Industry Forum on Future Opportunities in Harvesting and Logistics Research

INTRODUCTION

The cost of forest harvesting and log transport to port or mill in New Zealand is estimated to be in excess of $1.25 billion per year. Therefore even small gains can have large financial benefits. There is a need to continue to increase efficiency and reduce costs. Health and safety is also a major issue and must be improved. The current PGP-industry funded Steep Land Harvesting research programme finishes in mid-2016 and it is timely to begin the discussion on what happens beyond the end of this programme. It is vital that the industry maintains the momentum built up over the last few years in harvesting innovation. A strategic workshop forum was scheduled for industry stakeholders to discuss current industry issues and develop future research ideas in harvesting and logistics. The strategic forum was held in Rotorua on 26 November 2014. This report summarises the outputs of the forum.

OBJECTIVES OF THE HARVESTING AND LOGISTICS FORUM

1. To identify industry needs and gaps

2. To propose potential research projects to address the industry needs and gaps

3. To determine industry priorities for the potential research projects

Programme funding was not the focus of this forum. Depending on the level of support, later work will determine project resources – co-funding, research providers, timing etc. A funding bid will be developed through the appropriate channels of the FOA Research Committee or a coalition of willing investors.

Scope for Potential New Research

The scope for potential new research is harvesting and logistics operations in the forest industry in New Zealand. The research will consider the total value chain from felling to log delivery at mill or port.

Industry Representation

A summary of forum attendees is given in Table 1.

Table 1: Forum Attendees

19	Forest Owners
13	Consultant/Government
17	Researcher/Manager
9	Contractor
7	Training provider
5	Machinery supplier/Wood Processor
70	TOTAL

There was wide industry representation at the forum, with 70 participants representing Forest Owners, consultants, Government agencies, science and research management, harvesting and transport contractors, training providers, machinery suppliers and wood processors.

METHOD

Workshop 1: Identifying Industry Needs and Gaps

What are the Industry drivers? What are the future trends? Each group discussed each identified industry need and predicted the future trends for these needs. These were documented by each group.

Workshop 2: Future Research Opportunities

What are the research projects to address Industry needs? For each identified industry need each group discussed ideas and proposed research projects to develop the industry's best response to these needs and future trends. To ensure each idea was adequately developed a maximum of 5 Research Projects per group was imposed.

Each proposed research project was documented in the following format:

- Objectives / Benefits
- Methods
- Results / Outcomes

Workshop 3: Research Criteria and Priorities

To determine whether each project was suitable for inclusion in a new programme of Harvesting and Logistics research the following criteria were applied to each project:

1. Does this research meet an industry need?
2. Is it within scope?
3. Is it a gap – or are others doing this research?
4. What is the potential commercial payback?
5. Is there a safety or environmental imperative?
6. What is the potential for leverage of industry funding?
7. How quickly will benefits be realised?
8. What is the likelihood of adoption/uptake?
9. Will this research have spillover benefits?
10. Is this research enhanced by collaboration?
11. Does this research link to existing research?
12. Will this research maintain/build existing capability?
13. Will this research require new capability to be built?

Once each project was judged according to the research project criteria, the project ideas were displayed for each participant to examine. Individual priorities were determined by voting, whereby each participant had 5 votes to apply to as many projects as they wished. Votes were attached to each Research Project poster for other participants to view.

RESULTS

A. INDUSTRY NEEDS

The Workshop Groups considered the future trends in forestry, including:

- Increased harvest outside of the larger corporate growers
- Increased costs of fuel and machinery
- Availability of spill-over technology from other industries
- Opportunity for more collaboration in industry developments
- Potential for unintended consequences from changes implemented
- Possible future reduction in Government funding for research

Each group then identified industry needs, which have been grouped together into the following areas:

- Imperative to improve safety (Health & Safety)
- Need for improved profitability (Profitability / Productivity)
- Enable further expansion of the forest industry (Industry Expansion)
- Need for increased efficiency across the supply chain (Supply Chain Efficiency)
- Need to attract more workers into forestry and improve skills available (People / Career / Training)
- Need to reduce the impact of harvesting and improve environmental performance (Environmental Management)

