



Programme Manager: Keith Raymond



HARVESTING PROGRAMME UPDATE

Issue Number: 34

Date: March 2020

Summary

This update features news about the Forest Growers Research harvesting programme up to Q2 2019/20 and the Primary Growth Partnership (PGP) in automated forestry value chains. Progress is being made in early stage projects of the PGP programme, which commenced in January 2019.

Keith Raymond, Programme Manager

NEW PGP PROGRAMME

Update

The new PGP programme "Forestry Work in the Modern Age" commenced on 1 January 2019 and the business case was formally contracted by the Ministry for Primary Industries (MPI) in July 2019.

The Programme Governance Group (PGG) was formed in July 2019 comprising an independent Chair, Bryce Whitcher, two members from MPI, Bevan Chappell and Ruth Fairhall, and three industry representatives, Brendan Slui, Kerry Ellem and Russell Dale.

The Annual Plan for 2019/20 financial year was approved by the PGG in October 2019. The business case for the programme was published in November 2019 (Technical Report H036). The required Forest Growers Levy funding for the 2020 calendar year of \$900,000 was approved in December 2019.

Programme Activities

The Annual Plan from 1 July 2019 to 30 June 2020 has a total investment of \$4.23 million of which industry funding is \$2.54 million (60%) and MPI investment is \$1.69 million (40%).

Development of new products and processes (both on landing and at new log sort yards) is the focus of this year's work. Investment by harvesting contractors in new automated machinery will be de-risked. New opportunities for NZ forestry machinery and equipment manufacturers will be created to continue to catalyse innovations in harvesting and logistics.

Activities in 2019/20 focus on Objective 1, New Automated Technology, and Objective 2 Human Factors of Automation.

- Objective 1: New Automated Technology. Designing and developing new automated machinery and equipment.
 - Semi-autonomous yarder grapple and control system
 - Semi-automated log debarker-processor
 - Automated log residue chipper
 - Automatic log tagging and tag reading technology
 - Large capacity log loading grapple
 - Automated truck load securing system
 - Robotic log sorter
 - Automated truck loading gantry
- Objective 2: Human Factors of Automation. A focus on human-machine interaction and input to engineering design in Objective 1 to integrate the operator into automated machine design.
 - Benchmarking Human Factors
 - Cognitive & Physical Human-Machine Interaction

PROJECT UPDATES Q2 2019/20

1.1 Ground-based Harvesting Survey

The survey of all ground-based harvesting operations in New Zealand was completed in October 2019, and Technical Note HTN12-04 was published in February 2020.

A total of 385 crews were identified in the survey, and allowing for 10% not identified (mainly



Programme Manager: Keith Raymond



HARVESTING PROGRAMME UPDATE

Issue Number: 34

Date: March 2020

independent woodlot crews), gives the estimated total number of ground-based harvesting crews ranging from 385 – 425.

1.2 Residue Management and Biomass Processing

Graduate student Kigwang Baek completed a literature review of biomass recovery operations in New Zealand and a Technical Report (H041) was published in February 2020.

Campbell Harvey has commenced a PhD in managing harvest residues in 2019. Initial work will investigate volume, size distribution etc. of biomass, how it changes with harvesting system, and the potential for utilisation.

1.3 Improved Roding Systems

This project was completed in 2017/18 with the publication of a report on emergent technology in forest road management in New Zealand (H033).

1.4 Utilisation of Cable Assist Systems



Field studies of six winch-assist felling operations in New Zealand and B.C. Canada by graduate

student Cameron Leslie and FPInnovations researcher Colin Koszman were completed in July 2019. Technical Report H039 was published in February 2020.

Further work in this project involves a study of Speirs Logging Ltd.'s winch-assist skidder operation in Gisborne, in conjunction with DC Equipment Ltd and Forest Enterprises Ltd. Final year student Matt Pedofski has completed a draft Technical Report on the winch-assist skidder (H043).

1.5 Benchmarking Project

The FGR harvesting cost and productivity benchmarking database was expanded by 97 new entries from harvesting operations in 2018, and now has 10 years of summarised data with 1503 unique entries. Technical Note 12-01 "A Decade of Benchmarking Harvesting Cost and Productivity" was published in January 2020. Data collection for harvest areas felled in 2019 continues.

Meta-analyses of 10 years of data (1200 entries) using Data Envelopment Analysis has been completed by Francis Obi and Rien Visser. Technical Report H042 has been published.

