



HARVESTING PROGRAMME UPDATE

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Summary

This update highlights the upcoming field demonstrations of outputs of the Steepland Harvesting PGP programme and the key features of the new Primary Growth Partnership funding bid “Automated Forestry Value Chains”. Progress to Quarter 2 of the 2016/17 Annual Programme is summarised. Commercialisation of the products arising from the programme has been a key focus over the last quarter. The Commercialisation team, Geoff Todd, Dave Cochrane and Sunil Vather, has completed a number of reports for the technology developers in each project as part of the Business Environment Review. Significant progress has also been made in completion of technical developments in each of the projects.

FFR FIELD DEMONSTRATIONS

As part of the current year’s programme, three field demonstrations of the products arising from the Steepland Harvesting Programme (dubbed the Innovative Yarding System) are planned for April and June.



- FFR Demo in Wanganui on Monday 10 April in conjunction with the 2017 Farm Forestry Association Conference (6-9 April in Fielding).
- FFR Demo in Rotorua on Monday 19 June in conjunction with the Harvest Tech Conference (20-21 June, 2017).
- FFR Demo in Nelson in late-July (TBC)

NEW PGP PROGRAMME

Further progress has been made during the quarter on the proposal for a new Primary Growth Partnership (PGP) programme: Automated Forestry Value Chains.

The programme focusses on automation and robotics in the forest industry, based on the highest priority projects identified as a result of the extensive industry consultation undertaken in 2014/15.

Significant changes have been made to the proposal as a result of feedback from MPI, to improve clarity and increase the likelihood of success of the bid. These changes will be completed during Q3 for submission to the PGP Investment Advisory Panel in April.

Outputs from the new PGP Forestry Automation programme will be:

- An automated log debarker-processor
- Log tagging and tag reading technology
- A robotic log sorter
- A large capacity semi-automated truck loading gantry and load securing system
- Development of the tree-to-tree robot for thinning to waste
- Semi-automated yarder grapple and control system
- An automated wood residue management system

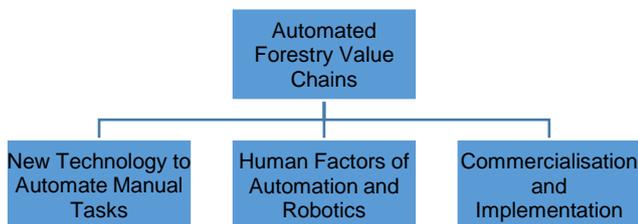
The programme builds on the successful Steepland Harvesting PGP vision of “no worker



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on the slope, no hand on the chainsaw” to extend this vision to “No boots on the ground, no hands on the log”, to eliminate all manual handling and deliver a step change in forest operations. New commercial products will also be built for domestic and export sale. Our vision is that by 2025 all harvesting operations will be fully mechanised, and at least 10% of operations will be automated to some degree.

The scope of the programme covers tree felling and extraction, log processing, sorting and loading and transporting log products. It has a much wider scope than the previous PGP programme, which covered felling and extraction on steep terrain only. It will build on the concepts of forestry mechanisation, remote control and teleoperation, and extend into the field of automation and robotics in forestry. There are three themes centred on technologies, people and commercialisation:



Outcomes will be: reduced forestry value chain costs by \$10.00/m³ through increased labour productivity and improved efficiencies. Workforce shortages will be alleviated through automation of some functions, skill levels in the industry will increase, labour turnover will reduce and career opportunities in forestry will be enhanced. There are also environmental sustainability benefits through reduced landing size (sorting logs off-landing), less chemical fumigation (through increased debarking), increased HPMV use from log sort yards, and utilisation of forest residues that are currently unmerchantable.

Automation will also drive a new high-tech manufacturing industry within New Zealand, opening up global export opportunities for sales of new machinery and equipment.

RESEARCH PROGRESS: Q2 2016/17

Quarter 2 of the 2016/17 Annual Research Plan was reviewed at the Technical Steering Team Meeting on Wed 8th February in Rotorua. Significant achievements during the quarter are:

- Modifications to the Skyshifter tail hold carriage has been completed and the carriage is now ready for field production trials.
- Completed construction, assembly and workshop testing of the Doherty Quick Coupler.
- Further progress in the technical development of the Teleoperation Control System.

1.0 Business Environment Review

Commercialisation of the technology products arising from the programme continued during the quarter.

The Commercialisation team visited all projects, and talked to all the developers. Business environment reviews have been prepared for the following products:

- HarvestNav on-board navigation system
- Teleoperation control system
- CutoverCam hauler vision system
- Remote-controlled felling wedge
- Awdon Skyshifter tail hold carriage

1.1 ClimbMAX Steep Slope Harvester

ClimbMAX #10, the first Cat-based machine, was shipped to the U.S. in early-January. This machine includes a full redesign of electronics and meets Tier 4 final emission standards for North America.

