SESSION III
Paper (b)

FORWARDERS - THEIR ROLE IN LIMITED SCALE LOGGING

J.E. Gaskin
Logging Development Officer
LIRA

INTRODUCTION

The role of forwarders as a harvesting system has been well proven, albeit overseas. They have been used successfully in New Zealand but rarely, I suggest, in situations where they can demonstrate their advantages best. As a result their reputation is not entirely favourable.

The real value of a forwarder is as a total logging machine capable of :

- gathering the wood at the stump
- loading itself
- transporting timber economically over long distances
- sorting, stacking or loading wood for the next phase of the operation.

This value has been perceived from a distance and with the usual pessimistic comment that "it will never happen here". Yet J. Kennedy has noted in his recent "Logging Roads Standards Project" review,

> *"of particular significance during the review was the number of times the comment was made that alternative transport options, e.g. forwarders, off-road trucks, cable roads warranted urgent evaluation as the cost to construct spur roads appropriate to conventional trucks could be prohibitive."*

This paper examines forwarders as a total logging machine. An important point is that readers don't think "Bay of Plenty", but instead consider East Coast, Taranaki, Northland or the two hectares planted at the back of a farm.

WHAT IS AVAILABLE?

Forwarders come in many shapes and sizes and, obviously, price ranges. A basic definition of a forwarder is a rubber-tyred articulated unit equipped with a crane capable of loading a bunk with wood at the felling face, then transporting that load of wood to a point where it can be loaded onto a truck or further processed. In transporting the load they do not need formed roads. Table 1 below lists a few options and very basic specifications for those options.

The Valmet 872 4 wheel drive forwarder

LIRA Photo L165/20)

The Gafner Iron Mule (LIRA Photo CN228/23)

Table 1 - Forwarder Options

	Kilowatt Power	Load (tonnes)	Maximum Travel Speed (kph)
Kockums 84-31	94	9.0	29
Valmet 872K	75	9.0	23
Lokomo 919	73	10.0	26
Mini Bruunett	55	7.0	27
Gafner Iron Mule	43	3.6	27

No prices have been quoted as any price figures becomes dated quickly. The range, however, would be from $120,000 for the Gafner Iron Mule to about $350,000 for the Lokomo 919. Estimating life of the machines is difficult. The report from which most of this information was gained (the first three forwarders mentioned in the table above) uses between 8,000 hours and 12,000 hours. Machine availability from a Swedish forestry company's annual report is quoted at around 75%. It should be noted that forwarders in Sweden are working on a 12 hour day and mechanical support far exceeds anything seen in New Zealand.

PRODUCTION OUTPUTS

Little published production data is available for the Gafner Iron Mule, but reliable information is available for the other four. The next smallest machine mentioned in the table, the Mini Bruunett, has been recorded achieving production levels from 6.5 m^3/hour on difficult sites (steep and/or wet with low density of wood), to 11.5 m^3/hour on easy sites (dry and level with a high density of wood). Those figures are for extraction of 3 m pulp wood billets over a distance of 150 m. Extraction of sawlogs will give higher outputs than those given above, while extraction of 2 m pulp wood or similar posts will lead to a reduction of up to 25%. Sawlogs longer than 5 m cannot be carried by the Mini Bruunett without adversely effecting the stability of the machine.

The productivity of the three larger machines in summarised in the table below.

Table 2 - Summary of Productivity of the Three 10 Tonne Class Forwarders

	Kockums 84-31	Valmet 872K	Lokomo 919
Load Volumes	(Production Per Machine Hour)		
Sawlogs, max. m^3	13.72	11.70	11.35
Sawlogs, mean m^3	11.22	10.19	9.29
3m pulpwood, max. m^3	7.67	7.70	6.72
3m pulpwood, mean m^3	5.97	6.49	5.20
Max. sawlog length extracted, m	8.00	8.00	8.20

Output Range

Thinnings, m^3/hour	9.20-12.6	9.11-11.34	10.15-11.74
Clearfell, m^3/hour	19.40	14.22	16.75-20.07
Time/m^3 for Loading and Unloading (mins)			
3m pulp in thinnings (pile volume 0.5 m^3, piece volume 0.035 m^3)	2.42	2.50	2.63
sawlogs and clearfell (mean piece size 0.30 m^3)	1.78	2.39	1.91

These production ranges are based on travel of 20 m each way on a formed road, 100 m each way in the bush, the average distance moved during loading was 50 m, giving a total one way distance of 170 m.

