefore, in this example, the cost of the overhaul at the end of the ninth year and which would not

take place, would be converted to the equivalent annual cost and applied as a credit to reduce the overhaul cost per year.
If the overhauls occur at the beginning of every three years, the capital recovery factor would be used.

Solution

Annual cost of capital	30,000 × 0.2247 =	$6,741
Annual cost of salvage value	2,000 × 0.0547 =	(109)
Annual cost of overhaul every three years	3,000 × 0.2826 =	848
Adjustment if last overhaul does not take place	3,000 × 0.0547 =	(164)
Total Annual Cost		$7,316

Example 7 Often costs will not be the same each year as maintenance costs increase each year. Also, overhaul may occur at different intervals and different amounts.

Problem What is the annual cost of a truck with a capital cost of $20,000 lasting for 5 years, with a salvage value of $2,000? Maintenance costs are $300 for the first year, increasing by $100 a year thereafter. Also an overhaul of $2,000 is needed in the third year.

Principle Where costs vary each year, they are converted back to their present worth using the present worth formula. The present worths are then totalled and converted back to a level 'annual' cost.

Solution

		Present Wth.
Capital Cost	20,000 × 1.0	$20,000
Maintenance Costs:		
1st year	300 × 0.8547	256
2nd year	400 × 0.7305	292
3rd year	500 × 0.6244	312
4th year	600 × 0.5337	320
5th year	700 × 0.4561	319
Overhaul 3rd year	2,000 × 0.6244	1,249
Salvage value at 5th year	2,000 × 0.4561	(912)
		$21,836

Therefore, a present worth of $21,836 is equivalent to an annual cost for 5 years of

$$21,836 \times 0.3126 = \$\ 6,826$$

COST REDUCTION:

Cost reduction projects can either be evaluated by the annual cost method or by calculating the return on investment.

The following examples use the annual cost method and compare the annual cost of the capital investment with cost saving. If the cost saving is greater, the project is desirable.

Example 8 Cost savings are the same each year.

Problem A new packing machine costs $10,000, is estimated to last 5 years with no salvage value and results in cost savings of $3,000. Is the project worthwhile?

Solution

Annual cost of machine:	10,000 × 0.3126	($3,126)
		3,000
Added earnings		($ 126)

Therefore, cost savings are inadequate to justify the machine.

Example 9 Estimate of cost savings needed to justify new equipment.

Problem A bale-tying machine costs $20,000, is estimated to last 8 years and the salvage value is $2,000. What minimum cost savings are needed to justify its purchase?

Solution

Annual cost of machine:	20,000 × 0.2377 =	$4,754
Annual cost of salvage:	2,000 × 0.0677 =	(135)
Minimum Cost Savings Needed=		$4,619

REPLACEMENT:

Replacement of equipment is often a reason for new capital expenditure. The questions are generally in two parts - "Why replace now" and "Why replace with this particular type of equipment?" It is assumed that the question of "Why replace at all?" has been answered in the affirmative.

Therefore, there are three estimates required:

(i) the cost of continuing with the existing equipment for one more year.

(ii) the average annual cost of new equipment of the same type. This should be based on the ideal economic life, since this will yield the lowest annual cost for this equipment.

(iii) the average annual cost of other new equipment which could do the same job, possibly at lower cost than the type already in use.

The lowest annual cost of these alternatives would be preferred. "Annual Cost" methods

are ideally suited for these replacement problems. Examples will be given of each phase of the comparison.

Replacement problems essentially revolve around the timing of replacement of existing equipment, since all equipment wears out or becomes obsolete. Also, they have a cost reduction aspect, since replacement by different equipment rather than the same type is essentially a cost reduction project.

Example 10 To determine the cost of continuing with existing equipment.

Problem The present salvage value of a tractor is $10,000. In one year's time its salvage value will have declined to $7,5000. Maintenance and repair costs for the year are estimated at $16,000.

Principle The cost of continuing with the existing equipment for one more year consists of:

(i) operating costs for the year.

(ii) decline in salvage value -since this means loss of cash by not selling immediately.

(iii) the minimum return on investment on the salvage value at the beginning of the year. This is because, if the tractor were sold immediately, the cash recovered from the sale could earn at least the minimum rate of return, if used elsewhere in the company.

Solution

Maintenance and repair costs	=	$16,000
Decline in salvage value: 10,000 - 7,500	=	2,500
Return on salvage value at beginning of year: 17% of $10,000	=	1,700
Total cost for one more year		$20,200

Example 11 Occasionally, where a major overhaul takes place in the year and this is not fully reflected in salvage values, the annual cost of continuing with existing equipment is lower, if more than one year is concerned.

Problem

	Salvage Value	Maintenance and Overhaul
Now	$10,000	
1st year	7,500	$16,000
2nd year	6,000	9,000
3rd year	2,000	12,000

Is the annual cost of this existing equipment lowest for one more year, or should the equipment be kept longer?

Solution If kept one year:

Maintenance Cost		=	$16,000
Capital Cost for 1 year	10,000 × 1.17	=	11,700
Salvage Value	7,500 × 1.0	=	(7,500)
Annual Cost for 1 year			$20,200

If kept two years:

Present Worth Maintenance:			
1st year	16,000 × 0.8547	=	$13,675
2nd year	9,000 × 0.7305	=	6,575
Salvage Value:			
Now	10,000 × 1.0	=	10,000
in 2 years	6,000 × 0.7305	=	(4,383)
Present Worth Total			$25,867
Annual Cost for 2 years:	25,867 × 0.6308	=	$16,317

If kept three years:

Present Worth Maintenance:			
1st year	16,000 × 0.8547	=	$13,675
2nd year	9,000 × 0.7305	=	6,575
3rd year	12,000 × 0.6244	=	7,493

Salvage Value:

Now	10,000 × 1.0	= 10,000
in 3 years	2,000 × 0.6244	= (1,249)
Total Present Worth		$36,494

Annual Cost for 3 years: 36,494 × 0.4526 = $16,517

Therefore, the annual cost of keeping existing equipment for two more years should be used in comparing with the annual cost of new equipment.

