

**FINANCIAL CONTROL OF FOREST  
MANAGEMENT OPERATIONS**

by

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### INTRODUCTION

A very important phase of modern forest management is the financial evaluation of investment opportunities which are competing for a portion of a limited capital budget. Decision situations of this nature confront the forest manager at every level of intensity of forest management and at many levels of the organizational hierarchy. However, in order to carry out the necessary financial analyses the manager must have access to a heterogeneous mixture of technical, economic and organizational information. Further he must recognize that he is making decisions with imperfect information under conditions of uncertainty. The purpose of this paper is to discuss the broad subject of financial control as a means for analysing, controlling and implementing forest management investment decisions.

### LONG-TERM GOALS

A prerequisite of any financial control is the establishment of long-range organizational goals and objectives. That is, a forest manager must have clear objectives in mind when he initiates any program of management. In practical terms this may be a simple statement such as - maintain a continuous supply of roundwood to a pulpmill at least - cost, or it may be a more complex policy statement such as - maintain a continuous supply of roundwood to a pulpmill so as to maximize the discounted net worth of the residual growing stock subject to restrictions concerning minimum levels of after-tax earnings for the timberlands division. The long-range policy may even specify that certain cultural activities such as thinning, fertilizing, planting, etc., may not be initiated unless it can

be shown that the rate of return generated by the activity is expected to be greater than some preset minimum.

Following the establishment of long-term organizational policies and objectives, the forest manager is ready to begin a program which hopefully will more than satisfy the stated goals. If, as we will assume in this paper, we are concerned with an industrial enterprise some of these objectives will undoubtedly be of a financial nature. Therefore, the manager must apply appropriate financial control procedures to enable him to satisfy his stated objectives.

### CAPITAL BUDGETING

Let us begin our discussion of some pertinent financial control procedures by briefly reviewing some basic principles of cash flow analysis. It is generally accepted that a dollar received today is worth more than a dollar to be received in one year or at any future time. Since many of a forest managers decisions concern the expenditure or budgeting of current funds with no anticipation of returns for 5-20 years in the future we must investigate procedures for taking the time factor into consideration in our financial analysis. Suppose that we are attempting to determine the financial attractiveness of the two alternatives shown in Table 1.

Table 1. Sample Problem No. 1.

Alt.	Initial Investment	Income By Year				
		1	2	3	4	5
A	\$10,000	0	0	\$12,500	\$11,000	\$7,500
B	\$15,000	\$3,000	\$4,000	\$ 6,000	\$ 8,000	\$8,000

In this example we have two alternative investments, each requiring an initial capital outlay with returns expected annually over a five year period. In making a choice between alternatives A and B, we probably would not simply add up the expected returns (cash inflows) for each of the five years of the investment period and select that alternative which produced the greatest positive

differential between initial investment expense (cash outflow) and total income. If we did we would select alternative A. However, we note that alternative A produces no income in years 1 and 2 while alternative B produces some income every year. Thus, while alternative B is expected to produce a \$3,000 cash inflow at the end of year 1, a \$4,000 cash inflow at the end of year 2, and a \$6,000 cash inflow at the end of year 3, alternative A is not expected to produce its first cash inflow until the end of year 3. Now if we value a dollar received today more than one to be received in the future we must equalize the expected cash inflows before a meaningful comparison of the two alternatives can be made. The common way of doing this is to discount all expected cash flows to the present to obtain the discounted present value (DPV).

