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Small and Medium-Scale Austrian Cable Hauler Equipment

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Figure 1 - Tractor mobile anchor

Summary

Although only 15% of their timber is extracted by cable systems, Austria has a number of very successful hauler and carriage manufacturing companies. Factors such as steep terrain, small piece size, limited clear-cuts and minimisation of both soil and regeneration disturbance has focused development on small to medium size haulers with standing skylines. Poor timber prices and high labour costs have also placed emphasis on the improvement of operating systems.

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This report presents an overview of the main developments in hauler and carriage design in Austria and comments on the application of such equipment in New Zealand conditions. Specific situations or conditions in New Zealand, such as the harvesting of woodlots, production thinning on moderate to steep slopes and harvesting with a minimum of soil disturbance, may warrant closer consideration of this type of machinery. Benefits include low capital costs, smaller crews, quick rigging time and the ability to operate from a roadside.

Introduction

Austria is a country one-third the size of New Zealand with approximately 46% of the land covered with forest. Timber is extracted from nearly all of this forest land. The commercial forestry land base is 2.5 times as great as New Zealand's 1.4 million hectares of plantation forest. The annual volumes of timber extracted in both Austria and New Zealand are comparable, 19.8 and 17 million m^3, respectively. However, the types of machinery used to extract this quantity of timber are very different. Although 45% of Austria's forested land is steep (>40% slope), and 35% in an altitude over 1000m, only 15% of timber is extracted using cable systems.

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Ground-based operations dominate in Austria: 65% of all harvesting is carried out using agricultural tractors that have been specifically modified for forestry operations. Figure 2 shows a typical ground-based machine; the winches are powered by the power take-off (PTO) and can be radio controlled. There are three main reasons why this machinery is used instead of cable systems:

a) The intensive forest road network: the average roading density in the forest is 32 m/ha of truck roads and an additional 36 m/ha of other roads

b) The ownership structure: there are 200,000 forest owners who own less than 20ha of land, or in other terms 50% is owned in lots less than 200ha which makes organising larger operations difficult

c) The small patch-cut or single tree extraction regimes: the maximum allowable clear-cut (without a permit) is 0.5ha.

Figure 2 - Austrian agricultural-based forestry tractor

The first cable systems in Austria can be dated back to the 1870s, when they were primarily used for lowering the timber from the mountains to the valleys. The most significant advancements for stationary (fixed) cable systems occurred during 1940s and 1950s. The first Austrian mobile hauler was produced in 1963. Since then a number of companies have successfully produced and exported haulers and carriages throughout the world.

This report begins with a short overview of forestry in Austria. Austrian forestry operations are carried out under different conditions and therefore machinery productivity cannot be directly compared to New Zealand operations. Secondly, a selected number of Austrian haulers, carriages and cable system accessories is presented. A short discussion follows on the possible application of small and medium scale haulers in New Zealand.

Forestry in Austria

By far the most common tree specie in the Austrian forest is the spruce (63%). Other common species include beech (10%), pine (7%), larch (5%), fir (3%) and oak (2%). The remaining 10% is made up of other hardwood species. Average growth rates are approximately 10m^3/ha/yr for lowland forests and less than 5m^3/ha/yr for the mountains. Average forestry rotation lengths range from 100 to 200 years; the law dictates that the final cut of a forest cannot take place before the trees reach 60 years. Natural regeneration is favoured since planting density needs to be high to survive both the cold winter and the browsing deer. Additionally, the annualised costs of planting, early thinning or pruning over a 100 year period are very large, relative to the harvesting returns.

Nearly all forest areas in Austria are managed for multi-purpose functions. These are described in the Austrian forestry law as production, protection (such as avalanche control, railway sight and sound buffering), welfare of the environment (such as carbon sink for air quality), and for their amenity values (particularly, walking tracks). The relative importance of these values are rated at each site and are managed for accordingly.

