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A STUDY OF LANDING ACTIVITIES IN PNW SWING YARDER OPERATIONS

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ABSTRACT

Swing yarders are high performance, high cost logging machines and as such, they need to achieve high productivity to be economically viable. Landing activities, associated with tree length logging, appear to be the main constraint on hauler production in New Zealand and these constraints would have to be eliminated for swing yarders to be successful here.

In conjunction with recent swing yarder studies in the Pacific Northwest, landing activities were sampled. Results showed that high productivity was possible with swing yarders provided the landing operation was efficient and well organised. While there were effectively 1 1/2 to 2 chasers[(1)] in both of these operations, they appeared to be underutilised and one man, occasionally assisted by a side-rod (supervisor) would have been sufficient. The studies showed that the proportion of the chaser's time spent unhooking and delimbing increased as piece size decreased.

Loader capacity and reliability affected the overall productivity of the operation. Up to 15 loads per day were handled with ease in one operation, whereas the other was disrupted with mechanical failure of the loader and productivity was considerably less, even though the average piece size of the extracted logs was bigger.

Figure 1 : Efficient landing activities are essential for high productivity with swing yarders.

Swing yarders have the capacity to be highly productive in New Zealand's second crop radiata. They will only be viable however if landing activities can be streamlined and the delays normally associated with tree length logging eliminated. The options are:

- *Tree length extraction with mechanical processing at the landing.*
- *Tree length extraction with two staging to a separate processing zone.*

[(1)]The chaser's job is similar to that of a skiddy in New Zealand - unhooking logs, final trimming, processing and branding.

- *Processing at the stump and log length extraction.*

All three should be considered when planning these operations.

INTRODUCTION

In the right situation swing yarders are very productive machines. Generally they have high line speeds and most machines built these days have some form of interlock between the tailrope and mainrope drums. This interlock mechanism transfers energy generated from the outwinding drum back into the input drive which reduces the braking required during inhaul and improves operator control. Swing yarders tend to be more expensive than conventional skyline or highlead haulers and as such they need to be operated efficiently for economic viability.

The boom layout on swing yarders allows the whole machine to pivot around the centre point of the turntable and the top of the "A" frame gantry through which the guylines pass. The benefits of this are:

(a) The hauler can swing the logs alongside the machine, reducing landing size requirements and making them more accessible for the next phase of the operation.

(b) Guyline position does not have to be adjusted during the swinging action.

These machines offer the most advantages when located on low quality roads and when landing construction is environmentally unacceptable or the costs are too high. The ability to swing the logs to one side also means that the chaser has a safer working environment.

Analysis of hauler operations in New Zealand (Murphy 1983, Prebble, 1988) indicate that landing efficiency has a significant effect on overall hauler productivity. In one operation landing related delays absorbed 14% of the haulers total cycle time. Loaders and skiddies tend to be underutilised in New Zealand operations and this was exemplified in another study where up to 60% idle/waiting time was recorded for a skiddy (Kellogg, 1987).

A recent study of landing activities in 21 m tower operations in the Pacific Northwest, (Prebble, 1989a) showed that chasers had 30-40% idle time in log length operations producing 280-300m^3 per day. The loaders in these operations were also better utilised but this would be expected with the higher productivity. For high cost swing yarders to be successful in New Zealand, landing activities will have to be streamlined. The current practice of tree length logging with manual processing being done under the ropes or alongside the hauler is unlikely to be able to handle the extra production on a sustained basis. Two staging with a secondary machine has been tried in various forms but the economics of these operations have not been fully tested and productivity increases were not as great as expected.

Loggers in Oregon and Washington, moving from old growth into second growth D. fir are looking towards mechanised landing operations to maintain high productivity without sacrificing safety standards. Indications are however that simply mechanising the delimbing and crosscutting does not produce a balanced system because the hauler is unable to extract sufficient wood to keep the delimber/processor occupied. Mechanising the felling operation has introduced a certain amount of equilibrium, but it adds another dimension to the level of investment required and makes the whole operation susceptible to failure of one of the machines. In New Zealand, a conventional system with manual felling, delimbing and processing will most likely be implemented with these machines.

During a recent visit to the Pacific Northwest, two swing yarders were evaluated (Prebble, 1989b & c). Data was also collected on the chaser and loader activities in these operations. The information is analysed in this report.

