ISSN 0111-6711

LOGGING INDUSTRY RESEARCH ASSOCIATION
NEW ZEALAND

REPORT

Vol. 14 No. 16 1989

LOADING LOGS: A COMPARISON OF BELL SUPERLOGGERS AND RUBBER-TYRED FRONT-END LOADERS AT TARAWERA FOREST

Lindsay Vaughan

Figure 1

ABSTRACT

Bell Superloggers and rubber-tyred front-end loaders were studied loading logs from clear-felling 27 year old stands of radiata pine at Tarawera Forest. Truck loading times averaged 18.3 minutes for the rubber-tyred loaders and 27.0 minutes for the Bell, but loading costs were lower with the Bell over a range of log sizes. The Bell has the advantage of greater manoeuvrability and can operate on smaller landings, but the higher loading rates of the rubber-tyred loader make it better suited for higher-producing operations. Equations for estimating truck loading times were derived for both types of machine.

ACKNOWLEDGEMENT

LIRA acknowledges the cooperation of the Tasman Forestry Limited contractors and staff at Tarawera Forest.

INTRODUCTION

Clearfelling systems on well-drained soils in New Zealand have traditionally used rubber-tyred loaders for fleeting and loading. Previous studies of rubber-tyred loaders have been undertaken in clearfelling old crop radiata pine where mean tree size exceeded 2.5m^3 (Twaddle, 1979).

Clearfelling of younger "transition-crop" stands in the central North Island has allowed down-sizing of logging machinery to suit the smaller piece size. The larger 130-165 kW loaders are being replaced by 90-120 kW machines.

Bell Loggers have been used extensively for fleeting operations in thinnings operations and in clearfelling of minor species (Gleason & Stulen, 1984). More recently, the larger Bell Superloggers have been used for fleeting in clearfelling radiata pine (Duggan, 1989). Its performance as a loader has been documented in smaller log sizes (Gleason, 1985) but no studies have been published on its loading performance in clearfelling radiata pine. This Report compares the loading performances of Bell Superloggers and rubber-tyred front-end loaders.

Two years ago, four contractors at Tarawera Forest purchased Bell Superloggers for fleeting when they started clearfelling young radiata pine. At the time of this study, three of these contractors were still using Bells for fleeting and loading out. Three other contractors working nearby were using rubber-tyred front-end loaders. All were working in young radiata clearfelling operations.

THE STUDY

The Stands

These stands were originally planted at 2400 stems/ha and thinned to a final crop of 350-400 stems/ha in two to three production thinning operations. At the time of clearfelling (age 27 years), average piece size varied from 1.2 to 2.0 m^3.

The Harvesting System

These clearfelling operations had two to three fallers who felled and delimbed for cable skidder extraction to the landing where logs were processed by two skiddies. The loader sorted, stacked and loaded out. To handle the loading, the Bell operators were making a number of early starts.

The Loaders

The Bell Superloggers have a 40 kW Deutz air-cooled engine, a rated lift capacity of 2.2 tonne and a maximum reach of 5.4 m with the telescopic boom fully extended.

The rubber-tyred loaders included three medium sized machines in the 90 to 100 kW range, a Cat 936, a Dresser 520, and an older Volvo 1610.

Daily Production

Daily gang production was around 200 tonnes per day. It varied with average piece size as previous thinning operations had been restricted to the flat and lower slopes, leaving some of the steeper slopes unthinned.

Product Type

A range of log types were produced - peelers, export logs, domestic sawlogs and pulp. These are summarised in Table 1.

STUDY METHOD

Continuous time study was used to record truck loading times from individual loader cycles. Each loading cycle was recorded as the time for the loader to travel to the stockpile, pick up a load of logs, return to the truck, load and adjust the logs. For each cycle the number of logs carried and travel distance was recorded. Operational delays were recorded along with docketing time.

RESULTS AND DISCUSSION

The results are summarised in Table 2. Significant differences exist between the "load truck" element, subtotal and total loading times for the two types of loaders. "Adjust load" included the time spent spreading the first load of logs, topping up the last load and keeping the butt ends of export logs flush.

