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## Evaluation of a Timbco TF-820D harvester-forwarder combination

### Abstract

Since July 2000, a contractor has been performing cut-to-length harvesting using a single machine: a modified shortwood forwarder that lets the operator switch rapidly between the forwarder's grapple and a single-grip harvester head. FERIC studied this combination machine working as a single-grip harvester and as a forwarder during the same week. The productivity was acceptable and the wood cost at roadside was comparable to that in a traditional system with two machines. The best use of this combination machine would be to complement the work of a conventional single-grip harvester.

### Author

**Deric Hillman**  
Eastern Division

### Keywords:

Single-grip harvester, Shortwood forwarder, Timbco TF-820D, Cut-to-length harvesting system.

### Introduction

Since July 2000, a forestry contractor working in the Lac Saint-Jean (Que.) region has been using a single machine to perform cut-to-length harvesting. The

machine is a modified Timbco TF-820D forwarder whose grapple can be replaced with a single-grip felling head (Figure 1). During the winter of 2001, FERIC measured the productivity and effectiveness of this combination machine. Using the data we obtained, it was also possible to simulate a comparison between a traditional cut-to-length system and a system that paired a harvester with the Timbco (used as both a single-grip harvester and a forwarder.)

### Context

The study took place near Chibougamau (Que.) in winter, in a nearly pure black spruce stand at a density of around 1470 stems/ha, with a mean volume of 0.104 m<sup>3</sup>/stem. The terrain conditions were ideal (CPPA class 1.1.1) and the snow was less than 1 m deep. The prescription was for harvesting with the protection of regeneration and soils (Quebec's "CPRS" approach).

Figure 1. The modified Timbco forwarder working as a harvester.



Modifications were made to the stick boom, the hydraulic hoses, and the electrical hookups ("quick connectors") to facilitate installation and removal of the two implements (a Logmax 750 single-grip felling head and a shortwood loading grapple). The boom geometry was also redesigned to permit both the felling of trees and the loading of processed logs. Boom reach was 10 m.

A service truck was equipped to permit maintenance of the implements. An overhead rail attached to the roof of the truck supported a 2-tonne electric winch that let workers handle the implements safely (Figure 2). A worker could thus perform preventative maintenance on whichever implement was not currently being used, and was able to activate the implement in a warm, well-lit, and dry work environment using an auxiliary hydraulic power unit with a capacity of 19.3 MPa (2800 psi).

Figure 2. A view of the rail-mounted winch moving the grapple out of the service truck.



The contractor worked 100 scheduled machine hours (SMH) per week. The machine worked for the first 60 SMH of the week as a single-grip harvester, with a utilization rate of around 80%. It finished the week working as a forwarder for 40 SMH, with a utilization rate of around 91%.

## Results

Despite the low volume per harvested tree, the Timbco had a productivity ( $\text{m}^3/\text{PMH}$ ) comparable to that of a conventional single-grip harvester or forwarder, depending on the work mode (Table 1). Based on the cost data supplied, the direct cost of the equipment with a grapple and single-grip head was estimated at \$150/PMH. As a forwarder, the nominal capacity of the load bunk is around  $15 \text{ m}^3$ . However, primarily because of the work method adopted, the mean volume extracted was much lower (only  $9.2 \text{ m}^3/\text{trip}$ ).

**Table 1. Results of FERIC's time study of the Timbco combination**

	Work mode	
	Harvester	Forwarder <sup>a</sup>
Study duration (PMH)	12.0	5.9
Mean cycle time (min)	0.5	22.0
Mean volume/tree ( $\text{m}^3$ )	0.104	0.104
Number of trees/cycle	1.5	88.0
Productivity		
Mean volume/cycle ( $\text{m}^3$ )	0.16	9.20
Number of trees/PMH	180	240
Productivity ( $\text{m}^3/\text{PMH}$ )	19	25

<sup>a</sup> Average extraction distance standardized at 175 m.

## Forest Engineering Research Institute of Canada (FERIC)

Eastern Division and Head Office  
580 boul. St-Jean  
Pointe-Claire, QC, H9R 3J9

☎ (514) 694-1140  
☎ (514) 694-4351  
✉ admin@mtl.feric.ca

Western Division  
2601 East Mall  
Vancouver, BC, V6T 1Z4

☎ (604) 228-1555  
☎ (604) 228-0999  
✉ admin@vcr.feric.ca

Publications mail #1677314 ISSN 1493-3381

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Cette publication est aussi disponible en français.

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As in cut-to-length harvesting systems based on two machines, the forwarder's productivity was greater than that of the single-grip harvester. Thus, the relative amount of work scheduled in each mode should account for this difference, which is affected in turn by the average extraction distance. Figure 3 presents the optimal proportion of the time to use the machine as a harvester when the machine works on its own, as well as the associated weekly production, as a function of the average extraction distance.