Industry Need – Health and Safety

Subject Area	Industry Needs and Gaps	Group
Health & Safety	To provide safe work that is highly productive and profitable. Need to understand and change behaviour and cultural drivers. ("Why do smart people do dumb things?"). Need to understand causes of fatigue (Work methods, job hours etc.). Need to implement better fatigue management – shift work, multiple operators, teleoperation. Need to understand effects of mechanisation. What are the implications of more computer screens for longer periods?	2
	Eliminate manual felling. Motor-manual felling is getting more dangerous as harvesting moves into more difficult areas. Need to continue to replace manual felling and breaking out with technology. Eliminate manual work processes especially on landing (e.g. tree processing, log branding, log stocks, QC). Where is the best/safest place to process? When is it appropriate to manually process on a skid?	4, 10, 11
	Need to simplify safety standards, operating rules and safety procedures. Review international rules and procedures. Streamline company systems.	4, 11
	Safe retreat distances. Need to undertake a productivity study of breaking out safe retreat distances.	3
	Man-machine interaction. Technology such as cameras, GPS, proximity sensors etc. is available but needs uptake.	10
	Need common specification for operating steep slope systems. Engineering standards and operational best practice.	11
	Alternatives to fumigation of export logs by methyl bromide for phytosanitary requirements. Determine whether debarking of log exports is a satisfactory alternative to fumigation. Need to reduce environmental issues with debarking at port. Develop in-forest debarking with processor head.	4

Industry Need – Profitability / Productivity

Subject Area	Industry Needs and Gaps	Group
Profitability / Productivity	Increase profitability of sector. Improve contract framework (more equitable contracting models). Develop a "partnering environment" between forest owner and contractor so there is a win/win for both parties. Need to develop trust between supply chain players. Need a process to capture improvement initiatives. High capital cost of machinery increases risk. Need to understand critical risks. Need capacity to pay higher wages.	2, 6, 9, 11
	Machine configuration ("Need right machine for the job"). Current knowledge of machine features. Awareness of harvesting systems available is poor by harvest planners and contractors. Multi-use machinery technology. Machine underutilisation, latent productive capacity. Utilise equipment pools.	1, 2, 3, 4, 11
	Need to improve wood handling through landing (bottleneck). Need to reduce multiple handling at a site to load a truck. Need tools to assist contractors to forecast daily productivity to reduce variability in log supply and improve truck scheduling.	2
	Log value too low. How to extract more value from tree. Need to increase end use value of wood. Need to find new products for radiata pine (apart from saw logs and pulp logs). Need to better allocate wood to correct customer end use. Or reduce cost of harvesting wood at extremes.	2, 6
	Quantify log value loss in forest (or value not recovered). Need to know what the value of recovering the last tonne of wood is. Damage to logs from processors. Need to investigate central log processing to determine if log out-turn is better and whether gains outweigh costs. Need to find uses for residuals. Currently contractors produce residues that are not paid for.	2, 5
	New technology in value chain. Need to understand the impact and what the real gains are. Need improved felling machine (lightweight, mobile, remote controlled). Directional felling of bigger trees. Better planning for consequences of extended harvesting hours / production. Understanding the impact that a more productive felling machine has on the stump-to-stack process. Next step change is improving the way trees are cut down (non-chain felling methods). Maintenance of mechanised equipment to reduce chain throwing. ("What happens when machine breaks down on steep slopes?")	2, 3, 4
	Hauler productivity improvement. Need to continue to expand ground-based systems. Need to look at Europe for low capital cost solutions.	4, 11

Industry Need – Expansion of the Forest Industry

Subject Area	Industry Needs and Gaps	Group
Industry Expansion	Need to address needs of large number of owners of small forests. Increasing harvest, continued viability, community impacts, environmental and health and safety issues. Current short term view creates "one-off" high cost operations vs. continuous work for large forest owners. Need to be able to deal with downturns or lose labour force.	2
	Need to provide tools to small forest owners for dealing with the increasing harvest. Sector analysis. Tendering electronically for several woodlots.	9

Industry Need – Supply Chain Efficiency

Subject Area	Industry Needs and Gaps	Group
Supply Chain Efficiency	Reduce fragmentation of supply chain between grower / harvester / trucker / mill. Value chain collaboration and coordination. Change short term view of industry limits capacity to transfer information / reduce costs. Need longer term planning and commitment. Understand that optimum for one part is not optimum for other parts. Need to recognise corollary impacts/benefits. Minimise double handling and duplication. Move to electronic docketing, reducing delays in trucking and loading (e.g. writing dockets, waiting for trucks, queuing etc.).	1, 2, 6, 9, 10, 11
	Need to use data from processor more (e.g. stocktaking, production and maintenance management). Calculate volumetric measurement and apply individual log ID. Use for log tracking and data transfer. Improved infrastructure / communications coverage (cell phone / wi-fi / satellite). Convert to sale and payment on cubic volume basis. Sharing of information.	4, 5, 9, 11
	Improve logistics efficiency between skid and customer. Do current log specs realise best value? Cutting too many log cuts, and too many short lengths. Need to standardise / rationalise log grades. Develop long length optimisation (combining short log lengths) and recut out of forest. Simplification of supply chain. Similar to "meat and dairy processing model" where many suppliers supply same products to processing plant.	2, 3, 4, 6, 7, 11, 12