Example 12 To find the economic life of new equipment.

Problem A tractor costing $30,000 is estimated to have the following operating and maintenance costs:

Year	Operating and Maintenance Costs	Salvage Values
1	$10,400	$20,000
2	11,300	15,000
3	12,220	11,000
4	13,160	8,000
5	14,120	6,000
6	15,100	4,000
7	16,100	3,000
8	17,100	2,000
9	18,600	-
10	20,600	-

Principle Determine the average annual cost if kept for one year, two years, three years, etc., as follows:

(i) convert the capital cost into the annual cost according to the number of years for which the equipment is kept.

(ii) convert the salvage value into a negative annual cost using the sinking fund factor.

(iii) convert the operating and maintenance costs each year to their present worth. Add the present worths and reconvert to level annual costs using the capital recovery factors.

(iv) add the annual cost for the capital cost, salvage value, and operating and maintenance costs and find which year gives the total lowest cost.

Solution This is given in the attached table and indicates the annual cost is lowest at $19,910 for 8 years, page 59.

COMMENTS:

While not included in the above examples, in determining the ideal economic life, consideration should be given to the unreliability and productivity of old equipment and also obsolescence.

For example, if equipment is liable to breakdown, equipment may have to be rented to do the work which the existing equipment should have performed. It may, therefore, be desirable to include these additional costs of unreliability in the estimates of operating costs each year.

Secondly, new and better equipment is continually being developed. This newer equipment would have lower annual costs and result in equipment now being installed to be replaced sooner. If this equipment now being installed is replaced sooner, its annual costs will be higher. Therefore it may be desirable to base costs on a shorter life than that indicated by the methods proposed in Example 12. Probability factors can also be used to assess the impact of obsolescence.

DETERMINATION OF IDEAL ECONOMIC LIFE FOR A TRACTOR

(Example 12)

Yrs.	Inv't (1) Actual $	Trade-in-Value (3) Actual $	Operating Costs (5) Actual $	(6) P. Wth. $	(7) Cu. P. Wth. $
0	30,000				
1		20,000	10,400	8,890	8,890
2		15,000	11,300	8,250	17,140
3		11,000	12,220	7,730	24,770
4		8,000	13,160	7,020	31,790
5		6,000	14,120	6,440	38,230
6		4,000	15,100	5,890	44,120
7		3,000	16,100	5,360	49,480
8		2,000	17,100	4,870	54,350
9		-	18,600	4,530	58,880
10		-	20,600	4,280	63,160

	Annual Cost (2) $	Annual Cost (4) $	Annual Cost (8) $	Total Annual Cost (9) $
0				
1	35,100	(20,000)	10,400	25,500
2	18,920	(6,910)	10,810	22,820
3	13,580	(3,110)	11,210	21,680
4	10,940	(1,560)	11,590	20,970
5	9,380	(860)	11,950	20,470
6	8,360	(430)	12,290	20,220
7	7,650	(250)	12,610	20,010
8	7,130	(140)	12,920	19,910 *
9	6,740	-	13,230	19,970
10	6,440	-	13,550	19,990

Notes:

(a) Column (9) Column (2) Column (4) Column (8)
(b) Column (5) includes operating, maintenance and insurance costs, but no depreciation or operating labour.
(c) Columns (2) and (8) - Calculated using F_{cr} Factors.
(d) Column (4) - Calculated using F_{sf} Factors.
(e) Column (6) - Calculated using F Factors.
(f) * Ideal economic length of life - 8 years.

Example 13 To determine whether equipment should be replaced.

Problem Estimated annual cost of continuing with existing equipment for one more year (Example 10). $20,200

Estimated annual cost of continuing with existing equipment for two more years (Example 11). $16,317

Estimated annual cost of new equipment of the same type (Example 12). $19,910

Estimated annual cost of new equipment of a different type (details not given, but would be the same type of estimate as in Example 12). $16,000

Solution Since new equipment of a different type yields the lowest annual cost based on the methods described, it should be used to replace existing equipment.

RETURN ON INVESTMENT

COST REDUCTION:

Example 14 Cost reduction - based on the same dollar saving each year.

Problem A new machine costing $100,000 with a life of 10 years and no salvage value, is estimated to save labour costs of $40,000 a year. Maintenance costs on the new machine are estimated at $10,000 a year.

Principle Find the ratio of the annual savings in cash costs to the capital cost. Then find the rate of interest applicable to this ratio. Depreciation is ignored since it is a non-cash cost.

Solution

Gross cost savings	$40,000
Increase in costs due to new machine	10,000
Net cost saving (cash)	30,000
Capital cost	100,000
Ratio of cost saving to capital cost	0.3000

From inspection of interest tables:

Capital Recovery Factor for 27% for 10 years	0.2972
Capital Recovery Factor for 28% for 10 years	0.3059

By interpolation, the rate of return on investment:

$$= 27 + \left(\frac{3000 - 2972}{3059 - 2972}\right)$$

$$= 27 + \frac{28}{87}$$

$$= 27.3\%$$

EXPANSION:

Example 15 Expansion - based on level annual earnings.

