

Harvesting & Logistics Theme

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The Uptake of Human Factors & Ergonomics Research

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
BACKGROUND	3
Use of accident and injury data to inform interventions.....	3
Development of Forest harvesting human factors and ergonomics research.....	3
INTRODUCTION.....	5
Review of findings – Stage One (1 st Interim report)	5
Review of findings – Stage Two (i) (2 nd Interim report)	6
METHODOLOGY	7
Aims	7
Data collection.....	7
Stage One	7
Stage One to Stage Two transition - Development of categories for use in interviews and discussions.....	7
Stage Two-i	8
Stage Two-ii	9
Results - Presentation of findings	10
Harvesting crew perceptions of hazards to work, safety, health and productivity	11
Section One - Key findings from Stage Two-i interviews and Stage Two-ii discussions.....	13
Summary of findings.....	31
Interpretation of findings	32
Future work	33
CONCLUSION	34
Section Two – Update of findings (topic related)	36
Technical: Clothing and equipment Initiatives	38
Individual: roles, skills, abilities and attitudes	49
Environment, Work Organisation & Management.....	62
Section Three – Generic findings (Recommendation related).....	75
Personal	76
Defences / PPE	79
Procedures.....	85
Task / technique /training topics	87
Training criteria.....	92
Supervision	99
Equipment, tooling machinery	100
Layout / space / environment.....	104
Target / payment	107
Work scheduling.....	108
Work and job design.....	109
Organisational goals.....	113
Extra-organisational	118
REFERENCES.....	119
ACKNOWLEDGEMENTS.....	125
Appendix One - Re-Categorisation by recommendations	126
Appendix Two – Questionnaire used for Specialist interviews	127
Appendix Three – Questionnaire used for hazard rating.....	131
Appendix Four –Templates – Harvesting crew Discussions	132

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EXECUTIVE SUMMARY

The Future Forests Research Programme F200.02 is concerned with the evaluation of forest harvesting human factors and ergonomics research. The aim is to identify how this research has been taken up by industry, whether it has been effective and where future needs lie. The research commenced in January 2008 and was completed in July 2009.

This final report incorporates material from two earlier interim reports, and findings from this two-staged research. Stage One concerned a review of the literature concerning New Zealand human factors and ergonomics logging initiatives recommended since 1990, and evaluation of uptake. Although there was little published material regarding evaluation, this has been explored through Stage Two of the research – interviews with twelve industry specialists, and discussions with 21 harvesting crews concerning understanding, uptake and implementation of ergonomics and human factors interventions. Ideas for further improvement were also gathered from each group.

1. Collated industry specialist and harvesting crew data.

Key findings identified that:

- Successful initiatives tended to be those directed at technical factors (such as widespread adoption of PPE and greater use of mechanisation) and individual behaviour (such as hazard identification, supervision, and training).
- Further data concerning successful initiatives were revealed from each industry group; industry specialists noted the introduction of improved health and safety management systems, whilst harvesting crews reported the value derived from forest company representative (e.g., forest supervisors) participation or guidance in crews safety or skills auditing.
- However, differences were noted between information provided by industry specialists and harvesting crews, and these primarily concerned different perceptions of the success of systems for training, for health and safety management, and for PPE selection use and care. For example:
 - Training – the experiences of field workers indicate a wide range of problems concerning scheme credibility and older worker morale; industry specialists were more positive.
 - Health and safety management – harvesting crews described varied uptake (from informal to structured systems); industry specialists did not make such a distinction.
 - PPE – harvesting crews provided some quite negative reports of suitability for task (eye protection and footwear), cost, durability, availability and comfort; industry specialists were not so critical.
- There were some areas where it was not possible to establish the nature of progress. Key areas highlighted for additional future information search include: the nature of equipment use in the field; innovations in technology development; drivers / barriers to alternative skid sites design and operations; opportunities for field workers to have greater autonomy in selecting work techniques; the direction of job design initiatives (job rotation / enlargement); the nature of recruitment and retention initiatives; and inconsistent management of occupational health issues.
- Findings indicate continued lack of progress in interventions relating to work organisation and management factors. Typical examples concern:
 - work scheduling (e.g., inconsistent taking of breaks, long work days for machinery drivers, taking of only one break per day)
 - production pressures (payment by volume predominates).

2. Hazard perception among harvesting crews

To augment data, harvesting crews also completed a questionnaire concerning hazard perception in their work. Questions concerned factors relating to the individual, the job and organisation and management.

Most commonly provided responses indicated that:

- A high proportion of workers attribute hazards mostly to individual factors such as failure to recognise dangers, carelessness, and low skill. These were followed by tiredness, thirst and hunger.
- Job factors such as working on slippery ground or a heavy workload are also areas of concern.
- Overall, a high proportion of workers typically attribute hazards to individual and job factors, rather than organisational and management factors.
- A high awareness of individual or job-related hazards may indicate a positive reflection of crew training, but it is not clear whether crews feel that organisational factors are well controlled, OR, that organisational and management factors are not perceived as hazards. This should be explored through future initiatives.

3. Common features of successful initiatives

Appraisal of the most common features among successful initiatives revealed that they typically have a more thorough research base, have been the subject of widespread information dissemination, are of a tangible subject or have a specific audience, and generally have a 'champion' to implement and develop recommended initiatives.

4. Future work

Two proposals for ongoing research have been submitted for consideration - one concerned the development of a product database with evaluations of commonly used logging tooling, PPE and large equipment against ergonomics design criteria. The other (accepted and in development at the time of writing), concerned the identification of barriers and factors influencing work scheduling within sample logging operations. The need for further work to address the outstanding problems described in Section 1 above is also indicated. The features common to successful initiatives need to be accommodated into any current and future work.

BACKGROUND

Accident, injury and fatality statistics have both charted the profile of the industry over the years, and informed development of forest harvesting human factors and ergonomics research within New Zealand.

Use of accident and injury data to inform interventions

Analysis of early forest workers' hospital admission and fatality data has been available since 1976 (McFarlane, 1979). However, although this hospital admission data informed earlier research, a key tool used to evaluate accidents in the logging industry was the Logging Accident Reporting Scheme (ARS), which made available data relating to near-misses, and minor and lost time accidents. With annual collation of accident data for participating companies between 1984 -2003 (thought to represent approximately 80% of the logging workforce), findings have not only revealed the fluctuating profile of accidents and injuries over the years, but have also charted the likely effect of positive industry interventions. For example, in the decade to 2003 there was a reduction in the number of lost time injuries (at least one day off work) from 19.1 lost time injuries / million m³ timber extracted to 4.5 lost time injuries (LTI) / million m³ (Parker and Ashby, 2007). The number of fatalities also declined, although the statistics should be treated with caution as the numbers are too low to truly interpret a trend.

The decline in injury rate / million m³ of timber extracted was steep until 1998. The pace of improvement has since slowed, as shown in Figure 1. One possible explanation for this slowing is that most of the obvious injury prevention changes were introduced in the early years after coordinated, informed (by ARS), and sustained injury prevention efforts began; the 'easy runs' had been scored. The more stubborn problems without cheap, readily identifiable or palatable solutions remained.

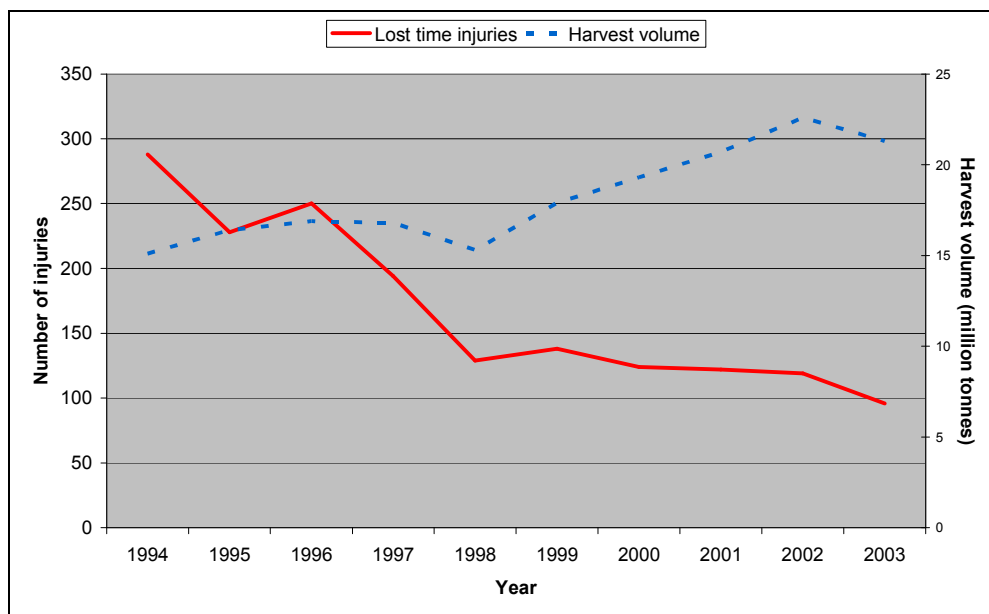


Figure 1 – Lost time injuries in logging in relation to harvest volume - 1994 to 2003 (Parker and Ashby, 2007)

Development of human factors and ergonomics research

The Logging Industry Research Association (LIRA) was established in 1974. Early work concentrated on the introduction of physical barriers or technical changes (such as chainsaw design improvements and task-specific Personal Protective Equipment – PPE) to prevent injury, and defining skill requirements for loggers. As a result of organisational changes, LIRA became the

Logging Industry Research Organisation (LIRO), and now the Human Factors component operates as the Centre for Human Factors and Ergonomics (COHFE). Alongside these developments logging research has continued, and its progression has steadily extended to incorporate the wider systems issues that impact not just upon protecting worker health and safety, but also upon promoting performance and productivity for individuals and the sector alike. This all encompassing approach underpins human factors and ergonomics research; Figure 2 illustrates typical aspects explored within logging research.

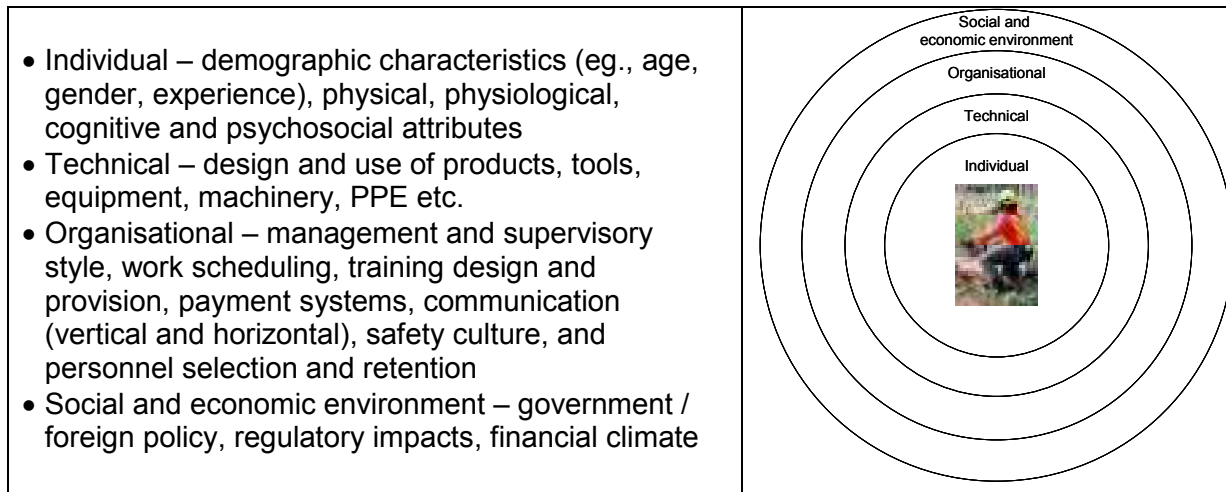


Figure 2. Overview – typical wider systems issues considered within logging research

An important component of ergonomics and human factors research concerns consideration of the interaction between the individual, technical, organisational and social and economic factors. For example, from an individual perspective, the 'protective' component is that worker capabilities should not be exceeded by work demands (with adverse conditions perhaps resulting in ill health, injuries or accidents); the 'promotional' component is that the work should also be fulfilling in terms of job satisfaction, remuneration, social needs, opportunities for development, etc. From a sector perspective the 'protective' component is also to avoid the uncertainty and losses that arise from absence, downtime, poor quality work, and poor productivity; the 'promotional' component incorporates improved capability, reliability, safer systems, quality products and a healthy financial outlook.

Through human factors and ergonomics research the aim is to generate interventions that promote optimal conditions for both individuals and the sector alike. In simple terms this could take the form of improving the design of an item – a tool for example – specifically to meet user capabilities. With optimal use of this tool worker comfort, productivity and performance are also enhanced. As such the success of an intervention is not necessarily evaluated at its point of application; in this case although tool design development is a technical innovation its success may be measured at individual (user feedback) and organisational (productivity, output quality) levels. In an alternative example – training – initiatives are created at an organisational level, but need to be evaluated at an individual one (for example a file full of signatures showing courses delivered is of little meaning in comparison to objective checking of whether the skills taught are understood and applied over a period of time).

The above examples demonstrate active monitoring systems whereby feedback on performance is captured before the occurrence of an accident, incident or ill health (Health and safety Executive, 1997). Typical examples include monitoring the success of specific plans or objectives, systematic assessment of compliance with desired performance (perhaps of tasks, operations, or management processes), performance review or health surveillance. These are distinctly different to reactive monitoring systems which include identification and reporting losses, accidents, incidents and ill health after they have occurred. The ARS is an example of a reactive monitoring system.

INTRODUCTION

The Future Forests Research Programme F200.02 is concerned with evaluation of forest harvesting human factors and ergonomics research. The aim is to identify how it has been taken up by industry, whether it has been effective and where future needs lie. The research commenced in January 2008 and was completed in July 2009.

This is the final report for the research programme (Figure 3). Stage One of the research, presented in the 1st interim report (Moore *et al.*, 2008), incorporated a review of the New Zealand ergonomics and human factors literature concerning research and interventions in harvesting conducted since 1990. Research interventions were collated along with any literature detailing uptake and evaluation of recommendations.

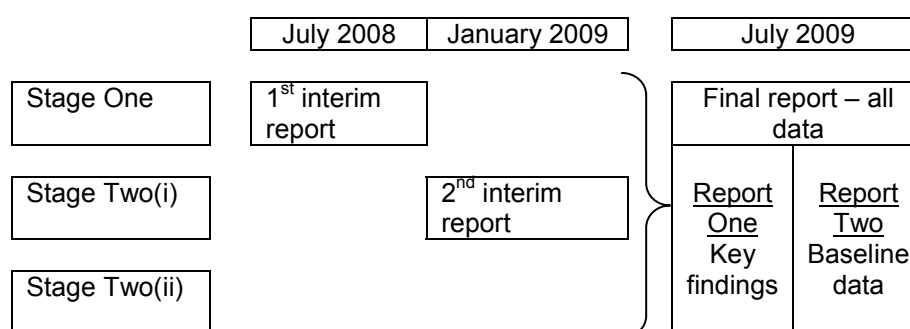


Figure 3. Overview of the research programme and outputs

Stage Two of the research incorporates feedback from industry specialists and practitioners concerning understanding, uptake and implementation of the ergonomics and human factors interventions. Industry feedback has been gathered both on issues identified in the literature review and on initiatives that may not have been formally published.

Stage Two has been undertaken in two phases. The first phase, Stage Two-i, was reported in the 2nd interim report (Hide *et al.*, 2009b). This incorporated gathering perspectives on successes or failures of initiatives, and perceptions relating to future needs, from those in varied key or specialist roles to the industry. These data have now been updated with findings from the final phase of work, Stage Two-ii. This entailed the collection of perspectives, through discussions with forest harvesting crews, on their experiences of the initiatives and the capture of ideas for further improvements.

Data from both phases are collated here as a means of identifying the full range of feedback and to identify where initiatives for ongoing remedial action lie.

In this final report, “Report One” draws together the key material, findings and conclusions of the research. This may stand alone, but also cross-references to the more detailed materials in “Report Two”. Report Two comprises two sections that provide the feedback from Stage Two interviews and discussions, and builds up the original literature review to show the nature of uptake of interventions.

Review of findings – Stage One (1st Interim report)

The systems approach (Figure 2) was adopted to categorise the research topics according to whether they were ‘Technical’, ‘Individual’ or ‘Organisational’ in nature (NB: None of the literature topics concerned social and economic environment). For each of these topics the nature of research recommendations was recorded, plus data (where recorded in the literature), detailing uptake by industry and (if available) whether effectiveness has been evaluated. [This material provides the basic framework of Section Two in “Report Two”].

Findings identified that research has addressed a wide range of systems issues concerning technical, individual and organisational factors. Particular strengths lie in the development and widespread adoption of personal protective equipment, practical guidance into behaviour (e.g., task techniques) and human performance (e.g., fatigue reduction measures), and in the determination of training needs and presentation styles of written communications.

However, overall, reports of uptake and evaluation within industry were few and were derived primarily through reactive monitoring using the Accident Reporting Scheme (ARS) data. There is little published material relating to adoption of equipment technical initiatives, or to uptake of environment, work organisational and management initiatives.

Review of findings – Stage Two (i) (2nd Interim report)

The more than 50 topics identified in the literature search were collated in order to identify generic recommendations in common. These thirteen generic recommendation areas (such as work scheduling, supervision, personal factors) were then used as a structure for interviews with twelve industry specialists. Initiatives proposed in the literature review were explored (and success or failures therein); the discussions also captured information about developments which, although not specified in the industry literature, were relevant to each area of recommendation nonetheless.

Findings from interviews with industry specialists were very similar to those identified through the literature review – that improvements directed at technical and individual factors continue. Data also indicated improved health and safety management systems, such as regular PPE maintenance, hazard identification, training, and supervision of new starters.

Greater adoption of mechanisation was also indicated, yet the nature of technical developments (design improvements, user purchase preferences) affecting equipment, PPE, tooling etc., was unknown. The interview data also indicated that greater information concerning occupational health management, new training schemes and skid site design initiatives was required. As with the literature review data, there was little information to suggest progress in initiatives to target work scheduling and work organisation, and to tackle production pressures.

METHODOLOGY

Aims

Stage One - The aim of this work phase was:

1. To review New Zealand ergonomics and human factors literature concerning harvesting research conducted since 1990.
2. To incorporate findings of comparable international research.
3. To identify whether industry has implemented initiatives and whether effectiveness has been evaluated.

Stage Two-i - The aim of this phase of work was:

1. To explore with key or specialist industry contacts whether recommendations for ergonomics and human factors interventions have been acknowledged, interpreted, implemented and evaluated. Do they remain current, and are they successful or not?
2. To establish whether there are other interventions that have not been formally published (in-house programmes, for example), and to capture ideas for future needs.

Stage Two-ii – The aim of this phase of work was:

1. To explore with harvesting crews their perceptions of hazards to work, safety, health and productivity.
2. To extend exploration of the uptake of human factors and ergonomics interventions (as above) by canvassing harvesting crews' experiences of the initiatives; whether or not they are successful, and gathering ideas for future needs.

Data collection

Stage One

The literature review material was drawn from searches at the following sources:

- Ergonomics Abstracts (database)
- Scopus (database)
- Web of Science (database)
- SCION library, Rotorua
- Centre for Human Factors and Ergonomics (COHFE) at SCION Research
- Logging Industry Accident Reporting Scheme (ARS)
- University of Concepcion, Chile

Criteria for inclusion were that the material be published in English and should report research activity conducted since 1990 (NB – a small number of earlier research projects are cited where highly relevant). Research material that included recommendations on practical initiatives that would benefit industry was specifically targeted. Literature lacking the potential for practical application (for example, some of the more fundamental epidemiological, biomechanical and physiological research) was omitted.

Conclusiveness is limited by: some inconsistencies in methodologies, terminology and evaluation; the unavailability of some relevant industry research data due to commercial sensitivity; unavailability (to date) of some older documents; lack of referencing for interventions to their (research) evidence base; and differences in definitions, classifications and terminology.

Stage One to Stage Two transition - Development of categories for use in interviews and discussions

The literature review collated topics and initiatives addressed through ergonomics and human factors research – 58 in total (see Table 8). For each of the topics, intervention recommendations often followed similar 'generic' themes or a common strategy approach. In order to be able to ensure equal exploration of the range of recommendations, a revised categorisation was devised according to these generic themes. Additionally this also provided an opportunity to capture

information not actually reported in the literature (e.g., unpublished company initiatives) and enabled the production of a concise format suitable for use during interviews and discussions.

Initiative categories identified in the 1 st Interim report	Initiative recommendation categories adopted for interviews & 2 nd Interim report	Generic aspect (examples)
Technical: Clothing and equipment Initiatives Individual: roles, skills, abilities and attitude Environment, Work Organisation & Management	Personal	Skill, experience, health, personality, attitude
	Personal protective equipment / defences	Personal protective equipment, use of barriers
	Equipment, tooling machinery	Hand / mechanised tools, large plant - individually or contractor owned, on-hire equipment / second-hand equipment, and deterioration, maintenance, duration of use
	Task / technique / training topics	Physical / mental workload, hazard related, interaction with other tasks, complexity.
	Training criteria	Access, costs, duration, detail, popularity, content development / omissions, trainer skills, responsibilities
	Supervision	Style of supervision, different supervision for different workers, training of supervisors
	Target / payment	Reward, benefit
	Work scheduling	Work pace, breaks, duration, shifts frequency
	Procedures	Applicability, style, revision, access
	Work and job design	Workload, social support, personnel availability, communication channels, roles & responsibilities
	Layout / space / environment	Movement / access, adverse light, noise, temperature, wet, vibration
	Organisational goals	Strategic decisions, generic organisational processes, safety culture
	Extra-organisational	Government policy, regulatory decisions, external influences

Table 1: Transition from initiative categories (topics) to initiative categories (recommendations)

The transition from initiative categories identified in the literature review, to initiative recommendation categories adopted for use during interviews and discussions, is shown in Table 1, with examples of the generic aspects included within each category.

Appendix One shows how recommendations from many of the topics addressed in the first interim report are distributed amongst the newer 'recommendation' categories used in this report.

Stage Two was undertaken through targeting two industry groups. Data were collected through both interviews with industry specialist (Stage Two-i) and discussions with harvesting crews (Stage Two-ii).

Stage Two-i

Twelve interviewees provided a perspective on interventions. These included representatives with a training services background (3), Forest Stewardship Auditing (1), Health and Safety (Forestry) Inspector (1), Contractors (2), and representatives from forest owner / management companies (3) with responsibilities for supervision and harvest management, and (offering abridged interviews on key themes) health and safety management (2).

Semi-structured interviews were undertaken, and the questionnaire used for interview is reproduced in Appendix Two. A pilot study was undertaken; only minimal changes were made

after the first interview, and all data are included in the analysis. Interviews were conducted either in person or by telephone and took between 1 – 3+ hours each.

Stage Two-ii

Twenty one logging crews participated; data were collected on-site during smoko breaks. All visits were undertaken in March and April 2009; this included eight North Island and thirteen South Island crews. Introduction to the research, and agreement to participate, was established at the outset.

Part 1 - Questionnaire		Part 2 - Discussion	
Hazards to work, safety, health and productivity	All crews	1	Hazards and incident prevention
		2	Training and communication
			11 crews discussed
			10 crews discussed

Table 2: Data collection with harvesting crews

The data were collected in two parts, as shown in Table 2:

Part 1 – Data collection commenced with completion of a short anonymous questionnaire by each individual, to gather perceptions of hazards to work, safety, health and productivity (reproduced in Appendix Three); assistance was given where necessary.

Part 2 - This was followed by either of two discussions – the discussion topics were split into two to ensure that neither should last longer than the 30 minute break. The first discussion concerned hazards and incident prevention (completed by 11 crews), and the second entailed training and communication (completed by 10 crews) (see Table 3).

Hazards and incident prevention	Training and communication
A. Tool and equipment developments	A & B. Information sources (people & media)
B. New style layouts / organisation	C & D. Hazard management methods (general and self-care)
C. PPE developments	E. Task techniques
D. Health related	F. Supervision & communication
E. Welfare facilities	G. Training administration
F. Financial incentives for crews	1. What encourages or discourages you to take up training
G. Enhancing commitment & motivation	2. How could things be improved?
H. Work scheduling	
I. Job rotation / variety	
J. Other organisational / safety issues ?	

Table 3: Discussion themes for harvester discussions

Examples from the literature, and material gathered during specialist interviews were provided for each heading (see Appendix Four) and displayed to the group in order to prompt discussion. For each discussion the main heading was announced and a few example given – crews then discussed some or all of the issues (depending on experience, opinion and interest in the topic).

In each case the crews were invited to describe (a) whether or not the examples provided have contributed towards health, safety and performance, and (b) how could things be improved? All discussions were recorded for later transcription.

A pilot study was undertaken. For the discussion themes only minimal changes were made after the first of each discussion interview, and all data are included in the analysis. The questionnaire used to gather perceptions of hazards to work, safety, health and productivity was completed by only the 19 crews seen after the pilot studies. Introduction of the questionnaire enabled more targeted exploration of hazard perception, and also served as an alternative data collection method and prompt for the range of material that might be considered during the discussions.

Results - Presentation of findings

All responses have been collated, and reflect the range of issues that were considered important amongst the interviewee and discussion groups. However it is not suggested that all comments reflect the thoughts of all specialist interviewees or all harvesting crews, nor is there necessarily any indication of strength of feeling. Where disagreement or contrast of opinion or inconclusive data was given this has been recorded. There has been no verification of information supplied.

The findings are presented in two reports:

	Specialist Interviews	Harvesting crew discussions
Report One		• Perceptions of hazards
	Section One	
	Collation of key findings from Section Two and Section Three and suggested future information needs	
	Conclusion	
Report Two	Section Two	
	Development of literature topics using responses from interviews and discussions to update data on initiative uptake and evaluation	
	Section Three	
	Collation of information from interviews and discussion according to each area of recommendation.	

Figure 4: Overview of Report One and Report Two contents

Report One contains data specifically canvassed from harvesting crews on their perceptions of hazard to work, safety and productivity. It also contains Section One:

Section One - A summary of the main findings and possible future information needs to be considered by industry. This includes topic-specific data brought forward from Section Two and generic (recommendation) specific data brought forward from Section Three.

A conclusion to the research is also given.

Report Two builds upon information already presented in the first (literature review) and second interim reports (findings from interviews with industry specialists). Information collected during discussions with harvesting crews has been incorporated into each section.

Section Two - The table developed for the 1st interim report has been updated to reflect feedback from interviews and discussions and the nature of possible further information requirements for each intervention topic.

Section Three - The information from interviews with industry specialists and discussions with harvesting crews has been collated according to each area of recommendation. This includes the topic-specific data (as summarised in Section Two), additional information relating to the generic themes, and ideas for future initiatives.

Harvesting crew perceptions of hazards to work, safety, health and productivity

Ninety-one crew members completed the questionnaire. Each was invited to state whether a range of adverse work circumstances might constitute hazards for work safety, health and productivity. A 5-point rating scale was used whereby possible responses were 1=not at all, 2= to a slight degree, 3= to some degree, 4=to a large degree and 5=to a very large degree.

Individual Factors	Mean	Mode	SD
Monotony or boredom	3	2	1.03
Tiredness, thirst or hunger	3	4	1.16
Low skill and competence levels	3	5	1.50
Failure to recognise danger or carelessness on the part of the employees	3	5	1.52
Individual medical problems	2	1	1.23
The demands of the job are not familiar	3	1	1.39
Job Factors			
Using tools and equipment that can cause harm	3	3	1.22
Noise and unpredictable weather / environment	3	3	1.01
Illogical design / unpredictable behaviour of equipment and machinery	3	3	1.09
Missing or unclear instructions	3	2	1.25
Workload that is high / heavy / dangerous	3	4	1.18
Work on slippery or difficult ground	4	4	0.98
Space constraints affecting storage / parking / traffic flow	3	2	1.16
Organisational and Management Factors			
Poor work planning, leading to high work pressure	3	2	1.29
Lack of safe systems	3	1	1.53
PPE deficiency (quantity or quality)	3	1	1.43
Inadequate responses to previous incidents	3	1	1.28
Poor supervision	2	1	1.36
Long work hours	3	3	1.31
No feedback about safety performance	2	1	1.19
Lack of training (e.g., task, equipment, hazards)	3	1	1.52
Poor health and safety culture	3	1	1.51

Table 4: Perceptions of hazards to work, safety, health and productivity

Findings indicate that, when looking at the mean (average) of all scores, responses to all questions are fairly homogenous. A response of 2 or 3 - "to a slight degree" or "to some degree" - was given for all questions, excepting one. The exception was that 'working on slippery or difficult ground' was considered a hazard to work, safety, health and productivity to a large degree. Standard deviation (SD) is also low, indicating that there was a large concentration of similar answers.

Data were also analysed to show the mode (the most commonly occurring score among respondents). The mode data indicate that the workers perceive 'low skill and competence levels' and 'failure to recognise danger or carelessness on the part of the employees' as a hazard to work, safety, health and productivity to a very large degree. However the SD is relatively high for each answer; this means that although '5' was the most common score there was a wide range of responses amongst respondents. Nevertheless, this is a concerning feature of crew culture as it implies that, for a large number of people, hazards are blamed on some form of failure by individuals. This viewpoint, in turn, may also impede the extent to which remedial action could be targeted at wider systems issues.

However 'working on slippery or difficult ground', 'Tiredness, thirst or hunger', and 'Workload that is high / heavy / dangerous' each have a most common score of 4 and lower standard deviations (indicating greater agreement amongst respondents). This means that each was considered a hazard to work, safety, health and productivity to a large degree.

An overview of mode results for each of the three sections suggests that hazard perception is more commonly directed at many of the individual and job factors. These are also aspects targeted in much of the crew training and may be a positive reflection of getting the message across. In contrast, mode results for the questions concerning organisational and management factors were generally low. Although the SD was fairly high for some responses (indicating that many respondents provided a different score), this suggests that most organisational and management factors are not considered hazards for work safety, health and productivity by the majority. This is concerning and may reflect a lack of understanding and subsequent intervention relating to hazard control through management of these types of work conditions.

This is the first known use in New Zealand harvesting of using this particular approach to gaining perceptions from the workforce on hazards from an individual, job, and organisation and management perspective.

Previous NZ research concerning loggers' assessment of risks in their work (Tapp *et al.*, 1990) has focused more on the accident risk whilst performing varied logging operations (trimming, breaking out etc.), or of risk perception for particular injury types and different body parts that might be affected. The Tapp *et al.* findings were compared against ARS Data in order to identify level of awareness nationally; trimming or felling on steep country were recorded as the most hazardous activities. Although task types have not been explored in this exercise, the similar concerns of working on adverse terrain ('work on slippery or difficult ground' amongst the current respondents and 'steep country' amongst the 1990 respondents) are noted.

Section One - Key findings from Stage Two-i interviews and Stage-ii discussions

Section One is a summary of the main findings from the following two sections - Section Two and Section Three in Report Two. Findings are reported according to whether they specifically concern topic-specific data (and these topics are listed under the title listed in the literature review), or whether they have arisen through collection of generic data on the 'recommendation' themes.

This summary also suggests possible future information needs for topic specific and generic issues.

The style of data presentation is given in Table 5, with findings presented in Table 6.

1. Initiative recommendation category (example prompts to elaborate meaning) [Topic titles from Section Two where recommendations were relevant to findings]		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	Success <i>What is considered to have gone well</i> Ambiguous / More information needed <i>Ambiguous or unknown information</i> Not successful <i>Little or no progress made</i>	Topic-specific data <ul style="list-style-type: none"> <i>Ideas related to original literature topic theme</i>
Generic data (supplementary to data already identified with topic specific analysis)	Success <i>What is considered to have gone well</i> Ambiguous / More information needed <i>Ambiguous or unknown information</i> Not successful <i>Little or no progress made</i>	Generic data <ul style="list-style-type: none"> <i>Supplementary ideas arising from generic data</i>

Table 5: Overview of presentation style adopted to report Specialist interview findings

Table 6: Summary findings from specialist interviews and discussions with harvesting crews

1. Personal (Skill, experience, health, personality, attitude) [High visibility and red-green colour blindness, Rehabilitation, Psychological climate, Occupational health related issues]		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success (nil)</p> <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> Breadth of address for psycho-social factors unknown FITEC/ACC offer return to work resources BUT there is concern regarding too early return to work post injury and inadequate availability of light duties Colour vision screen at pre-employment undertaken only intermittently – prevalence unknown Indication of little pre-employment health assessment other than drug / alcohol screening Inconsistent provision and content of health surveillance (From annual comprehensive screening to irregular /absent hearing tests) Indication that health screening more likely by larger employers than smaller ones Emphasis on drugs / alcohol screening rather than gradual process injuries (MSD, stress, hearing loss) <p>Not successful</p> <ul style="list-style-type: none"> Concern health surveillance not being used as a management tool 	<p>Topic-specific data</p> <ul style="list-style-type: none"> Identify how colour vision-impaired personnel are identified and managed Explore guidance on light duty allocations and strategies and services available to assist in return to work Explore prevalence of initiatives relating to psycho-social factors Review the nature of pre-employment health screening and health surveillance nationally. Identify any strategies for managing or rejecting applicants on health grounds Identify facilities / information needed by industry and health service providers in order to be able to offer these services Establish if smaller and larger businesses differ in their service provision
Generic data (in addition to data already identified with topic specific analysis)	<p>Success</p> <ul style="list-style-type: none"> Occasional help from health professionals (physiotherapist / psychologist, life skills tutors) Drug and alcohol rehabilitation services offered <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> Some crews perceive no guidance on injury prevention, whereas others resource this information from training, ACC, or forest company newsletters / hazard alerts Health surveillance reportedly funded by either 	<p>Generic data</p> <ul style="list-style-type: none"> Identify whether health surveillance should / could include monitoring of gradual process injuries and guidance on injury prevention Establish responsibility for service provision (contractor / forest company) and whether or not findings should be collated for wider industry use

	<p>contractor or forest company – potential for ‘ownership’ problems</p> <p>Not successful</p> <ul style="list-style-type: none"> • Fear of rejecting/ putting off potential workers • Occupational health services not seen as an opportunity to learn about occupational ill health prevention 	
<p>2. Defences / PPE (Personal protective equipment, use of barriers)</p> <p>[Protective legwear, Protective footwear design, Spiked boots, Protective eyewear, Visor, Eyewear (protective) use, Earmuffs, Hand and arm protection, High visibility and red-green colour blindness, Helmet durability, Vehicles – maintenance, Walking safely about site]</p>		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success</p> <ul style="list-style-type: none"> • Mandatory use of chainsaw protective legwear • Adoption of High viz clothing • Widespread use of chainsaw protective & non-slip footwear • Regular renewal of helmets <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Chaps deterioration replacement or repair triggers are unclear (chaps) • Chaps rotting from oil / sawdust contamination may indicate a more durable outer layer required • Footwear qualities – style, task application, drivers for selection of different styles unknown • Gumboots seen as good protectors but sweating / debris accumulation makes them unviable • Non-slip footwear other than spike-soled boots used (spurs, cleated soles, tricones)– prevalence and efficiency unknown • Leather mitt – conflicting reports indicate that it is considered both superfluous and useful • Visor design developments unknown • Drivers for eye-wear choices unknown • High-viz colour loss reported over time • Circumstances where Grade 5 hearing protection 	<ul style="list-style-type: none"> • Explore PPE life expectancy and markers for permitted repair or that define that replacement is required • Establish manufacturer initiatives in development of products for oil tolerance, chainsaw speed resistance, waterproofing, and the design style developments and variations chaps / trousers. • Find out from retailers / manufacturers regarding non-slip footwear choices (stock availability, use within industry, new design initiatives, comfort and cost ranges). • Explore prevalence of Sabaton use; barriers / drivers to their selection and whether there are any manufacturer initiatives relating to this product • Explore prevalence of using spurs, cleated soles, tricones. The drivers / barriers to their adoption and whether or not they are a viable alternative to the use of spike-soled boots • Explore drivers for eyewear choices for different task types and manufacturer initiatives in eyewear development • Identify whether the visor offers any UV protection. • Explore manufacturer initiatives in visor design development, whether these have targeted problems affecting visibility and dust entry; explore the drivers / barriers to their use by industry.

