FLAT COUNTRY EASY TERRAIN LOGGING

Findings of the Cycle Time Analysis Sub Group

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SUMMARY

The evaluation of past research and development on conventional logging system (for flat country easy terrain) in regards to cycle time analysis shows two main areas where the continuing research and development could yield dividends. The two areas are:-

1. Load accumulation phase

2. Skid phase

The cycle time analysis has also shown that where conditions allow the closer matching of machine to production of the system could result in cost reduction.

INTRODUCTION

The ranking of smallwood harvesting constraints has shown that piece size, load accumulation problems and terrain restrictions are three of the four most important constraints to smallwood logging. Considerable volumes of smallwood will still be available for harvesting in the future, and the demand for pulpwood and posts etc will ensure its continued harvesting.

The low value of smallwood has also been cited as a constraint on smallwood harvesting. Perhaps its not so much a low value but a high delivered cost that results in a low residual value.

Although this paper deals only with the prime mover, some mention is made of the affects on the rest of the logging sytem, e.g. the numbers of men necessary or the inclusion of additional machinery. Often a change in one part of the overall logging system requires other complimentary changes to be made in other parts of the system. This ensures the modified logging system is workable and efficient. Most of the systems outlined in this paper have required some degree of system and planning changes to enable an efficiency in the overall logging system.

With these points in mind this paper evalutes the affects of past research and development on conventional logging systems on easy terrain. Potential areas for future research and development will be highlighted.

Because most of the smallwood harvesting is in thinnings this paper deals only with thinnings. All the comments and research suggestions are just as applicable to all other smallwood logging as they are to thinnings.

ANALYSIS METHOD

Smallwood was broken down into three extractable piece size classes - 0.12 m3, 0.2 m3 and 0.35 m3. Various logging systems were compared within these three classes.

Targets were derived for each piece size based on flat terrain (i.e. travel slopes ≤ 7°) 150 m average haul and 390 minutes productive working time. They are machine targets only, with no allowance for any contingencies. Observed times have been used for target calculation which may be different to normalised times.

The extraction cycle was broken into three parts:

1. Prime mover travel - skid and bush
2. Load accumulation - positioning, stropping, winching for prime mover only.
3. Skid - unstrop, fleet

The current system of long length skidder extraction, one piece per strop is deemed to be the standard base method. Derivations were then compared to this standard.

No reference to costs, apart from the estimate of capital for the prime mover, has been made. Some of the benefits shown in the daily production may be insufficient to outweigh the increase in capital cost necessary to achieve those benefits. Individual users will have to apply their own costing format to estimate unit rate changes.

This study only looked at the effect of change on the prime mover cycle, and gives an estimate of the manpower necessary to operate it. It doesn't investigate the affects on the bush cycle or any other interrelated cycle because of that change. Limitations to the various logging systems studied are listed in Appendix I.

DISCUSSION

0.12 m3 piece size (refer to Table 1)

Many production thinning operations are carried out with a very small piece size. Its an established fact that the smaller the piece size the greater the extracted cost. At this end of the piece size spectrum the costs of extraction and log preparation in the bush will be high. This is reflected by the daily production figures coupled with the capital cost estimate and manpower requirements as shown in Table 1. These are the important columns to study.

In this situation the base case has a daily production of 25 tonnes, four men and $84 000 basic capital.

Current research has followed two paths:-

1. Increasing productivity of the conventional skidder

2. Development of smaller lower cost machines

Where conditions allow the lower cost prime mover in basic trim (single drum) is quite capable of extracting the same daily volume as the conventional skidder. Often conditions e.g. cutover waste, stumps etc. do not allow the use of these smaller prime movers, so the problem returns to increasing the productivity of the conventional skidder.

The use of a double drum winch on the conventional skidder shows an increased daily production of over 30%. However the same increase is not apparent for the small low cost prime mover. The increase in this case is only 8%. Perhaps reflecting that the optimum drag size has been reached.

Bunching of logs for the skidder shows massive increases in skidder productivity. Manual bunching in shortwood gives a 400% increase whereas mechanical bunching of long length yields upto 840% increase over the basic system. As the skidder productivity increases so other factors arise e.g. the number of cutters necessary to service the skidder increases. Even improving the existing felling practised by using directional felling, felling levers, felling benches (where ground conditions permit) etc. will also bring about some degree of bunching for longwood. This should continue to increase productivity for the conventional systems. In the final example the shear volume of wood produced presents all sorts of handling problems - skid size, area covered etc.

All these examples show that the accumulation time is still a large part of the total cycle time relevant to the other two phases. (Except for the shortwood system which uses pre-stropping with one strop). Even though productivity has increased there could be ways of furthering this increase by reducing the time taken. The use of pre-stropping could have benefits for all machines and both winch types. Even though the optimum payload may have been reached for the small skidder, reductions in the breakout through pre-stropping could further increase its productivity. The use of radio controlled winches needs further investigation, other methods of bunching e.g. portable winches and horses may also be of benefit.

<u>0.20 m3 piece size (refer to Table 2)</u>

The same trends shown in Table 1 are also in evidence as the piece size increases. The move from a small low cost single drum prime mover to a similar unit with a double drum doesn't result in the same productivity increase as that shown by the conventional skidder. Again the affect of manual bunching is reflected in a very large increase in productivity over the single drum long length system.

The same comments concerning areas for more research and development made above continue to apply as the piece size increases.

The table has the results of a study using grapple extraction instead of strops. In this case it was using the Bell Logger to extract long length pieces. Although the pieces/cycle were lower the daily production was the same as for the conventional skidder. This again reinforces the idea that if conditions suit a lower capital cost prime mover can extract as much as a conventional skidder.

