Monitoring to Improve Harvesting Performance

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Human performance management in harvesting crews has long been recognised as being key to setting and maintaining high production and safety standards. However, there continues to be a real lack of recognition for the forest worker and the influence he or she has on the success of the operation. A major problem is that neither productivity, nor system efficiency is well understood or consistently measured in most New Zealand operations.

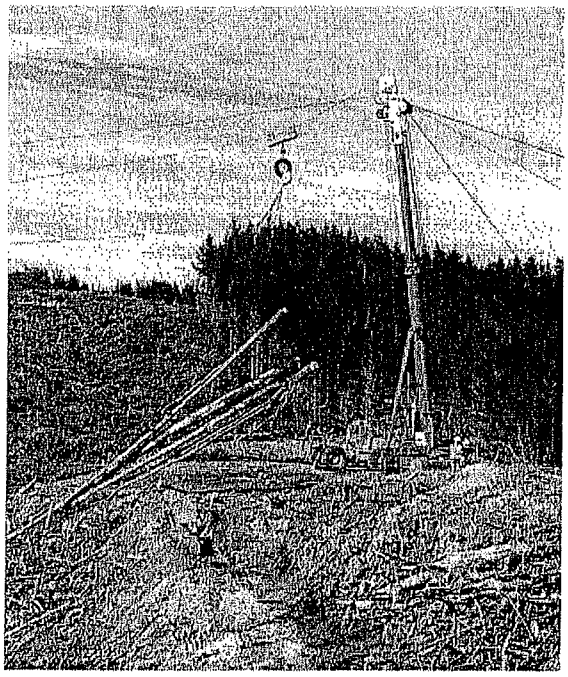

Figure 1: Cable logging requires performance monitoring.

Considering the capital invested in a typical cable logging operation ($500K to $1.5M) and the high hourly running costs ($400 to $800 per hour), little attention is paid to capturing productivity related information. This paper will show that significant gains are only possible when the cost of inefficiency, the benefits of recognising problem areas, and the effects of introducing change mechanisms, are measured. Such information will promote crew performance and place a true value on the experience and knowledge of the forest worker.

Key Words: Yarder Productivity, Performance Monitoring, Human Management, Benchmarking.

Introduction

The most appropriate and practical measure of an operation's performance (which, after all is a business) is one based on money: the ratio of income to expenditure. For many contractors, an accountant provides this on perhaps, a three-monthly basis. However, there is no scope within this financial summary to systematically improve the operation.

System efficiency can be expressed as the cost of extracting the timber ($/tonne). Payment is typically purely based on the outputs ($/tonne) which are easily measured (exactly = weighbridge, or approximately = butts pulled x average piece volume). The cost of the operation can also be determined quite accurately by summing all the machine and man-hour costs over that particular time period being considered (Riddle, 1994).

To improve operations, the parameters that affect either the ability to extract the timber or those that affect the costing of the system need to be monitored. These include: measures of production such as butt logs, top pieces, and cycles, as well as total time on-site, and delays of various kinds; measures of stand and terrain factors, such as stocking, predicted average

extracted piece size, and degree of difficulty to extract (felling pattern, deflection limitations).

When discussing systems, many company people and contractors talk about tonnes produced per day, which is the system's production. Production varies considerably day-by-day because of the large components of delay time associated with cable logging. It is the productivity and the productive time, relative to the system costs, which define the system's efficiency. Not the daily production!

Many contractors and companies end up calculating a daily target based on production data. This should be avoided because a) a day is not a defined time span, and b) the length of time each system component is used will vary each day. It is easy to show that targets should be set according to a setting, or more specifically according to the activity that is being undertaken.

Measuring the cost of inefficiency

Productivity measurement invites comparisons with previous data or predicted estimates. Only long term data (rather than short-term time studies) enable detailed analyses, identifying reasons for high or low values.

Systems for capturing productivity related data on yarder sites have been available and promoted for some time (Folkema *et al*, 1981; Evanson, 1992). Usually such data capture is only used by research to investigate productivity of various systems (e.g. Evanson and Kimberly, 1992). However, the systematic feedback of production information to the crew and incremental improvement based on the results has rarely been undertaken. To facilitate this, Liro has developed a Performance Monitoring System that allows such data to be captured in a non-intrusive way.

Capturing input information requires consistency and regular maintenance of the system. While the base information can be recorded on site by the yarder operator, the data processing, report writing or analysis can be carried out off-site.

An example of the reporting information that can be extracted from the Performance Monitoring database is shown in Figure 2. The data used is fictitious (Liro performance monitoring is carried out on a confidential basis), although not untypical for a New Zealand yarder operation. This contractor has three crews operating. The basic breakdown provided is into three commonly recognised categories: productive time, operational delay and mechanical delay, which make up the total working period of the day (Thompson *et al*, 1996).

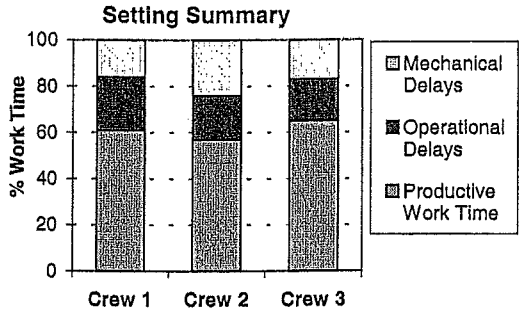

Figure 2: Work time breakdown for 3 yarder crews.

There is much to be gained from reviewing and comparing this time consumption information, either between crews or for the same crew over time. Figure 2 indicates Crew 2 has a lot of mechanical delays. This may indicate the equipment is getting old or the crew is rough on gear.

