TECHNICAL NOTE

TN - 46

November, 1998

AN ALTERNATIVE CABLE SYSTEM: SELF-PROPELLED CARRIAGES

Karl Stampfer[1], Peter Daxner, Rien Visser

Introduction

Technical innovation has led to the development of self-propelled carriages. Self-propelled (SP) carriages contain an internal motor which both drives it along the skyline and powers the dropline. There are two main types of SP carriages (Figure 1):

a) carriages that just use a single cable ('skyline') for both suspension and propulsion and

b) those that use a second smaller diameter cable as an additional 'driveline' to pull the carriage along.

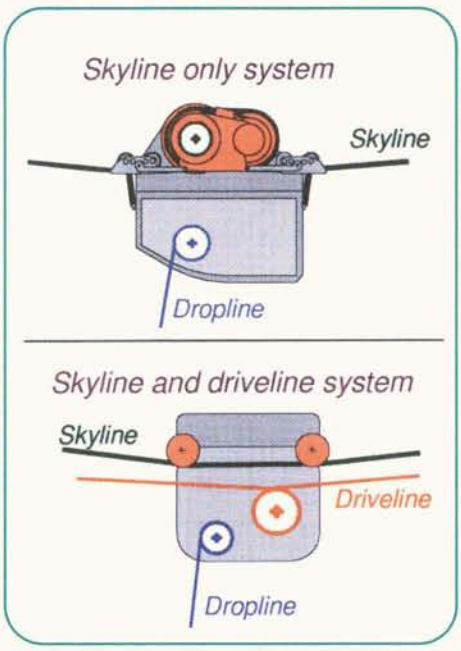

Figure 1 - Two main types of SP carriages.

Self-propelled carriages using a driveline have been used in Japan for some time: the first prototype was built in 1964. There are currently about 1700 SP carriages working in Japan and the product lines Radicarry (Iwafuji) and Skycarry (Sky Carry) are the most popular brands (Courteau 1991).

The first SP carriage to be developed in North America was in 1989, called the "Teletransporteur", and combined the function of the sky and driveline into one cable (Gingras und Lavigne, 1989). The further development of this carriage is the Telecarrier TL-3000 that is not capable of going over intermediate supports. It is therefore primarily limited to clear-cuts on concave terrain up to an extraction distance of 300 metres (Meek 1996).

Woodliner

The Austrian "Woodliner" was the first single cable self-propelled carriage capable of going over intermediate supports. It runs on a 20 mm diameter skyline and the carriage has an internal cable drum that is capable of holding 60 metres of 10mm dropline (Figure 2).

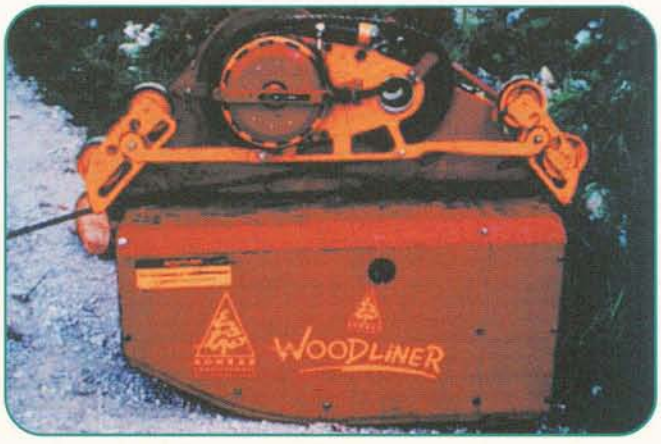

Figure 2 - "Woodliner" SP carriage.

[1] *Dr. Karl Stampfer is a lecturer and Peter Daxner a research assistant at the Forest Engineering Institute, Bodenkultur University, Vienna.*

The skyline completes a full 360 degree turn around two sheaves. Four smaller sheaves are used for stabilising the carriage as well as aligning the skyline on to the drive sheaves.

Both the driving sheave and the dropline are driven by an automated radio-controlled hydraulic motor. The latest "Woodliner 1800" is driven by a VW diesel motor with a power output of 44 kW giving it a maximum speed of 4 m/sec. The maximum payload is given as 2 tonnes and the carriage itself weighs 810 kg.

Typically, the skyline has been rigged between a head and tailspar with the skyline stored on a trailer mounted drum which is towed and powered by an agricultural tractor. Recently, a simplified mobile yarder was used to store and tension the skyline and provide lift which has simplified and sped up the rigging considerably.

