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New Developments in European Yarder Technology

Summary

One of FFR Harvesting theme's objectives is to reduce the cost of harvesting on steep country by considering new technology that is more productive and cost effective than existing equipment. This report reviews some of the new developments in cable logging equipment and technologies available in Europe today. Significant advances have been made in the automation of processes that have improved both labour and fuel efficiency. The potential application of this new equipment for New Zealand forest stands and terrain conditions is discussed.

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Introduction

Cable yarders (more commonly known as haulers in New Zealand) have been the main method of steep terrain harvesting for over 100 years. Their versatility, good production characteristics and lower environmental impact have ensured their sustained success. However, there are concerns about harvest costs, worker safety and more recently the decline of specialist cable logging skills among the workforce. Even though companies and contractors are pushing ground-based harvesting operations on to areas of increasingly steep slopes and difficult access, yarders will continue to play a dominant role over the next few decades as New Zealand demands for harvesting on steep terrain expand.

One of FFR Harvesting theme's objectives is to reduce the cost of harvesting on steep country by introducing new technology that is more productive and cost effective than existing equipment. New Zealand has relied almost exclusively on North American developments in yarder technology to meet our needs. There may however be some cable logging equipment and technology in Europe that may have application in New Zealand.

A yarder survey in 2002 indicated that of the 216 active yarders at that time, 130 (or 60%) were either Madill or Thunderbird models (Finnegan and Farecloth 2002). The NZ-made Brightwater yarder range competes with the North American brands in size and type. To date 70 Brightwater yarders have been produced, the majority being constructed during the forestry boom in the 1990s.

In the last 10 years the total number of yarders has probably increased to over 300 (Jonny Schick, Shaw's Wire Ropes Limited, pers. com.)[1] Unlike most forestry machinery that has a realistic useful life of 5-10 years, a yarder is often maintained, repaired and refitted to stay in service for several decades. In fact many that are currently in use were manufactured in the 1970s and '80s.

The decline of timber harvesting on steep terrain in the 1990s in the Pacific North West (PNW) resulted in many used yarders becoming available at relatively low cost. Improvements are available for the older machines, for example a retrofitted electronic control system with a digital signal processor, joystick control and a visual display (Evanson and Henderson 2009).

The decline in total harvest in the PNW also resulted in the rationalisation, consolidation and finally bankruptcy of many yarder manufacturers, with Madill in 2008 being one of the last constructors to close. This decline is in contrast to Europe where some of the large

[1] University of Canterbury School of Forestry is currently in the process of updating this yarder survey.

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yarder manufacturers have experienced high levels of sustained demand for their products. For example the Italian company Valentini is producing 12 yarders per year and has advance-orders for two years; the Austrian companies Mayr-Melnhof and Koller have produced 13 units and 20 units per year, respectively.

In 2010, Brightwater Engineering obtained the rights to build the range of Madill yarders – including the popular Madill 124 swing yarder and Madill 172 tower. Swing yarders make up about 25% of the total number of yarding machines in New Zealand. They are not necessarily more efficient, but have their niche when working on small landings and with short extraction distances. Coupled with higher levels of mechanisation (such as a mobile tail hold, pre-bunching and mechanised processing on the landing), the average daily production of swing yarders is higher than that of tower yarders in New Zealand (Visser, 2011).

'PNW' versus 'European' Design

Based on a need to harvest large tree sizes in both uphill and downhill extraction in more remote locations, the PNW and NZ designs are characterised by larger and heavier machines that are very robust and powerful. They are designed primarily for clearfelling operations, where lines can be shifted by relocating the (mobile) tail hold. This makes lateral yarding capability much less vital, as the line can be repeatedly shifted according to need.

In contrast, the majority of European harvesting is based on thinning or smaller "patch" clearfell. This complicates line shifting and hence the substantial lateral yarding capacity of European yarders. High fuel and labour costs in Europe have also resulted in generally higher levels of innovative design and fuel efficiency. Lower intensity (and smaller piece size) European forestry requires yarders to be very mobile, be able to work from roadside, and yet still be able to cover spans exceeding 500 metres. They compensate for the lower turn volumes with higher extraction speeds (Figure 1).

