



# HARVESTING THEME UPDATE

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## Summary

This update summarises the Q1 2011/12 review of the Technical Steering Team on 26<sup>th</sup> October 2011 and highlights the progress with the “Innovative Harvesting Solutions” PGP Harvesting Programme. This update also covers the recent FORMEC Conference and associated field trip around European harvesting operations organised by Dr Rien Visser of the University of Canterbury School of Forestry.

## RESEARCH OUTPUTS Q1 2011/12

The following reports have been completed during the first Quarter of 2011/12:

- Technical Note Vol. 4 No. 1: New Developments in European Yarder Technology.
- Technical Note Vol. 4 No. 2: The Potential of LiDAR in New Zealand Forest Engineering.
- Technical Note Vol. 4 No. 3: Human Factors of Teleoperation in Harvesting.
- Technical Note Vol. 4 No. 4: Developing a Multi-function Hauler: A Feasibility Study (in press).
- Technical Note Vol. 4 No. 5: Effect of Future Fuel Cost on Harvesting Costs.
- Harvesting Technology Watch Number 8 September 2011.
- Report H005: Development of an Improved Grapple / carriage Control System: A Feasibility Study (in press).
- Report H006: Advanced Hauler Vision System: A Feasibility Study (in press).
- Report H007: Steep Slope Feller Buncher: A Feasibility Study (in press).
- Report H008: Concept Report: Proposed Introduction of Teleoperation to Steep Slope Harvesting (in press).

- Report H009: Potential for Improved Productivity through Teleoperation in Harvesting: An Economic Feasibility Study (in press).

These reports will be available on the FFR website: <http://www.ffr.co.nz/>.

## TECHNOLOGY TRANSFER ACTIVITIES

The Harvesting Theme Members Meeting was held in Wellington on 16<sup>th</sup> August 2011. In addition to a review of the 2010/11 research results the opportunity was taken to discuss technology transfer methods for FFR. One of the agreed actions was to ensure all FFR documents are available to members on the website.

All the presentations of the 2010/11 research results have been posted to the FFR website under “Member Meetings - Harvesting”.

The 2011/12 Harvesting and Logistics Research Plan, with detailed milestones and budgets for the programme, was approved by the FFR Board in June, 2011 and has also been loaded onto the FFR website under “Research Plans – Harvesting”.

With the assistance of the staff of the National Forestry Library at Scion, all of the Project Reports from the Logging Industry Research Organisation (LIRO) have been loaded onto the FFR website. This collection comprises 92 Project Reports dating from 1977 to 2000.



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FFR is also assisting the UC School of Forestry to scan all 25 of the LIRA/LIRO Conference Proceedings so these can be available to members on the FFR website.

## Next Harvesting Theme Member Meeting

Please note in your diary that the next FFR Member Meetings in Gisborne are scheduled for:

- Tuesday 13<sup>th</sup> March - Field Trip
- Wednesday 14<sup>th</sup> March - Harvesting Impacts on Erosion Workshop
- Thursday 15<sup>th</sup> March - Harvesting Programme Development Meeting.

## RESEARCH REVIEW Q1 2011/12

Updates of progress with the PGP Harvesting Programme were given at the Harvesting Theme Technical Steering Team held in Rotorua on 26<sup>th</sup> October 2011.

## Mechanisation on Steep Terrain – Steep Slope Feller Buncher

A Technical Note on the potential of LiDAR technology for steep country harvest and road planning was published during Q1 (HTN04-02). A Decision Support System is in development for operators to determine high and low stability areas in each harvest block. A second Technical Note on the use of LiDAR-derived DTM's to improve capability, safety and operator comfort of the steep slope machinery is also in preparation.

A technical and economic feasibility analysis of the steep slope feller buncher was completed (Report H007). Using the 26% improvement in productivity from the earlier technical study, and a range of capital costs, the break-even percentage usage ranged from 33-65%. Using an estimated capital cost of \$900k, the break even usage was calculated at 59%. Based on 100% usage a reduction in cost of \$2.50 per tonne would be achievable. Sensitivity analysis indicated that at 40% increase in productivity

(the target for the project) the break even usage would reduce to 43%.