Two changeovers between implements were observed during our study, and Table 2 presents the time required for each stage of the changeover. The first change was unexpected and thus took more time than the second, as no preliminary preparations had been done before making the switch. According to the owner, safe changes of the implements take between 15 and 20 minutes.

One interesting application of the Timbco combination would be to team the machine with a traditional single-grip harvester and thus eliminate the waiting time imposed on a conventional forwarder when the harvester cannot supply it with

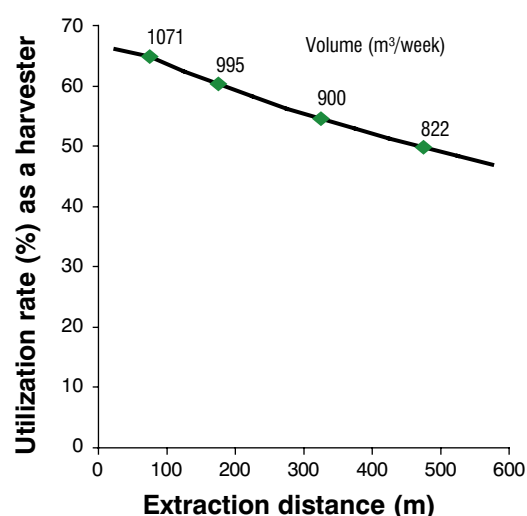


Figure 3. Variation in the weekly production (110 SMH/week) as a function of the average extraction distance.

sufficient wood. Based on our study data, we simulated the productivity of such a system and compared it with the productivity of a single-grip harvester working with a conventional forwarder (Table 3).

By using the Timbco in its two configurations together with a single-grip harvester, the production per week increased by 20%. Although the purchase cost would be greater than that of a traditional two-machine system, the wood cost per m³ at roadside could be slightly lower as a result of improved utilization of the forwarder.

**Table 2. Details of the time study of changing the Timbco's implement**

	Time (min)	
	Remove the grapple and install the Logmax 750	Remove the Logmax 750 and install the grapple
Disconnect the implement from the boom	2.6	2.3
Connect and test the hydraulic hoses	8.7	1.9
Connect the new implement	5.3	8.9
Adjustment and testing of the implement	7.4 <sup>a</sup>	1.5
Total	24.0	14.6

<sup>a</sup> An additional delay occurred due to a poorly connected hose.

**Table 3. Comparison of the costs of a traditional cut-to-length harvesting system and of the Timbco combination working with a single-grip harvester**

	Traditional system		Timbco plus single-grip harvester		
	Single-grip harvester	Forwarder	Single-grip harvester	Timbco working as a harvester	Timbco working as a forwarder
PMH/week	86.4	91.8	86.4	17.0 (19% of the time)	74.4 (81% of the time)
Productivity (m <sup>3</sup> /PMH)	18	25	18	18	25
Estimated direct cost (\$/PMH)	136	110	136	151	151
Production/week (m <sup>3</sup> )	1555	1555 <sup>a</sup>	1555	306	1860
Production at roadside (m <sup>3</sup> /week)	1555		1860		
Theoretical wood cost at roadside (\$/m <sup>3</sup> )	14.10		13.70		

<sup>a</sup> The forwarder would not reach its full production capacity of 2295 m<sup>3</sup> if teamed with only one single-grip harvester.

## Implementation

The Timbco TF-820D studied by FERIC has a place in certain operations, but requires efficient management by the contractor and a sufficiently long work season for the machine to be used economically. Working independently, the equipment would simplify the logistics of moving between sites when treating small cut blocks. In addition, the lower total capital cost might permit economical harvesting of smaller volumes. Used together with a single-grip harvester, it could help reduce wood costs, but would require a higher total investment. The system also permits weekly preventative maintenance of the implements inside a service truck under optimal working conditions. Because the implements are the components that require the most attention, this approach should extend their working life.

- From the worker's perspective, operators have an opportunity to develop multiple skills (felling plus processing, forwarding, preventative maintenance, etc.) and, as they change types of work

periodically, the job becomes more interesting.

- Because operators perform both harvesting and forwarding, they will be motivated to position processed wood so as to facilitate their forwarding work.
- The system requires only a single machine; thus, the operations are easier for the contractor to manage.
- Waiting times for the forwarder decrease because the machine's owner can decide the best time to switch between operating modes based on the site conditions.
- When changing the head, workers must take particular care to avoid contaminating the hydraulic oil; otherwise, the oil circulating towards the head after changing the implement could carry contaminants that can damage sensitive components.

## Acknowledgments

FERIC thanks the owner of the Timbco (Richard Dubois), his employees, and Abitibi-Consolidated Inc. for their assistance during the study.