TERRAIN CAPABILITIES

One feature of forwarders often overlooked is their very good stability and climbing ability. Given their weight distribution and axle configuration they are capable of negotiating quite severe terrain, especially when band tracks are fitted. A further feature of many recent model forwarders is the use of hydrostatic transmission that further improves their climbing ability. The Mini Bruunett fitted with such a transmission is quoted as being able to negotiate slopes of up to 23° (43%) unloaded, then load itself on such slopes and descend loaded. On wet ground no difficulty was encountered descending slopes of 23° (43%), but frequent failures can be expected when attempting to climb unloaded slopes exceeding 17° (31%).

Fully loaded it is capable of consistently climbing slopes approaching 15° (27%). The precise figure depends very much on ground conditions at the time of extraction. The Bruunett is stable on side slopes and has been driven fully loaded across slopes of 14° (25%), but as with all frame steer machines such areas should be avoided wherever possible.

Studies of the 10-tonne class forwarders indicate they were all capable of climbing slopes in excess of 22° (40%) unloaded, and descending fully loaded. No stability problems were encountered where side slopes of 11° (20%) were negotiated fully loaded. A comment made in the report is that the skill and expertise (daring?) of the forwarder operator is likely to be the limiting factor.

Considerable work has been undertaken in Britain on the use of forwarders on soft sites, such as peat bogs. Conditions found in these sites would be as bad, if not worse, than the type of conditions likely to be encountered at sites such as Mangatu Forest. On these sites excellent use is made of slash beds.

A distinct advantage of the forwarder is its ability to offload itself at the landing, either into wood stacks or directly on to truck and trailer.

(LIRA Photo L110/3)

A Mini-Brunett loading 4 m pulp logs on steep terrain in N.W. Scotland

(LIRA Photo L276a/35)

All the heads and branches are felled/placed into a concentrated track and the forwarder then moves along this mat of slash. The report notes that on such sites the machines were bogged at least once, but this was due either to moving off the slash mat or there was insufficient slash available. A short study on the effects of slash beds was included during a trial in Mangatu Forest. Observations indicated that slash beds can be used to serve the same function in New Zealand that they do in Britain.

HYPOTHETICAL CASE STUDY

The following study is a hypothetical one and examines a comparison of two options.

1. Using a forwarder to extract processed wood right to the main road, against;

2. Formation of a road suitable for shorts trucks and trailers to negotiate, with the logging then undertaken by a conventional logging gang.

ASSUMPTIONS

The soil types found on Mr Spoon's property (see attached map of fictitious Mr Spoon's property giving plan of the area plus profile) are pumice outwash on the flats and sandstone derived soils with mudstone outcrops on steeper country. The stand of Radiata is situated 2 km from his woolshed and there is a track up to it which is negotiable by wheel farm tractor, but would require considerable upgrading to be passable by logging truck. The paddock adjacent to the block is one of his best hay paddocks.

Gates exist on all places where fences intersect the track and these gates are 12 feet wide. There is a light bridge across the stream with a ford for heavy machinery next to it.

The stand has been well tended and the current stocking is 250 stems per hectare. At 25 years old it has an average merchantable tree size of 2 m^3. A good market exists for both sawlogs and pulp. The local mill prefers the sawlog in lengths of less than 8 m. Pulp goes through a chipper and again is required in less than 8 m lengths. The country on which the stand is situated is easy with a maximum slope of 30%.

Mr Spoon has sold his trees to the local mill and knows he will get at mill door \$25/m^3 for pulp and an average of \$49/m^3 for sawlogs. The mix is expected to be 30% pulp to 70% sawlogs. Log cartage is to be by a shorts truck and trailer.

He advertises for a contractor to log the area for him and gets two responses.