A recent questionnaire to all Woodline users indicate that the system is primarily being used for downhill cut-to-length extraction, sometimes stem extraction but almost never whole-tree extraction. Typical extraction corridor lengths were between 200-400 m. A concern of single rope SP systems has always been the increased wear of the skyline. However, the questionnaire revealed that all users rate the wear as being low or normal. The manufacturer of the carriage recommends that the skyline be replaced after the extraction of 10,000 m^3 (normal skyline recommended replacement is at 30,000 m^3).

Fux

In comparison to the Woodliner, the latest self-propelled carriage from the company Fux in Switzerland uses the driveline configuration. The main advantage of the two cable system is the preservation of the skyline and the ability to use a smaller gauge skyline. However, some of the systems simplicity is lost through the additional driveline rigging requirements.

The dropline is also configured differently, the Woodliner drops the cable vertically out of the base whereby the Fux carriage drops it out the side from a movable sheave to ensure that the carriage remains relatively vertical during lateral extraction. This is to ensure the engine lubrication system still functions smoothly (Figure 3).

Two types of Fux carriage are available: the SK 2000 capable of 2 tonne payload and a speed of 4.8 m/sec. The 4 tonne carriage (SK 4000) has two drive systems and is limited to a maximum

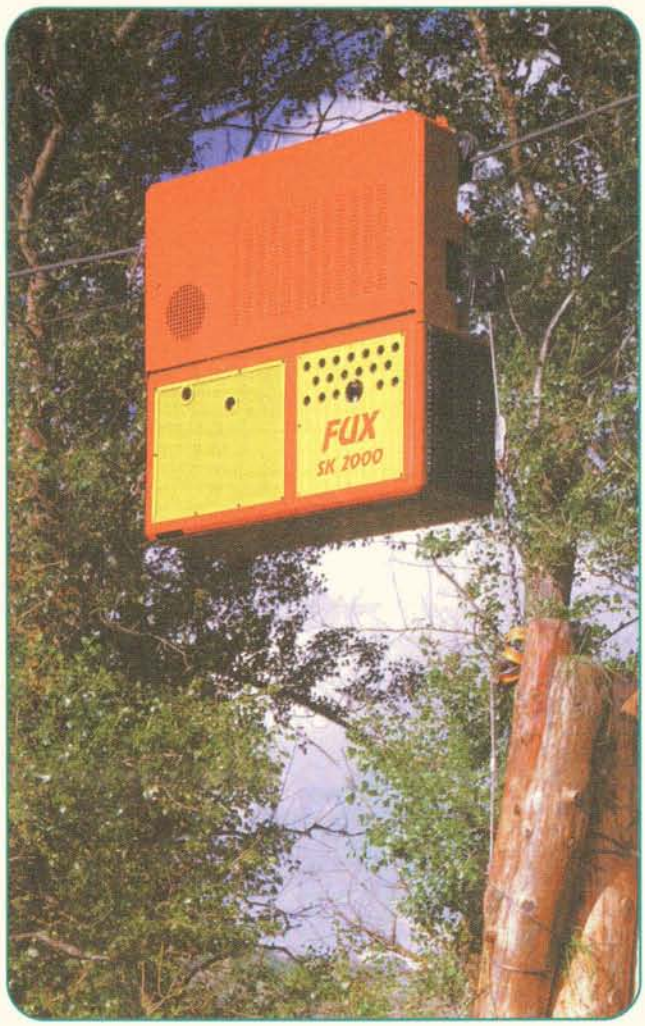

Figure 3 - "Fux" SP carriage.

speed of 2.8 m/sec. The turbo fuel injected motor has a power output of 60 kW. The SK 2000 has a weight of 900 kg and with a dropline diameter of 10.5-13.0 mm has a lateral yarding capability of 80-120 m.

Productivity

A productivity study was carried out on the Woodliner system in cut-to-length extraction in both thinning and clear-cut operations (Stampfer und Daxner, 1998). The system studied comprised of two workers, one choker-setter in the stand and one choker releaser on the roadside. On the basis of the study a productivity model was developed (Figure 4) and is presented dependent on the average piece size. It is possible to see the influence on productivity of the change in average extraction distance and thinning as opposed to clear-cut.

Apart from this study, little information is available on the productivity of SP carriages. Meek (1996) achieved an average of 7.5 m^3/PMH with a TL-3000 in a 0.24 m^3 average piece size.

