LOGGING INDUSTRY RESEARCH ASSOCIATION

LOGGERS' ASSESSMENTS OF RISKS IN THEIR WORK

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ABSTRACT

A total of 413 loggers from the Bay of Plenty, Hawkes Bay, Auckland/Northland, Nelson and Otago/Southland regions were surveyed to assess their knowledge of risks involved in their occupation. The survey asked loggers to rank the chances of having an accident while performing specific jobs in an operation, the chances of receiving specific injuries and the parts of their bodies likely to injured. These results were compared with data from the Accident Reporting Scheme.

Results showed that loggers were well aware of the risks involved in logging. Little regional variation was found to exist. There were some differences in the age and experience of those loggers who had had an accident in their work history, but this did not affect the way in which they ranked the items in the questionnaire.

This study raised a serious question. If the loggers are aware of the risks inherent in their occupation, why are those risks not avoided more often? A subsequent study is to be set up to try and provide a clearer picture on why loggers take risks.

INTRODUCTION

Accident research in the New Zealand logging industry to date has concentrated firstly on developing a reliable data base (Prebble, 1984) and secondly on interpreting the information collected (eg. Gaskin, 1989). The data base established is centered around the Accident Reporting Scheme (ARS), which is a voluntary scheme, with an industry wide coverage estimated at between 80 - 90% of all the logging accidents that occur. The information is then interpreted, trends in the data assessed and the results published to the industry in quarterly one page summary reports and annual summary reports (eg. Gaskin, 1989).

As part of a recently completed survey of the logging workforce (Gaskin, Smith and Wilson, 1989) the loggers involved were questioned on whether or not they had suffered an accident, what job they were doing at the time of the accident and what follow-up had occurred. Within this survey loggers were also asked whether they suffered from an occupational injury, such as back problems, hearing loss, etc.

The information collected through the ARS and the logging workforce survey note that the highest percentage of accidents occur in felling, trimming and skid work. The hands, feet and lower legs are the parts of the body most likely to be injured and lacerations (typically inflicted by a chainsaw) are the most common form of injury. While these statistics are essential for gathering information on the numbers and types of accident that occur, they do not reveal anything about how loggers perceive the risk of the occupation.

Dunn (1972) suggested that a person's judgement of risk may differ from the actual risk to which they are exposed. People must make interpretations about their environments and these interpretations, like any human behaviour, are subject to error. This would suggest that an accident may occur because a person placed themselves in a risky situation without being aware of the danger inherent in their actions.

Furthermore, it has been suggested that adopting a safer procedure or some other safety measure is motivated by a value judgement made by the individual (Green and Brown, 1978). A safety measure is evaluated by an individual and then used if there is a perceived benefit by doing so. An example of this is the protective legwear that has been made available to loggers. There is no legislation which makes these articles compulsory yet most loggers now use chaps or trousers and there has been a resultant drop in the number of chainsaw cuts to the legs resulting in lost time accidents (Gaskin, 1986). It would seem that the value of using this protective equipment has been judged to be higher than not wearing them.

This study has implications for future safety progammes. Should some new safety measure be introduced its success could, in some way, be predicted by firstly assessing whether loggers perceive a risk to be present and secondly, whether they judge the measure to have an improved safety value.

The objective of this study was to ascertain how loggers assessed the following:

(i) the chances of having an accident while performing specific jobs in an operation
(ii) the chances of receiving specific injuries
(iii) the part of the body most likely to be injured.

The loggers were asked to make their evaluations based on the likelihood of each item in the questionnaire occurring. It was expected that if their knowledge of the risks was accurate, then, their answers would closely approximate the Accident Reporting Scheme findings where comparisons can be made. Any major deviation from the scheme data would suggest a lack of recognition of the risk.

This study forms the first of a two part study; the second study will investigate how loggers rank specific hazardous situations.

This study also collected biographical information about each logger surveyed such as their age and experience, the type of operation they work in and their level of logger certification; to assess whether these variables affect their ability to judge risk.

ACKNOWLEDGEMENTS

LIRA gratefully acknowledges the co-operation of the contractors and loggers involved in this study and the support shown by various company management during data collection.

METHOD

Subjects

The loggers used in this study were those involved in the year long LIRA study of absenteeism and turnover.

There were 225 loggers interviewed in the Bay of Plenty region, 28 in Hawkes Bay, 44 in Auckland and Northland, 63 in Nelson and 53 in Otago and Southland. This gave a total sample of 413 people.

Procedure

A questionnaire with a 5 point Likert type scale was developed and pilot tested on 10 loggers in Tauhara forest. Data collection for the full study was begun in July and was completed in September. Each logger filled out the questionnaire voluntarily and individually.

