SESSION 1

Paper (b)

MANPOWER PLANNING IN LOGGING
Productivity basis for predicting manpower requirements

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Having been responsible for supplying my colleague Hamish Levack with some of the data upon which he based the previous paper, it was felt pertinent to provide some background as to the derivation of the data and also if possible some implications and constraints.

The data which is referred to is in the main the formula for deriving the production levels based upon available tree size. ".6436 (tree size) .57 x 32080 = tonnes or m^3/annum".

Also the stated manning strengths, and the correction factor for hauler production.

All the data used has been derived from studies and modelling within the Central pumice plateau of the North Island, with all its logging advantages, so it has been necessary to provide modifications or corrections to obtain national or New Zealand wide information.

The paper therefore is an explanation of the "state of the art" today, with all its shortcomings, and hopefully will provide sufficient challenge for others to continue to better fill in all the gaps. Each of the components is stated along with any necessary explanations and constraints.

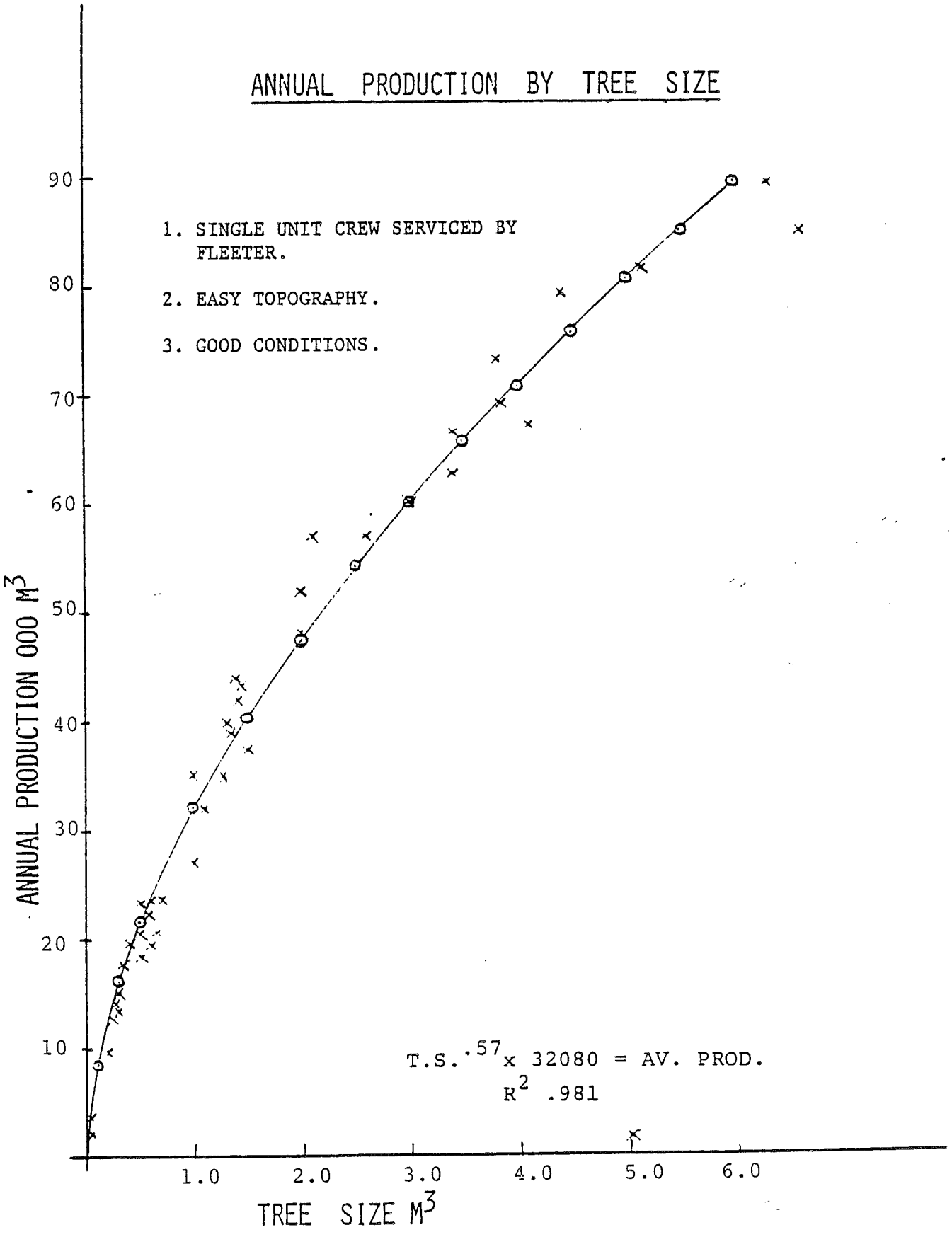
PRODUCTIVITY

What does it mean? From the Concise Oxford Dictionary:-

> *"capacity to produce quality or state of being productive, production per man hour, intensified production".*