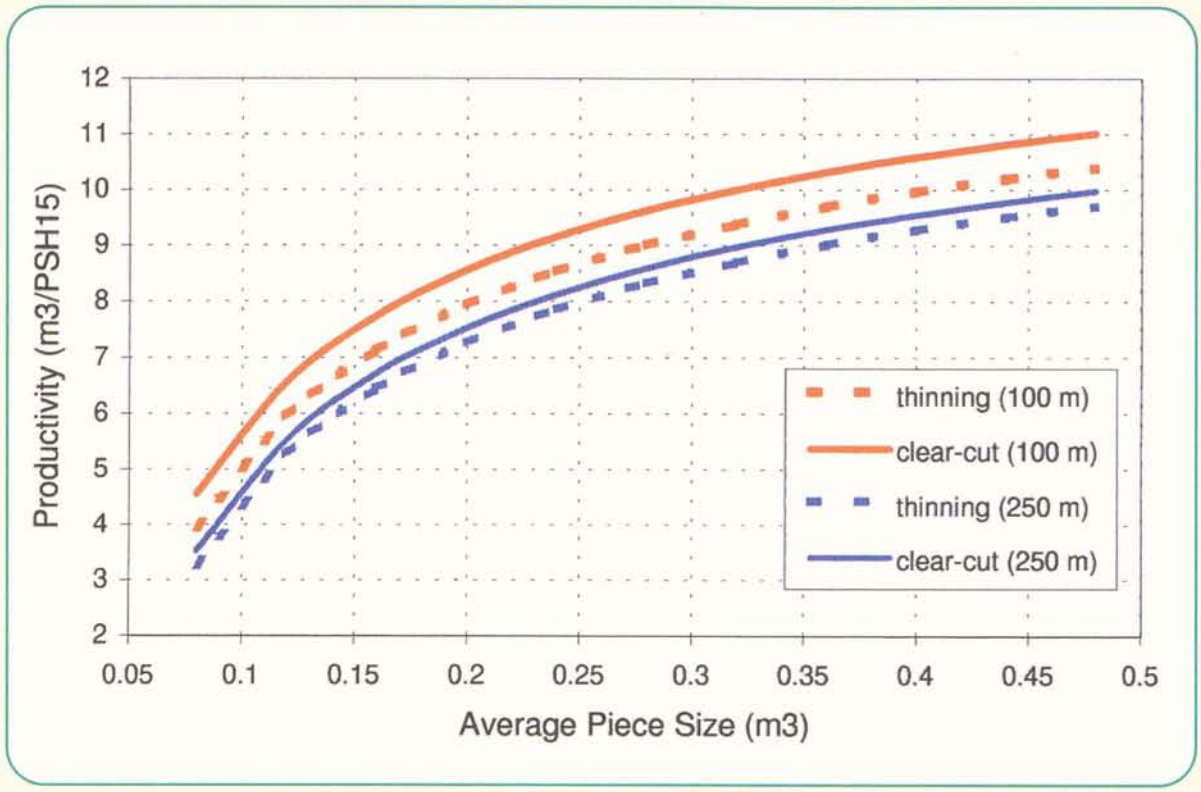

Figure 4 - System productivity of the Woodliner depending on the average piece size. The data shown in productive system hours including delays shorter than 15 minutes (m^3/PSH_{15}).

Miyata et al. (1994) found a productivity of 6 m^3/PSH using a Skycarry H-1300D, although their different time study concepts makes the information not readily comparable. The comparison with small yarders, especially in small piece size timber, is very favourable.

Conclusions

From the studies completed to date on self-propelled carriages such as the Woodliner, the potential of self-propelled carriages is primarily in the downhill extraction of cut-to-length timber or thinning operations up to a distance of 400m. The lower system costs, achieved through the simpler rigging up and smaller crew as well as reduced capital investment makes this system a real option for thinning operations in New Zealand.

References

Courteau, J. (1991): Technical mission to Japan: Cable Logging wih small-scale equipment. Forest Engineering Research Institute of Canada (FERIC). Special Report Nr. SR-77. 15 p.

Gingras, J.-F. and Lavigne, R. (1989): The "Teletransporteur": A new cable yarder concept. Forest Engineering Research Institute of Canada (FERIC). Field Note No. Cable Yarding-9. 2 p.

Meek, P.F.E (1996): Trials of the TL-3000 cable yarder in New Brunswick. Forest Engineering Research Institute of Canada (FERIC). Field Note No. Cable Yarding-15. 2 p.

Miyata, E.S., Y. Suzuki and S. Iverson, (1994): A small powered-carriage cable system for harvesting small trees and logging residues on steep sites in Proceedings of the international seminar on forest operations under mountainous conditions in Harbin/China. Sessions (editor). Department of Forest Engineering, Oregon State University, Corvallis: 347-353.

Stampfer, K. and P. Daxner. (1998): A productivity model of a self-propelled carriage of the type "Woodliner". Unpublished Report, Forest Engineering Institute, Bodenkultur University, Vienna. 13 p.