

Review of Commercialisation of Projects in the Steepland Harvesting Primary Growth Partnership Programme



Prepared for the Programme Steering Group

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About the Author

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Executive Summary

There is a visible uplift in innovation and a will to innovate across the forestry sector. There is real pressure to innovate from a safety and efficiency point of view. However the low margins and disaggregation of the sector, and the relatively low existing levels of mechanisation all contribute to make this a tough sector in which to innovate.

The Primary Growth Partnership (PGP) Steepland Harvesting programme, a partnership between the Ministry for Primary Industries (MPI) and Future Forests Research Limited (FFR) has made a clear contribution to the rate and level of innovation in the sector. The programme is managed by FFR. It is the best sector technology and innovation interaction the reviewer has seen. The programme has invested in technology development by working with the sector to develop an innovation strategy then pulling together scientists, engineers, manufacturers and contractors and investing substantially in the companies that will introduce the new product.

Early industry engagement in projects has been good. The direct investment into projects has had a big impact on the innovation process. For example, one technology developer interviewed said “Their (FFR’s) involvement enabled the innovation by reducing risk”. This has sped up the innovation process, reduced risk for the participants and built cross-sector capabilities. Many participants of the value chain have been engaged. These positive relationships have helped commercialisation and the diffusion of technology across the sector. It was noted that the weakest engagement is probably with the contracting sector and in particular the 50% that have not as yet started to mechanise aspects of their operation.

Commercialisation of technology in this sector requires:

- Involving early adopters early in the product development process
- Demonstrating benefits, practicality and robustness
- Securing a champion in the contractor community
- Getting the product into the contractors’ hands through loan, lease, trials and demonstrations
- Engaging key forest owner/managers

Of the eight projects reviewed, five have resulted in products that are now in the market place. The remaining three products are at the prototype stage with strong commercial prospects. This is an excellent outcome. All the successful projects in this programme have to some extent achieved the above requirements. However all the New Zealand companies engaged in the projects are small with insufficient resources and experience to introduce and support these products into the market. Most would benefit from targeted assistance to overcome challenges they have encountered.

Commercialisation in this sector is a challenge and some of the issues and learnings are:

- Most of the New Zealand companies developing the new products lack the capital to implement a successful commercialisation model.
- The companies interviewed have an unsophisticated business to business sales approach and all have low product margins.
- Intellectual property (IP) management is weak.
- The contractor purchasing process is very experiential. This suggests more involvement by contractors as early as possible in projects in order to secure future champions and exemplars in the contracting community.
- FFR has treated commercialising a product as complete once sales have been made. However all the products have had or need significant refining after the first few sales. The cost of initial sales is very high and difficult for the small engineering companies to sustain.

- The New Zealand companies partnered with FFR have limited capacity and experience in selling to export markets. Yet the experience of one developer in this programme shows it can be done.
- FFR needs to engage in the business development function of its projects more actively.
- There are agencies which can provide commercialisation support including Kiwinet, Callaghan Innovation, New Zealand Trade and Enterprise (NZTE) and venture capital providers.
- Each product has been developed and taken to market in isolation of other products. The best productivity gains will arise when they are deployed together in a system (albeit in different configurations). This will require more of a collaborative approach between forest managers and contractors to address the risks, costs of innovation and resultant benefits.

Summary of Recommendations

That FFR:

1. Meets with Callaghan Innovation and organisations such as Kiwinet, Callaghan Innovation and WNT Ventures and Powerhouse Ventures (technology incubators) to gain further commercialisation support to the engineering companies developing products post the PGP programme.
2. Immediately starts to develop the commercialisation plans and arrangements for the early stage projects.
3. Engages more business development support for the projects.
4. Organises and provides more support around introduction of products into the market and be more engaged in this process especially with the small companies. Commercialisation support should extend to improvements post-initial sales.
5. Involves selected (early adopter) contractors early in projects with a view to securing the first buyer and champion and engage more contractors into the project decision making process.
6. Considers ways for forest owners and contractors to work together to implement innovations by sharing risk and productivity gains. There is a role for FFR to encourage, facilitate and support this approach.
7. Takes a more active approach to development of intellectual property and its inclusion into each product's commercialisation strategy.
8. Gains assistance for FFR's manufacturing partners in developing offshore markets in North America, South America and Australia, possibly through New Zealand Trade and Enterprise (NZTE). There may be an opportunity to team up in the approach to some markets.