Problem Equipment for a new product is estimated at $200,000 with a 20 year life and no salvage value. Profit before depreciation is estimated at $30,000. What is the return on investment?

Principle Profit before depreciation is equivalent to the 'Cash in-flow' per year. Find the ratio of the cash in-flow to the capital cost and find the rate of interest which gives the same ratio for the capital recovery factor.

Solution

Cash in-flow per year	$ 30,000
Capital cost	200,000
Ratio of cash in-flow to out-flow	0.15000

From inspection of interest tables:

Capital Recovery Factor for 13% for 20 years	0.1424
Capital Recovery Factor for 14% for 20 years	0.1510
By interpolation, the rate of return on investment:	13.9%

Example 16 Expansion - based on varying levels of earnings.

Problem A capital expenditure of $100,000 is estimated to generate the following earnings for five years.

	Profit Before Depreciation
Year 1	$ 5,000
Year 2	15,000
Year 3	30,000
Year 4	35,000
Year 5	40,000

What is the rate of return on investment?

Principle Find the rate of interest which will make the present worth of all future cash in-flows equal to the capital expenditure. Since the rate of interest is found by trial and error, it is a useful guide to average the cash in-flow and find the capital recovery factor which equates it to the capital expenditure. For example, the average profit before taxes is $25,000 or 0.2500 of the capital expenditure, which gives a starting point of 8%.

Solution

		Interest Rate 8%		Interest Rate 6%	
Year	Cash Flow $'000	Present Worth F.	Present Worth $'000	Present Worth F.	Present Worth $'000
0	(100)	1.0	(100.0)	1.0	(100.0)
1	5	0.9259	4.6	0.9434	4.7
2	15	0.8573	12.9	0.8900	13.4
3	30	0.7938	23.8	0.8396	25.2
4	35	0.7350	25.7	0.7921	27.7
5	40	0.6806	27.2	0.7473	29.9
			(5.8)		0.9

Therefore the rate of return on investment:

$$= 6 + \left(\frac{0.9}{5.8 + 0.9}\right) \times 2$$

$$= 6.3\%$$

Example 17 Expansion - based on varying levels of earnings.

Problem A new machine costing $200,000 is expected to last 8 years and have a salvage value of $30,000. Additional working capital of $60,000 would also be needed. Earnings expected to result are as follows:

Year	Profit Before Depreciation $'000
Year 1	70
Year 2	65
Year 3	60

Year 4	40
Year 5	50
Year 6	30
Year 7	30
Year 8	20

Principle Same as in Example 16. Treat the working capital as a cash out-flow at the beginning and as in-flow at the end of the life of the equipment.

Similarly, salvage value would be an in-flow at the end of the life of the equipment.

Solution

Year	Cash Flow $'000	Interest Rate 15% Present Worth F.	Interest Rate 15% Present Worth $'000	Interest Rate 14% Present Worth F.	Interest Rate 14% Present Worth $'000
0	(260)	1.0	(260.0)	1.0	(260.0)
1	70	0.8696	60.9	0.8772	61.4
2	65	0.7561	49.1	0.7695	50.0
3	60	0.6575	39.5	0.6750	40.5
4	40	0.5718	22.9	0.5921	23.7
5	50	0.4972	24.9	0.5194	26.0
6	30	0.4323	13.0	0.4556	13.7
7	30	0.3759	11.3	0.3996	12.0
8	110*	0.3269	36.0	0.3506	38.6
			(2.4)		5.9

Therefore, the rate of return on investment:

$$= 14 + \left(\frac{5.9}{5.9 + 2.4}\right)$$

$$= 14.7\%$$

*(Profit $20,000
Recovery of Working Capital $60,000
Salvage Value $30,000)

CHAPTER IX

A SURVEY OF PRACTICE

In order to examine critically the concept of capital budgeting that has been outlined here, a study of several companies and industries was undertaken. In this survey the answers to the following questions were sought:

1. Are these principles being applied?
2. If they are, what is their value to management?
3. If this technique is not being used, what, if anything, was being used instead?
4. Can the procedures outlined here be broadly applied to decisions of this nature and are the criteria proposed of practical value to the administrator?

It is interesting to note that even in such a field as municipal administration, attention

is being given to capital budgeting. Financial Post reported in its issue of November 21, 1959, that the City of Hamilton, Ontario, has adopted a policy of capital budgeting. Here, of course, it must be realized that a Return on Investment concept in the sense of Profit cannot be applied. However, the principles of sound systematic programming of capital expenditures, and sound investment of taxpayer's money should and must be of utmost concern to a city management.

Another recent application of the principles of Return on Investment can be found in the studies of the Royal Commission on Price Spreads. The Royal Commission applied several criteria in their efforts to assess the spread between farm prices and retail prices, and to attempt to determine whether this spread was fair and reasonable, or excessive.[18] After approaching the problem from several different angles, the Commission adopted the Rate of Return

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18 Report of the Royal Commission on Price Spreads of Food Products, (Ottawa, Queen's Printer, September, 1959), Vol. I, pp. 37-46.

on Investment as its standard. It must be noted, however, that "investment" in this study was defined to mean "shareholder's equity" instead of total investment or "capital employed". While the results obtained may have been satisfactory for the purposes of the study, the definition of "investment" as "capital employed" would have given a more accurate indication of the profitability of the concerns under study.