1.6 Automation of Cable Yarders

Earlier this year Softree Technical Systems Inc., a world leader in forest road and engineering software, announced the release of the new RoadEng software package Version 9 Cable Planning and Analysis. This updated version offers a variety of new features for planning cable harvesting operations.

As part of a FGR project Campbell Harvey and final year student Luke Riedinger at the School of Forestry, University of Canterbury, have been testing the software and are very motivated to use it more extensively. They have made progress on more advanced harvest planning using RoadEng Version 9.

Next steps are to continue testing the functionality of the software, developing further



Programme Manager: Keith Raymond



HARVESTING PROGRAMME UPDATE

Issue Number: 34

Date: March 2020

course notes and examples aligned with NZ-style harvest planning. Once tested fully, this package has potential to replace the Cable Harvest Planning System (CHPS). The School of Forestry will roll out the harvest planning elements in its Harvest Planning course at University of Canterbury.

1.7 Harvester Simulator Training

This project comprised work by both UC Forestry student James Ma and Toi Ohomai tutor James Broadley.

James Ma tested 32 study participants on a John Deere harvester simulator at University of Canterbury. The focus of the project was on the effect of personality on machine operator performance. Technical Report H038 was published in February 2020.

In August 2018 FGR funded Toi Ohomai Institute of Technology tutor James Broadley to visit Riveria's Valtimo Forestry College in Finland. James reviewed the mechanised harvesting operator training system at Valtimo, with a view to recommendations for the establishment of a similar training system in New Zealand. Harvesting Technology Watch report (HTW-019) summarising results and recommendations from James' trip has been published.

2.1 Remote Felling Wedge project

This project aims to continue the development, identification and testing of remote-controlled battery-powered felling wedges over the last two years. The felling wedge developed by Georg Miggitsch, ex-Koller Yarder of Austria, was trialled by Rob Prebble Consulting Ltd in Tarawera Forest in August 2018, and later in Gisborne. These initial trials were not successful, and further modifications to the felling wedge are required.

Another commercially available remote-controlled felling wedge, the TR300, manufactured by Forstreich Maschinenbau of Germany has been trialled. This is a smaller,

lighter model (10.1kg) that has approx. 25 tonnes force and 5cm lifting height.



Initial trials were undertaken in a forest in Canterbury in October 2019. Further trials have recently been completed with Aratu Forests Ltd in Gisborne and a Technical Note is in preparation.

2.2 Quick Coupler project

Further testing of the first prototype of the quick coupler was completed in March 2019 by Total Hydraulic Solutions Ltd (Hydraulink), in Rotorua.

The testing of the coupler on an excavator base was not successful due to issues with lack of alignment of the coupler faces. Doherty Engineered Attachments Ltd in Mount Maunganui decided to redesign the prototype, to address these issues.

FGR is making arrangements with Aukett Contractors Ltd of Waipu and Forest 360 as the first adopter of this exciting new concept. A Letter of Intent will be signed with Lance Aukett to install and trial the second prototype Quick Coupler once it has been built.

3.1 Automated Grapple and Hauler

A new company, Alpine Logging Equipment Ltd was formed in January 2019 to develop and market Alpine Logging products such as the Alpine Shovel Yarder and Alpine Grapple Carriage.



Programme Manager: Keith Raymond



HARVESTING PROGRAMME UPDATE

Issue Number: 34

Date: March 2020

A field demonstration of the first Alpine Shovel Yarder in New Zealand was held in November 2018, and an article was published in the April 2019 issue of NZ Logger.



FGR has signed a Letter of Intent with Alpine Logging Equipment Ltd to develop a prototype automated yarding system (using the Alpine Shovel Yarder and Alpine Grapple Carriage) as part of the new PGP programme.

A second stream of this project is to develop an automated grapple and tower hauler control in conjunction with Rosewarne & May Ltd, Whangarei. This project commenced in 2018/19 with Letters of Intent signed with Rosewarne & May Ltd, and Hancock Forest Management Ltd and Rayonier Matariki Forests who are co-funding the total development cost of this project.

A Work Plan has also been completed and signed with all the parties, and a Services Agreement was signed with Rosewarne & May Ltd in October 2019. A Thunderbird TTY70 hauler and components have been sourced for the project and good progress is being made in this hauler and grapple project.

3.2 Automated Debarker-Processor

This project is aimed at developing a processor head-based debarker in conjunction with Waratah NZ Ltd. Waratah NZ Ltd have signed a Letter of Intent detailing the project and their indicative in-kind contributions.

A Work Plan has been prepared and is in the process of signing. The project should commence by the end of March 2020.