Introduction

Steep slope contract harvesting environment

There is a visible uplift in innovation and a will to innovate across the sector. There is real pressure to innovate from a safety and efficiency point of view. However the low margins in the sector, the disaggregation, and relatively low existing levels of mechanisation (38% mechanised felling and 55% mechanised processing of all operations reported in 2014) all contribute to make this a tough sector in which to innovate.

Key factors influencing the uptake of new products and innovation in the sector are:

- Low margins by all participants. Contractor margins are reported as being 2-3% which is probably below the long term marginal cost of operation
- Disaggregation of the sector
- An urgent need to increase productivity and safety in steep slope harvesting
- Short term or insecure contracts
- Low levels of mechanisation in harvesting – an estimated 50% of contractors are not mechanised for steep slope harvesting and have been reluctant to take on new technology
- Small size and low levels of capital for NZ engineering companies in this sector
- Cyclical log markets
- Substantial growth in steep slope forests to be harvested over next 20 years
- Ageing work force in many contractor businesses
- Environmental issues, particularly water quality
- Requirements set by forest owners and managers.

Contractor purchasing processes

Elements in contractor decision making:

- Previous experience of the product (have seen or used it before)
- The experience and opinions of other contractors
- Likelihood of immediate benefits (for example in securing contracts, improving safety, reducing cost)
- Provides a point of difference and opens up path to secure new or better contracts
- Requirements of the forest owners or managers
- The security and length of current contracts
- Trust in, and experience or comfort with vendor.

Price is an issue but not a key determinant. For example, one technology developer has lost several orders through long delivery times even though their price is significantly lower than the alternative grapple carriage.

Best practice selling approaches for new products and technology seem to include:

- Involving early adopters early in the product development process
- Demonstrating benefits, practicality and robustness
- Securing a champion in the contractor community
- Getting the product into the contractors hands early through loan, lease, trials and demonstrations
- Engaging key forest owner/managers.

Commercialisation

The innovation and commercialisation process has three key aspects:

1. The “funnel”. It is essential to look at many ideas to get one or two products or businesses that can be sustained long-term.
2. It is a stage-wise process, and each stage has its own key goals and milestones.
3. It is vital to involve key stakeholders early, including customers.

In the FFR context commercialisation means stimulating innovation through the adoption of new systems, processes and products. This includes:

- Direct adoption of technology from off shore for NZ purposes
- Access to (through agreements) and adaptation of technology from off shore for NZ purposes
- Technology used to develop new products in NZ engineering companies.
- Diffusion of technology to other engineering companies
- Uptake and use of the technology in the contracting sector for harvesting on slopes.

If successful, commercialisation will lead to increased:

- mechanisation and sophistication of harvesting contractors and crews
- safety on steep slope harvesting operations
- productivity of steep slope harvesting
- competitiveness of NZ engineering manufacturers providing services and equipment to this sector

A best practice new product commercialisation process involves:

1. Establishing clear goals.
2. Building good understanding of market and users.
3. Engaging key stakeholders.
4. Developing a series of prototypes, testing in the field, and proving the benefits, all with sector involvement.
5. Securing the path to market.
6. Confirming user champions.
7. Continuing to improve product rapidly on market entry.

In a best practice process the first four steps in this process should lead to clarity on the path to market and identify or build user champions by developing their commitment to the product.

Review Process

The review included the FFR business and commercialisation plans and interviews or discussions with the following:

- key FFR staff and Scion researchers
- all the commercialising partners

In addition, three harvesting contractors were interviewed to gain customer perspective.