Questionnaire

The questionnaire was in three parts, each part being contained on a single page. The same 5 point scale (1 being the lowest chance and 5 the greatest) was used for all three parts of the questionnaire. Part I asked the subjects to assess the chances of a logger having an accident while performing various jobs in a logging operation. The jobs were: felling, trimming, skid work, breaking out, operating an extraction machine and loading. The felling and trimming items were sub-divided into flat or steep terrain. Separate evaluations were made for carrying out these jobs on steep ground and flat ground as well as an overall risk assessment. Another item, included as a reference point, asked the risk involved

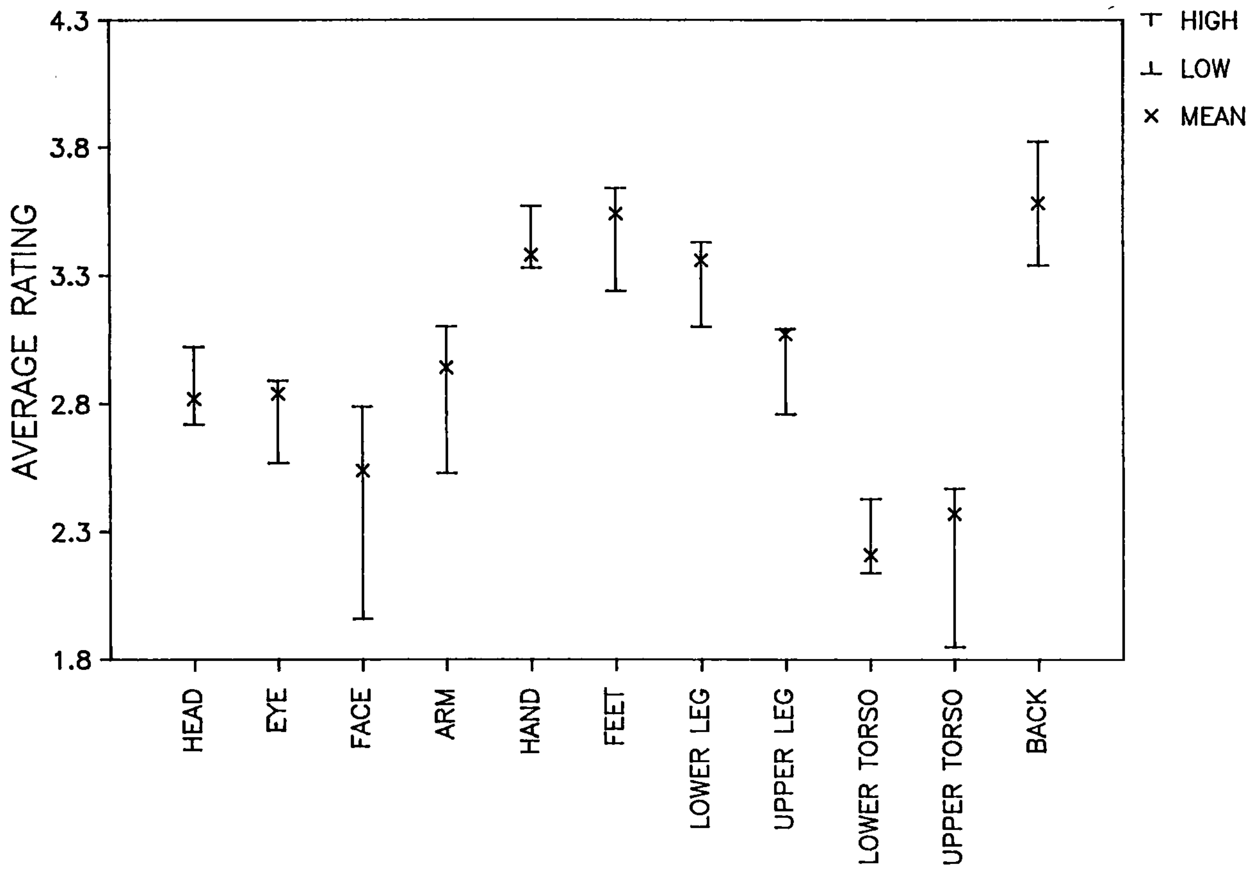

Figure 3 : Average rating for items in part 3, which examines the parts of the body most vulnerable to injury.

This difference between thinning and clear-fell crews was the only major area of departure between the loggers in the sample. Hauler crews, for example, who work in typically steeper country than other logging operations do not seem to rate the risks in their environments any differently from gangs working with other methods of extraction.