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LOGGING SYSTEMS

Case Study 1 - Madill 122

The Madill 122 was hauling log length D. fir to a roadside landing. Average cycle time was 6.51 minutes with 5.8 logs extracted per cycle (Prebble, 1989b). The mean volume per piece was .71 m^3. There were four log segregations being made with two major and two minor sorts.

Logs were unhooked at the landing by the chaser who was responsible for final trimming and crosscutting where necessary. The chasers duties also included assisting with rigging lineshifts etc. A side-rod (contractor employed supervisor) assisted with the chasers activities on an intermittent basis, but he was away doing other tasks for nearly half of the observed time.

The loader in this operation was a Barko 475. Basic specifications of this machine are:

Power	*- 133 kw*
Operating weight	*- 38,600 kg*
Lifting capacity	*- 5,815 kg @ 11.3m*

A diagram of the landing layout is shown in Figure 2.

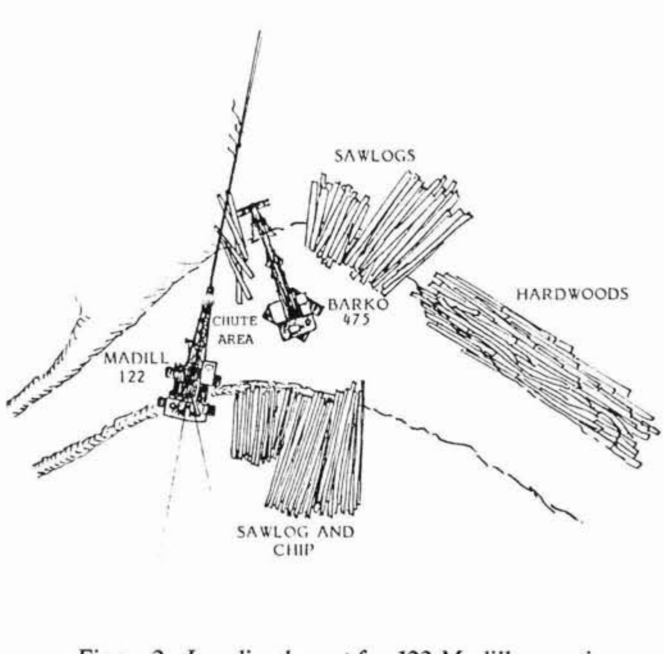


Figure 2 : Landing layout for 122 Madill operation

Case Study 2 - Thunderbird TSY255

This operation was in 80 year old D. fir (and a few minor species) which had been fully processed in the bush. The average log size was 1.05 m^3 and 3.9 logs were extracted per cycle. A total of six log sorts were being cut with three different species segregated. The TSY 255 was landing a drag at the road edge every 6.6 minutes (Prebble 1989c).

During the period of observation two landing sites were used, the first was simply a road edge with no preparation done to the chute area. Logs were being landed below the road on the cutover on a 20% slope and the loader was reaching in under the ropes to pick them up. The second landing was located on a curve in the road and there was more area for the hauler to land the logs. The loader in this operation was a Koehring C-366 track mount but during the period of observation it blew two hoses and had to be temporarily replaced with a rubber mounted Prentice 600B.

Two chasers were working on the TSY 255 landing for most of the time but there was a skidder (owned by the same contractor) working to an adjacent landing close by and one chaser alternated between the two landings. His activities were only recorded when he was working in the TSY 255 chute.

Landing layout for the second landing is shown in Figure 3. The actual landing area was less than .06 ha.

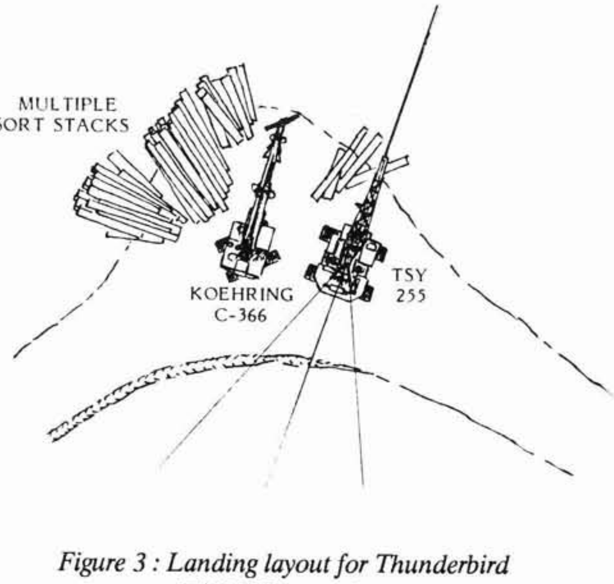


Figure 3 : Landing layout for Thunderbird TSY 255 operation.

