LOGGING INDUSTRY RESEARCH ORGANISATION
NEW ZEALAND

ISSN 1171-6932

REPORT

Vol. 21 No. 22 1996

TWO-STAGE LOGGING TO IMPROVE LOGGING SYSTEM PERFORMANCE

Dave Bennett

SUMMARY

The characteristics and benefits of two-stage logging systems are discussed. Seven different two-stage systems are described using: a skidder, skidder/trailer combination, all-terrain truck, articulated truck, conventional skyline hauler and Wyssen skyline system as the second stage machines. The situation in which each system was used is described, and typical production information is provided. A hypothetical example of a forwarder is described, using production data from an overseas study.

INTRODUCTION

Two-stage logging is a system where an intermediate machine (typically a skidder, tractor, forwarder or all-terrain truck) moves logs from where the extraction machine drops them to a processing or storage point. Processing of the logs can take place either before or after they have been transported by the "second stage" machine.

Burrows (1989) explained some of the advantages of two-stage logging using three hauler operations in Kaingaroa Forest as examples. Two used a skidder and one used a tractor as the "second stage" machine. For these operations, it was recommended that the distance from the hauler landing to the processing and storage landing not exceed 200 metres.

Changes to the loggers' environment since 1989 have led to an increase in the number and variety of two-stage logging operations. These changes include:

- increased logging on steep, broken terrain, often requiring second stage haul distances greater than 200 metres
- more logging in first rotation crop (including woodlots) where there are no existing roads of logging standard or landings
- increased awareness of the adverse effects of earthworks on soil and waterways
- increased attention to isolating hazards in logging operations
- increased use of small, highly mobile haulers

– increased number of log types to be cut and stored, requiring more space for log storage.

This report uses examples to illustrate how two-stage logging systems can work effectively. A cable hauler is the primary extraction machine in most of these examples, but a two-stage system may sometimes be applicable to operations using ground-based extraction machinery.

SELECTING A TWO-STAGE LOGGING SYSTEM

Table 1 describes the characteristics of eight two-stage hauling operations. Numbers 1 to 7 are situations which have been observed by LIRO with production data obtained from the forest owner's records for the setting. Number 8 was derived from "Output Guide 7 - Forwarders" by the Forestry Commission Work Study Branch, which lists loading,

Table 1- Examples of two-stage logging operations

	Second Stage Extraction machine	Primary Extraction Machine	Location	Situation
1	Cat 528 cable skidder	Thunderbird TSY 255 (swing yarder)	Omataroa Forest (B.O.P)	Small hauler landings were used to minimise earthworks on a highly visible ridge. A single processing landing was used for three hauler landings.
2	Mercedes 6 × 4 with Bailey Bridge	Thunderbird TMY 70 (hauler)	Glenbervie Forest (Northland)	At the hauler location only a small landing could be constructed, so that even though truck access was possible, a separate processing landing was used.
3	John Deere 640E skidder with tandem axle trailer	Madill 071 (hauler)	Glenbervie Forest (Northland)	The hauler landing was of sufficient size to allow processing but not log storage. The skidder was used because there was no other work for it available during
4	MAN 8 × 8 truck	2 × ground-based operations	Moerewa Station (Northland)	Logs from two or more ground-based operations were taken downhill along unmetalled tracks in silty-clay soils.
5	Bellis BE 70 hauler	Thunderbird TTY 45 (hauler)	Marahau Forest (Nelson)	Relatively small areas of unlogged forest remained out of reach of the roadside landing. The TTY45 was driven down a ridgetop firebreak, aided by a D6 tractor.
6	Clark Ranger 666F cable skidder	Madill 171 (hauler)	Kaingaroa Forest	To move the processing operations away from the hauler, two processing landings were used, one adjacent to the hauler and one approximately 150m away.
7	Gantner long reach skyline	Washington 88 (hauler)	Marlborough Sounds	Extracted logs needed to be transported 650m downhill over some steep (over 30°) terrain to near a barge landing. The aerial system avoided tracking.
8	Forwarder (typical, 12 tonne payload)		Forestry Commission Output Guide	Sample data from "Extraction of Sawlogs and Small Roundwood by Medium Class Forwarder" - Forestry Commission Work Study Branch, Output Guide 7

unloading and travel times for a range of forwarders. Unless stated otherwise, the examples in Table 1 refer to a flat second stage route.

When designing a two-stage logging system, the second stage machine should be selected to suit the form of the track on which it will operate. The selection process is not simple as many factors need to be evaluated. These factors include: load type, production required, second stage haul distance and slope and surface qualities of the track. The best method of selection is to consider the effectiveness of operations in similar situations elsewhere. A limited range of available machinery may simplify the selection process.

BENEFITS OF TWO-STAGE SYSTEMS

The common characteristics of two-stage systems are that:

Operational Procedures	Haul Distance (typical) second stage [m]	Daily Production (from long term data) [m³/day]	Load Volume (estimated) [m³]	Time to load / hook on (typical) [mins]
A Waratah 234 cleared the hauler chute, delimbed, removed heads and slovens. The skidder took full tree lengths to a landing for manual logmaking.	369	300	6.0	4
Untrimmed tree lengths were loaded by a Cat 950A and unloaded by a Kawasaki 85Z2. A Bell loader, Trinder static delimber and manual processing landing were used.	1100	200	30 to 40	14
Logmaking was carried out at the hauler landing then logs were loaded on to a trailer for transport to the storage area. The crew preferred to process away from the hauler.	140	170	12	5 to 8
Each ground-based operation had a processing landing where the MAN was loaded using a Bell Ultralogger. A Clark 45C was used to unload the MAN and load on-highway trucks.	3800	200 (moved by the MAN)	11 to 17	8 to 12
At the intermediate landing a Komatsu PC200 excavator loader moved the logs from the chute of the TTY45 to a "hooking on" area for the BE70.	380 (hor.) 130 (vert.)	150	-	-
The landings were used alternately; while one was being filled by the skidder, logs on the other were being processed. A Volvo L90 loader serviced both landings.	100	260	3.0 to 6.0	-
Trees were manually processed into log lengths at the upper processing deck. The logs were taken to a barge from the lower landing by a Cat 936 wheeled loader.	650 (hor.) 135 (vert.)	95	2.5	-
Forwarder self-loading and unloading pieces of volume 0.3m³ to 0.4m³, travelling 200m.	200	200	12	8

Hauler Isolated from Processing Area

- Greater deflection, which allows increased payloads, can be obtained by locating the hauler closer to the edge of the landing.