To carry out the necessary calculations we must select a discount rate. In many instances the selection of such a rate is not an easy task. In fact, numerous articles in contemporary finance literature present contradicting views concerning the appropriate figure to use for this purpose<sup>(2,3,13)</sup>. We will not discuss these arguments in this paper, but will assume that we have established a discount or alternative rate of 7% to use in our calculations. Having done so we can compute the discounted present value of the two previously discussed alternatives.

$$\begin{aligned} \text{DPV A} &= \$13,943 = -10,000 + \frac{12,500}{(1.07)^3} + \frac{11,000}{(1.07)^4} + \frac{7,500}{(1.07)^5} \\ \text{DPV B} &= \$8,002 = -15,000 + \frac{3,000}{(1.07)} + \frac{4,000}{(1.07)^2} + \frac{6,000}{(1.07)^3} + \frac{8,000}{(1.07)^4} + \frac{8,000}{(1.07)^5} \end{aligned}$$

If the DPV is greater than or equal to zero it indicates that we expect the alternative to generate a return on investment greater than or equal to the discount rate. If it is less than zero it indicates that the investment will not generate a return equal to the chosen discount rate. Using this criterion we would select alternative A.

A second common criterion that we should briefly discuss is the internal rate of return (ROR). This is defined to be that discount rate which equates discounted cash inflows with discounted cash outflows. To obtain the internal rate of return for our two alternatives we must solve each of the following equations for  $i$ .

$$\text{ROR A} = 0 = -10,000 + \frac{12,500}{(1+i)^3} + \frac{11,000}{(1+i)^4} + \frac{7,500}{(1+i)^5}$$

$$\text{ROR B} = 0 = -15,000 + \frac{3,000}{(1+i)} + \frac{4,000}{(1+i)^2} + \frac{6,000}{(1+i)^3} + \frac{8,000}{(1+i)^4} + \frac{8,000}{(1+i)^5}$$

Thus, for alternative A we obtain:

$$i = \text{ROR A} = 35.2\%$$

Similarly for alternative B we have:

$$i = \text{ROR B} = 22.0\%$$

As can be seen, alternative A is still preferable to B. One obvious advantage of the internal rate of return over the discounted present value method is that no discount rate need be assumed before the calculations are performed. However, the problem of "multiple roots" (i.e., the existence of more than one value of  $i$  satisfying one or both of the above equations) can be listed as a disadvantage of this method. Many computer programs are available for solving for the internal rate of return (4,8,9,10,14,15). Thus, realistic problems involving hundreds of alternatives can be evaluated very easily.

A third common criterion often used in evaluating investments is the benefit-cost ratio (B/C). This is a ratio of discounted benefits or cash inflows to discounted costs or cash outflows. For our two example alternatives we compute the B/C ratios as:

$$\text{B/C A} = \left( \frac{12,500}{(1.07)^3} + \frac{11,000}{(1.07)^4} + \frac{7,500}{(1.07)^5} \right) / 10,000 = 2.39$$

$$\text{B/C B} = \left( \frac{3,000}{(1.07)^1} + \frac{4,000}{(1.07)^2} + \frac{6,000}{(1.07)^3} + \frac{8,000}{(1.07)^4} + \frac{8,000}{(1.07)^5} \right) / 15,000 = 1.53$$

Note that in order to perform the necessary calculations we must first select a

discount rate. A B/C ratio greater than or equal to 1.00 indicates that the investment alternative is expected to generate a rate of return greater than or equal to the discount rate. Otherwise it is not a profitable investment.

Let us now investigate how we may use these techniques as financial control procedures. Further, let us put some restrictions on the types of investments we will be analysing. We will assume that all future cash flows are known with certainty and that we are comparing investments of equal life. As our first example let us assume that we wish to purchase a piece of equipment, and that we have two possible alternatives. Assume that we know that each piece of equipment has an expected life of ten years at which time each will be worthless (i.e., zero salvage value), and that we have selected 8% as our discount rate. The two equipment alternatives are shown in Table 2.

Table 2. Sample Problem No. 2.