Table 1: Comparison of Age, Experience and Accident Record by Region

	TOTAL	*Bay of Plenty*	*Hawkes Bay*	*Auckland/ Northland*	*Nelson*	*Otago/ Southland*
TOTAL SURVEY						
Ave Age	*31.5*	*31.0*	*31.1*	*32.2*	*33.8*	*30.9*
Ave Years Logging	*10.3*	*10.6*	*5.9*	*8.7*	*13.4*	*9.5*
% Accident	*55*	*55*	*50*	*52*	*68*	*49*
ACCIDENT						
Ave Age	*32.7*	*33.1*	*30.0*	*31.2*	*33.4*	*32.9*
Ave Years Logging	*12.2*	*12.8*	*6.1*	*11.2*	*13.8*	*11.6*
NO ACCIDENT						
Ave Age	*29.9*	*28.4*	*32.3*	*33.2*	*34.6*	*28.7*
Ave Years Logging	*7.9*	*7.9*	*5.7*	*6.2*	*12.4*	*7.5*

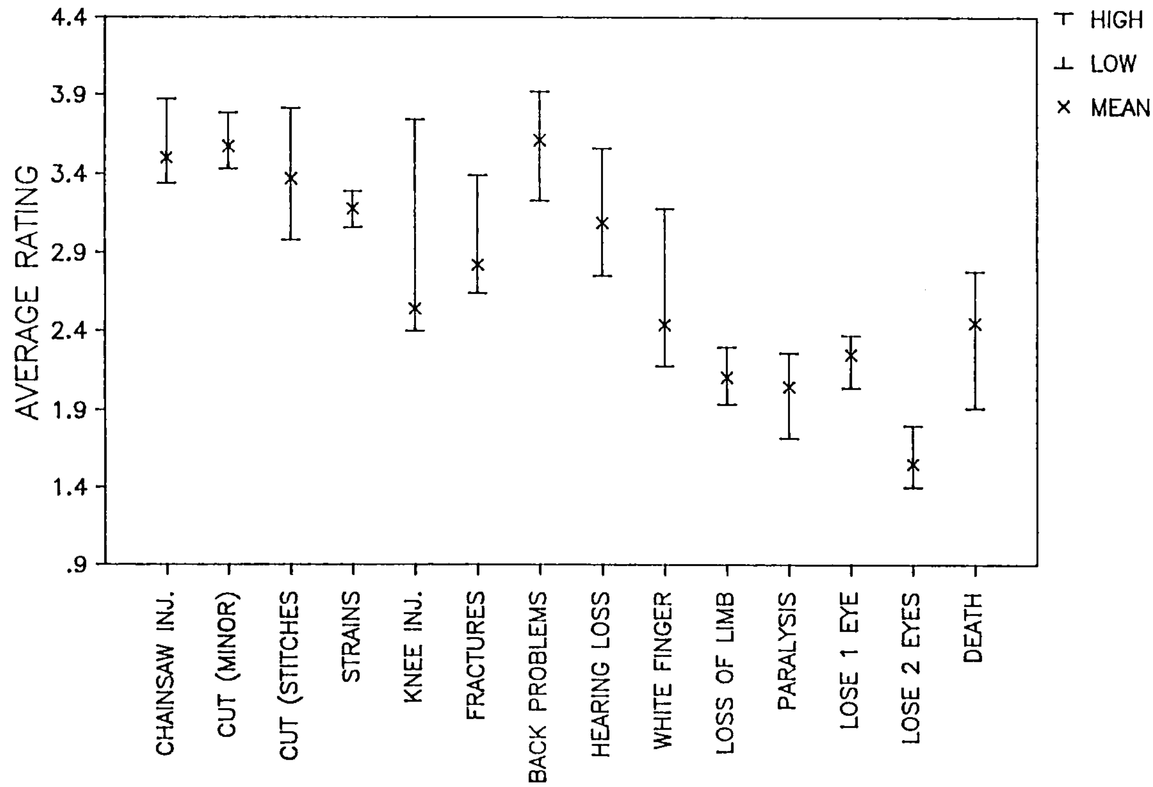

Figure 2 : Average rates for items in Part 2 of the questionnaire - assessing the chances of different types of injuries.

odds with the ARS statistics which show that in 1988 skid work accounted for about 21% of the total accidents recorded while breaking out only accounted for about 12% (Gaskin, 1989).

Felling and trimming on steep country are seen as being the most risky. As the Accident Reporting Scheme does not collect information about terrain, this result cannot be compared with the accident statistics. This finding indicates that should companies and contractors wish to increase the amount of log processing on steep slopes they may encounter some resistance from the loggers.