	<p>stipulated for certain situations – implications for those with Grade 4 unknown</p> <ul style="list-style-type: none"> Concern that markers for deterioration of earmuff cushions and spring attachments are not widely understood <p>Not successful</p> <ul style="list-style-type: none"> Trousers can blow in the crotch (when not elasticated), be the wrong length & be uncomfortable Sabatons not apparently used in industry – disadvantages outweigh advantages Suggestion that some crews wearing basic grade steel toed boots without chainsaw protection Spiked sole boot costs seen as prohibitive by some Spiked sole boots seen as inappropriate for rocky terrain or machine driving Complaints of poor footwear quality, cost, comfort and durability Glasses / goggles reported to fog up, cause discomfort and poor ear muff seal Gloves for sharpening not worn Fluoro pink helmets are used – rationale unknown Visors can lead to visual hazards (sunstrike, rain, sawdust) Ear muff efficiency reduced by glasses / beards 	<ul style="list-style-type: none"> Explore issue of high-viz colour loss (through wear/ tear / washing) and impact on detection under different lighting and task conditions. Seek manufacturer input to identify markers that can be used to establish a stage at which the colour must be renewed / garment replaced Confirm maintenance requirements with manufacturers and durability of ear muff cushioning and springs. Explore site practices for maintenance and ways to promote evaluation of ear muff quality by all crews. Establish the prevalence of Grade 5 protection requirements and implications for crew using Grade 4 Establish manufacturer initiatives in hearing protection and whether there are design developments to improve comfort / mitigate effects of beards/ glasses Identify underpinning research for adoption of the chainsaw mitt and gather wider perceptions of current use Establish why watermelon helmets used and possible alternatives Explore drivers / barriers to glove use for sharpening activities
Generic data	<p>Success (nil)</p> <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> Lack of legwear waterproofing may be a source of discomfort New legwear fabric qualities exist; it is not known how this will affect resulting protection Gloves for breaking out tasks are of varying qualities Crews have sunscreen, but actual use unknown Certain helmet styles have a poor fit Conflicting reports of extent of contractor liaison with manufacturers and impact on development of better 	<p>Generic data</p> <ul style="list-style-type: none"> Explore range of styles of legwear and design for user preferences Identify whether there are arrangements to transfer to legwear with protection that complies with the 1997 AS/NZ Standard Explore tasks requiring use of gloves and their qualities Explore prevalence of sunscreen use Explore function & fit of helmets used Explore qualities of gear used to protect against inclement weather & styles for winter / summer use Explore contents and implications of working with the

	<p>products</p> <ul style="list-style-type: none"> • There is concern that a fully laden faller's belt may compromise performance and safety • Indication that guidance lacking on PPE styles to select • Fabric quality to allow greater breathability in summer unknown <p>Not successful</p> <ul style="list-style-type: none"> • Indication of a lack of industry specific wet-weather gear • Some people are not looking after gear well • Limited access to a range of PPE in some locations 	<p>fully laden faller's belt</p> <ul style="list-style-type: none"> • Explore communication methods between manufacturers/ suppliers / crew concerning developments and feedback regarding PPE performances • Explore opportunities to improve PPE storage and care • Explore measures to provide ongoing guidance to industry on PPE range and attributes
3. Procedures (Applicability, style, revision, access) [Protective legwear, Earmuffs, Supervision]		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success</p> <ul style="list-style-type: none"> • Widespread adoption of systems for monthly PPE maintenance, care and audit <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Responsibilities for PPE purchase resting with employers, yet reports that some employees are reimbursed after making own PPE choices <p>Not successful</p> <ul style="list-style-type: none"> • A minority of crews have no regular system for PPE inspection and maintenance 	<p>Topic-specific data</p> <ul style="list-style-type: none"> • Methods of PPE provision that both permit personal choice and that avoid budgeting on an individual basis need to be explored and adopted by industry. • Explore and methods that would facilitate regular evaluation of PPE by all crews (such as checklists)
Generic data	<p>Success</p> <ul style="list-style-type: none"> • Equipment maintenance systems appear good, especially with individual ownership • Input from trainers of forest supervisor in audit / inspection programmes valued <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Programmes for maintaining chainsaws and machinery described, but frequency and responsibilities varied <p>Not successful (nil)</p>	<p>Generic data</p> <ul style="list-style-type: none"> • Explore nature of equipment maintenance programmes and whether this is a crew / external contractor responsibility
4. Task / technique / training topics (Physical / mental workload, hazard related, interaction with other tasks, complexity.) Fatigue - general, Fitness, Hydration, Hazard perception, Leg/feet laceration prevention training, Musculoskeletal disorders (MSD), Overuse (including repetitive motion) injures, Logging - mechanised, Safe distances, Vehicles – rollover, walking		

safely about site, Housekeeping]		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success</p> <ul style="list-style-type: none"> • Training in safe chainsaw handling & clarification of techniques • Widespread provision of hydration & nutrition training • Hazard awareness in all training and as integral to the production process • Specification of safe distance rules • Log making included in training programmes • Improved housekeeping arising from de-limber use • Guidance in BPG and ACOPs (e.g., stacking and log spacing) • Majority of crews have fallers ticketed / in training <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Ambivalent response to recommendations in health & nutrition training • Training methods for driving over poor terrain unclear • Difficulties training machinery driver due to space restriction in the cab • Concern that good practices (hydration, nutrition, etc.) have been dropped since initial LIRO introduction of recommendations • Reports of variable address of musculoskeletal disorder prevention during training, or that this knowledge is picked up through years of experience • Dislike of recommended chainsaw carrying and trimming techniques due to perception of additional workload • Isolated report of introduction of a 3-metre rule for fallers – outcome unknown • Isolated lack of awareness regarding maximum log stack height <p>Not successful</p> <ul style="list-style-type: none"> • Problems carrying sufficient water described by some 	<p>Topic-specific data</p> <ul style="list-style-type: none"> • Explore barriers to behaviour change post health and nutrition training • Explore whether guidance on acceptable foods can be developed to further include 'preferred' foods. • Explore measures to promote ease of water carriage • Explore nature of and opportunities to develop MSD /OOS preventative measures, how they are addressed within training, and drivers / barriers to their uptake • Establish success / failures of isolated initiatives to improve safe distances • Establish the nature of ground preparation for vehicle / skid site use • Establish how training for driving mechanised equipment over poor ground is managed. • Explore health implications of machinery operation work • Review both trimming and chainsaw carrying techniques; collate risks of STF with cardio-vascular workload and musculoskeletal loading and identify why proposed method is unpopular / undesirable. Explore whether there is a way that preferred techniques can be accommodated • Explore barriers to achieving optimum height of log stacks and information dissemination regarding desired heights • Establish the range of equipment / work methods that contribute to good housekeeping, and determine markers that might be used to disseminate guidance on what constitutes good 'housekeeping'. • Explore task components of mechanised logmaker work and physical and psychosocial demands therein

	<ul style="list-style-type: none"> • Reports of little progress in MSD prevention • Job pressures undermine OOS prevention techniques • Concern regarding the physical (weight gain and loss of fitness) and mental stressors amongst machinery drivers • Low adoption of OOS preventative measures by machinery drivers due to job pressures 	
Generic data	<p>Success</p> <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Log stack height may be adversely affected by production pressures and limited landing space • Ground preparation (stump heights) is more for quality /value than vehicle travel • Preferences for skid site vehicle types have changed over the years (e.g, forwarder rather than skidder) <p>Not successful</p> <ul style="list-style-type: none"> • Perception of undermining skilled decision making of experienced workers through mandating specific work techniques 	<p>Generic data</p> <ul style="list-style-type: none"> • Establish the nature of ground preparation for vehicle / skid site use • Establish preferences and underlying rationale for vehicle choices on the skid site • Explore how respect for older and experienced workforce can be emphasised.
5. Training criteria (Access, costs, duration, detail, popularity, content development / omissions. Trainer skills. Responsibilities.) [Safety training needs, Logging - mechanised, Safety attitudes, Training & assessing provision, Training effectiveness – general, Communication and literacy]		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success</p> <ul style="list-style-type: none"> • A variety of communication and delivery modes are adopted for training • Representatives / materials from the forest company and FITEC are considered the most informative • Paper-based materials are the most common and convenient information source for crews • Information regarding training opportunities is well circulated • Skills audit / competence / performance assessments undertaken by forest companies seen as beneficial • New programmes and training levels have been 	<p>Topic-specific data</p> <ul style="list-style-type: none"> • Explore barriers relating to trainer / assessor accessibility • Explore concerns within industry relating to skills of the trainer and those on the new apprentice scheme • Identify whether competence / performance assessment, follow-up training and skills audit serve the same purpose • Establish guidance criteria about what to do (content, frequency, etc.) of the competence / performance assessment, follow-up training and skills audits • Identify whether more a more systematic approach to skills review, with involvement of the forest company /

	<p>developed</p> <ul style="list-style-type: none"> • Each worker has a personal training plan • One-to-one training on site and classroom type training available <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Varied access to training, although generally good • Varied terminology for 'follow-up training', 'competence / performance assessments' and 'skills audit' used by industry – clarification of homogeneity (or otherwise) needed • Skills audit / refresher training at time irregular / unclear / an informal arrangement only • Some concern re time demands on the contractor to print out / circulate information to crews • Some concern amongst contractors regarding their time commitment in developing and directing the training plan • Extent of foremen / supervisor training in accident investigation unknown • Achievement of additional tickets may or may not result in additional pay • Currently only intermittent availability of audio-visual materials for training <p>Not successful</p> <ul style="list-style-type: none"> • Concern within industry of poorly funded trainers / payment per volume of tickets • Dissatisfaction with new apprentice scheme • Fear that the new apprentice scheme undermines existing qualifications and older workers • Disheartened that new modules are heavily repetitious of training undertaken for existing qualifications • Concern that skills of older and experienced workers are not acknowledged • Concerns of some very lengthy training periods for some in training • Training of Foremen / Supervisor skills not highly sought after 	<p>trainers, might be appropriate for the industry</p> <ul style="list-style-type: none"> • Explore drivers / barriers to training of Supervisors / Foremen. • Explore dissatisfaction with training modules among field workers • Explore dissatisfaction with inconsistent training duration • Explore measures to recognise the knowledge, experience and existing abilities of older workers • Explore how crew members can have more control over their own training development • Explore methods proposed for accident investigation and management between contractors, and forest companies • Explore concerns regarding trainer payment systems and make findings available to industry • Explore whether training media could be extended to include greater use of audio-visual materials.
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	<ul style="list-style-type: none"> • There is limited understanding of the benefits that can be achieved from training Foremen / Supervisors / managers • There are concerns regarding the competence of some trainers and new apprentices • There is limited access to assessors in some areas • Few crews have contact with ACC / OSH representatives • Concerns that some FITEC training documents too complex for those with limited literacy abilities • Some concern regarding lack of career direction once all tickets acquired 	
Generic data	<p>Success</p> <ul style="list-style-type: none"> • Good collaboration between FITEC & DoL regarding training liaison <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • An ACC mentoring scheme is available – it is not known whether this is a national initiative • Mixed reports (success and failure) of a voluntary faller competence scheme • Inconsistencies amongst number of trainer visits needed to approve a ticket – seen as unfair / costly • Isolated concern that not all contractors will pay for training • Only sporadic receipt for some of newsletters (forest company, FITEC, OSH) – their main information resource • Mixed perceptions of the benefits/ desirability of undertaking business skills training <p>Not successful</p> <ul style="list-style-type: none"> • Costs and loss through turnover are a concern • Paper materials easily damaged / muddled 	<p>Generic data</p> <ul style="list-style-type: none"> • Explore rationale for and reasons for success / failure of the voluntary faller certification scheme • Explore the dynamics between training and assessing and drivers for undertaking such roles • Explore cost implications to contractors arising from turnover of trained crew members • Explore measures to target those within crews who feel isolated from training opportunities • Explore barriers to career advancement and how career direction might be facilitated for all worker age groups
6. Supervision (Style of supervision, different supervision for different workers, training of supervisors) [Skill acquisition by new recruits, Supervision, Supervision – of inexperienced workers]		
	Findings from specialist interviewees and harvesting crews	Possible future information needs

Topic-specific data	<p>Success</p> <ul style="list-style-type: none"> Supervision / buddy up of new starters (to crew or to industry) and for those working on difficult terrain widespread Induction for new starters Graduated work pace offered High rate of monthly safety meetings within crews <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> Only isolated morning tailgate meetings – problems / progress otherwise discussed at smoko Indication that working to crew pace expected after 90days – whether this is sufficient for all is unknown <p>Not successful (nil)</p>	<p>Topic-specific data</p> <ul style="list-style-type: none"> Provide some guidance to industry regarding different scenarios, baseline skills and experience and the type of supervision that would be appropriate Explore whether morning tailgate meetings need any greater regularity / definition / acknowledgement from the forest company
Generic data	<p>Success (nil)</p> <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> Concerns that contractors and forest company roles in supervision appear blurred Concerns that contractors feel over-supervised by the forest owner / management company <p>Not successful (nil)</p>	<p>Generic data</p> <ul style="list-style-type: none"> Explore boundary definition between contractors and forest owner / management companies & identify any implications for role clarity
<p>7. Equipment, tooling machinery (Hand / mechanised tools; large plant, individually or contractor owned; on-hire equipment / second hand equipment; deterioration, maintenance, duration of use) [Chainsaw initiatives – general, Chainsaw - size for delimbing, Harvestech Static Delimber, Vehicles – mechanised logmaker, Vehicle – Warratah, Vehicles – maintenance, Vehicles – rear vision video system for Bell Logger vehicle, vehicle – skidder seat belt usage]</p>		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success</p> <ul style="list-style-type: none"> Much mechanised harvesting – ground-based operations Mandatory chainbrakes on chainsaws Seat belt use compulsory Improved visibility when vehicle lighting upgraded Improved and adjustable seating within new machinery 	<p>Topic-specific data</p> <ul style="list-style-type: none"> Identify manufacturer initiatives relating to chainsaw design development (e.g., size, weight revision, noise and vibration control) Review measures that might facilitate smaller saw use, where appropriate, for certain tasks Explore the nature and distribution of mechanisation

	<p>widespread</p> <ul style="list-style-type: none"> Enclosed cab design protects against weather and noise <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> Chainsaw size selection – manufacturers’ initiatives unknown Mechanisation being implemented for cable logging but the preferences for different machinery (Harvestech Static delimber, Warratah, Bell logger) are unknown Mechanisation design developments (e.g., access/ egress, cab ergonomics, rear vision video, Warratah) are unknown Concerns regarding ease of use and vulnerability to damage of rear vision video Radios within cabs are common but not universal <p>Not successful</p> <ul style="list-style-type: none"> Chainsaw purchasers thought unlikely to consider item weight Only isolated reports of using smaller saws – seen to increase physical workload Purchase of one saw/person suggests lighter saw purchase less likely Low kickback chain considered unsuitable for professional use Difficulties getting onto/off machinery (which is getting bigger) Visibility in cabs can be impeded by guarding position Visibility through plastic-windowed cabs can be impeded by sun strike / mud Isolated concern indicating lack of usable seat belts in older / damaged vehicles 	<p>initiatives, (including for the Harvestech Static Delimber), especially for cable logging.</p> <ul style="list-style-type: none"> Identify manufacturer initiatives relating to improved user interaction with machinery (e.g., cab design, Warratah technology) Identify initiatives relating to improving vehicle access / egress and extent of implementation within industry. Identify initiatives relating to adoption of the rear vision video system, extent of implementation within industry, and evaluate success / failures since introduction Explore and define frequency that seat belt function should be assessed Explore drivers / barriers to uptake of radio communication between crew members
Generic data	<p>Success</p> <ul style="list-style-type: none"> Chainsaw designs for balance, weight, comfort, maintenance and better safety features Use of chain catcher pegs <p>Ambiguous / More information needed</p>	<p>Generic data</p> <ul style="list-style-type: none"> Explore range of contractor modifications within industry and usability / performance therein Explore cost-benefit of machinery modifications Explore preference (drivers / expected outcomes) for

	<ul style="list-style-type: none"> Chainsaws may be somewhat lighter nowadays – unknown Chain catcher pegs sold at purchase insufficiently robust for some There is concern that newer chainsaw designs & adherence to US / European Standards are under-powered for NZ Revision of construction machinery (growers, guarding, cab elevation) for forest use may create problems never anticipated by the designers Types of design innovations implemented by contractors, and their usability and performance outcomes are unknown <p>Not successful</p> <ul style="list-style-type: none"> Concern regarding chainsaw noise levels Concern that some cab guarding impedes access for maintenance 	<p>machinery choices</p> <ul style="list-style-type: none"> Explore specification for chain catcher pegs supplied at the point of purchase are inappropriate Explore feedback amongst those who have received training regarding behaviour change to use a rear vision video Explore any adverse impact to equipment use within NZ of design specifications for international standards Explore nature of communication to industry regarding design innovation ideas Explore mechanisation initiatives used abroad
8. Layout / space / environment (Movement / access, adverse light, noise, temperature, wet, vibration) [Logging - mechanised, Skid site layout and processes]		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success</p> <ul style="list-style-type: none"> New style layouts proposed to reduce manpower and increase mechanisation on skid sites BPG and ACOP address log stack and spacing <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> Barriers to uptake of skid site initiatives (increased mechanisation, 2-phase, 2-stage) are unknown, Extent of uptake of skid site initiatives unknown - only isolated reports of off-site processing / dephasing Safety implications of extending skid site size with logs unknown <p>Not successful</p> <ul style="list-style-type: none"> Some skid sites are too small Small skid sites impede spacing for log stacks, and machine and truck access, and induce the creation of higher stacks 	<p>Topic-specific data</p> <ul style="list-style-type: none"> Explore drivers / barriers to improved skid site operations and layouts

Generic data	<p>Success (nil)</p> <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> Costs of increased mechanisation / handling associated with some initiatives seen as prohibitive Varied perceptions and experiences of the merits of using newer technology types (swing yarders, electronic choker, motorised carriage) Not successful (nil) 	<p>Generic data</p> <ul style="list-style-type: none"> Undertake a cost-benefit analysis of the various skid site innovations Explore drivers / barriers to optimum skid site designs, including all interested parties
9. Target / payment (Reward, benefit) [Logmaking – motor manual, Production targets – determination]		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success (nil)</p> <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> Crews generally receive a fixed wage – volume-based bonus schemes appear few Much production target calculation based on ‘past experience’ rather than application of specified methods – implications unknown <p>Not successful</p> <ul style="list-style-type: none"> A flat rate/tonne is the most common reward method Payment is withheld if out-of-spec logs are created Concern that production pressures may lead to shortcuts Incorrect anticipation of skid site size by contractors during contract development can lead to later production problems 	<p>Topic-specific data</p> <ul style="list-style-type: none"> Explore drivers / barriers to diversify reward criteria for production. Review the process used to determine production targets and expected operator performance. Explore whether there are social pressures to achieve production targets
Generic data	<p>Success (nil)</p> <p>Ambiguous / More information needed (nil)</p> <p>Not successful (nil)</p>	

10. Work scheduling (Work pace, breaks, duration, shifts frequency) [Fatigue – general, Fatigue in motor-manual tree felling and delimbing, Feller-buncher operators, Musculoskeletal disorders (MSD), Overuse (including repetitive motion) injures, Breaker-out work conditions, Logmaking – motor manual, Shift scheduling – for large machine operators, Skid site layout and processing, Logging – mechanised, Exposure to adverse weather]		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success</p> <ul style="list-style-type: none"> • Micropauses promoted – responsibility of individuals <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Sleep management methods with early starts in summer unknown • Shift / break schedules for mechanised log makers / large machinery operators unknown • Reduced break frequency may minimise opportunities to take hot/cold drinks <p>Not successful</p> <ul style="list-style-type: none"> • Crews can choose either one or two breaks. Single rest breaks are rewarded by early knock off • High-heat days managed only by fluids, shade and clothing – management through organisational measures unknown • Early starts appear more prevalent in North Island crews • Especially early starts amongst machinery drivers – especially North Island • Some machinery drivers may not take any breaks at all • Machinery drivers may work in excess of 4-hour stints (especially N. Island) • Some machinery drivers working extended days without sharing workload between two operators • Concerns about lengthy travel to and from site • Disruption from inconsistent truck arrival times • Early starts for machinery drivers are influenced by trucks arriving to remove logs from site 	<p>Topic-specific data</p> <ul style="list-style-type: none"> • Explore background to determination of break intervals and barriers to the taking of at least two breaks. • Explore how crews reschedule their sleep in order to compensate for early starts. • Explore what initiatives relating to high-heat days are implemented and typical barriers to adoption of organisational changes • Explore shift scheduling and breaks for mechanised log-makers
Generic data	<p>Success (nil)</p>	<p>Generic data</p> <ul style="list-style-type: none"> • Explore management of work in hot conditions

	<p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Report of initiatives in Australia to revise work organisation for high-heat days • Incidents of Warratah programming to stop at specified intervals described – implications for work and operator performance unknown <p>Not successful</p> <ul style="list-style-type: none"> • Additional holiday week contributing to manpower management problems • Concern that crews taking fewer breaks than when LIRO initiatives originally launched 	<p>overseas</p> <ul style="list-style-type: none"> • Explore prevalence of pre-programming Warratahs (or other equipment on site) to stop at specified intervals and user perceptions and implications upon performance • Explore the chain of factors affecting scheduling of log removal from site and implications on driver / crew work organisation • Explore underlying reasons for the differences influencing machinery drivers work hours between North and South Islands
<p>11. Work and job design (Workload, social support, personnel availability, communication channels, commitment, roles & responsibilities)</p> <p>[Musculoskeletal disorders (MSD), Overuse (including repetitive motion) injures, Logmaking – motor manual, Overuse (including repetitive motion) injures, Breakout – retreat distances, Breaker-out workconditions, Harvest planning, Logging – mechanised, Psychological climate, Role clarity, Job design]</p>		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success</p> <ul style="list-style-type: none"> • Graduated work pace for new workers • Adoption of buddy systems / training • Widespread provision of shelter for crews (vehicle/hut) • Forest company awards / newsletter articles that recognise achievement <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Both barriers and advantages to job rotation acknowledged – drivers to promote further uptake unknown • Isolated concerns that contractors and forest company boundaries of responsibility appear blurred • Isolated example of using a whiteboard and radio headsets within earmuffs to improve communications – the latter have mixed reports • Varied adoption of radios for communication within crews (any or all of machinery drivers, fallers, breaker-outs) – drivers for radio allocation unknown 	<p>Topic-specific data</p> <ul style="list-style-type: none"> • Identify drivers / barriers to job rotation and whether there are instances where the practical guidance has been adopted • Explore guidance and opportunities relating to job enlargement in the industry • Explore job design to identify whether drivers/ barriers to job satisfaction could be improved • Explore whether guidance regarding breaking out numbers required has continued relevance and whether guidance for conditions requiring two breaker-outs is stipulated. • Explore boundaries between contractors and forest owner / management companies & identify any implications for role clarity • Explore drivers / barriers and successes /failures of isolated interventions such as the whiteboard / radio headsets

	<ul style="list-style-type: none"> • Motivation often seen primarily in tangible / reward (pay / meal shouts) terms rather than a job satisfaction context (recognition of performance, feedback etc.) • Small number of crews receive qualification related pay rise – prevalence unknown • Isolated concern re poor planning of hard-to-access felling locations <p>Not successful</p> <ul style="list-style-type: none"> • Job enlargement not happening • radios can create an additional load to carry for fallers 	<ul style="list-style-type: none"> • Explore drivers / barriers to use of radios within ear muffs and establish whether there are any implications for resultant noise exposure to the wearer • Explore how planning for felling in precarious conditions is managed • Identify communication techniques that can be used by all the crew on a regular basis
Generic data	<p>Success</p> <ul style="list-style-type: none"> • Increase in vehicle condition (for more comfortable transit) and numbers available <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • New workers expected to be up to speed & earning same wage after 90 days • Production targets are based on work hardened workers – implications for newer staff unknown • A new initiative concerning fallers calling in at 45-minute intervals planned <p>Not successful</p> <ul style="list-style-type: none"> • Inconsistent provision of hand-washing facilities 	<p>Generic data</p> <ul style="list-style-type: none"> • Explore skill and competency aspects achievable within the 90-day start up period • Explore human factors implications of the British Standard 100 Rating Scale in production target calculations • Explore understanding within industry regarding the provision of water / welfare facilities • Follow progress and evaluate faller call-in programme • Explore any possible health implications of not washing hands after handling aspects such as fuels, paints etc.
12. Organisational goals (Strategic decisions, generic organisational processes, safety culture) [Psychological climate, Breaker-out work conditions, Skid site layout and processes, Chainsaw initiatives - general, Fatigue in motor-manual tree felling and delimbing, Safety training needs, Recruitment and retention, Safety incentives, Planting strategies]		
	Findings from specialist interviewees and harvesting crews	Possible future information needs
Topic-specific data	<p>Success</p> <ul style="list-style-type: none"> • Implementation of H&S Management systems considered to demonstrate commitment to safety • Tender process incorporates evaluation of safety management systems • Teaching of accident investigation to Supervisors / managers promoted 	<p>Topic-specific data</p> <ul style="list-style-type: none"> • Explore drivers / barriers to success of initiatives that affect safety culture • Review the process used to determine production targets and expected operator performance. • Establish whether log cutting frequency on skid sites is factored in to production calculations.

	<ul style="list-style-type: none"> • Wide variety of work / terrain factors considered in developing production targets • A variety of measures implemented to raise the profile of logging tasks and encourage worker retention • Provision of hands-on input from forest company facilitates auditing <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Logs can be transported off-site to a log processing yard; implications to workload and performance unknown • Exit interviews rare – Reasons for leaving unknown • Range of opportunities to pay by log grade unknown • Whether improved safety culture is arising from the variety of measures targeted and H&S management and training unknown • Relationships between turnover, training and accident propensity unknown • Adverse impact from global wood processes described – impact on recruitment and retention unknown • Safety auditing intervals vague and not consistent • Consideration of eventual faller access for felling in planting strategies unknown <p>Not successful</p> <ul style="list-style-type: none"> • Production pressures passed on to crews can lead to shortcuts • Production by volume is the main payment method for contractors 	<ul style="list-style-type: none"> • Explore drivers / barriers to exit interviewing • Explore drivers / barriers to management of recruitment and retention • Explore measures to address future felling in development of the production plan • Explore how planning for felling in precarious conditions is managed • Explore initiatives for retention of and skill development of older workers
Generic data	<p>Success</p> <ul style="list-style-type: none"> • A variety of active and reactive monitoring measures are adopted to evaluate H&S performance <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> • Concern regarding smaller crews and their access to the same H&S management systems as larger crews • Concerns raised that the accident investigation process is heavily bureaucratic • IRIS received both positive and negative reports 	<p>Generic data</p> <ul style="list-style-type: none"> • Explore opportunities for demonstrating organisational commitment to safety within small businesses • Explore methods proposed for accident investigation and management between contractors and forest companies • Research IRIS data in order to explore identification of intervention opportunities • Explore how production bonuses are calculated and

	<ul style="list-style-type: none"> Production targets are calculated yet opportunities to gain a production bonus may remain – underlying basis to calculations of each unknown <p>Not successful</p> <ul style="list-style-type: none"> Reports of production bonuses lead to the taking of shortcuts 	<p>whether there are social pressures to achieve these</p> <ul style="list-style-type: none"> Explore whether production bonuses can be achieved within the calculation criteria used to determine a production target.
13. Extra-organisational (Government policy, regulatory decisions, external influences)		
	Findings from specialist interviewees	Possible future information needs
Topic-specific data	<p>More info needed</p> <ul style="list-style-type: none"> Impact of global wood processes on recruitment and retention 	(nil)
Generic data	<p>Success (nil)</p> <p>Ambiguous / More information needed</p> <ul style="list-style-type: none"> Implications of the various demands of clients' specifications and those of mills, ports etc are unknown <p>Not successful (nil)</p>	<ul style="list-style-type: none"> Explore how external factors can be better managed to avoid compromise of profits / work conditions

Summary of findings

A number of features were identified from collated data of the interviews and discussions:

Success (what research was considered to have gone well)	
	<ul style="list-style-type: none"> • Adoption of varied PPE and (usually) good systems to ensure maintenance and replacements • Developments in training initiatives for the variety of task techniques / self-care aspects • Forest company involvement valued in safety and skills audit • Development of a personal training plan for each worker • Integrating hazard identification into the production processes • Supervision, buddy-up and graduated work pace for new workers • Greater adoption of mechanisation with comfortable cabs • Improved contractor implementation of H&S management systems – tender requirement
More information needed (ambiguous or unknown information)	
1	<ul style="list-style-type: none"> • New Training Schemes <ul style="list-style-type: none"> - Explore: poor reception of some new modules; many complaints of dissatisfaction with the new apprentice scheme; perceived lack of acknowledgement of existing worker skills / qualifications; varied access to training & assessment; whether or not there is follow-up / skills audit to ensure skill retention; lack of faith in competence of some trainers and new apprentices; limited interest in skills training for supervisors; over-dependence on written documentation in training; and lack of career direction once certification complete
2	<ul style="list-style-type: none"> • Health and Safety Management systems. Explore: <ul style="list-style-type: none"> - Varied perceptions of optimum practices (content, frequency of interventions) within industry
3	<ul style="list-style-type: none"> • PPE and Equipment, Tooling, Machinery etc. Explore: <ul style="list-style-type: none"> - Many concerns concerning quality, task appropriateness, durability, compatibility, comfort, style, cost & availability of the PPE range - Varied perceptions concerning markers for replacement / repair of worn PPE - Implications of reimbursement / allowance for individual crew members to select own PPE - A lack of underlying data concerning manufacturer initiatives (e.g., chainsaws, machinery, PPE) and systems to (i) design for individual variability and user-centeredness, and (ii) ensure collaborative liaison between crews, suppliers and designers - A lack of underlying data concerning isolated industry initiatives in retrofitting machinery and design therein (individual variability, user-centeredness, performance etc.)
4	<ul style="list-style-type: none"> • Skid Site Initiatives (alternative layouts, mechanisation, zoning and work phasing) <ul style="list-style-type: none"> - Explore: extent of uptake of alternative layouts or de-phasing; implications of small skid site size; experiences of using new technologies; and current machinery preferences
5	<ul style="list-style-type: none"> • Occupational Health / Personal Issues <ul style="list-style-type: none"> - Explore: concerns regarding intermittent and inconsistent occupational health services; concerns re early return to work; a lack of systems to identify gradual process injuries; and challenges faced by small businesses
6	<ul style="list-style-type: none"> • Tasks, Techniques and Behaviour <ul style="list-style-type: none"> - Explore: variable ambivalence to hydration & nutrition training; poor reception of specified work techniques (e.g., for trimming / chainsaw carrying); difficulties carrying sufficient water; machine operator training and health; and lack of progress in MSD / OOS prevention
7	<ul style="list-style-type: none"> • Work Organisation initiatives <ul style="list-style-type: none"> - Explore: underlying knowledge and direction of job design initiatives and adoption of different communication methods. Although adopted by some crews, the frequency of job rotation is unknown, unspecified or undertaken reactively to absence. Lack of job rotation may also inhibit opportunities for skill retention for those qualified in a wide range of tasks. Varied communication methods are used (relative advantages unknown), and recruitment and retention initiatives remain unknown
Not successful (Little or no progress made)	
8	<ul style="list-style-type: none"> • Work Scheduling initiatives, especially widespread adoption of 'one break & early home' scheduling, and apparently lengthy and uninterrupted work periods for machinery drivers. Problems appear worse in North Island. Implications to skid site worker hours from inconsistent truck arrival times
9	<ul style="list-style-type: none"> • Production pressures are reported in spite of apparently robust productivity calculation methods. Bonus payment considered unlikely, yet implication of pressure on performance / taking shortcuts unknown. Volume-based payment systems predominate

Table 7: Summary of findings from interviews and discussions

Interpretation of findings

Data from the literature, interviews with forestry specialists, and discussions with harvesting crews, indicate that initiatives thus far found to be successful tend to be those directed at technical factors (widespread adoption of PPE and greater mechanisation) and individual behaviour (such as hazard identification, supervision, and training).

Appraisal - Whilst their relative influence is unknown, there are features in common amongst these successful initiatives:

- a) Firstly, 'successes' are often areas that have been explored through a greater volume of research, such as recommendations arising through interpretation of findings from ARS analysis (e.g., leading to the adoption of PPE such as chainsaw chaps and high visibility clothing & directing task techniques), or through empirical studies with harvesting crews such as physiological trials, observation and interviews (e.g., leading to guidance on hydration and fatigue management).
- b) Secondly (and often related to underlying research) 'successes' have often been the subject of widespread circulation of information from LIRA/LIRO/COHFE; these both addressed findings, and offered guidance, on technical (e.g., selection of PPE, machinery styles), or behavioural change (e.g., sleep and nutritional requirements).
- c) Thirdly, that typical 'successes' commonly have a tangible subject (e.g., PPE, machinery), or a specific audience (e.g., logging workers), may indicate that these are easier to implement, and identify with, than intangible organisational issues with multiple or non-specific audiences.
- d) Finally, 'successes' often have an agent to 'champion' the cause, such as PPE or equipment manufacturers, FITEC or trainers. There is generally also a financial incentive for such champions to implement and develop recommendations.

Recommendation 1 – Where possible these features should be incorporated into the development of less successful and future initiatives.

Through discussion with industry specialists, the introduction of improved health and safety management systems also became apparent.

Appraisal - The background to the implementation and adoption of this intervention is unknown, although aspects such as contractors needing to demonstrate health and safety planning as a component of tender submission, or for eligibility to an ACC discount scheme may be relevant, as may some of the factors in (a) to (d) above.

Recommendation 2 - Further exploration is needed to establish the drivers to successful implementation of health and safety management systems

The data concerning 'successes' were further extended as a result of findings from discussions with harvesting crews; these showed the value derived from forest company representative participation (e.g., forest supervisors) or guidance in crews' safety or skills auditing.

Appraisal - As in (d) above, this may reinforce the importance of a 'champion' to provide leadership and direction.

Some differences were noted between information provided by industry specialists and harvesting crews. Primarily these concern different perceptions of the success of systems for training, for health and safety management, and for PPE selection use and care. For example:

- Whilst there are robust systems for training implementation, the experiences of field workers indicate a wide range of problems concerning scheme credibility and older worker morale

- For health and safety management; the systems appeared to be quite structured for some, others just focused upon training plans and PPE checks, and a minority had only informal arrangements but still felt that these were sufficient.
- There is widespread adoption of PPE yet there are some quite negative reports of suitability for task (e.g., eye protection and footwear), cost, durability, availability etc.

Appraisal - These discrepancies suggest failure in terms of incorporating end-user needs or perspectives.

Recommendation 3 – Factors such as user needs analysis, improved consultation, communication, defining minimum standards, information provision, trial of new products or methods etc. would be relevant considerations for future development.

The analysis has also thrown up a number of areas where findings varied and greater information is required – in particular relating to the nature of PPE and equipment developments (by manufacturers & isolated industry initiatives), skid sites innovations (drivers / barriers to alternative layouts and management methods), inconsistent management of occupational health issues, and varied adoption of work organisation initiatives. Harvesting crew discussions also indicated that ways to provide field workers with greater autonomy in selecting work techniques should be explored.

Appraisal – Whilst there are some components of each that might be considered a ‘success’, responses were too contradictory to indicate widespread adoption of best practice in any area.

Recommendation 4 - Consideration of the problems identified in Table 7 is proposed as areas for future work (and summarised again in Table 8).

Finally, as identified in each earlier interim report, there has been little progress in measures targeted at work scheduling (especially North Island crews) and the impact upon workload of production pressure and payment methods.

Appraisal - Each aspect has a different background, but through comparison with features in common identified amongst the successful initiatives, the following observations were made:

- Work scheduling (e.g., taking of rest breaks and micropauses) has been the subject of considerable research attention (a) and information dissemination (b). However, the literature showed some potential ambiguity in recommendations¹. In addition work scheduling is an ‘intangible organisational issue with multiple or non-specific audiences’ which typically are poorly addressed in interventions (c), and there is no apparent ‘champion’ for the management of work hours (d).
- There appear to be no specific initiatives to mitigate the effects of production pressure and payment methods upon workload. This area lacks underlying research (a), has limited information provision (b), is intangible (c), and appears to have no ‘champion’ to lead change (d).

Recommendation 5 – Efforts to incorporate features of successful initiatives (Recommendation 1), and end-user needs and perspectives (Recommendation 3) are proposed for future initiatives in these areas. Additionally there is a need for greater collation or updating of successive information sources ... when changes are made.

Future work

A variety of areas warranting deeper exploration were proposed in Table 7 – items 1 to 9 and these key areas are summarised in Table 8.

¹ For example Kirk (1998b) proposed a maximum 4-hour stint for continuous machinery operation (albeit with a preferred 40-minute break every 3-4 hours and hourly mini-breaks), yet earlier recommendations for ‘forest workers’ proposed two 30-minute evenly spaced breaks throughout the day (Kirk, 1996a). Hypothetically, on an 8-hour day it could be interpreted that it would be acceptable for a machinery driver to take either one or two breaks.

		Proposal
1	New training schemes	For future consideration
2	Health and Safety Management systems	For future consideration
3	PPE and equipment, tooling, machinery	Submitted & for future consideration
4	Skid site initiatives	Partially addressed in F200.02.03
5	Occupational health / Personal issues	For future consideration
6	Tasks, techniques and behaviour	For future consideration
7	Work organisation initiatives	For future consideration
8	Work scheduling initiatives	F200.02.03
9	Production pressures	For future consideration

Table 8: Summary of areas where further intervention is recommended

Two proposals for ongoing research were submitted in April 2009. One concerned the development of a product database with evaluation of commonly used logging tooling, PPE and large equipment against ergonomics design criteria; this would address many of the criteria identified in item 3, Tables 7 and 8. The other (accepted and in the process of development at the time of writing) concerned the identification of barriers and factors influencing work scheduling within sample logging operations; this will explore issues from item 8 and some of the issues in item 4 (Tables 7 and 8). The previous section identified typical features common to successful initiatives and recommendations to be accommodated into future work. Recommendation 5 (page 38) summarised desirable features that need to be accommodated into current and ongoing work.

