HARVESTING TECHNOLOGY WATCH

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Summary

TECHNOLOGY WATCH is a biannual report outlining research and technology developments that are occurring outside the FFR Harvesting Theme. The report is divided into the following sections:

- New Logging Technology – Showcasing new logging equipment and technology being developed around the world
- Technology Outside Forestry – Technology being utilised in other industries that could be applied in logging
- Ex-FFR Files – A review of interesting research projects carried out in other FFR research themes
- Global View – What's new in logging from around the world

In this our second issue, three new and "not-so-new" technologies are reviewed: hybrid trucks for forestry applications, high performance synthetic fibres for various logging applications, and the "walking harvester" Menzi Muck. For technology outside forestry, we dive underground to showcase developments in teleoperation and its advantages in the mining industry. Using harvesters as sampling tools for real-time data capture is the focus of one of the other FFR projects reviewed. In the Global View we provide a brief overview of the research work that is undertaken in harvesting across the Tasman by the CRC for Forestry.

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NEW LOGGING TECHNOLOGY

Hybrid Trucks for Forestry

The Australian CRC for Forestry Program Three (Harvesting and Operations) has a project which aims to improve vehicle efficiency, reduce greenhouse gas emissions and prolong the life of the conventional diesel motor. While the technology itself isn't new, its application is novel.

The CRC for Forestry has purchased a diesel shunt truck and fitted it with a supplementary electric motor on the front axle, which will power the vehicle at times of extra load, such as at start-up or moving up steep inclines.

Shunt trucks are diesel-powered older trucks that are modified by the forest industry to move chip bins from the bush to the road in some forest operations, where the bins are then transferred to road trucks for longer-distance transportation.

Tests on the prototype are expected to show cost and greenhouse gas emission reductions of 10–25%[1]. Shunt trucks use more than 80,000 litres of diesel per year at a cost of more than $112,000. A conservative reduction in fuel use of 10% due to the hybrid technology would equate to at least $11,200 and 21,600 kg carbon dioxide emissions reduced.

Hybrid test vehicle

The process of moving chip bins under considerable load to the bin transfer point and returning to the forest empty is an ideal cycle to

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enable the use of electric power under load and the use of diesel power unladen. During the second part of the cycle, when diesel power takes over, the power source for the electric motor is recharged. The CRC is also investigating the application of this technology for skidders and forwarders.

Demand for shunt trucks will rise over the next few years as more plantations come online for harvesting. Before they can be used by the forest industry they are first modified from four-wheel drive to six-wheel drive, which is when the electric motor can be added.

Its inventor, Cliff Hall, says that once the prototype has been finalised and tested, retrofitting fleets of shunt trucks with electric motors will be possible.

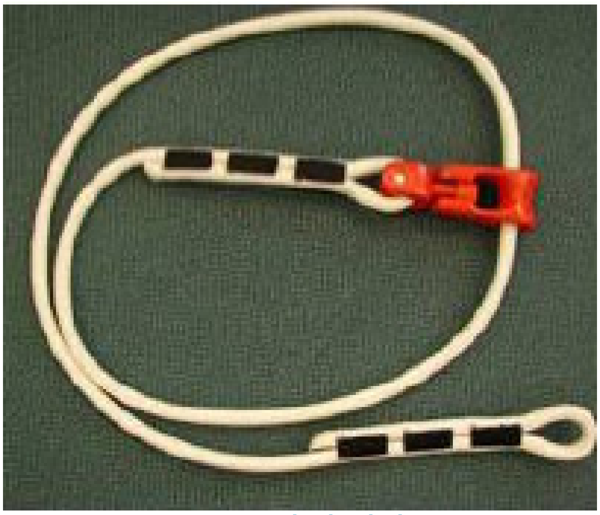
References: [1] The Log – Practical Forest Harvesting Improvements (2008) Issue Two.

Synthetic Ropes

High performance synthetic fibres were developed in the ‘80s and ‘90s of the last century and are not a novelty in many industries. HMPE (High Modulus Polyethylene) is one of the high performance fibres which has become established on a larger scale in all kinds of applications like ballistic protection (bullet resistant vests, car armouring, helmets), sports (yachting lines, fishing lines, paralines) and in netting and large-diameter engineered ropes.

Due to their high strength per weight, good UV-resistance and excellent dynamic fatigue properties like tension and bending fatigue, HMPE-based rope results in easy handling, improved safety and increased life time. These fibre and rope properties have enabled economically viable HMPE replacement of other synthetic and steel wire ropes in a number of predominantly dynamic applications.