	Response 1		Response 2	
	Visionary Logging Limited		Traditional Logging Limited	
Basic System to be Used	Fell trim and process to required log lengths in the stand. Extraction by forwarder to area by woolshed. There logs will be either loaded directly to truck or stockpiled for loading later.		Fell and trim in the stand. Pull tree lengths to the landing situated on the edg of stand (in hay paddock). Process by skiddy. Put into stockpile or load onto truck at landing.	
Equipment Used and Cost per Day	Lokomo 919 forwarder 3 chainsaws	$584.85 $45.00	Clark 666D skidder Cat 936 Loader 4 chainsaws	$351.82 $324.89 $60.00
Manpower	2 fallers 1 machine operator	$200.00 $100.00	1 faller 2 machine operators 1 skiddy	$100.00 $200.00 $100.00
	Incidentals and transport	$150.00	Incidentals and transport	$150.00
Total Cost Per Day		$1,079.86		$1,286.71
Expected Daily Production	Based on 1 return trip per 50 minutes extracting 9 m^3 per trip, estimate uses 1/3 maximum travel speed = 9 km/ hour. A 7 hour machine day to be worked		Based on 7 hour machine day to be worked	
	= 75.60 m^3/day		= 120 m^3/day	
Time to Log the Area	13.23 days		8.33 days	
Cost per cubic metre	$14.28		$10.72	

Mr Spoon thinks about these two responses and decides he needs an estimate of upgrading his road. Traditional Logging Limited has pointed out that once he has the road it will be there forever. Mr Spoon, however, has been on the farm for thirty years and has never found a need for a high quality road up there before.

His estimate duly arrives - $10,000/km. Fortunately he is sitting down. He then divides that estimate by the volume to come from the stand and realises that by upgrading his road he is adding an extra $20/$m^3$ to the logging costs if he takes Response 2, thus making his all up cost $30.72/$m^2$ as compared with $14.28 for Response 1. He is a little unsure of how much damage will be caused to his farm track by the forwarder, but reckons he could easily fix that himself later as there should not be any major reconstruction.

Now Mr Spoon didn't just go to school to eat his lunch. He has no entrenched, preconceived ideas of what will and will not work in logging, and as a farmer under a Labour Government, has a

rather austere approach to financial matters. He tables his two total logging costs and his expected revenue as shown below.

Estimates from sale of timber	$41,800.00
Total logging cost - response 1	14,280.00
Profit before trucking on response 1	27,520.00
Total logging cost - response 2 including roading	30,720.00
Profit before trucking on response 2	11,080.00

If I have to tell you which option he will take you shouldn't be attending this seminar.

The objective of doing such a comparison was to point out there is another way of doing a logging job. On a straight dollar for dollar extraction cost, forwarders may not look inspiring. But when the costs of the road is included (and it is a direct logging cost too often hidden or ignored) then a forwarder system may be much more profitable than conventional systems. It should be stressed that the forwarder production has been estimated conservatively and there has been no account taken of road maintenance, only initial construction. The profit margin then may well be considerably more than is indicated in this comparison.

CONCLUSION

Certainly the particular case presented has features which decidedly favour the forwarder system. For instance, in this case the terrain within the forest allows the forwarder to get right to the stump. It is obvious though that there will be variations in circumstances within the future forests and planning will have to be performed on a case by case basis along the lines demonstrated.

