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Exploring incident causation and intervention needs for forest industry logging

By systematically analysing 15 sample logging incidents a range of adverse underlying organisational factors were identified. Data were collected through fieldwork and interviews with injured workers, those in supervisory positions and with forest sector industry experts.

Findings from all sources were collated to establish common areas of concern. Areas for future initiatives are proposed.

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Summary of key recommendations

- Improve communication between contractors and planners in developing harvest plans
- Develop planning & planting strategies for felling access for the next crop of trees
- Target methods to improve and isolate pedestrian access ways
- Explore space restriction issues (especially relating to skid sites) and interacting requirements of plant, pedestrians and those visiting site
- Identify, evaluate and disseminate the range of practical initiatives by which industry manage poor site and working conditions
- Liaise with manufacturers / suppliers regarding development & innovation for PPE, tooling and large equipment
- Explore risk factors for slips, trips and falls, and the development of musculoskeletal disorders through use of common tooling and equipment
- Collate the nature of how training is addressed, in relation to report findings
- Review work productivity targets and factors adversely affecting work pace among the crew
- Review work scheduling by considering
  - working hours and barriers to recommended breaks
  - scheduling of truck access to the skid site
  - guidance regarding forest closure and holidays, and manpower to cover sickness and absence
  - time of year affects upon accidents
- Explore welfare related issues (especially with reference to provision of water and washing facilities, and the ongoing provision of health and nutrition guidance)
- Address requirements for logging sector occupational health services.

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1. Introduction

Injury rates have steadily fallen over the years, yet recent logging figures indicate that entitlement claims remain high and ongoing intervention is necessary (Accident Compensation Corporation 2007). ACC has therefore directed research into exploring incident causation, through study of a sample of key incident types and collating findings to identify common themes or concerns, in order to establish intervention needs for industry.

Historically seen as perpetrator events, incidents are now understood to be multi-causal in origin. The ACC WorkSafe Injury Model reveals the wide range of possible underlying organisational factors (culture, systems and task related) that can influence event occurrence.

ACC WorkSafe Injury Model, 2006

The study was designed to ensure that data relating to incident events and the range of possible contributory organisational factors were collected and analysed. In turn, findings also revealed intervention needs, from which a range of possible initiatives were proposed. Recommendations may be of interest to government agencies, those providing or managing logging services, and those outside the sector, whose products, operations or services impact upon logging operations. Full details of findings are in the main report (Hide et al, 2008a).

2. Identifying the key incident types for inclusion

In order to decide on an appropriate focus for the research, **analysis of ACC data of injuries** sustained during logging was conducted. ACC entitlement and medical fee claim data for "logging" for the years 2002 – 2007 were analysed (3539 viable cases) (Hide et al. 2008b). Typically 'entitlement claims' are more expensive (indicating more extensive injury), however the greater volume of 'medical fee' claims may result in other non-claim related costs to industry, so all warranted inclusion. Claims included accident events and gradual onset cases.

Target **incidents types** were those implicated in the most frequently occurring ACC 'diagnosis' classifications. The relative proportions of these groups (where they made up at least 10% of claims) were used to identify the minimum profile of target incidents to be analysed (Table 2).

Table 2: Incident types and associated logging activities targeted for incident analysis

Incident types	Target activities
• 4-5 incident types resulting in soft tissue injury • 2 cases incident types resulting (or with potential to result in) fracture / dislocation • 1-2 incident types resulting in laceration, puncture, sting • 1 incident type resulting in industrial deafness • 1 incident type resulting in foreign body in orifice	• General chainsaw use (felling & skid site work) • Breaking out (log movement & securing) • Working around moving equipment and walking about site • Trimming, marking, cutting, walking around (or over) logs • Use of machinery

In total, 871 entitlement claims and 2305 medical fee claims were considered (74% of the total dataset of 3539 viable cases). The most frequently occurring entitlement claim diagnoses were 'soft tissue injuries' – more than twice the volume of the second largest group of incidents resulting in 'fracture or dislocation'. Soft tissue injuries were the highest for medical fee claims too, followed by 'laceration, puncture, sting', and 'foreign body into orifice / eye'.

Many claimants also provided descriptions (with varied detail) of circumstances surrounding their injury. The most consistent information concerned initiating events (event or action associated with sustaining the injury) and agents (work items or conditions) involved. The most frequently occurring were used to **target activities** / circumstances for the study.

