FUTURE FORESTS RESEARCH

HARVESTING TECHNICAL NOTE

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Human Factors & Ergonomics Research – Uptake and Evaluation

Summary

For many years there have been wide ranging recommendations arising from human factors and ergonomics research for the New Zealand logging industry. However, there is little data concerning uptake and evaluation, and this has been explored through literature review and feedback from industry representatives.

The findings revealed that successes generally concerned interventions of either a technical nature (adoption of personal protective equipment (PPE) or mechanisation) or of an individual nature (measures to enhance behaviour change). Differences in the perceived successes of systems relating to training, health and safety management, and PPE suitability were noted between the two groups of industry representatives consulted, indicating a need for further intervention.

Findings also indicated a general lack of progress in many of the interventions relating to key work organisation and management factors, such as work scheduling and productivity calculations. The exploration of these, combined with aspects where insufficient or ambiguous data were gathered, are highlighted for further work.

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INTRODUCTION

From the mid-1970's work of the Logging Industry Research Association (LIRA), through to the more recent research of the Centre for Human Factors and Ergonomics (COHFE), there has been wide ranging ergonomics and human factors research undertaken for the New Zealand logging industry. For example two well known outcomes of this research are the introduction of high-visibility clothing and guidance on hydration and nutrition. However the recommendations of the earlier research had much wider application, and this research project explores whether or not the range of recommendations has been taken up, whether they made a difference, and how future initiatives should be directed.

This Technical Note summarises findings from the main Project Report (Hide, Parker and Moore, 2009)

RESEARCH METHODS

The work was undertaken in two phases. Firstly, a review of literature concerning New Zealand human factors and ergonomics research in harvesting conducted since 1990 was done (incorporating comparable international research where relevant). This identified whether industry had implemented initiatives and whether effectiveness had been evaluated. In the second phase, successes, failures or independent development of initiatives were then explored through interviews with industry representatives. Findings from all sources were compared to identify different perspectives and future needs.

Literature Review

By evaluating published material, a profile of the issues addressed through New Zealand logging ergonomics and human factors research was collected (Moore, Parker and Hide, 2008).

The main areas of research were summarised into three categories: technical (clothing and equipment – 19 different topics identified), individual (roles, skills, abilities and attitude – 17 topics) and environment, work organisation and management (22 topics). Among these the main areas of success were identified as the development and widespread adoption of personal protective equipment (PPE), 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.

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However, although the literature identified these particular improvements, it also showed that there had been no substantial evaluation of effectiveness of the range of interventions arising from research programmes. Evaluation of success was largely dependent on interpretation through the forest industry Accident Reporting Scheme (ARS) data; there was little independent evaluation of impact. Additionally there were no records of whether intervention recommendations had developed over time, alongside other industry changes.

Consultation with Industry

These information gaps were explored through consultation with industry representatives. The research topics had many of the same types of recommendations in common; 13 different aspects were identified (Figure 1) and used as a structure upon which to explore uptake of interventions or to capture information about independent developments within the industry.

Research categories	Recommendation categories used in interviews and discussions
Technical: Clothing and equipment Initiatives (n=19) Individual: roles, skills, abilities and attitude (n= 17) Environment, Work Organisation & Management (n=22)	Personal
	Personal protective equipment / defences
	Equipment, tooling machinery
	Task / technique / training topics
	Training criteria
	Supervision
	Target / payment
	Work scheduling
	Procedures
	Work and job design
	Layout / space / environment
	Organisational goals
	Extra-organisational

Figure 1: Categories for discussion with industry representatives

Two different groups of industry representatives were consulted, in order to capture their perspectives on the research recommendations (their relative successes or failures), other related industry developments, and future needs, using the following methods:

1. Twelve industry specialists were each interviewed. They comprised trainers, forest company staff (both in harvest management and health and safety roles), a Forestry Inspector, an auditor for a certifying standard authority, and industry contractors. Each was asked to comment on each of the 13 areas of recommendation.

2. Discussions were held with 21 harvesting crews in both the North and South Islands. Each worker discussed one of two discussion themes, “Hazard and Incident Prevention” or “Training and Communication” (Figure 2), and the content of these discussions was aligned to most of the areas of recommendation. Before each discussion, harvesting crews also completed a questionnaire concerning hazard perception in their work.

Hazards and incident prevention	Training and communication
• Tool and equipment developments • New style layouts / organisation • PPE developments • Health-related • Welfare facilities • Financial incentives for crews • Enhancing commitment & motivation • Work scheduling • Job rotation / variety • … other organisational / safety issues?	• Information sources (people & media) • Hazard management methods (general and self-care) • Task techniques • Supervision and communication • Training administration - What encourages or discourages you to take up training? - How could things be improved?

Figure 2: Discussion themes for harvesting crews

RESULTS

Uptake of Research Findings

A number of features were identified from collated data of the interviews and discussions. These are shown in Table 1. In summary:

- From all sources, successful initiatives tended to be those directed at technical factors (such as the widespread adoption of PPE and greater use of mechanisation), or those enhancing individual behaviour