The application of a quantitative evaluation standard by an individual investor seeking to utilize his savings in the most effective manner was examined. In this instance the alternatives under consideration were further investments in commercial real estate, residential real estate, or the security market. The amount of funds was small but it would seem that these principles should be applied if they have the merit claimed for them. It can readily be seen from the examples previously given that alternative investment proposals can be evaluated by applying the return on investment criterion. However, the factor of risk can not be quantitatively expressed.

As a result it must be concluded that rate of return calculations, while a valuable aid to making a sound decision, cannot eliminate the necessity of good judgment.

The application of the capital budgeting concept was examined in the airline industry and in particular with reference to one major international airline with over 13,000,000 revenue miles in 1959. The information obtained was based on personal interviews with a senior executive of the company. In general, it may be concluded that the return on investment concept while very desirable is not extensively used. One of the main reasons given for this lack of use is that the industry has been faced with very rapid technological change in the years since World War II. The airlines are involved in intense competition, and their primary emphasis has been to keep pace with technological change, and competive and customer demand. In these circumstances, payback with its emphasis on near-year earnings has been used to a greater extent than return on investment. For example,

in purchasing a Super Constellation aircraft for two million dollars in 1954, a company would have to realize that by 1959-1961 jet powered aircraft would be available and in use in commercial air transport. As a result, although the economic life of the asset might be ten years, all calculations of return on investment would have to be based on five to seven years. At the end of five to seven years the aircraft may well continue in use, but not in first class passenger service. It will be leased out, sold, or used in freight (air-cargo) service. In such uncertain conditions, the company may well have to be satisfied with a payback return instead of a long term profit. The long run return on investment will be sacrificed to keep or establish a position in the total market.

To have refused the investment on the grounds of an inadequate return on investment would have meant the loss of a position in the competitive market. A level payback with no annual profit might well have to be accepted as

a temporary expendient under uncertain technological conditions.

In the case of the major airline whose approach to this problem was examined in more detail, it was found that the broad concept of capital budgeting, as outlined in this thesis, was being utilized. Its value was acknowledged by the executives interviewed.

The demand for capital is determined at periodic intervals and capital budget proposals are submitted. The cost and supply of capital are handled together and are indirectly a factor in the decision, within the limits of the market and competitive situation outlined earlier. Budget proposals are on a total project basis, that is, service and subsidiary equipment are included in the total appropriation, and as long as that total is not exceeded, no further reference to the budget authority is required. To reduce the demands for capital outlay, extensive use of leasing is made. This practice also assists with the problems outlined previously of keeping pace with the competitive situation by reducing the amount of

capital inflexibly committed for long periods.

In this industry postponability as a criterion has a valuable service to perform. If an investment in aircraft can be postponed, a better return on the investment in existing assets can be realized. Postponability is exercised to the limits imposed by competitive circumstances and market demand. If postponability cannot be applied, and the investment deemed necessary for the reasons cited, the proposal will then be examined from the standpoint of payback. If the investment promises a payback within the estimated time available before the next advance in this rapidly changing industry, the proposal will probably be given approval. It was stated by the executives interviewed that they recognized that these criteria will not suffice for the future. The industry is entering a new phase. With the advent of jet travel it appears that no major technological change in aircraft will be expected for approximately ten years. This length of time is being used for evaluation of investments

in jet aircraft. A return on investment criterion will become increasingly useful in the years ahead. With a industry that is gradually stabilizing but yet remaining fiercely competitive, management will be forced to examine more critically and objectively all capital expenditure proposals. Under these conditions an evaluation yardstick that is accurate, inclusive, realistic, and versatile, will be of the utmost value as an aid to decision. Postponability and payback cannot meet these requirements. The return on investment approach is the best method of evaluation available for this purpose, and will merit more consideration in the future than has been accorded it in the past.

An examination was also made of two public utilities. The large scale expenditures of this type of enterprise appear to lend themselves admirably to the use of the return on investment concept. One of these companies was a telephone utility with assets in excess of $200,000,000, which is regulated by the Board of Transport of the Federal government. The concepts

of sound capital budgeting are receiving careful attention. Expenditure forecasts are prepared on a yearly basis with long range planning being developed on a continuous basis for a twenty year future period. A return on investment in the sense of profit cannot be applied here due to the method of regulation. Regulation, through rate structure, is done on the basis of setting rates covering all costs with an allowed contribution to surplus. In this approach dividends assume the same status as interest charges and are taken as a cost of money. In other words, the amount of profit allowed over and above total defined costs is very small. Nevertheless, careful evaluation and analysis is required, as the margin available to cover unforeseen costs is negligible.

Within this framework, payback becomes of prime importance. Any capital expenditure will be subjected to evaluation on the basis of covering all costs over the useful life of the asset. It must be remembered that 'costs', as defined for this purpose, include the cost of

dividends. Postponability is also used to some extent in determining priority of expenditures, in the light of the conditions of supply of capital. Normally priority would be determined on a rate of return scale, but with this factor fixed and rates regulated, the choice of alternatives is eliminated on all grounds but that of postponability.

Under these conditions, the supply of capital will be restricted to external sources. Operating with regulated additions to surplus, and in effect regulated dividends, and in view of a ninety percent payout of earnings in dividends, it can be seen that retained earnings cannot be of any material assistance in financing future expansion.