Outstanding issues in Table 8 should also be considered in the development of future initiatives.

CONCLUSION

Findings from the literature review, specialist interviews and discussions with harvesting crews show that many of the preliminary conclusions concerning success (or otherwise) of interventions (described in the 1st and 2nd interim reports) persist. Collation of data from each industry source has also enabled the isolation of differing perceptions of success within the industry.

An important point, relating to information uptake within industry, is that the breadth of data was captured not through topic-specific search, but through establishing generic aspects that define the range of recommendations made to industry. The transfer of literature 'topic-specific' to 'generic (recommendation)' enquiry served as an important means of capturing a wider range of industry information and establishing information (or information needs) relating to current practices.

Guidance for future initiatives is given – these not only target the agencies traditionally involved (such as contractors, training agents) but show the importance of those integral to the system as a whole, such as those involved in harvest planning and planting, manufacture and supply of products used in the industry, and those others in the supply chain such as trucking companies.

The development of practical guidance and longer term collaboration and support in finding and managing solutions for areas resilient to change may also be warranted.

Report Two

Section Two – Update of findings (topic-related)

The literature was classified according to the wider systems issues considered within logging research (Figure 2). Accordingly the initiatives are divided into three categories:

1. Technical, including clothing and equipment initiatives (initiatives aimed at changing physical objects used in the job)
2. Individual, covering roles, skills abilities and attitudes (initiatives aimed at changing the way that people do the job asked of them)
3. Work organisational, environmental, and management initiatives (a wider category capturing the more distal initiatives aimed at changing what people are asked to do, and the context in which they are asked to do it).

NB: Data concerning social and economic environment factors was not found. Table 9 lists the different research topics for each category.

Technical: Clothing and equipment Initiatives (n=19)	Individual: roles, skills, abilities and attitude (n=17)	Work Organisation, Environment, & Management (n=22)
Chainsaw initiatives - general	Communication & literacy	Breaker-out work conditions
Chainsaws - size for delimbing	Eyewear (protective) use	Breaker-out techniques
Earmuffs	Fatigue - general	Breakout - retreat distances
Hand and arm protection	Fatigue in motor-manual tree felling and delimbing	Harvest planning
Harvestech static delimeter	Feller-buncher operators	'Housekeeping' on skid sites
Helmet durability	Fitness	Job design
High visibility clothing	Hazard perception of loggers	Log making – motor manual
High visibility and red-green colour blindness	Hydration	Log making – mechanised
Protective eyewear	Leg/feet laceration prevention training	Occupational health-related issues
Protective footwear design	Musculoskeletal disorders (MSD)	Planting strategies
Protective legwear	Overuse (including repetitive motion) injures	Production targets (determination of)
Spiked boots	Safe distances	Psychological climate
Vehicles – maintenance	Safety attitudes	Recruitment and retention
Vehicles – mechanised log maker	Safety training needs	Rehabilitation
Vehicles – rear vision video system for Bell Logger vehicle	Skill acquisition by new recruits	Role clarity
Vehicles – rollover	Training effectiveness – general	Safety incentives
Vehicles – skidder seat belt usage	Walking safely about site	Shift scheduling - for large machine operators
Vehicle – Waratah		Skid site layout and processes
Visor		Supervision
		Supervision – of inexperienced workers
		Training and assessing provision
		Work pacing

Table 9. Three categories of initiatives listing research areas

The review for each of the topics listed above is presented in the first column of Tables 11 - 13. Items are arranged alphabetically, with the most recent research for each topic listed first. A small amount of material is presented in grey font and this represents relevant overseas research.

Where published, details of how industry has implemented initiatives and the measures taken to evaluate effectiveness are also recorded – these are prefixed **Literature**. These data have also been updated with findings collated from interviews with industry specialists and from discussions with harvesting crews; these new data that have been added are prefixed '**Specialist interviews**' or '**Harvesting crew discussions**'. A cross reference to the information source in Section Three is provided.

The presentation structure is reproduced in Table 10. The first four columns retain the structure of the 1st interim report, but a 5th column 'Possible future information needs' has been added as a response to evaluation of the information received from all resources.

	Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
Technical: Clothing and equipment Initiatives	<i>A very brief outline of the research is followed by the specific recommendations:</i>	Specialist interviews Harvesting crew discussions (Section Three data source) Findings from interview and (if reported) discussion data and a symbol indicating success, or not. Literature: Known instances of uptake or initiatives such as advisory material circulated to crews in the case of awareness-raising exercises.	Specialist interviews Harvesting crew discussions (Section Three data source) Findings from interview and (if reported) discussion data and a symbol indicating success, or not. Literature: Published reports of studies that have directly evaluated the effectiveness of an initiative across industry; or indirect studies – such as the ARS annual reviews conducted by LIRO from which trends may possibly be inferred	<i>Suggestions for future initiatives are provided for each topic, where relevant.</i>
Individual: roles, skills, abilities and attitude				
Environment, Work Organisation & Management				

Table 10: Overview of presentation style adopted to report literature review findings

For Specialist interview data, an indicator for success is suggested through annotation with the following symbols.

- ☒ An apparently successful initiative
- ☐ Ambiguity amongst findings or initiative still 'work in progress'
- ☐ Data unknown
- ☐ Initiative not apparently successful

The full dataset of information from specialist interviews and harvesting crew discussions is summarised in Section Three.

Technical: Clothing and equipment Initiatives

Table 11: Technical Initiatives.

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>Chainsaw initiatives - general</p> <p>Kirk (1992) following his STIHL-sponsored tour of several countries recommended:</p> <ul style="list-style-type: none"> The NZ industry should make every effort to isolate the worker (from the risk of laceration during motor-manual chainsaw use) by using mechanised harvesting systems where possible – as has occurred in other countries Chain brakes should be required on all new machines, not just an option <p>Parker (2007) reinforced the need for extreme care during delimbing, keeping feet away from the bar, avoiding being hit by a tensioned limb and training</p>	<p>Specialist interviews 12(g)</p> <ul style="list-style-type: none"> Greater / alternative use of mechanisation on cable logging is reported; development of initiatives in this work type remains work in progress <input type="checkbox"/> 	<p>Harvesting crew discussions 7(a) Specialist interviews 12(g) & 7(a)</p> <ul style="list-style-type: none"> Mechanised harvesting is more prevalent on ground-based operations. <input checked="" type="checkbox"/> Chain brakes are a mandatory requirement on all hand held chainsaws (ACOP, 1999) <input checked="" type="checkbox"/> Low kick-back chain considered unsuitable for professional chainsaw use <input checked="" type="checkbox"/> <p>Literature - Review of ARS data for the period July 2001 – Dec 2003 noted a reduction from 122 reports of chainsaw injuries amongst professional forest workers in 1985 to just 20 in 2003. Authors attributed this to coordinated industry efforts across a number of initiative areas such as mechanisation (to avoid chainsaw use), engineering safety features (chain brake, low-kickback chain) and PPE (chainsaw cut-resistant legwear and footwear + face visors . (Parker & Ashby, 2005)</p>	<p>Explore the nature and distribution of mechanisation initiatives, especially for cable logging.</p>
<p>Chainsaw - size for delimbing</p> <p>Studies entailed controlled tests of cardiovascular workload used varying sizes of saw in a simulated task setting. Findings indicated that further research</p>	<p>Specialist interviews 7(a)</p> <ul style="list-style-type: none"> Purchase according to chainsaw size was considered unlikely. Manufacturer initiatives unknown <input type="checkbox"/> 	<p>Harvesting crew discussions 7(a)</p> <ul style="list-style-type: none"> Only isolated reports of using smaller chainsaws <input checked="" type="checkbox"/> 	<p>Identify manufacturer initiatives relating to size & weight revision.</p> <p>Review measures that</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
concerning chainsaw weight on strain during trimming is required. (Parker, Sullman, Kirk, & Ford, 1995)		<p>Literature - A study of causation in 15 logging incidents identified that ownership of one saw may potentially result in using an overpowered saw for some occasions (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> Explore feasibility of contractors keeping such a product for general use <p>Literature – Trend reported towards the use of smaller chainsaws with better bar control resulting. (Sullman, Kirk, Parker & Gaskin, 1999)</p>	might facilitate smaller saw use, where appropriate for certain tasks.
<p>Earmuffs</p> <p>Kirk (1993) assessed the performance of the Peltor Grade 4 and its ability to last 12 months in the field.</p> <ul style="list-style-type: none"> Found to be effective, with proviso that cushions are changed annually. <p>McFarland (1989) recommended measures to improve hearing protection performance</p> <ul style="list-style-type: none"> Chainsaw maintenance Machinery maintenance Hearing protection maintenance 	<p>Harvesting crew discussions 3(a) and (b)</p> <p>Specialist interviews 2 (h) and 3(a)</p> <ul style="list-style-type: none"> Driver to change ear muff cushion = damage, wear or tear – probably at 12 month intervals <input type="checkbox"/> Concerns that many are unaware of markers for deterioration – both cushioning and springs <input type="checkbox"/> Frequency of chainsaw and machinery maintenance unknown <input type="checkbox"/> Possibly some confusion regarding situations where Grade 4 or 5 are required <input type="checkbox"/> 	<p>Harvesting crew discussions 3(a)</p> <p>Specialist interviews 3(a)</p> <ul style="list-style-type: none"> Strategies and systems for PPE maintenance are widespread but not universally adopted <input type="checkbox"/> <p>Literature - A study of causation in 15 logging incidents identified reports of incompatibility between ear muffs and safety glasses /beards. It also identified confusion regarding adequacy of baseline hearing protection requirements (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> The collation of a PPE product database to include evaluation of the user-centred design criteria of products Further research into forestry noise exposure 	<p>Confirm maintenance requirements with manufacturers and durability of cushioning and springs. Explore site practices for maintenance and ways to promote evaluation of ear muff quality by all crews.</p> <p>Explore opportunities for exploration / re-clification of required hearing protection grade</p>
<p>Hand and arm protection</p> <p>Kirk, 1992 following his STIHL-sponsored tour of several countries recommended:</p> <ul style="list-style-type: none"> a combination of chain brake <u>and</u> leather mitt should be compulsory for all NZ chainsaw operators 	<p>Specialist interviews 2(f)</p> <ul style="list-style-type: none"> There is suspicion regarding the validity of using the leather mitt, given ongoing design improvements of the saw and possible potential of the mitt to impede safety features <input type="checkbox"/> 	<p>Harvesting crew discussions 2(f)</p> <ul style="list-style-type: none"> Comments were few but positive about their use <input checked="" type="checkbox"/> <p>Specialist interviews 2(f)</p> <ul style="list-style-type: none"> Use of the leather mitt is mandatory <input checked="" type="checkbox"/> <p>Literature - A 53% reduction in chainsaw</p>	<p>Identify underpinning research for adoption of the chainsaw mitt and gather wider perceptions of current use</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
		inflicted hand injuries between 1990- 1992 attributed to improved chain brakes, greater use of the mitt and greater training (Parker, 1993)	
Harvestech Static Delimber	Specialist interviews 7(b) <ul style="list-style-type: none"> Successful take-up reported but prevalence of use is unknown <input type="checkbox"/> 	Literature – Evaluation for industry conducted by COHFE. Findings overall were encouraging. Fewer branches and other tripping hazards left on the ground. Chainsaw sharpening frequency halved. Faster delimbing overall. (COHFE Contract Report)	Explore the nature and distribution of mechanisation initiatives, (including for the Harvestech Static Delimber).
Helmet durability Kirk (1996b) identified, during a trial to UV light, that the effective life of helmets exposed to outdoor weathering is 13.5-36 months and that fluorescent helmets last for 36 months (no recommendations given) LIRA published advice on effect of ultra-violet light, solvents, impact, heat etc. Recommendations included: <ul style="list-style-type: none"> expect to renew it at least every three years don't store it exposed to sunlight e.g., in the back of a vehicle avoid drilling holes or attaching tape as the solvents may shorten life of the helmet. (Ward, 1984) 		Specialist interviews 3(a) <ul style="list-style-type: none"> Driver to change helmets = damage, wear or tear – at intervals between 12 - 24 months. <input checked="" type="checkbox"/> 	
High visibility clothing Relative conspicuity in peripheral vision was tested using head-mounted eye-tracking equipment while viewing transparency slides of forest settings with an array of garment colour designs. White provided highest contrast, but: <ul style="list-style-type: none"> lime-yellow was most readily 	Literature - Most companies required the use of hi-viz by 1993 (Sullman, Kirk & Parker, 1996) Literature - Fluorescent lime-yellow promoted as standard safety colour for forest work in NZ. (Isler, Kirk, Bradford & Parker, 1997)	Harvesting crew discussions 3(g) Specialist interviews 3(g) <ul style="list-style-type: none"> Successful uptake reported <input checked="" type="checkbox"/> Colour loss reported over time <input type="checkbox"/> Literature - Ten 'not seen' cases in 1991 (two fatal and an average of 32 days lost for each of the other eight). Zero 'not-seen'	Explore issue of high-viz colour loss (through wear/ tear / washing) and impact on detection under different lighting and task conditions. Seek manufacturer input concerning any design

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>detected in daylight and twilight conditions. (Isler, Kirk, Bradford & Parker, 1997; Parker, Bentley & Ashby, 2002. p329)</p>		<p>injury incidents reported to ARS in 1995. (Sullman, Kirk & Parker, 1996)</p>	<p>developments</p> <p>Identify markers that can be used to establish a stage at which the colour must be renewed / garment replaced.</p>
<p>High visibility and red-green colour blindness 3.8% of 704 forest workers tested positive for some degree of colour blindness in red-green.</p> <ul style="list-style-type: none"> • Testing at pre-employment medical recommended. • Paint colours recommended silver, blue, yellow, fluoro orange. Red, green and fluorescent pink to be avoided. • Helmets recommended – yellow and white. Fluoro watermelon (pink) appears dull to R-GCB workers – not recommended. • Fluorescent yellow on dark blue or black recommended for garments – found to be most visible to those with colour blindness. <p>(Cummins, Kirk & Sullman, 1999).</p>	<p>Specialist interviews 1(a)</p> <ul style="list-style-type: none"> • Only intermittent adoption of vision testing at pre-employment was noted <input type="checkbox"/> 	<p>Specialist interviews 2(g)</p> <ul style="list-style-type: none"> • Fluoro pink helmets use reported <input checked="" type="checkbox"/> 	<p>Identify how colour vision-impaired personnel are identified and managed.</p> <p>Establish the nature of use of watermelon helmets and possible alternatives.</p>
<p>Protective eyewear Reports on penetration and UV resistant. Research not specific to forestry. Keenan (1998), cited in Cummins (1999c). See also Cummins (1997) on attitudinal barriers to use.</p>	<p>Specialist interviews 2(d) and (e)</p> <ul style="list-style-type: none"> • Data suggest use of either a visor or sun glasses. Whether UV protection offered by visor is unknown <input type="checkbox"/> <p>Literature - Leaflet circulated in industry - LIRO Report containing advice to industry on melanoma, sunglasses, sunscreen, use of shade and clothing. Cummins (1999a)</p>	<p>Harvesting crew discussions 2(d) and (e)</p> <ul style="list-style-type: none"> • Glasses / goggles reported to fog up, cause discomfort and poor ear muff seal <input checked="" type="checkbox"/> <p>Literature - A study of causation in 15 logging incidents complaints of fogging, being scratched and losing eyewear (Hide <i>et al.</i>, 2008). Recommendations included:</p>	<p>Establish whether visors and sunglasses are used concurrently and resulting implications to visual ability</p> <p>Identify whether the visor offers any UV protection.</p> <p>Explore drivers for eyewear choices for different task</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
	<p>Specialist interviews 2(j)</p> <ul style="list-style-type: none"> Provision of sunscreen indicated <input checked="" type="checkbox"/> <p>Literature – Cummins (1997) explored eyewear design developments that incorporated features to such as anti-fogging, dust entry covers, varied lens colours, avoiding ear-muff interference and scratch resistance.</p>	<ul style="list-style-type: none"> Measures to improve the quality of visual protection warrant special attention such as design alternatives, manufacturer innovations and barriers to change 	types and manufacturer initiatives in eyewear development
<p>Protective footwear design</p> <p>Through analysis of ARS slip trip and fall (STF) data 1996-2001 (Bentley, Parker and Ashby, 2001) recommended footwear that is non-slip, comfortable and that offers chainsaw cut protection.</p> <p>To reduce lacerations to mid foot proximal to the steel toe cap Sabaton foot protectors were trialled (Parker, Bentley & Ashby, 2002. p337). Ashby and Parker (2002) investigated causes and incidents of foot lacerations. Recommendations included:</p> <ul style="list-style-type: none"> Encourage development and feedback on Sabaton and other foot protection styles <p>Parker (1997) in reporting on the ARS analysis for 1996 highlighted that chainsaw lacerations to feet continued to be the single most common injury. Recommended:</p> <ul style="list-style-type: none"> correct chainsaw technique must be used to ensure feet are kept well clear of the cutter bar Chainsaw resistant footwear strongly recommended by LIRO. (Parker, 1996, Parker, 1992). 	<p>Harvesting crew discussions 2(b) Specialist interviews 2(b)</p> <ul style="list-style-type: none"> Data suggest Sabatons not used within industry <input checked="" type="checkbox"/> Suggestion that some crews are wearing basic grade steel toed boots without chainsaw protection <input checked="" type="checkbox"/> Adoption of gumboot type chainsaw resistant boots appears to be widespread but it is not clear what are the range of drivers for choice between these and other forms of chainsaw protective footwear <input type="checkbox"/> <p>Literature - Sabaton used by Department of Conservation staff.</p>	<p>Harvesting crew discussions 2(b) and 4(c) Specialist interviews 2(b) and 4(c)</p> <ul style="list-style-type: none"> Many crew complaints about footwear quality, cost, comfort, and durability <input checked="" type="checkbox"/> Gumboots seen to offer good protection but not seen as viable due to excessive sweating & filling-up with debris <input type="checkbox"/> Isolated reports of Sabaton use suggests that advantages are outweighed by disadvantages <input checked="" type="checkbox"/> Chainsaw handling is widely addressed in all training and guidelines to the industry <input checked="" type="checkbox"/> There are some misgivings amongst fieldworkers regarding recommended carrying and trimming techniques <input type="checkbox"/> <p>Literature – A study of causation in 15 logging incidents identified varied perceptions, some concerning poor footwear durability and comfort (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> The collation of a PPE product database to include evaluation of the user-centred design criteria of products <p>Literature – Operational reports from Department of Conservation (DoC).</p>	<p>Find out from retailers / manufacturers regarding footwear qualities (stock availability of different styles, most popular purchases, new design initiatives and cost ranges) for chainsaw use.</p> <p>Explore prevalence of Sabaton use; barriers / drivers to their selection and whether there are any manufacturer initiatives relating to this product.</p>




Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>LIRO promote rubber gumboot type chainsaw cut resistant boots (Parker 2002)</p> <p>LIRO strongly recommend the use of chainsaw cut resistant footwear (Parker 1996)</p>		<p>Literature - Parker (1997) observed from ARS data that chainsaw lacerations to feet continued to be the single most common injury. (ARS data had indicated the same for the previous year too [Parker, 1996]). This is interesting given that in the same report the author notes no injuries at all to the lower legs – by this time protected by cut-resistant chaps.</p> <p>Literature - Gaskin & Parker (1993), reported that ARS showed 33% of cuts to the lower limb were to either the big toe side of the left foot behind the protective steel toecap, or the back of the leg (calf). Design of the mandatory protective legwear not yet optimal.</p> <p>Literature - Greater use of chainsaw cut-resistant rubber boots may have decreased chainsaw-inflicted injuries to the feet by 30% from 1990 – 1991 (Parker, 1993)</p>	
<p>Protective legwear</p> <p>A case-control study was recommended to find out which factors differed between near-miss and lost-time incidents in ARS data. (Evanson, Bentley, Parker, Ashby & Tappin, 2001)</p> <p>Sullman (1997), in a second study on garment life identified that small amounts of oil had most deleterious effects. Recommended an oil-resistant layer be added.</p> <p>Sullman (1996a), found that after six</p>	<p>Harvesting crew discussions 2(a) and 3(a)</p> <p>Specialist interviews 2(a) and 3(a)</p> <ul style="list-style-type: none"> • Use of chainsaw protective legwear is mandatory <input checked="" type="checkbox"/> • Legwear is generally inspected monthly and changed approximately annually. Criteria to direct change is subject to variable interpretation <input type="checkbox"/> <p>Literature - Oil-resistant layer added by one NZ protective legwear maker to increase effective life. (Sullman, Kirk, Parker & Gaskin, 1999).</p>	<p>Harvesting crew discussions 2(a)</p> <ul style="list-style-type: none"> • There are concerns that trousers blow in the crotch and can be uncomfortable <input type="checkbox"/> • Some crews repair damaged chaps <input type="checkbox"/> <p>Literature – A study of causation in 15 logging incidents identified varied perceptions of permitted repair, criteria for replacement, and fabric quality (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> • The collation of a PPE product database to include evaluation of the user-centred design criteria of products 	<p>Establish manufacturer initiatives in development of products for oil tolerance, chainsaw speed resistance, waterproofing, and the design style developments and variations chaps / trousers.</p> <p>Explore life expectancy and markers for permitted</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>months of use garments no longer provided the protection required by the New Zealand Standard. This contributed to an understanding of why 14.5% of injuries came from a cut through the material, or by ripping the material around to expose unprotected leg. Recommendations on replacement schedules and design modifications were made.</p> <p>The view of researchers on why it was not possible to eliminate chainsaw cuts to legs altogether during the 1990s was that the chain speed of some machines exceeded the 20m/s that the legwear was designed to resist. Deterioration of the garment over time was another factor. (Gaskin & Parker, 1993; cited in Sullman, Kirk, Parker & Gaskin, 1999).</p> <p>Legwear should be replaced after damage (Parker, 1996)</p> <p>1980 Swedfor research (LIRA Project Report 14, 1980) showed 41% of all LTI resulting from chainsaw cuts to the leg. Import restrictions allowed protective gear of this type to be brought into NZ only for research purposes, and so 12 pairs were imported by LIRA for trial and examination by local manufacturers. Trials were successful and production recommended (Sullman, Kirk, Parker & Gaskin, 1999).</p>	<p>Literature – Made compulsory for all chainsaw operators in the industry in 1985. (Gaskin & Parker, 1993)</p> <p>Literature – First NZ-made garments available on the market in 1982. (Sullman, Kirk, Parker & Gaskin, 1999).</p>	<p>Literature – The most thoroughly evaluated item in this review.</p> <p>Literature – Sullman (1998) notes the importance of tracking not only the overall figures, but also changes in the type of injuries and causal mechanisms. Upper leg injuries have not reduced as much as lower leg ones, reasons for this remained unknown.</p> <p>Literature – An evaluation of near-miss reports to the ARS system in the 1995-1999 period produced the interesting finding that the chainsaw featured far less often for fallers than in the lost time reports for this group. For skid workers and trimmers, by contrast, chaps and protective boots are more commonly mentioned – underlining the importance of PPE in these task areas. (Evanson, Bentley, Parker, Ashby & Tappin, 2001)</p> <p>Literature – ‘No chainsaw lacerations reported (to ARS) in 1998 – first time in 14 years (since ARS started)’. (Parker, 1999)</p> <p>Literature – Chainsaw cuts to legs reduced from 34% of all lost time injuries to 7% in first five years of introduction (LIRA Project Report Vol. 14. No. 16, 1988)</p> <p>Literature – By 1986 chainsaw cuts to the legs accounted for only 8% of LTI. The use of protective legwear largely credited with this change. (Gaskin, 1986; and Kawachi, Marshall & Cryer, 1995; cited in</p>	<p>repair or that define that replacement is required.</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
		Sullman, Kirk, Parker & Gaskin, 1999). Other contributory factors may have included: better training of trainees, trend towards smaller chainsaws within bar control resulting, increased awareness of potential for leg injury due to ARS quarterly flyers and other sources. (Sullman, Kirk, Parker & Gaskin, 1999)	
<p>Spiked boots Use of spikes or spurs recommended for appropriate settings following series of 13 case studies on specific incidents (Ashby & Parker, 2003a)</p> <p>Use of spiked boots recommended based on ARS analysis for most years including 1993 and 1992 (Parker, 1994; Parker, 1993).</p> <p>Comparative study included operational trials with five loggers using spiked and conventional boots. No reduction in productivity noted in study. Significant gain in sure-footedness, both observed and subjectively reported; especially on slash. Original report (Kirk & Parker, 1992) discussed in Kirk & Parker, (1994) also later in Parker, Bentley & Ashby, (2002. p333)</p>	<p>Specialist interviews 2(c)</p> <ul style="list-style-type: none"> Spiked boots commonly adopted but there is also use of other non-slip footwear / boot attachments. Drivers for selection are unknown ? <p>Literature – Wider subsequent uptake believed to have taken place in logging and silviculture. No hard evidence of this in published material.</p>	<p>Harvesting crew discussions</p> <ul style="list-style-type: none"> Costs are seen as prohibitive for some X <p>Literature – A study of causation in 15 logging incidents identified incompatibility between use of spiked boots and use of vehicle pedals (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> Liaison with large equipment designers / local retailers, to explore potential for design improvements to metal vehicle pedals <p>Literature – Analysis of ARS slip trip and fall (STF) data 1996-2001 (Bently, Parker and Ashby, 2001) recommended revisiting issue of spiked-sole boot use.</p> <p>Literature – ‘Still under-utilised by NZ forest workers’ (Bentley, Parker & Ashby, 2005)</p> <p>Literature – ARS data indicates significant reduction in slip-induced injuries since introduction. (Bentley, Parker, Ashby, Moore, & Tappin. 2002.)</p> <p>Literature – ‘In the year July 1994 to June 1995, the Forestry Corporation reported</p>	<p>Find out from retailers / manufacturers regarding non-slip footwear choices (stock availability, use within industry and initiatives in design and comfort).</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
		that 19% of LTI were attributed to slipping over. The wearing of spiked boots was made compulsory in April 1995, and in the July 1995 to June 1996 only 6% of LTI were attributed to slipping' Parker (1996).	
Vehicles – maintenance LIRO Newsletter Vol. 25(5) (2000) reported on a study on maintenance-related issues in harvesting, drawing on 12 months ARS data from September 1999-2000. Most of the 19 maintenance-related reports out of the total of 218 in that period were to machine operators. Of these 19 just two were LTI, the rest minor, mostly lacerations to fingers. Slips, trips and falls were the other main type of injury event. Recommendations included: <ul style="list-style-type: none"> the use of suitable gloves, especially when sharpening chain or knives. taking particular care when moving around and on the machine especially after a long period seated. They note that on skidders worn and/or wet tyre lugs do not make reliable footholds 	Specialist interviews 7(f) <ul style="list-style-type: none"> Design innovations to improve access / egress were reported but level of implementation within industry unknown <input type="checkbox"/> 	Harvesting crew discussions 7(f) Specialist interviews 2(i) <ul style="list-style-type: none"> There were many reports by harvesting crews of difficulties associated with getting on and off machinery that is getting bigger and bigger <input type="checkbox"/> There was little indication of much use of gloves for sharpening of chains / knives <input type="checkbox"/> 	Explore drivers / barriers to glove use for sharpening activities Identify initiatives relating to improving vehicle access / egress and extent of implementation within industry.
Vehicles – mechanised log maker A survey with 23 operators of excavator-based mechanised single-grip processors who were cutting to length in clearfell harvesting operations found areas for improvement relating to cab and work environment (Cummins, 1998). Recommendations included: <ul style="list-style-type: none"> development of stem feature recognition aids improved visibility through the front cab guarding improved windscreen cleaning facility 	Specialist interviews 7(c) <ul style="list-style-type: none"> Improvements to the design of mechanised log makers was reported, but details regarding cab design improvements are unknown <input type="checkbox"/> 	Harvesting crew discussions 7 (c) <ul style="list-style-type: none"> Visibility is enhanced when vehicle lighting upgraded <input checked="" type="checkbox"/> Visibility can be inhibited by features such as sun strike and dirt on plastic windows and guarding <input type="checkbox"/> Many reports of improved and adjustable vehicle seating in new machines <input checked="" type="checkbox"/> 	Identify manufacturer initiatives relating to cab design

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<ul style="list-style-type: none"> • better sun-shading of cab • brighter computer displays with larger screens and numbers • seat system that can be adjusted for each specific operator <p>See 2.3 for work environment notes.</p>			
Vehicles – rear vision video system for Bell Logger vehicle Study on three machines using system showed 20% increase in vehicle work completed in test conditions. (Parker, R. 2004. Masters thesis, Massey University; COHFE Newsletter November, 2003).	Harvesting crew discussions 7(g) Specialist interviews 7(g) <ul style="list-style-type: none"> • There was little knowledge regarding the adoption of this initiative; there were concerns regarding its ease of use and vulnerability to breakage [U] 		Identify initiatives relating to adoption of the rear vision video system, extent of implementation within industry and evaluate successes / failures since introduction.
Vehicles – rollover Holes, stumps and sloped surfaces were predominant factors identified in a review of near-miss reports to the ARS in the period 1995-1999. Recommended that initiatives be developed to improve work practices on terrain where these conditions exist. (Evanson, Bentley, Parker, Ashby & Tappin, 2001)	Specialist interviews 4(h) <ul style="list-style-type: none"> • Improvement to work practices were seen as a component of on the job learning rather than a Unit Standard component. [U] 	Harvesting crew discussions 4(h) <ul style="list-style-type: none"> • Few comments, but no reports of guidance for driving over poor terrain [?] 	Establish how training for movement of mechanised equipment over poor ground is managed.
Vehicles – skidder seat belt usage A study by Sullman (1996c) looked for methods of increasing use of seat belts in skidders in response to the high numbers of serious injuries and fatalities from rollovers. Changes to make it easier to use produced a mean increase in seat belt usage of 58% amongst the users of seven skidders in the trial.	Specialist interviews 7(d) <ul style="list-style-type: none"> • Seat belt use is compulsory, one of 10 critical rules that contractors must abide by [✓] 	Harvesting crew discussions 7(d) <ul style="list-style-type: none"> • There is isolated concern that some older vehicles are without seat belts and that seat belts can be broken [?] 	Explore and define frequency that seat belt function should be assessed
Vehicle – Waratah An evaluation was carried out by OPRA Ltd on behalf of COHFE of the human–	Specialist interviews 7(e) <ul style="list-style-type: none"> • Isolated data suggest improvement, but range of application within industry 		Identify manufacturer initiatives relating to user

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>computer interface in the design. The findings are detailed in three LIRO Project Reports (Nos. PR86, PR91 and PR92).</p> <ul style="list-style-type: none"> Recommendations related to: operator comfort/discomfort, risk factors and related preventative measures, hand controls and other factors related to ergonomics in the mechanised harvesting task that might affect performance levels or training demands. LIRO (2000). 	<p>is unknown - </p>		<p>interaction with the Waratah.</p>
<p>Visor The recommendations arising from a series of 13 case studies on specific incidents (Ashby & Parker, 2003a) included</p> <ul style="list-style-type: none"> improving visor design to better protect mouth and face. <p>Parker, 1993, promoted greater use of visors to reduce eye injuries</p>	<p>Specialist interviews 2(d)</p> <ul style="list-style-type: none"> Visors were considered to offer facial protection but also cause considerable visual barriers  	<p>Harvesting crew discussions 2(d)</p> <ul style="list-style-type: none"> Visors are disliked due to impeded visibility due to sun strike, rain, sawdust accumulation  <p>Literature - A study of causation in 15 logging incidents identified restricted vision arising from sun strike or rain and sawdust entry (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> Measures to improve the quality of visual protection warrant special attention such as design alternatives, manufacturer innovations and barriers to change 	<p>Explore manufacturer initiatives in visor design development, whether these have targeted problems affecting visibility and dust entry; explore the drivers / barriers to their use by industry.</p>