3. Incident analysis and follow-up

The next stage entailed an **analysis of fifteen sample incidents,** which met the identified criteria, including 8 accident events and 7 ongoing / gradual onset cases. The profile of incidents initially targeted was reached and, although there were no cases of 'fracture' events, a number of the soft tissue injuries had the potential to be more serious. There were 21 interviews in total, including 14 involving the injured worker (one had experienced two events) and 7 with supervisors /managers. Most were experienced workers (averaging 17 years' experience).

All access (to site and to people) was conducted independently of ACC claim data (i.e. whether a claim had been made was not known). Incident circumstances and the underlying organisational conditions were explored through consideration of the work system; a wide range of personal and work profile related aspects were explored (as summarised in table 1). This approach enabled identification of factors that could have a negative impact on the work conditions of logging crews.

Table 1: Factors explored in data collection process

Organisational culture & systems	Task, equipment, environment	Individual
• Training and instruction • Welfare facilities • Recruitment influencers • Supervision and management • Procedures and instructions • Target / payment aspects • Job design • Work scheduling • Harvest planning (affecting felling, breaking out and skid sites)	• Climate / ground conditions • Use of PPE • Task / activity details • Tools / equipment / large machinery related aspects	• Employment history • Accident history • Health related issues • Motivational factors • Living arrangements NB: Some findings are unremarkable and not reported here.

Data was collected during an on-site interview with the injured worker, with their supervisor/manager and, where possible, it included observation of equipment / conditions (or similar) related to the incident. Incident analyses were carried out between June – October 2008 in the central North Island, Northland and the Nelson areas. A two month time limit was set for those that had experienced an accident. Criteria for those with gradual onset conditions (such as soft tissue injuries) was ongoing symptoms / injury effect, albeit whilst continuing to work.

The findings were then pulled together and issues (generic rather than incident specific) were explored through **discussion with forestry sector industry experts**. Ergonomists collated all data in order to identify the main concerns and concluded with recommendations for intervention. For conciseness, only key aspects of each are given here; the full report presents the balance of data collected.

4. Findings and recommendations

4.1 Climate, terrain and layout

Main concerns identified:- • difficulties associated with access to and physical demands of manual felling on sloping ground • poor ground conditions of both work areas and shared machinery & transit routes (mud, undergrowth etc.) • small skid site size for log movement & storage • poor log spacing on skid sites for worker logmaking access • variable management of adverse weather (rain, cold, darkness)

Recommendations:-

- Measures to *minimise planting on hard to fell areas* are required. This will require improved communication and understanding of the issues between fallers, their managers, harvest planners and forest owners.
- Measures to *segregate machinery and pedestrian routes* should be explored. Barriers to providing larger skid sites or minimum sizes (per operation) also warrant further investigation as do opportunities for further use of 2-phasing, or other means of separation and improved skid site layout. Exploration of ideas should involve consultation amongst site related (e.g. forest owner, log truck drivers and contractors) and off-site (such as those responsible for resource consent) parties.
- Measures to *address exposure to cold and wet,* such as greater attention to rain gear for forest workers or measures that may enhance the quality and protection offered by existing PPE, need to be explored. Warm-up exercises and access to warm or cold drinks prior to and during exposure (of cold or hot weather respectively) may also help.
- Measures to *manage darkness and lighting* of common facility areas also warrant attention.

4.2 Tools and equipment

Main concerns identified:- • Awkward postures, manipulation and load bearing during repetitive chainsaw use (as risk factors for musculoskeletal disorders) • potential health and performance implications arising from postural invariability and extended periods of cab work for drivers • the nature of user centred design (handling, vibration attenuation, access / egress for large machinery, noise reduction, etc.) for new or retrofitted equipment is unknown

Recommendations:-

- Evaluate the nature and management of *design innovations* for commonly used tools and equipment with manufacturers, and compare with criteria for user-centred design. This should extend to the use of on-hire equipment and include consultation with those who have adapted plant at the point of purchase – exploring the nature of changes, their underlying reasons for change and successes or failures therein.
- Given the risk factors for musculoskeletal disorder development during use of the chainsaw and during use of large equipment a more detailed analysis is warranted. This should draw upon earlier related research and study current operational practices in greater detail, in order to establish where opportunities for remedial action lie.

4.3 Personal protective Equipment (PPE)

Main concerns identified:- • restricted vision with visor use arising from sun strike or rain and sawdust entry • incompatibility between some PPE (e.g. ear muffs and safety glasses or beards), or PPE and equipment (e.g. spiked boots and vehicle pedals) • varied perception of durability and comfort (footwear), permitted repair (chaps), criteria for replacement (chaps, helmet), and fabric quality (chaps) • confusion regarding adequacy of baseline hearing protection requirements

Recommendations:-

- Measures to *improve the quality of visual protection* warrant special attention; this should include evaluation of design alternatives, the nature and management of manufacturer innovations and barriers to change.