Figure 1: The remote controlled Valentini V-1500 has an 18 m tower, 1500 metres of skyline (3000 m tail rope), main rope speed of 9 m/sec and 7 tonnes of pulling power. One of the most modern yarder designs coming out of Europe, it may find suitability in New Zealand.

So far, there is no record of productivity of any European yarding operation reaching or surpassing the levels of NZ yarding contractors (200+ tonnes per day). The small yarder crews working in central Europe typically extract around 50-80 m^3 per day on a 700 m skyline. The larger modern high-speed yarders provide a dramatic improvement, boosting productivity to 100-150 m^3 per day. This lower productivity against NZ levels is achieved in an environment of complex silvicultural goals (patch and selection cutting), smaller tree size and smaller crew sizes. While these production figures are unlikely to impress a New Zealand contractor, it is interesting to contemplate what productivity levels these modern machines could achieve if

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able to extract in the relatively less constrained NZ conditions of clearfelling larger piece size over shorter extraction distances.

There are almost no North American yarders in Europe, and conversely there are no modern European yarders in NZ. A simple competitive market-driven product choice has not been available to New Zealand logging contractors. It is interesting that in emerging (and competing) markets such as Chile and Argentina, the European design has gained dominance.

Without being able to complete a comparison of models, this paper is a review of the following new developments in European yarder design that differentiate the European developments:

1. Drum design / interlock
2. Automated carriage control
3. Integrated processing
4. Automated yarder control
5. Two-part carriage.

New European Developments

Drum Design / Interlock

European yarders almost exclusively run standing skyline systems. When yarding with a slackline system (skyline, main rope and tail rope) the interlock feature saves power by transferring the energy from one drum to the other. American-based designs will often have the drums designed wide and with a relatively small diameter as this will maximise the pulling force for a given torque. Given that less main rope force is required, the Europeans have designed larger diameter drums that will spool faster and very evenly – and hence the interlock can be simplified.

Figure 2: 1500 metres of main rope (on the left) and the 3000 metres of haul back is split between an operating drum and a storage drum. The amount of line in the operating drum is adjusted to the site so that it can turn evenly with the main rope drum.

To achieve a desired skyline tension, European yarders have often used a tensioning compartment on the skyline drum (Figure 3). Once most of the slack has been pulled from the skyline, the wire rope is pushed across into this compartment. This serves two purposes: first is the benefit from the additional tensioning force generated from the same torque with an empty drum; and second is the lower level of damage imposed on the skyline.

Using a tensioning drum also simplifies the skyline safe working load setting as the torque transferred is the same regardless of operating distance. The application of skyline tension monitors is becoming an increasingly popular feature of the most modern units, as it allows operators to optimize payload size.

Figure 3: The skyline drum, with the tensioning compartment on the left.

Automated Carriage Control

Most modern European yarders (e.g. Greifenberg, Konrad, Koller and Valentini) now have some form of computer automated carriage control. One of the first to commercialise this development was Dr. Baar Electronics (Graz, Austria), in conjunction with the company Mayr-Melnhof (Frohnleiten, Austria - *www.mm-forsttechnik.at*). The system was programmable to include zones where speed could be reduced for passing intermediate supports and or terrain features such as full suspension zones. The mechanical slack-pulling carriage could be controlled by the choker-setter to improve both productivity and safety during the hooking up phase. The "Talkie-Tooter" system therefore became redundant, and in fact it is no longer installed on European yarders. Walkie-talkies are still popular, as communication between the cutover and the landing remains important.

Integrated Processing

The automation of yarder/carriage controls freed up the operator for other useful tasks. The integration of a loader arm onto the yarder was a logical step. The main purposes included being able to support the stems during unhooking as well as pre-sorting and stacking the stems/logs around the yarder for further processing (Visser and Stampfer, 1998). Given a preference for self loading trucks, there is less need for an independent processing and fleeting machine, which would require extra landing space.