Individual: roles, skills, abilities and attitudes

Table 12: Initiatives related to the individual

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>Communication & literacy Brook & Brooks (2000), in their study on safety training noted that nearly one third of the respondents had not completed first state examination at school. 41% had passed the School Certificate.</p> <p>Study found average reading age of 11.5 years in harvesting and silviculture workers.</p> <p>Recommendation:</p> <ul style="list-style-type: none"> always consider reading ability when communicating with forest workers. (Cummins & Sullman, 1999) <p>Gibson (1994) included the following (not derived from research specific to forest workers) recommendations in his study of attitudes towards safety in the forest and logging industry:</p> <ul style="list-style-type: none"> use sources who are liked, similar and credible to the target population to sell the message as they are more persuasive present strong arguments, but information that is not totally different to present views increase perceived risk to a moderate level, and then demonstrate how the new message will help them remove the risk assume that informal face-to-face spoken communication is superior to 	<p>Specialist interviews 5(e)</p> <ul style="list-style-type: none"> Fieldwork training is primarily offered on a face to face and 1:1 basis. A variety of initiatives to promote usability of visual media were reported <input checked="" type="checkbox"/> <p>Literature – LIRO Report – explanation and guidelines published for writing documents for an audience where 58% read at below adult level. (Cummins & Sullman, 1999).</p> <p>Literature – Industry guidance such as leaflets or cards have input from industry representatives and target a lower literacy bracket (e.g., by high use of cartoons and pictures).</p>	<p>Harvesting crew discussions 5(e)</p> <ul style="list-style-type: none"> There were concerns that some FITEC training documents were too complex and that greater use of audio-visual material would be beneficial <input type="checkbox"/> <p>Literature - A study of causation in 15 logging incidents identified that methods used to improve record keeping may displace more practical methods preferred by field work users (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> development of plans that both direct fieldwork and facilitate record keeping 	<p>Identify communication techniques that can be used by all the crew on a regular basis</p> <p>Explore whether training media could be extended to include greater use of audio-visual materials.</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>any written or other media transmission</p> <ul style="list-style-type: none"> repeat persuasive campaigns. 			
<p>Eyewear (protective) use Study on attitudinal barriers to use. 54% currently used some type, 94% said they would – if problems existing with available models were addressed.</p> <ul style="list-style-type: none"> These included: fogging, reduced vision in rain or glare, interference with earmuffs, poor fit, too easily scratched, irritation and headaches. <p>Cummins (1997)</p>	<p>Harvesting crew discussions 4 (a) Specialist interviews 4(a)</p> <ul style="list-style-type: none"> Some employees are reimbursed after making own PPE choices. Whether this applies to eyewear is unknown [?] 		<p>Establish drivers for eyewear choices</p>
<p>Fatigue - general</p> <p>Lilley, Feyer, Kirk & Gander (2002) reported from a self-administered questionnaire survey of 367 forest workers that those reporting fatigue were also significantly more likely to be experiencing near-miss incidents.</p> <ul style="list-style-type: none"> They noted that logging was an industry with a 'slim margin for error' where fatigue should be taken seriously as a significant risk factor. 	<p>Specialist interviews 4(f) and 10 (a, b, c and d)</p> <ul style="list-style-type: none"> Widespread education into health & nutrition continues [✓] Concern that behaviour change post health & nutrition may be limited nonetheless [⚠] Frequency and duration of rest breaks varies & is determined at crew discretion. Job and early finish applies to those taking only one break. [✗] In summer earlier work starts are influenced by heat / fire risk avoidance. Whether this is offset by earlier bed-time is unknown [⚠] <p>Literature – LIRO fatigue awareness programme. One-hour audio-visual and verbal presentation, run close to work sites by LIRO staff. 2000 workers attended in total, in groups of 50-100. Refresher courses six months later and 'continual reminders' in short targeted articles in company and contractor newsletters (Kirk, 1998c).</p>	<p>Harvesting crew discussions 4 (f) and 10 (a) and (c)</p> <ul style="list-style-type: none"> Nutrition guidance was acknowledged but did not accommodate preferred food types of some [⚠] Problems carrying sufficient water are described by some [⚠] Crews vary in the taking of breaks/ day – from one to two. Where only one is taken this may result in earlier home time [✗] Early starts appear more prevalent amongst the North island crews – especially machinery drivers [✗] <p>Literature - A study of causation in 15 logging incidents identified widespread early rising (especially amongst machinery workers), and situations where some workers take only one rest break/day, undertake frequent overtime, or eat nothing until first smoko (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> A review of workload and working hours, especially for machinery 	<p>Explore barriers to behaviour change post health and nutrition training.</p> <p>Explore whether guidance on acceptable foods can be developed to further include 'preferred' foods.</p> <p>Explore measures to promote ease of water carriage</p> <p>Explore background to determination of break intervals and perceived consequences of taking at least 2 breaks.</p> <p>Explore how crews reschedule their sleep in order to compensate for early starts.</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
	<p>Literature – Sleep loss leaflet produced for industry. Content: advice on: diet, exercise, napping, reducing stimulant intake (caffeine, alcohol, nicotine, dope), sleep scheduling. (Cummins & Kirk, 1999).</p> <p>Literature – LIRO Report Vol 21(3). Published. <i>Reducing the impacts of fatigue on forest workers</i>(Kirk, 1996a) 8-page black and white illustrated leaflet with general advice on nutrition, alcohol, fluid intake, body conditioning, rest breaks, sleep and summer start times.</p>	<p>operators</p> <ul style="list-style-type: none"> • A review of measures to facilitate taking of two breaks/day • Review provision of guidance to industry regarding fluid intake and good nutrition <p>Literature – LIRO fatigue awareness. Good participant feedback reported. Unsupported report in Kirk (1998c) of wider success – two large forest companies said that they had lowest ever injury rates in the period following their staff's attendance.</p> <p>Literature - See Hydration.</p>	
<p>Fatigue in motor-manual tree felling and delimbing. Fatigue identified in the review by Parker & Ashby (2005) is still a major factor, but they noted that the underlying causes of the fatigue remain unclear.</p> <p>Apart from hydration and nutrition, it is recommended that chainsaw performance and sharpness, work organisation and work technique are associated with the problem. (Parker & Ashby, 2005)</p> <p>The recommendations arising from a series of 13 case studies on specific incidents (Ashby & Parker, 2003a) included the advice to</p> <ul style="list-style-type: none"> • reduce the effects of fatigue through good use of breaks, maintaining fluid and food intake and getting enough sleep during the week. 	<p>Specialist interviews 4 (c) and (f), 10(a) and 12 (g)</p> <ul style="list-style-type: none"> • Widespread education into health & nutrition continues, although there was concern that behaviour change may nonetheless be limited [Q] • Frequency and duration of rest breaks varies & is determined at crew discretion. Job and early finish applies to those taking only one break. [X] • In summer earlier work starts are influenced by heat avoidance. Whether this is offset by earlier bed-time is unknown [Q] • Greater / alternative use of mechanisation on cable logging reported; development of initiatives in this work type remain work in progress [Q] • Chainsaw handling is widely addressed 	<p>Harvesting crew discussions 4 (c) and (f), 10 (a) and (c)</p> <ul style="list-style-type: none"> • Nutrition guidance was acknowledged but did not accommodate preferred food types of some [Q] • Problems carrying sufficient water are described by some [Q] • Crews vary in the taking of breaks / day – from one to two. Where only one is taken this may result in earlier home time [X] • Early starts appear more prevalent amongst the North island crews [X] • Recommended techniques, when compared with traditional methods, for chainsaw carrying whilst walking and for trimming are seen to induce greater workload. Most adopt them but they are disliked [Q] 	<p>See Fatigue – general</p> <p>See Chainsaw initiatives – general</p> <p>Review both trimming techniques; collate risks of STF with cardio-vascular and musculoskeletal workload and identify why proposed method is unpopular / undesirable. Explore whether there is a way that preferred trimming techniques can be accommodated</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>Recommendations to reduce the ill-effects of fatigue for this specific task included</p> <ul style="list-style-type: none"> optimising fluid and food intake through the day, designing work-rest patterns to minimise build up of mental and physical fatigue, mechanisation of the trimming and felling task wherever possible, and training in techniques with reduced musculoskeletal risks such as the Swedfor trimming method. (Kirk, Sullman & Parker, 1996). 	<p>in all training and guidelines to the industry <input checked="" type="checkbox"/></p> <ul style="list-style-type: none"> Mechanised harvesting is more straightforward on ground-based operations. <input checked="" type="checkbox"/> 		
<p>Feller-buncher operators – guidelines for improved health. Study found high incidence of hand/wrist pain in survey of 23 operators with less than two years' exposure. Swedish studies indicated such symptoms common only after 5-10 years on this job. (Byers, 1997).</p> <p>LIRO Report circulated recommending</p> <ul style="list-style-type: none"> more appropriate early training, the taking of adequate rest breaks away from the machine, and the use of micropauses. (Byers, 1997). 	<p>Specialist interviews 10(a) and(b)</p> <ul style="list-style-type: none"> Frequency and duration of rest breaks varies & is determined at crew discretion. Job and early finish applies to those taking only one break <input checked="" type="checkbox"/> 	<p>Specialist interviews 10(b) Micropauses are recommended and considered the individual responsibility of each worker <input checked="" type="checkbox"/></p>	See Fatigue – general
<p>Fitness The recommendations arising from a series of 13 case studies on specific incidents (Ashby & Parker, 2003a) included the recommendation to maintain an appropriate level of fitness for the job; obesity makes the tasks harder and had been identified as a contributing factor in incidents.</p>	<p>Specialist interviews 4(f) and 7(c)</p> <ul style="list-style-type: none"> Widespread education into health & nutrition continues <input checked="" type="checkbox"/> Concern that behaviour change post health & nutrition may be limited nonetheless <input type="checkbox"/> There is concern regarding weight gain and loss of fitness amongst machinery drivers <input checked="" type="checkbox"/> <p>Literature - LIRO Report Vol 21(3).</p>	<p>Harvesting crew discussions 4 (f)</p> <ul style="list-style-type: none"> Nutrition guidance was acknowledged but did not accommodate preferred food types of some <input type="checkbox"/> Problems carrying sufficient water are described by some <input type="checkbox"/> 	See Fatigue – general

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
	Published. <i>Reducing the impacts of fatigue on forest workers.</i> (Kirk, 1996a) 8-page black and white illustrated leaflet with general advice including body conditioning.		
<p>Hazard perception of loggers Comparative study between subjective impressions and actual ARS data on task and part of body most commonly being injured. (Gaskin & Parker, 1993; Tapp, Gaskin & Wallace, 1990). Findings provided 'valuable insights'. Recommended that initiatives be developed to instil more accurate perceptions about where and how they were most likely to be hurt. For example:</p> <ul style="list-style-type: none"> As many people are hurt trimming, as they are when felling, but the latter is seen as much more risky. Gaskin, (1988) suggested this may be due to the higher incidence of fatalities in felling, the noise and power of a large tree crashing to the ground implying danger, and that one death gets more press coverage than a few hundred injuries. Workers believed breaking out and landing work as equally represented in the ARS, skid site workers in fact featured twice as often More awareness-building was also recommended in body area injured. The upper torso was rated least likely site by the subjects, but in fact suffered more damage than the upper leg, head, arm or eye. 	<p>Specialist interviews 4(b)</p> <ul style="list-style-type: none"> A major focus on hazard awareness is contained in training and production processes <input checked="" type="checkbox"/> The IRIS database has both positive and negative reports <input checked="" type="checkbox"/> <p>Literature – Hazard information used in ACC / COHFE collaborative Forestry Safety Guidance Leaflets over a period of years (2002-2005) & subsequent individual pocket 'mini-HaPS (Hazard Profiles and Solutions) cards (2006).</p>	<p>Literature – A telephone and postal survey of 32 'mini-HaPS' card recipients revealed that cards have been used and distributed at all levels – for both personal use or as a training medium. Ideas for ongoing development of content and style were also recommended (Hide and Moore, 2007)</p>	Identify whether national IRIS data can reveal injury profile of the different task types within logging, and be used for awareness building
Hydration.	Specialist interviews 4(f)	Harvesting crew discussions 4 (f)	

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>Recommendations generated from a number of studies on determining fluid intake requirements for loggers to avoid dehydration and aid performance included awareness materials with specific guidelines on: fluid intake regimes required, high risk times of day and season, symptoms of under-hydration and clinical dehydration . (Bentley, Parker & Ashby, 2005;</p> <p>COHFE Report for industry Vol 4(7) <i>Dehydration – update on research and literature</i> published findings on new research using urine specific gravity (U_{SG}) to test hydration levels, and also evaluative findings on previous initiatives (Ashby & Parker, 2003b). See evaluation column entry. These learnings from the field fed back into new revised recommendations including:</p> <ul style="list-style-type: none"> • Loggers remain generally under-hydrated with some de-hydrated • This occurs in winter as well as summer • A variety of approaches needed; bottles, backpacks, central supply, cab supply to make it easy enough for all to stay topped up • Even those with a good understanding of the issues (and indicators suggest that awareness has grown) still do not necessarily change their behaviour – due most commonly to availability of fluid at the time they can stop to drink <p>Earlier hydration studies. Parker, Ashby & Bates, 2002;</p>	<p>Widespread education into health & nutrition continues, although there was concern that behaviour change may be limited nonetheless [7]</p> <p>Literature – LIRO Report for industry Vol 22(8) <i>Fluid and energy for forest workers</i> published. (Paterson & Kirk, 1997) Advice for forest workers on effects of fluid loss and type and quantity of fluid to be drunk. Sports drinks discussed.</p> <p>Literature – LIRO Report on nutrition published for forest workers. Included sample menus with high carbohydrate and protein for high energy, and for comparison a typical logger's daily food intake high in fat and sugars (Kirk, Glibert, Darry, 1996).</p> <p>Literature – Hazard information used in ACC / COHFE collaborative Forestry Safety Guidance Leaflets over a period of years (2002-2005).</p> <p>Literature – Countrywide seminars and educational material (fluid, nutrition, suncare, fatigue reduction LIRO 1998-1999</p>	<ul style="list-style-type: none"> • Problems carrying sufficient water are described by some [7] <p>Literature - A study of causation in 15 logging incidents identified that drinking water is not always available all year round, but even when provided some crews are unaware. Fluid intake is fairly low for some workers (especially in summer) (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> • Water provision and better communication and reinforcement about its use. <p>Literature – Parker & Ashby (2005, p 7) note that hydration and nutrition have not been shown to be totally effective on their own in addressing fatigue.</p> <p>Literature – Reduction in afternoon incident reports noted in comparison to previous years. "This could be due to better management of fatigue, dehydration and nutrition by loggers." (Parker, Ashby & Evanson. 2003)</p> <p>Literature - COHFE Report for industry Vol 4(7) <i>Dehydration – update on research and literature</i> (Ashby & Parker, 2003b). Included evaluative findings on earlier initiatives from the mid-1990s. Findings included that</p> <ul style="list-style-type: none"> • Some advice extrapolated from small samples and sports settings suggested greater fluid intake than was necessary for many forest workers. • Practical difficulties needed to be 	<p>See Fatigue – general</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
Parker, Ashby & Bates, 2001; Paterson, 1997;		<p>overcome in physically carrying the volume of fluid needed</p> <ul style="list-style-type: none"> Over-hydration could make people uncomfortable or even unwell – intake needed to be flexibly tailored to individual circumstances Under-hydration still seen (wrongly) as a summer-only issue 	
Leg/feet laceration prevention training LIRA Project Report 14 (1980) on Swedfor project.	<p>Specialist interviews 4(c)</p> <ul style="list-style-type: none"> Chainsaw handling is widely addressed in all training and guidelines to the industry <input checked="" type="checkbox"/> <p>Literature – Leg protection trialled 1983.</p> <p>Literature – In-house training on chainsaw methods redesigned as a result of using incidence and causal data from ARS (Parker & Ashby, 2007).</p>	<p>Harvesting crew discussions 4(c)</p> <ul style="list-style-type: none"> Recommended techniques, when compared with traditional methods, for chainsaw carrying whilst walking and for trimming are seen to induce greater workload. Most adopt them but they are disliked <input type="checkbox"/> <p>Literature – Chainsaw cuts to legs reduced from 34% of all lost time injuries to 7% in first five years of introduction (LIRA, 1988)</p> <p>Literature – Part credited, with PPE and increased mechanisation for the complete absence of chainsaw-leg reports in 1998. (Parker, 1999).</p>	See - Fatigue in motor-manual tree felling and delimbing
<p>Musculoskeletal disorders (MSD)</p> <p>Analysis of musculoskeletal disorders from ARS 1995-1999 data recommended:</p> <ul style="list-style-type: none"> recognition of gradual onset mechanisms as well as acute. systematic analysis recommended using: task analysis, posture and motion analysis supplemented by subjective data from forest workers. (Ashby, Bentley & Parker. 2001) 	<p>Harvesting crew discussion 4 (f) Specialist interviews 4 (c), 10(a) and 11(a)</p> <ul style="list-style-type: none"> Chainsaw handling is widely addressed in all training and guidelines to the industry <input checked="" type="checkbox"/> Frequency and duration of rest breaks varies & is determined at crew discretion. Job and early finish applies to those taking only one break <input checked="" type="checkbox"/> . 	<p>Harvesting crew discussion 4 (c),(f) and (i), 10 (a) and (c), 11(a)</p> <ul style="list-style-type: none"> There is variable address of musculoskeletal disorder prevention during training <input type="checkbox"/> There is variable uptake of job rotation – barriers are skill, experience, fitness, training, productivity and age <input type="checkbox"/> General feeling that there are positive efforts to improve housekeeping <input checked="" type="checkbox"/> Crews vary in the taking of breaks/ day 	<p>See Fatigue – general</p> <p>See – Fatigue in motor-manual tree felling and delimbing</p> <p>Explore barriers to the uptake of MSD preventative measures</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>A summary of research into the prevention of strains and sprains on the skid site identified risk factors for musculoskeletal disorders (Ashby, Tappin. and Parker, 2002)..</p> <p>Recommendations included:</p> <p>Guidance on work practices and techniques, such as promoting physical fitness for work, housekeeping, space requirements, de-phasing, chainsaw techniques for use and sharpening, personal behaviour around stacks, logs and stems, and use of bearers to raise the 'working surface'</p>	<p>Literature – LIRO Report Vol 24(1). <i>Back to Basics; better ways to manage your back to reduce injury</i> published. Content included: scale of the problem, anatomy of the back, causes of back pain, interventions (breaks, job rotation, reducing speed of action, reducing exposure to vibration, exercise, postural variety, developing personal fitness), working technique. (Cummins, 1999b)</p>	<p>– from one to two. Where only one is taken this may result in earlier home time <input checked="" type="checkbox"/></p> <ul style="list-style-type: none"> • Early starts appear more prevalent amongst the North island crews <input checked="" type="checkbox"/> • Recommended techniques, when compared with traditional methods, for chainsaw carrying whilst walking and for trimming are seen to induce greater workload. Most adopt them but they are disliked <input type="checkbox"/> <p>Literature – A study of causation in 15 logging incidents identified awkward postures, manipulation and load bearing during repetitive chainsaw use. It also identified the potential for health and performance implications arising from postural invariability and extended periods of cab work for drivers (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> • More detailed analysis drawing upon earlier related research and current operational practices for using these equipment types is warranted • Evaluate the nature and management of chainsaw and machinery design innovations (for both manufacturer and retrofitted products) against user-centred design criteria 	
<p>Overuse (including repetitive motion) injures</p> <p>Prevention approaches research reported – not specific to forestry. Initiatives recommended: job rotation within team work system, job enlargement, training on good sustainable work practices, workplace design (not made relevant to forestry).</p>	<p>Specialist interviews 4 (c), 10(a) and 11(a)</p> <ul style="list-style-type: none"> • Chainsaw handling is widely addressed in all training and guidelines to the industry <input checked="" type="checkbox"/> • Frequency and duration of rest breaks varies & is determined at crew discretion. Job and early finish applies to those taking only one break <input checked="" type="checkbox"/> 	<p>Harvesting crew discussion 4 (f) and 11(a)</p> <p>Specialist interviews 4 (f) and 10(b) and 11(b)</p> <ul style="list-style-type: none"> • There is variable address of musculoskeletal disorder prevention during training <input type="checkbox"/> • There is variable uptake of job rotation – barriers are skill, experience, fitness, 	<p>See Musculoskeletal disorders (MSD)</p> <p>See Fatigue – general</p> <p>Explore guidance and</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>(Kirk, Bertollini and Drewczynski, 1998).</p> <p>Kirk, Gilbert and Simpson (1996) recommended injury prevention warm up (pre-work) and stretching routines (pre- and post-work) for forest workers throughout the day.</p>	<ul style="list-style-type: none"> The prevalence of job rotation within the industry is unknown and limited by a range of organisational factors <input type="checkbox"/> <p>Literature – LIRO Report Vol 23(19). Published. <i>Repetitive motion injuries in the forest industry: a real pain in neck, arms, wrist...!</i> (Kirk, Bertollini & Drewczynski, 1998). Contents: description of overuse injuries derived through repetition, causes, symptoms, treatments and remedies prevention approaches.</p> <p>Literature - LIRO Report Vol 21(23). Published. <i>Techniques for reducing OOS injuries in machine operators.</i> (Byers & Skerten, 1996) 8-page black and white illustrated leaflet with general advice on rest breaks, micropauses, posture, and stretches.</p>	<p>training, productivity and age <input type="checkbox"/></p> <ul style="list-style-type: none"> Micropauses are recommended and considered the individual responsibility of each worker <input checked="" type="checkbox"/> There is little indication that job enlargement happens in the industry <input type="checkbox"/> 	<p>opportunities relating to job enlargement in the industry</p>
<p>Safety attitudes</p> <p>Gibson (1994) interviewed 465 people from six companies. The sample was composed of 22 managers, 28 supervisors, 59 contractors and 356 forest workers.</p> <p>Key recommendations were:</p> <ul style="list-style-type: none"> address the perceived lack of commitment to safety in the forest and logging industry as only 27% of managers and 14% of supervisors thought that the workforce would believe that the company was committed to safety implement a more professional approach to accident investigation 	<p>Specialist interviews 5(g) and 12(a) and(c)</p> <ul style="list-style-type: none"> Larger companies put foremen / supervisors through accident investigation training; whether there is more widespread adoption is unknown <input type="checkbox"/> Resources for training those at supervisor / foremen and management roles exist, but opportunities for further initiatives are also being explored. There is concern that these courses are under under-appreciated by industry <input type="checkbox"/> <p>Literature - ACC. Small Business publications for forestry</p>	<p>Harvesting crew discussions Specialist interviews 5(g) and 12(a) and(c)</p> <ul style="list-style-type: none"> The adoption of health and safety management systems (a requirement by the forest owner / management companies) was considered an underlying success in showing commitment to safety <input checked="" type="checkbox"/> Safety audits, especially those with input from the forest company, were seen as beneficial <input checked="" type="checkbox"/> Accident investigation is taught at L4 National Certificate in Health and Safety. <input checked="" type="checkbox"/> 	<p>Explore methods proposed for accident investigation and management between contractors, and forest companies</p> <p>Explore drivers / barriers to training of Supervisors / Foremen.</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>based on modern theories of injury causation. Accidents were still being blamed on the worker, and the hazards were being accepted due to the hazardous nature of forestry and logging, the industry should take a leadership role in the field of safety. Training should be focussed at all levels of the industry, not just the workers. Some (latent) hazards are created by senior managers adoption of a 'comprehensive' ergonomics approach (as described in Guastello, 1993)</p>		<p>Literature – Findings from the Gibson 1994 study included evaluative data on uptake of health and safety information. 'Attitudes to PPE were positive, although a number of workers were unaware of more recently developed equipment such as spiked boots and high visibility clothing'. The majority of those interviewed were unaware of the scale of fatalities and injuries in the previous year. Although most companies had set safety goals, most people were unaware of what these were exactly, or how progress towards them was being measured.</p>	
<p>Safe distances The recommendations arising from a series of 13 case studies on specific incidents (Ashby & Parker, 2003a) included the advice that:</p> <ul style="list-style-type: none"> when calculating safe distances from hazards, extra caution should be taken on steep slopes or where obstacles were present that could not be moved. <p>These factors had been identified as contributing to incidents.</p>	<p>Specialist interviews 4(g)</p> <ul style="list-style-type: none"> A 3-metre rule for fallers also has isolated application – it is not known whether more widespread application of this rule is warranted <input type="checkbox"/> 	<p>Specialist interviews 4(g)</p> <ul style="list-style-type: none"> The 2-tree length rule and breaker out retreat distances continue to be promoted. <input checked="" type="checkbox"/> 	<p>Establish success / failures of isolated initiatives to improve safe distances.</p>
<p>Safety training needs Brook & Brooks (2000), in a three-year study funded by ACC and supported by NZFOA, identified the need for:</p> <ul style="list-style-type: none"> some form of apprenticeship system to blend formal training with on-site experience more follow-up training to maintain 	<p>Specialist interviews 5(a), (d), (e) and (h) and 12(h)</p> <ul style="list-style-type: none"> The apprenticeship scheme is established, but there are concerns about skills of trainers and their subsequent trainees <input type="checkbox"/> Varied competence / performance assessments, rather than follow-up 	<p>Harvesting crew discussions 5(a), (d), (h) and (i)</p> <ul style="list-style-type: none"> There was a lot of dissatisfaction with the new apprentice scheme, its short duration, the trainer skills and resultant skills of the trainees <input checked="" type="checkbox"/> The new apprentice scheme was seen to undermine the skills and respect 	<p>Explore concerns within industry relating to accessibility and skills of the trainer, and of those on the new apprentice scheme.</p> <p>Explore dissatisfaction with</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>knowledge and skills amongst crew members</p> <ul style="list-style-type: none"> • closer cooperation and better communication between management and crews when planning training • increased focus on retaining experienced crew members to help the younger ones develop • greater individualisation of training 	<p>training, are conducted by contractors and forest owner/ management companies <input type="checkbox"/></p> <ul style="list-style-type: none"> • Training plans are developed for each worker <input checked="" type="checkbox"/> • A variety of practical measures are adopted to encourage retention; offers of higher wages elsewhere are understood to initiate some moves, but with little apparent data from exit interviews reasons for leaving are relatively unknown <input type="checkbox"/> 	<p>that should be afforded to older and longstanding crew members <input type="checkbox"/></p> <ul style="list-style-type: none"> • The system for skills audit / refresher training was in a minority of cases good, but otherwise irregular, unclear or an informal arrangement <input type="checkbox"/> • Generally a positive response to the personal training plan with most keen to gain the full complement of modules <input checked="" type="checkbox"/> • Some concern amongst contractors regarding their time commitment in developing and directing the training plan <input type="checkbox"/> <p>Literature – The Brook & Brooks (2000), evaluation of training needs relied on questionnaire and interview data. It included no objective measurement of training effectiveness.</p>	<p>training modules (i.e., duration to qualify and amount of trainer intervention) among field workers and how this might be redressed</p> <p>Explore measures to recognise the knowledge, experience and existing abilities of older workers</p> <p>Identify whether competence / performance assessment or skills audit meets the criteria of ‘follow-up’ training and skills refreshment.</p> <p>Explore how crew members can have more control over their own training development</p> <p>Explore drivers / barriers to exit interviewing.</p>
<p>Skill acquisition by new recruits</p> <p>Identified as most at risk group for ‘struck-by’ incidents which it is believed could be improved through better training and improved management in early stages of work. Also recommended:</p> <ul style="list-style-type: none"> • Graduated work pace encouraged until up to speed. • Better decision-making skills acquired for stand & environment assessment and falling (Bentley, Parker & Ashby, 2005; Bentley, Parker, Ashby, Moore, & Tappin. 2002; Ashby, Bentley & 	<p>Specialist interviews 4(e), 6(a) 11(d) and (e)</p> <ul style="list-style-type: none"> • Supervision of new workers reported <input type="checkbox"/> • Graduated work pace is offered for new workers. <input checked="" type="checkbox"/> • Hazard identification, including stand & environment assessment is addressed on daily basis and underpins all teaching <input checked="" type="checkbox"/> • Buddy training is widely adopted <input checked="" type="checkbox"/> 	<p>Harvesting crew discussions 4 (e), 6 (a)</p> <ul style="list-style-type: none"> • High level of induction for new starters <input checked="" type="checkbox"/> • Supervision (1/2 day – 6 months) varies according to underlying skills, task type, conditions and progress <input checked="" type="checkbox"/> • Call for clarification of supervision requirements made <input type="checkbox"/> 	<p>Provide some guidance to industry regarding different scenarios, baseline skills and experience and the type of supervision that would be appropriate</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>Parker, 2002).</p> <ul style="list-style-type: none"> Buddy system (Parker & Ashby, 2005) <p>Analysis of ARS slip trip and fall (STF) data 1996-2001 (Bentley, Parker and Ashby, 2001) recommended a range of injury prevention measures – hazard identification, assessment and control; safe work methods; appropriate footwear; and ways to protect the head and neck in the event of a fall</p> <p>Workers in their first year had been identified as requiring particular attention by a number of studies, and over a long period. Also noted by Parker (1995) in his annual review of ARS data, and Byers (1995) in a workforce census of 1994.</p>			
<p>Training effectiveness – general</p> <p>A report on the Logging Workforce Survey involving 400 subjects (Smith, Gaskin & Wilson, 1998), identified the need to:</p> <ul style="list-style-type: none"> raise levels of awareness about formal training opportunities evaluate the effectiveness of training through objective checks on skills and application of these skills – not attendance at courses 	<p>Specialist interviews 5(b) and (i)</p> <ul style="list-style-type: none"> Information on training opportunities is widely circulated and discussed <input checked="" type="checkbox"/> Varied competence / performance assessments, are conducted by contractors and forest owner/ management companies <input checked="" type="checkbox"/> 	<p>Harvesting crew discussions 5(b)</p> <ul style="list-style-type: none"> Main information resources are the forest supervisor, trainers and, to a lesser extent, crew managers / foremen <input checked="" type="checkbox"/> Main information media are information from FITEC, newsletters and hazard alerts. To a lesser extent magazines, email and internet <input checked="" type="checkbox"/> Unless provided to the individuals by the trainer most materials are distributed via the contractor – comments of extra demands on the contractor were made <input type="checkbox"/> The system for skills audit / refresher training was in a minority of cases good, but otherwise irregular, unclear or an informal arrangement <input type="checkbox"/> 	<p>Explore how information dissemination concerning training could be improved through the range of communication methods described</p> <p>See – Safety training needs</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
		<ul style="list-style-type: none"> • <p>Literature - A study of causation in 15 logging incidents identified dissatisfaction by site workers with new training / apprentice schemes, little evidence of widespread refresher training to retain skill and fitness, little support for training in supervisory / management skills, and unknown nature of supervisor / manager training in human capabilities and performance (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> • further consideration of skills development, supervision and performance expectations upon the newly qualified • Exploration of whether or not Topspot / skills audit redresses the lack of refresher training / skills update • Collation of the nature of how training is addressed nationally regarding systems issues 	
<p>Walking safely about site Study of 2001-2003 ARS data found that a third of all minor injuries were still due to tripping and stumbling while carrying a saw. Recommended that initiatives be enacted to encourage:</p> <ul style="list-style-type: none"> • use of the right footwear for the job • correct handling of the saw while walking • avoiding rushing. <p>Rushing was a common factor identified in a number of studies including a series of 13 case studies on specific incidents (Ashby & Parker, 2003a). Reasons for the rush may be personal or</p>	<p>Specialist interviews 2(c) and 4(b) and (c)</p> <ul style="list-style-type: none"> • Non-slip footwear adopted. <input checked="" type="checkbox"/> • Hazard identification and risk reduction behaviour is addressed on daily basis and underpins all teaching <input checked="" type="checkbox"/> • Training information has been consolidated to clarify chainsaw handling techniques <input checked="" type="checkbox"/> 	<p>Harvesting crew discussions 2(c)</p> <ul style="list-style-type: none"> • There is only variable use of non-slip footwear, with spike-soled shoes seen as inappropriate in some cases (rocky terrain / machinery use) or too expensive for others <input type="checkbox"/> • Recommended techniques, when compared with traditional methods, for chainsaw carrying whilst walking and for trimming are seen to induce greater workload. Most adopt them but they are disliked <input type="checkbox"/> 	<p>See – Spike-soled boots</p> <p>See – Fatigue in motor manual tree felling and de-limbing</p> <p>Review both chainsaw carrying technique, collating risks of STF with cardio-vascular workload and musculoskeletal loading and identify why proposed method is unpopular / undesirable. Explore whether there is a</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
organisational. <ul style="list-style-type: none"> Recommendations for the individual include resisting the temptation to take short cuts with tasks, not to walk on logs, and not to jump over logs or slash 			way that preferred carrying techniques can be accommodated

Environment, Work Organisation & Management

Table 13: Environment, work organisational and management initiatives

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
Breaker-out work conditions Kirk & Sullman (1995) studied the task using physiological measures, applied mostly in the field. Hazard analysis was also conducted, and it was noted that type and frequency was significantly affected by the ambient environment, logging system and experience of the breaker-out. Recommendations included: <ul style="list-style-type: none"> the use of two, or preferably three, breaks of at least 20 min during the day at set intervals to allow rest, eating and fluid replacement these breaks to be in a shelter offering respite from extremes of heat and cold in extreme thermal conditions, rotate people out of the job for respite accordingly or shorten days for the exposed operators contractors and senior workers should lead by example to resist poor or lax work practices. The safety of 	Harvesting crew discussions 11(i) Specialist interviews 10(a) and (d), 11(i) and 12(e) <ul style="list-style-type: none"> Early starts in summer were reported for high-heat days; adoption of other organisational interventions is not known ☹ Systems including one or two breaks are in operation. Breaks appear to be determined at crew discretion, with earlier knock off for those taking only one break ☒ Shelter (vans / caravan / container / bus) is generally available ☑ Terrain and known hazards are incorporated into the determination of production targets ☑ There is concern that production pressures are being passed on to the crews and that this influences the taking of short cuts ☒ 	Harvesting crew discussions⁴ (f) and 10 (a) and (c), 11 (i) Harvesting crew discussions <ul style="list-style-type: none"> Nutrition guidance was acknowledged but did not accommodate preferred food types of some ☹ Problems carrying sufficient water are described by some ☹ Crews vary in the taking of breaks / day – from one to two. Where only one is taken this may result in earlier home time ☹ Early starts appear more prevalent amongst the North island crews – especially machinery drivers ☒ 	See Fatigue – General Explore what initiatives relating to high-heat days are implemented and typical barriers to adoption of organisational changes. Review the process used to determine production targets and expected operator performance.

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>the breaker-out should not be compromised to increase production.</p> <ul style="list-style-type: none"> Production target figures need to reflect meaningfully the presence of natural hazards 			
<p>Breaker out techniques Evaluation of 2006 ARS data recommended care in breaking out techniques, hooking up and adherence to and clarity of signals (Parker, 1997)</p>			
<p>Breakout – retreat distances A study comparing actual with required practices found that an extra person was needed to meet agreed safety standards. (COHFE Contract Report)</p>	<p>Specialist interviews 11(c)</p> <ul style="list-style-type: none"> Crew numbers reported to vary according to mechanisation, workload, experience, labour availability etc. [?] 		<p>Explore whether guidance regarding numbers required has continued relevance and whether guidance for conditions requiring 2 breaker outers is stipulated..</p>
<p>Exposure to adverse weather (no preliminary research identified)</p>	<p>Literature - Kirk (1998a) proposed use of warm and breathable clothing, warm drinks and high energy foods, and rest breaks and job rotation as measures to manage exposure to the cold.</p>	<p>Harvesting crew discussions 2 (g), 10(a) and 11 (a)</p> <ul style="list-style-type: none"> Isolated comment regarding fabric that would permit greater cooling requested [?] Opportunities for hot drinks and high energy foods likely to be reduced where only one break taken [?] There is variable uptake of job rotation – barriers are skill, experience, fitness, training, productivity and age [?] <p>Literature – A study of causation in 15 logging incidents identified variable management of adverse weather (rain, cold, darkness) (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> greater attention to rain gear for forest workers or measures that may enhance the quality and protection offered by existing PPE 	<p>Seek manufacturer input concerning any breathability of base fabric types and styles available for winter / summer use</p> <p>See – musculoskeletal disorders</p> <p>See – Fatigue general</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
		<ul style="list-style-type: none"> • Warm-up exercises and access to warm or cold drinks prior to and during exposure (of cold or hot weather respectively). • Explore measures to manage darkness and lighting of common facility areas 	
Harvest planning (no earlier research identified)	Specialist interviews 12(f) <ul style="list-style-type: none"> • Isolated reported that greater attention to feasibility for felling on hard to access areas required – prevalence unknown 	A study of causation in 15 logging incidents identified reports of impractical or inappropriate information in harvesting plans and belated communication between the forest company and contractor in the preparation of drawings (Hide <i>et al.</i> , 2008). Recommendations included: <ul style="list-style-type: none"> • Improve communication between harvest planners and contractors 	Explore how planning for felling in precarious conditions is managed
'Housekeeping' on skid sites Analysis of ARS slip trip and fall (STF) data 1996-2001 (Bentley, Parker and Ashby, 2001) recommended improved housekeeping on landings		Harvesting crew discussions 4 (i) Specialist interviews 4(i) <ul style="list-style-type: none"> • Housekeeping reported to be improved. <input checked="" type="checkbox"/> • Use of delimber / Waratah seen as a positive influence in isolating debris and removing workers from this hazard <input checked="" type="checkbox"/> Literature – Reduction in slips, trips and falls down considerably from 2002. 'May be due to tidier skid sites with less slash and waste wood (especially slovens) lying around. (Parker, Ashby & Evanson. 2003)	
Job design Through transferring experiences from Swedish operations Gellerstedt (1997) proposed job rotation (and methods to calculate this) between machine and manual work for more efficient and productive use of machinery and to reduce the risk of getting occupational overuse syndrome		Harvesting crew discussions 11 (a) and (b) <ul style="list-style-type: none"> • There is variable uptake of job rotation – barriers are skill, experience, fitness, training, productivity and age <input checked="" type="checkbox"/> • No evidence of job enlargement <input checked="" type="checkbox"/> Literature – A study of causation in 15	Identify drivers / barriers to job rotation and whether there are instances where the practical guidance has been adopted Explore guidance and opportunities relating to job enlargement in the industry

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
		<p>logging incidents identified that job rotation may be avoided due to fears of lost productivity and undesirability of some job; it may also have limited affect on alleviating boredom and exposure to physical hazards (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> • Deeper investigation of the potential to develop logger work organisation methods <p>Hanse and Winkel (2008) found through a questionnaire survey of 358 forest machine operators across six European countries that job rotation had a positive effect on job satisfaction and MSD symptoms.</p>	<p>See – Musculoskeletal disorders</p>
<p>Logmaking – motor manual Studies on human factors affecting log-making performance observed that when bored a 6% reduction in log value resulted on skid sites. (Parker, Cossens, & Strang, 1993). Concluded that as found in overseas studies (Cossens & Murphy, 1988),</p> <ul style="list-style-type: none"> • even small reductions in log-maker boredom through organisational changes such as job rotation, job enlargement (task variety) and break scheduling could result in significant improvements in value recovery. <p>Other recommendations included:</p> <ul style="list-style-type: none"> • Training in log making • Alter financial incentives from production to quality • Provide greater price differentials between log grades to reward value recovery 	<p>Harvesting crew discussions 5(a) Specialist interviews 9(a), 10(a), 11(b) and 12(e)</p> <ul style="list-style-type: none"> • Few considered that job enlargement occurs in the industry <input checked="" type="checkbox"/> • The taking of micropauses is promoted and considered an individual responsibility <input checked="" type="checkbox"/> • Log making is included in training programmes <input checked="" type="checkbox"/> • Production by volume is the main driver for contractors <input checked="" type="checkbox"/> • Payment by log grade may be offered if maximisation of a particular grade was required. Whether this is widespread is unknown <input type="checkbox"/> 	<p>Harvesting crew discussion 9 (a), 10 (a), 11 (a) and (b)</p> <ul style="list-style-type: none"> • There is variable uptake of job rotation – barriers are skill, experience, fitness, training, productivity and age <input type="checkbox"/> • No indication of job enlargement <input checked="" type="checkbox"/> • Crews vary in the taking of breaks / day – from one to two. Where only one is taken this may result in earlier home time <input type="checkbox"/> • Early starts appear more prevalent amongst the North island crews <input checked="" type="checkbox"/> • Crews are generally paid a fixed wage, opportunities to receive volume bonus schemes appear few <input type="checkbox"/> <p>Literature – A study of causation in 15 logging incidents identified that payment by priced / volume related output might create conditions that encourage extended work hours, or discourage the</p>	<p>See Musculoskeletal disorders</p> <p>See Overuse (including repetitive motion) injures</p> <p>See Fatigue – General</p> <p>Explore drivers / barriers to diversify reward criteria for production.</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
		taking of breaks (Hide <i>et al.</i> , 2008). Recommendations included: <ul style="list-style-type: none"> Explore alternative methods to volume related payments 	
Logging – mechanised A survey with 23 operators of excavator-based mechanised single-grip processors who were cutting to length in clearfell harvesting operations found areas for improvement relating to cab and work environment. (Cummins, 1998) Recommendations included: <ul style="list-style-type: none"> limiting shift lengths to less than four hours' continuous work use of frequent short breaks better initial training and follow-up training improve communication between processor operator and the rest of the crew educate operator specifically about overuse injuries (OOS) adopt a system which minimises machine interference on the skid Kirk, 1992 following his STIHL-sponsored tour of several countries recommended using mechanised harvesting systems where possible.	Specialist interviews 5(a) and (d), 8(a), 10 (b), and 12(g) <ul style="list-style-type: none"> Training occurs, but may be impeded by space restrictions within the cab permitting entry of only one operator at a time <input type="checkbox"/> Arrangements for follow-up training are unknown <input type="checkbox"/> Mechanisation, 2-phasing, 2-staging and zoning on skid sites are considered successful initiative ideas, but implementation may be hindered by additional handling / financial considerations and skid site design. <input type="checkbox"/> 	Harvesting crew discussions 8 (a), 10 (a), (b) Specialist interviews 4(f) <ul style="list-style-type: none"> Machinery drivers may take breaks with crews or none at all <input type="checkbox"/> Machinery drivers may work in excess of four hour stints – especially those in North Island crews <input checked="" type="checkbox"/> Machinery drivers may work 12+ hours / day – especially in the North Island <input checked="" type="checkbox"/> Radios within cabs are common but not universal <input type="checkbox"/> Adoption of OOS preventative techniques is considered low and adversely affected by job pressures <input checked="" type="checkbox"/> Only isolated reports of alternative work methods (off-site processing, dephasing) reported <input type="checkbox"/> Injury rates before and after introduction of mechanised tree felling studied in USA, with significant injury claim rate following introduction – suggested potential decline in injury rates if mechanised fellers used where possible (Bell, 2002).	Explore shift scheduling and training for mechanised log-makers. Explore drivers / barriers to uptake of radio communication between crew members See Overuse (including repetitive motion) injuries Explore drivers / barriers to improved skid site operations
Occupational health related issues A survey of forest crew health and wellbeing in 9 regional areas of NZ identified that 28% had fitness for work assessed and that health monitoring was inconsistent at 58% (Thomas, Bentley and Ashby, 2001). Recommendations included:	Specialist interviews 1(a) and (b) <ul style="list-style-type: none"> Varied implementation of health assessment and health surveillance described – both considered more prevalent amongst larger companies <input type="checkbox"/> Emphasis more on drug and alcohol screening, less so on gradual process 	Harvesting crew discussions 1(a) and (b) <ul style="list-style-type: none"> Impression of little happening at point of employment other than drug and alcohol screening <input checked="" type="checkbox"/> Comprehensive health surveillance for some crews whereas others may only 	Review the nature of pre-employment health screening nationally; any strategies for managing or rejecting applicants on health grounds; and facilities / information needed by industry and