ClimbMAX Equipment Ltd has also reached agreement with Caterpillar Original Equipment Manufacturing (Cat OEM) division regarding access to partially built machines ex-factory. This change will significantly improve issues with warranty and international agreements, and will offer significant benefits and value for money



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over the previous units built. ClimbMAX #11, the first unit sold through Cat OEM, has been purchased and is scheduled for shipping to Vancouver Island, B.C. in mid-2017.



Commercialisation of the ClimbMAX harvester in 2012 and widespread uptake of other winch-assisted machinery over the last three years (such as DC Equipment's Falcon, the EMS TractionLine and Rosewarne and May's ROB) has increased the level of mechanised tree felling in New Zealand. As reported in the FFR Benchmarking database, the proportion of mechanised felling has increased from 23% of all harvesting operations in 2009 to 57% of operations in 2015.

1.1 HarvestNav On-board Navigation

Further commercialisation of the HarvestNav on-board navigation system to provide a full "out of the box" system has continued.



The Commercialisation team has met with Dr Hamish Marshall of Margules Groome Ltd and

prepared a report on commercialisation of the HarvestNav on-board navigation system, covering commercial partnership, intellectual property (IP) strategy, and updating the Commercialisation Plan (HDP018).

1.2 Teleoperated Felling Machine

Further progress has been made in completing the technical development of the Teleoperation Control System. The wireless link has been replaced giving significant improvement to reception and solving the interference issue with mobile phone band.

The engine no longer cuts out when the capacity of the wireless link deteriorates. The next step is to further improve the wireless link to avoid interference from the boom or other obstructions. These changes will be implemented later in February.

In the Remote Control Mobile Tail Hold project, improvements to the remote control unit (RCU) for the Volvo EC290 mobile tail hold machine were discussed with the contractors at Wood Contracting Ltd in Nelson in December. Further technical development of the RCU for the Mobile Tail Hold project will be completed in Q4. The improved system will use a remote control system based on the teleoperation control system and the improved CutoverCam camera system, making it more easily commercialised.

Specifically, the following improvements are proposed:

- three axis joysticks to be used so the boom and the tracks can be used at the same time
- the dead band and sensitivity of the system improved to improve control of the machine
- the controls to be mounted near the hauler controls
- the wireless link to be made more robust
- the hauler-side electronics will be powered from the hauler rather than from batteries.

The TST recommended a reallocation of project funding into this project to ensure the RCU is suitable for day-to-day use. The TST recognised that it is essential to solve these issues as the



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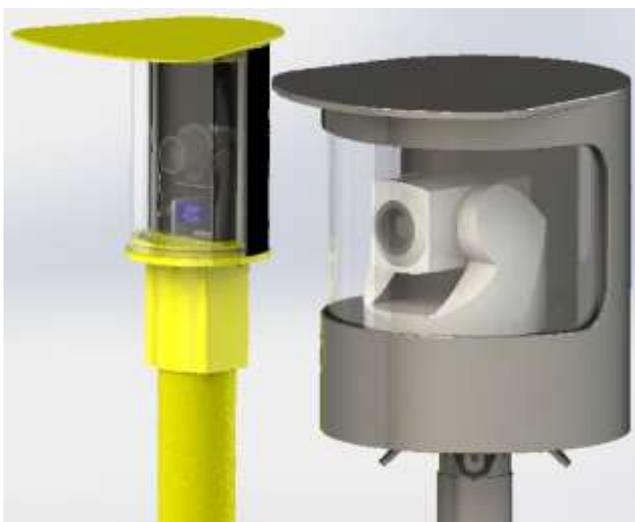
Mobile Tail Hold RCU is an important project. FFR wishes to demonstrate this teleoperation product as part of the Innovative Yarding System demonstration, at HarvestTech in June.

The Commercialisation team has met with project manager, Dr Paul Milliken, and prepared a report on commercialisation of the Teleoperation Control System. Preliminary findings are that it is unlikely that John Deere will license the teleoperation product. They may however be an excellent partner for distribution of the product in some markets. There is also a potential business based on building, installing, training and servicing retrofitable teleoperation units for feller bunchers and mobile tail holds in conjunction with the CutoverCam, as much of the technology of the three devices is common.

An improved Commercialisation Plan for the Teleoperation Control System is in preparation (HDP-039), including economic analysis of costs and benefits, market potential, commercial arrangements, marketing plans and manufacturing / scale up considerations.

2.1 CutoverCam Hauler Vision System

Further commercialisation of the new CutoverCam hauler vision system is underway.



This work is aimed at redesigning the unit to offer a significant quality and price improvement to earlier models. The new improved CutoverCam

(left) is smaller, lighter, more robust and cheaper than the previous model (right).