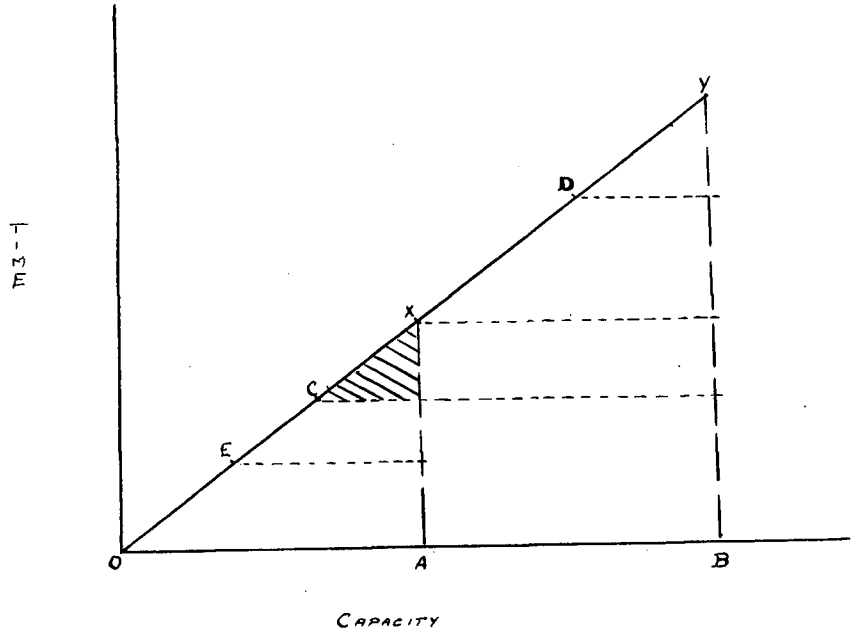
A further complication arises, in that depreciation is allowed only on the basis of original cost. Due to a long period of continuous inflation, depreciation allowances retained for replacement of assets are inadequate. Hence, even to maintain the asset structure of the enterprise, new external financing must be sought. It would appear that this practise requires a newer, more

realistic approach, either through more liberal "cost" allowances for depreciation (replacement cost method), or through allowing a greater margin of retained earnings to offset the effects of inadequate depreciation based on historical costs.

Another aspect that merits attention within the framework of capital budgeting in this telephone utility, is the use of a revenue requirements concept. This is best defined by the question will the expenditure produce sufficient revenue to support the outlay now? Telephone service is based on peak load demand during "busy hour" periods. This is the result of business load. Residential load is sought to level out the peak and produce more off-peak revenue. This concept may be illustrated by an example. In Figure A, OX represents existing trunk capacity (trunk capacity is inter-exchange capacity), OC is the amount presently in peak load use. XY is a proposed extension. However, peak load traffic will not provide sufficient revenue to support this extension. OE is existing residential load. Some action is required as CX is insufficient safety

capacity, and some extension is required. Next a saturation survey is conducted to determine the total off-peak theoretical market available. This is represented by OD (or ED is the additional load theoretically available). Therefore the expenditure can be justified if sales can saturate off-peak market up to X and peak load to D, leaving DY as uncommitted capacity.

FIGURE A



Here is another application of capital budgeting concepts, but there emerges once again a series of unknowns that are difficult to reduce to formula expression.

Electricity and gas utilities may also find merit in the capital budgeting concepts. The installation of plant, distribution lines, and the alternative ways of generating power appear to be natural areas for application of these methods. Capital budgeting procedures are being used, but once again, criteria for measurement and evaluation are payback and postponability much more frequently than return on investment. Postponability results from an expediency approach of doing the minimum at a given time, and attempting to keep pace with an ever-growing market demand. In times of rapid expansion and great demand for money, those projects which can be postponed usually are. Payback is applied to those projects which are seriously considered and it appears that as long as a project shows a reasonable prospect of being paid out over an arbitrarily set period of time, it

will be proceeded with. Little attention seems to be directed to future earnings return after the payout period. One major group of companies with assets in excess of $170,000,000 however, has an excellent long term expenditure plan, and does in fact apply quite rigorous standards of minimum return on investment as a factor in evaluating all expenditure proposals. It was observed that the objective evaluation on a rate of return basis was regarded as a significant factor in evaluation but was only part of the total evaluation which included many subjective and qualitative considerations.

Next manufacturing industries, both primary and secondary, were examined. Here again, the greatest emphasis was placed on pay-back. In one company studied, arbitrary rates had been set that small investments of $5,000 or less must meet a one year payback standard. Larger investments were required to pay back over a three to five year period. No upper limit was formally set but in general a limit of $50,000 was recognized. Expenditures involving larger

amounts than this were extensively examined and a minimum return on investment (capital employed) was set. This minimum was based on management's judgment and included consideration of the cost of money, risk involved, and the rate of return being realized in the primary line of operations being conducted. This company also recognized the possibility of using a rate of return analysis on such intangibles as in-plant training of standby workforce. In this instance the cost of training can be evaluated in the light of increased costs that would result if an operation had to be shut down or reduced in speed because of the lack of a trained replacement. Among the companies studied, this was the most extensive use found of the rate of return concept. It can be seen that here too, there is a substantial preoccupation with payback as a criterion.

All other manufacturing companies consulted, indicated similar procedures. In most cases there is greatest attention and weight given the payback approach. In another case of

a primary metals refining operation, return on investment was used in the original plant study but present additions, changes and improvements are being judged on an arbitrary payback basis. The reasons and circumstances surrounding this emphasis on the criteria of postponability and payback and the lack of consideration of the theoretically sounder return on investment criterion will be examined in the chapter which follows.

