Session I
Paper (d)

MACHINE COSTING

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INTRODUCTION

In recent years a common basis for machine costing has become much more widely recognised. Its use is demonstrated in such diverse publications as:

- The LIRA contractors costing handbook
- the Caterpillar performance handbook
- FERIC (Forest Engineering Research Institute of Canada) reports
- FRI (Forest Research Institute) reports
- NZ contractors Federation "Blue Book".

It is also used by the major industry organisations.

The most thorough examination of the method in the New Zealand context is that by Walker (1976).

Within this paper, however, a more simple treatment is provided. First the underlying structure is presented and then some of the potential difficulties discussed.

The basis of machine costing.

The method recognises the cost classifications indicated below:

OWNING COSTS		*OPERATING COSTS*	
Depreciation	______	*Fuel*	______
Interest	______	*Oil*	______
Insurance	______	*Tyres (or tracks)*	______
		Repairs & Maintenance	______
Total owning costs	______	*Total operating costs*	______

Total machine cost = owning + operating costs

Note the two major cost classifications: Owning and Operating costs. In the costing process these are synonymous with Fixed and Variable costs.

OWNING COSTS

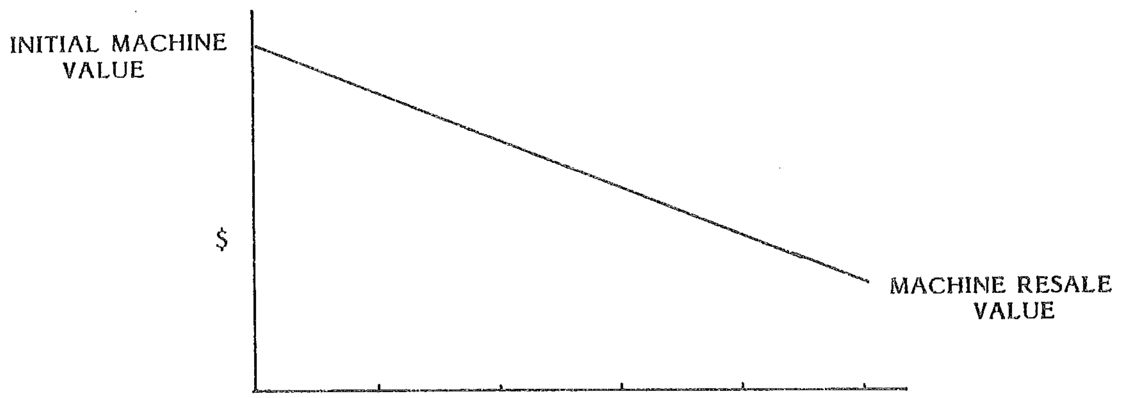
Depreciation

This is an accounting concept, and should not be confused with 'deterioration' - although both refer to the effect of the machine losing value. The distinction arises because depreciation does not necessarily relate at any time to the actual physical state of the machine. Instead depreciation is a means of spreading the anticipated loss in value of a machine over is working life.

There is more than one way of achieving such spreading eg. straight line method, declining value, sum of digits, units of use etc.

By convention a straight line approach is assumed in the machine rate calculation ie. there is a steady decline in value.

DEPRECIATION



The calculation formula is straightforward :

$$\text{Depreciation per year} = \frac{\text{Initial value (C) - Resale value (R)}}{\text{Life in years (N)}}$$

The resale value is expressed in current dollar terms - that is there is no attempt to try to anticipate inflation (which will be discussed later).

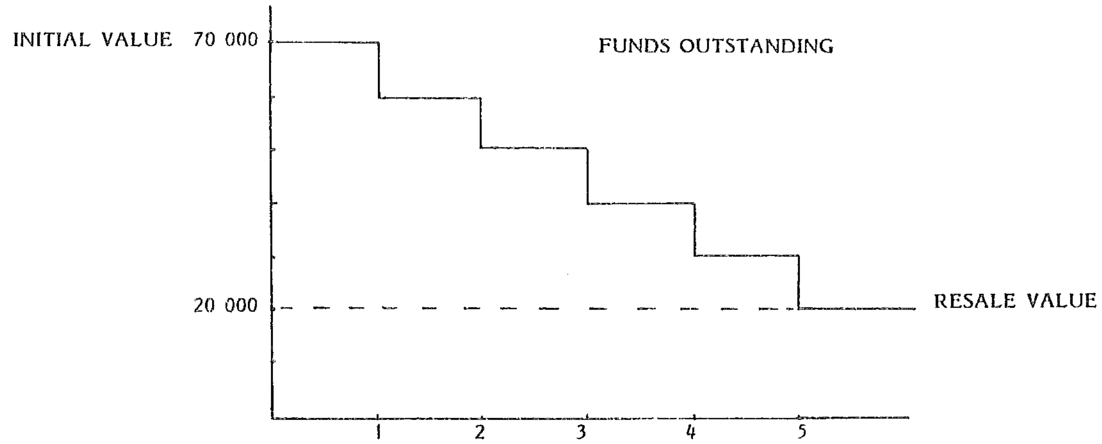
The machine life is based on current best estimate and of course this reflects the hardship of the logging operation, and the hours worked per day and per year.

Interest

Prior to considering interest and insurance the basic costing format leads to the calculation of a quantity referred to as the Average Capital Invested (ACI - or occasionally AAI, Average Annual Investment). The rationale for this is as follows :

It is assumed that funds are borrowed to purchase the machine, and that through the course of its working life the machine will repay those borrowed funds.

By convention, again, it is assumed that those borrowed funds are repaid in equal annual amounts ie.