The logging industry makes extensive use of wire rope in harvesting operations. High strength synthetic ropes are an excellent replacement for wire rope in various logging applications. Synthetic ropes have the equivalent strength of the same diameter wire rope, but only one-seventh of the weight of wire. A high strength, light weight synthetic rope can dramatically reduce set-up times and increase efficiency.



***Stratos* Synthetic choker**

However, synthetic rope is NOT the same as wire rope and logging operators will need to change their practices to maximise the benefits of the synthetic rope. It will not take the same abuse operators give wire rope in logging applications, but it does stand up comparably when used appropriately. Further research on the economic gains from using synthetic rope is planned to show benefits that may offset the higher cost.

“Walking” Excavator/Harvester

An existing technology that could have application in steep country harvesting in New Zealand is the wheeled “walking” excavator with extending stabilisers and independently operated “wheel-legs”. Examples are the Swiss-made Menzi Muck, the Kaiser “Spyder”, made in Liechtenstein and the German-made “Highlander”. The first Menzi Muck woodland harvester made its debut in 1997. Since then, it has been developed into a sophisticated, professional forestry machine.

According to the manufacturer, this “walking harvester” combines reduced weight with increased performance. Thanks to the harvester's chassis, which can be adjusted to suit the ground on which it is to work, the powerful all-wheel drive and the walking function, it can operate over a wide range of terrain. Gradients up to 70% pose no problems [2]. High lifting torque is provided by the forestry arm with 2-metre telescope, which results in a jib range of up to 9 metres. All four wheel mounts can be adjusted independently both horizontally and vertically. The horizontal adjustment range of up to 6.5m pushes the working face of the Menzi Muck outwards and maximises stability. Thanks to vertical wheel adjustment, the machine can adapt to uneven terrain and compensate for steep gradients when working on slopes.

A91 Menzi Muck in Australia

Ergonomics are good thanks to numerous individual possible settings on the air-sprung comfort driver's seat, armrests, joysticks and foot pedals. The large cab gives drivers a feeling of space and affords a clear and unobstructed all-round view. Designed specifically for forestry applications, the cab has passed all appropriate safety tests.

Most Menzi Muck customers work with the Woody H50 harvester. It is ideal for use interchangeably as a harvester or processor. Features include: maximum felling diameter of 65 cm; trimming diameter 7 to 50 cm; maximum grab aperture 95 cm; feed rate up to 4 m/sec.; sawing rate 40 m/sec.; endless rotator.

In New Zealand, these machines could allow the use of wheeled machines on steeper terrain than is currently possible, for felling, bunching or both. If suitability for bunching on steep terrain is proved, the breaking out phase of the cable logging cycle will be greatly reduced and cable payloads improved. There may also be opportunities in thinning. There are a number of issues relating to size of machine, safety and its use with New Zealand piece size and terrain conditions, and more research work is needed on identifying these issues, clarifying the potential for use, and the costs / benefits of such machines in harvesting.

References: [2] Menzi Muck AG. (2009) (http://www.menzimuck.com/)

TECHNOLOGY OUTSIDE FORESTRY

Armchair Mining

By Richard Parker, Scion

Underground mining is dusty, noisy, and dangerous work for those who run the big drills and haulers in the tunnels, and it is costly for the companies that operate the mines. Over the last several years, however, a few mining companies have begun working with remotely operated machinery (teleoperation).

Teleoperation is really a semi-automated process, in which an operator manipulates equipment from a distance. Guidance systems, based on either optical systems or lasers, are installed underground, allowing vehicles to travel through tunnels autonomously. Distance has basically become irrelevant in teleoperation. A Canadian mining company has run demonstrations controlling machinery at one of its mines from roughly 600 miles (~960 km) away. Response time of the equipment is 100 milliseconds.

These are the first steps in moving human operators out of harm's way, while at the same time increasing the mine's competitiveness.

As companies and automation experts bring teleoperated machinery into working mines, they are facing questions of how this evolution will affect day-to-day operations, worker responsibilities, and mine designs. Figuring out the best ways to handle those issues could help pave the way for wider implementation. Two developments in recent years have dovetailed to make teleoperation in mines possible: one is a robust communication backbone in the mine, capable of handling data, voice, and video signals; the other is "smart" mining equipment, outfitted with on-board computers and a host of sensors.

Having better communications networks, comprising cable and wireless, is the key development that opened the door to teleoperated mining. While bandwidth is a limited commodity above ground, the full radio frequency spectrum is available underground, where it is essentially self-contained for use in the mine. This is one reason that teleoperation may be more feasible for underground mining than for open-pit mining.