Figure 2 shows the findings from Part 2 of the questionnaire. Again there is similarity between the different regions, of the chances of various sorts of injuries, indicated by the narrow range about the mean. This is particularly so with the occurrence of the more serious and less frequent injuries, such as loss of a limb and blindness.

The loggers' evaluations are again consistant with the accident statistics in that lacerations, back problems and chainsaw injuries are rated the highest, however, they seem to have over-estimated the chances of being killed. It is possible that the subjects are not just considering the frequency of fatal accidents when they are making their evaluations, but rather severity is weighting their judgements.

The sample from Nelson rate the chances of a knee injury noticebly higher than did the rest of the subjects. No reasonable explanation for this result can be found from the available data.

The similarity of loggers responses is again evident in Figure 3. The hands, feet and lower legs are rated highly which agrees with the accident statistics and the subjects also recognise the high risk of back injury in the industry. The variation in the ratings for the face may be related to the type of operation in which the subjects work. Bay of Plenty loggers working in thinning crews estimate the risk to their faces significantly higher than loggers in clearfell crews. This may be due to the trimming content involved in the work. This perceived risk to the face provides a case for the use of visors by fallers working in thinning operations.

in travelling to and from work. Loggers were also asked in this section if they had ever suffered a lost time accident and if so, what they were doing at the time and the nature of the injury incurred.

Part 2 asked the loggers what the chances were of incurring specific types of injuries. The injuries were: fractures, back problems, knee injury, strains, deafness, loss of a limb, loss of one or both eyes, death , paralysis, injury from a chainsaw, white finger and cuts (both minor and those requiring stitches).

Part 3 consisted of the cartoon picture which appears on the quarterly reports of the accident reporting scheme. The loggers were asked to use the 5 point scale and place a number indicating the chances of being injured at the places indicated on the picture. These injury sites were: the head, eyes, face, arm, hand, foot, lower leg, upper leg, lower torso, upper torso and back.

Instructions were written at the top of each part of the questionnaire and verbal instructions were also provided. Verbal advice typically involved clarification of the instructions. Care was taken to avoid biasing the subjects' responses.

RESULTS

The mean rating, for each item in the questionnaire, was calculated by region and for the total population. Figure 1 shows the mean for the total sample for Part 1 of the questionnaire. The high and low values shown on the figure are the highest and lowest regional means. There is marked similarity between the regions in their estimates of the risk associated with different logging tasks. Felling and trimming rated as the most risky tasks, which is in line with the actual accident statistics. Skid work was ranked similarly to breaking out and extraction machine operation. This is at