A Commercialisation Plan for the steep slope feller buncher has been completed (HDP 004). The market for the feller buncher was estimated at 22 machines domestically and an international market of 30 machines, based on the assumption that the machine can access the steep country (subject to constraints of slope, ground wetness and seasonality).

The design and development of the beta prototype of the steep slope feller buncher by Trinder Engineers commenced last Quarter. FFR funds were reallocated from the grapple control project to assist Trinder Engineers to complete the design work and stress analysis of the design and accelerate the construction project.

The Beta Prototype has the following design features – new front-mounted integrated winch; blade at rear as primary braking device; 40-tonne, non-levelling excavator base; modified boom and shortened stick; redesigned counterweight with larger fuel tank (1100 litres) and increased hydraulic oil capacity to improve oil cooling. The design was changed to a dry sump engine, which was installed in mid-Sept.

The Beta prototype was scheduled for completion in November 2011 and will be commissioned in trials in Nelson. The machine was also made available for the FICA "Contractors Big Day Out" on 17th November in Nelson. The plan is to undertake a series of field trials early in the New Year.

## Mechanisation on Steep Terrain – Teleoperated Felling Machine

A technical paper assessing human factors of the transition to machine teleoperation / automation was published during the Quarter (HTN04-03). This report covered the operator field of view, orientation of the machine, depth perception and stereoscopic vision, frame rate and quality of video image, time lag and audio feedback. Recommendations were given for future work in the project.



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A concept report outlining the proposed progression of the use of teleoperation in steep slope harvesting was completed (Report H008). This report looked at a number of possible scenarios for teleoperation in steep country harvesting and defined the perceived optimal outcome for this programme in terms of increases in production verses cost verses technical risk. The concept included the following features: being retrofittable, using existing controls, having a staged approach, designed with standard equipment and protocols, and using on-board computing.

A technical and economic feasibility study of the potential for improved productivity of a teleoperated machine in steep country harvesting was completed in Q4, 2011 (Report H009).

Agreement has been reached with Professor XiaoQi Chen of the Mechatronics Programme at University of Canterbury. One PhD student is due to commence a project in the area of teleoperation in early 2012.

## **Increased Productivity of Cable Extraction – Hauler Vision System**

A Technical Report (H006) on economic feasibility of the system has been completed. Vision requirements were discussed with contractors, hauler operators and engineering companies. Analysis showed positive indications that even at low usage and the high end of the capital cost range, the system will yield savings of over \$1.00 per tonne on the cable logging rate.

Scion's part of the project involves testing optimal camera locations or combinations (such as in the cutover, on the hauler and on the tail hold machine) and measuring the improvements in grapple loading time. Scion has developed an alpha prototype system comprising three network surveillance cameras (5MP, 3x manual zoom plus 5GHz aerial).

Trinder Engineers have developed a camera system using an Ag-Cam camera mounted on

the grapple of a cable hauler and have been working with Nigel Kelly trialling this camera in the Nelson area. The camera and the transmitter are housed in a 200mm box steel housing mounted on the rider block of the grapple. The system uses an external antenna mounted  $\frac{3}{4}$  of the way up the hauler spar and they have purchased a larger 15" screen mounted in the hauler cab. Trinder have used high amperage Lithium-ion batteries that should hold charge for one week. They are looking at using a repeater at the tail hold for better transmission. Issues to be addressed include operator depth of field, operation in poor light conditions, vibration and battery charging.

The designs of the alpha prototypes from Scion and Trinder Engineers have been finalised and Development Plans for the Advanced Hauler Vision System have been completed.

## **Increased Productivity of Cable Extraction – Improved Grapple Control System**

A technical feasibility analysis for an improved grapple/carriage control system was undertaken using given assumptions of cost and a range of usage. For a system cost of \$120,000 the breakeven usage was 18%. A Technical Report has been completed (H005) and is in press.

