REPORT

ISSN 1174 - 1406

Volume 23 No. 11 1998

Logmaking from a Cab: Improving operator performance

Tina Cummins

Summary

A survey was carried out with 23 operators of excavator-based single-grip processors who were cutting to length (logmaking) in New Zealand clearfell harvesting operations. The study aimed to identify which features of the cab environment, operator controls, and work organisation, may be reducing the operator's ability to effectively process stems into logs. The study found poor visibility from the cab, difficulty measuring sweep and knot size, and extended work hours were contributing to reduced operator performance. To improve levels of productivity and quality in mechanised logmakers, a range of ergonomic and individual factors related to the cab environment, work organisation, and logmaker need to be addressed.

Recommendations

Results from the study show the following issues need to be addressed to improve the working environment of the operator and so improve logmaking performance.

- Limit shift length to less than four continuous hours
- Use frequent short breaks
- Education of operator about Occupational Overuse Syndrome (OOS)
- Development of stem feature recognition aids
- Seat adjustment to each specific operator
- Adopt a system which minimises machine interference on the skid
- Improve communication between processor operator and rest of crew operations

Liro Forestry Solutions

Private Bag 3020, Rotorua, New Zealand
Telephone: +64 7 348 7168 Facsimile: +64 7 346 2886
Email: tina.cummins@fri.cri.nz

Background

Mechanisation of harvesting operations has reduced the physical demands on workers and improved the safety of harvesting operations, by removing the operator from many of the hazards of the work face. Past research has shown machine operators to have less than 15 % of the accidents suffered by chainsaw operators in harvesting the same amount of timber (Poschen, 1993). However, there is concern that a new type of injury is being substituted for the traditional harvesting injuries, resulting from the long, repetitive and often monotonous hours of manipulating the controls (Poschen, 1993). Operating forest equipment places new demands on the forest worker. Repetition, short work cycles, and a high demand for sustained concentration can increase job monotony and lead to worker overload and reduced job satisfaction. High production targets, coupled with a high proportion of static work, make the job mentally demanding. This combination of risk factors has been shown to be linked to musculoskeletal problems like OOS (Wilson, 1998). In Scandinavia, despite years of substantial ergonomic improvements to machines, a significant number of harvesting machine operators continued to suffer musculoskeletal injuries (Erikson, 1995; Hansson, 1990).

Past research has shown that poor ergonomic cab design has contributed to back, neck and shoulder injuries, slips and falls, cumulative trauma disorders of the hand and wrist, and even tragic accidents due to poor visibility (Tyson, 1994). Fatigue, boredom, job dissatisfaction, negative stress, absence/sickness, reduced productivity, reduced quality, increased errors, and equipment replacement are also symptoms of poor cab design (Tyson, 1996). Tired workers have been shown to have a higher error potential, leading to lost production, equipment damage, less effective work output and increased rate of injury (Anon, 1994). The consequences of poor ergonomic design are summarised in Figure 1.

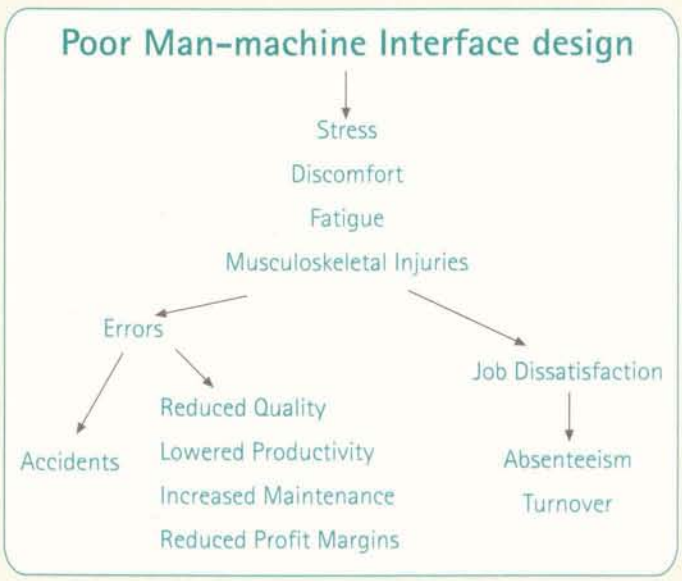

Figure 1 - The consequences of poor interface design

Acknowledgments

Liro would like to thank the machine operators and harvesting contractors who provided their time to assist with the study. Thanks also to Jules Larsen of Waratah Forestry Equipment Limited for his assistance.