Industry Need – People / Career / Training

Subject Area	Industry Needs and Gaps	Group
People / Career / Training	Knowledge of current workforce. Identify current state through survey of demographics, education levels, qualifications and skills.	4
	Need to develop workforce for the future. Lack of people that are skilled, productive, with right attitude ("Why are only 1-2 out of 10 workers currently trained appropriately?").What will be the physical, educational and technical needs of future workers (both manual and machine operators) in 3-5 years' time? Design training courses that will deliver skills required. Improved safety training to deal with the new environment of mechanisation. Apply selection criteria (simulator) to training. Also address up skilling and retraining ("Technology capable"). Also address contractor business and people management skills.	2, 3
	Poor industry image /perception. Need understanding of public perception. Need to attract people into forestry. Need to improve marketing / industry promotion and communicate benefits of forests ("Unified vision and story"). Exposure to the industry for young people.	2, 4, 6, 9
	Lack of career pathways, clarity and visibility. Lack of workplace flexibility, especially for women and young people (starting positions). Need more women in forestry.	2, 5
	Need for improved leadership. Need coordinated approach to industry problems ("Pan-industry unanimity of direction"). Government representation / support. Consistent message to Government. Develop leadership ("industry ambassadors") that champion the sector.	2

Industry Need – Environmental Management

Subject Area	Industry Needs and Gaps	Group
Environmental Management	Maintain licence to operate. Need to understand environmental impacts of harvesting. What do we need to do to maintain our social licence to operate?	2, 8, 11
	Issue that many harvesting systems are environmentally unfriendly. From forest nutrition point of view need to leave limbs on cutover. Develop on-slope delimbing systems.	4
	Need to reduce earthworks in logging. Engineering options to minimise soil disturbance.	6, 11
	Publication of biodiversity of forests.	5

B. RESEARCH AREAS

Each project that was generated during the Workshop was assigned a number designating the group and project number. For example, the three projects in Group 1 were numbered 1.1, 1.2, 1.3 etc. A total of 54 project ideas were generated.

Projects were then grouped into common research areas. A summary of each group's projects consolidated into research areas is given in Table 2.

Table 2: Summary of Group Projects by Research Area

Group	No. Projects	Supply Chain Efficiency	People / Training	Technology / Productivity	Health and Safety	Environmental Management	Small Growers
1	3	1	1	1	0	0	0
2	5	1	1	2	1	0	0
3	4	3	1	0	0	0	0
4	5	2	1	1	1	0	0
5	5	2	1	2	0	0	0
6	4	1	1	1	0	1	0
7	4	3	0	1	0	0	0
8	6	2	1	0	1	1	1
9	5	3	1	0	0	0	1
10	4	1	1	0	1	1	0
11	5	2	0	1	1	1	0
12	4	1	1	0	1	1	0
TOTAL	54	22	10	9	6	5	2

C. RESEARCH PROJECTS

Summary of Research Projects

All the research project ideas were grouped into six main research areas (Table 3). Within each research area, research projects were ranked in order of priority according to the number of votes received from workshop participants. It is clear that that most project ideas proposed were in the supply chain logistics area with 22 projects gaining 44% of the total votes.

Table 3: SUMMARY OF RESEARCH AREAS IN PRIORITY ORDER

Research Area	Subject	No. Projects	No. Votes	% of Total
1. Supply Chain Efficiency	Tools / Products	4	45	15.3%
	Information/ Data Flow / Modelling	8	38	12.9%
	Process simplification	7	38	12.9%
	Log Transport	3	10	3.4%
	Sub-Total	**22**	**131**	**44.4%**
2. People/ Training	Shortage of Labour	4	43	14.6%
	Developing skills and culture	6	9	3.1%
	Sub-Total	**10**	**52**	**17.6%**
3. Technology/ Productivity	New Technology and Systems	5	39	13.2%
	Improving existing equipment	4	15	5.1%
	Sub-Total	**9**	**54**	**18.3%**
4. Environmental Management	Planning	3	6	2.0%
	Roading/Engineering/Operations	2	12	4.1%
	Sub-Total	**5**	**18**	**6.1%**
5. Small Growers	Planning and Operations	2	22	7.5%
	Sub-Total	**2**	**22**	**7.5%**
6. Health & Safety	Systems	3	18	6.1%
	New Technology	3	0	0%
	Sub-Total	**6**	**18**	**6.1%**
	TOTAL	**54**	**295**	**100%**