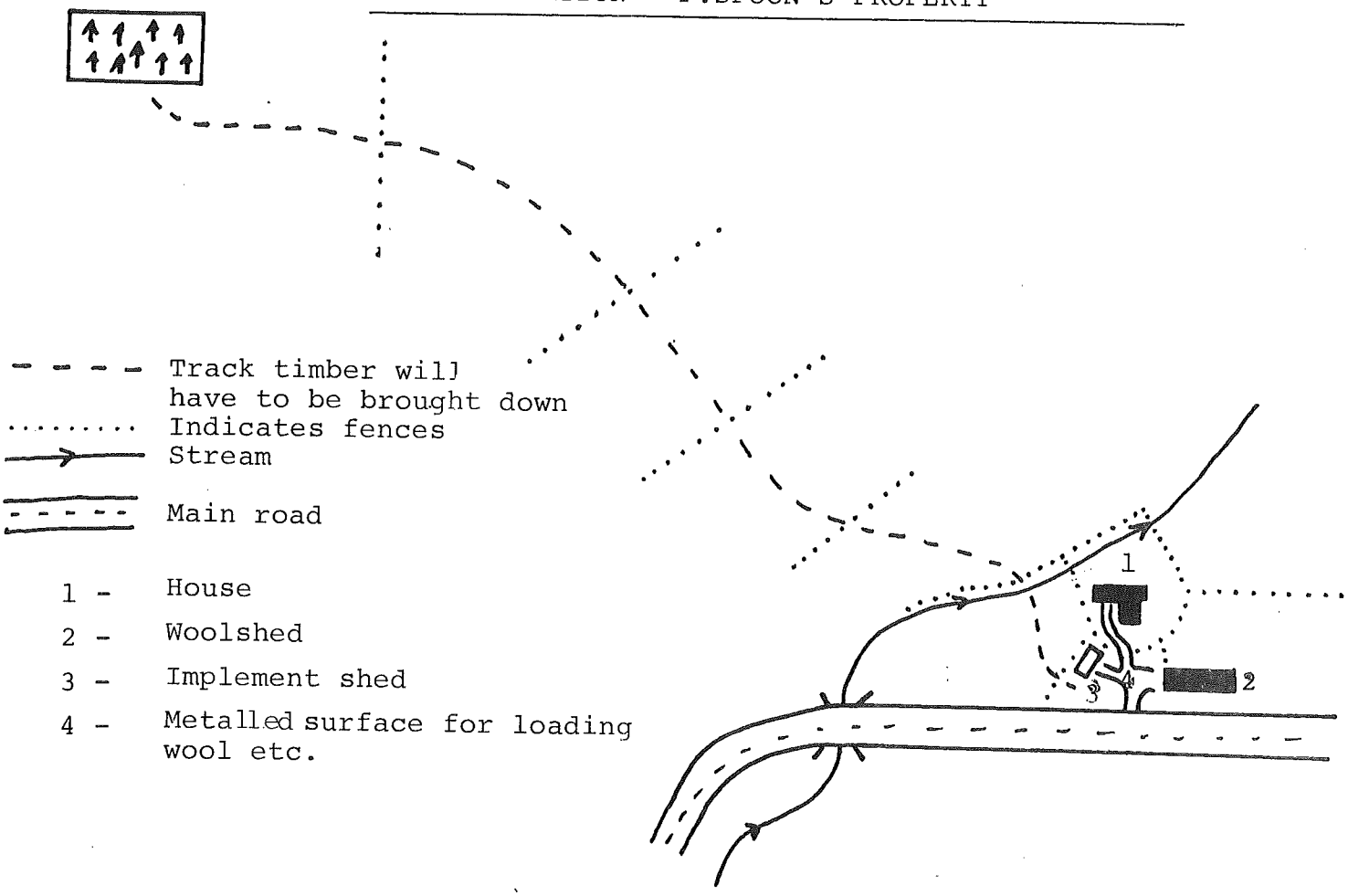
If logging options are compared on a total cost basis, that is considering the combination of logging and roading costs, then I am confident that the advantages of forwarders will be easily demonstrated.

It remains to the industry to show more imagination with forwarders and implement further trials. There are already (dated) machines within the country and no shortage of potential sites.