There are three common 'regimes' for the final harvest. More traditional is the patch clear-cut, the allowable size of which has decreased over time. Currently, the clear-cut limit is 0.5 hectares, although with a special permit this can be increased to a maximum of 2 hectares. The small patches regenerate under the protection of the surrounding remaining forest. Also common, particularly in the beech forests, is a final harvest carried out in two stages. The first stage extracts about half the trees and allows enough light through for a dense understory to establish itself. The main benefits are protection during winter and a large quantity of seed from the remaining stand. Approximately 10 to 20 years later, the remaining trees will be removed with great care taken to protect the regenerating plants. Most modern is single tree extraction in a completely mixed aged and mixed species forest.

Timber is primarily extracted cut-to-length. Four metre lengths are common although 5 m lengths may be cut for valuable timber. Log-optimisation is relatively unknown. Forest workers are paid on an hourly rate plus a production bonus; if they reach the target it adds 25% onto their base rate. The labour cost for a forestry worker is about NZ$45 per hour. Target production is calculated using widely available standard tables.

Haulers

There are a number of important operating factors which define the development of Austrian hauler equipment. Nearly all operations are carried out on the roadside; no landings are constructed. The amount of timber extracted per setting is relatively low due to the harvesting regimes explained in the previous section. The use of intermediate supports explains the low (or no) tower height on most cable machinery. Standing skylines are therefore the most common rigging configuration, which is a must when using intermediate supports.

For this report, the Austrian cable extraction equipment has been broken into the following groups: (a) conventional winches, (b) small haulers, (c) medium-sized haulers and (d) self-propelled carriages.

(a) Conventional cable winches

Gantner and Wyssen (Swiss) are the two main producers of this type of sledge-mounted winch. A single cable drum containing the mainline is mounted on a sled, which is powered by a small diesel engine. A standing skyline (typically 24 mm) must first be rigged, and enough slope available for gravity return of the carriage or for lowering the load. Older versions of both types are operating in New Zealand. Robinson and McConchie (1996) described two Gantner machines used for a long reach skyline operation.

The latest designs, such as the Gantner HSW 80 NBF, have an hydraulic step-less continuous drive system with fully automated hydraulic brakes. A four cylinder diesel engine (58 kW) provides a maximum mainline pull of 6 tonnes (12 mm rope), and a linespeed of 6.5 m/sec. Up to 1425 m of mainline can fit on to the drum and the total weight comes to approximately 2.5 tonnes.

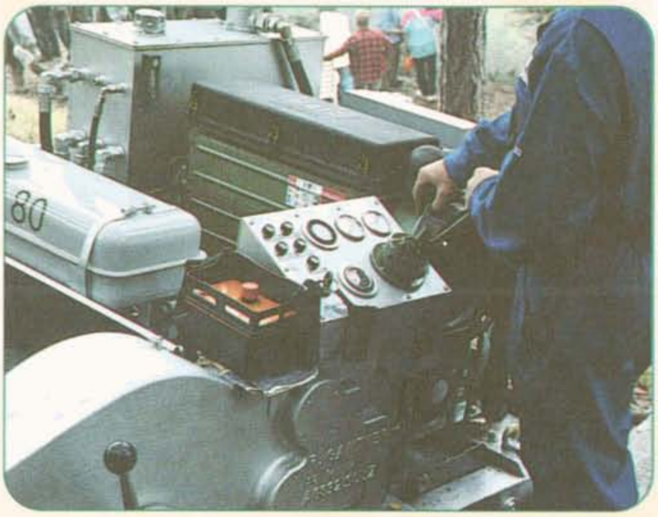

Figure 3 - Gantner HSW 80

For Austrian conditions, productivity rates between 3 and 7 m^3/Productive Machine Hour (PMH) are quoted as being common for conventional winch systems. For comparison, a study in Onepua Bay (Robinson and McConchie, 1996) recorded the productivity of a long reach skyline as 14.4 m^3/PMH. This shows the benefit of clear-cut regimes, higher volumes of timber per metre of skyline, and the larger piece size in the New Zealand conditions.