Alt.	Initial Investment	Annual Benefits	P.V. of Annual Benefits*	DPV	ROR	B/C
A	\$10,000	\$1,800	\$12,078	\$2,078	12.4%	1.21
B	\$20,000	\$3,400	\$22,814	\$2,814	11.0%	1.14

\*Present value of annuity =  $\left( \frac{1 - \frac{1}{(1+i)^n}}{i} \right) \cdot (\text{annual benefit})$

Since the purchase of one piece of equipment prohibits the purchase of the other piece (i.e., we want either A or B, not both), we say that the two alternatives are technically mutually exclusive. Further, it is obvious that we must buy a whole piece of equipment and not a fraction of one plus a fraction of the other. Now, let's add an additional constraint. Suppose that we have only \$25,000 available for purchasing new equipment. This new restriction now makes our two alternatives financially mutually exclusive as well as technically mutually exclusive.

We now face an interesting question. We wish to utilize our \$25,000 capital budget such that we earn the maximum return on the invested capital. That is we wish to maximize the discounted present value to be received from investing \$25,000. Which alternative will generate the best return? A or B? As shown in Table 2,

if we use the discounted present value as our selection criterion we would select B over A. However, if we use the internal rate of return or the B/C ratio we will select A over B. We have an inconsistency. It can be demonstrated that for problems like this, (i.e., for financially or technically mutually exclusive alternatives where the fractionalization of investment units is not allowed) the correct ranking criterion to use is the discounted present value, and not the internal rate of return or B/C ratio<sup>(7,16)</sup>. However, if we use the internal rate of return method correctly we will obtain results consistent with the DPV method.

The basic problem here is that we are comparing investment alternatives which involve different levels of initial expenditures. That is, is a 12.4% return on a \$10,000 investment better than 11.0% return on a \$20,000 investment? Or more dramatically, is a 1000% return on \$1.00 better than a 50% return on \$1,000?

The correct internal rate of return to use in this situation is the "incremental rate of return." To use this method we rank the investment alternatives in increasing order of required initial investment capital (i.e., as shown in Table 2). Then we compare the first alternative (requiring an investment of \$10,000) with doing nothing. The return on this investment was previously shown to be 12.4%. Since this is greater than the alternative discount rate of 8% we proceed with our analysis. We next compare alternative A with B. The incremental investment required by selecting B rather than A is \$10,000, and the incremental annual benefits are \$1,600. Solving for the incremental rate of return we obtain a rate of about 9.65%.

Incremental Rate of Return=

$$0 = -10,000 + 1,600 \cdot \left( \frac{1 - \frac{1}{(1+i)^5}}{i} \right)$$

$$i = 9.65\%$$

Since this is still greater than the alternative discount rate of 8% we conclude that it is wise to select alternative B instead of A. The use of this method then provides results consistent with the DPV criterion (i.e., the selection of alternative B).

Similarly, one could use the benefit-cost ratio as a ranking criterion. To use this criterion correctly would require that an "incremental benefit-cost ratio" be computed. If this is done one will obtain results consistent with the use of either the DPV or the ROR.

For purposes of further illustration I will present a second example of a capital budgeting problem. For this example we will use the same data as presented in Table 2, but we will now assume that alternatives A and B are not technically mutually exclusive, (i.e., the alternatives may be to plant or to seed 1000 hectares). Further let us assume that we may invest in fractional portions of either A or B (i.e., we may plant 500 hectares and seed the rest). Under these new assumptions we find that the ROR and the B/C ratio rank the two competing alternatives correctly, while the DPV criterion doesn't. To show this we rank the alternatives using the internal rate of return (or B/C ratio) and obtain the following:

<u>Alternative</u>	<u>Initial Investment</u>	<u>DPV</u>
A	\$10,000	\$2,078
B*	<u>15,000</u>	<u>2,111</u>
	\$25,000	\$4,189

\*Assuming that no economy of scale is present and that we may invest in a fractional portion of an alternative.

Note that if we rank our alternatives by using the DPV instead of the ROR we will obtain the following:

<u>Alternative</u>	<u>Initial Investment</u>	<u>DPV</u>
B	\$20,000	\$2,814
A	<u>5,000</u>	<u>1,039</u>
	\$25,000	\$3,853

Clearly this is a less efficient use of our investment capital under the existing assumptions.