Technology commercialisation projects reviewed were:

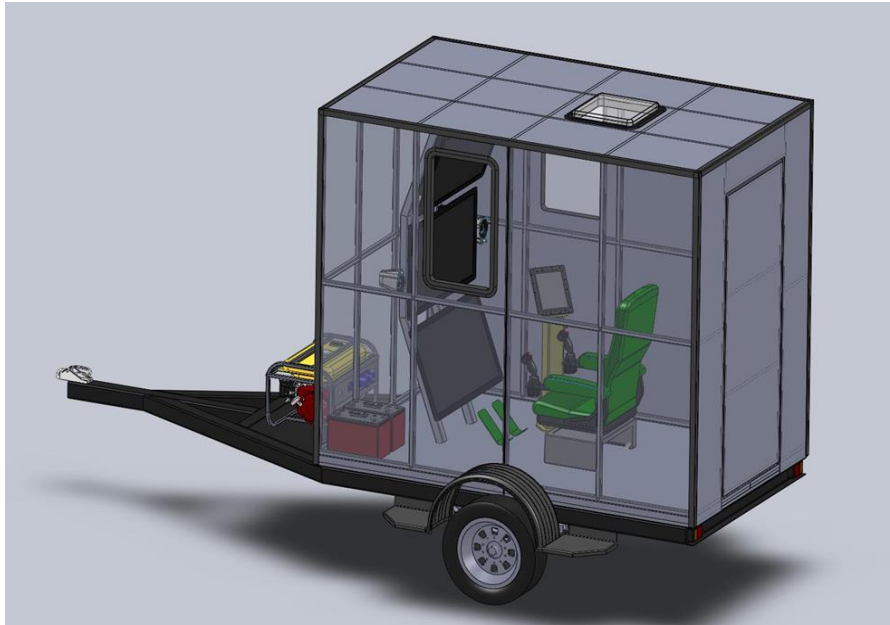
1. ClimbMAX Steep Slope Harvester (Trinder Engineering Ltd)



2. HarvestNav on-board navigation application (Interpine Ltd)



3. Teleoperation Control System (Scion)



4. Robotic tree-to-tree felling machine (Scion/University of Canterbury)



5. CutoverCam hauler vision system (Cutover Systems Ltd)



6. Alpine Grapple Carriage (Logpro Ltd)



7. Jackson Beckham Lifting Wedge (Jackson Beckham Ltd)



8. Awdon Twin Winch Tail Hold Carriage (Awdon Technologies Ltd)



The commercialising partners interviewed were:

- Trinder Engineering Ltd (ClimbMAX Steep Slope Harvester)
- Interpine Ltd (HarvestNav on-board navigation application)
- Cutover Systems Ltd (Teleoperation control system and CutoverCam)
- Scion (Robotic tree-to-tree felling machine)
- Logpro Ltd (Alpine Grapple Carriage)
- Jackson Beckham Ltd (Jackson Beckham Lifting Wedge)
- Awdon Technologies Ltd (Awdon Twin Winch Tail Hold Carriage)

Commercialisation Approach

The Steepland Harvesting PGP programme aims to provide a pathway for the New Zealand forest industry, to realise substantial gains in productivity, safety and cost reduction through improved harvesting technologies.

The programme vision is for low cost steep country forest harvesting operations in New Zealand carried out in safer and better working conditions by a well-trained, highly motivated workforce using sophisticated technology. This is encapsulated in the vision statement: “no worker on the slope, no hand on the chainsaw”.

The programme is governed by the Programme Steering Group (PSG) and managed by FFR. The PSG is made up of representatives of MPI and FFR. Technical advice is provided to the PSG by a Technical Steering Team (TST).

The programme has engaged many companies in the sector and is clearly stimulating change and innovation across the sector. FFR sees the contracting sector as innovating in steps. For example, firstly deployment of feller bunchers to mechanise tree felling on steep slopes. Secondly, the deployment of grapples to mechanise the log extraction phase. The subsequent introduction of lateral shifting of the skyline then enables teleoperated and tree-to-tree robots to be viable. Collectively these changes introduce mechanisation that also pave the way for automation and new approaches to harvesting.

Principles expressed by FFR:

- To take a leadership role in innovation, research and development
- To be an industry catalyst - sharing of risks and benefits in industry is a challenge to institutionalise innovation
- To get products into the sector as soon as possible
- That FFR doesn't want to own IP, but that it should be transferred to the commercial partner.

FFR membership largely comes from the large forest owners, it only has two members that are harvesting contracting companies. The Technical Steering Team guides the technical research team and ensures an end-user research interface and technology transfer. The TST comprises nine representatives who are all forest owners/managers and it does not include harvest contractors or machinery companies. The technical research team comprises researchers from Scion and University of Canterbury, forestry consultants, manufacturing company engineers and forest harvesting specialists.