(b) Small haulers

The small haulers typically have the following characteristics:

- tower height of 5 to 7 m
- power by farm tractor PTO or small trailer unit with a 40 to 60 kW motor; maximum of three drums
- 14 to 18 mm skyline, and 8 to 11 mm mainline and tailrope
- 3 to 8 m^3/hour productivity in Austrian conditions.

The company, Koller, was one of the first to successfully construct and market a small tower hauler that was attached to and powered by a normal farm tractor. The first K300 was produced in 1977, and with minor modifications are still being produced

(Figure 1). Over 500 have been sold, 150 to non-European countries. The tower height is 7 m, has 300m of skyline (18 mm), and is normally just made with skyline and mainline drums. The tower can be modified and a third drum added to allow both downhill and all-terrain extraction. Four guyline (hand) winches are mounted on the tower. Machine operation is relatively simple: two clutch and two brake levers. Variations of this hauler include the Koller 301 which has its own trailer power unit, or the Koller 303 which is truck-mounted.

(c) Medium-sized haulers

Medium-sized haulers typically have the following characteristics:

- tower height of 7 to 10 m
- 2-axle truck mounted with a 75 to 130 kW motor
- three to five drums
- 20 to 22 mm skyline, and 10 to 12 mm mainline and haul-back rope
- 5 to 12 m3/hour productivity in Austrian conditions.

The latest mid-sized hauler from the Mayr-Melnhof company, the Syncrofalke, is a four drum machine. It is truck-mounted and operated from a rotatable cab on the back. The cab has a knuckleboom loader with 9 m reach for clearing the chute and stacking. Carriage control is largely automated (Visser and Pertlik, 1996). A feature is the side-by-side mounted mainline and haul-back rope drums (Figure 4). The ropes are wound in opposite directions and during operations the drums spin at the same speed in the same direction, saving both on power and braking requirements. An hydraulic coupling allows for the slight speed variation caused by the rope diameters on the drum, although this variation is minimised by the drums being 1m in diameter.

Figure 4 - Side-by-side mounted mainline and haul-back rope drums

On most medium-sized haulers, a steel tray (apron) can be fitted to the side of the truck, the front edge of which has steel teeth which holds a drag in place (Figure 5). This feature is particularly important for tree length roadside operations on steep slopes. Additionally, the operator does not need to get down from the machine to unhook the load. The knuckleboom arm can be fitted with a processor, allowing tree length extraction.

Figure 5 - Syncrofalke steel landing apron

Popular both within Austria and for export, is the truck- mounted Koller K501, over 70 of which have successfully been exported to North America and Chile (for P. radiata clear-cut). The K501 has a 10 m tower, 99 kW motor, hydrostatically powered drums and a maximum pull of 3.7 tonnes. Standard is 500 m of 20 mm skyline, and 600 m of 12 mm mainline and tailrope. A mounted knuckleboom loader arm is optional.

A non-truck mounted variation of this machine is the K503. All the tower and drum characteristics are the same as for the K501. However, both it and its power source are trailer mounted.

(d) Self-Propelled Carriage

The Woodliner, manufactured by Konrad Forsttechnik, is a self-propelled carriage with a payload capability of 1.5 tonnes (Figure 6). It is powered by a four cylinder diesel engine, weighs 600 kgs and requires just a skyline to operate (typically, 24 mm). The drive system of the carriage requires the skyline to be spooled around a double roller which reduces the skyline's working life.

Operating the system is done through two identical radio control units (Figure 7); one for the breaker-out, the other for a person at the landing site. Although the loaded carriage speed is only 2.5 m/sec, the simplicity of the system controls, means that it has been successfully used in short corridors and is increasing in popularity.

Figure 6 - Woodliner

Figure 7 - Woodliner controls

Most of the cost of this type of self-propelled carriage system is in the carriage itself (engine and control system). Should the skyline break, in addition to the problem of retrieving the carriage from the site, the repairs to a complex carriage can be costly and time consuming.

