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Improving Cable Extraction Efficiency

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Figure 1 - Focusing on cable extraction efficiency

Summary

Liro investigated the impacts of three operational decisions on extraction efficiency. These related to (1) estimating and (2) building optimum drag sizes, and (3) selecting the right number of breakerouts to match the number of strops.

A three-step decision procedure was developed and applied. Use of the procedure can increase productivity and lead to the avoidance of overweight drags.

Introduction

Increased pressure to reduce rates and improve performance has led to the "smarter not harder" focus. To survive, logging contractors are having to highlight and remove any inefficiencies from their business.

One aspect of cable logging needing attention is the efficiency of the extraction phase. To help contractors, Liro studied the effects of three operational decisions on extraction efficiency. These decisions related to:

- Estimating optimum drag size
- Building optimum drags
- Selecting the right number of breakerouts.

As a result, Liro developed a three-step decision procedure for improving efficiency. This report provides a discussion of the three operational decisions, presents that procedure, and provides an example of application.

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Important operational decisions

The efficiency of a cable logging operation is affected by a wide range of factors. These range from the site and stand characteristics to production and harvest planning decisions. However, from a contractor's view point, the number of factors within their control is much less.

The first is the rigging system. Some contractors use a wide range of systems to match the situation. Others, however, use just one or two systems for all. In some cases, this may sub-optimise extraction efficiency.

Once the appropriate system has been selected and rigged, it is then possible to start pulling wood. However, three further decisions need to be considered. These are:

1. What is the optimum drag size?
2. How do I achieve the optimum drag size?
3. How many breakerouts should I use?

The following section addresses the importance of each of these decisions on extraction efficiency.

Estimating optimum drag size

The optimum drag size is the one most efficiently extracted (highest productivity). In most cases, this is the maximum allowable drag size.

The maximum drag size is that which does not over-tension the rigging (skyline or mainline). For a given yarder set-up, it is the skyline deflection (or sag) and drag suspension that controls maximum allowable drag size. The greater the deflection, the higher the maximum drag size. Partial suspension allows bigger drag size than full suspension. This is because in the former some of the load is transferred to the ground.

In a setting with no terrain constraints, the skyline tension will be highest when the load is at mid-span. Deflection is therefore measured at mid-span to find an approximate load limit for the whole span. Higher loads can often be hooked up in the front part of the setting because deflection over this portion is greater. However, constraining points, such as ridges or the edge of the landing, should also be identified and the maximum allowable drag size calculated at those points as well.

A small increase in deflection can increase the maximum drag size significantly (Table 1). In this case, a 2% increase in deflection requires just 3m more skyline length. The result is a 1.7 m^3 increase in drag size.

Deflection (%)	Maximum allowable drag size (m^3)	Skyline length (m)
6	5.1	411.8
7	5.9	413.2
8	6.8	414.8

Table 1 - Effect of deflection on maximum allowable drag size and skyline length (20% span slope, 400m span, 28mm swaged skyline, full suspension)

In most cases, the optimum drag size is the same as the maximum allowable drag size. This occurs when productivity increases as drag size increases. This was the case for Operation 1 in Figure 2. Limited yarder power may, however, reduce productivity at the upper range of drag sizes. In such a case (Operation 2), the optimum drag size will be less than the maximum allowable.