Table 1 : Log Specifications

Product	Length (m)	Minimum SED (cm)
Export Sawlogs	8, 12	28
	8, 10	23
Domestic Sawlogs	Customer specified	20
C & I Peelers	4	30
Groundwood	4-6, 8-12	10
Kraft	4-6	60
Pulp	6, 8, 12	10

Table 2 : Summary of Truck Loading Cycle Time and Loading Productivity

Elements	Bell Mean	Bell 95% CL(1)	Rubber-tyred loader Mean	Rubber-tyred loader 95% CL
	(minutes)			
Load truck	17.8	1.9	9.9	2.0
Adjust load	2.5	0.8	1.4	0.9
Docketing	2.7	0.3	2.6	0.3
Subtotal	23.0	2.1	13.9	2.4
Operational Delays	4.0	1.4	4.4	3.7
Total loading time	27.0	2.3	18.3	4.5
No. of loads studied	29		10	
No. of cycles per load	24		9	
No. of logs per load	62		64	
Average log size (m^3)	.45		.47	
Average load size (tonnes)	27.8		30.1	
Average productivity (m^3/pmh)	62		98	

(1) 95% confidence limits

Operational delays for the front-end loader were mainly concerned with unloading truck-trailers, waiting for the truck driver to straighten bolsters, adjusting pole trailer length and tightening chains. For the Bell, operational delays included time waiting for the truck driver and time spent travelling between landings to complete loading. Trucks had already had their trailers unloaded, usually by the nearest rubber-tyred loader.

The Bells manoeuvrability allowed trucks to park close to the stockpile and distances under 10 metres were usually achieved. By comparison, trucks parked 20 to 30 metres away from stockpiles to allow rubber-tyred loaders to turn before loading. Bells would have an advantage in situations where landing size was limited or on roadside landings.

Bell operators handled larger logs (e.g. 12m export) by dragging them and loading one end at a time. Loads of export logs are also required to have flush ends to aid measurement at the port. In some situations, it was necessary for the Bell operator to travel to the end of the truck and adjust the log. Often, the truck driver would assist by indicating during loading. This was not a problem for rubber-tyred loaders with their higher cab position and better visibility.

It took longer to load large diameter long-length logs on to "Bailey Bridge" rigs with its stanchions spaced at 3 to 4 metre intervals with the Bell, as it required the logs to be loaded end first between the second and third stanchions.

As load height increased, the operator needed to lean forward and look upwards while loading, an uncomfortable working position.

Local experience suggested that the Bells were suitable for fleeting and loading up to 150 tonnes per day, but unable to handle production rates of 200 tonne per day without working extended hours or having a separate machine to assist loadout.

The lack of protection from dust, and the limited protection from climatic factors, discourage operators from working extended hours. Some improvements are incorporated in the newer range of Bells.

Factors affecting loading time differed for each type of loader. For the rubber-tyred loader, most of the variation was due to piece size. Loading time could be estimated from the regression.

Load time = 22.0 - 4.55 x piece size $(r^2 = .69)$

Prediction of loading times for the Bell was difficult because of the variation in the data.

The number of logs loaded accounted for almost half of this variation; other important factors were log type and truck type. The simplest predictor of loading time was:

Load time = 20.2 + 0.104 x (no. of logs) $(r^2 = 0.49)$

It should be noted that these loaders were operating on flat well-drained scoria; wet or muddy conditions will increase loading times, particularly with the heavier front-end loader.

A comparison of average loading times over a range of piece sizes for a on-highway payload of 30 tonnes is shown in Figure 2.

Unlike the rubber-tyred front-end loaders, the Bell loading times are not linear. There are two reasons for this. For small logs (under .2m^3), the grapple on the Bells appeared to be too small to pick up an optimum payload. Once individual logs exceeded 2.2m^3, the Bell had to load end for end.

Loading Productivity

Loading productivity for the front-end loader averaged 98 m^3 per machine hour (PMH), varying from under 80 to over 120m^3/PMH for individual loads. Previous studies with a similar sized loader averaged 85 m^3/PMH in an operation producing predominantly export and long sawlogs (Twaddle, 1979).

For the Bell Superlogger, loading productivity averaged 62 m^3/PMH. This ranged from under 50 to over 80 m^3/PMH for individual loads. Previous work with the Bell Logger (Gleason, 1985) suggested loading rates of 30 to 50 m^3/PMH for sawlogs and long pulp. The higher levels of productivity are attributed to the larger Bell Superlogger, good landing layout and flat well-drained landings.

Loading Costs

Daily costs are shown in Table 3 using the LIRA Costing Handbook format (Wells, 1981) and based on a five year replacement period. The costs include an allowance for vehicle travel and margins for overhead and profit.

