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**An Ergonomic Analysis of a Closed Circuit  
Television Rear Vision System for Forestry  
Machine Operators**

A thesis in partial fulfilment of the requirements for the degree of  
Master of Ergonomics at Massey University

Richard Parker 2003

## ABSTRACT

The Bell Logger is a fast highly mobile forestry machine used in close proximity to workers on foot. It can, along with other machines, inadvertently collide with workers, other machines or logs which subsequently hit workers. To date the only successful way to prevent injury to workers on foot is to completely remove them from the work area of the Bell Logger. This is often operationally difficult and does not prevent collisions between machines or other objects. One potential solution is to improve the rear vision of the machine operator.

A literature search was carried out to review information on human vision, issues of driver vision from vehicles, epidemiology of forestry injury related to mobile machines, methods of assessing vision from vehicles and existing rear-view aids for vehicle drivers. A questionnaire was used to gather information from Bell Logger operators on their opinion of the rear view camera system. Video records of Bell Logger movements and operator head glance direction were analysed to characterise the operating environment and style without and with the rear view camera system.

Mobile machine related injuries on the skid site are a significant problem resulting in 1304 lost work days in the period 1995 to 2002. The normal operational environment of the Bell logger operator is characterised by frequent machine changes in direction (eight to 10 per minute) and frequent head movements (four to five per minute) to see if the way is clear. Results indicate that the rear vision camera system appears to have potential as a valuable addition to the Bell Logger operating under typical New Zealand forestry conditions, and it resulted in a 20% increase in Bell Logger activity.

## REPORTS WRITTEN FROM THIS WORK

(Copies in Appendix 7)

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## **CHAPTER 1 INTRODUCTION**

### **1.1 Purpose**

The Bell Logger is a fast highly mobile forestry machine (Appendix 6) used in close proximity to workers on foot. It inadvertently collides with workers, other machines or logs which subsequently hit workers. To date the only successful way to prevent injury to workers on foot is to completely remove them from the work area of the Bell Logger. This is often operationally difficult and does not prevent collisions between machines or objects. One potential solution is to improve the rear vision of the machine operator. This project evaluated a prototype rear-vision system for the Bell Logger operator.

### **1.2 Background**

One of the single most common causes of injury to workers in logging in New Zealand is being struck by a mobile machine or a log which was struck by a mobile machine. In the period 1995 to 2002 there were 92 lost time injuries reported where injury was caused by worker/mobile machine interaction. These injuries resulted in a total of 1304 work days lost. Interventions to prevent these injuries include; training of forest workers and machine operators to develop improved situational awareness, improved design of work sites to minimise the opportunity for interaction between workers and mobile machines, the wearing of high visibility clothing and the introduction of technology to improve machine operator visibility from the cab.

This project assesses a technology intervention. The project involved the study of three Bell Logger operators under normal operational conditions. They drove an unaltered Bell Logger with the normal situation of no rear vision. The prototype rear-vision system was added to the machine and the operators were given some days to get used to the system. The operators' opinions of the rear-vision system, changes in their operating style (frequency of machine movement) and glance style (looking left or right) were measured.

### **1.3 Project aims**

1. To review the problem of machine associated injuries on the skid site
2. To characterise the normal operational environment of the Bell Logger operator
3. To measure the effect of a prototype video rear-view system on normal Bell Logger operation.

### **1.4 Approach**

Ergonomics takes the *system* as the unit of analysis – the person performing a task in an environment (including other people) supported by technology.

Documents relating to Bell Logger operational procedure, training material and industry guidelines were studied.

Methods used in the study included:

A semi-structured interview

Document analysis

Video measurements of behaviour (vehicle and operator movements)

Development of a rear-view camera system

Development of a data handling system

Analysis by General Linear Models

Use of guidelines on in-vehicle vision recommendations.