ISSN 0111-6711

LOGGING INDUSTRY RESEARCH ASSOCIATION NEW ZEALAND

REPORT

Vol. 13 No. 6 1988

MANUAL AND MECHANICAL FELLING IN RADIATA PINE THINNINGS

Trevor Moore

Figure 1 - Bell Model T Feller-Buncher

ABSTRACT

A study of mechanised felling in radiata pine thinnings indicated that mechanical felling and bunching for grapple skidder extraction was more cost effective and productive than manual felling followed by bunching with a separate machine.

The wood did not require trimming with either system as it was hauled to a Harricana delimber for processing.

A Bell Model T Feller-Buncher replaced six fallers and a Bell bunching machine in the operation and had the ability to fell and bunch whole trees at a rate of 79 trees per hour. The feller-buncher reduced the cost of the manual operation by 10%. The hours of work for both systems were the same.

INTRODUCTION

In thinning operations where felling and trimming is carried out motor manually, daily production is often

limited by faller productivity. An increase in gang-day production is normally achieved through the addition of a further faller. While this appears to be a simple solution, factors such as a lack of skilled labour, turnover, absenteeism, and the increased cost of an extra man tend to complicate this solution.

In a recent study where the trimming aspect of the job was carried out mechanically at the skid (Raymond, 1988), the flow on effect of that mechanisation on the felling cycle was monitored. The above study indicated delimber productivity of 62 trees per machine hour (approximately 170 m^3/6.5 hour day).

The mechanisation of felling in New Zealand commenced in 1975. The majority of the early machines with exception of the Clark Bobcat, were more suited to clearfell of minor species than thinning (Gleason, 1982). More recently, the introduction of the Bell 120 fitted with a Hultdins F45 felling grapple has shown excellent potential to fell and bunch in radiata thinnings (Raymond and Moore, 1986). A Bell Model T Feller-Buncher, fitted with a Bell felling head (600 mm chainsaw bar) was used to fell and bunch in this comparison.

This Report discusses three logging systems:

(1) Option 1:
Manual felling and delimbing, Bell bunching and grapple skidder extraction.

(2) Option 2:
Manual felling, Bell bunching and grapple skidder extraction to a stroke delimber.

(3) Option 3:
Mechanical felling and bunching with grapple skidder extraction to a stroke delimber.

ACKNOWLEDGEMENT

The assistance of Timberlands (Central Region), Contractor Sam Webb and his crew, and Contractor John Duffy for supplying and operating his Bell Model T Feller-Buncher is gratefully acknowledged.

STAND DETAILS

The study was carried out in a stand of 18-year old radiata pine in Kaingaroa Forest.

Table 1 - Stand Details

Age	18 years
Total Stocking	600 stems/ha
Yield Stocking	350 stems/ha
Yield mean dbh	28 cm
Mean Merchantable Piece Size	0.4 m^3

The topography was flat and well suited to the rubber tyred machines. The stocking of 600 stems per hectare allowed the Bell Model T sufficient room to manoeuvre in the unthinned stand.

SYSTEM DESCRIPTION

This report compares the gang day production and unit cost of three work systems:

Option 1:

Motor manual felling and trimming, Bell bunching, grapple skidder extraction, manual processing at skid, and loader sorting and stacking.

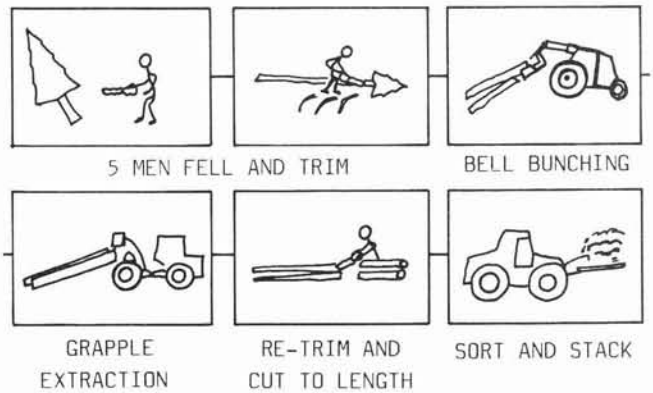
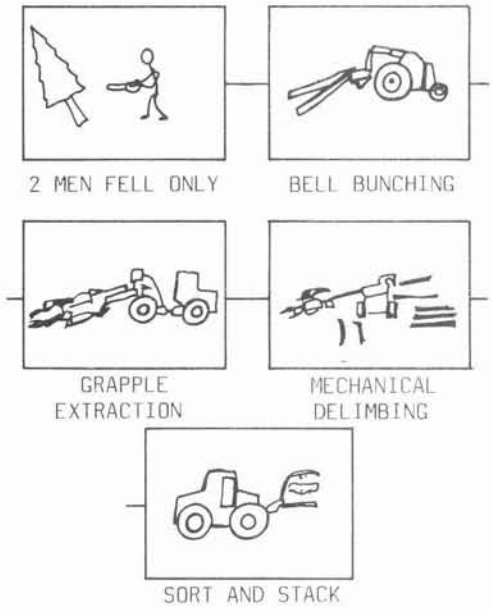