The contractors play a critical role in the uptake and use of new technology and new methods, and finding the right mechanisms to secure contractor engagement in the programme and communication of outcomes to contractors is an important component of the programme.

As the development programme is primarily engineering development, a standard methodology has been used:

- **Feasibility** – brainstorming what's out there that can be adapted, development of concepts etc.
- **Simulation** – computer modelling to test if it can deliver the expected benefits, identify the flaws and ability to develop some very early stage prototype.
- **Alpha prototype** – development of lab or bench top prototypes to test the concept and develop the specifications for a working model.
- **Beta prototype** – development of a working prototype that can be field tested under carefully monitored conditions and used as the basis for a commercial design.

- **Commercialisation** – going from the Beta prototype to production of the commercial unit, and securing uptake of the unit by industry through technology transfer and extension.

Leadership and catalyst role

By its composition, activities, breadth of projects and its engagement process this PGP programme has led innovation and made it possible in the forestry sector. It has set out to catalyse sector thinking and encourage strategic thinking in companies.

The level of engagement has been impressive. Many participants of the value chain have been engaged. However in spite of workshops and field days, technology watch reports, regional technical meetings, trials in the field, economic and productivity data, and direct investment a surprising number of participants are unaware of some of the activities. Everyone interviewed however had an opinion of the robotic tree-to-tree felling machine (which evidently is far out of the experience of contractors who see themselves as practical people focused on the here and now.)

The mid-programme progress review recommended, inter alia, a campaign to enrol more direct contractor participation in the programme to facilitate commercialisation and uptake. FFR has not been successful in securing new contractor members. The weakest engagement is probably with the contracting sector and in particular those that have not as yet started to mechanise aspects of their operation.

The direct investment into projects has had a big impact on the innovation process, for example, one commercialising partner said “Their (FFR’s) involvement enabled the innovation by reducing risk”. Most of those interviewed outside of FFR thought the PGP process was good.

Outcomes

The commercialisation of specific projects is discussed in specific reports to each commercial partner. In terms of the three broad parameters of commercialisation the programme has been successful:

1. FFR has used a “funnel approach” on most projects with good idea generation and testing involving the sector – the process to develop the twin winch tail hold carriage is an excellent example.
2. All project developments have had a stage wise process which has been robust.
3. In most cases stakeholders have been involved in projects from their early days but contractors have been absent from the formal decision making process. This is a weakness given the role of contractors in adoption of the technology.

The success of the winch-assisted feller bunchers and the grapple developments has been apparent. Not only are the innovating companies selling products but other companies have followed their example. There are now several companies in the market providing grapples. In total, about 38 more grapples have been introduced in the last few years. A survey in 2015 found that since 2012 there has been widespread development, adoption and adaptation of winch-assisted harvesting machines on steep slopes in NZ with five main manufacturers. Five of the eight projects reviewed have resulted in products that are now in the market. This is an excellent outcome.

Issues for the future include:

- Contractor margins and innovation - As they have low margins most contractors hold on to their gear. What is a reasonable margin for them to be motivated to invest and have a reasonable reward for their contribution to productivity gains?
- Sector approach to adoption of new systems – it is likely to be too big a risk for a contractor to invest in completely new systems such as a mobile skyline with a tree felling robot. The

industry needs to develop a collective approach to secure the benefits from such innovations coming down the pipeline. Further and significant investment will be required to realise these.

Summary of Commercialisation Plans

Table 1 demonstrates each project's fit with the commercialisation process. Specific project details have been kept confidential.

Table 1: Fit with commercialisation process

Project	Project A	Project B	Project C	Project D	Project E	Project F	Project G	Project H
Clear goal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Understanding market and users	Good	Adequate	Good	Technology driven	Adequate	Some	Good	Adequate
Engagement	Good	Limited	Good	Limited	Limited	Some	Excellent	Unclear
Prototyping and testing	Next step	Good	Good	Limited testing	Good	Next step	Good	Good
Path to market	Not started	Yes but small company	Yes but small company	Yes but small company	Yes but small company	Not started	Yes but small company	Start-up company
User champion	Identified	Yes	Yes	No	No	Yes	Identified	No
Continued improvement	Not at this point	Funding limited	Difficult	None planned, potential not realised	No	Not at this point	Not at this point	Needed
Awareness by market	High but not understood	High	High	Low	Low	High, but not understood	Low	Medium, price not understood

Key Findings

There is real pressure to innovate arising from economic pressures on the sector, very public health and safety issues and potential liabilities, and an increasing proportion of harvest required from steep slopes. Environmental issues are just around the corner. But the low margins in the sector, the disaggregation, and low levels of mechanisation all contribute to make this a tough sector in which to innovate.