STUDY METHOD

The chasers and loaders were activity sampled at half minute intervals during the hauler studies. If either of the chasers were observed within 3 m of any moving rope under tension, this was recorded as a hazardous situation. The number of trucks loaded and the number of logs per truck were also noted. Truck arrival and departure times could be calculated from the activity sample data.

RESULTS

Chaser Studies

Figure 4 shows the distribution of chasers time for the two operations. This is based on 804 observations on the 122 landing and 752 in the TSY 255 operation. Lunchbreaks were taken during both of these studies and the activity sampling was discontinued over those periods.

Logs were branded on the truck in the 122 operation so the chaser was not required to brand them on the landing. He was still reasonably well occupied however with unhooking and delimbing taking up 41% of his time and 17% of the side-rods time. Between them the chasers on the TSY 255 landing spent a lower proportion of their time unhooking, branding and delimbing. This is a reflection of both the larger piece size and there being two on the landing for a greater proportion of the time (74% compared to 53%).

A major component of the lineshift time for chaser one in the TSY 255 operation was in fact a machine shift to a new landing. The second chaser was absent, working with the skidder. The 122 was using a Grabinski system with a Cat D8 as a mobile tailhold. This meant that more frequent lineshifts were required but these were done quickly with the use of the Cat. A total of three shifts were recorded during the period of observation.