- An up to date *database of the range of PPE products* used in the logging industry should be put together. This should include information on performance, fit, function, application, maintenance, feedback etc, to help guide forestry workers, and purchasers, and establish the needs for and direction of future developments in PPE design.
- It may also be appropriate to *liaise with large equipment designers / local retailers*, to explore potential for improvements to metal vehicle pedals, so that workers can more easily operate them while using spiked boots.
- Concerns about noise exposure could be looked into through forestry related noise exposure research, to find out if the conditions found conform to current guidelines.

4.4 Training and communication

Main concerns identified:- • new training / apprentice scheme is less liked by those site based rather than off-site based (due to low trainee skill / experience upon qualification) • little evidence of widespread refresher training with potential for adverse implications for skill retention and passing on of undesirable skills during on the job training • training in supervisory / management skills (excepting that relating to health and safety) appears to have little support at site level • the nature of supervisor / manager training in human capabilities and performance is unknown

Recommendations:-
- Skills development, supervision and performance expectations upon the newly qualified warrant further consideration
- Whether or not Topspot / skills audit redresses the lack of refresher training / skills update should be explored
- An up to date collation of industry training (both localised and national) in relation to their application to findings in this report is warranted

4.5 Procedures and Site related plans

Main concerns identified:- • there are reports of impractical or inappropriate information in Harvesting Plans • communication between the forest company and the contractor may take place only after the drawings are complete but in need of revision • nomination of responsibilities for drawing up plans for skid site / breaking out etc. are unclear • administrative methods used to improve record keeping may displace more practical methods preferred by field work users

Recommendations:-
- *Improve communication* between harvest planners and contractors to create more efficient first plans.
- Site plans may benefit from *improved space allowance* and provision of separate traffic and pedestrian routes. Responsibilities among staff skilled to achieve this need greater specification
- The development of plans that both direct fieldwork and facilitate *record keeping* could be devised and explored

4.6 Work pace, payments and targets

Main concerns identified:- • higher perceptions concerning expected output per day reported by some crews v.s lower expectations of their supervisors / managers and off-site specialists • time pressure and minimised opportunities for rest may arise through 'team pacing' among crews (sourcing / providing the next task in the line) • overtime is routine for some crews which further minimises opportunities for rest & recovery • payment by priced / volume related output can create conditions that encourage extended work hours, or discourage the taking of breaks

Recommendations:-
- Opportunities to keep strong *teamwork* but to limit "inter-dependency" of tasks should be explored - for example, incorporating a stock buffer zone may be considered, to reduce pressure. This would have implications for space requirements and changes to existing work organisation measures. Any initiative of this nature, in the first instance, would need to be

developed from conceptual plans, with industry participation, appropriate trial and evaluation before considering any wider spread implementation.

- Achievability of *production targets* within a 40 hour week needs exploration. This should incorporate perspectives from the Forest Owner and Contractor, and needs to accommodate any adverse conditions (mud, slope, access, manpower etc.) that may compromise expected targets. The targets should be reviewed and varied according to the conditions for each new site.
- *Alternative methods to volume related payments* for logging workers should be explored. Industry already has a number of good example measures used by a variety of contractors to recognise and reward performance. It would be valuable to spread information, and pros and cons, about different types of initiatives used across the industry.

4.7 Work scheduling

Main concerns identified:- • many workers rise early and there is potential for a cumulative effect of fatigue and sleep debt with long-term insufficient overnight rest • skid site machinery drivers often rise even earlier (to remove logs from the skid site / log storage area before crew start at 07.00) and work much longer hours, which increases their risk further • many workers take only one break per day • overtime is necessary for some crews to achieve production targets • some contractors struggle to man absences / holiday outside of "Christmas closure" • there are seasonal differences in prevalence and severity of injuries.

Recommendations:-

- A review of *working hours* is needed, especially to ensure that production targets are achievable within a 40 hour working week. This will require consultation with forest owners to ensure that there are realistic expectations regarding output (and variability under different conditions – poor climate, terrain, man power availability etc.) and that this is not undermined by the competitive tendering process. The industry may also consider the introduction of a cap on hours worked and the taking of power naps.
- Special attention to *machine operator work scheduling* (especially on skid sites) is required in order to reduce and 'humanise' their working hours. This will also require interaction with those subsequently affected in the supply chain, such as representatives for truck drivers, sawmills and ports. This would also involve re-consideration of skid site space availability and review of the programme and placement for storage and removal of logs from site.
- A review of measures to facilitate and encourage the *taking of at least two breaks* per day is required. At the very least this will require further education through all levels of logging seniority about the effects of fatigue and potential for error. There is also potential to make case study examples of crews successfully operating a two break system – showing the positive impact on productivity, performance, quality etc. Crews may also benefit from practical support / guidance in revising work methods.
- Interventions to facilitate taking the *full holiday allowance* and to *cover absence and sickness* are needed; contractors need guidance on minimum staffing levels to cover. In areas with chronic recruitment problems, the extension of forest closure may also be considered.
- Team of year effects in incident causation warrant deeper exploration.