Figure 2 - Manual Trimming

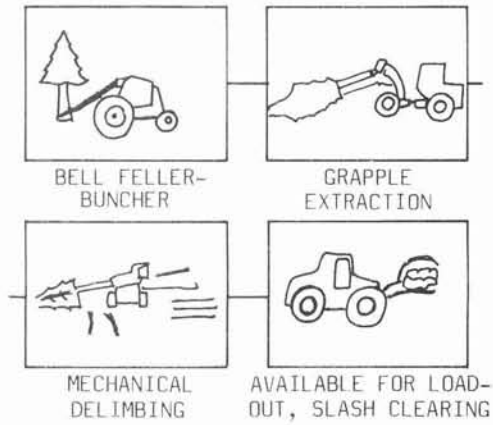
Option 2:

Motor manual felling, Bell bunching, grapple skidder extraction, mechanical delimbing and processing at skid, and loader sorting, stacking and clearing slash.



Option 3:

Mechanical felling and bunching (Bell), grapple skidder extraction, mechanised delimbing and processing at skids, and loader sorting, stacking and clearing slash.



As a grapple skidder was used, this precluded head first extraction of either trimmed or untrimmed bunches.

Figure 3 - Cat 518 grapple skidder extracting bunched wood.

STUDY METHOD

Brief continuous time study of the manual felling - no trimming in the bush - (103 cycles) and mechanical felling (298 cycles) were carried out. The Bell bunching of the manually felled, untrimmed trees, and grapple skidder extraction were not studied. During the Harricana delimber trial (Raymond, 1988), it was apparent that both these units were capable of producing 170 tonnes per day.

RESULTS AND DISCUSSION

All daily productivity calculations for the following systems have been based on a 7 productive machine hour (PMH) day.

Option 1

The gang operated as a motor manual thinning crew. Five fallers were employed to fell and delimb the wood in the bush. It was then bunched by a Bell Logger for butt-first extraction by a Caterpillar 518 grapple skidder.

Individual faller productivity for this system was 11 trees/hour (based on historical productivity information).

Secondary trimming and cutting to length was carried out by a skiddy prior to the wood being stacked by a Dresser 520B loader.

Option 2

By introducing the Harricana delimber, it was found that two fallers were adequate to supply sufficient wood for the delimber. The productivity of the delimber was between 50 and 60 trees per hour. However, there could be times when, due to wind or adverse lean, faller productivity would be less than the required level.

At the time of the study, faller productivity was 36 trees per hour per man. The conditions were good for manual felling with little undergrowth. Because of the requirement for whole tree, butt first extraction, some wedging was required.

Table 2 - Manual Faller Productivity (Felling Only)

Element	No.of Observations	Mean Time Per Cycle (mins)
Walk and Select	89	.26
Trim Butt	16	.06
Fell	103	1.05
Refuel Saw	4	.09
Operational Delays	7	.22
Total Cycle Time (mins)		**1.68**

Trees per hour per faller = 36

Option 3

The Bell Model T feller-buncher was introduced to the system. This removed the Bell bunching machine and the two fallers from the system.

The feller buncher operator entered the unthinned stand at an angle to suit the desired direction of extraction by the skidder. Trees were felled and then moved to a suitable point in twos and threes to make a bunch of normally 5 trees. After cutting each tree, the butt would be placed next to the nearest felled tree. The operator used this method to keep travel time during bunching to a minimum. By working out of the stand, the operator did not have to contend with felled and bunched trees behind the machine.

Productivity of the machine felling and bunching averaged 79 trees per hour with a maximum of 85 trees per hour. There was no stand damage caused by the feller buncher. Table 3 details the productivity of the Model T feller-buncher.