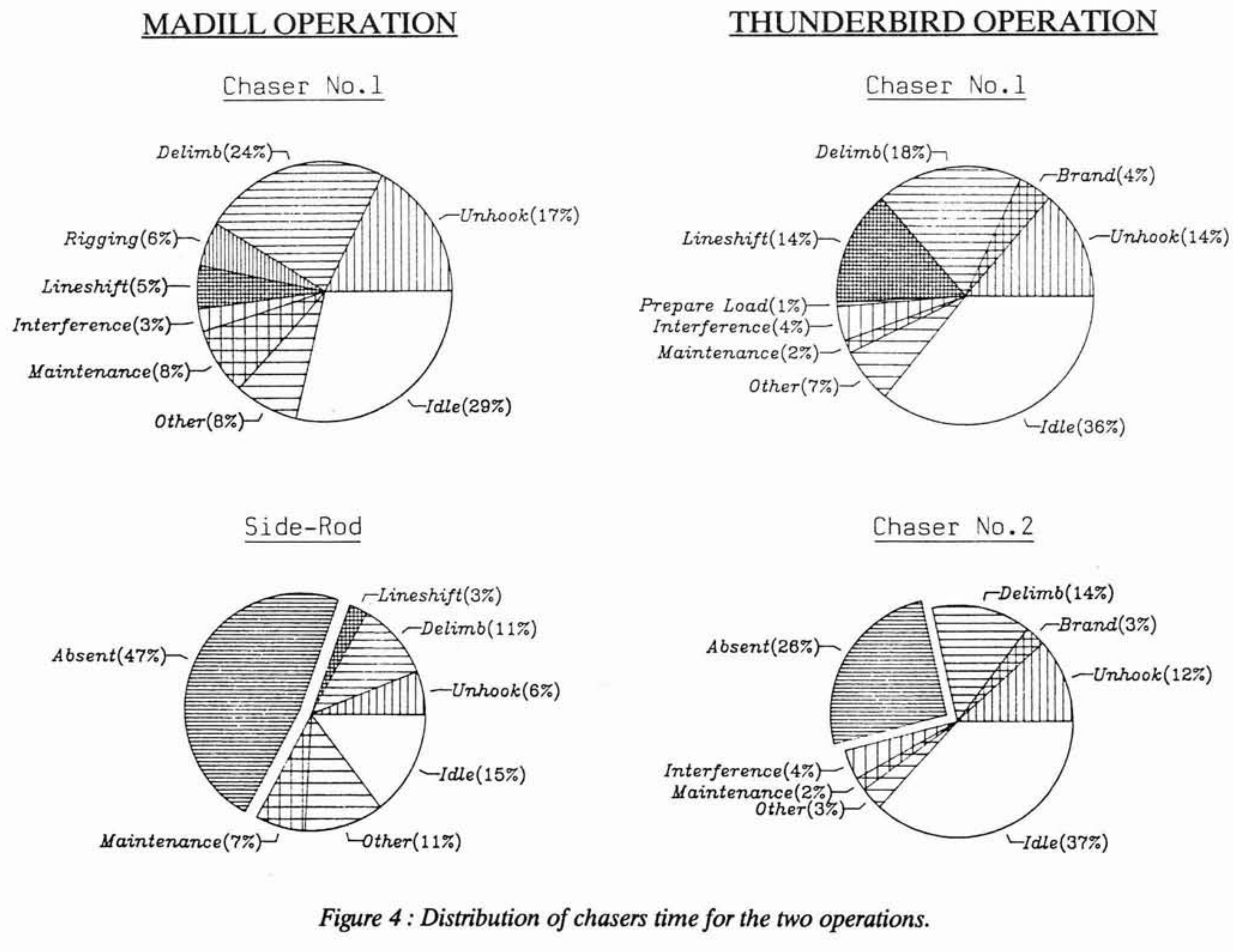


Figure 4 : Distribution of chasers time for the two operations.

Interference from machinery was low (3 - 4%) which is similar to that recorded in the 21 m tower operations (Prebble, 1989a).

The two chasers in the TSY 255 operation had considerably more idle time than the chaser and side-rod on the 122 landing. Once again this could be attributed to the larger piece size in the TSY 255 operation and the fact that there was less delimbing to do. Obviously the 122's side-rod had other supervisory duties to perform which caused him to be absent for nearly half of the day.

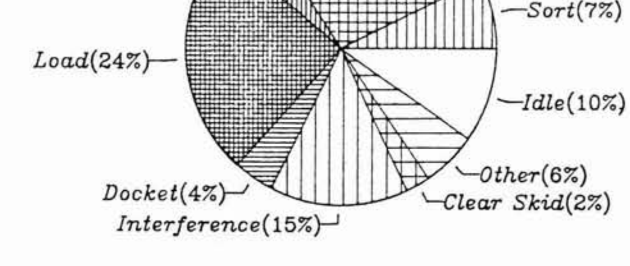
The chaser and side-rod in the 122 operation were observed within 3 m of the loaded ropes for only 2% of their time. In the TSY 255 operation only chaser 2 was seen within 3 m of the loaded ropes and that was for less than 1% of his working time.

From these two studies, the proportion of the chasers time spent unhooking and delimbing increased as the piece size decreased. Even with this extra work involved, the chaser on the 122 landing spent nearly 30% of his time idle, waiting for work.

Loader Studies

The distribution of time each loader spent on the various landing functions is shown in Figure 5. This is based on 890 observations of the Barko 475 in the 122 operation and 761 observations of the loaders working on the TSY 255 landing. The Koehring C-366 was out of service for 24% of the observed time.

Sorting and stacking occupied 34% of the Barko's time in the 122 operation which compared favourably with the previous studies of loaders under the 21m towers. There was no sorting required on the TSY 255 landing as logs were all stacked into multiple sort piles. The replacement Prentice 600B loader had lower lifting capability and less reach than the Koehring C-366. This meant the TSY 255 had to bring drags in closer and swing them further to enable the Prentice to reach them. Being rubber mounted, the Prentice also had to set down outriggers for stability when operating and these had to be retracted for machine relocation, which again limited stacking ability. The time taken to exchange loaders (twice) is reflected in the high "other" element for the loaders in the TSY 255 operation.