CHAPTER X

EVALUATION OF THE SURVEY

In considering the survey of practice outlined in the previous chapter it will be helpful if the ten components of a capital management program referred to previously are used as a basis.[19]

1. creative search for profitable opportunities
2. long range capital plans
3. short range capital budget
4. measurement of profit worth
5. screening and selection
6. control of authorized outlays
7. post mortems
8. retirement and disposal
9. forms and procedures
10. economics of capital budgeting

The capital management program that embraces these points has adopted the concept of capital budgeting. The degree of precision and comprehensiveness used to meet the requirements of each of the components will determine the effectiveness of the capital management program.

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19 Joel Dean, "Measuring the Productivity of Capital", op. cit., p. 122.

The overall concept of capital budgeting is being generally applied in all cases examined. Capital budgeting as a frame of reference, has found considerable support from management. However, the extent of application, the interpretation of the components, and the weighting attached to each, vary significantly.

CREATIVE SEARCH FOR PROFITABLE OPPORTUNITIES

Few will deny the validity of this point as the first step of a sound capital program. All firms recognize the need to keep pace with our expanding economy and technological change. As a result the astute business executive must be ever on the watch for new opportunities. The health of a business operation requires profit; profit in the broad sense is realizing an increment of gain over and above effort expended. Without profits there is no reward to the business activity, and the reward is essential to keep the process self-generating. Self-generation is the process which induces expansion and improvement.

LONG RANGE CAPITAL PLANS

Long range capital plans provide the 'terms of reference' which influence a company's policies and goals. If a firm has sought out a profitable opportunity, it must establish a plan to reach this objective, and implement the idea in order to realize the profits desired. Individual projects should fit within these broad lines.

Here again, the merit of this point is readily acknowledged by the practising businessman. However, practice does not always conform to theory and examples of "lip-service" only, can be found. This arises as a result of inadequate definition of long range goals. Firms and individuals often proceed on a day to day basis of meeting expediencies as they occur. As a result, departure from, or break-down of the capital budgeting concept may be found at this stage. If so, it will not be possible to reach sound capital expenditure decisions because broad guide lines of policy will be lacking. However, in the companies examined during the course of this study, long range planning was being effectively and actively carried out in most cases.

SHORT RANGE CAPITAL BUDGET

As pointed out earlier in this study, the listing of a project on a yearly capital budget indicates only that it is regarded as worthy of detailed study for that year. Here, a serious breakdown in practice occurs. Often, if a project passes some preliminary test and reaches the stage of being listed on the short term (yearly) budget, it is assumed that the project will be implemented. An example of this occurred in one company, where at this stage, a responsible executive called for tenders for construction of the project and opened negotiations for the necessary land and utility services. He was somewhat embarrassed, and his company put to considerable expense, when the project was called off and struck from the budget for that year.

This component of the total program is the stage, covered earlier in the paper, where departments or divisions submit proposals for detailed study by the budget committee. Probably it would be more appropriate to refer to this stage by the term "short term capital expenditure proposals".

MEASUREMENT OF PROJECT WORTH

This is the aspect of capital budgeting to which much of the literature in recent years has been directed. The advantages and disadvantages of the major approaches to measurement have been debated at great length. The basis or essential features of the three major approaches have been summarized earlier in this study and need not be repeated here. In theory, there seems little doubt that some form of a return on investment approach is much superior to the coarser screens of postponability and payback. In practice, return on investment does not have the currency it would appear to deserve. Payback, in spite of its shortcomings, is much more extensively used. Nevertheless, some attempt at measurement, however inadequate, is being made and thus the concept of capital budgeting is being followed.

SCREENING AND SELECTION

This component involves the comparison of a proposed investment with other projects in

the light of capital available, the cost of that capital, the attractiveness of alternative investments, and the results of the measurement test covered above. It is significant that quite different results can be obtained on the same project if payback rather than return on investment is used as a criterion for measurement. Thus, the priority or ranking arrived at in the screening and selection process might be quite different under the two methods, and the resulting decisions quite erroneous in the light of the first component, profitable opportunities.

Projects that meet or pass the screening and selection process are in effect approved for implementation. The remaining steps in the capital program are based on executing the plan approved at this stage. This study has been concerned primarily with the first five of the components, but of course, all being intergal parts of the total program they must be considered in the context of the whole program.

This component of screening and selection is the most important aspect, for at this stage

management must commit itself to a firm decision. Herein lies that great danger, mentioned earlier, of placing sole reliance on quantitative assessments. Even if the best available criterion is used, it is only as accurate as the assumptions made in the calculation. Furthermore, certain factors such as risk cannot be introduced to the calculations and cannot be reduced to a single figure. Hence, it must be reiterated that quantitative measurement devices, while a valuable aid, cannot be a substitute for management's judgment. Judgment is a very large part, if not the largest part of the final selection process.

The findings already reported indicate that, in actual practise, judgment forms most if not all the basis for decision. Because the refinement of technique, expressed through the return on investment approach to measurement, has not been widely accepted, management in these situations has little or no quantitative aids to supplement judgment in reaching a selection decision. Screening and selection must be a part of any capital investment decision and its inclusion in our list

of components is therefore automatic. The point to be emphasized is that a sound quantitative approach to capital budgeting will greatly facilitate wise selection.

It is this feature of selection procedure that appears to be very much lacking in the practice of the companies examined.