List of Research Projects

Supply Chain Efficiency

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Tools / Products	11.2 Volumetric measurement and tagging on processor head	To improve efficiencies of log processing and downstream log handling by eliminating manual scaling and weighing.	1. Design and development of processing head data management. 2. Develop sales and payment system based on cubic volume measured and graded by processing head.	1. Reduced cost. 2. Remove weighing/scaling. 3. Improved logistics. 4. Reduced downstream handling.	27	9.2%
	7.3 Stock Accuracy	Improve real time stock measurement	Develop a quick and accurate method to measure stock in real time.	1. Accurate orders with reduced value loss. 2. Improved transport utilisation. 3. Improved stock rotation, 4. Reduced stock levels required.	13	4.4%
	6.2 Improved Processing on Landing	1. Reduced bottleneck of increased production on landing 2. Reducing cost of processing 3. Eliminating manual processes to improve safety of operations	1. Validate accuracy/precision of current processing machinery. 2. Develop potential for improved optimisation. 3. Investigate Quality processes to eliminate Log QC. 4. Develop Log ID system.	1. Reduced docket delays 2. Optimised truck loads (known volume) 3. Eliminate log weighing. 4. Provide accurate log stocks 5. Move to cubic volume measure for sale and payment.	5	1.7%

Supply Chain Efficiency (continued)

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Tools / Products	5.5 Value Extraction	Realise more value from our entire forest resource	1. Assess current and new CPY's. 2. Assess waste streams. 3. Assess lumber/log grades. 4. Develop alternative uses for residues.	Increased returns from existing forest resource.	**0**	**0.0%**
Data Flow	2.5 Value Chain Collaboration and Coordination	1. Understand consequences of changes in one part of supply chain on other parts. 2. Reduce log making and production costs. 3. Develop automated solutions for manual processes to remove inefficiencies in supply chain.	1. Build value chain model to test and quantify financial impact of changes. 2. Assess scenarios of fewer log sorts. 3. Design better scaling/grading systems to meet customer needs.	1. More efficient and profitable harvesting supply chain. 2. Benchmarking raises industry standards	**14**	**4.7%**
	8.5 Improved supply chain performance	Improve performance of the harvesting supply chain	1. Quantitative supply chain mapping. 2. Improve data capture and utilisation 3. Improve traceability and knowledge of inventory. 4. Examine new business models, metrics and contracts.	1. Develop a business case for change. 2. Improve product traceability and chain of custody 3. Reduce costs and add value.	**12**	**4.1%**

Supply Chain Efficiency (continued)

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Data Flow	4.3 Improved Infrastructure / Data Communications	Assess current digital communications coverage and identify best technology solutions.	1. Survey existing coverage of NZ forest estate. 2. Investigate alternative technologies to fill gaps. 3. Evaluate costs/benefits.	Industry investment plan for digital communications upgrade to allow introduction of new technology.	4	1.4%
	5.2 Information / Communications	Improve transfer and accuracy of information through the supply chain.	1. Assess options for improved data communications (wi-fi, satellite etc.) 2. Benchmark other industries / military etc.	1. Improved utilisation of transport. 2. Reduced stocks 3. Reduced handling and better supply chain control	4	1.4%
	3.3 Supply Chain Optimisation	Optimise Supply Chain from stump to cut-to-length customer	Develop model to determine benefits / optimal conditions by region (similar to meat and dairy processing model)	Improved returns / safety / yield / lower interest costs	2	0.7%

Supply Chain Efficiency (continued)

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Data Flow	9.4 Automated information flow and product traceability	Automate the flow of information to allow product traceability along the supply chain	1. Review best practices internationally within forest and other industries. 2. Select the best cases of automated data transfer for trial in NZ.	1. Understanding technology needs and gaps. 2. Improved processes and practices. 3. Development of technology products for NZ.	1	0.3%
	12.1 Reduced costs throughout the value chain	Reduced delivered costs by 25%	Model existing supply chain into a more efficient system: 1. Identify bottlenecks and inefficiencies. 2. Understand cost implications. 3. Devise alternatives. 4. Prove new concept.	More efficient supply chain with lower costs and increased collaboration.	1	0.3%
	9.3 Reducing Fragmentation	Develop more cohesion in the industry by providing shared information, and transparency of data.	1. Benchmark performance with regards to sharing information. 2. Commence discussions between companies that leads to shared information. 3. Structured formalised data input, not just voluntary information.	Shared data and information.	0	0.0%

Supply Chain Efficiency (continued)