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<ul style="list-style-type: none"> Assessing fitness for work, and measures to manage fatigue, diet, fluid intake, working hours and provision of information on hazard control Guidance from OSH on monitoring frequency 	<p>injuries [Q]</p> <ul style="list-style-type: none"> Concern health surveillance not being used as a management tool [X] 	<p>have access to irregular / lapsed hearing test provision [Q]</p> <p>Literature – A study of causation in 15 logging incidents identified random provision and content of health assessment and health surveillance for crews, under-reporting of musculoskeletal type injuries and possible lack of understanding of the potential health implications of limited work breaks (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> Provision of occupational health advice to the industry Explore prevalence of discomfort, pain and injury Anticipation of future needs of an ageing workforce 	<p>health service providers in order to be able to offer health screening.</p> <p>Review the nature of health surveillance nationally and facilities / information needed by industry and health service providers (i.e., content / frequency) in order to be able to provide this service</p>
<p>Planting strategies (no earlier research identified)</p>	<p>Specialist interviews 12(f)</p> <ul style="list-style-type: none"> Planting strategies appear dominated by environmental requirements rather than anticipation of eventual feller access for harvesting [Q] 	<p>Literature – A study of causation in 15 logging incidents identified difficulties associated with access to and physical demands of manual felling on sloping ground (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> planting on hard to fell areas should be minimised through developing planning & planting strategies for felling access for the next crop of trees improved communication between contractors and planners in developing harvest plans 	<p>Explore measures to address future felling in development of the production plan</p>
<p>Production target determination Analysis of ARS slip trip and fall (STF) data 1996-2001 (Bentley, Parker and Ashby, 2001) recommended that production pressure should be reduced</p>	<p>Specialist interviews 12(e)</p> <ul style="list-style-type: none"> Although use of NZQA 1225 (“Calculate production targets and unit rates for forestry operations”) available, reported that much calculation is achieved on the basis of past experience [Q] 	<p>Harvesting crew discussions 9 (a) and 12 (e)</p> <ul style="list-style-type: none"> Report that determining rates through incorrect anticipation of skid site size a problem for contractors [Q] Reports suggest that bonus schemes 	<p>Explore drivers / barriers to diversify reward criteria for production.</p> <p>Review the process used to determine production</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
	<ul style="list-style-type: none"> Concern that men are encouraged to do additional loads/ day to get a production bonus, which may lead to shortcuts <input checked="" type="checkbox"/> 	<p>only sporadically in operation <input type="checkbox"/></p> <p>Literature – A study of causation in 15 logging incidents identified reports of differing perceptions of expected output/day between crews and supervisors / managers and off-site specialists. Routine overtime further minimises opportunities for rest & recovery (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> Review achievability of production targets according to varied sites and conditions 	<p>targets and expected operator performance.</p> <p>Explore whether there are social pressures to achieve production targets</p>
<p>Psychological climate</p> <p>A study by Rothwell (1998) found that this, and other work-related variables affected accident and turnover rates. LIRO Project Report published recommendations included:</p> <ul style="list-style-type: none"> reduction of role ambiguity for contractors, increased psychological support, and forest companies taking responsibility for a more positive and effective safety culture. The priority aims should be securing enhanced crew commitment and lowered intention to turnover. 	<p>Specialist interviews 1(d), 11(g) and (h), and 12(b) and (h)</p> <ul style="list-style-type: none"> Initiatives addressing psycho-social issues have been introduced, but their breadth of uptake is unknown <input type="checkbox"/> A variety of practical measures & efforts to raise the profile of logging tasks have been implemented <input checked="" type="checkbox"/> A variety of measures addressing health and safety management and training provision have been implemented, yet success at addressing safety culture is unknown <input type="checkbox"/> 	<p>Harvesting crew discussion 11(h)</p> <p>Specialist interviews 11(h)</p> <ul style="list-style-type: none"> Role ambiguity between contractors and forest companies is reported in a small number of cases <input type="checkbox"/> 	<p>Explore prevalence of initiatives relating to psycho-social factors</p> <p>Explore the potential for role ambiguity between contractors and forest owners / management companies.</p> <p>Explore drivers / barriers to success of initiatives that affect safety culture.</p>
<p>Recruitment and retention</p> <p>Byers (1996) compiled a case study on 12 Southland logging contractors who reported a higher proportion of serious injuries than the national average – derived from ARS data. Turnover was high (48%) consistent with levels found in the Bay of Plenty. Nearly half of those</p>	<p>Specialist interviews 12(h) and 13(a)</p> <ul style="list-style-type: none"> Relationships between turnover, training and accident propensity are unknown <input type="checkbox"/> Retention measures such as good management, long service bonus, employment certainty, petrol vouchers, 	<p>Specialist interviews 12(h) and 13(a)</p> <ul style="list-style-type: none"> It is not clear that exit interviews are undertaken within the industry <input checked="" type="checkbox"/> <p>Literature – A study of causation in 15 logging incidents identified that: some contractors struggle to man absences / holiday outside of “Christmas closure”,</p>	<p>See - Safety training needs</p> <p>Explore drivers / barriers to exit interviewing</p> <p>Explore drivers / barriers to</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>who left a crew also left the industry. Recommendations to address the reported reasons for this situation included:</p> <ul style="list-style-type: none"> • better understanding through analysis of the relationships between turnover, training and accident propensity • exit interviews to find out more about the reasons for the high flow in and out of the industry • Explore impact of company level decisions and global wood processes <p>In an evaluation of US Logger safety training programme, higher claim rates were significantly related to higher turnover. Research into barriers to job tenure (especially for chainsaw operators) was recommended (Bell and Grushecky, 2006)</p>	<p>work vehicle provision, fuel card were described <input checked="" type="checkbox"/></p> <ul style="list-style-type: none"> • A number of adverse impacts from global wood processes were described, but their association with recruitment and retention are unknown. <input type="checkbox"/> <p>Literature – Palmer and McMahon (2000) reviewed measures to attract and retain the required workforce. Recommendations included: better wages, job rotation, adequate rest breaks and reduced hours of work, mechanisation where possible and more comfortable vehicles.</p>	<p>that there are manpower shortages in some geographic locations, that there are problems with recruitment, turnover, and sickness management, and that a relatively narrow age range is seen as optimum within the industry (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> • Explore interventions to facilitate taking of full holiday allowance and to cover absence and sickness • Guidance for contractors on managing absence • Explore ways of redesigning work (through adaptation of tasks, equipment, organisation etc.) in order to facilitate access for older workers. 	<p>management of recruitment and retention</p>
<p>Rehabilitation</p> <p>A review of contemporary approaches to rehabilitation by logging and transportation already in use at that time concludes that</p> <ul style="list-style-type: none"> • the expansion of well tailored-schemes that suit individual needs would assist in reducing costs to ACC – and therefore ultimately to the industry. • Early return to work through treatment and the availability of light duties is recommended. <p>Sullman (1996)</p>	<p>Literature – An ACC-LIRO programme already in progress is mentioned. Sullman (1996b). No further references found.</p>	<p>Harvesting crew discussion 1 (c) Specialist interviews 1(c)</p> <ul style="list-style-type: none"> • Early return to work is promoted within the industry, yet there is concern that some return to work too soon. Difficulties finding appropriate light duties are reported. <input type="checkbox"/> 	<p>Explore guidance on light duty allocations and strategies and services available to assist in return to work</p>
<p>Role clarity</p> <p>A survey of 47 crew members found that role conflict correlated with LTI in the</p>	<p>Specialist interviews 11(g)</p> <ul style="list-style-type: none"> • Variety of measures available (good management, fair wages, attendance 	<p>Harvesting crew discussion 11(g) and (h) Specialist interviews 11(h)</p>	<p>Explore boundary definition between contractors and</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>preceding 5 years and job dissatisfaction. This in turn was highly correlated with intention to turnover. Role conflict was associated with having more than one boss directing crew members. Recommendations included:</p> <ul style="list-style-type: none"> • Have one boss to ensure clear communication • Provide crew members with performance-related feedback • Increase worker job satisfaction 	<p>bonus payments, shareholding etc.) but uptake unknown <input type="checkbox"/></p>	<ul style="list-style-type: none"> • Small number of crews provided with a wage rise on achievement of a qualification <input checked="" type="checkbox"/> • More commonly crews provided with social events <input checked="" type="checkbox"/> • Recognition by the forest company through awards / articles in newsletters <input checked="" type="checkbox"/> • Role ambiguity between contractors and forest companies is reported in a small number of cases <input type="checkbox"/> 	<p>forest owner / management companies and identify any implications for role clarity</p>
<p>Safety incentives Increasing the number of performance inspections associated with reduced claim rates (Bell and Grushecky, 2006)</p> <p>A survey of safety successful contractors (Wright, Cummins and Bentley, 2000) suggested:</p> <ul style="list-style-type: none"> • promote the use of education tools that include examples of programmes that combine successful safety and productivity • reward evidence of proactive safety management rather than low injury rates • offer work conditions that encourage retention of good crew members 	<p>Specialist interviews 3(c), 5(h) and 12 (d)</p> <ul style="list-style-type: none"> • The tender process incorporates evaluation of safety management systems, training plans, quality systems, and management of value recovery, environment, recruitment and turnover 	<p>Harvesting crew discussions 12 (a)</p> <ul style="list-style-type: none"> • Safety auditing was described by many crews, but intervals were vague – monthly to 6-monthly or more <input type="checkbox"/> • Beneficial outcomes of auditing were perceived as both the provision of a plan to guide the crew in what to do and increased involvement from the forest company <input checked="" type="checkbox"/> 	<p>Define the content and purpose of the safety and/or skills audits and explore how information about what to do can be disseminated more widely</p> <p>Identify whether a more systematic approach to skills review, with involvement of the forest company / trainers, might be appropriate for the industry</p>
<p>Shift scheduling - for large machine operators A study involving three single grip harvester/processor operators compared rest break schedules on mental fatigue, stress levels, physical workload and muscular discomfort. Published recommendations included:</p> <ul style="list-style-type: none"> • limiting continuous operation spells to 	<p>Specialist interviews 10(b) and (c) and 11(a)</p> <ul style="list-style-type: none"> • Data concerning shift schedules and breaks for large machinery operators are inconclusive <input type="checkbox"/> 	<p>Harvesting crew discussions 10 (a) and (b)</p> <ul style="list-style-type: none"> • Machinery drivers may take breaks with crews or take none at all <input type="checkbox"/> • Machinery drivers may work in excess of four hour stints – especially those in North Island crews <input checked="" type="checkbox"/> • Some machinery drivers working 12+ hours/ day – no indication that workload 	<p>See Logging - mechanised</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>four hours with a 40-minute break built into this</p> <ul style="list-style-type: none"> rest meal or job rotation to achieve break before next 3-4 hour spell five-minute break away from the machine every hour extended days to use two operators. (Kirk, 1998b). 		<p>undertaken by two operators <input checked="" type="checkbox"/></p>	
<p>Skid site layout and processes The recommendations arising from a series of 13 case studies on specific incidents (Ashby & Parker, 2003a) included:</p> <ul style="list-style-type: none"> 'design site to allow stems to be sufficiently far apart so that workers can walk and work between them', and also to not leave logs crossed. The need to walk on the stems, and crossed stems moving unexpectedly had been found to be contributing factors. Recommended also that skid site layout and processes be redesigned to minimise the potential for person–vehicle, vehicle– log and vehicle–vehicle contacts. (Bentley, Parker, Ashby, Moore, & Tappin. 2002.) <p>Analysis of ARS slip trip and fall (STF) data 1996-2001 (Bentley, Parker and Ashby, 2001) recommended avoidance of walking or standing on logs.</p> <p>Earlier studies concluded that:</p> <ul style="list-style-type: none"> Further research into in-cab video monitors, conspicuity of high-viz, 	<p>Specialist interviews 8(a)</p> <ul style="list-style-type: none"> Mechanisation, 2-phasing, 2-staging and zoning on skid sites are considered successful initiative ideas, but extent of implementation is unknown <input type="checkbox"/> The Best Practice Guidelines and ACOP provide guidance on stacking and log spacing <input checked="" type="checkbox"/> Implementation of mechanical and layout initiatives to improve skid site operations may be hindered by additional handling / financial considerations and small skid site size / design. <input checked="" type="checkbox"/> 	<p>Harvesting crew discussions 8(a)</p> <ul style="list-style-type: none"> Concerns about some small skid site sizes and impact upon number of log stacks that could be accommodated <input type="checkbox"/> Inconsistent truck arrival times can be disruptive – underlying reasons unknown <input type="checkbox"/> Truck arrival during the night influences lengthy work hours of machinery drivers <input checked="" type="checkbox"/> Only isolated reports of alternative work methods (off-site processing, de-phasing) reported <input type="checkbox"/> <p>Literature – A study of causation in 15 logging incidents identified poor ground conditions where machinery and transit routes are shared, and reports of small skid site size and poor log spacing for log maker access, and unclear responsibilities for drawing up plans for skid site layout (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> Explore measures to segregate machinery and pedestrian routes Explore barriers to providing larger skid sites or de-phasing skid work Explore responsibilities and skid site design criteria 	<p>See Logging - mechanised</p> <p>Establish whether log cutting frequency on skid sites is factored in to production calculations.</p> <p>Explore drivers / barriers to improved skid site operations</p>

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>fatigue control, and skills development for new workers (Parker and Bentley, 2000)</p> <ul style="list-style-type: none"> potential contact with machines, or logs moved by machines, should be designed out by providing safe zones for skid workers. (Parker, 1999) If possible the operation should be de-phased so that machines are not operating on the same landing as skid workers. Two-staging operations is suggested as a practical alternative. (Parker, 1997) <p>Evaluation of ARS data for 1997 by Parker (1998) noted a strong tendency for bruising and fracture injuries that year to happen at the start of the week, and be due to being hit by a log or vehicle moved by someone else. His interpretation was that working interactions between people may not be as smooth as later in the week.</p> <p>ARS data for 1995 analysed by Parker (1996), included 18 cases where a worker on the landing was hit by a vehicle or a log moved by a vehicle. In all cases high visibility clothing was being worn. Recommended that:</p> <ul style="list-style-type: none"> the industry investigate new technologies and strategies in landing organisation to safeguard the logger working in close proximity to heavy mobile machinery. 			
Supervision	Specialist interviews 6(b), (c), (d) and	Harvesting crew discussions 3 (a),, 6(a)	

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>The recommendations arising from a series of 13 case studies on specific incidents (Ashby & Parker, 2003a) included:</p> <ul style="list-style-type: none"> provide sufficient supervision so that safe practices are maintained during busy times in difficult terrain or weather conditions take responsibility for monitoring use and maintenance of PPE increase supervision when person is moving to a new task ensure up-to-date knowledge of hazards reduce or eliminate hazards wherever possible: use mechanised delimber, remove slash from site regularly reduced production pressures 	<p>(e)</p> <ul style="list-style-type: none"> Supervision is reported for new starters, and for difficult conditions or terrains <input checked="" type="checkbox"/> Widespread auditing of PPE on a regular basis <input checked="" type="checkbox"/> Robust measures to address and manage hazards throughout training and production processes are reported. <input checked="" type="checkbox"/> Use of mechanised delimbers is commonly reported <input checked="" type="checkbox"/> 	<ul style="list-style-type: none"> Supervision (1/2 day-6 months) varies according to underlying skills, task type, conditions and progress <input checked="" type="checkbox"/> Call for clarification of supervision requirements made <input type="checkbox"/> Often a monthly audit of PPE, but criteria for replacement / repair are unclear <input type="checkbox"/> Only occasional tailgate meeting for some crews although others use smoko time for updates <input type="checkbox"/> Safety meetings generally monthly and at a new site <input checked="" type="checkbox"/> 	<p>Explore whether morning tailgate meetings need any greater regularity / definition / acknowledgement from the forest company</p> <p>Explore criteria and methods to be adopted for regular evaluation of PPE by all crews.</p>
<p>Supervision – of inexperienced workers</p> <p>Ashby & Parker (2003a) recommended</p> <ul style="list-style-type: none"> the managing of workload specifically to take account of inexperienced people or trainees, according to conditions, work pressure and individual ability. <p>This was also recommended in Ashby, Bentley & Parker (2002), who noted that a disproportionate number of inexperienced workers in their first few months were being struck by falling material – a problem that diminished with experience.</p> <p>Guidance on supervision and training of workers in their first year promoted (Parker 1995).</p>	<p>Specialist interviews 6(a) and 11(d)</p> <ul style="list-style-type: none"> Reports indicate that working to crew pace is expected after ~ 90 days. It is not known whether this is widespread or sufficient for all <input type="checkbox"/> 	<p>Harvesting crew discussions 6(a) Specialist interviews 6(a) and 11(d)</p> <ul style="list-style-type: none"> Supervision or buddy-up working with an experienced person is provided as inexperienced workers develop competence. <input checked="" type="checkbox"/> <p>An American study found that training and extensive supervision by experienced management could reduce frequency and severity of accidents for employees new to logging: including stressing the use of PPE (Pine et al, 1994).</p>	<p>See - Skill acquisition by new recruits</p> <p>Provide some guidance to industry regarding different scenarios, baseline skills and experience and the type of supervision that would be appropriate for different scenarios</p>
Training & assessing provision	Specialist interviews 5 (a), 13(b)	Harvesting crew discussions 5(a)	

Initiatives recommended as a result of research	Initiatives taken up by industry	Evaluation of effectiveness	Possible future information needs
<p>Byers' (1996) recommendations to address high turnover included:</p> <ul style="list-style-type: none"> improved access to training and assessing systems for modules <p>The same conclusion was reached after the 1994 workforce census survey:</p> <ul style="list-style-type: none"> poor 'accessibility and availability of trainers and assessors currently one of the biggest barriers to training' 	<ul style="list-style-type: none"> Good access to training is indicated, but access to trainer / assessors has been limited in some geographic areas – whether this problem continues is unknown [?] 	<ul style="list-style-type: none"> Isolated reports of poor trainer access [?] Concern within industry of assessors being paid per volume of tickets approved OR that those training and assessing are poorly funded <p>Workers' compensation claims rates in West Virginia were used to evaluate effectiveness of a logger safety training programme – no claim rate decline was detected in 67% of companies that participated for four years of the training. (Bell and Grushecky, 2006).</p>	<p>Explore barriers to assessor availability</p> <p>Explore concerns regarding trainer payment systems and make findings available to industry</p>
<p>Work pacing</p> <p>Analysis of ARS slip trip and fall (STF) data 1996-2001 (Bentley, Parker and Ashby, 2001) recommended fatigue management through appropriate hours and sufficient breaks</p>		<p>Literature – A study of causation in 15 logging incidents identified that time pressure and minimised opportunities for rest may arise through 'team pacing' (Hide <i>et al.</i>, 2008). Recommendations included:</p> <ul style="list-style-type: none"> Explore opportunities to keep strong teamwork but to limit "inter-dependency" of tasks 	<p>See – Fatigue – general</p> <p>See – Logging mechanised</p> <p>See – Log making – motor manual</p>

Section Three – Generic findings (Recommendation-related)

Data captured during the Specialist interviews and Harvesting crew discussions have been collated.

Against each 'recommendation category' possible future information needs have been suggested. These detail information needs that specifically respond to the original topic (the relevant topic heading is provided), or that are of a generic nature but related to the enquiry theme. The presentation structure is reproduced in Table 14; findings are presented in Table 15. The numbering system cross-references to the questions used during the Specialist interviews (Appendix Two).

1. Initiative recommendation category (example prompts to elaborate meaning)	Possible future information needs
1(a). Generic aspect discussed at interview (example topic specific enquiry areas) <i>Collated Specialist interviewee responses</i>	Topic title <ul style="list-style-type: none"><i>Ideas related to original topic theme</i>
<i>Collated harvester crew responses (number of crews responding, in brackets, where available)</i>	Generic <ul style="list-style-type: none"><i>Supplementary ideas arising from generic data</i>

Table 14: Overview of presentation style adopted to report generic findings

Table 15: Findings from Specialist and harvesting crew interviews and ideas for possible future information needs

Personal (Skill, experience, health, personality, attitude)	Possible future information needs
<p>1(a). Pre-employment health screen (colour vision test, occupational health assessment)</p> <p><u>Specialist interviews</u> – Many were aware of pre-employment health / medical assessment, yet this appeared to be varied in application. Some companies apparently offer extensive screening (including hearing, visual and colour vision testing). Among those aware of such health screening, this was reported as being more prevalent or longstanding amongst bigger companies (especially management, forest owner companies, or those on the ACC tertiary / WSMP programme). Auditing by forest owners was also proposed as a driver for contractors to monitor health.</p> <p>For others it appeared that drug and alcohol testing was increasingly the priority in pre-employment screening and that additional health screening might also be conducted simultaneously, circumstances permitting. However, it was also suggested that scarcity of potential employees also meant that rejecting applicants was unlikely. The undertaking of health assessment more as a means of compliance, in defence against retrospective claims, was also reported.</p> <hr/> <p><u>Harvesting crew discussions</u> – Few distinguished health assessment at employment from that undertaken during annual screening. There were a few isolated comments (3) indicating that the drug and alcohol screening was the more prevalent (rather than health screening) assessment at the time of employment.</p>	<p>High visibility and red-green colour blindness Identify how colour vision impaired personnel are identified and managed.</p> <p>Occupational health related issues Review the nature of pre-employment health screening nationally; any strategies for managing or rejecting applicants on health grounds; and facilities / information needed by industry and health service providers in order to be able to offer health screening.</p> <p>Generic</p> <ul style="list-style-type: none"> • Establish if smaller and larger business differ in their service provision

<p>1(b). Health surveillance (to identify gradual onset conditions, occupational health assessment) <u>Specialist interviews</u> – Health surveillance (annual or biennial screening), as with pre-employment health assessment, also appeared more prevalent among bigger companies and reported in one case as more likely to occur than pre-employment health assessment. Typically the surveillance was thought to incorporate (at least) eyesight, blood pressure and hearing tests.</p> <p>There was also an isolated report of scheduled on-site physiotherapy visits, yet a number were concerned that there is no programme to monitor gradual process injuries (such as hearing deterioration and development of musculoskeletal disorders), that stress is not perceived as a form of harm within the industry, and that health surveillance is not being used as a management tool. Difficulties in introducing such a programme by small family-run businesses were noted, as was lack of commitment to participation among harvesting workers.</p>	<p>Occupational health related issues Review the nature of health surveillance nationally and facilities / information needed by industry and health service providers (i.e., content / frequency) in order to be able to provide this service</p>
<p><u>Harvesting crew discussions</u> – Crews provided varied responses about health surveillance. Five crews reported annual health surveillance incorporating aspects such as assessment of hearing, blood pressure, body mass index, and melanoma screening; these assessments were seen as a welcome initiative to monitor health and to have access to medical advice when otherwise isolated from such services during the week. The remaining crews reported hearing tests ‘in the past’ (such as 3 years ago) but that the system had lapsed in recent years or was not regular. Provision of hearing tests was reported to be managed by both contractors and forest companies.</p> <p>These visits, however, did not appear to be considered a resource for learning about the prevention of occupational ill health (such as sprains, strain, stress etc.). Four crews reported no access to guidance on injury prevention and a further two considered this in terms of treatment, such as improvement in first-aid training. Where access to guidance on prevention was described, this was through training (n=2), ACC pocket guidance cards (n=1), materials from LIRO (when they were available) (n=1) and through information provided by the forest company or ACC in newsletters or accident alerts (n=3).</p>	<p>Generic</p> <ul style="list-style-type: none"> • Identify whether health surveillance should / could include monitoring of gradual process injuries and guidance on injury prevention • Establish if smaller and larger businesses differ in their service provision • Establish responsibility for service provision (contractor / forest company) and whether or not findings should be collated for wider industry use
<p>1(c). Rehabilitation schemes (light duties) <u>Specialist interviews</u> – It was reported that early return to work post injury has been promoted in recent years; although a cost reduction measure some felt that at times this was applied too aggressively even for the allocated light duties and that the driver was to minimise recorded ‘lost time injuries’ (LTIs). Typical tasks were described as paperwork, monitoring machines, workshop activities, stop-go, quality control, spray-painting / stencil work, holding tape, work under the pole, auditing, safe behaviour observations, cleaning or other work relating to chemical use. However, difficulties were reported in lack of enough available ‘light work’, especially as these roles are generally already allocated within the crew.</p>	<p>Rehabilitation Explore guidance on light duty allocations and strategies and services available to assist in return to work</p>

<p>Resources guiding return to work were reported as FITEC Regional Training Advisors, ACC Injury Prevention Consultants / Case managers and the 'Back to work programme'. Health professionals such as a Physiotherapist may also be involved in establishing a return to work plan; another described a successful initiative whereby the treating doctor has been provided with a list of suitable jobs that might be recommended as light duties.</p>	
<p><u>Harvesting crew discussions</u> – Two crews had no experience of having to rehabilitate recovering workers. A couple of crews reported light duties such as painting logs or working the hauler (with training if necessary) as a method to ease return to work after injury. However four other crews felt that light duties were rarely possible and that the worker would have to get straight back into the job. Two crews were concerned about too early return to work and the lack of services to help with this process.</p>	
<p>1(d) Other .. <u>Specialist interviews</u> – There were a number of reports of provision by some companies of a rehabilitation service (and successful sustained employment) for those unsuccessful in the drug and alcohol testing. Another reported liaison with a local health board for the provision of life-skills teaching (smoking, budgeting etc.). There were also reports of more consideration of 'psycho-social' factors from the workplace and home, with training addressing personality, attitudes and the production of a DVD concerning the influence of social problems on work activities. Another reported that some contractor teams provide crew access to psychologists.</p>	<p>Psychological climate Explore prevalence of initiatives relating to psycho-social factors</p>
<p><u>Harvesting crew discussions</u> – No comment offered</p>	

Defences / PPE (Personal protective equipment, use of barriers)	Possible future information needs
<p>2(a).Chainsaw leg wear (oil resistance, chain speed resistance, design choice) <u>Specialist interviews</u> – There was widespread emphasis on the successful adoption of chainsaw protective legwear within the industry and subsequent reduction of LTIs.</p> <p>Various designs of leg-wear were described (chaps, trousers, bib overalls, varying protection of the back of the leg and with a choice of zips or clips). There were differing perceptions concerning which style was preferable. From one perspective trousers were seen to offer more protection and be more likely to receive a weekly wash; however, they were also concerns that they are too hot in summer and that the crotch blows out. Alternatively chaps were seen as the more common choice, offering more freedom, but not protecting the back of the legs. A lack of waterproofing among protective legwear was also seen as a source of discomfort.</p> <p>It was reported that LIRA research in the 1990s was a great success in determining resistance to chainsaw oil (and subsequent cleaning and maintenance recommendations), but it was not known whether these recommendations are still current or whether they are being applied; lack of visibility of the adverse effects of chainsaw oil confound this problem. Likewise, although it is possible to patch-repair damaged leg wear, the acceptability or tolerance before replacement is necessary was unknown. Shift of responsibility from the employee making poor choices or using deteriorating PPE to the employer was lauded, although there was also an isolated comment that not all contractors comply with this. There were also concerns concerning loss of gear with staff turnover, or lack of respect for, poor care of and loss (or even sale) of the gear by some workers.</p> <p>Development in fabric quality was also described with reports of both heavier and lighter weight fabric in the past. Heavier layers offered greater chain speed resistance yet created comfort issues – it was not clear whether or not this related to the use of Kevlar. That legwear is suitable only to protect against kickback and run off cuts was noted by a couple of interviewees. Although development over the years of comfort and protection in legwear design were described, there were enquiries about whether fabric that binds with and stops the saw might be achieved through the new products currently being introduced. It was reported that testing methods, capable of verifying performance against AS/NZS 4453.3:1997A1, had recently become available and that manufacturers and designers have worked on product revision. Arrangements to implement transition of legwear performance from NZS 5840:1989 to the new standard; are unknown.</p>	<p>Protective legwear Establish manufacturer initiatives in development of products for oil tolerance, chainsaw speed resistance, waterproofing, and the design style developments and variations chaps / trousers.</p> <p>Explore life expectancy and markers for permitted repair or that define that replacement is required.</p> <p>Generic</p> <ul style="list-style-type: none"> Identify whether there are arrangements to transfer to legwear with protection that complies with the 1997 AS/NZ Standard

Harvesting crew discussions – Most interviewees were happy with the protective legwear; the majority wore chaps. Trousers were also considered a good option for winter, although there were concerns about some brands being an inappropriate length or blowing in the crotch. For those who wore trousers, arborist trousers, with an elasticated crotch, were preferred; some difficulties in accessing these were described. Lack of elastication was described as a cause of earlier trouser deterioration, reduced comfort and less ability to move.

Whilst there was an isolated comment indicating that waterproofing of chaps would be a good improvement, others felt that early contamination with oil and lube negated the need for this. However, deterioration from becoming matted with oil or rotting at the bottom through excess sawdust contamination was described. Although chaps were expected to last between a year and 18 months (depending on wear from different tasks undertaken), greater durability of the outside layer was requested.

There was one isolated comment about the new legwear fabric standard, indicating that they were thinner and lighter.

2(b). Chainsaw footwear/sabaton, and 2(c). Spike-soled boots

Specialist interviews – There were mixed feelings about developments in footwear – one perspective being incomplete adoption of recommended initiatives or, more commonly (and considered as often arising from contractors stipulating their requirements), offering welcome improvements in durability, stitching quality, style range and protection offered.

Whilst a range of different footwear styles is used in the industry, the importance of selection for task and ground condition was noted. Gumboots appeared to be the product of choice for muddy / processing tasks, although none stated how widely they were used. Gumboots were reported to offer integral Kevlar up the front of the boot which provides protection, some rigidity and ankle support. Nevertheless these were also seen as disadvantageous features in terms of comfort, and release of sweat during summer-time use.

It was not clear from interview data whether or not fallers are wearing specific chainsaw protective footwear or standard leather safety boots with steel caps. There was one report of a boot with integral Kevlar behind the steel toe cap, but it was not known whether this was specific for logger work. None thought that Sabatons were commonly used, and there was isolated concern that they can act as a catching point whilst walking through scrub and that the bare metal might act as a hazard for chainsaw kickback (should the two come together). Fallers are also likely to wear spiked boots, especially if working on sloping ground.

Spiked boots appear to have been commonly adopted and, although not mandatory, are the boot of choice for breaking out, trimming tasks or anything taking place either upon logs or off the landing. Any concerns related to their hardness on the feet. Alternative products were also reported (although their use was seen as much less prevalent), such as cleated soles (a new development – no other information currently available), tricounis and spurs. Spurs, a predecessor to spiked boots, were reported to slip and require an uncomfortable foot posture during use which is 'hard on the Achilles'.

Harvesting crew discussions – A variety of work footwear was described; generally these concerned a range of logging specific boots, although a couple of crews described use of generic steel-capped high ankle work boots. A number commented about the lack of availability of good footwear.

Conflict between price and quality was noted by many crews. A small number felt that they were provided only with the cheapest available (2); cheapness was attributed to poor durability and associated with discomfort (although one felt that a cheaper boot was more comfortable). The provision of comfortable inners, lining and (for spike-soled boots) air soles were proposed to improve footwear comfort.

A range of different prices was described, with quite varied perceptions of what was acceptable. Boots priced in the range of \$400 - \$600 (with others for sale at even greater price of \$800) were reported; in contrast others felt that a cost of up to \$150 for spiked sole boots as overpriced and did not warrant their purchase.

- **Protective footwear design**

- **Walking safely about site**

Find out from retailers / manufacturers regarding footwear qualities (stock availability of different styles, most popular purchases, new design initiatives and cost ranges) for chainsawing.

Explore prevalence of Sabaton use; barriers / drivers to their selection and whether there are any manufacturer initiatives relating to this product.

Spiked boots

Find out from retailers / manufacturers regarding non-slip footwear choices (stock availability, use within industry and initiatives in design for comfort).