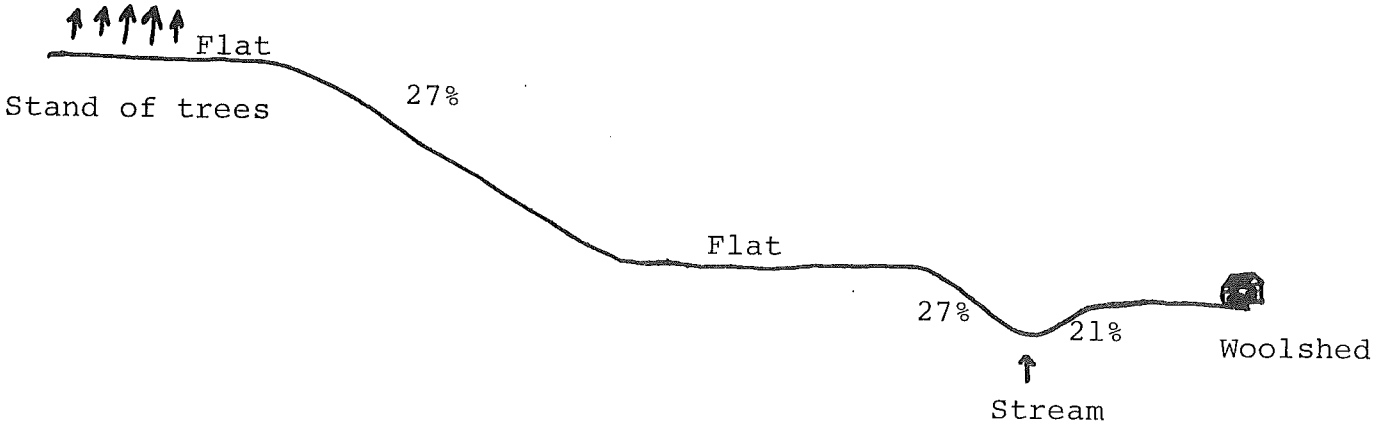
FOOTNOTE

Attached are printouts of cost variables used for costing these machines. Labour costing has been based on a straight $100.00 per day per man and chainsaws have been costed at $15.00 per day per chainsaw. A full literature search has been previously carried out at LIRA and is available for those with interest in this subject to further peruse.

THE SITUATION - F.SPOON'S PROPERTY



PROFILE OF AREA



MACHINE DAILY COST

Variables Used :

Lokomo 919 15-May-1985

Cost of Machine	= $350,000	Resale Value	= $125,000
Life of Machine in Years	= 6		
Prod.Hrs./Yr.	= 1500	Prod.Hrs./Day	= 7
Rate on Invest.	= 15%	Insurance	= 2%
Fuel Consump.	= 10.8	Fuel Cost	= $ .773
Oil Consump.	= .5	Oil Cost	= $2.6
R & M Factor	= 75%		
Strop Cost	= $ 0	Strop Life	= 0
Mainrope Cost	= $ 0	Mainrope Life	= 0

Lokomo 919 15-May-1985

Own Cost/Hr		Operating Cost/Hr	
Depreciation	24.11	Fuel	8.34
Return Inv.	25.62	Oil	1.3
Insurance	3.416	Tyres	2.66
		Mainrope	0
		Strops	0
		R & M	18.08
Tot Own $/Hr	53.15	Tot Op $/Hr	30.39

Total Cost Per Day = $584.85

MACHINE DAILY COST

Variables Used :

Clark 66D 15-May-1985

Cost of Machine	= $178,000	Resale Value	= $75,000
Life of Machine in Years	= 5		
Prod.Hrs./Yr.	= 1500	Prod.Hrs./Day	= 7
Rate on Invest.	= 15%	Insurance	= 2%
Fuel Consump.	= 12.5	Fuel Cost	= $ .773
Oil Consump.	= .5	Oil Cost	= $2.6
R & M Factor	= 50%		
Strop Cost	= $271.32	Strop Life	= 200
Mainrope Cost	= $230.86	Mainrope Life	= 300

Clark 66D 15-May-1985

Own Cost/Hr		Operating Cost/Hr	
Depreciation	12.66	Fuel	9.66
Return Inv.	13.68	Oil	1.3
Insurance	1.82	Tyres	2.66
		Mainrope	.769
		Strops	1.35
		R & M	6.33
Tot Own $/Hr	28.17	Tot Op $/Hr	22.08

Total Cost Per Day = $351.81

MACHINE DAILY COST

Variables Used :

Loader 15-May-1985

Cost of Machine	= $195,000	Resale Value	= $100,000
Life of Machine in Years	= 5		
Prod.Hrs./Yr.	= 1500	Prod.Hrs./Day	= 7
Rate on Invest.	= 15%	Insurance	= 2%
Fuel Consump.	= 11.1	Fuel Cost	= $ .773
Oil Consump.	= .4	Oil Cost	= $2.6
R & M Factor	= 50%		
Strop Cost	= $ 0	Strop Life	= 0
Mainrope Cost	= $ 0	Mainrope Life	= 0

Loader 15-May-1985

Own Cost/Hr		Operating Cost/Hr	
Depreciation	11.6	Fuel	8.58
Return Inv.	15.7	Oil	1.04
Insurance	2.09	Tyres	1.6
		Mainrope	0
		Strops	0
		R & M	5.8
Tot Own $/Hr	29.39	Tot Op $/Hr	17.02

Total Cost Per Day = $324.89

A New Zealand built shortpulp forwarder (converted Treefarmer C7D and Cranab 2510 crane). Of the various forwarders used in New Zealand, this has been one of the more successful.

(LIRA Photo CN125/6)