The programme has invested in technology development by working with the sector to develop an innovation strategy then pulling together scientists, engineers, manufacturers and contractors and investing substantially in the companies that will introduce the new product. Industry engagement early in projects has been good. This has speeded up the innovation process, reduced risk for the participants and built cross-sector capabilities.

There is a visible uplift in innovation and a will to innovate across the sector. The uptake of feller bunchers and grapples over the last three years is evidence of this, and for at least some of this, the

PGP programme deserves credit. FFR has a good robust product development process and all the people interviewed were very positive about the impact of FFR and the PGP programme.

Commercialisation in this sector is a challenge and some of the issues and learnings are:

1. Lack of capital in the NZ companies developing the new products. All the NZ companies engaged in the FFR projects are small with insufficient resources and experience to introduce and support these products into the market.
2. Unsophisticated business to business sales approach and low product margins. None of the companies interviewed demonstrated strong capability in sales. Most are preoccupied with keeping their sales price down, which only serves to further starve them of resources.
3. Intellectual property management is weak. There is no active plan to generate IP then integrate its use into the business strategy. The approach to IP by some developers is naïve.
4. The contractor purchasing process is very experiential. This suggests more involvement by contractors as early as possible in projects in order to secure contractor champions and exemplars.
5. FFR has treated commercialising a product as complete once sales have been made. However all the products have had, or need, significant refining after the first few sales. These sales to the very early adopters really serve to identify what the product really needs to be. The cost of initial sales is very high and difficult for the small engineering companies to sustain.
6. The NZ companies partnered with FFR have limited capacity and experience in selling to export markets. Yet the experience of one developer with sales overseas shows it can be done.
7. FFR needs to engage in or support the business development function of its projects more actively. Most of the business development tasks seem to be in the hands of the project managers. They are skilled in product development but not all the aspects of business development which includes:
 - building the commercial relationships
 - identifying the initial market
 - engaging early adopters and user champions
 - capturing funding
 - protecting intellectual property
 - developing further market opportunities etc.
8. There are agencies which can provide commercialisation support including Kiwinet, Callaghan Innovation, New Zealand Trade and Enterprise (NZTE) and venture capital providers.
9. Each product has been developed and taken to market in isolation of other products. The best productivity gains will arise when they are deployed together as a system (albeit in different configurations). This will require more of a collaborative approach between forest managers and contractors as the risks, costs of innovation and resultant benefits will be hard to balance.

Recommendations

That FFR:

1. Seeks to:
 - a. Meet with Callaghan Innovation to investigate further support for the engineering companies developing products post the PGP programme. Such support could include R&D grants and R&D services.
 - b. Meet with Kiwinet and Scion to gain commercialisation support including funding, business development, access to business networks
 - c. Discuss possible investment interests with WNT Ventures and Powerhouse Ventures, both being technology incubators.
2. Immediately starts to develop the commercialisation plans and arrangements for the early stage projects, including the robotic tree-to-tree felling machine.
3. Engages more business development support for the projects.
4. Organises and provides more support around introduction of products into the market and be more engaged in this process especially with the small companies. Commercialisation support should extend to improvements post-initial sales.
5. Involves selected (early adopter) contractors early in projects with a view of securing the first buyer and champion and engages more contractors into the project decision making process.
6. Considers ways for forest owners and contractors to work together to implement innovations by sharing risk and productivity gains. This is particularly important for the introduction of the robotic products as multiple manufacturers will be involved and a harvesting system change needs to be promoted. There is a role for FFR to encourage, facilitate and support this approach.
7. Takes a more active approach to development of intellectual property and its inclusion into each product's commercialisation strategy.
8. Gains assistance for FFR's manufacturing partners in developing offshore markets in North America, South America and Australia, possibly through New Zealand Trade and Enterprise (NZTE). There may be an opportunity to team up in the approach to some markets.