OPERATIONAL MONITORING FOR EVALUATING WORK FORCE PERFORMANCE

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ABSTRACT - Human performance in harvesting crews has long been recognised as being key to setting and maintaining high production. 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 machine or system efficiency is well understood or consistently measured in most forest operations. Considering the capital invested and the high hourly running costs in a typical logging operation, little attention is paid to capturing productivity related information. 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 and presented back to the operators. An operational monitoring has been developed and implemented in the Gisborne area of New Zealand that specifically targets their cable-logging operations. This paper presents the benefits of an operational monitoring program, its implementation and specifically how it can be used to place a true value on the experience and knowledge of the forest worker.

NOTE: This paper is an extension of work that was presented at the Liro Conference October 1999, Rotorua, New Zealand, and published in their proceedings.

INTRODUCTION

The most appropriate and practical measure of a harvesting operation's performance is financial: the ratio of income to expenditure. For many contractors, an accountant provides this on perhaps, a monthly or three-monthly basis. However, there is little scope within this financial summary to systematically improve the operation.

System efficiency can be expressed as the cost of extracting the timber ($/ton). Payment is typically based on the outputs ($/ton), which are easily measured (exactly = weighbridge, or approximately = butts pulled x average piece volume). 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.

Systems for capturing productivity related data on yarder sites have been available and promoted for some time (Folkema *et al*, 1981; Evanson, 1992). To date such data capture has only been used by researchers to investigate productivity of various systems, rarely for the systematic feedback of production information to the crew and incremental improvement based on the results. To facilitate this, a performance monitoring system was developed at Liro that allows such data to be captured in a non-intrusive way.

PERFORMANCE MONITORING

Operational performance monitoring can be implemented at many different intensity levels. Our objective was to capture base-level productivity information without affecting the operation. Having previously identified the opportunities for improving

the productivity through optimising payloads (Visser *et al*, 1999), the focus was on cable logging operations and the productivity of the yarder. Warwick Palmer of Asset Forestry implemented the system on four cable logging crews with poor financial performance records.

The base level information was captured daily on a form by the yarder operator. This included start and stop time; begin, end and type of any delay; and butt logs and top pieces per cycle. To aid future productivity predictions measures of stand and terrain factors, such as stocking, predicted average extracted piece size, and degree of difficulty to extract (felling pattern, deflection limitations) and average extraction distance for the day were also recorded.

PRODUCTION AND PRODUCTIVITY

When discussing harvesting systems, most company people and contractors talk about tons produced per day, which is the system's production. Production in cable logging varies considerably day-by-day because of the large associated components of delay time. Figure 1 shows a typical example of data from the Gisborne area.

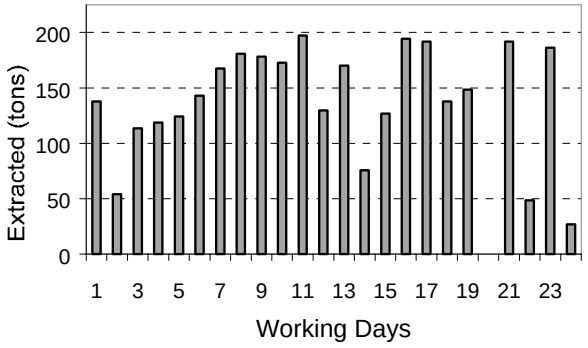

Figure 1: Daily production fluctuation of a cable logging job.

Additionally, production targets are often overestimated based on what the system can produce on a good day as opposed to an average day. In the above example the 'target' was set at 162 t/day, whereby the average was in fact only 135 t/day.

Figure 2 shows the effect of this on the accumulative production for this particular job. Typical is the lower average production periods at 'start-up', and a slowing of productivity at the end of a setting. Using average logging rates, it is possible to check progress on a daily basis and avoid significant losses through earlier rate adjustment.

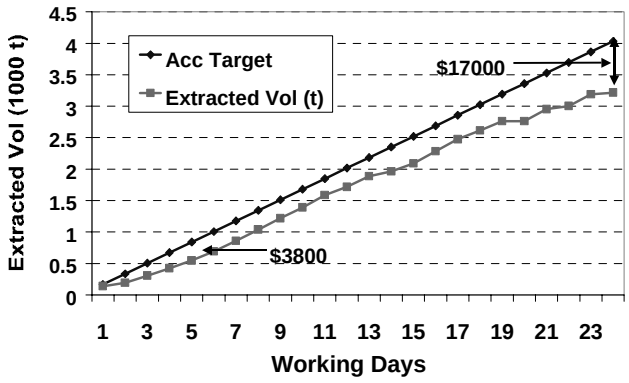

Figure 2: Accumulative actual versus target production at a cable logging job.