Earlier in the year a Technical Note assessing current cable rigging configurations was published (HTN03-11). This survey undertaken by University of Canterbury covered 37 cable logging operations. Since then the interviews have been increased to 50, including Waikato and BOP regions. Despite a general lack of use and knowledge of motorised carriages, strong interest was noted, especially for difficult logging areas (broken terrain, areas with native bush and streamside management zones).

Phase 2 of the project convened an "expert panel" (including harvest planners, cable logging consultants and FITEC) using a Delphi Technique to synthesise results from the data, resolve contradictory data and reach consensus





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regarding recommendations on the suitability of different systems for different conditions.

Three Delphi rounds have been completed and it was interesting to note that overall there was a lot of consensus between panel members. The immediate target is to prepare a Technical Note that will include the data analysis of the full Delphi process, as well as summarising the results of the full 50 interviews. Input will be provided to FITEC for a "Best Practice Guideline" to industry.

A Technical Note entitled "New Developments in European Yarder Technology" (HTN04-01) reviewed new cable logging equipment and technologies internationally. A full literature review on international grapple and carriage developments has also been published (Report H004). This summarised the specifications of various carriages and grapples available on the market today, and highlighted some of the new technology in remote control carriages and processor-tower-yarders available in Europe.

## Development of Operational Efficiencies – Harvesting Technology Watch

Harvesting Technology Watch No. 8 was published during the Quarter, covering the Herzog-Grizzly 400 and Larix Lamako cable yarders and other new technology potentially relevant to the logging sector.

Arising from the Technology Watch over the last year, an initial study was undertaken investigating the feasibility of installation of a boom/arm and grapple on a hauler to allow multiple functions. This multi-function hauler concept study commenced with measures of current hauler utilisation (ranging from 50-80%) and capacity to use "spare time". Discussions were held with engineering companies (EMS Ltd, Brightwater and Trinder Engineers) on mechanical feasibility. Disadvantages identified included the bending moment, over height restrictions, cost of a retrofit more than hauler value and need for some element of automation given the requirements of the hauler cycle. Conclusions were that it could be a feasible

development in a new hauler esp. in conjunction with automated carriages. A Technical Note on increasing hauler operational efficiency has been completed (HTN04-04).

A project assessing fuel usage of harvesting equipment in NZ and the effect of future rises in fuel cost on total harvesting costs was completed by Interpine Ltd. A Technical Note has been published during the Quarter (HTN04-05).

## Development of Operational Efficiencies – Harvesting Cost and Productivity Benchmarking

In the Benchmarking Costs and Productivity project a total of 92 harvesting operations have been added to the database in 2011 year to date. This brings the total number of harvest areas in the database to 278. Preliminary results of the 2011 data were presented to the TST at the meeting in October. The analysis of ground based operations showed a bias towards operations in more difficult terrain (from 15% slope up to 22% slopes) and the averages for both cost and productivity reflect that bias. The analysis for cable systems showed a more stable sample with a larger number of diverse entries. It has been agreed to extend the 2011 data collection to December, and a Technical Note will be completed in January 2012.

## EUROPEAN HARVESTING FIELD TRIP

In October, Rien Visser took a group of nine Kiwi loggers (including 4 FFR Harvesting members) to the 44<sup>th</sup> International Symposium on Forestry Mechanisation (FORMEC 2011) in Graz, Austria and a field day of Austrian Forest Machinery (AUSTROFOMA) where logging equipment was on display and working.

The FORMEC 2011 conference programme comprised over 80 presentations attended by 222 people from 37 countries. Two days of technical presentations highlighted the



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differences between forest operations in western and eastern Europe. Papers of interest to NZ included:

- “Using ground-based harvesting machinery on steep slopes; how steep can we go?” - Hamish Berkett and Rien Visser
- “Bunching with a self-levelling feller buncher on steep terrain for efficient yarder extraction” - Mauricio Acuna; Justin Skinnell; Tony Evanson; Rick Mitchell. (The felling and bunching phase of this study has been published as FFR Tech Note HTN03-08).
- “Improving forest transport efficiency through truck schedule optimization: a case study and software tool for the Australian industry” - Mauricio Acuna, Mark Brown and Luke Mirowski of CRC for Forestry.
- “Developing and validating the automatic log transfer mechanism between two carriages” - Tetsuhiko Yoshimura; Hirotaka Otsu; and Bruce Hartsough

To download the technical presentations (papers and slides) from the FORMEC 2011 conference click on the link below:

<http://formec.boku.ac.at/archive/48-graz-2011/98-proceedings-and-presentations-2011.html>

The AUSTROFOMA field day had more than 50 live demonstration sites, including nine yarders set up side-by-side to both illustrate and contrast their new developments.