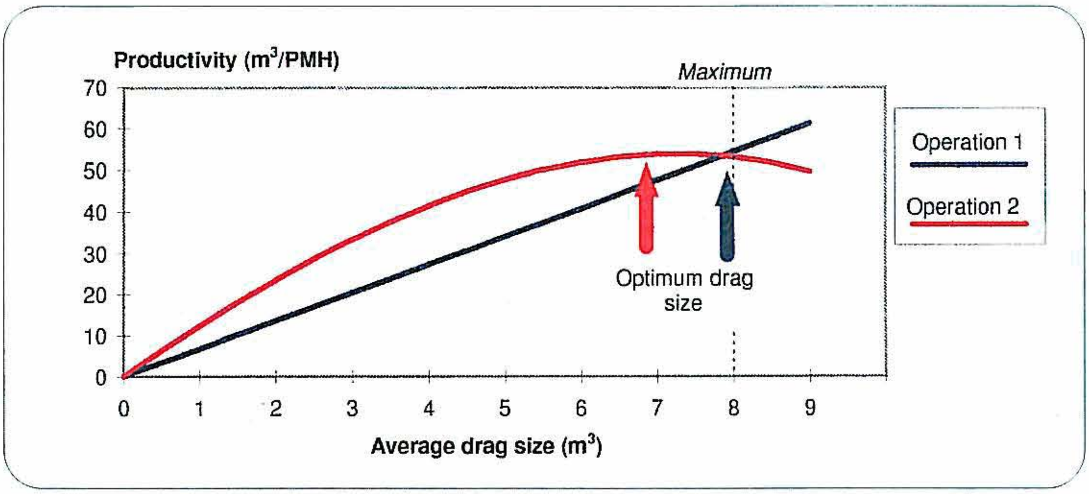


Figure 2 - Drag size versus productivity for two yarder operations

Achieving the optimal drag size

The building of optimum drags requires the right number of strops and the selection of individual pieces to achieve the optimum volume.

Average drag size typically increases with the number of strops. For example, Figure 3 shows the frequency distribution of individual drags sizes, when 2, 3, or 4 strops were used. In each case, about 80 drags were scaled for each number of strops.

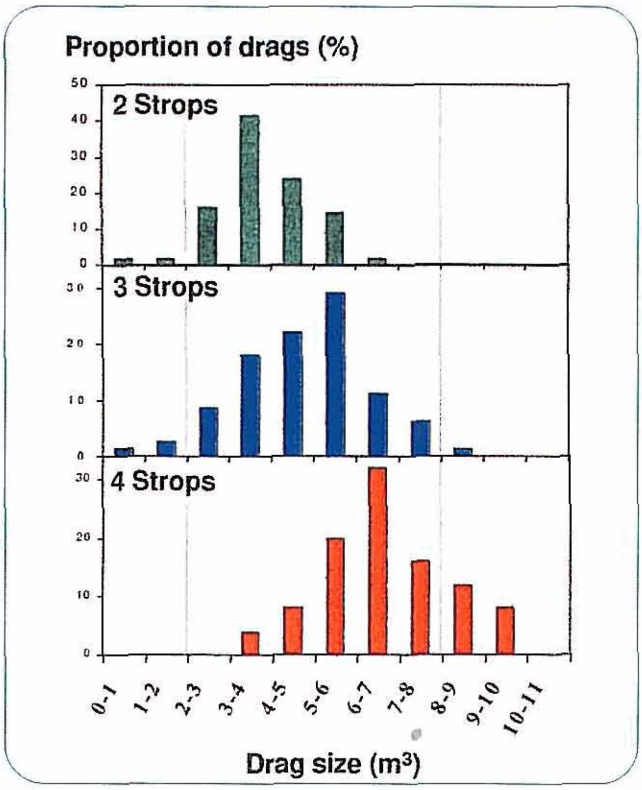


Figure 3 - Frequency distribution of drag sizes for 2, 3 and 4 strops

For this operation, the average drag size increased with the number of strops. Changing from two to three strops, increased average drag size from 4-5 m^3 to 5-6 m^3. By adding a fourth strop, the average drag size increased to 6-7 m^3.

In this operation, the optimum drag size was 8m^3. With an average piece size of 1.95m^3, the use of four strops provided more options to build an optimum drag. However, the use of four strops also meant that 20% of drags overloaded the skyline.

From an efficiency point-of-view, the use of four strops would be the best option. However, it is necessary to avoid the overweight drags. This would reduce the average drag size from 6.4m^3 to approximately 5.6m^3. In doing so, the use of four strops still provides a benefit over three strops (average drag size = 5.0m^3). Avoiding overweight drags means the breakerout(s) need to estimate individual piece size. If hooking on a butt piece exceeds the maximum, and there are no top pieces, then a strop should be left unused.

Number of breakerouts

The number of breakerouts will influence extraction productivity and cost. The most appropriate number of breakerouts will be that which gives the highest productivity/breakerout costs.

The effect of breakerouts on productivity for Operation 1 is shown in Figure 4. This productivity data is presented relative to 3 strops, 2 breakerouts (the combination used most commonly in the operation).