Table 3 - Mechanical Felling and Bunching Productivity

Element	No.of Observations	Mean Time Per Cycle (Min)
Move In	286	.23
Position	203	.06
Fell	298	.12
Bunch	237	.26
In Bush Travel	8	.03
Delays	8	.06
Total Cycle Time (Mins)		**.76**

Trees per PMH = 79

Table 4 - Summary of Felling Productivity of the Three Options (Based on a tree size of 0.4m³)

Felling	Option 1	Option 2	Option 3
Trees per hour	11	36	79
Vol.per hour (@ 0.4m³)	4.4	14	32
Vol.per 7-hour day, m³	31	98	224
Number of units	5	2	1
Total production, m³ per day	155	196	224
(0.9 m³/tonne), tonnes per day	140	176	202

COSTS

To keep production similar between the options, and satisfy the capacity of the delimber, an extra man has been costed into the manual system (Option 1) to give a daily production of approximately 170 tonne.

Using the LIRA Costing Handbook for Logging Contractors (Wells, 1981) the estimated costs for each system are as follows:

Option 1

10 men @ $120	$1,200
7 Chainsaws @ $23	161
1 Bell Logger (120)	210
1 Cat 518 grapple skidder	410
1 520B Loader	315
Total Daily Cost	**$2,296**

at 170 tonne/day = $13.50 per tonne

Option 2

6 men @ $120	$ 720
2 chainsaws @ $23	46
1 Bell Logger	210
1 Cat 518 grapple skidder	410
1 520B Loader	315
1 Harricana Delimber	680
Total Daily Cost	**$2,381**

at 170 tonne/day = $14.00 per tonne

Option 3

4 men @ $120	$ 480
1 chainsaw	23
1 Bell Feller-Buncher	242
1 Cat 518 Grapple Skidder	410
1 Harricana Delimber	680
1 520B Loader	315
Total Daily Cost	**$2,150**

at 170 tonne/day = $12.70 per tonne

Table 5 - Summary of Options Cost and Productivity

	Option 1	Option 2	Option 3
Daily Cost	$2,273	$2,381	$2,150
Productivity (m³/day)	170	170	170
$/m³	$13.50	$14.00	$12.70

During the trial, the loader was available and was used to stack shorts and clear slash. The delimber operators had reached a level of confidence where all the delimbed long wood was stacked straight from the delimber ready for loadout. With further experience, the

delimber operators would be expected to stack the short wood without reducing productivity.

The loader could, therefore, be eliminated from Options 2 and 3, thus reducing the daily cost by $315 ($1.85/tonne). (Note that as discussed by Raymond (1988) the loader and delimber operators interchange jobs, so the cost of the loader operator is retained as a spare machine operator).

CONCLUSIONS

The mechanised system (Option 3) was able to maintain a productivity rate of 170 tonnes per day at a cost of $12.70. Of the three options, the motor manual system with the delimber (Option 2) was most expensive.

The cost of the Bell Model T Feller-Buncher at $362 per day, including the operator, was the same as the cost of three men. It has the ability to mainain production in this type of stand that will ensure the viability of a totally mechanised system. Without the inclusion of the feller-buncher, the high cost of the delimber would not necessarily be recoverable with the manual system. This trial showed the importance of mechanising the whole system and matching machinery to increase volume at a cheaper or competitive rate. It has also highlighted the fact that poorly matched systems have the potential to increase productivity but not reduce end cost.

REFERENCES

Gleason, A.P.(1982): "Mechanisation of Felling and Delimbing in New Zealand", in "Logging Machinery" Seminar Proceedings, LIRA.

Raymond, K., and Moore, T. (1986): "Mechanised Felling with a Bell Logger" LIRA Report Vol.11 No.8.

Raymond, K.(1988):"The Harricana Stroke Delimber in Radiata Thinnings", LIRA Report Vol.13 No.1.

Wells, G.C.(1981):"Costing Handbook for Logging Contractors", LIRA.

The costs stated in this Report have been derived using the procedure shown in the LIRA Costing Handbook for Logging Contractors. They are only an estimate and do not necessarily represent the actual costs for this operation.

For further information, contact:

N.Z. LOGGING INDUSTRY RESEARCH ASSOC. INC.
P.O. Box 147,
ROTORUA, NEW ZEALAND.

Telephone: (073) 87-168