The major objection to the use of return on investment calculations should be recognized. It is argued that this approach applies a very precise formula to some very imprecise assumptions. The cost of a project, its useful economic life, the appropriate interest rate and the profits or earnings resulting from the investment are at best only estimates. Hence while the ROI calculation implies a very accurate appraisal, in fact the conclusion based on it might be quite erroneous. The uncertainty of any quantitative evaluation developed thus far is its greatest weakness. However, in reply it may be said that while this weakness is acknowledged, the ROI calculation is the most refined, accurate technique available. Its advantages in preference

to less accurate techniques or no quantitative evaluation at all would seem to justify its inclusion as a valuable component in the capital management program.

IMPLEMENTATION OF THE DECISION

The remaining five components of the capital management program can be grouped under the above heading of implementation.

Control of authorized outlays involves a system of budget control and comparison.

Post mortems refers to reassessment and reappraisal of both cost and earnings after the project has been completed and placed in operation.

Retirement and disposal. Management's responsibility ends only when the asset is retired and a suitable source of action planned (e.g. a new capital project selected).

Forms and procedures are a necessary nuisance to any smooth operation.

Economics of capital budgeting refers to management's keeping abreast of develop-

ments in current economic thinking which may influence greatly future courses of action.

In the studies undertaken these five components were being utilized. Post mortems appeared largely by accident, however, and were seldom consciously sought. Great emphasis was found on budget control. Forms and procedures which, while necessary, are somewhat mechanical functions of the program and should not receive excessive attention. The economics of capital budgeting is receiving quite detailed and intensive study by many executives. A realization was evidenced that the era of generous profit margins and seller's markets that has been a characteristic of much of the post war period has ended. Survival in an increasingly competitive economy demands enlightened and aggressive management actively seeking all the information available. Application of this information as a tool in decision making, as has been pointed out, still leaves something to be desired.

CHAPTER XI

CONCLUSIONS

The concept of capital budgeting has been examined, and some of the factors that are included in a capital management program have been outlined. Through the examination of actual practice, an attempt has been made to assess the significance of these concepts in applied decisions. The examination of practice was based on four questions:

1. Are the principles of capital budgeting being applied?
2. If they are, what is their value to management?
3. If they are not, what concepts and criteria, if any, are being used?
4. Can these principles be applied to capital management decisions with resultant value to the administrator?

The principles of capital budgeting are being applied in those companies and industries examined. Management acknowledges their importance yet seems to place too little weight on them in the decision making process. In the area of measurement and evaluation of projects, the criteria used in some cases are not sufficiently sensitive to give good quantitative assessments. The use of a return on investment formula would greatly improve this evaluation. The principles of a sound capital management program are, in general, being followed and are materially aiding management in reaching sound expenditure decisions. However, the results of calculations are only as valid and accurate as the factors which are used in the calculation. In addition, it must again be cautioned, not all factors can be expressed quantitatively. The subjective areas requiring the exercise of sound judgment loom very large in any capital expenditure decision.

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APPENDIX A

APPENDIX A

An example illustrating the difference between net profit (income) and the internal sources of funds, (see Chapter III, The Supply of Capital).

Dominion Stores Limited[20]
Consolidated Statement of

Income and Expenditure (condensed)
Year ended March 21, 1959.

Sales	$ 356,424,351
Cost of Goods Sold	293,502,871
	62,921,480
Expenses (including depreciation)	49,662,922
	13,258,558
Taxes on Income	6,525,000
Net Profit for the year	$ 6,733,558

20 Source: Dominion Stores Limited, Annual Report, 1959.

Internal Sources of Funds

Sales		$356,424,351
Total cash charges against sales:		
Cost of Goods Sold	$293,502,871	
Expenses (excluding depreciation)	46,427,595	
Taxes on Income	6,170,000	
		346,100,456
Cash generated by operations		10,323,885
Sale of fixed assets		8,811,893
Total Funds from Internal Sources		$ 19,135,778

It is acknowledged that the same result as above may be obtained by the conventional source and application of funds statement. The Dominion Stores Annual Report 1959 presents the information this way:

Sources of Funds:	
Net Profit	$6,733,558
Book value of fixed assets sold	8,811,893
Depreciation provided - not requiring cash outlay	3,235,327
Provision for future income taxes	355,000
	$19,135,778

However, it is inaccurate to view depreciation as a source of funds which it is commonly said to be.

In Chapter III (page 16) it was stated "the amount available from this (internal) source will depend on three factors: the ability of the business to generate cash, existing committments for the use of cash, ... and the dividend policy". This may be illustrated by a further example from the Dominion Store Annual Report, 1959:

Total Funds from Internal Sources (the ability to generate cash)	$19,135,778
Sinking fund installments (existing committments for the use of cash)	960,000
	18,175,778
Dividends to shareholders (dividend policy)	2,012,501
Net Funds available from Internal sources	$16,163,277
Use of Funds	
Capital expenditures	$13,048,521
Increase in working capital	3,114,756
	$16,163,277

APPENDIX B

APPENDIX B

The Effect of Taxation on the R.O.I. Calculation

Calculating return on investment as illustrated in Chapter VIII on a "before tax" basis avoids some complexities in the calculation but may alter the results significantly. Obviously a higher minimum rate of return must be used than if an "after tax" basis is adopted. By taking into consideration the after tax effect (considering taxes as a cash cost; an outflow of cash) a significantly more accurate answer may be obtained.

A formula for use under these conditions is developed below:[21]

I - Investment
d - rate of depreciation per year for tax purposes
t - rate of taxation
n - number of years
i - rate of interest on minimum rate of return
C - operating costs

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21 C.G. Edge, op. cit., pp. 39-40.