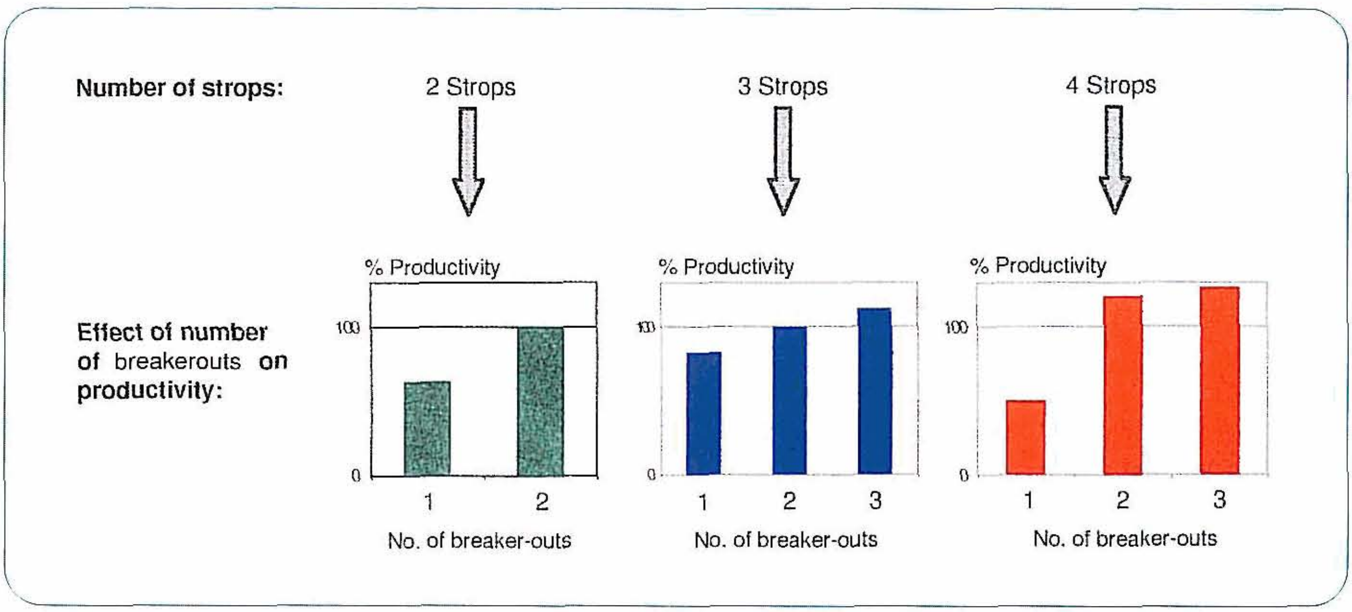


Figure 4 - Effect of number of breakerouts on extraction productivity

For each strop number, productivity increased with the number of breakerouts. This does not mean that the higher number of breakerouts is always the most appropriate. The use of a third breakerout may incur an added cost. If so, then the productivity gain will need to cover this personnel cost.

Figure 4 shows that the productivity figures were similar for two and three strops, two breakerouts. This reflects the unproductive time for one of the breakerouts while the second breakerout fills the third strop.

In the case of three strops, decreasing to one breakerout reduced productivity by 17%. By adding a third breakerout, productivity increased by 12%. If the productivity with two breakerouts was greater than 35m^3/hr, then the cost of hiring a third would be covered if they worked only three hours a day[1].

In the 4 strop case, decreasing to one breakerout reduced productivity by 71%. Increasing to three breakerouts increased productivity by only 6%. The productivity with two breakerouts would need to be 70m^3/hr before any additional cost of the third breakerout was covered. This suggests that 4 strops, 3 breakerouts is not an option if needing to hire a third breakerout.

Making better decisions - three steps

(1) How to estimate optimum drag size

There are three practical ways of estimating the maximum allowable drag size. These are:

1. Use the Liro Deflection King
2. Use the LoggerPC program
3. Use a skyline tension monitor.

The Liro Deflection King is a hand-held sighting device that allows the maximum allowable payload to be estimated from the skyline deflection. It can be used for any rigging configuration (including fallblock systems). The Delection King is available from Liro at a cost of $250 + GST.

[1] Assumes personnel cost of $190/day and logging rate of $15/m^3

LoggerPC is a PC programme most often used by harvest planners. It can provide a detailed estimate of maximum allowable payloads along the profile. LoggerPC should not be used to estimate payloads for fall-block systems (Northbend, Southbend)

If the yarder is fitted with a skyline tension monitor then maximum allowable payloads can be determined by lowering the skyline as much as possible and monitoring tensions for different sized drags. This is the least useful of the three methods as it does not tell breakerouts what the actual maximum is.