Method

A survey was completed by 23 operators of excavator-based processors, who were cutting to length (logmaking) in 12 mechanised harvesting operations in the Auckland, central North Island, Hawke's Bay and Nelson regions of New Zealand. This sample represented 86% (12/14) of all harvesting crews who were using an excavator-based processor to cut to length at the time of the study. Data from the survey were used to identify key areas which could be used to improve the work environment of the mechanised logmaker, and hence improve both productivity and quality.

Results and Discussion

Logging Experience

The operators had spent from one to 21 years working in motor-manual logging operations, and from three months to six years in a mechanised operation. On average, the operators had spent more time in a motor-manual operation than in a mechanised crew. This suggests that operators are transferring from motor-manual to mechanised operations, rather than being sourced from other industries or polytechnic training courses.

Logmaking Experience

Most of the operators (78%) said they had worked as a logmaker prior to operating a processor. Logging experience was on average four years in a motor-manual crew, and two years in a mechanised operation. The operators had spent from three months to six years operating their current machine.

Previous Training for Mechanised Logmaking

A significant number (78%) of operators said they had received training for mechanised logmaking. Of this group, 47% was from the supplier of the processor head, 37% from a previous operator, and 16% from the contractor. Only 36% of the identified training (shaded) was actually related to logmaking (Table 1). In 60% of cases, the training had been a one-off session lasting up to a week.

Type of Training	%
Use of controls in cab	36
Use and interpretation of logmaking software	28
Recognition of stem defects from a distance	17
Recognition of knot size from a distance	15
Motor-manual logmaking course	4

Table 1 - What was covered in your training?

Currently there is little formal training available in New Zealand for operators of mechanised processing equipment. In 1988, the Forest Industry Training and Educational Council (FITEC) was in the process of registering units of learning toward a National Mechanisation Certificate. Proven benefits of training include: higher productivity; less downtime; reduced turnover; an improved safety record; lower owning and operating costs; shorter learning curves; faster rate of productivity increase; less machine damage; lower site damage; fewer machine overturns; and reduced operator injuries, including OOS (Parker et al., 1996; Sullman and Evanson, 1998). In Scandinavia, training machine operators is seen as an indispensable additional investment, because repairs and downtime are very expensive (Johansson and Strehlke, 1996).

Working with an Auditor to Improve Performance

Eleven of the surveyed operators said they were routinely audited on their logmaking, but only four of this group said they had worked with the auditor to discuss problem areas. Working with an auditor would provide an operator with the opportunity to improve their skills, by learning where wrong decisions had been made. In many mechanised harvesting operations there is a requirement by the company for a quality check to be carried out on 100% of logs cut from mechanised operations. However, audits can only assist the operator when they are carried out on processed logs prior to any additional crew quality checks being made.

Stem Features and Mechanised Logmaking

Most of the operators said they needed to see several different stem features to logmake successfully, many of which were difficult to see from the cab (Figure 2). Sweep and knot size were identified as the most difficult features to see. Thick bark, spike knots, forks and nodal swelling were identified as features which contributed to measuring wheel slippage, and therefore to inaccuracy with log length measurement.

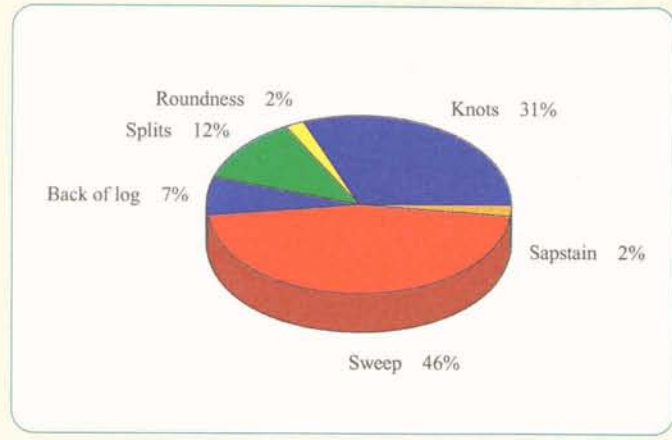

Figure 2 - Which stem features are not easy to see?

Length of Work Day

Shift lengths ranged from two to 13 hours, including breaks (Figure 3); nine or ten hour shifts on the machine were common (45%). Many (81%) were the sole operator, processing for the entire work day. Due to the potential for increased fatigue levels associated with long periods of mentally demanding and repetitive but sedentary work, it is important for the operator to get off the machine during the work shift to introduce movement into muscles. This will assist the body to remove fatigue-inducing waste products (Byers, 1996). Getting off the machine also stimulates the mind, and reduces the cumulative effect of mental fatigue, such as inattention, reduced concentration and reduced vigilance. These are critical factors in lost revenue, due to increased rate of error and sub-optimal logmaking.