Depreciation - year 1 - $I\,d$
year 2 - $I\,d\,(1-d)$
year 3 - $I\,d\,(1-d)^2$
year n - $I\,d\,(1-d)^{n-1}$
Taxation credit year n - $I\,t\,d\,(1-d)^{n-1}$

Present worth of tax credits (diminishing balance depreciation applies to an infinite number of years):

$$= Itd\left(\frac{1}{1+i} + \frac{(1-d)}{(1+i)^2} + \frac{(1-d)^2}{(1+i)^3} \text{ ---} + \frac{(1-d)^{n-1}}{(1+i)^n}\right)$$

$$= Itd\left(\frac{1}{1+i}\right) + \left(1 - \frac{1-d}{1+i}\right)$$

$$= Itd\left(\frac{1}{1+i}\right) + \left(\frac{i+d}{1+i}\right)$$

$$= Itd\left(\frac{1}{i+d}\right)$$

$$= I\left(\frac{t\,d}{i+d}\right)$$

Present worth of investment (after tax basis):

$$= I - I\left(\frac{t\,d}{i+d}\right)$$

$$= I\left[1 - \left(\frac{t\,d}{i+d}\right)\right]$$

Annual cost on an after tax basis:

$$= \text{Annual cost} \quad X \quad \left(1 - \frac{t\,d}{i+d}\right)$$

Tax effect on operating costs:

$$= C\ (\ 1 - t\ )$$

Example 2(a) - (see page 49)

tax rate assumed - 50%
depreciation rate assumed - 6%

Steel tank - Annual cost - $3,126
Stainless steel tank - Annual cost - $4,444

Annual costs on after tax basis:

Steel tank: $3,126 x $\left(1 - \frac{.50 \times .06}{.17 + .06}\right)$

= 3,126 x .8696 = $2,718

Maintenance costs: $1,600 x (1-.50) = 800

$3,518

Stainless steel tank - $4,444 x $\left(1 - \frac{.50 \times .06}{.17 + .06}\right)$

= 4,444 x .8696 = $3,865

Maintenance costs: $100 x (1-.50) = 50

$3,915

Therefore choose the steel tank.

Example 4(a) (see page 50)

Steel tank - (lasting 5 years)		
	- annual cost	$3,126
	- after tax basis	$2,718
Steel tank - (lasting 8 years)		
	- annual cost	$2,377
	- after tax basis	2,067
Maintenance	- after tax basis	150
		$2,217

Therefore paint the tank and replace every eight years.

Example 8(a) (see page 53)

Annual cost of machine	$3,126
- after tax basis	$2,718
Annual cost savings	$3,000
- after tax basis	$1,500

Therefore:	$2,718
	1,500
Added earnings	($1,218)

Cost savings are inadequate to justify purchase of machine.

Example 14(a) (see page 61)

Depreciation rate	20%
Tax rate	50%

Net cost saving	$30,000
- after tax basis	
= C (1-t)	15,000

Capital Cost	100,000
- after tax basis	

$$= \$100{,}000 \left(1 - \frac{.50 \times .20}{.17 + .20} \right)$$

$$= 100{,}000 \quad (1 - .27)$$

$$= 100{,}000 \times .73 = 73{,}000$$

Ratio savings to capital cost -

$$\frac{15{,}000}{73{,}000} - 0.2055$$

Capital recovery factor:

10 years	- 15%	=	.1993
10 years	- 16%	=	.2069

R.O.I. (after tax basis):

$$= 15 + \left(\frac{.2055 - .1993}{.2069 - .1993} \right)$$

$$= 15 + \frac{62}{76}$$

$$= \underline{15.82\%}$$

Example 18:

The present worth of the tax credit on the capital cost is determined by the previously described formula. Next the tax rate is applied to the profit before depreciation and the balance converted to its present worth. The result is corrected by the tax credit and the ROI calculated.

Capital Cost $100,000 Tax Rate 50%
Additional Working Capital $20,000
Depreciation Rate 10% (diminishing balance)
Salvage Value Nil

Year	Profit Before Depreciation	50% Taxes	Cash Flow
0	-	-	($120,000)
1	10,000	5,000	5,000
2	20,000	10,000	10,000
3	30,000	15,000	15,000
4	50,000	25,000	25,000
5	40,000	20,000	20,000
6	40,000	20,000	20,000
7	30,000	15,000	15,000
8	10,000	5,000	5,000
	20,000*		20,000

(* Working Capital)

Present worth of tax credit - $I\left(\frac{td}{i+d}\right)$

(8%) (7%)

$= \$100,000\left(\frac{.50 \times .10}{.08 + .10}\right)$ $= \$100,000\left(\frac{.50 \times .10}{.07 + .10}\right)$

$= \$27,780$ $= \$28,410$

Year	$,000 Cash Flow	8% Present Worth		7% Present Worth	
0	(120)	1.0000	(120)	1.0000	(120)
1	5	.9259	4.6	.9346	4.7
2	10	.8573	8.6	.8734	8.7
3	15	.7938	10.9	.8163	12.3
4	25	.7350	18.4	.7629	19.1
5	20	.6806	13.6	.7130	14.3
6	20	.6302	12.6	.6663	13.3
7	15	.5835	8.8	.6227	9.3
8	25	.5403	13.5	.5820	14.6
	Capital Cost Tax Credit		27.8		28.4
			(1.2)		5.7

$$\text{Return on Investment} = 7 + \left(\frac{5.7 + 1.2}{5.7}\right)$$

$$= \underline{\underline{7.12\%}}$$