Generic

- Explore prevalence of using spurs, cleated soles, tricounis. The drivers / barriers to their adoption and whether or not they are a viable alternative to the use of spike-soled boots

<p>Gumboots (at a cost of approximately \$100) were described only by a few crews. However they are perceived as offering high level (class 3) chainsaw resistance, but that their use is restricted only to especially muddy tasks due to discomfort arising from excessive sweating and filling up with woodchips.</p> <p>The task types and work conditions on the day were also reported to define whether or not spike-soled boots would be worn. Spiked boots were seen as advantageous for those falling, cutting, limbing or walking on logs. However their unsuitability for other jobs / conditions was also described, such as working on rocky terrain or machine operation (ripping up padded floors or sliding across steel floors).</p> <p>Few had experience of spurs or sabatons. However advantages and disadvantages of each were described. Firstly, although spurs can ride up the side of the foot there was an isolated report that they are very good with gumboots. On the other hand Sabatons were seen as offering good protection but with disadvantages such as: can blunt the saw considerably if it hits the boot, get twigs underneath, needs a method other than attachment to the steel cap as a securing method, and adds extra weight.</p>	
<p>2(d). Face visors and 2(e). Eyewear / safety glasses</p> <p><u>Specialist interviews</u> — It was proposed that ~ 80-90% of fallers wear a face visor and, in comparison with other eyewear / glasses they offer some kickback protection, do not fog-up, nor are they so easily lost. Nevertheless there were many concerns relating to the visual hazards arising during their use from sun strike, water beading, debris flicking up underneath them, and the need to continuously flick them up and down whilst cutting. One interviewee described sample fieldwork of visors incorporating finer laser-cut stainless steel, and, although more costly, greatly improved durability and visibility were reported; uptake within industry of this product is unknown.</p> <p>The selection of either a visor or eyewear / safety glasses was seen as personal choice and an exception to the rule not to wear anything. There was an isolated report of many fallers now starting to wear glasses, although they are perhaps used more commonly during landing work. The advantages of glasses were described as convenience, sturdiness and improved scratch resistance. However, there were also concerns that their adoption has been limited due to fogging (or loss of anti-fog properties), visual disruption with rain sweat and dirt, and that they may serve more as a fashion than a protective item. Sample fieldwork using a new innovative style (with mesh where the glass would be) was also reported, yet these proved unsuccessful.</p>	<ul style="list-style-type: none"> • Protective eyewear • Eyewear (protective) use <p>Establish whether visors and sunglasses are used concurrently and resulting implications to visual ability</p> <p>Identify whether the visor offers any UV protection.</p> <p>Explore drivers for eyewear choices for different task types and manufacturer initiatives in eyewear development</p> <p>Visor</p> <p>Explore manufacturer initiatives in visor design development, whether these have targeted problems affecting visibility and dust entry; explore the drivers / barriers to their use by industry.</p>
<p><u>Harvesting crew discussions</u> - Many crews described problems with eye and face protection; these concerned both eye wear and visors, and there were no positive comments.</p>	

<p>Problems relating to the visor concerned effects both of bright sunshine (inability to see the tip of the saw in the shadows) and rain (causing sawdust to stick to the visor and impede visibility). There were also concerns about the dust and sawdust entering and settling inside the visor and becoming airborne and entering the eyes whenever the head is moved or (especially) when the wearer looks upwards – one reported that it is second nature to shake your head before looking upwards in order to expel sawdust that has settled inside the visor. Fine particles can also go straight through the mesh and enter the eyes directly. There were a few comments that the risk of getting debris into the eye arises from visor contamination rather than the saw directly. Some felt that there was no need to protect the whole face, whereas others felt that a deeper and wider wrap round of the visor might protect against sawdust ingress.</p> <p>Goggles or glasses appeared to protect against sawdust entry to the eyes, but nevertheless inhibited visibility through fogging up, especially on wet days or as a result of sweating. There were also reports of wearer discomfort around the nose and poor seal of ear muffs. Only one reported use of fly eyes (glasses made of mesh) and these were described as uncomfortable.</p>	
<p>2(f). Leather mitt <u>Specialist interviews</u> – Use of a chainsaw mitt was reported as mandatory and there have been improvements to soften the leather and improve the grip to prevent sliding and loss of control. However, a number of interviewees questioned whether this innovation remains necessary given technological developments with the chainsaw? It was reported that NZ is the only country using this product (with other countries relying on the chainsaw inertia chain brake). There were concerns that the presence of the mitt could inhibit chain brake efficiency; one reported a situation whereby the mitt had actually caught upon the saw handle.</p> <p><u>Harvesting crew discussions</u> – Only three comments were offered, but all were positive</p>	<p>Hand and arm protection Identify underpinning research for adoption of the chainsaw mitt and gather wider perceptions of current use</p>
<p>2(g). High-viz clothing (helmet colours, yellow on blue/black tops) <u>Specialist interviews</u> – The introduction and mandatory adoption of high-viz colours was seen as very successful. Much of the initial success was attributed to early liaison during the research process with the forest owners and suppliers, which enabled widespread influence and ensured that equipment was immediately available to the market. All felt that initiative continues to be successful, with introduction of more breathable fabrics, personalisation through the selection by companies of certain colours, and use of the gear as a promotional tool.</p> <p>The need to comply with best practice guidance (such as minimum requirements for text size, uninterrupted area of high-viz material) was reported. NZFOA define minimum requirements, and manufacturers must be registered with them.</p>	<p>High visibility clothing Explore issue of high-viz colour loss (through wear/ tear / washing) and impact on detection under different lighting and task conditions. Seek manufacturer input concerning any design developments</p> <p>Identify markers that can be used to establish a stage at which the</p>

<p><u>Harvesting crew discussions</u> – A couple of crews commented that the colour was lost fairly quickly. Although one supplier was reported to offer renewal of the colour, none had taken up this offer, preferring to replace clothing at this stage – fading generally indicated that it had also worn out. There was an isolated comment that improvement to gear could also be in the provision of products to aid cooling.</p>	<p>colour must be renewed / garment replaced.</p> <p>Exposure to adverse weather Seek manufacturer input concerning any breathability of base fabric types and styles available for summer / winter use.</p> <p>High visibility and red-green colour blindness Establish the nature of use of watermelon helmets and possible alternatives.</p>
<p>2(h). Ear protection <u>Specialist interviews</u> – The use of hearing protection was considered to be good, although was reportedly not worn by breaker outs or machine operators in enclosed cabs (with the door closed); it is considered that they have only light exposure.</p> <p>It was indicated that Grade 4 is specified in the Code of Practice (and that most helmets have these already attached), yet interviewees also reported use of Grade 5 muffs as these are recommended by some suppliers. There was one report of inserting a speaker inside ear muffs to permit radio communication between the crew. Ear muff efficiency was reportedly adversely affected by safety glasses, beards and discomfort over the ears.</p> <p><u>Harvesting crew discussions</u> – One crew had tried speakers in ear muffs; these were abandoned in favour of hand signals due to interference (maintenance issues – see 3a)</p>	<p>Generic</p> <ul style="list-style-type: none"> • Establish the prevalence of Grade 5 protection requirements and implications for crew using Grade 4 • Explore drivers / barriers to use of radios within ear muffs and establish whether there are any implications for resultant noise exposure to the wearer • Establish manufacturer initiatives in hearing protection and whether there are design developments to improve comfort / mitigate effects of beards/ glasses
<p>2(i). Gloves for sharpening chains / knives <u>Specialist interviews</u> – None of the interviewees considered that gloves were worn for sharpening chains / knives, although one felt that this might happen occasionally whilst working on a Waratah. Having had a cut in the past was seen as a possible driver for use, yet interviewees offered contrasting views of prevalence of accidents (considered both as frequent and infrequent) arising during this task.</p>	<p>Vehicles – maintenance Explore drivers / barriers to glove use for sharpening activities</p>

<p>General comments concerning glove use concerned their need during rope handling and digging by breaker outs, to prevent contamination of the hands, and the need to save hands from blistering and getting rough / slipping. Although availability of a huge selection of gloves was reported, this was confounded by varying quality (especially of cheaper gloves), and problems experienced once the gloves had got wet.</p> <p><u>Harvesting crew discussions</u> – no comments offered</p>	<p>Generic</p> <p>Explore tasks requiring use of gloves and their qualities therein</p>
<p>2(j) Other ..</p> <p><u>Specialist interviews</u> – In addition to the PPE described above, interviewees also described the successful provision of sunscreen (although actual use was not known). It was also reported that helmets with greater durability and 6-point (rather than 4-point) harnesses are available to the market, although there was also concern that some styles with a high harness can pull up the ear muffs.</p> <p>Concern was voiced about the lack of wet weather gear (with one interviewee reporting successful use of fishing gear among crews), and hindrance caused by the volume of work products that needed to be carried. This was especially the case for fallers for whom a full belt can get caught in vines and increase physiological demands during work on steep slopes. The possible misinterpretation by Dept of Labour legislation relating to this was suggested.</p> <p>There were also contradictory reports (albeit isolated) concerning whether or not the industry had a good mechanism to trial products and brainstorm solutions.</p> <p><u>Harvesting crew discussions</u> There were a couple of comments (from those working in Otago) that there is a limited range of what can be bought. One noted that PPE guidance that used to be provided by LIRO had helped.</p>	<p>Generic</p> <ul style="list-style-type: none"> • Explore prevalence of use and provision of sunscreen • Explore styles & fit of helmets used • Explore qualities of gear used to protect against inclement weather • Explore contents and implications of working with the fully laden fallers' belt • Explore communication methods, relating to PPE development and availability between manufacturers/ suppliers / crew • Explore measures to provide ongoing guidance to industry on PPE range and attributes
<p>Procedures</p> <p>(Applicability, style, revision, access)</p>	<p>Possible future information needs</p>
<p>3(a). Regularity of changing PPE (hearing protection, legwear, helmet)</p> <p><u>Specialist interviews</u> – There were many reports of monthly contractor meetings to audit the quality and condition by visual inspection of workers PPE. It was also suggested that this might be a topic of safety meetings, but their frequency is unknown.</p> <p>Indicators for replacement were described as nicks, rips or tears and the general response would be to replace the affected gear; this was the general response to the longevity of legwear and hearing</p>	<p>Protective legwear</p> <p>Liaise with manufacturers / suppliers about chaps changing / repair / replacement criteria (see also 2a)</p> <p>Earmuffs</p>

<p>protection. A couple commented that approximately 12 months' wear would be expected of each product, whereas another felt that there is no frequency of when chaps should be changed; the prompt for renewal would be wear, tear, or oil contamination to an extent that when rubbing the fibres together, if they do not run freely then they need to be replaced.</p> <p>In the case of helmets a given expiry date was reported, although among interviewees this was variably perceived to be on a 12-monthly, 18-monthly or 2-year basis.</p> <p>It was reported that, with the HSE Amendment Act, employers are responsible for purchase and provision of PPE, yet it appeared that some contractors might reimburse workers' own selection of PPE in order to allow personal preference (comfort, style, preferred weather protection) in their choices. Nevertheless there were still concerns that some do not look after the gear well.</p>	<p>Confirm durability of cushioning and springs with manufacturers. Explore site practices for maintenance and ways to promote evaluation of ear muff quality by all crews</p> <p>Protective footwear design (see2b and 2c)</p> <p>Supervision Explore criteria and methods to be adopted for regular evaluation of PPE by all crews</p>
<p><u>Harvesting crew discussions</u> – Although one or two crews reported no particular system, all others described a regular inspection and maintenance programme for PPE. This was generally on a monthly basis and crews felt confident that this would pick up deterioration and repair or replacement needs. Crews reported either getting PPE repaired, or never mending anything.</p> <p>There were varied reports with some crews describing chaps repair, whilst others discarded them because they felt that repair was not advisable. For some undertaking repair this was seen as acceptable only where the very outer layer was affected (i.e., the chain-stopping material remains unaffected). The nature and materials used for repair are unknown, although one crew described getting an external agency to undertake any necessary repair work.</p> <p>Poor durability (6 months per pair in one case) was especially associated with leather footwear, such as rotting and soles coming off.</p> <p>There were very few comments about maintenance of hearing protection. Those offered concerned the irregularity that ear muff cushioning might be changed by those unaware of deterioration, the loss of seal against the ears through wearing of glasses, and the loss of tension that can affect the springs holding the muffs against the head (which can pass unnoticed, even when the ear muffs themselves are renewed).</p> <p>There were isolated comments that some crews received an allowance to buy their own PPE.</p>	<p>Generic</p> <ul style="list-style-type: none"> • Methods of PPE provision that both permit personal choice and that avoid budgeting on an individual basis need to be explored and adopted by industry.
<p>3(b). Maintenance programmes (chainsaw, machinery)</p> <p><u>Specialist interviews</u> – Systems for maintenance were generally considered good, with individual ownership and random safety checks serving as an incentive for chainsaw maintenance. A programme of 6-12 monthly machinery inspection was described by one interviewee (for cracks, splits, missing bolts etc.), but it is not known how widespread this is. It was also reported that a lot of such work was done</p>	<p>Vehicles maintenance</p> <ul style="list-style-type: none"> • Explore frequency of equipment maintenance programmes and identify which practices are crew / external contractor responsibilities

<p>either by external contractors (to fix machinery such as mobile plant), or might be allocated as a light duty, or something that the contractor may wish to undertake himself to avoid time wasting. The need for extra maintenance of machines during fire season was also described.</p> <p>It was reported that maintenance training is covered in varied Unit Standards and is also covered in a FICA course.</p>	
<p><u>Harvesting crew discussions</u> – There were many descriptions concerning chainsaw and machinery maintenance; although discussions concerned maintenance that they would undertake themselves, none indicated the frequency that this would be undertaken.</p>	<ul style="list-style-type: none">
<p>3(c). Other .. <u>Specialist interviews</u> – Intervention by forest owners / management companies was also described in terms of providing regular audits and the scrutiny of management systems during the tender process. <u>Harvesting crew discussions</u> – The input from those outside the crew (such as forest supervisor or auditor) in checking suitability of PPE was also noted.</p>	
<p>Task / technique /training topics (Physical / mental workload, hazard related, interaction with other tasks, complexity.)</p>	<p>Possible future information needs</p>
<p>4(a). PPE (selection, use, care) <u>Specialist interviews</u> – A heavy emphasis within training materials and trainer attitudes regarding PPE use and care was described and the overall impression was that people are using the correct gear. <u>Harvesting crew discussions</u> – see (3a)</p>	
<p>4(b). Hazard awareness - general including 4(e). Stand & environment assessment <u>Specialist interviews</u> - Robust measures and a major focus upon hazard awareness throughout the training and production process were described. Initially at the contract set-up phase and incorporating pre-site meetings, identification of generic and specific hazards, and sign-off by both the forest owner and contractor. In turn contractors offer induction to crew at a new site (or at any stage for new crew members), and discuss new and existing hazards and any necessary work techniques to be adopted, during tailgate meetings at the start of work each morning. The specification of appointment only of ticketed fallers by forest owners / management companies was also noted, as were a number of descriptions of either a monthly skills audit or providing a roaming trainer to undertake skills assessment (trainers appeared to be provided both by the contractor, forest owner / management company, or be appointed on contract from FITEC) – non-compliance eventually resulting in being stood down from the crew.</p> <p>Additional measures described were the encouragement of workers to look out for each other</p>	<p>Safety incentives Define the content and purpose of safety and/ or skills audits and explore how information about what to include can be disseminated more widely.</p> <ul style="list-style-type: none"> Supervision Communication and literacy Explore whether morning tailgate meetings need any greater regularity / definition /acknowledgement from the forest company

<p>and supplementary communication methods through use of head set radios for each worker (described as uncommon), or use of a whiteboard for interactive use by all crew, not only to highlight work hazards but to summarise progress of the entire work programme.</p> <p>Hazard identification and the policies and procedures to follow are addressed in all training materials and task orientated Unit Standards. There is additional address of the hazard assessment and management process within the Health and Safety Unit Standard.</p> <hr/> <p><u>Harvesting crew discussions</u> – Almost all crews who were asked about induction indicated that this occurred for new workers; for a minority this was relatively new, whereas for others this was a longstanding arrangement. Inductions were generally considered to be helpful, providing guidance on the health and safety policy and insight into the job.</p> <p>One crew described undertaking a tailgate meeting most mornings; additionally a few others felt that smoko offered opportunities to update or share any necessary information about work progress or problems. Excepting one (that had no regular monitoring programme) the remaining crews described safety meetings on a monthly basis; many also described safety meetings or hazard identification at the start of a new job / site. Monthly safety meetings were generally seen as an opportunity to check safety equipment (e.g., fire gear) and PPE; occasionally these were supplemented with random checks from forest supervisors or trainers. The majority felt that these were worthwhile and the supplementary input from forest supervisors / trainers, when this was offered, was welcomed as additional motivation and support to maintain standards.</p> <p>The adoption of a few new methods or procedures was described: visitor induction; learning to use chokers; new radio call in signs for fallers; separate channels to keep in touch with truck drivers; placement of hazard information on a wall board; use of carriages; performance review (skills audit) of workers within first 3 months and then every following 6 months. Excepting one crew, all others required that fallers were either ticketed or undertaking faller training.</p>	<p>Identify communication techniques that can be used by all the crew on a regular basis</p>
<p>4(c). Chainsaw technique (handling whilst walking, falling, trimming)</p> <p><u>Specialist interviews</u> – It was reported that chainsaw technique is well covered in the Approved Code of Practice and also in the task-related Unit Standards and Professional Felling Field Guide. Recent measures to consolidate and clarify information were also described, such as refining information to stipulate just one way to carry a chainsaw whilst walking or to undertake a trimming task.</p> <p>Special attention when dealing with novices was described (such as needing to apply chain brake when walking between tasks). It was also noted that among increasingly mechanised crews (some contractors now only have 3 men) chainsaw use is fading away.</p>	<ul style="list-style-type: none"> • Fatigue in motor-manual tree felling and delimbing. • Leg/feet laceration prevention training <p>Review both trimming techniques; collate risks of STF with cardio-vascular and musculoskeletal workload and identify why</p>

<p><u>Harvesting crew discussions</u> – There were mixed responses from fallers on the appropriateness of the guidance for carrying the chainsaw or for trimming techniques. All were aware of the guidance to carry it to one side but a number of crews (4) reported that carrying the chainsaw over their shoulder was more comfortable, less demanding on the back, and made walking easier and safer especially during hill climbing. The risk of falling and sustaining injury from the saw was attributed to both carrying methods, yet orientation of the bar was seen as a method to reduce injury potential with either carrying style. Where trimming was concerned one crew described discomfort through lifting and twisting whilst trimming at the side of the stem, whereas postural discomfort was reduced whilst standing upon it. When discussing possible resultant slip hazards from working on top of the log, working on the ground alongside the log was also considered to be a risk factor for slipping and tripping, or for sustaining lacerations from the branches. It was suggested that many people continued to trim whilst working on top of the log.</p> <p>Further issues associated with chainsaw handling were from alternative techniques adopted by a left-handed user; the selection of a longer bar to avoid extent of bending over; and interest in the revision of guidance on the number of trees that can be driven in any one occasion.</p>	<p>proposed method is unpopular / undesirable. Explore whether there is a way that preferred trimming techniques can be accommodated</p> <p>Walking safely about site Review chainsaw carrying technique, collating risks of STF with cardio-vascular and musculoskeletal workload and identify why proposed method is unpopular / undesirable. Explore whether there is a way that preferred carrying techniques can be accommodated</p>
<p>4(d). Log stacking <u>Specialist interviews</u> – There was widespread agreement that walking on log stacks is prohibited (within past ~10 years). Nevertheless there was isolated concern that production pressures may affect desired height, even though log stacking is covered in Unit Standards (machine operators, skid work) and training posters. The provision of limited landing space and size was also seen as a possible limiter to achieving optimum log stacking.</p> <p>Innovation in skid site layout or engineering initiatives was also described. This includes new ways of forming landings and log stacking using a bench style (split-level) method with a forwarder, 2-phasing, 2-staging, and the use of a fixed rather than a swinging grapple.</p> <p><u>Harvesting crew discussions</u> – Few respondents commented, but those that did were aware of the guidance and felt it their own responsibility to maintain safe distances or manage confined space work. One crew was unaware of any restriction for log stack heights.</p>	<p></p> <p>Generic Explore barriers to achieving optimum height of log stacks and information dissemination regarding desired heights.</p>
<p>4(f). Self care (↓fluid type, food type, rest & sleep requirements, ↑ body condition [stretch / exercise], effect of stimulants, avoiding OOS / musculoskeletal disorders) <u>Specialist interviews</u> – Many mentioned the success of the new Unit Standard for Health and Nutrition. Informed by earlier research into fatigue, fitness, hydration etc... it is also promoted by ACC and the ITO and it appeared that a number of forest owners / management companies are specifying that crews</p>	<ul style="list-style-type: none"> • Fatigue - general • Fitness • Hydration <p>Explore barriers to behaviour change post health and nutrition training.</p>

<p>undertake this training, in one report within a 3-month period of appointment.</p> <p>The success of earlier LIRO initiatives was also mentioned, but whether some of these initiatives have fallen by the wayside (such as recovery snacks at the end of the day) was questioned. Likewise, problems with lack of interest or lack of behaviour change after training provision or a trial of food provision [Subway] was described by a number of interviewees. This may become apparent during accident investigation; the need for strong leadership (e.g., young guys copying older guys' good quality lunch choices) was noted.</p> <p>None of the interviewees were positive about progress in prevention of the development of musculoskeletal disorders, and there was concern that this will be an issue for the future. Whilst training might be given there was little faith that people adopt stretching (or micro-pauses or intermittent walking about for machine operators) as part of their work practices. Job requirements / pressures were mentioned as barrier to some of these 'self-care' options; the occurrence of back pain even if following guidance to 'bend you knees' was also noted.</p> <hr/> <p><u>Harvesting crew discussions</u> – Whilst those that had received training on health and nutrition felt that the information provided was understandable, there was little indication that behaviour had subsequently changed. Some indicated that they were obliged to do the Unit or that it was boring. Barriers to uptake were a sense that the guidance was common sense; that experience on the job had already provided sufficient ability to cope with nutrition and hydration needs; that the recommended food was not as tasty as their preferred food; that recommendations to drink (for example) 2L water/hour or 6 bread rolls/day were unrealistic. Problems carrying sufficient water were noted, especially where fuel also had to be transported. The use of camel backpacks was described but reportedly these quickly got ripped up; one faller described drinking from creeks where available.</p> <p>Some crews reported either nothing or that they had received guidance on prevention of strain/strains; where covered this was generally seen as something addressed to varying degrees either through training (from the trainer, forest supervisor or from the training materials), or as common sense picked up over years of experience.</p>	<p>Explore whether guidance on acceptable food can be developed to further include 'preferred' foods. Explore measures to promote ease of water carriage</p> <ul style="list-style-type: none"> • Musculoskeletal disorders (MSD) • Overuse (including repetitive motion) injures • Logging - mechanised <p>Explore nature of and opportunities to develop MSD preventative measures, how they are addressed within training, and drivers/ barriers to their uptake</p>
<p>4(g). Safe distances in the presence of slope / obstacles</p> <p><u>Specialist interviews</u> – As a general initiative, specification of the 2-tree length rule & breaker out retreat distances was described. The reported adoption of at least a 3-metre final retreat during falling was described (it is not known whether this has been applied nationally), although another felt that this might be very difficult on steep terrain. Rope-assisted falling was also described by one interviewee as a measure to safely fell on steep slopes.</p> <p>Choice of machinery, such as use of a swing yarder (rather than the tower) and improved operational techniques with this equipment were also reported to improve safety of this operation.</p>	<p>Safe distances Establish success / failures of isolated initiatives to improve safe distances</p> <hr/> <p>Generic Establish range of equipment-based initiatives & whether they are widespread</p>

<p><u>Harvesting crew discussions</u> – no comments offered</p>	
<p>4(h). Vehicle use on uneven / stumpy, steep terrain</p> <p><u>Specialist interviews</u> – Whilst policies for machinery use on sloped ground were described, interviewees felt that from a driver perspective this was addressed more as on-the-job training rather than through Unit Standard training. However the difficulties of putting two men inside a cab for such training were also noted, and that relevant training might incorporate situation management after it had occurred rather than as a preventative measure. There was also an isolated comment that ground preparation (stump heights) would be addressed from a perspective of quality / value rather than for vehicle travel.</p> <p>Technical changes were also considered relevant, with increased cab comfort (widespread among mobile plant and work vehicles), which also facilitate longer periods of work. Other initiatives included preference for forwarders rather than skidders on ground-based sites and track revision (creating bigger grousers) to improve traction of such machinery used on slopes.</p> <p><u>Harvesting crew discussions</u> – none reported guidance on vehicle use on poor terrain.</p>	<p>Vehicles – rollover Establish how training for movement of mechanised equipment over poor ground is managed.</p> <p>Generic</p> <ul style="list-style-type: none"> • Establish the nature of ground preparation for vehicle / skid site use • Establish preferences and underlying rationale for vehicle choices on the skid site
<p>4(i). Housekeeping / ↓ trip hazards</p> <p><u>Specialist interviews</u> – A number of ways to address housekeeping needs were described, such as coverage in Unit Standards, review at tailgate meetings, 10 deadly sins, audit/ inspections, and (occasionally) the provision of skips. These interventions generally related to skid site / landing work, although one felt that breaking out was overlooked on this front. Nevertheless a number of interviewees felt that there had been a lot of improvements with housekeeping over recent years.</p> <p>Technological interventions were also considered important, although the prevalence of their adoption is not known. Examples included debris reduction through the use of delimbers / Warratah processes under the tower that localise debris collection and enable easy clearing of the area. The use of a Bell logger with a blade to clear around manual processes was also described, as was the adoption of spiked boots for slip prevention.</p> <p><u>Harvesting crew discussions</u> – A couple of crews commented on housekeeping, one of which reported a big effort to improve standards</p>	<p>Generic Establish the range of equipment / work methods that contribute to good housekeeping, and determine markers that might be used to disseminate guidance on what constitutes good 'housekeeping'.</p>
<p>4(j) Other ..</p> <p><u>Harvesting crew discussions</u> – A few crews described mixed feelings about the specification of or revision of work techniques. From one perspective these were seen as something helpful or something</p>	

<p>that needed to be adopted given the contractual agreement with the forest company. However, where objections were voiced these concerned perceptions of lack of hands-on experience by those devising guidance and lack of insight into the underlying reasons for why alternative measures are chosen by harvesting workers. A sense of inflexibility for experienced workers to make their own skilled decisions (according to task and conditions) was also described.</p>	<p>Generic Explore how respect for the older and experienced workforce can be emphasised.</p>
<p>Training criteria (Access, costs, duration, detail, popularity, content development / omissions. Trainer skills. Responsibilities.)</p>	<p>Possible future information needs</p>
<p>5(a). Improve access to training (apprenticeship / skills development, introduction of specific requirements) and 5(c). Access to module or assessment systems <u>Specialist interviews</u> – There were mixed feelings about training within the industry, although all felt that there was access to training (especially as much happens within the crew) and assessment (albeit with some difficulty accessing registered trainers /assessors in some areas) nationally.</p> <p>For those with a positive perspective the modern apprenticeship programme was seen to provide the industry with more accessible and targeted training, accomplished and productive workers, provide roving assessors, properly administered training plans and records of learning, and to raise the profile of the National Certificates. The new programme of smaller block training for National Certificates was offset by opportunities to acquire a greater number of National Certificates resulting in a broader range of experience and skills; this was contrasted against just obtaining single task modules in the old days. The benefits of introducing three levels of training from introductory, operator (to ensure productivity and safety) and advanced (to acquire additional skills in management) were also promoted.</p> <p>From a cost-related perspective it was reported that FITEC also provided training that didn't require sign up to a National Certificate. A good collaborative relationship between FITEC and DoL was also described, with the former providing Regional Training Advisors who undertook training needs analysis and provided a link between contractors and trainers. An East Coast ACC Mentoring Scheme (it is not known whether this is available nationally) and FICA courses in negotiation were also reported.</p> <p>For those dissatisfied with the scheme, the problems concerned poor quality of the modules (unit standards) and the trainers. There was concern that Regional Training Advisors are signing up young people (for whom employers reportedly receive a subsidy) for inappropriate apprenticeships. It was also considered that a push for compliance encouraged some employers to require 'tickets' and this had a negative impact on outcome quality. That 'tickets' could be acquired within a very short time frame was also seen as demoralising for those who had undertaken the original training (especially as they might be paid the same) and did not mean that they were necessarily more competent than somebody without a 'ticket'. There was also a report of a government initiative to attract trainees who have been on the</p>	<ul style="list-style-type: none"> • Safety training needs • Skill acquisition by new recruits • Training effectiveness-general • Training and assessing provision <p>Explore concerns within industry relating to accessibility and skills of the trainer, and of those on the new apprentice scheme.</p> <p>Explore dissatisfaction with training modules (i.e., duration to qualify and amount of trainer intervention) among field workers and how this might be redressed</p> <p>Explore measures to recognise the knowledge, experience and existing abilities of older workers</p>

<p>dole for more than 26 weeks to Polytechs; however this did not necessarily make them suitable for training or later employment in a crew role. Costs were also considered a key issue for contractors; although the Unit Standard assessment is free, the high attrition rate in the industry meant that for many their investment was lost. There were also concerns regarding whether the free assessment is sustainable or is creating an artificial situation for the industry, and that payment of trainers according to successful completion of training /assessment also encouraged assessment of unnecessary or poor quality qualifications. [NB: it was also reported that this method of payment has now been repealed]. Another voiced concern about the risk of invalidating basic qualification when new modules are added, and that there is a danger of creating a situation of 'chasing moving targets'.</p> <p>Regional and growth variations were also seen to influence this, with both fluctuations in need (once employees are finally trained and skilled in the job) and pockets of need for particular skills (such as machinery operators) or to deal with particular conditions (such as windthrow). The need to bring in outside trainers for mechanical crews was also described – for Waratahs and forwarders, for example.</p>	
<p><u>Harvesting crew discussions</u> – One crew described problems accessing a trainer; the remainder had no problems, although at least four crews described having considerable problems in the past; geographic isolation, excessive trainer workload and lack of faith in the abilities of the trainer were cited as underlying reasons.</p> <p>Some crews (5) felt that cost was not relevant to whether or not they could access training; it was reported that costs were distributed across forest companies, contractors and the government /FITEC. Some indicated that training had to go ahead in order to fulfil specified hours for credit standards. However, there was also an isolated comment that some contractors would not pay for training and that employees were powerless in these circumstances. Another felt that some contractors were having to pay more for training than other contractors; a situation where one trainer may make 10-20 visits before approving a faller's unit standard compared to perhaps 5 visits by a different and more lenient trainer for a faller with another crew was seen as unfair. There were a small number of comments about variable standards of trainers and questioning of their own underlying skill and competence in the tasks being taught.</p> <p>Most crews (7) felt that being 'ticketed', or in training, had a positive influence on getting ongoing contract work from the forest company; others also felt that being 'ticketed' was a requirement of the forest owner.</p> <p>Whilst a small number of crews (3) were happy with training duration there were a number of complaints about the inappropriate training duration and content between those on the apprentice scheme and those already with many years experience trying to get tickets. Some commented that gaining tickets through the apprenticeship scheme was too easy, with apprentice trainees gaining (for example) 8-9 tickets/ per year without adequate practical experience; the targeting of funding at younger workers was considered to influence the fast tracking of apprentices. There were comments that because younger workers gained tickets with such ease this undermined the value of the qualification</p>	<p>Generic</p> <ul style="list-style-type: none"> • Explore cost implications to contractors arising from turnover of trained crew members • Explore measures to target those within crews who feel isolated from training opportunities

and sense of achievement for those that had studied hard and gained their national Certificate and a lot of experience. In comparison there were a few comments that more experienced workers struggling to gain even one or two tickets per year because it was too drawn out; only sporadic attendance of trainers / assessors was seen to influence ability to complete tickets, as was the lengthy or lacking time frame (up to 18 months in one case) over the period of which any initial training material that had been provided was forgotten. The training for experienced workers also received a small number of comments about it being boring, overly repetitious or biased towards apprentices rather than long-standing employees.

There was little support for further introduction of new modules (unit standards). Some were happy with things as they are, whereas others felt that the changes that had already been made were not advantageous to them. The problems attributed to the training development were a sense that, in some cases, previously gained qualifications were being split-up and revised into new qualifications. This created situations where the same material had to be studied again in order to gain the national certificate, and the sense of achievement and value of previously gained qualifications was redundant. Isolated comments were that frequent changes to training and qualifications served only to create work for those in training organisations, or to gain additional government funding.

Many felt that there was sufficient time to train, although others suggested problems. Where difficulties were described these arose through being a man down whilst the trainer was present or because of family commitments inhibiting opportunities to study at home.

All crews felt that training provided opportunities for more varied work opportunities, although a couple noted that this would depend on opportunities to swap, such as whether or not the crew (and this may only entail certain roles) undertook job rotation. However the need to assess all new personnel was noted, given that the skills of some ticketed workers were questionable. Only a couple of crews reported that additional training might be reflected in better wages, whereas the remainder noted that their income was unchanged regardless of what training had been undertaken.

5(b). Raising awareness of training availability

Specialist interviews – FITEC was the main source of information about training availability; this included the circulation of brochures to contractors (by post and from Regional Training Advisors), use of the internet, email and through a series of workshops targeting assessors' own understanding of the new training structure.

Harvesting crew discussions – The main information sources for crews were trainers (8, although a couple questioned their credibility) and the forest supervisor (10). Many also thought that crew managers/ foremen were a good information source (6), although reservations concerned their greater emphasis on production. A small number of crews (2) met with workers / family members from other crews (chance meetings, crossing over when crew numbers were down) and also found this a good

Training effectiveness- general

Explore how information dissemination concerning training could be improved through the range of communication methods described

information source. However, whilst some spoke with truck drivers any information shared was seen more from the perspective of gossip. Most crews felt that they had no or only irregular contact with visitors from ACC (8) or OSH (7). The exceptions were a small number of crews that had regular visits, found them useful and welcomed the input. Annual breakfast meetings in January, mentioned by some crews, were the only contact for the remainder.

(NB: question duplicated in both interviews) Regarding different media used the main resources were information from FITEC, newsletters and hazard alerts. FITEC information (including newsletters, magazines and emails) was passed on either by trainers (in one case a forest company rather than contractor-appointed trainer) and crew managers; other than the crew managers none received any information at home. Both email and hard copy resources were described; although some problems with people not having a computer or the burden of having to repeatedly print out emailed information to bring in to the crew was reported. One crew indicated use of another training provider rather than FITEC, but noted that no information was received from them. Newsletters (from the forest company, FITEC or OSH) were received either monthly, three-monthly, irregularly or not at all. Whilst there were isolated comments that these repeated information already known, most welcomed information such as accident details / statistics, how others crews nationally manage hazards or problems, and a general opportunity to raise awareness and keep informed. A number of crews also read newsletters from other forest companies and noted that it was helpful to know what others were doing. Many of the crews (6) also read the magazine 'Logger' when this was bought in to work; there were isolated comments that this should be provided free to the industry. A criticism of the bought publications were that there is too much emphasis on commercial material. The creation of a database or guidance on the best machinery / tools or logging systems for different jobs or work situations was proposed as a resource that would be welcomed. At work all information was stored either in a smoko hut or work van. Materials appeared to be vulnerable to water / mud damage.

The internet was used by some members in about half the crews. Lack of access / knowledge was a barrier to use, but where it was used this included: access to personal record on the FITEC website; drug and alcohol information on the NZFOA website; and a general search regarding work equipment. A couple also praised the weekly email system 'Wood week' and 'Friday offcuts'.

Information from accountants was a good information source for a couple of crew managers. Conversely the radio, TV and pub were not seen as good information resources (although a few had watched an American series on Sky TV – Axmen – and were critical of their safety performance).

5(d). Follow-up training and 5(i). Evaluation of effectiveness through skills assessment

Specialist interviews – A range of spontaneous in-house contractor and forest owner / manager schemes to review competence of trained crews was described; these included spontaneous observations (such as task technique, seatbelt use, guy rope anchor stability, chainsaw technique etc.) at any stage by the foreman, trainers or, alternatively, by an independent audit (such as Topspot) on a scheduled / monthly

- **Safety training needs**

- **Safety incentives**

Identify whether competence / performance assessment or skills audit meets the criteria of 'follow-up training' and skills refreshment.