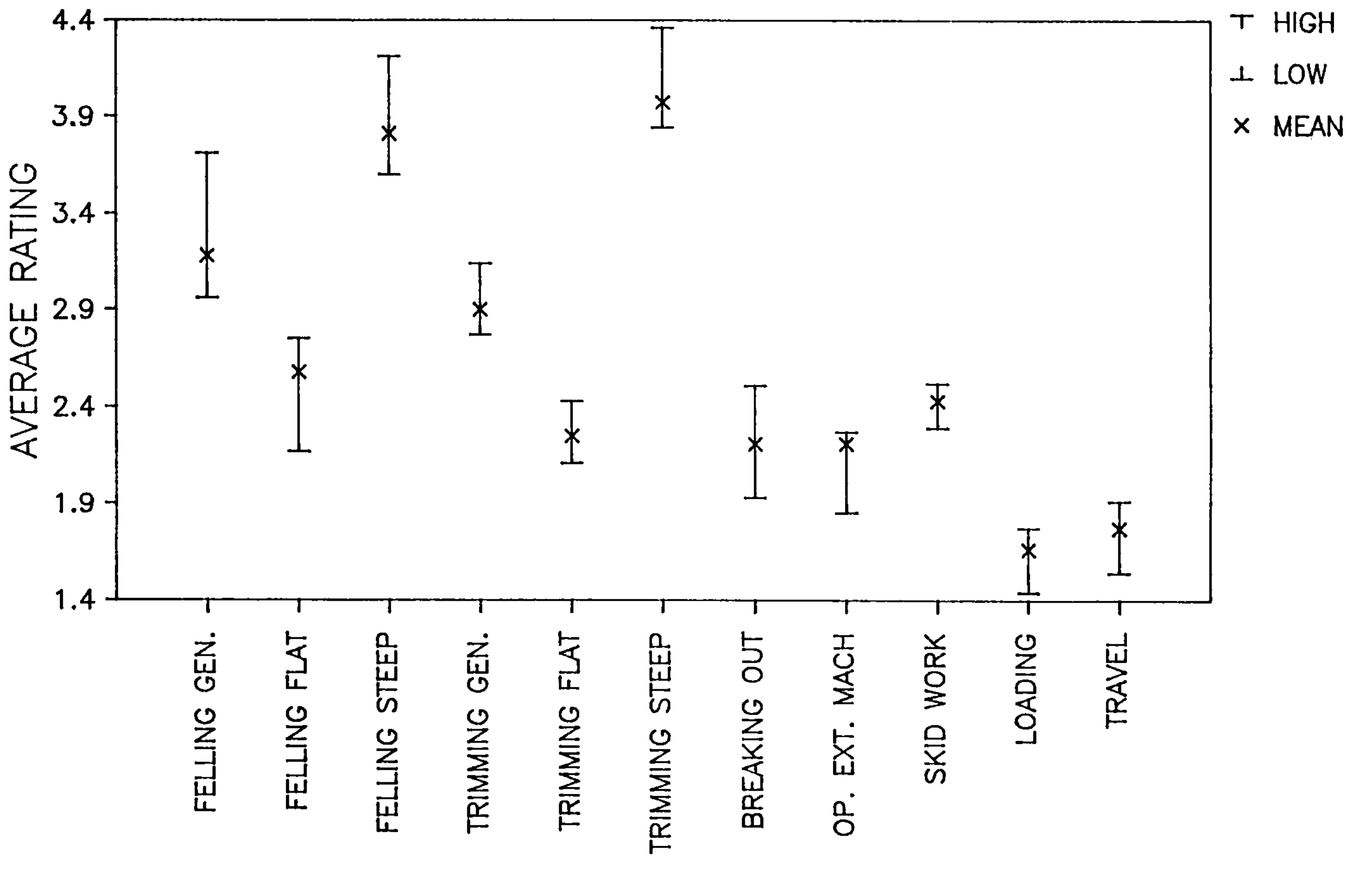

Figure 1 : Average ratings for items in Part I of the questionnaire - assessing the risk for various jobs in the operation.

THE EFFECT OF AN ACCIDENT

The first section of Table 1 shows the average age and length of service of the total sample and the percentage of loggers who have had an accident.

Fifty six per cent of the sample indicated that they had suffered a lost time accident in their logging careers. In Nelson, however, this proportion was higher at 68%. The Nelson group have, on average, spent longer in logging so it is likely that the higher accident rate reflects a longer exposure to the risks in logging. The linkage between accident and experience is strongly supported in Bay of Plenty, Auckland/Northland and Otago/Southland where accident victims have significantly longer experience than the average for the total population.

The survey results for each area were subdivided into those loggers who have had an accident and those who have not, and the mean ratings for each item of the questionnaire were re-calculated. These mean ratings were then used to rank the items in the three parts of the questionnarie from highest to lowest. It was found that the order in which the loggers ranked the items, was very similar regardless of whether they had had an accident at some stage in their work history.

CONCLUSION

From the data collected during this study,it appears that New Zealand loggers are well aware of which parts of the operation are risky, what types of injuries occur and the parts of the body which are most vulnerable. There was a great deal of similarity between loggers in the way they rated the items in the questionnaire regardless of whether they had suffered an accident or the type of operation and terrain in which they worked. In this study, the loggers' evaluations of risk closely approximated the accident statistics, which is a major departure from the findings of Dunn. One possible explanation to explain this is that the loggers have access to the quarterly summaries from the Accident Reporting Scheme so are well informed. Further research is needed to test whether in fact this is the case.

This study, however, raises a serious question. If the loggers are aware of the risks inherent in their occupation, why are those risks not avoided on more occasions? The second part of this study should go some way towards providing a clearer picture on why loggers take risks.

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Discussion of the Input Data

Fuel Consumption

The addition of a tag axle has an adverse effect on fuel consumption. The tag axle increases truck tare weight and increases overall tyre rolling resistance and scuff. For operators who choose to leave the tag axle on when the suspension is not completely load sharing, tyre rolling resistance and scuff is reduced by replacing the dual tyres on the tag axle with a single tyre.

When the suspension is completely load sharing, four tyres must be on the tag axle and it must remain on the road all the time.

Road User Charges

Road user charges are purchased according to the number of axles on the unit and the on-highway gross operating weight. The addition of a tag axle reduces road tax costs by 42% which for a vehicle doing 130,000 km annually and working mainly on-highway can be as much as $15,000.

Repairs and Maintenance

The rates for working off-highway reflect the lack of road user charges and the opportunity for the operator to carry a larger payload. Consequently, logging trucks working off-highway do so at high gross weights and on relatively low quality roads.

When working off-highway the addition of a tag axle is a factor in reducing repair and maintenance costs, particularly those costs associated with suspensions, chassis and axle components. Correct tag axle pressure setting reduces the load per axle and spreads the weight evenly over all the axles on the truck.

