September 1996

Field Note No.: Skidding/Forwarding-34
Previous Reference Sheet No.: None

LONG-DISTANCE FORWARDING TRIALS IN THE FUNDY MODEL FOREST

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INTRODUCTION

During the autumn of 1995, J.D. Irving, Limited's Sussex (New Brunswick) division ran trials of long-distance forwarding in the Fundy Model Forest. Whereas the maximum forwarding distance on most operations seldom exceeds 450 m, extraction distances of more than 1 km were used in these trials. FERIC's role was to study the economic effects of using longer forwarding distances as an alternative to road construction. Specific sites on which such an alternative can be considered include those where environmental constraints limit road access or where low harvest volumes or high road construction costs would result in a steep cost increase for a conventional infrastructure. The trial site contained 928 m³ at a distance of 1000 to 1500 m from the nearest landing. The main trail used by the forwarder was divided into three sections, two of which were upgraded by an excavator or bulldozer to permit higher forwarding speeds.

METHODS

FERIC used differential positioning (DGPS) to time the forwarder and measure forwarding distances (Figure 1). The mobile unit on the forwarder acquired one position every 5 seconds and was left unattended for two extraction cycles before downloading and correcting the data files. The 16 work cycles monitored in this way were then subdivided into various time elements for analysis. The three types of trail surface were:

- high quality: an even surface, treated by an excavator and a bulldozer and equivalent in quality to a winter road;
- medium quality: stumps removed with an excavator; and
- natural: no improvements made.

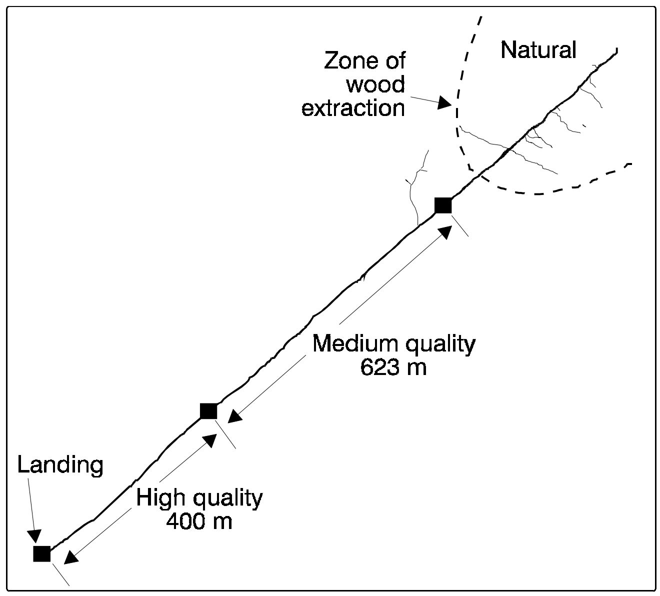

Figure 1. The extraction pattern in the forwarding trials, as plotted from the DGPS file.

RESULTS

The site was generally flat, with firm ground (CPPA classification 2.1.1). The weather during the trial was cold, but not enough to freeze the ground. No significant trail degradation occurred during the trials.

Table 1 presents the average speeds and productivities observed during the study. Terminal times (not shown) and travel speeds over natural ground were similar to those observed in other studies. As expected, greater speeds were achieved on the high-quality trail. Though the medium-quality section (stumps removed) allowed faster empty-travel speeds than the natural section, loaded speeds were not significantly different; however, travel speed tended to be more constant over the medium-quality section. The medium-quality section had a slight adverse slope, which may partly explain why the loaded travel speeds did not improve over that section. Three productivities were projected by applying the average of the travel speeds observed over all three trail qualities to only the *upgraded* length of trail.

Table 1. Timberjack 1010 forwarder speeds and productivities

	Trail quality			
	High	Medium	Natural On trail	Natural Off trail
Average travel speed (m/min)				
Empty	142.7	74.1	62.9	42.9
Loaded	74.3	44.1	44.3	50.5[a]
Combined	97.7	55.3	52.0	46.4
Projected productivity (m^3/PMH)	10.3	8.4	8.2	

[a] Limited sample (n=2).

Table 2 presents the combined trail upgrading and forwarding costs for each type of trail surface. The upgrade data was supplied by Irving using the hourly rates for the earth-moving equipment and the number of hours it worked. The costs for each of the two types of trail upgrade were extrapolated over the combined length of the high- and medium-quality sections. The costs were then distributed over the 928 m^3 of wood that were extracted.

The direct forwarding cost was obtained by dividing the estimated hourly cost of $86/PMH by the productivity listed in Table 1.

The cheapest option ($10.49/$m^3$) would have been to leave the trail in its natural condition. However, these results are very sensitive to the volume of wood extracted using the trail. Under the observed study conditions, the cost of a high-quality upgrade would be offset by higher forwarding speeds if the extracted volume reached 1670 m^3. The high-quality trail option decreases in cost as volume increases (e.g., $10.14/$m^3$ for 2000 m^3; $9.54/$m^3$ for 3000 m^3), whereas a medium-quality upgrade does not become cheaper than using the natural trail for any realistic wood volume.

If an arbitrary flat cost of $200 was added for bringing in the earth-moving equipment, the breakeven volume would increase to 1768 m^3 with the high-quality upgrade.

Table 2. Costs for trail upgrades and forwarding

	Trail quality			Actual
	High	Medium	Natural	combination
Cost of upgrade ($)	1400	1500	0	2900
Length of trail upgraded (m)	400	623	0	1023
Cost for a 1023-m trail ($)	3580	2463	0	2900
Standardized costs ($/$m^3$)				
Trail upgrade (for 928 m^3)	3.86	2.65	0.00	3.13
Forwarding	8.35	10.24	10.49	9.45
Total	12.21	12.89	10.49	12.58

Interestingly, this breakeven volume does not depend on the length of the upgraded trail, so whether one has 400 or 2000 m to upgrade, the breakeven volume remains the same. One of the variables on which the breakeven volume depends most strongly is the amount by which trail improvement increases travel speeds (88% in the case of the high-quality upgrade of the natural trail). Had speeds increased by only 50%, the breakeven volume would have been 2340 m^3.

CONCLUSIONS

For the volume of 928 m^3 extracted during the trials, the trail upgrade brought no economic advantage in terms of overall forwarding costs. However, the results showed that a high-quality trail upgrade would have lowered costs if a volume greater than 1670 m^3 had been extracted. If the cost of bringing trail-upgrading equipment to the site must be considered, this breakeven volume increases further. The breakeven volume is independent of the trail length, but depends on the travel-speed improvement that can be achieved, and this is why the medium-quality upgrade showed no benefit.

Because the high-quality trail might have been suitable for a haul truck after freeze-up, it might have been cheaper to wait and then use the trail as a winter road. However, mill scheduling constraints may prevent this approach.

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 ISSN 1180-4432