



Alpine Shovel Yarder in New Zealand

Summary

This TECHNOLOGY WATCH report outlining technology developments occurring outside the FGR Harvesting Programme follows up an earlier Technology Watch report on excavator-based cable yarders available as lower cost options than tower yarders and swing yarders. It presents details on the first Alpine Shovel Yarder in New Zealand. This model of excavator-based yarder is ideally suited for extracting trees over a maximum of 450m distance on medium to steep slopes in both large scale and small scale forests. The machine is highly mobile, it is simple to operate, is less capital intensive than larger swing yarders, and is designed to operate safely without the need for guy lines to stabilise the tower. Specifications for the Alpine Shovel Yarder are presented.

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INTRODUCTION

Smaller scale forest owners (those owning less than 1000 hectares) made up 30% of the national plantation forest estate in 2017 (MPI, 2017). Recent forecasts indicate that the potential harvest volumes available from these small-scale owners' forests could increase from 8 million cubic metres per year to around 15 million cubic metres per year from 2020 through to 2035. This increase will help lift the total available volume for harvest up to 35 million cubic metres per year by the mid-2020s (MPI, 2016) from current levels around 30 million cubic metres.

Market conditions, such as log and lumber prices, harvesting costs, shipping costs and exchange rates, and logistics constraints such as availability of harvesting crews, log transport capacity and harvest planning factors, will drive the decision as to whether these forests will be harvested. Cable harvesting costs, a critical component affecting the economics of harvesting steep terrain forests, have steadily increased over the last 8 years in New Zealand from \$32.40 per tonne in 2009 to \$39.40 per tonne in 2017 (Visser, 2018), due to increasing labour and machinery costs.

The combination of increased wood availability from small forests on steep terrain, in locations remote from mills or ports means that harvesting systems must be carefully matched to these conditions to avoid high cost harvest access and harvesting.

This report details a new excavator-based yarder, the Alpine Shovel Yarder, now working in New

Zealand, that has the potential to reduce harvest access and harvesting costs, and is particularly suited to harvesting small, steep terrain forests.

Excavator-based yarders, also known as 'Yoaders' in North America and 'Shovel Yarders' in other parts of the world, are not a new development. An excavator yarder concept was described in 1990 as a response to the need for efficient and environmentally acceptable logging systems in the U.S. (Skurdahl, 1990).

Renewed interest in excavator-based yarders has lately been seen in New Zealand. Electrical and Machinery Services Ltd of Rotorua is the manufacturer of the Harvestline excavator-based yarder (E.M.S. 2018). A recent survey of yarders in 2018 identified 20 excavator yarders working in New Zealand (Harrill & Visser, 2018). This type of cable yarder represented 6% of the total number of yarders in New Zealand, up from 3% in 2012, when the last survey was undertaken. The Alpine Shovel Yarder is a recent addition to the numbers stated above.



Figure 1. Alpine Shovel Yarder working in New Zealand



Features of a typical excavator yarder

Excavator yarders, such as the Alpine Shovel Yarder (Figure 1), generally have the following characteristics:

- Based on a medium-sized to large-sized tracked excavator (30 – 45 tonnes base weight)
- Have a rear or top mounted double drum winch
- Feature a tower mounted as an extension to the boom or stick of the excavator
- No guy lines
- An operating range up to approximately 475 metres.
- Mobile, multi-function machines for yarding, processing and/or loading logs
- Part of a low cost harvesting system

Traditionally, excavator-based yarders were suited to relatively low production operations or in combination with ground based systems, and this is largely still the case. More recently however, the advantages of excavator yarders have seen these systems grow in popularity in stand-alone crews.

They can operate on smaller landings or roadside effectively as no guy lines are required to support the tower arrangement, a major advantage in terms of space requirements and set-up and move time. Labour costs are also lower than other more conventional yarder systems, as excavator yarder-based logging systems can be run by a smaller crew than larger yarders. The capital cost and flexibility of excavator based yarders make them suitable for short haul distance, steep slope logging in difficult-to-reach areas or where it may be uneconomic to use larger tower yarders or swing yarders.

Excavator yarders can be produced as single, two- or three-drum machines. Location of the drums and the tower itself can vary. Tower height can also vary, as can the choice of grapple, bucket or processor head. Excavator-based cable yarder specifications were reviewed in an earlier Harvesting Technology Watch report using information sourced from New Zealand-based manufacturers and the websites of international manufacturers (Evanson, 2016).

SPECIFICATIONS OF THE ALPINE SHOVEL YARDER

The Alpine Shovel Yarder is less capital intensive than larger cable yarders, is simple to operate, and can work in limited space, such as roadside, as it does not require guy lines, allowing quick shifts.

The key features of the Alpine Shovel Yarder are:

- Tower assembly
- Winch set
- Yarding distance
- Carriages
- Capital cost

Tower assembly

The Alpine tower assembly is sturdy but lightweight and folds away for transportation. The main features of the Alpine tower assembly are the swivelling fairleads and an in-built tension monitoring system. Typically, the tower height is approximately 12m, but this depends on the base machine specifications. The first Alpine Shovel Yarder in New Zealand had the Alpine winch set fitted to a 40-tonne Komatsu PC400 base by Total Hydraulic Solutions Ltd in Rotorua.