- Smaller hauler landings are required, and one processing and storage landing can be used to service several hauler landings.

- The extraction and processing operations are separated. A separate contractor could possibly be used for processing. This would allow hauler contractors to concentrate on maximising hauler utilisation.

- Swing yarders and small-to-medium towers can work along a road without the processing operation following them. If the hauler moves each time the tailhold is moved, adjacent extraction corridors can be parallel, with each corridor containing more wood. (This

Time to unload / unhook (typical) [mins]	Travel speed loaded (typical) [km/h]	Travel speed empty. (typical) [km/h]	Comments
1	7.8	9.8	The skidder could produce at 90% of hauler rate. The Waratah was able to stockpile surges and keep chute clear. The skidder could work during smoko to catch up.
10	-	-	The truck had to wait at the hauler for about 20 minutes for a full load to accumulate.
3 to 5	6.8	4.9 (in reverse)	The capacity of the skidder easily exceeded that of the hauler. When the skidder returned to the hauler, the driver assisted the skid workers until there was a complete load.
8 to 12	14 (downhill)	21 (uphill)	The MAN truck easily transported the 200 tonnes per day produced by the ground-based operations.
-	-	-	At about 150 tonnes per day the BE70 had to wait for a full drag to accumulate (that is, it had surplus capacity).
-	-	-	The production of the skidder exceeded that of the hauler when taking logs to the closer landing, although a stockpile could accumulate when haul distance was longer.
-	-	-	Two skyline systems were used side-by-side. Both skylines were used only during surges in production from the swing yarder.
8	15	15	The hypothetical forwarder will transport 200m³/day in these conditions.

will be most beneficial when a mobile tailhold and a mobile guyline anchor are used, and is probably only applicable to swing yarders using two guylines.)

- There are fewer machine movements for which skid workers are to be aware. (If multiple processing landings are used, machines may not be required on the landing while the skid workers are there.)

- The processing landing can be located in a flat area where more space is available (than on the steep area where the hauler is). The processing landing can then be larger if required.

- There may be economies of scale (for example, mechanical processing becomes more economic) if logs from more than one extraction operation are processed at one site.

- If delimbing takes place away from the hauler landing, the problem of potentially unstable birds' nests on steep slopes will be reduced.

Two Machines Available for Extraction

- Production can be maintained during periods of hauler downtime by using the second stage machine for extraction, if the terrain is suitable.

- Production can also be maintained during periods when wet ground conditions prevent the second stage haul track from being used, by using the second stage machine for extraction.

- Small areas, for which hauler set up time would be a large proportion of the total logging time, may be logged faster using the second stage machine for extraction if the terrain is suitable.

Trucks need to Travel only to the Processing Landing

- The track for the second stage machine can be steeper, softer, narrower, more slippery, and have tighter corner radii than a truck-grade road, depending on the machine used. Earthwork requirements may be considerably reduced and less metal required to construct a second stage track.

- Landings to which trucks need access can be located so that the trucks avoid difficult grades, thereby increasing travel speeds.

- As a higher volume of wood may be taken from a processing landing than a single hauler landing, a higher quality of pavement can be justified, which may result in increased accessibility in wet weather.

Less Earthworks

- With a smaller total area of roads and landings, the loss of productive land is reduced. Costs of rehabilitating roads and landings are also reduced.

  Note: In some situations (such as example 6) the total area of roads and landings is increased to allow a two-stage system which increases hauler productivity and/or landing safety.

- With smaller hauler landings, there is less fill sitting on steep slopes, reducing the risk of soil movement.

- If environmental benefits are demonstrated, obtaining consents in the future for similar operations may require less time and expense.

REFERENCES

Bennett, D. (1996) : "Two Cable Haulers in Series". LIRO Report, Vol. 21 No. 11.

Burrows, T. (1989) : "The Viability of Two-stage Hauling in Cable Operations". LIRA Cable Logging Seminar, Nelson.

Falloon, J. , Cummins , T. and Evanson, T. (1996) : "A Two-staged Mechanised Cable Logging Operation". LIRO Report (in prep.)

Forestry Commission Work Study Branch - "Output Guide 7 - Forwarders"

McConchie, M. and Bennett, D. (1996) : "The North Bend System - Operating with a Tagline". LIRO Report (in prep.)

McMahon, S and Wylie, N (1995) : "The M.A.N. 8×8 Truck". LIRO Technical Note TN-18.

Robinson, T.D. (1993) : "Wood Transport Using a Long Reach Skyline". LIRO Report Vol. 18 No.20.

Robinson, T.D. (1995) : "Planning Harvest Operations in New Zealand". NZIF Forestry Handbook.

For further information, contact:

LOGGING INDUSTRY RESEARCH ORGANISATION
P.O. Box 2244,
ROTORUA, NEW ZEALAND.

Fax: 0 7 346-2886 *Telephone: 0 7 348-7168*