In this report repair and maintenance costs have been estimated depending on the gross vehicle operating weight and the number of axles on the unit.

Gradeability

Gradeability on skids and roads where traction is limited is improved by having the ability to lift the tag axle. Some operators, working mainly off highway, fit tag axles for this reason alone. This procedure reduces tyre drag in muddy conditions and also transfers the majority of the weight on to the driving axles. This is possible only on non-compatible suspension types as the requirement for compatible suspensions is that the tag axle lifting facility be removed.

Stability and Braking

Tag axles, where the suspension is not load sharing, give the operator the ability to vary the pressure in the air bags and thus vary the load being carried by the tag axle. Providing the unit is set up correctly initially (in terms of wheel base and bolster positions) and the pressure in the tag axle air bags is not set too high (transferring too much weight to the front axle) then the addition of a tag axle will improve the braking and stability characteristics of the truck.

For a non-load sharing suspension type, the tag axle can be lifted or the tag axle bag pressure adjusted to give better handling characteristics when the vehicle is travelling empty. In the case where both the tag and drive axle suspensions are load sharing, a solenoid valve is incorporated into the system, to dump a pre-set volume of air giving the vehicle optimum handling characteristics when travelling empty or piggybacking the trailer. Torsion bars and shock absorbers also contribute to improving the handling characteristics.

Tyre Costs

It is generally accepted that spreading the load over more tyres is beneficial to tyre life. However in the case of a 6 x 4 truck and tag axle, steering tyre life is reduced by approximately 12,000 to 15,000 km through tyre scuff and oversteer.

RESULTS AND DISCUSSION

The LIRA truck costing programme, TCOST (Goldsack, 1988) was used to simulate the financial performance of an operator using each of the three configurations over a five year period.

Tables 3, 4 and 5 show the financial breakdown of each configuration with Figure 1 showing the cumulative cash surplus accumulated over five years.