One interesting feature was the SEIK split carriage that provides each choker-setter with his own dropline (Fig 1 ).

In the ground-based operations area there was a remote-controlled Woody 175 skidder weaving its way through the forest. Another machine of interest was the purpose-built Highlander with its own small remote controlled forwarder.

For further information on the Austrofoma field day click on the link below:

<http://www.austrofoma.at/en/>



**Figure 1: SEIK yarding carriage with 2 droplines**

Rien also organised a post-conference field trip around Austria to check out new developments in forest engineering and steep terrain harvesting.

The visit to the Valentini V-600 yarder in the Italian Alps around Palluza also included meeting Mr. Valentini himself who explained the features and developments in his new yarders. He has sold about 15 yarders per year and with over one year of orders on the books, he is expanding his construction area to double production.

The trailer-mounted yarder has a 12 metre telescoping tower and weighs only 13.5 tonne total weight but could still pull 3-4 tonne payloads at high speed. The NZ visitors were impressed with the compactness and smooth operation of the machine. Operating the yarder remotely involves just two small switches; carriage in or out, drop line down or up – and the carriage in and out can also be fully automated. Even with the very advanced level of automated technology built into the current equipment, the manufacturers were still continuing to develop new ideas. This perhaps reflects the level of competition, with 5 major yarder manufacturers competing within a small geographical area in central Europe.

One highlight of the tour was on the last day with a visit to the Gurndin Logging Company operation in the Salzberg region, operating the Valentini V-1500.





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**Figure 2: Valentini V-1500 18m tower yarder**

One of the loggers had been to NZ earlier this year and he had a good understanding of American-based yarder designs. He worked together with the Valentini Company to develop a yarder that has the strength and robustness of the American type machine, but the compactness and automation of European yarders. The result is the Valentini V-1500 which has the new generation of compacted wire rope with the 28mm skyline having a breaking strength of 72 tonnes. On the previous setting they had used 1250m of skyline, running up over a convex slope, using a total of 7 intermediate supports. Using radio-controlled chokers, and automating the landing of the logs, this two-man cable yarding operation was capable of producing 170 m<sup>3</sup> per day in a good setting.

For more information on the Gurndin Logging Company click on the link below:  
[http://www.gurndin.com/kippmast\\_en.php](http://www.gurndin.com/kippmast_en.php)

Trip participants discussed the potential of what they had seen for New Zealand logging. They recognised that there are many differences in operating conditions that made an accurate cost-efficiency comparison difficult. All the operations seen had 'difficult' settings over relatively long reaches, with smaller sized trees and very low total volumes per setting, extracted to small roadside landings requiring care to avoid areas of regeneration.

All the participants agreed that the Gurndin operation was a highly innovative operation with the combination of smart cable logging systems (motorised carriages and intermediate supports); mechanisation of processing and remote control. Although new yarding equipment is more expensive relative to second-hand yarding equipment sourced from the USA, it was felt that the size and capacity of the Valentini V-1500 yarder was such that it could be considered in a clearfell setting in New Zealand.

NZ has good yarder manufacturing capability in NZ (e.g. Brightwater in Nelson, and EMS in Rotorua) but they need sufficient orders for new machines to enable them to invest in the new technologies and system concepts demonstrated on this European field trip. It may be possible to integrate some of this new technology (remote control, automation etc.) into our larger scale higher production logging systems, and that is the focus of the FFR Harvesting research programme.

## MERRY CHRISTMAS!



Thanks to all Harvesting Theme members for your support through the year. Best wishes for 2012!