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Process	4.2 Reducing Log Grade Complexity	Quantify cost benefit of reducing number of log sorts from stump to customer (mill/port)	1. Evaluate current sorts and associated supply chain costs. 2. Benchmark against world best practice. 3. Evaluate different supply chain systems and market implications / costs.	1. Information on supply chain costs so that forest owners can make decisions on harvesting / supply chain systems. 2. Standard NZ Log Grades.	**17**	**5.8%**
	9.1 Improved stability and security of the industry	Stabilise markets, contracts, supply of work and standards.	Through case studies understand what other industries are doing to provide stability and security.	Ideas for improvement of NZ harvesting operations.	**13**	**4.5%**
	3.1 Operational Agility	Cooperation between owners in regions to match contractor configuration to site.	1. Requires contractor flexibility 2. Develop forward planning 3. Improve trust and open dialogue between parties 4. Adopt standard costing methodology between regions 5. Develop cooperative arrangements (e.g. share contract for mechanical felling)	Improved operational agility to respond to changes in market, forest cut, contractor supply	**5**	**1.7%**
	10.1 Reduce barriers to supply chain cooperation	Determine the benefits of breaking barriers to cooperation in log transport	1. Benchmark current practice 2. Identify potential gains 3. Decrease delays 4. Increase truck utilisation 5. Increase supply chain efficiency	1. Increased efficiencies in transport. 2. Better customer and service provider relationships. 3. Better industry cohesion.	**2**	**0.7%**

Supply Chain Efficiency (continued)

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Process	11.3 Collaboration	Develop support and guidance for improved collaboration between forest owners, contractors and other stakeholders.	A social research project	1. Increased stability in the industry 2. More skilled stable workforce 3. Platform to drive supply chain efficiencies and innovations.	1	0.3%
	3.2 Process Change	Understanding impacts of significant process change (manual or mechanised)	Measure the impact and cost consequences of introducing a system or technology change.	Better informed decisions / contracts / production expectations/ fewer unintended consequences	0	0.0%
	7.4 Supply Chain Process Simplification	Simplify and standardise processes within the log supply chain.	1. Reduce the number of log sorts. 2. Standardise rules and regulations relating to health and safety, environmental management, log grade specifications, and communications.	1. Increased standardisation of rules and regulations 2. Improved understanding by workers in the industry	0	0.0%

Supply Chain Efficiency (continued)

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Log Transport	1.3 Truck optimisation opportunities	Optimise truck despatch - "the right truck at the right time"	1. Use real time tracking and communications 2. Develop an electronic docket system to capture baseline information and transfer data to trucks electronically. 3. Set up a monitoring system to schedule trucks to skids and avoid arrivals at the same time.	1. Better truck and loader utilisation 2. Improved return on capital investment 3. More profitable operations.	**5**	**1.7%**
	7.1 Sapstain Prevention	1. Increased use of steep slope mechanised felling 2. Log drying to reduce weight. 3. More time results in reduced production pressure. 4. Separation of harvesting phases	Develop new sapstain treatment methods at time of felling	1. Reduced value loss due to sapstain 2. Reduced transport costs due to larger volume per load	**3**	**1.0%**
	8.6 Increase volume per load	Reduce water content of transported material through in-forest drying	1. Examine time of intervention (before/during/after felling). 2. Develop alternative methods of intervention. 3. Manage incidence of sapstain.	1. Lower costs along the supply chain 2. Bigger volumes on truck (lower cost) 3. Improved product shelf life	**2**	**0.7%**

Research Area: People / Training

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Shortage of Labour	1.2 Increased forest industry workforce	Attract people to the forest industry	Labour market research / future requirements / advertising / apply 'Playstation concept' to loader controls	Continued supply of motivated workers	**17**	**5.8%**
	2.1 Attracting and retaining workforce for the future	Clarify career pathways and design training courses that deliver skills required.	Define skills gap / benchmark exemplar sectors / measure quality of trainees / create career pathway / promotional material	Industry has supply of well-trained workers / Trainees see forestry as a great career choice / forest workers are held in high regard	**12**	**4.1%**
	8.1 Better public awareness, engagement and interest in forestry	Achieve better public awareness, engagement and interest in forestry as a vocation	Develop forestry culture / improve technical and computer-based training / improve school resources / practical field days /	Career pathway development / demonstrate sustainability / forestry as a desirable vocation / improved public perception	**7**	**2.4%**
	12.2 Addressing labour shortage in forestry	Reduce staff / labour requirements by 50%	Continue to apply high technology solutions to harvesting (such as teleoperation, robotics and automation)	Higher technology jobs, fewer crew members with higher skills and increased pay / more motivated workers	**7**	**2.4%**

Research Area: People / Training (continued)