The estimation of the optimum drag size is not easily achieved. It requires detailed monitoring of the relationship between drag size to cycle time. Unless you are operating a small yarder (i.e., Madill 071) with large ropes (28mm skyline), it is best to assume that the maximum and optimum drags sizes are the same.

(2) How to achieve the optimum drag size

- The right number of strops can be determined from optimum drags size divided by the average piece size for the block

- Where there is significant breakage, an extra strop should be added.

- Estimation of individual piece volumes can be done using the Liro Drag Builder (Visser and Palmer, 1999). This tool allows breakerouts to estimate piece volume from butt diameter. The Drag Builder can be used to estimate individual piece volumes. These can be summed to give an estimate of the drag volume. Drag Builders are available from Liro at a cost of $100+GST.

(3) How to select the right number of breakerouts

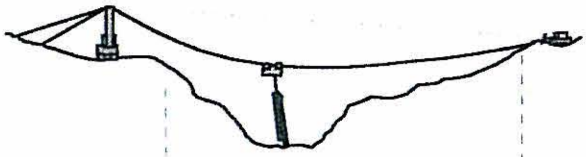
Breakerout numbers need to be matched to the number of strops. In the case of two and four strops, two breakerouts is the optimal number. In the case of three strops, the use of three breakerouts provides a productivity benefit over two breakerouts. The use of a third breakerout will be subject to the availability of a current crew member. If a third breakerout has to be hired, then the productivity increase must exceed the added personnel cost.

Example

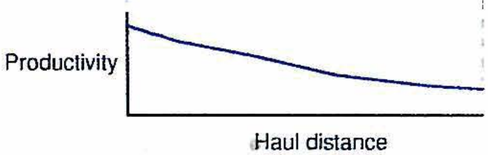
Figure 5 shows two cases. In the first, the skyline is raised and a standard strop/breakerout combination is used. In the second, the three steps outlined above were used to maximise productivity and avoid overloading the rigging.

Case 1: Situation

- No estimate of optimum drag size was made.
- Three strops, two breakerouts used for entire span.
- Skyline deflection not adjusted.
- Drag sizes were estimated by breakerouts.



No. of strops	3
Breakerouts	2

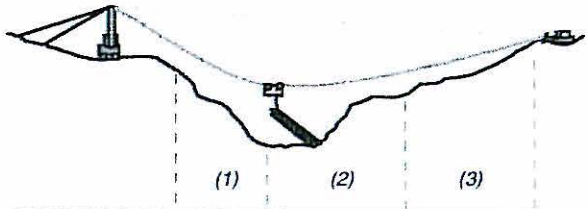


Case 1: Results

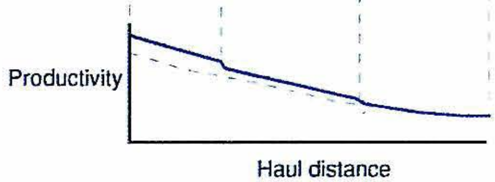
- Productivity decreased with haul distance.
- Skyline SWL was exceeded on numerous occasions at the back of setting.

Case 2: Situation

- Three load zones were identified.
- Three strop/breakerout combinations used for span.
- Skyline deflection varied for each load zone.
- Drag builder used to build optimum-sized drags.



Max. Payload	$7m^3$	$5m^3$	$3m^3$
No. of strops (drag/piece size)	= 7/1.5 = 4	= 5/1.5 = 3	= 3/1.5 = 2
Breakerouts	2	3	2



Case 2: Results

- Productivity increased 20% in first zone.
- Use of third breakerout increased productivity in second zone by 12% (if only 2 breakerouts were used there would be no increase in productivity in this zone).
- Use of only two strops and drag builder in third zone avoided overweight drags.

Figure 5 - Example cable span cross-section showing the productivity effect from changing strop - breakerout combination

Relative to Case 1, the use of the decision steps outlined above resulted in two major benefits to the contractor. First, estimating the deflection and optimum drags sizes for the span identified three distinct load zones. By optimising the strop/breakerout combination for each zone, overall productivity was increased. Secondly, the use of the Drag Builder and only two strops in the third load zone avoided the building of overweight drags.

References

Visser, R. and Palmer, W. (1999) : Drag Builder optimises payloads. Liro Technical Note 51.