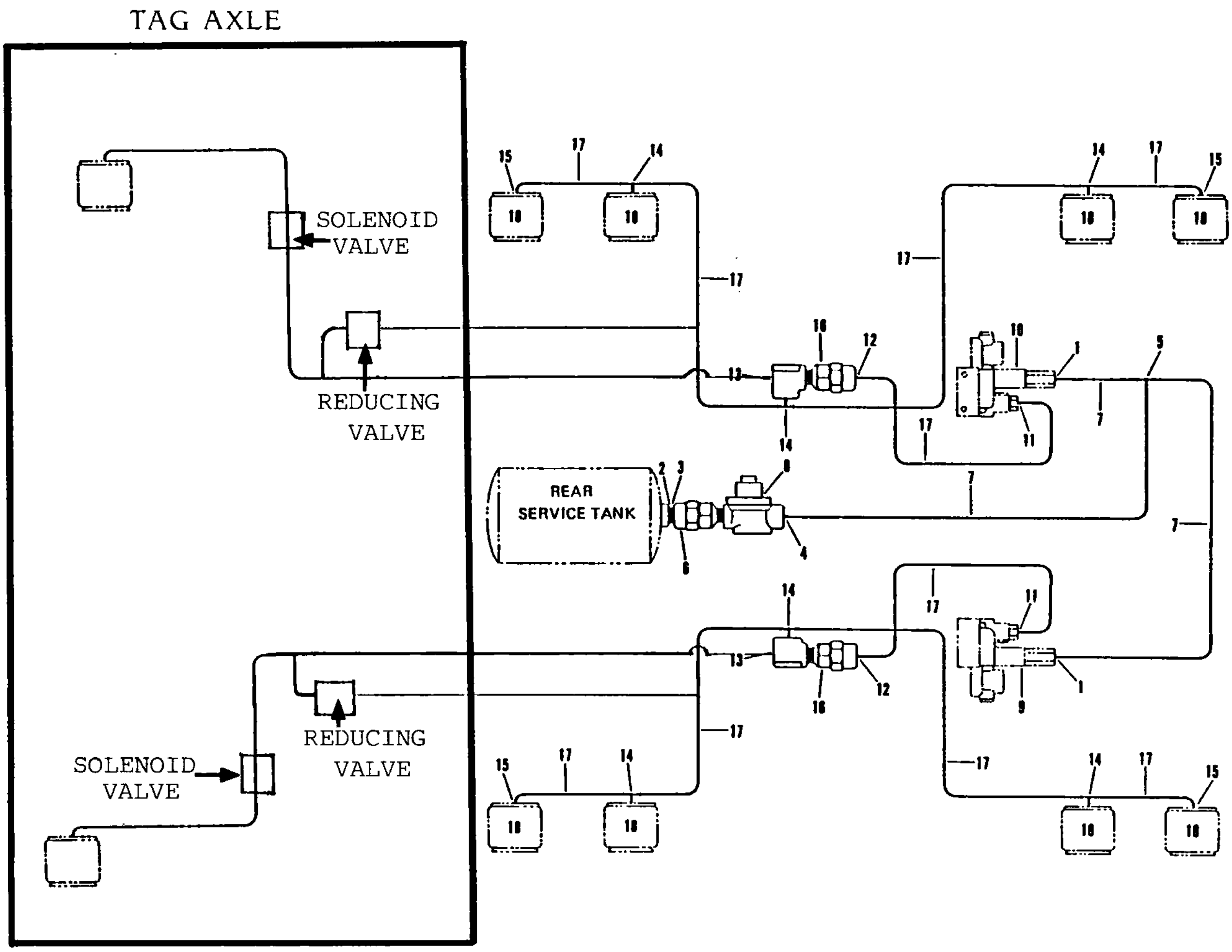

Figure 2 : Load Sharing Tag Axle Piping Diagram

CONCLUSION

The new weights and dimensions legislation allows 6 x 4 trucks and tag axles that have load sharing suspension to operate at 42 tonnes gross on highway. This configuration is one of the most cost efficient ways to transport logs both on and off-highway. However, the durability of some air bag suspensions in a logging environment is under question and further developmental work is required.

Operators of 6 x 4 trucks and tag axles, where the suspension is not load sharing, are faced with the dilemma of removing the tag axle and increasing productivity, or leaving the axle on the unit and reducing road user charges. The findings of this report, where the trucks compared were working mainly on highway, indicate that removing the tag axle is the best option.

It should be noted that these results are sensitive to repair and maintenance costs. A small change in the repair and maintenance costs could alter the relative cost effectiveness of a 6 x 4 with no tag axle and a 6 x4 with a load sharing tag axle. However, a substantial change in these costs would be required to make the 6 x 4 with non load sharing tag axle cost effective.

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Table 3 : Cash Flow Analysis, 6 x 4 + tag axle
Load Sharing Suspension

Revenue Utilisation ($)

	Year 1	Year 2	Year 3	Year 4	Year 5
Overheads	*8784*	*8756*	*8728*	*8701*	*8673*
Finance	*60183*	*60183*	*60183*	*60183*	*60183*
Insurance	*6557*	*5999*	*5441*	*4884*	*4326*
Registration	*450*	*450*	*450*	*450*	*450*
Wages	*32000*	*32000*	*32000*	*32000*	*32000*
Fuel and Oil	*43598*	*43598*	*43598*	*43598*	*43598*
Tyres	*7324*	*7324*	*7324*	*7324*	*7324*
Repairs and Maintenance	*25341*	*25341*	*25341*	*25341*	*25341*
Road User Charges	*41224*	*41224*	*41224*	*41224*	*41224*
Funds (cumulative)	*31492*	*61801*	*91188*	*119767*	*147508*
Tax	*1678*	*7540*	*12989*	*18203*	*23340*
Total Income	*258863*	*262957*	*2668967*	*270717*	*274432*

Table 4 : Cash Flow Analysis, 6 x 4 + tag axle
Non-Load Sharing Suspension

Revenue Utilisation ($)

	Year 1	Year 2	Year 3	Year 4	Year 5
Overheads	*8551*	*8521*	*8491*	*8461*	*8431*
Finance	*61068*	*61068*	*61068*	*61068*	*61068*
Insurance	*7050*	*6450*	*5850*	*5250*	*4650*
Registration	*450*	*450*	*450*	*450*	*450*
Wages	*32000*	*32000*	*32000*	*32000*	*32000*
Fuel and Oil	*40676*	*40676*	*40676*	*40676*	*40676*
Tyres	*7246*	*7246*	*7246*	*7246*	*7246*
Repairs and Maintenance	*22536*	*22536*	*22536*	*22536*	*22536*
Road User Charges	*36006*	*36006*	*36006*	*36006*	*36006*
Funds (cumulative)	*22545*	*45742*	*65984*	*84542*	*101307*
Tax	*0*	*2910*	*9510*	*14455*	*19291*
Total Income	*238128*	*241059*	*244074*	*246706*	*249118*

Table 5 : Cash Flow Analysis, 6 x 4
No Tag Axle

Revenue Utilisation ($)