Hopefully, these two sample problems have illustrated some of the difficulties that a forest manager may encounter when analysing investment opportunities subject to capital constraints. In actual practice there may be several hundred alternatives to be analyzed. Also, there may be additional constraints other than investment capital. In such cases the manager must turn to some mathematical programming procedure such as linear programming<sup>(16)</sup>. The use of such a procedure provides the manager with the optimum combination of investment activities subject to the constraints that he has imposed. A detailed example of such an application will be presented in the following paper.

Up to this point, we have been discussing procedures for analyzing alternative investment opportunities under conditions of a limited capital budget. These procedures may also be used when determining an optimal management regime for a particular forest stand or for evaluating the financial attractiveness of a particular silvicultural treatment. When analyzing investments of this nature the following steps are required:

- a) Identify all feasible alternatives.
- b) Determine the cost of treatments.
- c) Determine timing of all costs.
- d) Calculate volume added as a result of treatment.
- e) Determine value of added wood.
- f) Determine timing of all incomes.
- g) Calculate DPV, ROR or B/C ratio for each alternative.
- h) Rank alternatives and determine optimum combination.

These general steps will be illustrated in the example in the following paper.

#### FINANCIAL CONTROL

I will now leave the topic of capital budgeting and move on to the more general topic of the financial evaluation and control of a total management system. We will not be concerned here with the financial evaluation of individual projects

but will concentrate on the financial control of a total forest management system.

One common method of instituting financial control in large vertically - integrated companies is to organize divisions or responsibility centers. Typical examples might be a geographically-oriented division or a functionally-oriented division. For instance, a paper company might wish to organize a timberlands responsibility center and a manufacturing responsibility center. The obvious reason for organizing responsibility centers is to give division managers complete control of the resources under their supervision and also to hold them directly responsible for the performance of their responsibility center. Not only is this a method of maintaining control, but it also provides a straight forward way of judging the performance of lower level divisional managers.

There are three common types of responsibility centers. These are: (a) expense centers; (b) financial performance or profit centers and (c) investment centers<sup>(1)</sup>. The basic difference between these three is in the measurement of the inputs and outputs associated with each center and in the selection of criterion to use when evaluating performance. An expense center only consumes resources and does not produce anything that can readily be measured in monetary terms. Thus, an expense center manager can not be judged on the basis of the output his center produces. A profit center consumes resources but also must produce a profit. In this case the manager is judged principally on the basis of the amount of profit he produces. An investment center is similar to the latter except that the manager is responsible for earning a satisfactory profit in relation to the assets under his control. I will direct my attention to the investment center as it is probably the most widely used of the three<sup>(11)</sup>.

Let us assume that we are in charge of the timberlands division of a large industrial pulp and paper company which has been organized as an investment center.

In addition, we will assume that the only other investment center in the corporation is the manufacturing division. Each center receives its own accounting reports weekly and uses them to aid in the evaluation of its past performance. Also top management receives copies of each division's accounting reports and uses them to judge the performance of each division manager. Figures 1 and 2 present useful information which will be used to illustrate several important aspects of the measurement of an investment center's performance.

We will assume that the manager of the timberlands division is being judged through the use of one of the return on investment criterion shown in Figure 2. As shown there are several alternatives available for computing the return on investment for an investment center. However, it should be clear that all of these methods are quite different from those presented earlier when capital budgeting was being discussed. The principal difference is that we are now talking about an unadjusted (for time) return on investment. Also note that we are using the term "cash flow" quite differently than we did before.