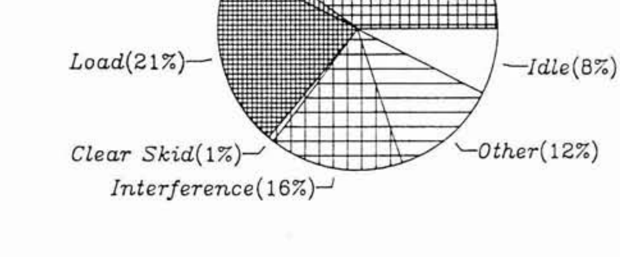


Figure 5 : Time utilisation of the loaders in the two studies.

The Barko loaded out a total of 12 loads during the period of observation and yet loading time only occupied 24% of the total. This compares very favourably with the loading times recorded in the TMY 70 and Madill 171 operations (Prebble, 1989a). The two loaders on the 255 landing spent a total of 21% of their combined time loading nine trucks. A breakdown of the loading times recorded are shown in Table 1.

Regression analysis of loading time with number of pieces shows a strong relationship between the two (2)(r^2 of .79). If the Barko times are considered on their own, the relationship is even stronger (3)(r^2 of .91). As with the previous studies (Prebble, 1989a) the loader operators tended to load just one log at a time, although it wasn't uncommon to see two logs per grapple swing when truckloads exceeded 30 logs. In both operations around 60% of all logs loaded were handled one at a time.

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(2)*Regression :*
Loading time (min) = 2.97 + 0.30 (no. pieces)
(3)*Regression :*
Loading time (min) = 2.15 + 0.31 (no. pieces)

As was shown in the 21 m tower studies, differences of up to 10 minutes between actual loading time and total loading time were recorded. When the Prentice was operating under the ropes of the 255, it was essential that logs were loaded out regularly as stockpiling capacity was limited.

Truck departure times can be used as an indication of the woodflow through the landing and Figure 6 clearly demonstrates how regular truck loading can balance the loaders workload throughout the day.

In the 122 operation three loads had been despatched before sampling began. Regular truck arrival times throughout the day meant that there were few delays to the hauling cycle. The loader operator had complete control of truck arrival times and could minimise the delays to both the hauling and trucking operations. Mechanical failure of the C-366 Koehring in the TSY 255 operation delayed the loading of the first truck until nearly 11 a.m. and that, combined with the limited capabilities of the replacement loader, completely disrupted the day's load-out. Trucks had to be scheduled for an early morning load-out the following day to clear some of the backlog.

Table 1 : Truck Loading Times, 122 and TSY 255 Operations (minutes)

Loader	Sample Size (loads)	Delay*	Total Time** (range)	Load Time*** (range)	No. of Pieces (range)
Barko 475	11	.73	17.0 (13-26)	9.9 (5-17)	25.8 (12-54)
Koehring C-366	4	2.87	13.5 (10-16)	9.9 (8-12)	24.2 (21-29)
Prentice 600B	3	9.50	21.3 (20-22)	11.8 (10-13)	18.7 (10-25)

* Delay is the average time between when the truck arrived and the loader began to unload the trailer.