Carriages

There are many different carriage types and models that have been or are being constructed in Austria. The simpler carriages are very similar in concept to those normally in use in New Zealand's live skyline operations. The exception is that to suit the Austrian conditions they are relatively small with payload capabilities of 1.5 to 3 tonnes. The mainlines are typically 8 to 12 mm.

Since they rarely operate in larger clear-cuts, for most carriages the emphasis is placed on providing lateral hauling capability. This can be achieved using two-rope (gravity return) or three rope systems using a carriage with either (a) time, (b) carriage reverse or (c) radio controlled clamps; or using a four-rope system.

a) Time trigger: For example, the Koller 2.5 tonne carriage can be fitted with a time trigger. When the carriage is halted for a pre-determined time, the skyline clamp is engaged and the fall block lowered. The clamp is hydraulic, and the hydraulic pressure is generated by a small pump driven by a friction sheave from the skyline and stored in hydraulic accumulators. When the fall block is returned into its holder on the carriage, the skyline clamp is released and the carriage is free to travel. One such carriage has operated in New Zealand (Duggan, 1989).

b) Carriage reverse trigger: Very similar to the time trigger, except in this case the carriage is made to travel a pre-determined distance (commonly 6 m) past the intended clamping point. A mechanical winding device triggers the hydraulic clamp after it has reversed the necessary distance and the fall block is released.

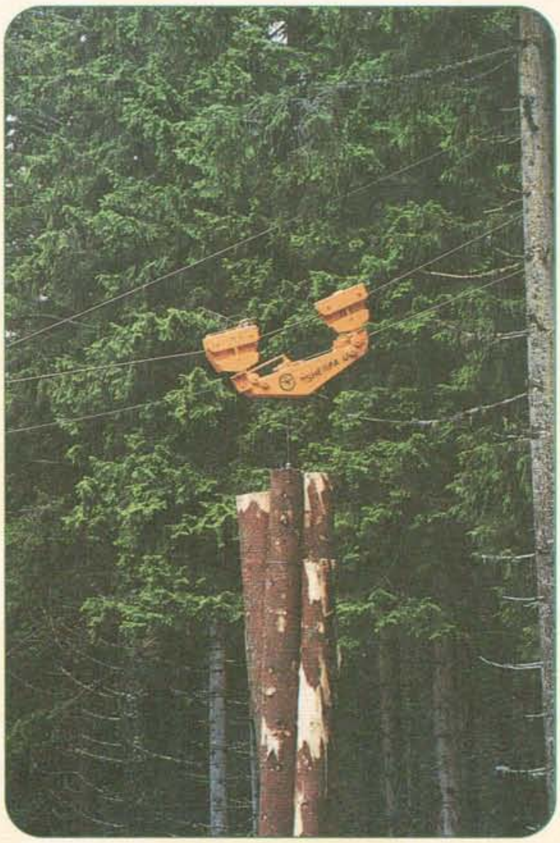

Figure 8 - Universal 3 tonne carriage

c) Radio controlled: The standard Mayr-Melnhof Universal 3 tonne carriage (Figure 8) has a radio control unit. A small internal friction roller, driven from the skyline, is used to generate oil pressure which is stored in hydraulic accumulators. The radio control swaps the valve setting, which means either the skyline or the mainline is clamped (Visser and Pertlik, 1996). The additional expense of these systems, in relation to either the time or reverse triggers, can often be offset through cycle time savings.

d) Four cables: A four cable system utilises one slackpulling rope (8 mm) that is wound on to a carriage mounted slackpulling drum (20 to 40 m of rope). Either the mainline or the tailrope is used to hold the carriage in place while the other rope is pulled through the carriage with the aid of a friction pulley driven by the slackpulling drum. This system has the advantage over the other three in that no fall block is required since the rope is fed through mechanically. This makes the work for the breaker-outs on sites with larger lateral hauling requirements considerably easier.