The Commercialisation team has met with developer, Dr Paul Milliken of Cutover Systems Ltd, and an improved commercialisation plan for the new CutoverCam hauler vision system is in preparation. This will cover economic analysis of costs and benefits, market potential, commercial arrangements, marketing plans and manufacturing considerations.

The new model CutoverCam will be demonstrated at the NZFFA Field Day in April and at the HarvestTech demo in June.

2.2 Remote Controlled Felling Wedge

In the Felling Wedge project, the results of the trials of the prototype remote-controlled powered felling wedge failed to meet the project objectives. The felling wedge still required use of conventional plastic wedges, therefore the key objective of remote operation to remove the faller from the hazard zone around the tree, was not achieved. To make further progress the wedge would have to be redesigned to solve the technical problems encountered during the trials.

The commercialisation team also determined that the felling wedge was likely to be too expensive to be competitive in the market, based on discussions with suppliers in the felling accessories market.

The TST recommended that further development of the remote controlled powered felling wedge be deferred, as the focus this year is on commercialisation and this product is clearly not at that stage. Unspent budget in this project was reallocated to the Teleoperation Control System project, which has higher benefit and likelihood of success.

2.3 Skyshifter Tail Hold Carriage

Modifications to the Awdon Skyshifter twin winch tail hold carriage have been completed:



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- Dry sumping the engine to solve the issue of the engine overheating when carriage on an angle.
- Front sheave assembly – where rope wear was identified as an issue.
- Option of releasing one winch brake at a time

Production field trials of the prototype Awdon Skyshifter tail hold carriage will resume in Quarter 3 to investigate the following:

- Carriage setup
- Operational productivity
- Winch rope tensions
- Winch rope wear
- Line shifting
- Down rigging



The Commercialisation team has met with Don Scott of Awdon Technologies Ltd and prepared a report on commercialisation of the Awdon Skyshifter tail hold carriage. The team will also assist Awdon with preparation of an improved Commercialisation Plan (HDP030) and IP strategy for the Skyshifter carriage.

3.2 Doherty Quick Coupler

In the Quick Coupler Attachment project, Doherty Engineered Attachments Ltd of Mount Maunganui has completed construction and workshop testing of the remote controlled automatic quick coupler.

The photo shows the innovative design of the hydraulic valve block covers to keep hydraulics connectors clean.

The next stage of the project is to install the automatic quick coupler into the base machine of the first adopter contractor and commence field trials. This is scheduled for Q4.



The commercialisation team will also assist Doherty Engineered Attachments Ltd with preparation of a Commercialisation Plan for the Doherty Quick Coupler.

3.2 Benchmarking Harvesting Costs and Productivity

The report on the 2015 Benchmarking database of harvesting costs and productivity has been published (Harvesting Technical Note HTN09-03). Data collection of 2016 harvesting results is almost completed. We encourage all forestry companies to submit harvesting data to the benchmarking database to ensure the data is a good sample of all harvesting operations in New Zealand.

RESEARCH OUTPUTS TO JANUARY 2017:

The following research reports were published during the last Quarter:

Harvesting Technical Notes:

- Harvesting Technical Note HTN09-03: Trends in Harvesting Cost and Productivity Benchmarking – Rien Visser.



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Harvesting Technology Watch:

- Harvesting Technology Watch HTW-017: Excavator Yarders for New Zealand – Tony Evanson.

These reports are now available to FFR members on the FFR website: <http://www.ffr.co.nz/> (requires login and password).

Other communications during the period:

- FTD Supply Chain Management Oct/Nov issue featured the PGP Steepland Harvesting project in remote control.
- NZ Logger magazine, November issue featured the presentation on the PGP Steepland Harvesting Programme to the Forest Growers Conference in October.
- NZX AgriHQ Pulse, an agri-business news service, on 5 Nov featured an article “Forestry projects lead to efficiency, innovation and save lives” about PGP Steepland Harvesting.

Steep Terrain Harvesting Field Trip, Germany, Austria & Italy 10-15th September 2017

The School of Forestry (Rien Visser) has organised a field trip for New Zealand forest managers and harvesting contractors to visit steep terrain harvesting operations in Germany, Austria and Italy from 10th -15th September, 2017.

The schedule for the five-day field trip includes visits to operations targeting machinery most applicable to NZ conditions, as well as cable yarder manufacturing facilities and road construction operations.

The cost of the field trip is €1275, which includes all accommodation, food and transport for the 5 days / nights. All travel to and from Freising, Germany (start/end point) is the participants' own responsibility.

It is pleasing to note that this trip has been fully subscribed and offers forest managers and harvesting contractors the opportunity to keep up to date with the latest European harvesting developments.