It is the productivity and the productive time, relative to the system costs, which define the system's efficiency. The 'fixed' daily target 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.

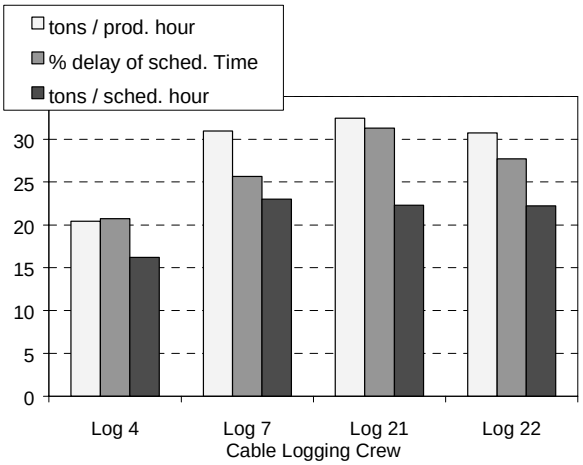

Figure 2: Productive time productivity, % delay time and the resulting schedule time productivity.

The productivity in the productive work time and the percent of productive work time define the

actual average daily production. Figure 2 shows the tons pulled per hour in productive work time, the percent delay time and the resulting effective productivity in the scheduled work time of the four crews.

While scheduled-time productivity can be arrived at easily by dividing the daily production by the scheduled hours, the breakdown provides the detailed information needed for systematic improvement. We can see that the 'Log 7' crew had the highest scheduled productivity rate not because they work faster, but because they have less delay time.

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.

A further example that can be extracted from the Gisborne database is shown in Figure 3. It shows the breakdown of the delay time as a percentage of the operating time for the four crews monitored. The range of delay time is from 20% to just over 30%. Conversely the productive time, the time that the yarder actually spends extracting timber, is in the range of 70 to 80% of the total time.

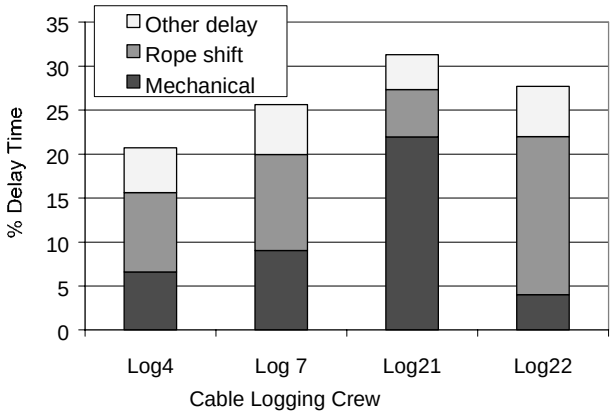

Figure 2: Delay as a percentage of operating time for 4 yarder crews.

There is much to be gained from reviewing and comparing this information, either between crews or for the same crew over time. Figure 3 indicates 'Log21' crew had significant mechanical breakdown problems, and this may indicate the equipment is getting old or the crew is rough on gear. 'Crew 22' had 18% delays though rope shifts alone, and some training may be required

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

Example:

There is a setting with 3200 tons of timber to pull. If we took Log 4 crew with an effective scheduled production rate per hour of 16 tons, and working an 8-hour working day, then it would take 25 days to complete the job. This would indicate an average daily production of 128 tons. If the crew pulled 50 tons on the first day and 140 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 (@ 20 tons per hour) we expected to pull only 40 tons but got 50. 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 140 tons of timber, but only 120 was pulled. Additionally, we had a mechanical delay. So day 2 was in fact disappointing and should be the focus for improvements!

INTRODUCING CHANGE

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 should 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 choker-setters: the average number of pieces hooked on per drag; for the operator, rope-breakage delays; for the fallers, breakage by the ratio of butts to heads 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.

IMPROVING CREW PERFORMANCE

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

Considering forest worker wages are currently very low (approx. $8-$12 compared with $10-$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.

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 was 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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