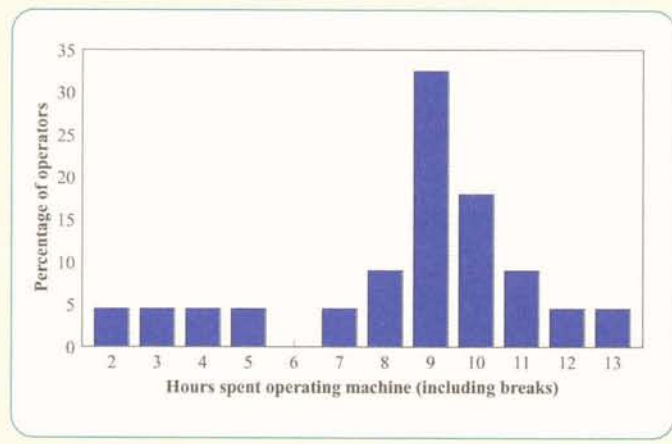

Figure 3 - Operator shift lengths

Seventy-eight percent of operators worked eight hours or longer. The longest time worked continuously was 13 hours. This operator started at 6.30 am and worked through until 7.30 pm. Gellerstedt (1997) stated that working at an early or late hour of the day is more fatiguing and requires more rest breaks to remain healthy. Based upon previous research, the level of mental fatigue experienced by this operator would be expected to be considerable (Hansson, 1990; Inoue, 1996), reflecting in reduced productivity and value recovery.

Occupational Overuse Syndrome (OOS)

OOS is a collective term for a range of conditions characterised by pain or discomfort in the muscles, tendons and other tissues, which is thought to be brought on by the cumulative effect of static or repetitive workload on the body (Macfie, 1995). The potential for musculoskeletal injury in mechanised operators is high, as they are exposed to a high number of risk factors in their work (David, 1979; Hansson, 1990; Wilson, 1994; Erikson, 1995; Holmes, 1996; Wilson, 1998). Most of the operators (78%) had heard of either RSI or OOS, and half (55%) of this group said they were aware of prevention techniques. Micropauses* can be effective in reducing the cumulative build-up of waste in the muscles caused by repetitive tasks. It is of concern that only 17% (four) of the operators had heard about micropauses, as this is a technique commonly promoted in other industries to reduce the risk of OOS (Byers, 1996). Of more concern, is that only two of the four operators who knew about micropauses, actually used them.

*** A *micropause* is a brief break for relaxation (e.g. 5 to 10 seconds complete relaxation every 3 minutes)**

Symptoms of Fatigue

All of the operators experienced some form of physical discomfort when logmaking from the cab. Drowsiness, sore eyes and various body aches were commonly reported (Figure 4). Body part discomfort experienced by the operators is illustrated in Figure 5. One of the main reasons operators believed had contributed to their feeling drowsy, was the length of shift they had worked. Shorter shifts, regular breaks and micropauses would reduce this problem and result in a more alert and productive operators (Inoue, 1996).

Considering the length of time operators were spending on the machine, and the characteristic nature of the job (high repetition, sedentary, requiring constant attention), these symptoms were to be expected, consistent with findings from Scandinavian research (Sondell, 1984; Axelsson and Ponten, 1990). Rest breaks are important to reduce the cumulative effects of physical and mental fatigue (Kopardekar and Mital, 1994; Boucsein, 1996; Henning et al., 1997).

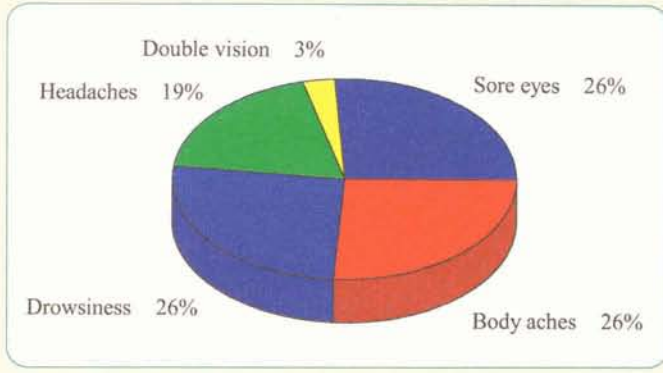

Figure 4 - Symptoms reported by mechanised operators

Causes of Bodyaches
angle the machine sitting on
numb buttocks from no rest breaks
top of back sore from seat
wrists sore from using joysticks
not fit for job
using the controls
not moving head around
sitting all day in one position
tiredness
using top of joystick