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(through greater 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 participation or guidance from forest company representatives (e.g., forest supervisors) in the crew's safety or skills auditing.
- Differences were noted between information provided by industry specialists and harvesting crews. 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 indicated a wide range of problems concerning scheme credibility and morale of older workers
  - Health and safety management – there is varied uptake, from structured to informal systems
  - PPE – some negative reports of suitability for task (e.g., eye protection and footwear), cost, durability, availability and comfort
- There were some areas where it was not possible to establish the nature of progress. This was because responses were too varied or not enough information was provided, and these are highlighted for further investigation:
  - Equipment – what are the preferred machine types in industry and innovations in technology design development?
  - Skid site design and operations – what are the drivers / barriers to adopting alternative work phasing and layouts?
  - Work techniques – what are the opportunities for field workers to have greater autonomy in selecting preferred work methods?
  - Occupational health issues – what are the drivers / barriers to standardisation and implementing more services in this area?
  - Work Organisation – what are the drivers/barriers to initiatives concerning job design (tackling lack of direction for job rotation/enlargement) and recruitment and retention initiatives?
- Findings from all sources indicated lack of progress in interventions relating to some key work organisation and management recommendations. Examples included:
  - Work scheduling (inconsistent taking of two breaks, long work days for machine operators)
  - Production pressures (payment by volume predominates)

Hazard Perception

As a supplementary measure, 91 harvesting crew workers each completed a questionnaire about their perceptions of a range of work-related hazards; these concerned individual (personal/health), job (task, conditions) and organisation and management factors (Table 2). Each person was asked 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 (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).

Analysis of the mean (average) response to each question resulted in either a 2 ("to a slight degree") or 3 ("to some degree"), for every question except 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) of responses to this question was the lowest, indicating that there was general agreement on this question.

Data were also analysed to show the mode (the most commonly occurring score among respondents). The mode data indicated that many workers perceived two factors to be a hazard to work safety, health and productivity "to a very large degree": low skill and competence levels, and failure to recognise danger or carelessness on the part of the employees.

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	Success (what research was considered to have gone well)
	• 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	• New Training Schemes
	o 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 and 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	• Health and Safety Management systems
	o Varied perceptions of optimum practices (content, frequency of interventions) within industry
3	• PPE and Equipment, Tooling, Machinery etc. Explore:
	o Many concerns concerning quality, task appropriateness, durability, compatibility, comfort, style, cost and availability of the PPE range o Varied perceptions concerning markers for replacement / repair of worn PPE o Implications of reimbursement / allowance for individual crew members to select own PPE o 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 o A lack of underlying data concerning isolated industry initiatives in retrofitting machinery and design therein (individual variability, user centeredness, performance, etc.)
4	• Skid Site Initiatives (alternative layouts, mechanisation, zoning and work phasing)
	o 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	• Occupational Health / Personal Issues
	o 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	• Tasks, Techniques and Behaviour
	o 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	• Work Organisation initiatives
	o 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	• Work Scheduling initiatives, especially widespread adoption of 'one break and 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	• 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 1: Summary of findings from interviews and discussions

However the SD is high for each of these questions indicating that although 5 was the most common score, there was a wide range of answers among respondents. A further

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individual factor that was rated as a hazard to work safety, health and productivity "to a large degree" was tiredness, thirst or hunger. The variation in responses was lower in this case.

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 2: Harvesting crew perceptions of hazards to health, safety and productivity

These results imply that a large proportion of sampled workers attribute hazards to some form of failure by individuals. This is a concerning feature of logging crew culture. This viewpoint, in turn, may also impede the extent to which remedial action might also be aimed at wider systems issues.

Other aspects rated as hazards "to a large degree") were job factors such as working on slippery or difficult ground, and workload that is high / heavy / dangerous. These factors had the most common score of 4 and lower standard deviations (indicating greater agreement amongst respondents).

An overview of mode results for each of the three types of factors (individual, job and organisational/management) suggests that hazard perception is more commonly directed at many of the individual and job factors (8 out of 13 factors scored as a hazard "to some degree or more"). 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 (with 7 out of 9 factors not recognised as hazards at all). Although the variation (SD) was fairly high for most responses (indicating that many respondents differed in their rankings), this

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suggests that most organisational and management factors are not considered hazards for work safety, health and productivity by the majority of this sample of logging workers.

With the possible exception of "long work hours" these results could be interpreted in either of two ways. Crew members may have felt that these hazards are generally well controlled. Alternatively a less desirable outcome may be a lack of understanding (and subsequent intervention) relating to hazard control through management of these types of working conditions. This ambiguity should be explored through future research initiatives.

Future Initiatives

In the first instance, the fact that specialist and harvesting crew experiences of "success" differed in various areas indicates a need for greater ongoing two-way communication within industry.

Findings also suggest that the underlying research and ways that information is conveyed to an industry target audience needs to be considered – many of the successful initiatives have been the subject of more detailed ongoing research or have been taken up or "championed" within industry (e.g., by FITEC or equipment manufacturers). For many of these initiatives there was also guidance provided from earlier LIRA/LIRO/COHFE publications (e.g., PPE / equipment). That these research results are no longer released or addressed in material such as magazines indicates that additional guidance materials for different topics and for different audiences may be warranted.

Table 3 summarises areas for further initiatives as a result of these findings. A review of the training programmes may help in isolating and addressing problem components (Item 1, Table 1). Further direction in establishing criteria and guidelines is needed by crews to establish a health and safety management system (Item 2, Table 1), and evaluation of failures relating to PPE and exploring strategies to address these problems is also warranted (Item 3, Table 1).

		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 future FFR project 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**	Addressed in future FFR project F200.02.03
9	**Production pressures**	For future consideration

Table 3: Summary of areas where further intervention is recommended

Two proposals for ongoing FFR research were submitted to industry members 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, Table 1). The other proposal (included in the 2009/10 FFR programme) concerns the identification of barriers and factors influencing work organisation and scheduling within logging operations; this will explore some of the issues in Item 4 and issues from Item 8 (Table 1).

Accordingly, remaining issues identified in Table 3 should be considered in the development of future research initiatives.

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