** Total time includes unloading the trailer, clearing the chute and sorting during loading.

***Load time is the time spent physically loading the truck.

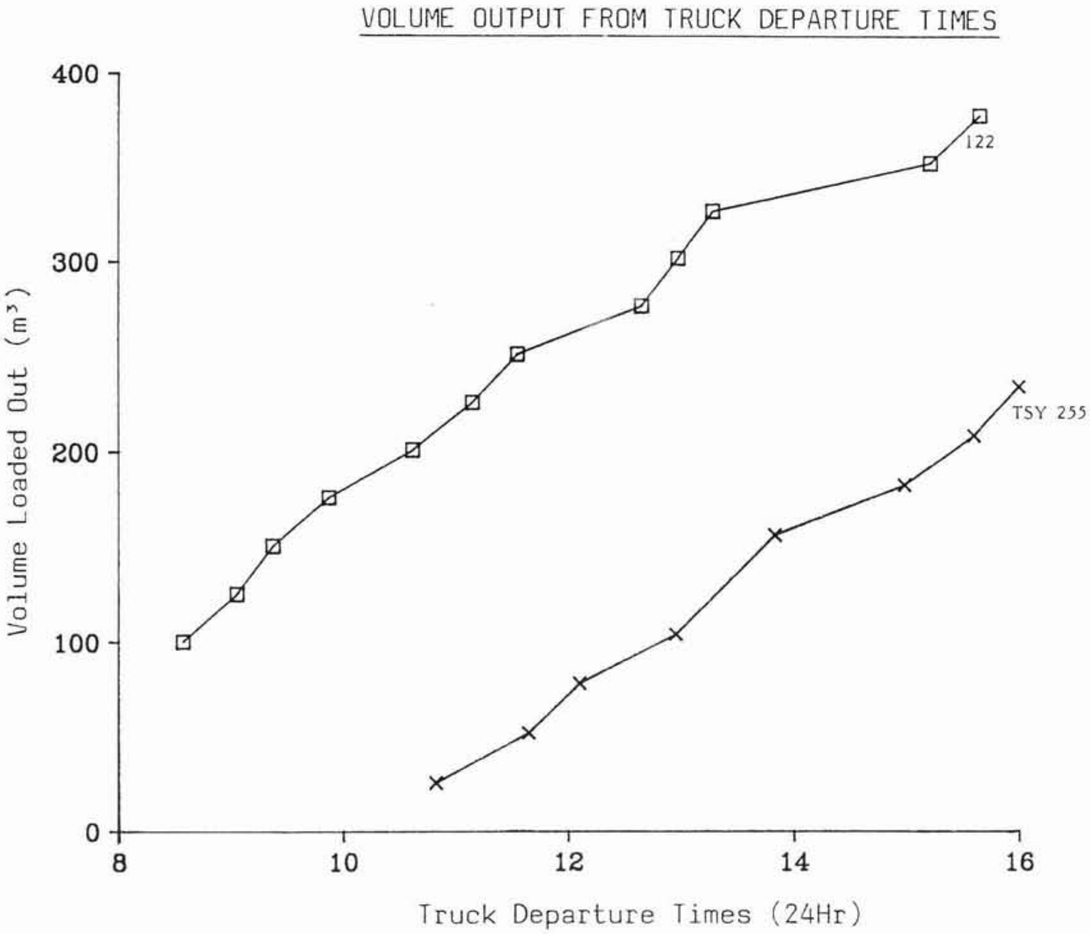

Figure 6

While productivity of the TSY 255 was high by New Zealand hauler standards, ($280m^3$/shift), it was limited by deficiencies in the loading operation.

Both the Barko 475 and the Koehring suffered 15-16% interference. The main cause of this interference in the 122 operation was from the chaser either delimbing or unhooking the logs. In contrast to this a hauler shift in the 255 study accounted for a major proportion of the interference to the loader.

The Barko and Koehring had around 8-10% of their time idle, waiting for work. This is very similar to that recorded in the 21 m tower operations.

CONCLUSIONS

Both operations had more than one chaser on the landing and the amount of idle time experienced infers that they were not fully utilised. One chaser, occasionally assisted by a side-rod, would appear to be a better balance than having two chasers. Overall the distribution of the chaser's time did not vary significantly from that recorded in other studies.

The effect that loader availability can have on hauler production is clearly demonstrated in the two loader studies. An unreliable loader under the TSY 255 cost the operation 2-3 loads in output and also affected the hauling cycles. Loader capacity is also important. A loader with limited reach and restricted manoeuvrability requires the swing yarder to pull the logs in closer and swing them around further so that it can reach them and this slows down the landing of the logs in the chute.

For efficient operation of these new swing yarders it is necessary to be able to handle the wood at the landing. This study shows that high production (up to 15 loads/day) is readily achievable in an operation where the trees are processed into log length at the stump. Average log size was only .71 m^3.

While machines such as the 122 Madill and TSY 255 Thunderbird have ample capacity for high production in New Zealand's second crop, they will not be economically viable unless a whole systems approach is taken towards their introduction. If trees are going to be extracted in full length, they will have to be either mechanically processed at the landing right next to the hauler, or transferred to a secondary processing area where manual or mechanical processing can be done. It is unrealistic to expect manual delimbing and processing to be done on the same landing as the hauler in high volume operations. The purpose of introducing the swing capabilities of a swing yarder are defeated if a large processing area has to be prepared to accommodate the whole tree processing.

Processing to log length in the bush is the only other alternative if mechanising the landing operations or secondary phase hauling is not acceptable. These studies show that the swing yarders were highly productive in the PNW operations and there is no reason why they couldn't be equally as productive in New Zealand.

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