<p>basis.</p> <p>A failed initiative to introduce a voluntary certification scheme in one region (to monitor competence of those already holding National Certificates) was described. It was also reported that one forest owner / manager had independently introduced one such scheme of this nature for professional fallers and another has plans to introduce refresher training as part of a Safety Culture training initiative.</p> <p>Difficulties experienced in some areas with recruiting people with unit standards was reported, as well as difficulties in instigating reviews of supplementary skills were also reported.</p>	<p>Identify whether a more systematic approach to skills review, with involvement of the forest company / trainers, might be appropriate for the industry.</p>
<p><u>Harvesting crew discussions</u> – There were mixed responses regarding the undertaking of skills audit. Some attributed this to the work undertaken by visiting trainers (for example shadowing fallers or other new crew on a once or twice-monthly basis) (3), whereas others were undertaking this in-house. For those undertaking this role within the crew (other than one that programmed review at 3-6 month intervals) the skills audit was seen as something much less formal – a process of generally looking out for co-workers and intervening as necessary to promote safe and skilful working practice (3). Some crews had no particular strategy (3); isolated comments included comments that a skills audit might disrupt smooth running of operations, be overbearing for the individual, or that the forest company staff should keep an eye on the crews. Alternatively there were a couple of comments that greater intervention in auditing by the forest company and/or trainers would be welcomed. None described the skills audit as follow-up or refresher training, although one felt that it would probably serve the same purpose. ‘Moderation’ was another term used to describe evaluation of the assessment of workers’ skills but no one provided any details of this practice.</p>	<p>Generic Explore rationale for and reasons for success / failure of the voluntary certification scheme</p>
<p>5(e). ‘User-centeredness’ in training and 5(f). Choice of communication styles (reading ability) <u>Specialist interviews</u> – Small-group training was more prevalent among the contractor training courses, whereas a range of methods for fieldwork training were described (such as verbal instruction during on-the-job training, 1:1 training, trainer awareness of learning styles and greater use of visual mediums); training was reported to take longer among those unable to read. The adoption of cartoons, drawings, good layout and generation of interesting text was also considered an important part of written training materials; the provision of DVD training guides that could be taken home to watch was also promoted.</p> <p>Additional measures described were the encouragement of workers to look out for each other and supplementary communication methods through use of head set radios for each worker (described as uncommon), or use of a whiteboard for interactive use by all crew.</p> <p>Nevertheless, there were a number of concerns about poor numeracy and literacy, especially with written activity required for taking qualifications; there was isolated concern that Unit Standard wording was too much and that some information (information pamphlets etc.) did not filter through to field workers. Brevity of written materials, with a conclusion at the front was welcomed.</p> <p>However, it was also reported that trainers now have guidance material to assess numeracy and</p>	<p>Logging - mechanised Explore drivers / barriers to uptake of radio communication between crew members</p> <p>Communication and literacy Explore whether training media could be extended to include greater use of audio-visual materials</p>

<p>literacy. One interviewee reported a case of provision of numeracy and literacy training to crews, but it is not known whether this is widespread.</p> <p><u>Harvesting crew discussions</u> – Most crews felt that a mix of one-to-one and group training is appropriate – one-to-one specifically for task skill development and because of different underlying knowledge and skills between people in the crew. Alternatively classroom style training was considered more appropriate where individual attention was not warranted (health and nutrition or first-aid training for example). Classroom style training was also considered a good opportunity to hear a variety of opinions, to meet with others in similar work situations, and to undertake and complete training in a single sitting. Opportunities to use different media (such as slide shows) were also described.</p> <p>Literacy problems in the industry were noted and there were a number of comments that the training booklets provided by FITEC are quite complex and meant that some workers felt disadvantaged because they could not learn from them, or reproduce answers ‘by the book’ during assessments. Greater use of learning and assessment by observation and discussion were suggested. A few crews had had access to training videos / DVDs and these received a positive response and suggestions that they could be extended to cover a wider range of different techniques and work situations. Others however had not seen any videos or DVDs and felt that these would be welcomed, especially by those with literacy problems.</p>	<p>Generic Explore successes /failures of isolated interventions such as the whiteboard</p>
<p>5(g). Target all levels of seniority</p> <p><u>Specialist interviews</u> – A mix of resources were described and these were aimed at Supervisors, Foremen or other management roles within contractor crews; providers described were FITEC, LFITB, FICA and BDO, and it was reported that they are funded either by contractors or forest owner / management companies; details regarding volume and spread of uptake are unknown. Typical areas covered were negotiation skills, job costing, how to manage people etc., and they were described as First line or Business Management courses. It was not clear whether these were Unit Standard courses.</p> <p>From an overview perspective it was reported that Operations Management training has been poorly supported in the past, and there is no longer a training provider for the National Certificate. An underlying problem reported by one interviewee was that many companies are very production orientated, rather than trained to employ as such, and that levels of competency and hands-on roles within the crews vary. Others felt that there continues to be a lot of effort directed towards levels 2, 3 and 4, yet training / development for the Contractor Manager is under-addressed. Nevertheless, this is currently under review by FITEC; as part of the Diploma review contractors are being asked if they want a qualification in business management.</p>	<ul style="list-style-type: none"> • Safety attitudes • Safety incentives <p>Explore drivers / barriers to training of Supervisors / Foremen.</p>

<p><u>Harvesting crew discussions</u> – There were isolated comments about a lack of opportunities or career direction once all the tickets had been acquired. Becoming a trainer was suggested, although it was noted that this perhaps would not suit everybody.</p> <p>There were mixed feelings about whether undertaking business skills training would be welcome. A minority were against it, describing costs through downtime, already tight profit margins for the contractor, and the chance that the trainee may then leave. Greater numbers felt that they would welcome such opportunities, although many of these felt that it would be more appropriate only for those aiming towards contracting or shareholding. A leaning amongst many workers to more physical work and avoiding reading and writing was also seen as a barrier to uptake.</p>	<p>Generic</p> <p>Explore barriers to career advancement and how career direction might be facilitated for all worker age groups</p>
<p>5(h). Management & crew consultation in defining training needs</p> <p><u>Specialist interviews</u> – The development of a training plan for each worker by the contractor was described. Although this records existing skills and those being aimed for in the future, it is not clear what process is adopted to determine the future ambitions for each worker. Nevertheless, it was also reported that these are used as a tool to demonstrate good management systems in the tender process. Additionally there is liaison between the FITEC Regional Training Advisor and the crews, the ACC Mentoring programme, and periodic audit / assessments.</p> <p><u>Harvesting crew discussions</u> – Crews were generally positive about the personal training plan and felt that it was a good development (6). Where reservations were voiced these were because: most of the crew have already completed all the training; where people undertake varied jobs they may not be on the same tasks when the trainer arrives (and hence the programme is disrupted); and the contractor does not have time to get more involved in developing and directing the plan.</p>	<p>Safety training needs</p> <p>Explore how crew members can have more control over their own training development</p>
<p>5(j) Other .. incorporating (13b). Accessibility and availability of trainers / assessors</p> <p><u>Specialist interviews</u> – A number of concerns were raised about the training / assessment process. An initial concern was that there was a lack of understanding within the industry of the benefits to be gained from somebody who has been trained to train (rather than relying just on the buddy-up process). Accordingly it was reported that FITEC had focused more on training the trainer and adoption of different media (e.g. Powerpoint / DVD) to teach.</p> <p>Another felt that it was a mistake to combine the trainer and assessor roles; one suggested that a trainer should not be able to assess his own trainees, yet assessment was also seen as a more lucrative role, with 'training' seen as the poor cousin. There was also general concern that training and assessing is not a good livelihood (and that many also take on auditing and other activities), and that it might be better to have fewer, but more active, people in this role.</p>	<p>Training & assessing provision</p> <p>Explore barriers to assessor availability</p> <p>Explore concerns regarding trainer payment systems and make findings available to industry</p>

<p><u>Harvesting crew discussions</u> – Many trainers also assess their own trainees (2). Whilst none of the crews felt that this caused a conflict of interest there were concerns that trainers were paid according to the volume of tickets provided (3). Isolated comments were that because the trainers are not provided with regular and sufficient funding or wages, this creates underlying pressure for them to pass trainees too early, and a desire to focus on apprentices because greater numbers can be trained in groups. There were concerns that being ticketed too early could create over-confident workers, whereas those without a ticket may in fact be very competent at their job – at times more so than the trainer themselves.</p>	<p>Generic Explore the dynamics between training and assessing and drivers for undertaking such roles</p>
<p>Supervision (Style of supervision, different supervision for different workers, training of supervisors)</p>	<p>Possible future information needs</p>
<p>6(a). Supervision of inexperienced workers (loggers within 1st year); 6(b). At the start of a new task; 6(c). For difficult tasks, terrain & busy periods; 6(d). On monitoring the use and maintenance of PPE; 6(e). Own skill development (knowledge of hazards & control measures)</p> <p><u>Specialist interviews</u> – A mandatory requirement for supervision was noted. This was described as a contractor rather than a forest owner / management company responsibility and that the crew manager might deal with the men in a different way than that of the forest owner/supervisor. It was not clear what these management techniques might entail, but there were concerns that this is an area for development of role clarity, especially as there have been complaints from contractors that they are over-supervised. However adoption of the systems monitoring process by forest owners / management companies was also promoted as a way in which contractors could operate with more independence (rather than through the traditional weekly review process).</p> <p>For inexperienced workers, supervisory methods were described as 1:1 or buddy-up with an experienced worker, which is gradually reduced as competence develops. It was also reported that additional supervision (and determination of competence, ticketed or not) would be needed for new starters, for a new harvest block or special conditions (such as windthrow), and for the first month start back after Christmas.</p> <p>There were isolated opinions of supervision being both an area of success and in need of improvement.</p>	<ul style="list-style-type: none"> • Skill acquisition by new recruits • Supervision – of inexperienced workers <p>Provide some guidance to industry regarding different scenarios, baseline skills and experience and the type of supervision that would be appropriate</p> <p>Role clarity Explore boundary definition between contractors and forest owner / management companies & identify any implications for role clarity</p>
<p><u>Harvesting crew discussions</u> – Most crews described the supervision of new starters. Often this was through a buddy-up system, or through general observation by all crew members of the progress of new starters. Length of supervision generally appeared to depend on the difficulty of the work conditions and /or progress of the individual; example timescales of ½ a day for a very experienced worker, to 40 hours, 2 months or even 6 months (if straight from college), were given. One commented that more clarification would be beneficial.</p>	

Equipment, tooling machinery (Hand / mechanised tools; large plant, individually or contractor owned; on-hire equipment / second hand equipment; deterioration, maintenance, duration of use)	Possible future information needs
<p>7(a). Chainsaw design (size, chain brake, low kick-back chain)</p> <p><u>Specialist interviews</u> – The development in chainsaw designs and controls to improve balance, comfort, weight and reduced kickback were acknowledged. Whilst the chain brake was seen as a positive innovation, this was in combination with other safety design features such as chain catcher pegs. However there was isolated concern that the low kickback chain inappropriate for production work and that the standard full chisel chain is needed.</p> <p>With purchase of only one saw per person, the need to have flexibility and ability to match the saw to any task was seen as paramount; none perceived that chainsaw size was a consideration in purchase choice. Indeed there was isolated concern relating to chainsaws being under-powered for the NZ environment – although designed to meet US and European emissions standards – leading to frustration and more frequent breakage.</p>	<p>Chainsaw – size for delimbing</p> <p>Identify manufacturer initiatives relating to chainsaw size and weight revision</p> <p>Review measures that might facilitate smaller saw use, where appropriate for certain tasks</p>
<p><u>Harvesting crew discussions</u> – Most crews used chainsaws. Innovations such as the chain brake and chain catcher pegs were unanimously popular; however there was indication from a couple of crews that the chain catcher pegs supplied at the point of purchase were not sufficiently robust and had to be changed. In contrast none used the low kickback chain, indicating that its slow speed and poor performance made it ineffective for professional use, although possibly more appropriate for farmer or pruning use.</p> <p>Whilst none felt that there had ever been major difficulties many felt that there had been improvements in design for maintenance, indicating that they are now a lot easier to maintain (6). Improvements were to adjustment of the chain, air filters, pre-filters in the air filters, ability to clean and take sprockets off down the hill, and take the clutch off. However there was isolated concern that some saws have become more complex, requiring professional shop repair rather than being able to undertake maintenance work at home. There was also concern about noise emissions from the saw and exposure when using worn out ear muffs.</p> <p>There were only isolated comments that indicated smaller saws were being used. Some felt that a smaller saw could perhaps be used by older workers, or on the skid site with a larger saw for falling (although one felt the opposite was the case – larger saws for skid work). The disadvantages of a smaller saw were described as more demanding work associated with having to push and sharpen more, and slower production. The advantages of using a bigger saw were: providing power (describing at least a 90cc saw needed for cutting trees); and better and faster cutting resulting in easier work with less bending over. Some crews indicated that they used the smallest saws they felt that they could get away with, but would happily use a lighter saw if such a product were available at the same power level.</p>	<p>Generic</p> <ul style="list-style-type: none"> • Explore chainsaw innovations (including noise and vibration attenuation) and their implications on the performance of design developments • Explore any adverse impact to equipment use within NZ of design specifications for international standards • Identify why chain catcher pegs supplied at the point of purchase are inappropriate

<p>Many felt (6) that although saws were probably not smaller than they had been in the past, they had become slightly lighter in the past 10-20 years. Other improvements in anti-vibration features and balance (depending on selection of appropriate blade length) were reported. A strong loyalty to either Stihl or Husqvarna products was often described.</p> <p>The discussions also revealed that other aspects needed to be considered, such as: each person having only one saw; selecting equipment most suitable for the job; perceived weight depends on each person's capability; and user technique in saw use and sharpening.</p>	
<p>7(b). Static delimber introduction <u>Specialist interviews</u> – Introduction of the greater mechanisation, including the static delimber was seen as a great success by all. Benefits were described as eliminating the hazards of manual felling and delimbing work, more timeliness, a clearer landing (and hence risk of STF through walking on slash), and requirements for fewer men especially given labour force shortages and more enthusiasm among potential recruits for machinery operation.</p> <p><u>Harvesting crew discussions</u> – no comments offered</p>	<p>Harvestech Static Delimber Explore the nature and distribution of mechanisation initiatives, (including for the Harvestech Static Delimber).</p>
<p>7(c). Vehicle – mechanised log maker (control / stem design, display brightness & size, visibility improvements through cleaning and guarding design, sun shading cab and seat adjustability) <u>Specialist interviews</u> – There was widespread agreement that there have been very successful improvements in mechanised log maker design development. Improvements included a wider wheel base and greater ground clearance (improving stability and work ability), sealed cabs to reduce noise, provision of air conditioning, bullet proofing and tinting of the glass, guarding and protection of the side of cabs, improved seat comfort and 'ergonomic' improvement to controls and displays [NB: details of these particular ergonomic improvements are unknown].</p> <p>However some concerns were also raised; these included misting over, discolouration or scratching of the glass, calibration problems (it was reported that if the chain breaks it flies off like a bullet) and a cutting speed issue through having to walk back and forth up and down the log to input the data. It was also noted that there are health and wellbeing issues for workers, including mental stresses from production demands and using a very expensive machine, and weight gain and loss of fitness (especially for those formerly in faller roles).</p>	<p>Vehicles – mechanised log maker Identify manufacturer initiatives relating to cab design and user-centeredness therein</p>
<p><u>Harvesting crew discussions</u> – There were mixed reports concerning improvements in visibility. Many comments were positive (4) and attributed to better design and vehicle lighting. Where negative comments were provided, these concerned: poor visibility as a result of plastic windows which become contaminated with mud (wipers can't be used for fear of scratching) and which present visibility problems when the sun shines; and poor visibility arising from guarding.</p> <p>Whilst there were many positive comments about the much better protection offered by modern day guarding, an isolated comment was that this was excessive and increased the potential to be trapped within a vehicle. Additional comments relating to guarding and ease of maintenance; most (6)</p>	<p>Generic</p> <ul style="list-style-type: none"> • Explore task components of mechanised log maker work and physical and psychosocial demands therein • Identify usability implications that might arise through retrofitting machinery (e.g.,

<p>felt that access to filters, oil etc. was improved in newer machinery, whereas a smaller number (3) felt that the position and weight of guarding made access for maintenance more difficult. It was considered that this problem would be minimised in purpose-built machines, but problems had arisen because excavators are being revised for use by industry in ways possibly never intended by the designers. An alternative perspective was that different brands such as the Volvo offered better access features than Komatsu or Hitachi, and that newer models were not necessarily more straightforward.</p> <p>Most felt that there had been many positive developments in cab design. Typical reports were that total enclosure offered protection against the weather and noise, and allowed use of air conditioning and radios. Improvements to seating comfort and ability to slide it into different positions were also reported.</p>	Guarding placement and access)
<p>7(d). Vehicle – skidder (seat belt redesign/ location)</p> <p><u>Specialist interviews</u> – The use of seatbelts was described as compulsory, one of the 10 critical rules required within the industry, and addressed in safety audits. A recent ruling of a minimum 75 mm diameter was also described, although one interviewee felt that more work and greater collaboration with suppliers was needed in this area (in terms of application of previous research findings).</p> <p><u>Harvesting crew discussions</u> – An isolated comment concerning seat belts was that they offered a more secure seated position whilst working on steeper ground; however broken seat belts or their absence in older equipment were reported.</p>	<p>Vehicles – skidder seat belt usage</p> <p>Explore and define frequency that seat belt function should be assessed</p>
<p>7(e). Vehicle – Waratah, feller buncher (control / display designs)</p> <p><u>Specialist interviews</u> – Improvements to controls – using palm triggers rather than rocker switch on top of lever were described.</p> <p><u>Harvesting crew discussions</u> – no comments offered</p>	<p>Vehicle – Warratah</p> <p>Identify manufacturer initiatives relating to user interaction with the Warratah.</p>
<p>7(f). Access /egress design (slip /fall prevention)</p> <p><u>Specialist interviews</u> – Behaviour, such as ensuring a 3-point hold during access/egress, was described but a number of design developments by manufacturers were also reported. These included wider entrances on machines, hydraulics to lift up engine hoods, diggers with handrails and a step up, wider and wood-lined (to enable use wearing spike soled boots) running boards around the periphery of a machine to enable operator movement, and hydraulic ladders (fewer angles and with wider walkways) in forwarders – it is not known how widespread these features are within industry. There were also reports that individual modifications may be made by contractors, but that there is no national programme for this.</p> <p><u>Harvesting crew discussions</u> – Many crews identified that there can be problems getting on and off vehicles, especially from slipperiness if accessing via tracks. Vehicles getting increasingly bigger or being raised up higher were considered contributory causes to these problems. A range of additional</p>	<p>Vehicles – maintenance</p> <p>Identify initiatives relating to improving vehicle access / egress and extent of implementation within industry.</p>
	<p>Generic</p> <p>Explore range of contractor modifications within industry and</p>

<p>features that might help access (especially for shorter people) were proposed, such as additional steps/ extra rungs and handrails. However these were often seen as very vulnerable to damage or removal by trees and branches (although one mentioned the use of a hydraulic step on a forwarder). The adoption of alternative techniques were proposed as ways of mitigating access / egress difficulties, and these included parking next to a log and climbing down onto that, and angling the cab to enable descent onto the tracks .</p>	<p>usability therein</p>
<p>7(g). Rear vision video – Bell Logger <u>Specialist interviews</u> - Few interviewees had much knowledge of whether this intervention had been introduced or not (although one recalled attachment of a rear vision video to an excavator); the reduced prevalence of Bell use was also noted. For those aware it was described as a retrofit (part of the guarding package) by the retailer. Problems associated with this innovation were described as recognition difficulties through use of a flat screen, added expense, and possible avoidance of use by those already familiar with traditional operational methods (i.e., turning around) even by those trained to use it.</p>	<p>Vehicles – rear vision video system for Bell Logger vehicle Identify initiatives relating to adoption of the rear vision video system, extent of implementation within industry and evaluate successes / failures since introduction</p>
<p><u>Harvesting crew discussions</u> – None of the crews used rear vision video and many commented that it would be impractical due to liability to get broken or covered in mud.</p>	<p>Generic Explore feedback from those who have received training regarding behaviour change to use a rear vision video.</p>
<p>7(h). Other <u>Specialist interviews</u> – There were reports from both forest owner / management companies and contractors indicating that there are good relationships with manufacturers / plant suppliers. Some innovation was reported to have been imported into NZ as the result of ergonomics improvements in machinery design undertaken overseas (e.g., Sweden / USA). A number of these have become mandatory innovations (such as rollover protective structures (ROPS), chain guarding on harvester machines), whereas other innovations have resulted from direct liaison between contractors and engineers (NB: harvesting machines comprise different manufacturer products. Example innovations (excluding those already described in 7(a) - (g) include:</p> <ul style="list-style-type: none"> • Modification of the Waratah head to allow calibration in both forward and reverse directions • Putting risers on log trucks to improve balance and inhibit rolling • Use of a long-nosed truck (rather than cab over) to avoid kickback and offer better operator performance • Modified excavator base to permit log bunching on breaking out slopes • Use of a fixed rather than a swinging grapple • Use of a tong thrower (a high speed winch) to avoid handling of wires, reduce physical workload and 	

<p>risk of “sprags” during breaking out</p> <ul style="list-style-type: none"> • Use of electronic chokers to reduce handling interaction during breaking out • The use of Skycar carriages with lighter rigging • Welding bigger grousers onto tracks (see 4h) <p>One person described greater adoption of a swing yarder (rather than the tower with drop line) as a result of learning new skills and operational techniques from visiting Canadian workers.</p> <p>The driver for change appeared to be fewer men on the ground and greater productivity; however additional machinery purchase costs were acknowledged. There appeared to be no particular mode of disseminating information about these innovations, although there were isolated reports of articles in Logger magazine. In addition it was also reported that a new Approved Code of Practice for operating machinery is in development.</p> <p>Changes to choice of equipment used were also described. These included a move from using a wheeled loader to a hydraulic excavator (with a knuckle boom) and from skidders with open cabs to forwarders or excavators with closed cabs (one described a general move from wheeled to tracked machines or to machinery with fully enclosed cabs and better design features). Nevertheless, one commented about the economic downturn and the negative impact this would likely have on a move to the newer style machines.</p>	
<p><u>Harvesting crew discussions</u> – A number of revisions to machinery were described; typically these allowed purchase of less expensive equipment rather than purpose-built logging machinery. The need for machinery with qualities such as more versatility, power and size was described. Design revisions appeared to be instigated by the contractor manager. Common revisions described by many crews were: the addition of extra grousers (to treads and the tail hold) to improve traction (especially on sloped ground); elevating the cab (for better operator visibility, although one respondent felt this unnecessary); additional guarding (for operator and vehicle protection); addition of a longer boom with greater reach; addition of a high end lift; the addition of an attachment to the excavator arm so that it can push trees; additional lights; and the addition of a traction grip plate onto the back of the skidder (for operator access and to allow pushing / pulling of trees without damaging the roller).</p> <p>Few commented on new machinery preferences, although there were isolated comments suggesting new purchases of grapple skidders, haulers, buying a digger if you couldn’t afford a Waratah, and buying a forwarder if you already had a Waratah.</p>	<p>Generic</p> <ul style="list-style-type: none"> • Explore range of contractor modifications within industry and usability therein • Explore cost-benefit of machinery modifications • Explore nature of communication regarding design innovation ideas • Explore development of equipment choices for current day
<p>Layout / space / environment (Movement / access, adverse light, noise, temperature, wet, vibration)</p>	<p>Possible future information needs</p>
<p>8(a). Skid / landing transit route layout / safe zones (person: vehicle: log overlaps, introduction of systems to de-phase mechanised log making & people)</p> <p><u>Specialist interviews</u> – Interviewees reported a mix of interventions relating to mechanisation, layout and</p>	<p>Logging - mechanised Skid site layout and processes Explore drivers / barriers to</p>

<p>work planning that had each influenced layout and site design.</p> <p>Mechanisation improvements included the use of a swing yarder (which can be placed off the skid site and needs only 3 guy ropes) rather than a static pole (requiring multiples ropes across the skid site), and the increased use of forwarders for road lining and ground-based salvage.</p> <p>New style layouts were also promoted and primarily these concerned measures to reduce co-presence of men and machines in any work area, but with greater emphasis on increasing use of machinery. These included bench style / split level landing methods (with forwarders laying out the wood in readiness for QS as a 2-phase process), increased prevalence of 2-staging (incorporating separate landing for exclusive man or machinery use, especially where only small skid sites exist, or where a previous hauler pad is available), and zoned areas for safe access for the saw, sharpening, refuelling, parking and truck access.</p> <p>However, some problems were also reported. Although raised productivity and safety is reported from such initiatives, it was also acknowledged that there may be reluctance to invest in the additional machinery costs associated with such initiatives (given existing pressures from debt and current log markets). Additionally there were also reports of increased handling with 2-staging and problems arising from restrained skid site sizes (both in creating congested man: machine zones and maintaining the desired level of productivity). Small skid sites were seen to have arisen from various influences; firstly as a forest owner / management company initiative to minimise taking productive land out of use (and costs associated with reduced growth rate on compacted ground and those incurred to rehabilitate the land) and secondly, as a problem with Regional Councils restricting resource consent (and volume of soil that can be moved from site). Nevertheless greater use of mechanisation was seen to have helped mitigate small skid site size.</p> <p>A work planning initiative whereby pre-emptive cuts at 12 -18m permit stems to be trucked off-site to a log processing yard was also described. It is not known how prevalent or efficient this intervention is. Time-of-year effects relating to roading installation (especially affecting accessibility on farmer blocks) and environmental constraints were also reported.</p> <p>Resources suitable for design development were described as the FITEC Best Practice Guidance and Approved Code of Practice; there is also a newly published booklet on log truck safety. Development of a Unit Standard for the design of skid sites was also described, as was the availability of an 8-week FITEC course on harvest planning (including roading / skid design).</p>	<p>improved skid site operations</p> <p>Establish whether log cutting frequency on skid sites is factored into production calculations.</p>
<p><u>Harvesting crew discussions</u> – There were a number of concerns that skid sites are too small (6), although a couple of crews had no problems. The outcome of small size was described as having to pile logs higher (depending on production volume) and ultimately putting pressure on everybody. It was suggested that the number of log grades or stacks should be limited accordingly (say from 10 to 5). Whilst some felt that the nature of the terrain dictated the size of the skid that could be achieved and that forest companies did their best, others felt that small skid site size was influenced by their financial and time constraints. A couple of crews described pushing out the size by loading up logs around the edge.</p>	<p>Generic</p> <ul style="list-style-type: none"> • Undertake a cost-benefit analysis of the various skid site innovations • Explore drivers / barriers to optimum skid site designs, including all interested parties

<p>The importance of having a flat skid site (to prevent log rolling or movement) was noted. Only once crew discussed organisation of the skid layout; this was determined by the two skidder operators.</p> <p>Skid site size was also seen to affect truck access in a minority of cases, such as where there is only one route and trucks have to turn around on the site, or disruption to the work of those on the skid site if they are close to the loading area. However, others felt that they could work around each other through use of the safe area, good communication and wearing of correct clothing. Work disruption through inconsistent truck arrival times was described by many crews (6); typically this concerned: trucks arriving during smoko; at 4pm; none at all for many hours and then arriving in groups of 6-10 at once; inconsistent volumes day by day (such as 10 one day and 4-5 the following day); and turning up in the night (N. Island especially). Dominance by single trucking companies was seen to influence such events and there was concern to that inconsistent arrival times resulted in excessively high logs piles requiring use of a ladder or even having to bring them back down to stencil / mark up.</p> <p>Regarding innovative work techniques, none of the crews transported stems for processing off-site, although a small number were in the process of starting such a process and anticipated less mud and handling as a result. One crew had trialled and rejected off-site processing in the past. Only one crew reported taking delimbed stems to another landing for processing; this was done in the winter when conditions were wet. None of the other crews were involved in operations where work was phased or undertaken in different stages. Reasons for this were: being a machine processing operation; being too small in production volume, and not having access to any more skid site space. One crew described occasional bunching of stems, but felt that this was inhibited through working on too steep terrain.</p> <p>A variety of new equipment choices or barriers to choosing new equipment were described. Isolated reports suggested that the use of a swing yarder was seen as something more appropriate for shorter haul distances, whereas the static pole suited areas where there were bigger distances and hills. Three crews reported use of electronic chokers; a couple had not persisted with them as they did not get sufficient lift from the ground and were at risk of damage. The use of a motorised carriage was also described, but the costs were seen as prohibitive and off-putting for the forest company.</p>	<ul style="list-style-type: none"> Explore the differences between the North and South Islands in truck arrival times and underlying reasons for the discrepancies
<p>8(b). Colour choices (↓ red, green, pink and ↑ silver, blue, orange, yellow) <u>Specialist interviews</u> - Interviewees reported that fluorescent colours are used primarily (fluoro pink and yellow), although stencilling / branding may be done with other colours (bland blues or dark green are avoided, to enhance clarity). One interviewee was concerned about the volume of paint required, the contamination that occurs and potential hazards arising from use.</p>	<p>Generic Explore health implications of exposure to paint</p>
<p><u>Harvesting crew discussions</u> – no comments offered</p>	
<p>8(c) Other.</p>	

Target / payment (Reward, benefit)	Possible future information needs
<p>9(a). Financial incentives (quality of work, by grades of logs)</p> <p><u>Specialist interviews</u> – Criteria for the establishment of contracts and production volumes between the contractors and forest owner / management company were described. These included: training requirements, anticipated difficulties in extracting the wood, roading infrastructure, equipment needed, number of people required, current fuel costs, contractor management processes (such as administrative processes, near-miss reporting history, site tidiness, attendance) and volume requirements.</p> <p>Volume requirements (a flat rate/ tonne) appeared to be the primary mode to determine payment rates. Occasional variations according to different grade requirements were also described. In the first instance, if the environment was too unpredictable (e.g., windthrow or unusual circumstances) a day rate might be negotiated with the contractor to reduce risk taking. The second instance would be if maximising a particular grade was specifically required; this was seen to create more waste yet maximise financial gains for the wood. Nevertheless quality and value recovery would be monitored; it was reported that although these offered no financial incentive, payment would be withheld if ‘out of spec’ logs were created and correct provision of logs could not be provided to the customer.</p> <p>The paradox of expecting quality, value recovery, safe operations, and environmental protection, whilst rewarding only volume extraction per tonne was noted by a couple of interviewees. The need for an alternative incentive system (i.e., by output, quality etc.) rather than by volume was proposed.</p> <p>Resources to guide this process were described as a new forestry Diploma (supplementary to the existing National Certificate in Operations Management) on working out unit rates / bonuses etc. The development of a DoL initiative looking at contractual agreements was also described.</p> <hr/> <p><u>Harvesting crew discussions</u> – Crews appeared to be paid on a fixed wage scheme(6). However, a couple of crews described an additional volume-based bonus scheme, but these appeared to be sporadic or adversely affected by inconsistent production targets. The lack of much profit margin, guidance received on a training course, and potential to damage crew culture (through generating resentment towards people not pulling their weight) were proposed as reasons for not adopting a bonus scheme.</p>	<ul style="list-style-type: none"> • Log making – motor manual • Production targets - determination <p>Explore drivers / barriers to diversify reward criteria for production.</p> <p>Review the process used to determine production targets and expected operator performance.</p> <p>Explore whether there are social pressures to achieve production targets</p>
(b). Other ..	

Work scheduling (Work pace, breaks, duration, shifts frequency)	Possible future information needs
<p>10(a). Work-rest durations (chainsaw, feller-bunchers, breaker-outs, large machine operators) and 10(b). Self selection of breaks / micropauses, 10(c). Shift schedule (start, finish), 10 (d). Action on high heat days and 10(e). Rest day provision after extensive heavy periods</p> <p><u>Specialist interviews</u> – The taking of both one (at 11.00) and two breaks (at 10.00 and 13.00) per day were described (although one felt that at times 3 breaks might be taken), and this was generally felt to be at crew discretion but may also be subject to regional variations. There was isolated concern that crews might be taking fewer breaks now, than when the original LIRO work (recommending 2 breaks) was published and promoted. It was reported that either 1 or 2 breaks was promoted during training.</p> <p>Breaks were seen as important as much to fulfil social needs as for rest and hydration / nutrition (and it was also suggested that they might also be used as an opportunity for 10-minute power naps); however the staggering of break times within crews was also described. In another case reducing breaks from 2 to 1, with early knock off was also reported, especially around Christmas or in summer time to avoid fire risk or the hottest part of the day (having started at any time from 05.00 but finishing by 14.00).</p> <p>Action on high heat days was otherwise described as ensuring adequate fluid intake, taking advantage of shade where possible and use of appropriate clothing. An upper temperature limit dictating work knock off was described for Australia, but it is not understood that there is anything comparable here in NZ. There was an isolated report that rest day provision after extensive heavy periods may happen in particular situations, but action in other cases would be upon emphasis to go home and rest.</p> <p>The taking of micro-breaks, as needed, was described as an individual responsibility. However in one case programming of the Waratah to stop at specified intervals (to give operators the chance to take micropauses) was described, but it is not known whether its adoption is widespread.</p> <p>There was concern that some machinery drivers are pushed a bit hard (with some barely leaving the cab except to go to the toilet). Very early starts (e.g., from 01.00 in some cases) are acknowledged. In these cases contractors may chose to double shift, or go home ‘an hour’ earlier; however there was also concern that some of this is self-imposed, especially if drivers are reluctant to share machines. The early start was described as influenced by a number of factors. Firstly, in order to get loads off the skid site before the crews arrived on site, secondly as a result of truck drivers wanting to get the best value (such as 2 trips per day) out of the log truck, and thirdly in order to comply with delivery and storage requirements stipulated by mills and ports.</p>	<ul style="list-style-type: none"> • Fatigue – general • Fatigue in motor-manual tree felling and delimbing. • Feller-buncher operators • Musculoskeletal disorders (MSD) • Overuse (including repetitive motion) injures • Breaker-out work conditions • Logmaking – motor manual • Logging – mechanised • Shift scheduling – for large machine operators <ul style="list-style-type: none"> • Explore background to determination of break intervals and perceived consequences of taking at least 2 breaks. • Explore how crews reschedule their sleep in order to compensate for early starts. <p>Breaker-out work conditions Explore what initiatives relating to high heat days are implemented and typical barriers to adoption of organisational changes.</p> <p>Logging – mechanised Explore shift scheduling and training for mechanised log-makers.</p>

<p><u>Harvesting crew discussions</u> – A variety of work hours were described; these often varied according to time of year and, for some crews, depended on whether or not they drove machinery. Most crews worked 7 – 3.30 or 4pm (although one continued until 5pm), but with a later 7.30 to 8 am start (whenever light enough) in the winter. A 95-hour fortnight was described by one crew. Working hours for machinery drivers in a number of cases appeared to be longer; at times this would only be an occasional arrangement (4) whereas others routinely started work earlier than the rest of the crew. Very early starts appeared to be more prevalent amongst the N. Island crews, and for some this might be a daily arrangement. Using a couple of examples from machinery drivers, two revealed that their work might start at 3am (from one this entailing getting up at 1.30 or 2.30am), and work through until 3.30 or 4pm; another described working 12hrs/day, rising to 13/14 hours with travel. Concerns about lengthy travel to work were described, which combined with a 7am start meant that some crews had to get up a 4am.</p> <p>Crews varied in whether they routinely took one or two (6) breaks. Many took two breaks (6) or, if one was missed (due to truck arrival) went home ½ an hour early instead. None took longer than a 30-minute break (one crew reported that a longer time period resulted in getting cold and loss of momentum). For those that took one break it was noted that only this break was paid – crews reported both opportunities to take additional (unpaid breaks) and that that this was not permitted. One crew described a rotating smoko break, to ensure that production wasn't interrupted. However the taking of breaks together was also seen as an opportunity to discuss the work programme and catch up socially. It was reported that machinery drivers both took breaks with the rest of the crew (albeit interrupted if a truck arrived), or might take none at all.</p> <p>Overtime was undertaken by some crews (4), whereas others did none (1). One crew reported receipt of time-and-½ for working more than 80hours / wk or Saturdays. The additional holiday entitlement, although popular with the crew appeared unpopular with some crew managers; one stated that this was due to difficulties with manpower. One crew felt that they would not be able to take their 4th week of holiday. In an isolated case, graduated work pace in the first week after holidays was described, and this was appreciated.</p>	<p>Generic</p> <ul style="list-style-type: none"> • Explore management of work in hot conditions overseas • Explore prevalence of pre-programming Waratahs (or other equipment on site) to stop at specified intervals and user perceptions and implications upon performance • Explore work organisation arrangements of machinery drivers and the drivers / barriers to work hours and taking of breaks • Explore the chain of factors affecting scheduling of log removal from site and implications on driver / crew work organisation • Explore underlying reasons for the differences influencing machinery drivers' work hours between the North and South Islands.
<p>Work and job design (Workload, social support, personnel availability, communication channels, roles & responsibilities)</p>	<p>Possible future information needs</p>
<p>11(a). Job rotation (duration on any one task, impact on vigilance & boredom) <u>Specialist interviews</u> – Interviewees described the occurrence of job rotation, perhaps on a daily, weekly or 2-weekly basis; the advantages of a multi-skilled and workforce were acknowledged, but it is not known how widespread job rotation is in the logging sector.</p> <p>A number of over-riding factors limiting the implementation of this work method were described. These were lack of available skill variety within a crew to rotate all members to all tasks, resistance among crew members to rotation (especially older workers), variable desirability of some roles (e.g.,</p>	<ul style="list-style-type: none"> • Musculoskeletal disorders (MSD) • Overuse (including repetitive motion) injuries • Log making – motor manual • Job design

<p>machinery operation is highly desirable), greater certainty for timeliness and quality of operations for the contractor, lack of fitness among some crew (e.g., machinery operators) to undertake more physical activities (such as felling), and highly specialised skills (and hence learning time) for some tasks (e.g., hauler operations).</p> <hr/> <p><u>Harvesting crew discussions</u> – About half of the crews (5) were not undertaking job rotation, although some of these suggested that alternating to other jobs would be desirable or make their work more interesting. Other crews undertaking rotation described benefits such as preventing boredom, greater flexibility among the crew that can multi-task, and being able to target particular jobs that needed to be finished.</p> <p>A number of barriers to job rotation were described, such as skill and experience, training, fitness and age, different desirability of some jobs (such as machinery operation v. breaking out or skid work), and being able to work to production level.</p> <p>Various jobs appeared to be easier to pick up than others (albeit perhaps with co-worker supervision), such as breaking out and skid work. Ability to drive a hauler, skidder, or excavator appeared to be reasonably common, whereas felling is more limited to those with appropriate qualifications.</p>	<p>Identify drivers / barriers to job rotation and whether there are instances where the practical guidance has been adopted</p>
<p>11(b). Job enlargement <u>Specialist interviews</u> – There was little indication that job enlargement happens in the industry, except perhaps among those seen as good workers / team players and with the willingness and aptitude to take on more responsibility. Although covered in some of the management Units and Level 4 Certificate, barriers to job enlargement were seen as: limitation of good workers, transient populations, geographic differences in basic skill availabilities, existing workload demands, lack of ‘enlarged skills’ for people to take on board, demands for additional payments, and avoidance of additional responsibility by the workforce. It was suggested that programmes of a more practical nature (e.g., smoking cessation, nutrition, life skills etc.) needed targeting more so than career progression.</p> <hr/> <p><u>Harvesting crew discussions</u> – no comment offered</p>	<ul style="list-style-type: none"> • Overuse (including repetitive motion) injures • Logmaking – motor manual <p>Explore guidance and opportunities relating to job enlargement in the industry</p>
<p>11(c). Defining required crew numbers (breaking out, for extended days) <u>Specialist interviews</u> – Interviewees indicated that there is no specified number within a crew, and that this will vary with level of mechanisation, workload, contractors’ experience and lack of availability of a good labour force.</p> <hr/> <p><u>Harvesting crew discussions</u> – no comment offered</p>	<p>Breakout – retreat distances Explore whether guidance regarding numbers required has continued relevance and whether guidance for conditions requiring 2 breaker outs is stipulated.</p>
<p>11(d). Graduated work pace for new starters <u>Specialist interviews</u> - Graduated work pace was seen as a contractor responsibility. Expectations of skill, knowledge and physical ability are less initially, and it is expected that, after a few weeks (up to 90</p>	<ul style="list-style-type: none"> • Skill acquisition by new recruits • Supervision – of