In forestry, a concept harvesting machine is being developed by the forest industry in northern Sweden, together with Umeå University and the Swedish University of Agricultural Sciences (SLU). They have launched a project entitled, *Intelligent Off-Road Vehicle* developing an unmanned wood shuttle . The shuttle is a logging machine that transports wood from where it has been felled to larger forest roads. A number of unmanned wood shuttles will be combined with a manned harvester. The wood shuttle has several advantages: since it is unmanned, companies reduce their labour costs; the shuttle is also several tonnes lighter due to the elimination of the heavy, reinforced cab for the driver; and unmanned shuttles can use lighter, less fuel-hungry engines. Could this technology be applicable in New Zealand harvesting conditions in terms of terrain and tree size?

EX-FFR FILES

Real-time Forest Inventory

A project in the Radiata Management Theme, is looking at real-time “Forest Inventory”. Sustainability and globally competitive forest product supply are two of the pressures that forest managers face today. Both require that managers have good metrics of the quantity, quality, and location of timber resources within their forests. These metrics can help the forest manager to ensure that (a) wastage is minimised, (b) harvest and volume growth increments are balanced, (c) log products are optimally assigned to markets, and (d) the value of the forest is maximised at the time of harvest.

New approaches to obtaining these metrics are being examined with the goals of increasing their accuracy and reducing their data-gathering costs.

The real-time “forest inventory” project involves mechanical harvesting systems collecting stem information. Currently this information is only utilised at the time of log measurement and manufacture. It could play an important role if combined with pre-harvest resource information to improve operational planning, reduce costs and increase the financial value of the harvest.

The project aims at developing statistical techniques that allow existing merchantable volume assessment information to be updated and localised with time of harvesting/processing information in order to improve information about trees to be harvested over the very near term (next day to within 3 months production).

Other similar studies have reported promising results [3]. Developmental trials of harvester-based inventory systems in Australia indicate that using a harvester to destructively sub-sample could provide reasonable estimates of volume and log grade provided that it has the same in-built assumptions and optimisation systems as the harvester undertaking the actual

harvest. Greater than 92% of predicted value recovery could be obtained. Further work is underway on such topics as sampling systems, area determination, costs and operating procedures.

References: [3] Murphy, G.E., I. Wilson, and B. Barr. (2006). Developing methods for pre-harvest inventories which use a harvester as the sampling tool. *Australian Forestry* 69(1):9 –15.

GLOBAL VIEW

CRC for Forestry Australia – Program Three: Harvesting and Operations

The Cooperative Research Centre (CRC) for Forestry, an Australian national research consortium with headquarters in Hobart, Tasmania, links leading Australian forest research organisations, companies, government agencies and universities in a forest science and management research and education partnership. Their mission is to “support a sustainable and vibrant Australian forestry industry through research, education, communication and collaboration.”

The primary objective of Research Program Three (Harvesting and Operations) is to significantly improve the safety and efficiency of industry partners' forest harvesting and log transport operations. The measure of efficiency will depend on the specific project; for example, operator safety, cost or revenue per cubic metre of production, per cent recovery, and fuel consumption. The secondary objective of the programme is to build capacity in forest harvesting and transport operations research in Australia.

The research programme studies forest harvesting and log transport operations in a range of locations extending across southern Australia, in both native forest and plantations. Research will be conducted under five subprojects:

- safety, productivity and cost effectiveness of harvesting systems across sites / operations
- safety, productivity, cost effectiveness and design of wood transport infrastructure
- forest resource utilisation and waste reduction
- bucking / scheduling optimisation
- stand parameter information from harvest data

A quick glimpse at their latest electronic newsletter (*The Log*) reveals a few projects on which they have progressed. Mauricio Acuna and visiting researcher Ernie Heidersdorf (previously from FERIC in Canada) have proposed a standard harvesting machine evaluation framework for Australia and ultimately the Southern Hemisphere that targets both industry operations personnel and harvesting researchers. The objective is to define standard performance measures for better control and understanding of forest operations, permit the exchange of information on a common basis, and allow for the pooling of data from different sources. They have also prepared and distributed to their members three bulletins on completed research work:

- Impact of piece size and slope on productivity and costs of cut-to-length harvesting equipment
- Best practice harvester calibration
- The effect of tare weight on transportation efficiency in Australian forest operations

Another set of trials investigating the main factors affecting productivity and costs of mechanised harvesting systems for varied stand conditions has begun in Western Australia.

For more information see the CRC for Forestry website on this link: http://www.crcforestry.com.au/research/programme-three/