On average, over the life of the machine, the amount that remains invested in it is described by the formula :

$$ACI = \frac{(C - R) \times (N + 1)}{2 \times N} + R$$

where C = Initial value
R = value residual
N = life in years

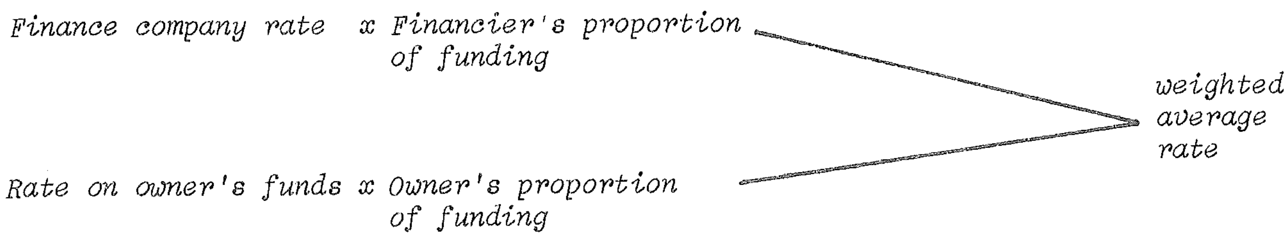
Although this looks a little daunting, it is in fact easy to work out provided that you solve the equation in the right sequence. (First complete the steps within the brackets, multiply the results together, divide by the product of 2 x N, and then, finally, add R).

For those of you familiar with the LIRA Costing Handbook, this expression gives the table of so-called 'resale factors' in that publication. Use whichever approach you prefer, but obviously the formula is most readily adaptable to different combinations of values.

Whose are the funds assumed invested in the machine - a banks? a finance companies? the owners? The answer is all of these - everybody who has put funds into buying the machine because everybody, after all, is entitled to a return on their investment.

It is now appropriate to consider what interest rate should be applied to the ACI.

While the subject could potentially be made quite complex, the prevailing practice is to complete a calculation such as the following:



Why should the financier and owner expect a different rate of return? (The owner's rate, incidentally, is almost always lower). The principal explanation is risk - the financier is risking his funds with someone elses management. A second reason for the difference is that although the owner is awarded less of a return on funds there are places elsewhere in the costing process where his own risk and profit margins are recognised.

The next question, inevitably, is "what proportion of the funds comes from each source?".

It is recognized that few contractors can provide all of the funds necessary to by their machine outright, and, even if they can, it may not be the best use of their money to do so. Commonly adopted proportions are:

30% owner's funds
70% borrowed

As an example:

	RATE		PROPORTION		
Finance co	20%	x	70%	=	14.0%
Owner	15%	x	30%	=	4.5%
Weighted average rate :					18.5%

The rest of the exercise is purely mathematical eg.

ACI x weighted average rate = cost of interest per year

Insurance

The most accurate cost to include is the actual cost of insurance quoted or paid for on the machine concerned. If however, such a figure has not been obtained a percentage of the ACI between 2% and 4% generally gives a result which is in the right order of magnitude.

OPERATING COSTS

Fuel

The fuel cost per operating hour is the product of fuel consumption per hour and fuel cost per litre. Ideally your own records should enable a good estimate of fuel consumption. The various equipment handbooks frequently suggest consumption rates, and qualify these rates as to whether they correspond to hard, easy or average workload.

The LIRA Costing Handbook contains a table of fuel consumption rates. The Colco2 costing program provides the option of deriving consumption rates based on formulae relating fuel use to machine power rating.

Oil

The same principles as for fuel apply. Commonly, however, the oil cost is just derived as a set percentage of the hourly fuel cost - a figure of 15% seems well recognised.

Tyres

Depreciation of the machine was discussed earlier. In effect we also depreciate the tyres, but, because we do not expect them to last as long as the rest of the machine we depreciate them separately.

The cost of a set of tyres is spread over their life in hours to give a cost per worked hour. Obviously, according to this arrangement, if the machine works more hours in a year, the tyres will not last as many years.

Rigging

Rigging, like tyres, is depreciated, and again, like tyres, has a depreciation schedule all of its own. In fact two classifications of rigging may be recognised so that the different life of different components is allowed for eg.

mainrope $\frac{\text{cost/metre x length}}{\text{life of mainrope in hours}}$

strops $\frac{\text{cost of strop}}{\text{life of strop in hours}}$

Repairs and Maintenance

Deciding on the appropriate allowance for repairs and maintenance represents the greatest challenge in the machine rate calculation.

If you keep good records you may have some hard data on which to base your estimates. However, a large quantity of such recorded data may be necessary if it is to have some statistical validity. Bear in mind that machines generally incur more R & M costs as they get older. We may therefore be only able to conclude from last years R & M costs that this years R & M cost will be greater, without being able to confidently estimate how much greater.

By default the costing method we are considering generally calculates an R & M allowance as a percentage of the depreciation. The percentages used mostly lie in the range 60-100%.

The lower figures are used for rubber tyred machines and easy operating conditions - higher figures relate to tougher conditions, or to tracked machines (where a track rebuild operation may be assumed as part of the total R & M cost).

Adopting a factor of 100% of depreciation implies that over the life of the machine as much money again as the machines value will be spent on its repairs. Supporting data for such factors, from both overseas and New Zealand, is generally based on recorded costs for fleet operations. ie. in larger companies. There the garage records systems provide the necessary data. How applicable the results from fleet operations are to the individual contractors operation is debatable. The contractor, for instance, is less likely to recognise the value of his own time put into repairs and maintenance after normal work hours - this is not to say he should not expect some return for this.

Ideally, if more logging contractors in the industry were to keep accurate, detailed records, as described earlier in this seminar, there would be a good database from which to refine the R & M factors.

References

Walker K (1976) The Principles and Practices of Costing as Applied to Log Harvesting Systems Management, Economics of Silviculture Unpublished Report No 87