<p>days) that the new worker should have increased to crew pace (and receive the same wage). The process may be relatively relaxed (with the new worker undertaking the most simple or buddied tasks), or entail a process of being set tasks to be observed, trained and monitored on. Being on the FITEC apprentice scheme or a training plan was considered a point of difference here.</p> <p>It was also noted that production target calculations (and use of British Standard 100 Rating Scale) are based on work-hardened workers rather than new starters.</p>	<p>inexperienced workers Provide some guidance to industry regarding different scenarios, baseline skills and experience and the type of supervision that would be appropriate for different scenarios</p>
<p><u>Harvesting crew discussions</u> – (see 6a)</p>	<p>Generic</p> <ul style="list-style-type: none"> Explore human factors implications of the British Standard 100 Rating Scale in production target calculations
<p>11(e). Use of buddy systems <u>Specialist interviews</u> – The application of buddy systems was described as relatively frequent for supervision or training of new starters, and addressed the Health and Safety Plans, the Bush Code and Best Practice Guidelines. It was also used as a method adopted during machine assisted falling to reduce fatigue, to provide an observer, and other assistance. A problem concerning this was described as difficulties in getting two people in the cab.</p> <p><u>Harvesting crew discussions</u> – (see 6a)</p>	
<p>11(f). Communication (between mechanised log makers & ground crew) <u>Specialist interviews</u> - A number of communication methods were described. The first of these was an interactive (to be updated by all crew) whiteboard, detailing the day's work and production plan. Additionally there were isolated reports of integral radio telephones with a microphone inside the ear muff which permitted communication among all of the crew at any time; where used this was described as very successful, although it is not known whether their use is widespread or whether resultant noise exposure has been recalculated. More traditional methods of hand signals or throwing something at the cab or a stick at the grapple (to get the driver's attention) were also described.</p> <p>A recent ruling for call in (at 30-45 minute intervals) by felling crews was also described, whereby the recipient, if they do not receive the call, has to investigate.</p>	<p>Logging – mechanised Explore drivers / barriers to uptake of radio communication between crew members</p>
<p><u>Harvesting crew discussions</u> – (NB: question duplicated in both interviews) Crews varied in their communication methods. Although all had radios their number and distribution varied. In some cases radios were available just to drivers of machines and vehicles (7, which in 2 cases related only to one single piece of machinery on site); in other cases radios were also available to fallers (3) or to breaker outs (3 and used in combination with a Talkie Tooter). Where radios were unavailable alternative methods such as revving up the saw engine, hand signals, throwing things at the cab, getting out of</p>	<p>Generic Explore drivers / barriers to use of alternative communication systems</p>

<p>vehicles /walking to talk directly, relying on a driver to check on fallers, or waiting until lunchtime were described. There were a couple of comments that a radio can adversely add to the burden of items that need to be carried around. One crew had tried radio communication within the ear muffs, but abandoned them in preference to hand signals.</p>	
<p>11(g). Measures to enhance crew commitment <u>Specialist interviews</u> – A variety of measures to enhance crew commitment were described. These included good management, fair wages, bonus payments if the entire crew turns up, productivity and quality bonuses, encouraging crews to plan and use their own initiative in their work, and greater understanding of the influences of home or social issues on work ability. Additional measures whereby crew members have opportunities to buy equity or join shareholding schemes were also described as quite common.</p> <p>Efforts at raising the profile of certain roles (such as log making) were also described, such as measures to improve conditions, morale and skill recognition through qualifications and training. A call for better understanding of underlying factors affecting motivation was made.</p>	
<p><u>Harvesting crew discussions</u> – Three crews felt that there was nothing to enhance commitment, whereas others described a range of aspects. Social functions included aspects such as being provided with meals, beers or fishing trips; these were relatively common and, for the most part appreciated, although there was an isolated comment that this was a little patronising. A small number of crews (2 or 3) were provided with a wage rise on achievement of a National Certificate or modules achieved. Awards or recognition of performance or achievement by the forest company were also reported; these included awards for crew improvement or newsletter publication of photos of those achieving national Certificates. The financial contribution by forest companies towards crew training was also a demonstration of pride in their workers</p>	<p>Generic Explore whether drivers/ barriers to job satisfaction could be improved further</p>
<p>11(h). Defining role clarity (contractors) <u>Specialist interviews</u> – There were conflicting reports on whether there is good role clarity; good communication was considered a key quality. One perspective was that job descriptions are already clear, whereas from another perspective blurred responsibilities between forest owner / management company Supervisors and contractor managers were reported.</p> <p><u>Harvesting crew discussions</u> – Only a few crews commented on role clarity. Responses ranged from no confusion, to occasional problems between the contractor and the forest company. Two examples were provided: firstly contradiction can occur when more than one forest company representative (e.g., supervisor, somebody dealing with quality) gives guidance to those on site. Secondly, a lack of clarity regarding whether or not representatives from the forest company attend site as a 'visitor', or whether</p>	<p>Psychological climate Explore the potential for role ambiguity between contractors and forest owners / management companies.</p> <p>Role clarity Explore boundary definition between contractors and forest owner / management companies & identify any implications for role</p>

they assume their own responsibility for knowledge of hazards etc.	clarity (see also 6a)
<p>11(i). Provision of facilities – water, shelter</p> <p><u>Specialist interviews</u> – Many interviewees described improvement in the provision of shelter over recent years, either through provision of a shipping container, caravan or dedicated work van. It was also reported that these may contain hand cleaning / washing facilities. Water was variably described as provided by the contractor or as something that the men should bring.</p> <p>Improvement in vehicles for crew was also described; this concerned their interior comfort, storage facilities, and numbers provided. This meant greater travelling comfort and greater time flexibility for those travelling in and out from different areas.</p> <p><u>Harvesting crew discussions</u> – Many of the crews had a smoko hut (shipping container, caravan, old bus) and the remainder used a works van for shelter and smoko breaks. A couple of crews indicated that there were no facilities for hand washing, whilst the remainder indicated that water was available that could be used for drinking or hand washing, in some cases (3) also with the provision of with hand cleaner. Some comments indicated that it appeared that the water and hand washing facilities were used only intermittently.</p>	
11(j). Other ..	<p>Generic</p> <p>Explore understanding within industry regarding the provision of water</p> <p>Explore any possible health implications of not washing hands after handling aspects such as fuels, paints etc.</p>
<p>Organisational goals</p> <p>(Strategic decisions, generic organisational processes, safety culture)</p>	Possible future information needs
<p>12(a). Demonstrating organisational commitment to safety</p> <p><u>Specialist interviews</u> - A number of measures were described and many of these were components of a company Health and Safety Policy recording goals and commitment to a safe working environment. From a systems perspective, methods to achieve this were described as the hazard identification process, requiring adherence to the critical rules, generation of a health and safety plan by the contractor, health and safety Units for each training level, and an auditable health and safety management system (by the forest owner / management company or through the WSMP / WSD ACC programmes).</p> <p>From a practical perspective measures include the possible offer of a bonus for those identifying a hazard / reporting near misses, display in the smoko hut of details such as the health and safety plan, hazards identification chart, pie charts of accidents / near misses and duration since last accident. Discussion of safety and health at morning tailgate meetings, the appointment of a health and safety</p>	<p>Safety incentives</p> <p>Define the content and purpose of the safety and/or skills audits and explore how information about what to do can be disseminated more widely</p>

<p>adviser, and specific company safety meetings were also described. The provision of written materials such as a magazine (e.g. NZ Logger or In-wood magazines) or regular newsletters (bespoke to location / companies involved) including similar data to that also displayed in smoko huts, but also with news items such as photos of new personnel, and feedback (good and bad), were described. Such materials were described as emanating from a number of resources such as contractor, forest owner / management company, or associations (such as FICA).</p> <p>Concern was expressed about smaller crews (1-3 man crews) who miss out on these interventions.</p>	
<p><u>Harvesting crew discussions</u> – A range of safety audits were described. Commonly crews undertook an in-house audit and, where described, this entailed repair or replacement of damaged products (such as PPE and vehicle related) and discussion of hazard / safety issues. In one case a trainer had supplied a “safety plan” to guide the crew in what to do. Sometimes audits were undertaken in conjunction with the forest supervisor (randomly or – more commonly – on a monthly basis), whereas other crews were undertaking additional audits on their own – to 2 or 3 times/month. Many commented on the benefits of audits, especially those also involving a representative from the forest company, as this ensured that problems are picked up and managed straight away.</p> <p>Three crews identified that they were not on any of the ACC levy reduction schemes, whereas others were on the Workplace Safety Discount (2) or WSMP schemes (2). All those on either scheme indicated that they had already been undertaking monitoring, or applying the necessary safety systems prior to joining the schemes.</p>	<p>Psychological climate Explore drivers / barriers to success of initiatives that impact safety culture</p>
<p><u>Harvesting crew discussions</u> – No comment offered</p>	
<p>12(b). Measures to improve safety culture & climate</p> <p><u>Specialist interviews</u> – Recent work on increasing attitudes to safety, with a move away from compliance towards culture and productivity were described; simplification of health and safety and reduced ‘tick box mentality’ were seen as measures to get people on board. Greater involvement has also been targeted through teaching contractors to investigate their own incidents and through incorporating health and safety into all work-related discussions (such as quality reviews). Targeted and fully funded education (level 3 Occupational Health and Safety) is also available. Level 4 also addresses accident investigation skills and management of safety meetings.</p>	<p>Psychological climate Explore drivers / barriers to success of initiatives that impact safety culture</p>
<p><u>Harvesting crew discussions</u> – No comment offered</p>	

<p>12(c). Accident investigation methods <u>Specialist interviews</u> – Accident investigation is addressed in the Level 4 Health and Safety National Certificate. It was reported that larger companies put their subcontractors and foremen through such training; a template accident investigation form may also be provided by forest owner / management companies.</p> <p>Nevertheless there was isolated concern that the process is heavily bureaucratic and that forest owners / management companies are punitive rather than supportive if an event happens.</p> <hr/> <p><u>Harvesting crew discussions</u> – No comment offered</p>	<p>Safety attitudes Explore methods proposed for accident investigation and management between contractors and forest owners / management companies</p>
<p>12(d). Use of mixed methods to evaluate H&S performance <u>Specialist interviews</u> – A variety of mixed methods, using both active (feedback on performance) and reactive (post event) data, were described. Active data collection methods were described as the audit process, both of individual crew member or contractor practice, and also on a more formal annual review practice (such as for the WSD/WSMP programmes). The tender evaluation process (looking not just at compliance but for evidence of systems for managing quality and value recovery, the environment, and health and safety, recruitment / turnover) was also described. Productivity data (actual v. predicted outcome) were also monitored; lack of crew or machinery breakdown were examples of causes that might be inferred from poor figures. The use of feedback reports from mills / ports was also described.</p> <p>Descriptions of reactive data methods were given, the most common being accident, near-miss and LTI data, with additional attention to any trends in injury types. The use of IRIS data was also described with both positive (ability for companies to compare performance) and negative (limitations as a reporting tool without follow through to direct interventions) perceptions of its value.</p> <p>There were mixed reports concerning the link between specific initiatives and various improvements – descriptions of being able to make no link, to examples of fewer near misses following separation of man and machinery on skid site and a 60% reduction in STF after spiked boot introduction were reported.</p> <hr/> <p><u>Harvesting crew discussions</u> – No comment offered</p>	<p>Hazard perception of loggers Identify whether national IRIS data can reveal injury profile of the different task types within logging, and be used for awareness building</p> <p>Generic</p> <ul style="list-style-type: none"> • Research IRIS data in order to explore identification of intervention opportunities • Explore whether success / failures of initiatives can be calculated

<p>12(e). Criteria used in establishing production targets</p> <p><u>Specialist interviews</u> – A combination of factors, defined under NZQA 1225 (“Calculate production targets and unit rates for forestry operations”) were described, and these were used in the development of a work specification for contracts. These included establishing the stand parameters, stems per hectare, slope / terrain, piece size, and yard/ haul distance. A database / spread sheet was described for the development of some of this material (it is not known whether this is available nationally or is an individualised product developed and used locally), yet it was also apparent that much is determined on the basis of past experience (of both the contractor and forest owner / management company), and is negotiated on a block-by-block basis.</p> <p>Problems associated with setting production targets were described; there was concern that there is pressure ++ on contractors and that the men are encouraged to do additional loads per day in order to get a production bonus. As a result they are also more likely to take shortcuts, yet nobody complains. It was also understood that adverse weather / fatigue would reduce a contractor’s output.</p> <p><u>Harvesting crew discussions</u> – An isolated report that there are difficulties anticipating how forest companies will plan / size the skid site from maps, and that this then compromised the subsequent rate determination if a smaller / less-usable-than-expected skid site was provided.</p>	<ul style="list-style-type: none"> • Breaker-out work conditions • Determining production targets <p>Review the process used to determine production targets and expected operator performance.</p> <p>Explore whether there are social pressures to achieve production targets</p> <p>Skid site layout and processes Establish whether log cutting frequency on skid sites is factored into production calculations.</p>
<p>12(f). Planting strategies (stem spacing for replanting, land preparation / site design)</p> <p><u>Specialist interviews</u> – Interviewees indicated that a policy of planting as much as possible prevailed and that other than research looking at planting spacing for mechanisation or because of better quality tree stock, there had been little or no attention to future motor manual felling access for the next crop of trees.</p> <p>Factors currently influencing planting strategies were described; forestry planters are advised to avoid boundaries, waterways, steep slopes, and archaeological sites. Local government specifications for environmental protection were described as key influencers for much of the planting strategy, especially regarding the protection of waterways and set breaks from rivers. Under such conditions riparian rights are created.</p> <p>The avoidance of planting on hard-to-access areas was also described, yet it was not apparent that there is a specific strategy to target this process at harvest planner level. It was also acknowledged that access safety for planting may not later be reproduced in access safety for felling. Nevertheless leaving affected trees may also be hazardous, and this creates a dilemma for contractors and forest owners / management companies. Removal by winch was noted as a possible extraction measure yet there were also reports of extreme cases of felling upon rocky bluffs, in spite of prior discussions regarding risk between the forest owner / management company and contractor.</p> <p><u>Harvesting crew discussions</u> – No comment offered</p>	<ul style="list-style-type: none"> • Planting strategies • Harvest planning <p>Explore measures to address future felling in development of the production plan</p> <p>Explore how planning for felling in precarious conditions is managed</p>

<p>12(g). Mechanisation of harvesting systems <u>Specialist interviews</u> – Widespread and successful introduction of mechanisation was described by interviewees; the huge benefit of manual work reduction, especially on ground-based operations, was described. Better ergonomics qualities of operational features (controls etc.) was also seen as a bonus. Nevertheless opportunities to learn more about technology from overseas experiences and the need to update knowledge of harvesting mechanisation were also reported. <u>Harvesting crew discussions</u> – No comment offered</p>	<ul style="list-style-type: none"> • Chainsaw initiatives – general • Fatigue in motor-manual tree felling and delimbing. <p>Explore the nature and distribution of mechanisation initiatives, especially for cable logging</p> <p>Generic</p> <ul style="list-style-type: none"> • Explore mechanisation initiatives used abroad
<p>12(h). Retaining experienced crew members – (exit interviews, relationship with training availability and accident occurrences) <u>Specialist interviews</u> – A number of measures to retain experienced crew members were described, including: good general work practices, good management systems, desirable remuneration, employment certainty, long service bonus, petrol vouchers, provision of a work vehicle (for limited private use too – hunting, firewood, family holidays), use of a fuel card, and acceptable travel distances to and from work. Need for both younger and older workers was described; retention of older workers with knowledge and experience was desired, yet there was also concern that they are less flexible in taking up other crew skills. National differences in skills availability and turnover were noted. There was an isolated comment indicating that some organisations may undertake exit interviews, but it was not clear how widespread or frequently they were adopted. Problems with competitor contractors offering more attractive wages were described, plus problems with people leaving to work in more secure industries or overseas. <u>Harvesting crew discussions</u> – No comment offered</p>	<ul style="list-style-type: none"> • Safety training needs • Recruitment and retention <p>Explore drivers / barriers to exit interviewing.</p> <p>Recruitment and retention Explore drivers / barriers to management of recruitment and retention</p> <p>Generic</p> <ul style="list-style-type: none"> • Explore job design to identify whether drivers/ barriers to job satisfaction are accommodated • Explore initiatives for retention of and skill development of older workers
<p>12(i). Other. <u>Specialist interviews</u> – Interviewees also described national initiatives to raise the profile of forestry as a career option for school leavers and as a good place to work. The FITEC awards night was also proposed as a valuable initiative to celebrate the industry and raise morale. Increased interest and acceptance of the importance of biodiversity through FSA audits was also reported. <u>Harvesting crew discussions</u> – No comment offered</p>	

Extra-organisational (Government policy, regulatory decisions, external influences)	Possible future information needs
<p>13(a). Impact of wood processes globally (demand, oil costs, client pressures)</p> <p><u>Specialist interviews</u> – A general picture of reduction in world wood prices, demand and revenue was described, with contractors being asked to cut only what is needed. Attempts at a common marketing approach amongst key forest owner / management companies had not been successful.</p> <p>Interviewees reported that the variation in oil costs meant that freightage costs had increased and that some jobs ran at a loss. There were concerns that the carbon credit calculation method was difficult to understand and that the government had commandeered carbon credits from the forest industry.</p> <p>A number of external influencers were described, not only customers but also mills, ports (from a perspective of storage, delivery times etc.) and the Forest Stewardship Council (from a perspective of buyer stipulations applying market pressure on forest management practices). From a customer perspective (both domestic and overseas), the demand for receipt of shorter logs which are ready for end use has meant that logs are being cut into up to eight pieces before leaving site; this was seen to create more hazards (through additional cutting operations) and reduce productivity.</p> <p><u>Harvesting crew discussions</u> – No comment offered</p>	<p>Generic</p> <p>Explore how external factors can be better managed to avoid compromise of profits / work conditions</p>
<p>13(b). Accessibility and availability of trainers / assessors (see Section 5)</p>	
<p>13(c). Other ..</p> <p><u>Specialist interviews</u> - There were positive reports on resources available to the industry, including proactive work from DoL, ACC, NZFOA and FICA, from experienced workers willing to put something back into the industry and funding from agencies such as ACC, MAF and FFR.</p> <p><u>Harvesting crew discussions</u> – No comment offered</p>	

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Appendix One - Re-Categorisation by recommendations

A large sample of headings used in Tables 11, 12 and 13 is reproduced in Figure 5 below; they show the distribution of recommendations arising from each area of address in the respective tables. A contrast in the spread of recommendations can be seen; for interventions of a technical nature the recommendations remain relatively localised, whereas for those of an 'Individual: roles, skills, abilities and attitude' or 'Environment, Work Organisation & Management' nature the recommendations are much more widespread. For example, recommendations arising from "Logmaking – mechanised" research were applied in 'Task / technique / training topics', 'Work scheduling', 'Work and job design', and 'Training criteria'.

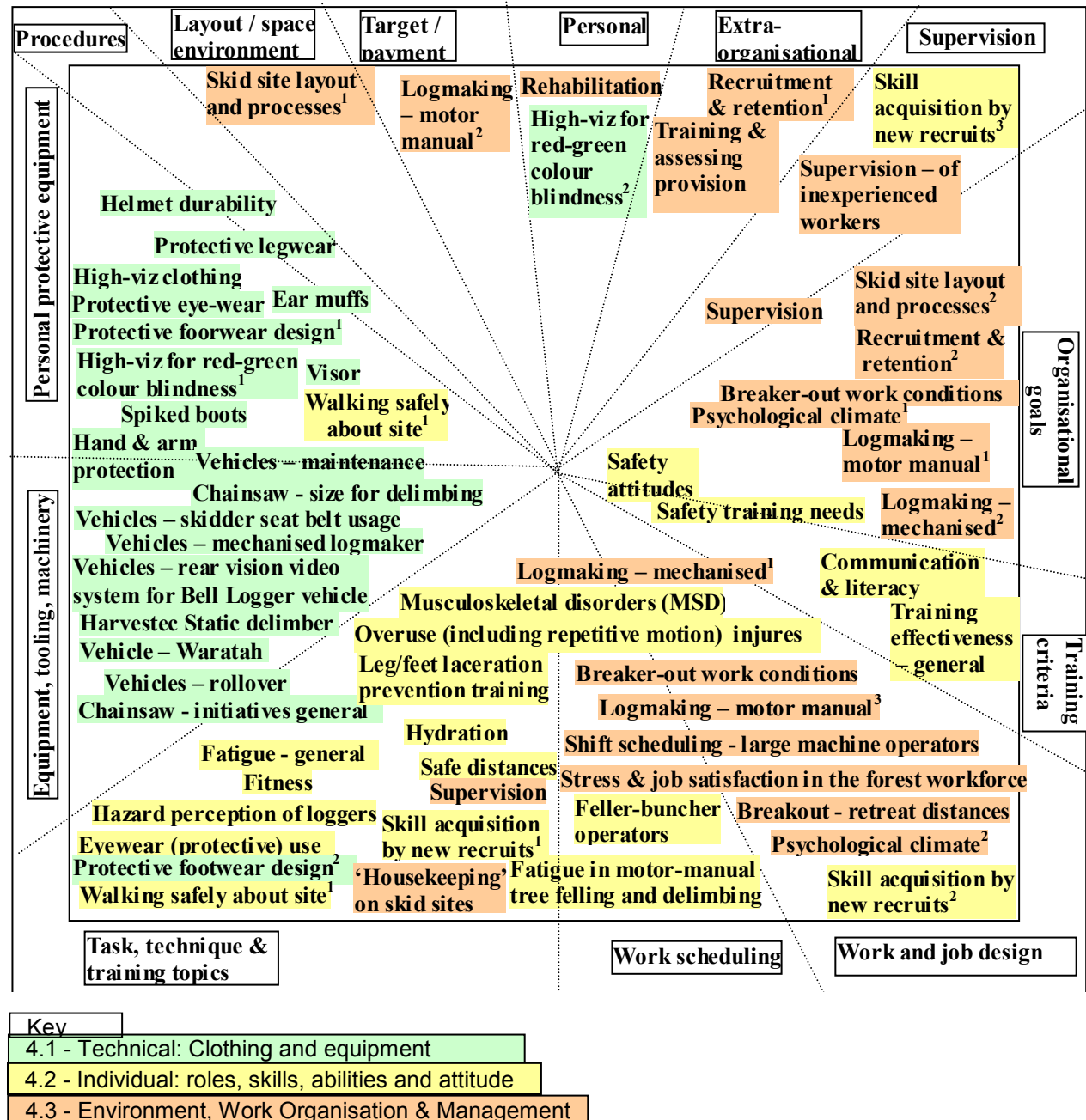


Figure 5 – Categorisation of intervention topics according to areas of recommendation

Appendix Two – Questionnaire used for Specialist interviews

Future Forests Research –

Evaluation of forest harvesting human factors and ergonomics research.

The Future Forests Research Programme F200.02 is concerned with evaluation of forest harvesting human factors and ergonomics research – identifying how it has been taken up by industry, whether it has been effective and where future need lie.

Through an earlier literature review we have collated a database of a range of different intervention ideas proposed for implementation within NZ. **Now we need to look beyond the literature and establish what actually happened - what initiatives were adopted, how they were implemented and whether they were successful or not?** Additionally there may also be initiatives that have not been formally published (in-house programmes, for example), and this is an opportunity to incorporate this type of material into the database.

The table overleaf summarises information captured in the database, using this presentation style:

	Intervention areas (examples in brackets)	Your feedback
<i>The generic area of interest</i> <div>Prompt words relating to the area of interest</div>	<i>Intervention ideas captured through the literature review (with specific examples of what was recommended in the literature)</i>	1. What initiatives have been implemented 2. How have they been implemented 3. Have they been successful or not
Eg: Personal <div>skill, experience, health, personality,</div>	Pre-employment health screen (colour vision test) Health surveillance (to identify gradual onset conditions) Rehabilitation schemes (light duties)	“Used to have medicals in [location], now using in-house screening questionnaire & urine drug tests. (not sure re colour vision OR whether there has been any evaluation)”

Your Feedback ...

1. What initiatives are you aware of that have been implemented?
 - a. Do you have any knowledge of implementation of the interventions (including the examples in brackets)
 - b. Do you have knowledge of related aspects (use the prompt words in column one) that might not be on the list but which have been introduced in the industry
 - c. Are these national, or in specific areas, or specific to certain teams
2. How have they been implemented
 - a. Where relevant what implementations style has been used (video, text, pictures, computer, one to one, lecture style etc.)
 - b. Is the industry using any incentives to encourage the uptake of initiatives (mandatory, prize, ticket / qualification, free meal / drink, other)?
3. Have the initiatives been successful or not?
 - a. Have they had any impact on harvesting safety and productivity?
 - b. How is impact measured?
 - c. Which initiatives didn't work and why?

Helpful tips ..

- Don't feel you have to comment on everything .. just provide the information you know about
- If you're not sure please suggest somewhere / someone else who might be able to help
- If the detail of your answers (or part of) are already recorded (e.g., in training manuals / Unit Standards) just give us the name of .. or access to .. the resource, to avoid unnecessary repetition.

	Intervention areas (examples in brackets)	<u>Your feedback</u>
1. Personal <div>Skill, experience, health, personality,</div>	(a). Pre-employment health screen (colour vision test) (b). Health surveillance (to identify gradual onset conditions) (c). Rehabilitation schemes (light duties) (d) Other ..	what, how & success? (to be recorded by the researcher)
2. Defences / PPE <div>Personal protective equipment, use</div>	(a). Chainsaw legwear (oil resistance, chain speed resistance, design choice) (b). Chainsaw footwear/sabaton (c). Spike soled boots (d). Face visors (e). Eyewear / safety glasses (f). Leather mitt (g). High-viz clothing (helmet colours, yellow on blue/black tops) (h). Ear defence (i). Gloves for sharpening chains / knives (j) Other ..	
3. Procedures <div>Applicability, style, revision,</div>	(a). Regularity of changing PPE (hearing protection, legwear, helmet) (b). Maintenance programmes (chainsaw, machinery) (c). Other ..	
4. Task / technique training topics <div>Physical / mental workload, hazard related, interaction with other tasks,</div>	(a). PPE (selection, use, care) (b). Hazard awareness - general (c). Chainsaw technique (handling whilst walking, falling, trimming) (d). Log stacking (e). Stand & environment assessment (f). Self care (fluid type, food type, rest & sleep requirements, ↑ body condition [stretch / exercise], effect of stimulants, avoiding OOS / musculoskeletal disorders) (g). Safe distances in the presence of slope / obstacles (h). Vehicle use on holed / stumpy, steep terrain (i). Housekeeping / ↓ trip hazards (j) Other ..	
5. Training criteria <div>Access, costs, duration, detail, popularity, content development / omissions. Trainer skills. Responsibilities.</div>	(a). Improve access to training (apprenticeship / skills development, introduction of specific requirements) (b). Raising awareness of training availability (c). Access to module or assessment systems (d). Follow-up training (e). 'User-centeredness' in training (f). Choice of communication styles (reading ability) (g). Target all levels of seniority (h). Management & crew consultation in defining training needs (i). Evaluation effectiveness through skills assessment	

	(j) Other ..	
6. Supervision	(a). Of inexperienced workers (loggers within 1 st year)	
Style of supervision, different supervision for different workers, maintenance	(b). At the start of a new task	
	(c). For difficult tasks, terrain & busy periods	
	(d). On monitoring the use and maintenance of PPE	
	(e). Own skill development (knowledge of hazards & control measures)	
	(f). Other ..	
7. Equipment, tooling machinery	(a). Chainsaw design (size, chain brake, low kick-back chain)	
Hand / mechanised tools; large plant, individually or contractor owned; on-hire equipment / second hand equipment; deterioration, maintenance,	(b). Static delimber introduction	
	(c). Vehicle – mechanised log maker (control / stem design, display brightness & size, visibility improvements through cleaning and guarding design, sun shading cab and seat adjustability)	
	(d). Vehicle – skidder (seat belt redesign/ location)	
	(e). Vehicle – Waratah, feller buncher (control / display designs)	
	(f). Access /egress design (slip /fall prevention)	
	(g). Rear vision video – Bell logger	
	(h). Other	
	8. Layout / space /	(a). Skid / landing transit route layout / safe zones (↓ person: vehicle: log overlaps, introduction of systems to de-phase mechanised log making & people)
Movement / access, adverse light, noise, temperature, wet,	(b). Colour choices (↓ red, green, pink and ↑ silver, blue, orange, yellow)	
	(c) Other..	
9. Target / payment	(a). Financial incentives (quality of work, by grades of logs)	
Reward, benefit	(b). Other ..	
10. Work scheduling	(a). Work-rest durations (chainsaw, feller-bunchers, breaker-outs, large machine operators)	
Work pace, breaks, duration, shifts frequency	(b). Self selection of breaks / micropauses	
	(c). Shift schedule (start, finish)	
	(d). Action on high heat days	
	(e). Rest day provision after extensive heavy periods	
	(f). Other ..	
11. Work and job design	(a). Job rotation (duration on any one task, impact on vigilance & boredom)	
Workload, social support, personnel availability, communication channels, roles &	(b). Job enlargement	
	(c). Defining required crew numbers (breaking out, for extended days)	
	(d). Graduated work pace for new starters	
	(e). Use of buddy systems	
	(f). Communication (between mechanised log makers & ground crew)	
	(g). Measures to enhance crew commitment	
	(h). Defining role clarity (contractors)	
	(i). Provision of welfare facilities – water, shelter	
	(i). Other ..	

12. Organisational goals Strategic decisions, generic organisational processes, safety culture	(a). Demonstrating organisational commitment to safety	
	(b). Measures to improve safety culture & climate	
	(c). Accident investigation methods	
	(d). Use of mixed methods to evaluate H&S performance	
	(e). Criteria used in establishing production targets	
	(f). Planting strategies (stem spacing for replanting, land preparation / site design)	
	(g). Mechanisation of harvesting systems	
	(h). Retaining experienced crew members – (exit interviews, relationship with training availability and accident occurrences)	
	(i). Other ..	
13. Extra-organisational Government policy, regulatory decisions, external	(a). Impact of wood processes globally (demand, oil costs, client pressures)	
	(b). Accessibility and availability of trainers / assessors	
	(c). Other ..	

Finally ...

- What resources are used to learn about industry developments (LIRO / COHFE, word of mouth, DoL, ACC, magazines, international, associations, training institutes, consultants, other...).
- What locations are good resources for information sharing (in the bush, fairs, field days, pubs, retailers, any specific internet sites, other?)
- Are there measures in place that 'catalogue' or 'track' failures or successes of industry initiatives (e.g. data concerning productivity, quality, auditing, lost time, injury type, ill health, turnover, recruitment,(other KPIs??), etc..) (*to enlarge question 12d*)

Thank you for your assistance. Please direct enquiries to Sophie Hide, Phone 09 415 6281 or Richard Parker 07 343 5605.

Postal contact: COHFE - Centre for Human Factors and Ergonomics, SCION - A Crown Research Institute, Suite H, Building 6, Rosedale Office Park, 331 Rosedale Road, Albany, PO Box 300-540, Albany, Auckland, New Zealand. www.cohfe.co.nz

Appendix Three – Questionnaire used for hazard rating

Based on your experience are the following hazards for work safety, health and productivity?

PLEASE CIRCLE NUMBER AS APPROPRIATE

Individual Factors	Not at all	To a slight degree	To some degree	To a large degree	To a very large degree
Monotony or boredom	1	2	3	4	5
Tiredness, thirst or hunger	1	2	3	4	5
Low skill and competence levels	1	2	3	4	5
Failure to recognise danger or carelessness on the part of the employees	1	2	3	4	5
Individual medical problems	1	2	3	4	5
The demands of the job are not familiar	1	2	3	4	5

Job Factors	Not at all	To a slight degree	To some degree	To a large degree	To a very large degree
Using tools and equipment that can cause harm	1	2	3	4	5
Noise and unpredictable weather / environment	1	2	3	4	5
Illogical design / unpredictable behaviour of equipment and machinery	1	2	3	4	5
Missing or unclear instructions	1	2	3	4	5
Workload that is high / heavy / dangerous	1	2	3	4	5
Work on slippery or difficult ground	1	2	3	4	5
Space constraints affecting storage / parking / traffic flow	1	2	3	4	5

Organisational and Management Factors	Not at all	To a slight degree	To some degree	To a large degree	To a very large degree
Poor work planning, leading to high work pressure	1	2	3	4	5
Lack of safe systems	1	2	3	4	5
PPE deficiency (quantity or quality)	1	2	3	4	5
Inadequate responses to previous incidents	1	2	3	4	5
Poor supervision	1	2	3	4	5
Long work hours	1	2	3	4	5
No feedback about safety performance	1	2	3	4	5
Lack of training (e.g. task, equipment, hazards)	1	2	3	4	5
Poor health and safety culture	1	2	3	4	5

Developed from Hide, 2003, Exploring accident causation in the construction industry - Doctoral Thesis, Loughborough University, UK

Appendix Four –Templates – Harvesting crew Discussions

Hazards and incident prevention

A. Where possible score 1, 2, or 3 for how the following have contributed towards health, safety and performance

1 = good contribution

2 = possibly

3 = poor contribution

B. How could things be improved?

A. Tool and equipment developments
1.Chainsaws Smaller size, lighter weight, better designed handholds and controls, chain brake, low kick-back chain, chain catcher pegs, ease of maintenance
2. Big machinery Cab design features (reduced noise, air conditioning, ↑ glass quality / guarding, seat design, layout and styles of controls, displays and seatbelts, rear vision video) Design for getting on & off. Maintenance regularity / quality
3. New equipment / modifications Examples = Modified excavator base for stability, fixed rather than swing grapple, use of a tong thrower. Welding on additional tread grousers, others?
B. New style layouts / organisation
1. Skid sites 2-phasing or de-phasing, 2-staging, split level landings, trucking stems to a log processing yard. Equipment preferences (eg. Forwarders rather than skidders, use of swing yarder rather than a static pole), log truck arrival times, skid site size / layout
2. Breaking out Bunching stems, use of a tong thrower or electronic choker ... other methods? Different communication methods
C. PPE developments
Protective legwear (quality , style, durability) Protective footwear (spike soles or similar, sabaton, chainsaw boots / gum boots) Head / face protection (styles of helmets, ear muffs, eyewear, & face protection) Use of the safety mitt Use of high viz clothing Regularity of changing / maintenance
D. Health related
Health screening before employment / annually (hearing, vision, BP, cholesterol, drugs & alcohol, etc.)

Preventing ill health – stress, strains & sprains Rehabilitation assistance after an injury
E. Welfare facilities
Shelter / smoko hut, hand washing facilities, storage facilities
F. Financial incentives for crews
Pay by production volume criteria, grade based payments, waste reduction incentives, quality of safety systems, site tidiness, other incentives?
G. Enhancing commitment & motivation
Fair wages (skill, experience), bonuses, shareholding, social functions, recognition of performance
H. Work scheduling
Start & finish times – preferences or factors influencing Break preferences – duration, 1 or 2 Hours per week – overtime, varied demands per time of year / weather Holiday entitlement Machinery drivers – hours / shifts, machine shut down
I. Job rotation / variety
Creating variety / interest at work, frequency of change, barriers to change, knowledge / skill requirements, fitness requirements, desirability of change
J. other organisational / safety issues ?
Belonging to ACC schemes, Forest owner auditing H&S performance, magazines, newsletters, grapevine

Where possible score 1, 2, or 3 for how the following contribute as good resources for health, safety and performance

1 = good contribution

2 = possibly

3 = poor contribution

How could things be improved?

A. Information sources (people) -Trainers, crew managers / foremen, forest company supervisors, visitors from ACC / OSH, co workers, truck drivers, others?
B. Information sources (media) - FITEC information, newsletters, magazines, the internet, radio/TV, the pub, others ?
C. Hazard management methods (general) – Induction programmes, tailgate meeting, adoption of procedures, , appointing ticketed only fallers, monthly skills audit, different ways of doing things,
D. Hazard management methods (self care) - hydration, nutrition, preventing strain / sprain programmes
E. Task techniques Clarification (e.g. chainsaw carrying), log stacking guidelines, safe distances (2-tree lengths / mechanisation), use of vehicles on unsafe /unstable ground, ↑housekeeping
F. Supervision & communication Clarity of role, from forest owner, adequacy of duration of supervision for new starters, benefits / disadvantages of buddy system, other methods to improve communication (e.g., radio)
F. Training administration
1. What encourages or discourages you to take up training
2. How could things be improved?
<ul style="list-style-type: none"> • Access to trainers / assessors • Content / duration of training • Costs involved • Personal training plan • Time to train • One to one or group training, OR classroom / theory training
1. What encourages or discourages you to take up training
2. How could things be improved?

• Introduce new modules
• Different styles (books, videos, DVDs etc.)
• Career development opportunities such as business skills training
• More varied work opportunities
• Employment opportunities
• Better wages
• Compliance with forest company