	Year 1	Year 2	Year 3	Year 4	Year 5
Overheads	*8770*	*8741*	*8712*	*8683*	*8653*
Finance	*58413*	*58413*	*58413*	*58413*	*58413*
Insurance	*6825*	*6241*	*5657*	*5072*	*4488*
Registration	*450*	*450*	*450*	*450*	*450*
Wages	*32000*	*32000*	*32000*	*32000*	*32000*
Fuel and Oil	*42502*	*42502*	*42502*	*42502*	*42502*
Tyres	*7070*	*7070*	*7070*	*7070*	*7070*
Repairs and Maintenance	*28146*	*28146*	*28146*	*28146*	*28146*
Road User Charges	*54791*	*54791*	*54791*	*54791*	*54791*
Funds (cumulative)	*27142*	*52824*	*77250*	*100507*	*122526*
Tax	*126*	*5806*	*10831*	*15726*	*20526*
Total Income	*266235*	*269589*	*272810*	*275823*	*278672*

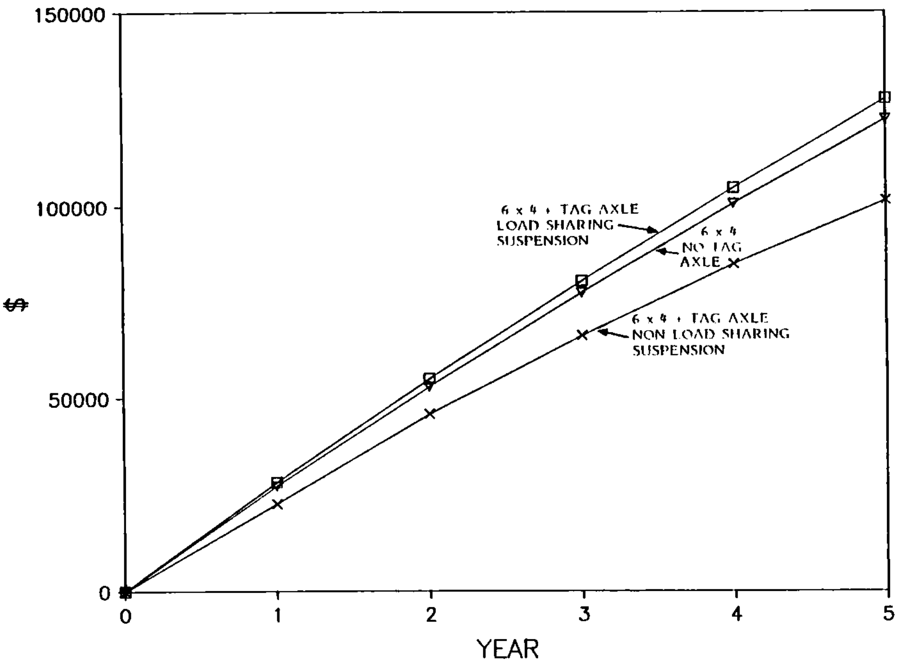

Figure 1 - Cumulative Cash Surplus

The best suspension option for operators of 6 x 4 trucks is compatible air bag drive and tag axle suspension. Air bag drive axle suspension is cheaper initially, substantially lighter than some conventional suspension types and gives good ride quality.

The durability of air bag suspension, particularly in a logging environment however is of concern. Some operators have experienced severe cracking of the main saddle which bolts on to the chassis, and is an integral part of the whole suspension system. Further development work is required which may result in some of the air bag suspension tare weight advantage being lost.

Most 6 x 4 logging trucks with tag axles fitted were bought prior to the introduction of the new weights and dimensions legislation and as such are of the non-compatible suspension type and are limited to 39 tonnes GVW on highway. In this situation the question regarding the cost effectiveness of removing the tag axle from the truck or leaving it on depends very much on the amount of off highway running. In the cash flow analysis, the three configurations compared were all working on highway for 80% of the time. In a non-load sharing suspension layout, the removal of the tag axle yields an 8% increase in productivity. However leaving the tag axle on the truck reduces road user charges by approximately 42%.

This report illustrates that where the suspension is not load sharing, under the new weights and dimensions legislation, the removal of the tag axle is the desirable option.

LOAD SHARING SUSPENSION CONVERSION PROCEDURE

The results from this report show that the best suspension option for operators of 6 x 4 trucks is compatible air bag drive and tag axle suspension. The conversion procedure is relatively simple and low cost. Additional componentry required includes two solenoid valves, two reducing valves, some fittings and a small amount of air hose (total cost approximately $450).

The individual air bag capacities and bolster positions will determine the type and size of the reducing valves. Figure 2 shows the installation. Air is taken from an in-line filter (13), through the reducing valve and back to the main air bag supply line (17).

The solenoid valve is incorporated into the system to compensate for the difference in pressure ratio between the drive axle and tag axle air bags when the truck is in the loaded and unloaded states.