Figure 4: Woody 60 Processor showing the articulated head which allows the knives and rollers to be folded up for improved grapple control.

Processing heads are invariably problematic when being used for sorting and fleeting. A specialist processing head was designed by Konrad Forsttechnick (Preitenegg, Austria - *www.forsttechnik.at*) called the Woody 60 (Figure 4). An innovative feature includes the articulation of the head which provides for the ability to retract the drive rollers and the saw box, leaving the long delimbing arms unhindered to act as an effective grapple. Other manufacturers have followed suit, and notably Zoeggeler (Leogang, Austria - *www.zoeggeler.at*) has built a larger processor

equipped with extra grapple arms for loading and fleeting.

Automated (radio controlled) Yarders

The yarder manufacturer Valentini (Cles, Italy - *www.valentini-teleferiche.it*) has taken the next logical step with computer control, and equipped their machine with a modern on-board computer, controlling all functions (such as the Valentini V-1500 in Figure 1). The new control system required a long refining process, as special care is required to balance reaction times between electronics and hydraulics. The on-board computer works very much like the on-board computer installed on modern harvesters and allows total machine control, cable tension assessment and full diagnostics. As the controls are contained in a relatively small box they can be installed anywhere. The most common place is inside the cab of the processor serving the yarder landing. Hence the landing is served by one worker only, sitting inside the processor cab. That person operates the yarder to land the turn – but even that function is automated so it requires only a confirmation that no person or object is near the chute.

The on-board computer stores information about machine operation. It includes skyline tension profiles and the activation of different hydraulic functions over time, thus providing an excellent opportunity for machine monitoring and preventive maintenance.

The machine was partially designed by the Gurndin brothers (Ziano, Italy - *www.gurndin.com*) and they have operated the machine for over two years. Additional developments include a new reactive hydraulic motor spooler on both the main rope and tail rope that is controlled by tension sensors mounted on feeler arms to avoid a cable 'birds nest' on the drum. It also has a hydraulic brake/slack-puller installed near the tower tip: its function is to maintain constant tension in the cable segment between the tower block and the spooler to ensure no drum problems at the higher line speeds.

Figure 5: A drawing of the Valentini V-1500 yarder showing the main system components.

Two-part Carriage

An example of carriage developments in Europe is the "SkyBull" designed by Seik (Trodena, Italy – *www.seik.it*) on specifications issued by Gurndin. The Sky Bull is a motorised carriage whereby the motor (130hp), pump and drum with drop-line are housed in the main body. Connected by a fixed length rod that also supports a hydraulic hose, a trailing second part also contains a drum and dropline.

Each dropline can be operated independently, allowing multiple stems loads to be created without needing to pre-bunch trees. This means better load optimisation and less tangling of chokers. When using multiple breaker-outs each has his own dropline and can work on different sides of the skyline. However, the two-part carriage was primarily developed for full suspension, which is achieved when hitching the same tree or trees at two separate points along the stem. Gurndin requested full suspension because high-speed yarding requires a stable load, especially when yarding downhill. Full suspension reduces the risk of snagging a standing tree along the corridor and minimises soil disturbance.

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Figure 6: The SEIK 'Sky Bull' two-part carriage showing multiple trees being fully suspended in a horizontal position.

Conclusion

The New Zealand forest industry has very effectively used cable yarding systems to meet its steep terrain harvesting needs. Our increased demand in steep terrain harvesting requirements, coupled with the decline in availability of lower-cost used yarders from the PNW, will require contractors to purchase new equipment. NZ's own Brightwater Engineering is able to provide not only its own range of yarders, but can now also manufacture the Madill range.

It is unlikely that the advanced European yarders will gain dominance over the larger and more robust PNW type designs. However their innovative and automated machines may find niche market applications that include not only woodlots, but also clearfell operations in difficult terrain or in stands with smaller piece size. The high levels of fuel and labour efficiency offered by these smaller more automated machines will also become more relevant to contractors as costs of fuel and labour continue to rise.

References

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