Winch set

The key feature of the Alpine Shovel Yarder is the innovative high-torque high-speed double drum interlock winch set. This has been specifically designed for a high speed, running skyline grapple yarding system. Another feature of the Alpine Shovel Yarder, is that all the drums are over-wound, which helps with rope fleeting, as shown in Figure 2. The manufacturer claims that the winches are easy to maintain and are expected to be low maintenance due to the high quality components used.

The two main attributes of hydraulic winches are line pull (tonnes) and line speed (m/sec). To increase the line speed means reducing line pull, and Alpine have struck a good balance of fast line speed and sufficient line pull. The size of the base chosen does not affect the line pull, but the smaller the base the slower the line speed, so careful consideration and machine selection is required to



get the ultimate performance, especially if grapple harvesting is the preferred logging system.



Figure 2. Alpine Shovel Yarder top-mounted winch set
(Source: Logpro Ltd)

What makes the Alpine winch set unique, is that it is both mechanically and hydraulically interlocked by means of a third (interlock) hydraulic motor. During inhaul and outhaul, oil is fed from the tail motor into the third motor. Tension in the tail rope is regulated by simply regulating the pressure in the tail rope motor. This system is a fully regenerative braking system, with only minor energy losses, resulting in the high line speeds, since all the excavator's power is going directly into hauling in the load. Initial observations show that the inhaul and outhaul speeds of the Alpine Shovel Yarder are not far off those actually measured on larger haulers and swing yarders.

Based on a Komatsu PC400 excavator as shown in Figure 1, the expected average outhaul line speed is approximately 8 m/s empty, and the expected

inhaul line speed is approximately 4 m/s with a three-tonne payload (depending on deflection).

The main drum winch motor delivers 12 tonnes of line pull on empty drum, and the tail drum motor delivers 10 tonnes. The main and tail drum speed and line pull is regulated by simply altering the displacement of the respective hydraulic motors, by tabbing buttons on the joysticks.

There are a number of different Alpine Shovel Yarder winch kit options available, from the lower cost hydraulic interlock winch sets, to their range of live skyline winch sets, which are popular in other parts of the world (Alpine, 2018).

For New Zealand conditions however, the double drum interlock winch kit described in this report is the preferred option for grapple harvesting.

Yarding distance

Buyers of the Alpine Shovel Yarder can specify the winch design and drum capacity. The standard drum configuration will hold 530m of 19mm mainline and 1050m of 16mm or 850m of 19mm tail rope, as shown in Table.1.

This gives the Alpine Shovel Yarder an effective maximum haul distance of approximately 400m. Longer distances are possible however, using extensions. These rope capacities are slightly lower than the majority of larger swing yarders operating in New Zealand.

Carriages

Many excavator-based yarders are two-drum machines. This usually simplifies the rigging systems to either live or standing skylines for shotgun systems or running skylines (scab).

Table 1. Specifications of Alpine Shovel Yarder

	<i>Mainline</i>	<i>Haul-back</i>
Rope dimensions	19mm	16mm
Capacity (m)	530 m	1050 m
Bare drum line pull (tonnes)	12 tonnes	10 tonnes
Full drum line pull (tonnes)	9 tonnes	7 tonnes
Bare drum line speed (m/sec)	6.8 m/s	6.8 m/s mainline driving out
Full drum line speed (m/sec)	9.0 m/s	9.0 m/s mainline driving out



With a world-wide push to more grapple-capable cable systems, a number of remote-controlled grapple carriages are now available for two-drum cable systems, eliminating the need for a third drum to merely open a conventional mechanical grapple.

Alpine have developed a very simple remote-controlled grapple carriage with powered opening jaws for effective grapple harvesting using either skyline or running skyline systems (Evanson, 2014).

Capital cost

The cost of the Alpine Shovel Yarder RS450MI is much lower than larger swing yarders such as the Madill 124 or the Log Champ LC-550 and LC-650.

The estimated cost for the Alpine Shovel Yarder RS450MI on a new Komatsu PC400 with cab protection, fully rigged and ready to work, is approximately NZ\$1.22 million.

The smaller Alpine Grapple Carriage sells for NZ\$88,000. Therefore a complete grapple yarding system from Alpine, including the Alpine Grapple Carriage, would cost approximately NZ\$1.3 million.

Given the line speeds of the Alpine Shovel Yarder, the productivity potential looks promising, and the extraction cost of the Alpine Shovel Yarder should be competitive with other cable extraction systems.

CONCLUSION

There is enormous potential for more yarders in New Zealand, in view of the increasing volume of wood coming up for harvest from smaller forests in the near future.

It has been forecast that over the next 5-7 years the proportion of the annual plantation harvest sourced from farm-based woodlots and small forests will increase from 25% at present to over 40%. As many of these small forests were planted during the planting boom from 1992-

1998, when new planting by small-scale owners ranged from 40,000 to 60,000 hectares per year, many of the plantings were situated on short steep slopes with poor roading access and space constraints.

There is a need for medium sized swing yarders, such as the Alpine Shovel Yarder, which is ideally suited for extracting trees from these small-scale steep forests, and is economic at lower production rates. This yarder would be ideally matched with a remote-controlled hydraulic grapple, such as an Alpine Grapple Carriage.

FGR hopes to be in a position to collaborate with Alpine in further development work with the Alpine Shovel Yarder and Alpine Grapple Carriage as part of the new PGP Programme "Forestry Work in the Modern Age".

This programme aims to develop a prototype automated grapple carriage and hauler control system, involving stem recognition camera software relaying information back to the yarder system to control yarder functions.

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