In Industrial Engineering circles it has a much more precise meaning:-

> *"Productivity is the ratio between input and output, it improves when the ratio increases or the output per $ dollar value of input improves. There are therefore three classical cases:-*
>
> *(1) Output improves with the same input.*
>
> *(2) The same output is maintained with reduced input.*
>
> *(3) Output is proportionally greater than a given increase in input."*


ANNUAL PRODUCTION BY TREE SIZE
1. SINGLE UNIT CREW SERVICED BY FLEETER.
2. EASY TOPOGRAPHY.
3. GOOD CONDITIONS.
ANNUAL PRODUCTION 000 M3
TREE SIZE M3
90
80
70
60
50
40
30
20
10
1.0
2.0
3.0
4.0
5.0
6.0
T.S.·57 x 32080 = AV. PROD.
R2 .981

It is interesting to note that over the years the Logging Industry has almost invariably expressed improved productivity as a means of reducing the manpower necessary to achieve any given level of production.

TREE SIZE AS BASIS FOR PREDICTING PRODUCTION

The data comes from contract levels set at Kaingaroa Forest in the period 1979-1982. It is for single unit hot deck production serviced by a fleeter loader, easy topography and good logging conditions. Tree size is merchantable and has been reduced to reflect the effects of breakage and essential bush cutting to the landing site. It does not differentiate between clear felling or production thinning and has been adjusted below 0.6 m^3 to smooth the graph and have the line go through the "0" axis of the graph. The r^2 value from the 41 plot points is .98.

The data was selected to represent the best average production not the peak production, this is reflected in that contractors have over the last few years (windblow excluded) averaged between 102% and up to 126% of these production levels on an annual basis, with a much greater range individually and or, a weekly or monthly basis.

This graph is used to judge performance particuarly as it eliminates the variable of tree size. Haul distance, the other great logging variable is eliminated with good planning in a managed forest,or at least should be.