3.4 Automated Log Tagging

Timberlands Ltd presented a proposal to FGR for a new project on automated log tagging using the Otmetka Log Marking System in October 2019. Timberlands had reviewed the technology for RFID, ink-jet printing and impact stamping technology, and the Otmetka system looked to be the best option. Previous meetings had been held with PF Olsen Ltd, Rayonier Matariki Forests and Aratu Forests and it was suggested that the industry should drive this project as it fits well inside the new PGP programme on Forestry Automation and Robotics.

Otmetka had also had a meeting with Engineering Services Rotorua Ltd (Woodsman) who have shown interest in the project to develop the technology from prototype log stamper and reader technology to commercialised unit on a Woodsman processor head.

It was agreed by the TST that the project had industry-wide benefits, that several companies should collaborate together to ensure success and that FGR should lead the project, as an industry funded project, with MPI co-funding with funding support from participating forestry companies.

FGR has engaged Dr Glen Murphy as project leader on behalf of FGR. A Project Scoping document was prepared and presented to Otmetka in November, to progress the project. Subsequently FGR has prepared a draft Services Agreement with Otmetka, and discussions are continuing to reach agreement on this project.

4.3 Felling Techniques to reduce woody debris on steep slopes

A project to reduce breakage when felling trees on steep slopes was approved for funding from Forest Growers Levy in 2019. The project



Programme Manager: Keith Raymond



HARVESTING PROGRAMME UPDATE

Issue Number: 34

Date: March 2020

involved a field trial comparing two types of mechanised felling heads, a feller director ('dangle head') and a feller buncher ('fixed head').

The field trial was completed by Rob Prebble and Don Scott in April 2019 in Tasman Pine Forests Ltd.'s forests in Nelson. Results showed that the relative break height of stems from the fixed head feller buncher was between 87 – 92% of mean tree height (MTH). Analysis of harvester wood flow management software (STICKS) data from the trial confirmed that the average merchantable stem length of trees felled by the 'fixed head' was significantly longer than stems felled by the 'dangle head'. Technical Note HTN11-01 was published in January 2020.

4.4 Heli-extraction for improved recovery of harvesting residues

Another project approved for funding from Forest Growers Levy in 2019 was aimed at improving extraction of harvesting residues on steep country.



Ron Parker of HeliHawk Ltd, manufacturer of the self-release HeliHawk Log Grapple, designed the HeliHawk Slash Grapple, and it was built at Colchester Engineering Ltd in Matamata.

The field trial of a helicopter using the slash grapple in different types of slash material was completed in May 2019 by Ron Parker of HeliHawk Ltd, Tim Williams of Wairarapa Helicopters Ltd, Hamish Macpherson of PF Olsen Ltd and Keith Raymond of FGR.

Results of analysis of time study data linked to net helicopter payload as measured by an on-board load cell, showed that when the helicopter log grapple had extracted the log component of the slash first, then the slash grapple was used, average net extraction productivity increased to 18.5 tonnes per productive flying hour. It is recommended that as much log material is extracted first before using the slash grapple.

Technical Note HTN11-02 on the first production trial of the HeliHawk Slash Grapple was published in January 2020.

4.5 Small Growers Harvesting Guide

This project, funded by FGR, was aimed at small forest growers to provide them with a costing model and harvesting guide to analyse the expected net returns from harvesting their small forests and woodlots. It would also have application for larger companies that are purchasing or marketing small forest blocks.

The project, led by Dr Glen Murphy, with assistance from Dr Rien Visser at UC Forestry, commenced in March 2019. A Work Plan was completed and the Woodlot Analysis Tool has been designed and completed in August 2019. A draft web-based version of the tool has been completed (www.bright-tank.surge.sh).

Technical Note HTN12-05 on the design, development and testing of the Woodlot Analysis Tool has been published.



Programme Manager: Keith Raymond



HARVESTING PROGRAMME UPDATE

Issue Number: 34

Date: March 2020

5.3 Technical and Economic Feasibility

Scion have been engaged to develop a Value Chain Optimisation project, which is aimed at validating the benefits from the new FGR programme in forestry automation.

Scion have been working with graduate student Ha Bui from Massey University to develop the logistics simulation model using ExtendSim simulation software. This model will provide input to an economic analysis model.

A Work Plan has been developed for the project which involves three stages: firstly to develop the logistics simulation model to validate cost benefits; secondly an economic model will be built using outputs of the simulation to determine the feasibility of cost benefits and constraints for the first Log Sort Yard; then lastly the model will be further developed and customised to analyse the feasibility of specific log sort yard sites for various participating forestry companies.