4.8 Recruitment and personnel availability

Main concerns identified:- • shortages of personnel in some areas • typical problems are recruitment, covering the 4th week of annual leave, managing turnover, and sickness or health problems such as sore backs • a relatively narrow age group range is seen as optimum within the industry

Recommendations:-

- Continued measures to encourage uptake of work within the industry are required.
- Ways of redesigning work (through adaptation of tasks, equipment, organisation etc.) need to be considered to help inclusion of a wider age group in all logging tasks.

- Contractors need practical guidance on how to manage absence through sickness and holidays.

4.9 Welfare, hydration and nutrition

Main concerns identified:- • 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) • some workers eat nothing until first smoko • health implications of lack of hand washing and toilet facilities are unknown

Recommendations:-

- *Water* should be available for logging workers all year round. Methods to communicate responsibility for provision need to be developed.
- *Welfare facilities* warrant deeper investigation – especially the potential for any health implications arising from lack of toilets and hand washing.
- Methods to increase provision of guidance to industry regarding *fluid intake and good nutrition* warrants review, especially in terms of making information regularly available (such as during crew safety talks) and independent of ticketed training.

4.10 Occupational health related issues

Main concerns identified:- • there is only random provision of pre-employment or in-service health assessment • content and nature of such assessments appear to vary widely • it is not clear whether assessment and surveillance of musculoskeletal type health problems is prioritised • many developing gradual process injuries such as musculoskeletal disorders are not being reported within crews and this could negatively affect hazard management • the implications of long work periods with few rest breaks and task risk factors on musculoskeletal disorder / injury development appear to be under appreciated

Recommendations:-

- *Occupational health advice* for the logging sector is required. This will need to address the nature and content of both pre-employment health assessment and health surveillance, and provide guidance for contractors and occupational health service providers alike.
- Likewise methods to explore the *prevalence of discomfort pain and injury* (especially concerning the development of MSD and hearing problems) is justified.
- Appropriate interventions and management of future needs for an *ageing workforce* must also be anticipated.

4.11 Job design issues

Main concerns identified:- • some crews avoid job rotation due to potential for loss of productivity and undesirability of some tasks • job rotation (especially where infrequent) may have only limited affect upon reducing boredom and exposure to physical hazards • retention of skill and fitness may be lost without regular practice for those trained in multiple work activities

Recommendations:-

- The *work organisation* of loggers requires deeper investigation, to include looking at the way that the work of crews is managed, and to identify the benefits and disadvantages that are experienced by those operating alternative systems (not only job rotation) within New Zealand.
- It would be useful to look into identification of alternative work organisation methods used internationally in logging, or perhaps in industries with comparable issues. Alternative work systems should be evaluated in terms of human factors and ergonomics fit. Industry representatives may consider and collaborate in findings to propose alternative work methods that offer more positive physiological and psychosocial advantages for loggers. Such work methods, where considered suitable for wider dissemination within industry, would need to be introduced to industry with practical guidance and support.

5. Limitations of the study

Whilst the research has identified a wide range of factors affecting the logging industry the work has been constrained by a number of factors. Due to safety concerns there was limited access to working areas to analyse tasks; such data would have been a useful inclusion and may be addressed in future work. Additionally there were instances where some observations were quite isolated and it is not known whether these are representative of the industry as a whole or outlier comments. All effort has been made to isolate and identify those warranting deeper exploration. Opportunities to explore such issues amongst a wider dataset may be considered for future work.

6. Conclusions

Exploration of the fifteen different incidents allowed the identification of various factors that may negatively impact the work conditions of logging crews. There were many reports of health problems (not necessarily related to the incident event) reported by individuals, and these were often unfavourably affected by shortcomings in the work task, tooling equipment and PPE, site layout and environmental conditions. There were also undesirable influences arising from organisational systems (such as work scheduling, work pace, training, welfare facilities, planning, production targets, provision of manpower, occupational health related issues and job design).

Enhanced understanding concerning existing injury prevention initiatives and future intervention needs was gained by considering the range of opinions from those with site and off site based roles, in combination with Ergonomists' input.

References

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