MANPOWER

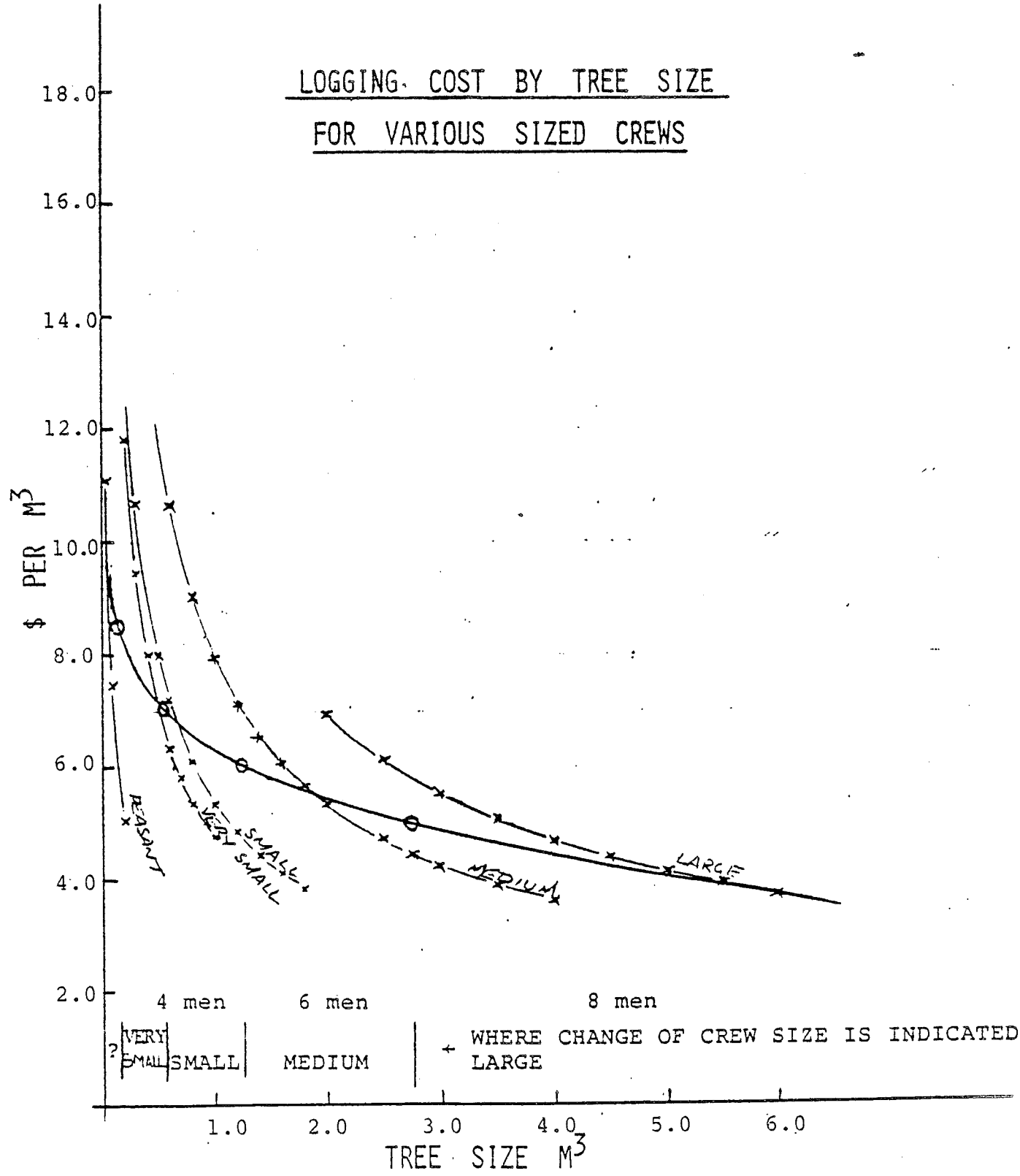
The data used is:-

4 men for thinning
8 men for clear felling
10 men for haulers

The basis of this data comes from a paper prepared by the writer for the 1982 LIRA Seminar, Session 10 Paper 5 dealing with economics and costs of logging. It should be noted the graph wasn't prepared to demonstrate manpowering but rather when should different logging configurations and sized equipment be changed to suit different tree sizes.

However when considering the graph, particularly the break points, and superimposing the manpower figures with each option it becomes clear the 4 man option for thinning covers an appropriate range of tree sizes. This is not the case for clear felling unless tree size is above 2.8 m^3 where the eight men is quite correct, particularly so as the production estimates and current practice uses these numbers. When predicting for the future (the object of the exercise) it may well be that 6 men for clear felling is more appropriate, however at the moment this particular tree size is not being clear felled as there is still some old crop available. With the predicted increase in available wood the 8 men may well stay the correct figure as it will take time for industry to take up the wood options and all the time the trees are getting bigger. This with loggers propensity for dropping crew numbers as productivity increases could well be automatically accounted for by adjusting the performance fudge factor.

With some simple adjustments it is possible to produce a regression of manpower requirements expressed per tree size. It is a curved relationship but can quite well be expressed as a straight line with a maximum value. Tree size x 1.5 + 2.5 = crew strength with a maximum value of 8 men. Haulers stay constant at 10 and only used for clear felling.



PERFORMANCE

This is that odd looking figure thrown in at the beginning of the equation, .6436, also the factor of .62 used for haulers.

A definition of performance is:-

> *"That level of output achieved by an individual or a group of people expressed as a percentage, compared to standard performance. Standard is expressed as 100%."*