The productivity (in the productive work time) can be used to define the actual average daily production. Figure 3 shows the tonnes pulled per hour (productivity) in

productive work time. Multiplying productivity by the % productive work time of the total work place time provides the average effective production of that crew. Both these measures are shown as tonnes per hour (Figure 3). Note the large difference between what a yarder can pull in an hour and what it pulls on average!

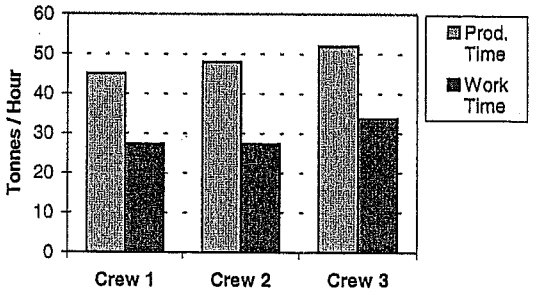

Figure 3: System productivity and average production.

It can be seen that although Crew 2 had a high mechanical delay time, their extraction rate was higher leading to the effective productivity being the same as Crew 1.

Identifying problem areas

Because of the way the information is recorded, greater detail is available for analyses. Table 1 shows a breakdown of the operational delays. This is also known as Supportive Work Time: essential activities that do not directly contribute to the completion of a task. This is best presented in absolute terms as shown, that is for example the average number of minutes it takes a crew to complete a line shift.

Table 1: Operational Delays

Activity	Ave. Crew1	Ave. all Crews
Yarder Shift (hrs)	5.5	6
Turn Yarder (min)	55	45
Line Shift (min)	15	10.5

In this example, it is easy to see that Crew 1 are having trouble with their line shifts. It is taking them 40% longer than the other crews on average. Now that the monitoring program has identified a problem, it is easier to go out on site and find out why. Maybe the breakerout has little experience in driving the bulldozer-tailhold, or maybe somebody needs to help pre-rig the line shift?

Figure 4 shows a breakdown of the mechanical delays for these three crews shown as a percent of Work Time. Once again, a number of things can be seen. Crew 1 has very little rope breakage, do they have new ropes or is the operator just that much more careful? Crew 2 has excessive tailhold delays, are the correct techniques being used?

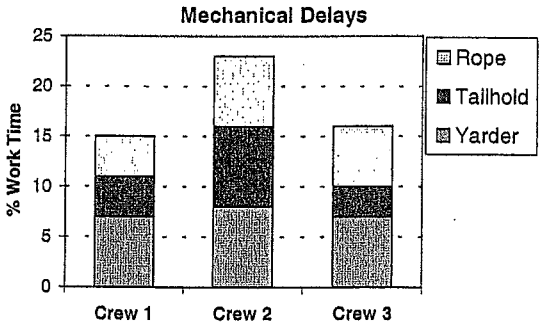

Figure 4: Mechanical Delays

It should be noted that each 1% change is equal to at least $7,000 per annum for a typical New Zealand yarder operation!

Example:
There is a setting with 4500 tonnes of timber to pull. If we took Crew 1 with an effective production rate per hour of 28, and working an 8-hour working day, then it would take 20 days to complete the job. This would indicate an average daily production of 225 tonnes. If the crew pulled 100 tonnes on the first day and 315 the second, which day was better?

Although it is tempting to say the second day is, the reality is, without more information we can not tell. For example, on the first day they may have spent 5 hours doing the setting shift, 1 hour on maintenance and then 2 hours pulling timber. From the benchmarking process, we know that 5 hours is in fact an excellent set-up time. In two hours extraction (@ 45 tonnes per hour) we expected to pull only 90 tonnes but got 100. So altogether Day 1 was extremely successful.

The second day 7 hours was spent extracting timber, half an hour on two line shifts and half an hour on a rope breakage. In 7 hours we expect to extract 315 tonnes of timber, but only 280 was pulled. Additionally, we had a mechanical delay. So day 2 was in fact disappointing and focused on for improvements!

Introducing change mechanisms

There is no real point in monitoring performance if the information is not acted on, or used. Once problems have been identified, training or operational improvements can be considered. The real power of a performance monitoring system is that the benefit of any such change will automatically be recorded.

This process is referred to as benchmarking. It is not only possible to work out the potential of the whole crew, but also to gauge operators or workers individually. For example for breakerouts: the average number of pieces hooked on per drag; for the operator, rope-breakage delays; for the fallers, breakage by the percent of butts being pulled.

The performance monitoring database can be used to show improvement potential and can help set 'productivity ceilings'. By taking the most positive aspect from each crew as shown in the previous example, the current ceiling for productive time is 70% operational time. This is a 7% increase on the current best performer.

Improving crew performance

Providing real-time feedback, as well as benchmarking information to the crew is in itself a powerful motivational force. A crew out-performing the accepted average can raise profits considerably.

Considering forest worker wages are currently very low (approx. $9-$14 compared with $13-18 for other trained and experienced tradesmen), it would be reasonable to share some of the financial benefits that can been gained from increased crew performance.

Financial incentives can be provided or alternatively time off or trips away. Conversely, failure to reward the crew for improved performance means the increases will only ever be temporary.

The other related crew performance issue is that contractors are running more crews in an effort to achieve economies of scale. The ability to monitor performance and subsequently act only when necessary means less on-site supervision and reduced overhead costs.

Conclusion

It can be seen that by measuring logging system performance you can (a) measure the cost of inefficiency, (b) identify problem areas, (c) introduce and monitor the effects of change, and (d) systematically improve crew performance. The result is a more profitable business, and a more motivated, better paid, stable workforce.

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