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Developing skills and culture	5.4 Improving Industry Culture	Improving the way we communicate and collaborate in industry	Not defined	Improve safety, research uptake and business environment for workers and contractors	4	1.4%
	4.4 Attracting Suitably Skilled Workers	Quantify level of skills of workforce and set benchmark for industry needs	Survey of skill level of existing workforce / survey skill level of Scandinavian industry as world class benchmark	Industry benchmark to establish gaps of skills to provide framework for future training and certification standards.	3	1.0%
	6.4 Attracting the right people into the forest industry	Getting the best fit for each role, develop career pathways and investigate improved training methods	Measure current status / determine best recruitment and selection methods (e.g. simulator)	Improved training outcomes and reduced labour turnover	2	0.7%
	3.4 Developing a sustainable workforce	Provide more skilled workers for jobs available	Understanding the future skills required and attract and retain the right workers	Provide sufficient skilled workers	0	0.0%
	9.2 Human Resources for the Forest Industry	How to get the right people for the right job	Identify public perception of harvesting / explore benefits of training / develop tools for operator selection	Identify a targeted strategy for improving skills / training initiatives	0	0.0%
	10.2 Improve quality and technical capability of industry recruits	Workforce is capable of using new technologies / machines	Identify future industry needs / target marketing to meet industry requirements / develop training programmes and career pathways	Skilled productive workforce	0	0.0%

Research Area: Technology / Productivity

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
New Technology and Systems	6.1 Improved Felling Methods	Continue existing projects to improve mechanised felling where tracked machines cannot work	Generating new ideas for felling technology / continue development of robotics & automation / remote control felling saw & felling wedge	Eliminate felling injuries	**18**	**6.1%**
	5.1 Automation	Continue momentum in projects to remove worker from danger.	Automate current operations. Redesign / rethink / modify	Improve safety / address labour constraint / allow for new workers / improve machine utilisation / expand export opportunities	**9**	**3.1%**
	11.1 Development of tree-to-tree machine for improved safety	Complete development of tree-to-tree machine to commercial stage.	Lab and field testing. Identify and involve commercial partner.	Commercial machine available to replace manual felling. Safer, lower environmental footprint, lower cost.	**7**	**2.4%**
	5.3 Totally New Methods	Take a fresh look. Look in new places.	Continue development of tree-to-tree machine Use new methods to brainstorm ideas and engage people not traditionally used (both inside and outside industry).	Recognition of great ideas, stimulate communications, find disruptive technologies.	**3**	**1.0%**
	2.4 New Technology and Systems to "step change" forest operations	Develop robots to undertake high risk forest operations and "chainless" harvesting to reduce downtime and increase safety.	1. Maintain future Technology Watch offshore. 2. Complete development of tree-to-tree machine. 3. Develop ICT systems to enable data sharing.	Innovative culture that fosters continuous improvement towards more productive and safer forest operations.	**2**	**0.7%**

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Improve existing equipment	7.2 Harvester Head Advances	Development of harvester head for measurement and individual log ID.	1. Improve measurement of length, diameter and volume and achieve market acceptance. 2. Achieve reduction in stump height and roller damage. 3. Capability to debark and anti-sapstain treat logs. 4. Ability to tag log and transfer data.	Commercial machine available	5	1.7%
	2.3 Machine optimisation, configuration and utilisation - "Right machine in the right job in the right place"	1. Provide contractors and harvest planners with forecasting tools to optimise production, use of machines and maximise profit. 2. Improve design of forest roads/landings to ensure efficient, low environmental impact & safe operations.	1. Video analysis and time management studies of skid operations. 2. Translate GIS/forest sensing data to harvesting operations. 3. Undertake "gap analysis" of planner/contractor skills.	1. More productive and profitable contractors and forest growers with low environmental effects. 2. Easy to use decision support tools for everyday use. 3. Social licence is maintained and improved.	7	2.4%
	1.1 Matching equipment / resources to site	Increase harvest productivity	Investigate other machinery that match sites suitable in NZ (e.g. wheeled harvesters, tethered machines, felling heads on skidders, roadside load out)	Increased productivity, reduced manpower on ground, increased profit to all parties.	3	1.0%
	4.1 Cable Harvesting Efficiency	Reduce the cost of cable harvesting	1. Understand cost structures of existing systems. 2. Understand resource consumption. 3. Establish improvements to increase productivity and reduce costs (including alternative systems).	Reduce cost of cable harvesting by 25%	0	0.0%

Research Area: Environmental Management / Planning

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Roading / Engineering/ Operations	6.3 Reducing Earthworks in Harvesting	Reduced roading cost and environmental impact of harvesting operations	Explore cableway systems and swing yarder roadside operations, develop alternative extraction systems and improve landing location, planning methods and terrain modelling.	Reduced cost and improved environmental performance	**11**	**3.7%**
	12.3 Reduce soil disturbance and sediment yield from forestry operations	Reduce sediment yield from roading landing and low deflection cable extraction operations to meet new standards (NPS-FW)	1. Adapt and implement efficient multi-span systems. 2. Develop grapple systems for multi-span configuration. 3. Adapt and implement alternative roading systems.	Cleaner water, undisturbed land, improved public perception of harvesting and sustainable licence to operate.	**1**	**0.3%**