The use of a grapple on the Bell Logger raises the question of grapples on other prime movers. Could the breakout ease of a grapple be coupled to the faster travel speed of a conventional skidder to give significant increases in daily production?

The use of a grapple for extracting bunches of logs also warrants attention. Reductions in the skid phase could also be expected with the use of grapples. This aspect should be covered in other papers concerned with mechanisation. The logical development of grapples is their use on forwarders and clam-bunk skidders etc.

0.35 m3 piece size (refer to Table 3)

As production thinning generally occurs well below this piece size there is little data available on productivity research. There is however no reason to expect that the gains shown in the previous piece-sizes won't be achieved in this piece-size as well.

FRI have looked at productivity by taking a different approach. Stand re-organisation is the term FRI has given to manipulate the stands management to assist in skidder productivity. This is in effect a row thinning approach instead of normal selection thinning. Row thinning can have advantages in reduction of accumulation time, reduction in machine travel times if road edge landings are used, reduction in residual crop tree damage, and greater potential for methods improvement e.g. mechanisation.

Table 3 shows the affect of what is in effect a clearfell. Alternate pairs of rows are removed. Although the pieces/cycle and cycle element percentages are similar to the conventional system the daily production is much greater. The concentration of logs to be extracted in the row thinning approach considerably reduces the time taken to accumulate a full load behind the skidder.

The other benefit (for the logger) of this type of stand management is that because its a type of clearfell operation large as well as small trees are removed. Both the piece size range and average piece size will be larger than would be expected in a normal selection thin for the stand at the same age. Therefore depending on the end use of the stand this type of approach could reduce the extraction cost if young stands have to be thinned.

Skid Phase

Virtually nothing has been said about the skid time. All the tables show the skid time is a high proportion of the actual cycle. The one exception is the mechanical bunching trial which yielded 210 tonnes/day. A loader had to be included in the operation to deal with this amount of wood. Little if any research has been documented on this aspect of the cycle. More needs to be done in finding methods of eliminating or reducing the skid time. Can the inclusion of a small loader significantly reduce cycle times ?, e.g. Bell or Iwafuji that can also assist in extraction. Better log presentation in the bush can also result in the reduction of skid time if poor trimming means the prime mover operator has to retrim before fleeting.

SUMMARY OF RESEARCH AND DEVELOPMENT RECOMMENDATIONS

1. Load Accumulation Phase

   a) Pre-stropping
   b) Double drum winches
   c) Radio control winches
   d) Use of grapples on small skidders
   e) Pre-bunching - portable winches
      - horses
      - bell logger
   f) Stand re-organisation

2. Skid Phase

   a) Eliminate or decrease skid time of prime mover

3. Matching Systems

   a) Man-power machine matching
   b) Alternative extraction methods - forwarders
      - clam-bunks
      - loaders

TABLE 1

0.12 m3 PIECE SIZE

Extraction	Percentage of Total Machine Life Time. Travel	Accum.	Skid	Pieces /cycle	Daily prod^{n}	Capital ($)	Men
Small skidder (60 kw) single drum	21	53	26	10	25	84 000	3-4
Agricultural tractor	30	50	20	8	25	50 000	3-4
60 kw skidder double drum	30	49	21	14	34	95 000	4-5
Small skidder double drum (Holder, Iwafuji)	25	35	40	10	27	45 000	3-4
Skidder-manual bunching pre-stropping	56	20	25	1.5 tonnes	102	84 000	13-14
Skidder-mechanical bunching	47	48	5*	21.4	210	271 000**	15-16

* loader for skid work
** includes skidder, mechanical bunches and loader

TABLE 2

0.20 m3 PIECE SIZE

Extraction	Percentage of Total Machine Life Time. Travel	Accum.	Skid	Pieces /cycle	Daily prod^n	Capital ($)	Men
60 kw skidder single drum	28	46	26	7	38	84 000	4
Agricultural tractor	35	40	25	4.2	30	50 000	
Small skidder (Bell logger Iwafuji)	42	23	34	4	37	45 000	4
60 kw skidder double drum	20	40	40	9.3	48	95 000	4-5
Small skidder double drum (Holder, Iwafuji)	34	30	36	6.0	34	45 000	4
60 kw skidder manual bunching	56	20	25	1.5 tonnes	102	84 000	13-14

TABLE 3

0.35 m3 PIECE SIZE

Extraction	Percentage of Total Machine Life Time. Travel	Accum.	Skid	Pieces /cycle	Daily prod^n	Capital ($)	Men
60 kw skidder single drum	29	47	24	7	63	84 000	4
Stand re-organisation	35	41	24	6.3	87	84 000	4

CONSTRAINTS

The overall constraint of any logging system is the matching of men and machine to obtain an acceptable wood cost.

Other constraints that affect the prime mover to lesser or greater degrees are:-

1. Ground conditions and obstacles

    - Stones, sand, pumice etc.
    - Number of residual trees
    - Waste from earlier land clearing, silviculture or logging operations.

2. Capital cost/payload balance

    - Bigger the machine the greater the payload necessary to fully utilize its work capacity.

3. Mechanical reliability and robustness of construction

    - Lightly built and/or machines adapted from other uses may not have the construction necessary to withstand many of the ground conditions and obstacles in forests. This can lead to excessive mechanical downtime.

4. Versatility of prime mover

    - Can it handle a range of piece sizes?
    - Can it operate in a range of logging operations?

5. Piece size

    - If too big will affect manual bunching methods

6. Availability of, and service for selected machines