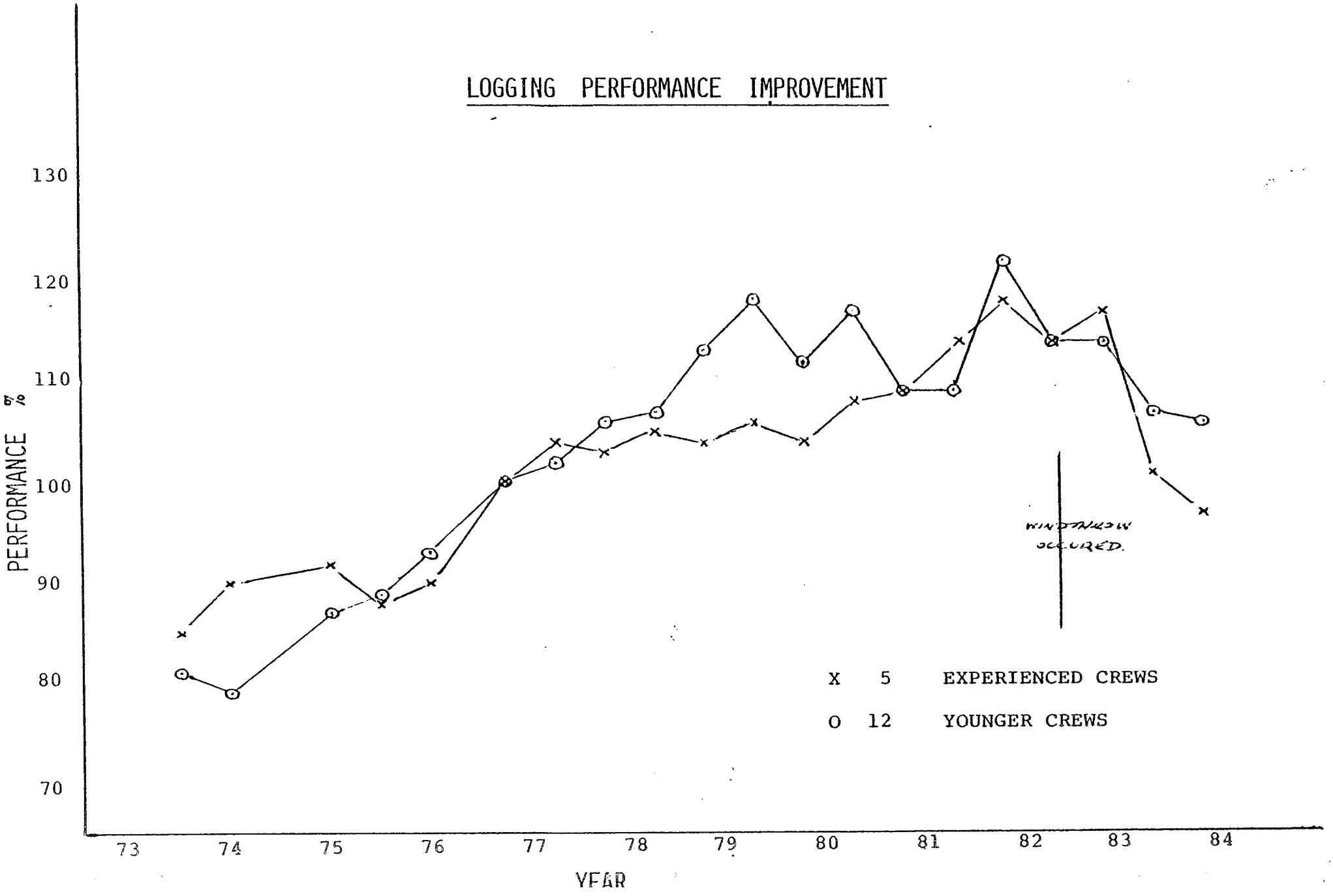
Definition of Standard Performance:-

> *"The rate of output which qualified workers will naturally achieve without over-exertion as an average over the working day or shift provided they adhere to the specified method and provided they are motivated to apply themselves to their work, once again denoted as 100%."*

It will be clear that the production levels having been set from a known data base stem from the pumice plateau, dare I say that this represents probably the best tree growing area with also the best logging conditions and also once again the most skilled loggers. It is obvious therefore that in a national planning model allowance must be made for other areas of New Zealand, hence the fudge factor, in essence it allows for the rest of New Zealand to operate at 64.36% of these production figures and with a correction figure to 80% in the 1986-1990 lustrum, 90% in the 1991-1995 lustrum and 100% thereafter. It must also be remembered the figures relate to and are inseparable from the stated production levels. The reduction in subsequent lustrums quite effectively reduces crew size, is an estimate of dubious origins but should stand until someone produces better estimates with an objective basis.

I believe this is in fact being undertaken. A look at a precis of research topics, reveals "The object of this study is to identify, measure and explain variation in labour productivity for the main forest operations. When this is achieved, improved formulae can then be provided for estimating future labour demand for a given operation in a given forest". It remains for such a study to be completed and made available.