Research Area: Environmental Management / Planning (continued)

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Planning	8.3 Improved Environmental performance	Improved Environmental performance to allow freedom to operate and improved prosperity	1. Survey public perception of harvesting. 2. Examine impacts on water quality across a range of sites. 3. Determine impact of coup size regulation on wind risk, cost and environmental impact. 4. Study impact of harvesting on visual effects and biodiversity.	Provide defensible information for improved licence to operate, knowledge-based decisions and expanded industry.	4	1.4%
	11.5 Improved Harvest Planning Decision Support Tool	Develop planning criteria and guidelines to better match new harvesting technologies and systems to forests	Build a software-based decision support tool for forest harvesting planners	Better alignment of contractors and equipment to the forest specifications (site, soils etc.) and reduced harvesting cost	2	0.7%
	10.3 Environmental risk calculator (ERC) for steep slope harvesting	Provide a model for forest owners to calculate environmental risk of steep slope harvesting.	1. Define scope of model. 2. Identify data sources 3. Fill data gaps. 4. Build environmental risk calculator (ERC)	Risks managed according to magnitude of impact. Reduced cost.	0	0.0%

Research Area: Systems for Small Growers

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
Planning and Operations	8.4 Improved systems for small growers	Improve harvesting and logistics for small forest owners	1. Develop multi-tier contractor certification scheme. 2. Develop harvest planning and machinery suitable for small forest owners. 3. Explore innovative transport. 4. Influence levy allocation for smaller growers.	1. Better contractor performance for small forest owners. 2. Nationally consistent Code of Practice. 3. Lower costs and better returns for small forest owners, encouraging more forestry.	22	7.5%
	9.5 Tools for Sector Expansion / Growth	Provide tools for dealing with the increasing harvest	1. Investigate international best practice for sector level information 2. Identify constraints to sector growth 3. Provide mapping of resources. 4. Develop decision support tools for economic analysis.	Industry decision support tools for sector economic analysis and information for Government level support	0	0.0%

Research Area: Health and Safety

Subject	Project Name	Objectives	Methods	Outcomes	No. Votes	% Votes
Systems	2.2 Safe high productivity workplaces	Improving safety in the context of productivity	1. Undertake human factors workplace studies (on-site monitoring and evaluations). 2. Design "Guidelines" to manage fatigue.	1. Tools/guidelines to manage fatigue and other problems. 2. Increased profit. 3. Better industry image (reputation).	**12**	**4.1%**
	4.5 Elimination of Manual Tasks	Eliminate all manual tasks in harvesting and distribution (including manual chaining up)	1. Identify all current manual tasks 2. Assess through workplace studies and develop solutions 3. Undertake cost benefit analysis.	1. Eliminate hazards from manual tasks (improved safety statistics) 2. Improved productivity (in man-hours /m3)	**3**	**1.0%**
	11.4 Best Practice Guidelines for Mechanical Harvesting on Steep Slopes	Develop common specifications for design and build and operation of harvesting machinery on steep slopes	Develop industry-driven Best Practice Guidelines for operation, including safety.	Provide certainty around legislative safety requirements, agreed consistent standards, improved safety and confidence to invest in equipment	**3**	**1.0%**

Research Area: Health and Safety (continued)

Subject	Project Name	Objective	Method	Outcome	No. Votes	% Votes
New technology	8.2 Improved health and safety performance	Improve health and safety performance in harvesting	1. Develop new safety technologies (clothing, auto recognition, proximity devices, transponders, interlock methods). 2. Investigating other industries and other countries for new developments.	1. Make equipment fail safe. 2. Do the basics well and improve safety culture. 3. Make harvesting a more attractive vocation and improve public perception.	0	0.0%
	10.4 Proximity monitoring for safer operations	Improve worker/machine interactions through proximity monitoring	1. Undertake a technology scan (e.g. military) of state-of-the-art. 2. Scale and simplify. 3. Develop simple low cost proximity monitoring device using commercial partner.	Improved worker safety and reduced insurance and ACC costs	0	0.0%
	12.4 Eradication of Alcohol and Drug Use in the Workplace	Development of Machine Operator Testing for Alcohol and Drug Use in the Workplace	Development of Machine Master switch for breath/saliva test for alcohol and drugs. Adapt/adopt technology in use in Europe to reduce drink driving. Machine unable to start if operator under influence.	Safer forest environment and improved productivity.	0	0.0%

NEXT STEPS

During the forum industry stakeholders identified industry needs and gaps, proposed research projects to address those needs, and determined industry priorities for the research projects.