Table 2 - Operator comments on probable causes of body aches

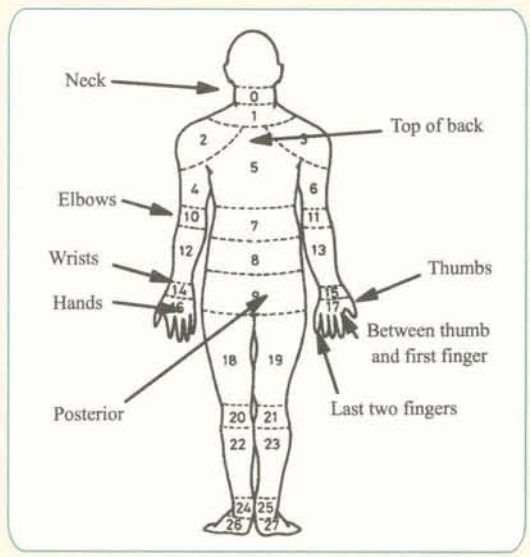

Figure 5 - Body part discomfort experienced by operators

The similarity in reported symptoms of fatigue between this survey and another survey of feller-buncher operators (Byers, 1997) suggests that operating a machine for extended hours with few breaks has a greater impact on performance than the actual task (logmaking, felling) being undertaken by the operator.

Operator's Seat

Some of the physical symptoms reported by the operators may have been related to the adjustment of their seat. A seat which absorbs shock loadings, machine vibration, and fits the operator's body comfortably (Figure 6), will place less stress on the body and reduce fatigue levels over the day. While recognising that a well-fitting seat can improve the working environment of the operator, it appears that this may be only part of the solution in reducing operator fatigue. Getting off the machine is still a critical factor in reducing fatigue.

Figure 6 - Operator seat design - 1997

Work Breaks

The most common meal breaks were 2 x 30 minute breaks per day (Table 3). Two operators did not stop at all for a meal, but ate either as they worked or at the end of their shift.

Meal Break Time and Frequency	Number Operators
30 minutes x 2	13
30 minutes x 1	4
1 hour x 1	2
No meal break	2
15 minutes x 2	1
No reply	1

Table 3 - Operator meal break patterns

Many of these meal break patterns suit manual tasks such as felling. Heart rate is lowered and body energy reserves are refuelled, allowing the body a suitable period to recover from physical fatigue. However, operating a processor is different to hard physical work in that it is a mentally demanding job which exposes the operator to high levels of mental fatigue (Sullman and Gellerstedt, 1997), but requires low levels of physical effort. As a result, more frequent breaks need to be taken in conjunction with organisational measures such as job rotation to reduce mental strain (Gellerstedt, 1997) and physical workload (Johansson and Strehlke, 1996). It is more important to have frequent breaks of a shorter duration in jobs with a high mental workload.

In addition to meal and maintenance breaks, many of the operators took spontaneous rest breaks consisting of either a five second stop to light a cigarette, two to five minute breaks taken frequently throughout the day, or two 10 minute breaks which the operator used to get off the machine. Getting off the machine is an easy way to introduce movement into the muscle groups, allowing them to remove any damaging waste products from the muscles and reducing the cumulative effects of fatigue, while providing a break in routine from the job, stimulating the mind and aiding mental recovery.

Skid Organisation

Most (70%) of the operators were cutting to length in a ground-based system rather than cable. Hot-deck truck loadout systems were used in 70% of the crews visited. Unlike cold-deck truck loadouts, operators in hot-deck systems had to contend with logging trucks in addition to other machinery and crew movements on the skid. Discussion with the operators following the survey indicated that they thought a cold-deck system was better to work in, as full concentration could be applied to the job without the distraction of having to watch or wait for other machinery.

In a ground-based system, the skidder operator can play an important part in facilitating processing when dragging wood, by presenting wood butt first, stems uncrossed, and preferably in a position where the processor grapple can seize the wood and process in a downhill direction. This may not be such a problem in cable operations, as processors often clear the chute in addition to processing, controlling the formation of the processing stockpile. Machine interference was another critical factor identified. Processing on a skid separate to where other machinery is working, such as in two-staging operations and cold-deck truck loadouts, reduces the amount of machinery and people present and allows the processor operator to focus on the job. The use of smaller, alternating stem stockpiles can minimise machine interference, allowing the operator to work on one stack while the skidder creates a second stack out of the way of the wood being processed. Comments from both processor operators and crew members stated that clear and effective lines of communication between crew members was essential in developing a well-run system.

Conclusion

The job of logmaking from a cab is mentally demanding. The study found poor visibility from the cab, difficulty measuring sweep and knot size, and extended work hours were contributing to reduced operator performance. While the ergonomic design of the cab environment has a large part to play in the optimum performance of the operator, other factors including rest break patterns, job rotation, and length of shift are also important. Developing machine operating hardware and a work system which allows the operator a period away from the mentally intensive task of logmaking, will reduce the cumulative and fatiguing effect of a high mental workload and improve levels of productivity and quality achieved.

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