The hauler figure of .62 is applied on top of the previous figure and simply corrects skidder or tractor production to that of haulers. Obviously one figure for all sorts of haulers over all sorts of terrain with all sorts of operations is an over simplification. However I suggest it is correct for the present state of New Zealand wide skills with haulers, only 62% of other forms of production. One thing is certain however there will have to be a very large increase in the number of hauler units in operation before the ratio improves and also before a better figure is obtainable, particularly on a national basis. The extent to which haulers will be used in the future is still debatable.


LOGGING PERFORMANCE IMPROVEMENT
PERFORMANCE %
130
120
110
100
90
80
70
73
74
75
76
77
78
79
80
81
82
83
84
YEAR
WINDTHROW OCCURED.
X 5 EXPERIENCED CREWS
O 12 YOUNGER CREWS

LEARNING CURVES

This brings up the problem of how long will it take to build up skills in the logging industry, other contributions to this seminar are discussing methods of improving skills. There is very little evidence or writing which can guide in this area of learning manual skills. Most of the writers feel that after the initial desire to improve has been passed then repetition of the basic work cycles gives the best clues as to when proficiency is obtained. The magic figure is variously stated between 15,000 and 25,000 repetition.

In the Forest Industries it is not hard to believe proficiency after planting or pruning 20,000 trees and I believe everyone here has witnessed this. In logging however, which is a group activity involving interactions between four and up to eight different persons it looks like the figure is 20,000 hauls or maybe even more work cycles, this takes a bit of time to achieve without interruptions. It seems gaps or interruptions reduces the skill levels again which then have to be re-built up, a sort of saw tooth effect.

Some data was available on learning or improved performance from records kept at Kaingaroa Forest.

The basis of the data is the six monthly performance records of two groups of operations:-

(1) Five crews of generally older more experienced contractors.

(2) Twelve crews of younger contractors who have had less time to gain experience.

Performance is recorded on a percentage scale and refers to achievement in terms of a predetermined (for each logging setting) level of output. This later being set from Work Study standards, mensuration data for tree size and 1 in 5000 layout maps for topography and length of haul.

The averages from each group only are plotted and the data stopped before the effects of windthrow are evident, generally however performances dropped during the windthrow but this may well have been caused by many other factors and may well indeed indicate what learning curves are all about. There has been a break in continuity another saw tooth is formed.

Generally speaking performance has improved steadily then started to fluctuate, indeed again developing a saw tooth effect. If the time span was long enough this could be considered a straight flat line with fluctuations and these indicating either new learning situations or changes in the crews involved.

From this data is appears the learning time in logging is long term, something like 6 to 8 years without other outside influences

provided always that someone is at first looking for improvement. It is not known what influence an intensified training programme would have on these trends.

Considering the gang efficiency factor used by Hamish Levack, with hindsight I would consider on a National scale the following corrections but wouldn't in the least be embarrassed if challenged.

1981-85	.64
1986-90	.76
1991-95	.85
1996-00	.92
2001-05	.95
2006-10	.96
2011-15	.96

On a local scale this learning curve may well be steeper and achieving 100% quite quickly but this will depend mostly on the timing of the start up of each new block of wood becoming available and the relative skills intrinsic within the local area when extensive logging starts up. If small wood lots continue to be put up for sale, in effect a series of quota production levels, then there will be very slow accumulation of skills and hence productivity.

COMMENT

Hamish Levack in his paper has drawn attention to the sensitivity of the resultant manpower to the performance "fudge factor", I would agree. Now to do something about the accuracy of the factor two things can be done:-

(1) Carry out more detailed studies and derive new better factors which must still suffer the problems of having to predict into the future.

(2) Do something about the reason for having the factor. In other words what do you do to improve productivity in logging. Further speakers will be dealing with aspects of this subject and are better equipped than the writer to comment. However one point needs saying. Production or productivity will not improve of its own, first and most important someone or organisation must want an improvement, then secondly must set new objectives and point out something better is possible. I don't see in this seminars programme any sessions addressing itself to this section of the "Human Resources in Logging", where do they come from? How are they trained? How are they motivated? How are they retained in logging? These are the people we need first, training programmes, new machinery, new incentive schemes and all these other factors will be of no lasting value if we don't have the means of obtaining improved productivity or even just seeing if it has occurred.