The outputs of the Workshop sessions have been summarised in this report. A range of ideas for research projects were generated. There were some commonalities or overlaps between project ideas which indicated clear "hot spots" to meet industry needs.

Some of the ideas are clearly not research projects. It will be important to identify the appropriate resources to address these ideas and direct these ideas to the right place to ensure they can be discussed, agreed and actioned (e.g. FFA/FOA committees, Worksafe, Competenz etc.)

Priorities for the research projects were determined by the workshop participants through the use of a voting system. A wider consultation process will continue to ensure other industry stakeholders have the opportunity to articulate their priorities. We invite your input to this further consultation.

Later, FOA/FFR will synthesize the highest priority projects into a series of research programmes, determine the project resources likely to be required (co-funding, research providers, timing etc.). We will seek your further feedback on the programme priorities, and gain broad agreement or consensus prior to developing funding bids through the appropriate channels.

Funding for undertaking these research programmes may be through the Forest Growers Levy (if additional resources are available) or through a coalition of willing investors, matched by PGP or other Government funding. Once funding bids are developed in 2015 these will be communicated back to the stakeholders in the forest industry.

APPENDIX 1: LIST OF FORUM ATTENDEES

Name	Company
Alan Dick	Waiteata Forest Partnership
Alan Sinton	AG & G Sinton Ltd
Alex Gauthier	Te Wananga o Aotearoa
Barry Wells	Blakely Pacific Ltd
Bert Fourie	Belcher Industries Ltd
Brett Vincent	Tramroad Ltd
Carel Bezuidenhout	Scion
Chris Tombleson	Timberlands Limited
Coen van der Veer	Forest Stewardship Council
Damon Wise	Pan Pac Forest Products Ltd
Darren Mann	Rayonier | Matariki Forests
Dave Little	Crown Forestry
David Balfour	Timberlands Limited
Dean Neilson	PF Olsen Ltd
Don Finnegan	Finnegan Forestry
Don McMurray	NZ Forest Managers Ltd
Don Scott	Awdon Technologies Ltd
Dzhamal Amishev	
Edward Miller	FIRST Union
Gareth White	G White Logging Ltd
Glen Murphy	Waiariki Institute of Technology
Glenn Sutton	Ministry for Primary Industries
Goetz Roth	Interpine Group Ltd
Graeme Young	Tenon Manufacturing
Graham West	Scion
Hamish Macpherson	PF Olsen Ltd
Hamish Marshall	Forest Analytics Ltd
Hunter Harrill	University of Canterbury
Ian Harvey	FPNZ Ltd
James Broadley	Waiariki Institute of Technology
Janet Scott	Anvik Ltd
Jason Syme	Rayonier | Matariki Forests
Jeremy	Southstar Equipment Ltd
John Ellegard	NZ Logger magazine
John Stulen	Forest Industry Contractors Association
Joseph Graham	City Forests Ltd
Keith Raymond	Future Forests Research Ltd
Kerry Hill	Trinder Engineering
Kerry McCormick	McCormick Logging
Kevin Reardon	Forme Consulting Group Limited
Kit Richards	PF Olsen Ltd
Laresia Heke	Timberlands Limited
Marie Heaphy	Scion

Mark Blackburne	Blackburne Group LP
Mark Cleland	Waiariki Institute of Technology
Mark Coghill	Timberlands Limited
Melissa Evans	Scion
Mike Candy	Ministry for Primary Industries
Mike Soper	Rayonier | Matariki Forests
Paul Lane	Ministry for Primary Industries
Paul McCreedy	Forme Consulting Group Limited
Peter Auge	Interpine Group Ltd
Peter Clinton	Scion
Rawiri Daniels	FIRST Union
Richard Parker	Scion
Rob Miller	Ministry for Primary Industries
Rob van Rossen	Rob van Rossen Consulting Ltd
Ross Burns	Forest Distribution Ltd
Russell Dale	Forest Owners Association
Spencer Hill	Scion
Steve McCabe	Juken NZ Ltd
Tim Petro	Ernslaw One Ltd
Tony Evanson	Scion
Tony Gamble	Gamble Forest Harvesting Ltd
Tracey Anderson	AG & G Sinton Ltd
Warren Parker	Scion
Wayne Dempster	Rayonier | Matariki Forests
Weston Brown	Horizons Regional Council
Weytze van Heerden	Southstar Equipment Ltd
XiaoQi Chen	University of Canterbury