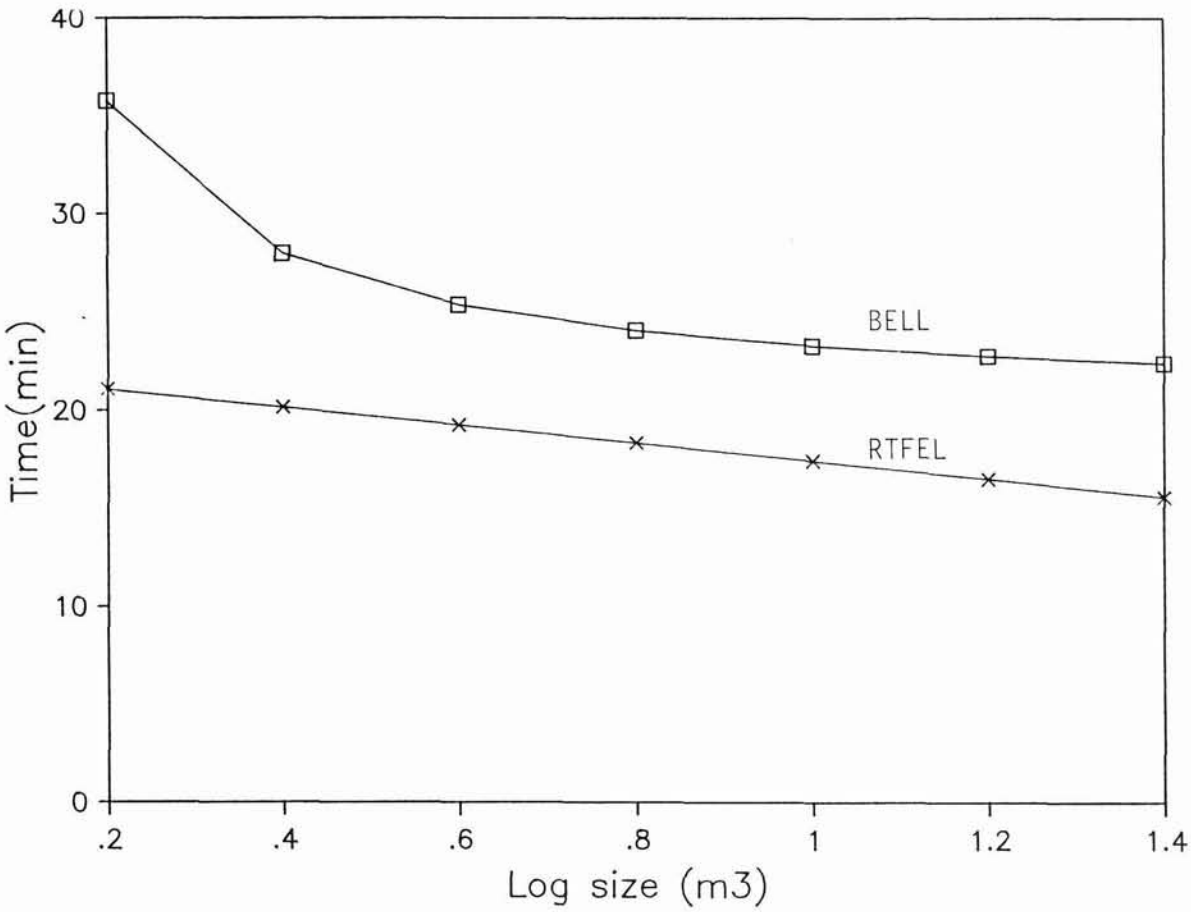

Figure 2 : Predicted Truck Loading Times for Bell Loggers and Rubber-tyred Front-end Loaders for a 30 tonne payload

Table 3 : Summary of Daily Costs

	Bell 220	Caterpillar 936
Loader	199	462
Operator (10 hrs)	160	160
Travel (160 km)	64	64
Overheads (2%)	8	14
Profit (10%)	43	70
Total	475	770

Figure 3 shows lower costs for the Bell (in $ per tonne) for a wide range of log sizes, except for very small logs ($0.2m^3$). The lower productivity of the Bell was offset by lower owning and operating costs, a result of its lower capital cost and lower-powered engine. For comparative purposes, it was assumed that these machines were fully utilised in loading. In most situations, loading performance will be dependent on gang production and the requirement for sorting and stacking.