The first point which requires some discussion is how we measure the value of the investment (the denominator in the return on investment formulae). Basically, we have two choices: (a) value all assets at cost; or (b) value all assets at current market value. Traditionally, accounting reports have valued all assets at cost. While this may be appropriate for financial accounting reasons it may not be appropriate for management accounting. Obviously, a decision of this nature must be carefully thought out as it directly influences a division's performance. Following a decision on this point, we still have two choices. Should we value our assets at gross book value or net of depreciation? Obviously this choice will also have a significant effect on the division's return on investment<sup>(5,6)</sup>. Also, this decision may affect the timberlands division quite differently than the manufacturing division, thus further complicating investment center evaluation procedures.

The second point to consider is that traditional accounting procedures do not provide any direct mechanism for handling an asset which appreciates in value over time. Such is the case with timber. Further, if a manager attempts to value his timber assets at their current market value he will more than likely increase their value (over their cost or book value) and hence, for a given profit he will decrease his division's return on investment.

Figure 1. Sample Timberlands Income Statement.

<b>Sales</b>		
Sale of eucalyptus for pulpwood		xxx
Sale of eucalyptus for posts		xxx
Sale of eucalyptus for charcoal		xxx
Sale of pines for pulpwood		xxx
Sale of pines for sawtimber		xxx
Sale of native hardwoods for charcoal		xxx
Sale of native hardwoods for sawtimber		<u>xxx</u>
<b>Total Sales</b>		<b>xxxx</b>
<b>Expenses</b>		
Logging expenses	xxx	
Administrative expenses	xxx	
Building depreciation	xxx	
Equipment depreciation	xxx	
Cruising and marking	xxx	
Scaling and weighing	xxx	
Fire protection	xxx	
Property taxes	xxx	
Purchase of outside wood	<u>xxx</u>	
<b>Total Expenses</b>		<b>-xxxx</b>
<b>Net operating profit</b>		<b>xxxx</b>
<b>Non-operating losses</b>		<b>-xx</b>
<b>Net profit before taxes</b>		<b>xxxx</b>
<b>Provision for Federal income taxes</b>		<b>-xxx</b>
<b>Net book profit after tax</b>		<b>xxxx</b>

Figure 2. Common Business Ratios

Net income percentage:

$$\frac{\text{net book profit after tax}}{\text{total sales}} \times 100$$

Accounting return on investment:

$$\frac{\text{net book profit after tax}}{\text{investment base}} \times 100$$

Cash flow return on investment:

$$\frac{\text{cash flow}}{\text{investment base}} \times 100$$

Where cash flow is calculated as follows:

$$\text{Cash Flow} = \text{Net book profit after tax} + \text{Depreciation expenses} - \text{Capitalized expenditures} + \text{non-operating losses.}$$

A third point to consider is which profit figure to use in the numerator of the return on investment formula. That is, the manager may use either net book profit after taxes or he may use cash flow for the past year. Traditional accounting procedures stress the use of net book profit after taxes but for management control purposes cash flow is a much more indicative evaluator to use because it represents the true turn-over of cash and not an artificial book profit.

A fourth problem which arises when one responsibility center provides the input to another center is the question of transfer pricing. This is the price that one responsibility center receives when it sells its product to another center. Basically, a transfer price may be based on either cost or market value<sup>(1)</sup>. Generally, a market based transfer price is preferable to one based on cost. The reason is that this makes it more difficult for an inefficient responsibility center to pass on its inefficiency (in the form of a higher selling price) to another center. Many times the solution of the transfer pricing problem is very difficult to solve in an equitable manner. Thus, it is a problem which should receive adequate attention. Unfortunately, time prohibits a more in depth discussion of this topic.

I hope that the above brief discussion has provided sufficient background to allow you to visualize how decisions concerning the points mentioned above can either advantageously or adversely affect the performance evaluation of a timberlands manager. One area that I have neglected up to now is the use of cost accounting and cost control in forest management. This is a very important topic which I will not have time to discuss this morning. Hopefully, however the material presented above will serve as a foundation for the future implementation of these additional procedures.

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