Cable Hauling Accessories

Skyline Trailer

For both the conventional winches and the self-propelled carriage systems, the skyline is not an integral part of the machine. To facilitate the rigging of the skyline, a 'skyline' trailer has been developed. Powered by the PTO from the towing tractor, the skyline can be pretensioned to over 6 tonnes and 500 m can be stored (Figure 9). To avoid crushing the remaining cable, the drum has a separate tensioning compartment. The skyline is guided into this section for the last few turns, and maximum pull is achieved through the smaller circumference in the tensioning compartment.

Woody 50

The Woody 50 is a 750 kg processing head designed and manufactured by the Konrad Forsttechnik company specifically for a knuckleboom loader arm (Figure 10). It is capable of delimbing stems up to 45 cm diameter, although it can cut up to 52 cm. Tree velocity through the processor is 3 m/sec. In combination with a medium-sized truck-mounted hauler, it provides the ability to extract the timber tree length and delimb and cut-to-length at the roadside. Although slightly more 'clumsy', it is also capable of stacking and sorting the timber as with the standard loader arm.

Figure 9 - 'Skyline' trailer

Figure 10 - Woody 50

Akja Winch

Designed at the Ossiach Forestry Training centre, this small chainsaw-motor powered 'Akja' winch is mounted on a sledge (Figure 11). It is primarily used for pulling the tailrope line out and around the setting, or directly pulling a skyline across a setting. It can also be used for pre-tensioning a standing skyline or pulling heavy equipment through a forest.

The Akja winch has 120 m of 6 mm wire rope that can be pulled out and hooked around a tree. The throttle is mounted on the handlebars. By pulling on the handlebars, the operator can actuate the drum brake. The rope leaves from the nose of the sledge and the sledge can therefore 'climb' its way through a cutover. With the drum near empty, the pull is about 1.2 tonne, with a full drum 700 kg.

Figure 11 - Akja winch

Use in New Zealand

There are a number of issues that have become important in New Zealand which may warrant a closer look at the suitability of the typical type of cable logging machinery used in Austria. These issues include:

1. the harvesting of smaller woodlots in difficult locations (such as those with intermediate spurs or with difficult to reach or far away landing locations)
2. avoiding the need to construct landings by using the ability to work from the roadside
3. maximum utilisation of timber for both economic and efficiency reasons, which includes the effective and efficient extraction of thinnings from mild to steep slopes
4. minimisation of soil disturbance on sensitive sites, such as those prone to instability, excessive erosion or above important waterways
5. machinery that is ergonomically sound, considering factors such as reduced noise and greater work variety for the crew.

Conventional Wyssen and Gantner-type winch systems have not been used widely in New Zealand. Their use has been limited to long reach operations or where vehicle access was not possible.

Self-propelled carriages appear to have some advantages through their simple rigging requirements. Their limited payload and speed is being worked upon to make it more competitive against the medium-sized haulers.

Small or medium-sized fixed skyline systems cannot productively compete with the large mobile haulers common in New Zealand. Particularly constraining is the smaller payload capability which has the implication of having to cut larger timber to length in the cutover. However, with the considerations or conditions, such as those presented in 1) to 5) above, small or medium cable systems have the following advantages:

- Low capital cost: Using recent sale prices from America, fully equipped small haulers including carriage sell for approximately NZ$100,000 and medium haulers sell for NZ$250,000.
- Small crew: two to three, or three to four crew members can efficiently operate small or medium-sized hauler systems, respectively.
- Quick rigging-up and down times: for short corridors (< 200m) without intermediate supports 2 to 3 hours, with one support (< 300 m) 4 hours (Frutig and Trümpi, 1990).
- Both the truck and trailer versions are easily transported to new locations.

When considering roadside operations, it is important that the extracted timber is picked up on a regular basis. In Austria, this is almost exclusively carried out by self-loading trucks. Without a separate loader machine on site, only a limited amount of sorting and stacking can be carried out with the hauler mounted knuckle-boom loader arm.

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