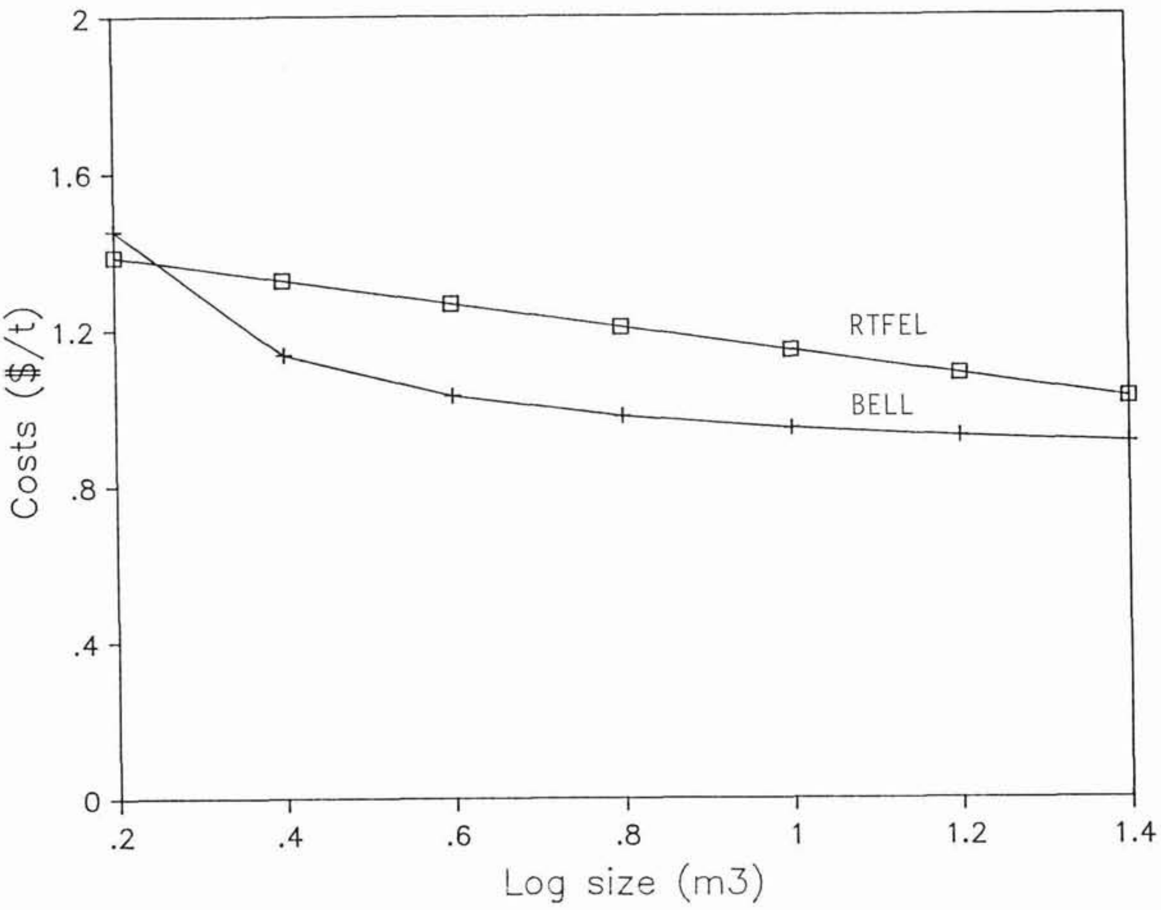

Figure 3 : Comparative Loading Costs for a 30 tonne payload

CONCLUSIONS

The Bell Superlogger is well suited for fleeting and loading in thinning operations and in clearfelling operations up to 150 tonnes/day where logs over 2.2 tonnes can be loaded end first. Once gang production approaches 200 tonnes per day, Bell Superloggers need to work additional hours to complete loadout. They can operate on a much smaller landing than a rubber-tyred loader.

Rubber-tyred front-end loaders require larger landings with good surfaces but their mobility and higher loading rates make them better suited for higher producing operations.

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.

REFERENCES

Duggan, M. (1989) : "Clearing the Tower with a Bell Logger" LIRA Report No. 14 Vol. 7.

Gleason, A. (1985) : "Bell Logger Operations Manual" LIRA Handbook.

Gleason, A.; Stulen, J. (1984) : "Smallwood Handling with the Bell Logger" LIRA Report No. 9 Vol. 5.

Twaddle, A.A. (1979) : "A Pilot Study of Loading Operations" F.R.I. Econ. of Silviculture No. 129.

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

For further information, contact:

N.Z. LOGGING INDUSTRY RESEARCH ASSOC. INC.
P.O. Box 147,
ROTORUA, NEW ZEALAND.
Fax: (073) 462-886 Telephone (073) 487-168