The process of harvesting under the conventional scenario and under the proposed log sort yard process has been mapped, including gathering data on productivity, delays, constraints and buffers.

6.1 Benchmarking Human Factors

This project is aimed at documenting a baseline of injury types, situations and causes so that changes due to technologies (and other innovations) developed in the Primary Growth Partnership “Harvesting in the Modern Age” research programme can be identified.

The project investigated injury reports supplied to the New Zealand forest industry Incident Recording Information System (IRIS) database from January 2014 to December 2018.

Technical Note HTN12-02 focussing on landing-based injuries was published in January 2020. There were a total of 185 landing-related injury incidents recorded over this period. The most common cause of injury was being hit by a log that rolled or moved unexpectedly, indicating the

potential to reduce future incidents by eliminating manual tasks on the landing.

Technical Note HTN12-03, focussing on breaking out injuries in cable logging, was also published in January 2020. The report detailed a total of 132 breaking out-related injury incidents recorded over the period. The number of injuries generally trended down since the high in 2014, due to the wider use of grapples instead of manual breaking out.

6.2 Harvester Operator Stress

One of the projects in the Human Factors research programme for 2019/20 is an investigation into Harvester Operator Stress by Trevor Best, a PhD student at University of Canterbury. This work is aligned to Project 6.2 Cognitive & Physical Human-Machine Interaction looking at the linkage between mechanisation / automation and operator stress.

Work over the next year includes a qualitative survey of machine operators. Trevor has completed a pilot interview and transcript and secured agreement for two more interviews. A paper has been submitted to the New Zealand Journal of Forestry Science, and Trevor is working with FISC, FICA and FIRST Union to gain participant recruitment from industry.

RESEARCH OUTPUTS TO MARCH 2020

The following research reports were published during the last twelve months:

Technical Reports

- Harvesting Technical Report H036. “Primary Growth Partnership Business Case: Te Mahi Ngahere i te Ao Hurihuri – Forestry Work in the Modern Age”. Business Case prepared for the Ministry for Primary Industries. 30 September 2018.
- Harvesting Technical Report H037. “Design of a Prototype Autonomous Forestry Extraction Machine”. Treanor, J., Hartley, A.,



Programme Manager: Keith Raymond



HARVESTING PROGRAMME UPDATE

Issue Number: 34

Date: March 2020

Harvey, G., May, B., and Bell, T. October 2018.

- Harvesting Technical Report H038. "Effect of personality on felling machine operator performance: Case study using a John Deere Simulator" – James Ma, Hunter Harrill and Rien Visser. October 2018.
- Harvesting Technical Report H039. "Productivity and Utilisation of Winch-Assist Machines: Case Studies in New Zealand and Canada". Cameron Leslie and Colin Koszman. July 2019.
- Harvesting Technical Report H040. "Steepland Harvesting Programme Post-Programme Report 2019". 31 July 2019.
- Harvesting Technical Report H041. "Biomass recovery operations in New Zealand: a review of the literature". Rien Visser, Hunter Harrill and Kigwang Baek. April 2019.
- Harvesting Technical Report H042. "Using Data Envelopment Analysis to explore productivity benchmarking in the New Zealand harvesting sector". Okey Francis Obi, and Rien Visser. December 2019.

Harvesting Technical Notes

- Harvesting Technical Note HTN11-01. "Comparison of Felling Heads to Reduce Tree Breakage". Rob Prebble and Don Scott.
- Harvesting Technical Note HTN11-02. "Helihawk Slash Grapple – First Production Trial". Ron Parker and Keith Raymond.
- Harvesting Technical Note HTN12-01. "A Decade of Benchmarking Harvesting Cost and Productivity". Rien Visser.
- Harvesting Technical Note HTN12-02. "Harvesting Landing-based Injuries: Analysis of IRIS data". Richard Parker, Brionny

Hooper, Christine Dodunski, and Keith Raymond.

- Harvesting Technical Note HTN12-03. "Harvesting Breaking Out Injuries: Analysis of IRIS data". Richard Parker, Brionny Hooper, Christine Dodunski, and Keith Raymond.
- Harvesting Technical Note HTN12-04. "A Survey of Ground-based Harvesting Systems in New Zealand". Hunter Harrill and Rien Visser.
- Harvesting Technical Note HTN12-05. "A Woodlot Analysis Tool – Design and Initial Testing". Glen Murphy.

Harvesting Technology Watch

- Harvesting Technology Watch HTW-019 August 2019. "Harvester Simulator Training" – James Broadley

These reports are now available on the FGR website: www.fgr.nz