LARGE SCALE CENTRAL SITE STEM PROCESSING WILL WE EVER WIDELY ADOPT THIS OPTION?

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ABSTRACT

Central Processing Yards have been touted as a means to better cope with the multiple log grades required to be produced from our stands. While offering some benefits, financial analysis of this option reveals an indifferent return.

INTRODUCTION

Centralised processing yards are used as part of wood flow management systems in several locations, including Germany, Sweden, Chile, and most notably, the Pacific Northwest. The attraction of bringing the manufacturing stage of the system more directly under management control has appeal to many, and most particularly, wood flow managers.

A major problem facing wood flow managers in New Zealand arise mainly from an increasing requirement to produce multiple log sorts. It is now not uncommon to up to 14 different sorts to be made at one landing. The mix of logs also can alter rapidly therefore changes in instructions must be rapidly transferred to distant logging crews. The variety of logs sorts mean that the materials handling problems, such as truck scheduling and inventory control, increase.

It is unlikely that the demands on the log production side will diminish. In their attempts to maximise efficiencies, log purchasers are increasingly demanding with regard to the specification of the logs they purchase. In order to successfully sell log products from New Zealand's increasing supplies, the log production sector must be able to comply with purchaser demands.

The allure of a single large centralised facility where the full length of a stem is delivered for processing is understandably attractive. It allows the opportunity to more closely control the manufacturing operation and incorporate computer-based production and inventory control techniques that have undeniable advantages.

The New Zealand harvesting sector has had some, albeit limited, experience with centralised processing. There have been three occasions in recent times where yards which conformed to the general definition of a centralised processing yard, have been used.

1. West Coast Beech Scheme

The first central yards were as part of the West Coast Beech Scheme of the mid 1970's recovering sawlogs from a predominately pulpwood input. Two small yards were used in the Reefton/Inangahua area, situated beside public highways. These yards had low throughput (60-80 m³ per day) which created high per unit handling costs. This combined with a number of other reasons, made the two yards uneconomic, although the wood flow through the yards suited log purchasers.

2. Hamner Forest, Canterbury

In 1985 Hamner Forest installed a successful central log yard to cope with the variety of species and number of customers supplied from this forest. Installation of the yard was cheap (about $12,000 for the three hectare site), and it seemed to provide many of the predicted benefits of a yard, including better log-making, greater customer satisfaction, and improved inventory control. The yard ran for three years until a downturn in demand from the forest made the yard uneconomic.

3. Ngaumu Forest, Wairarapa

Commencing operation in 1987 this 1½ hectare yard processed about 70-80,000 m^3 per year though to its closure in 1991. Designed to handle only radiata pine, the yard was conceived to overcome the problems of servicing numerous small customers, Previous experience had lead to the accumulation of stockpiled logs throughout the logging area when using conventional log handling systems. In addition, the CPY was seen as a way to minimise the use of expensive roading gravel.

The CPY's that have been tried have all had a relatively small throughput. In an attempt to highlight the potential of centralised processing in New Zealand, a paper examination of a single yard designed to handle a relatively large production was undertaken. It must be recognised early however, that the style of yard necessary for New Zealand conditions would differ from those used elsewhere. The yards on the west coast of North America are used more for log sorting than for merchandising, while the European yards, with full merchandising, process considerably smaller trees.

Changes from the conventional system will affect the whole materials-handling chain as the stem is transferred from its standing position in the forest, to the yard, and finally to the customer.

This paper examines each of the transportation phases to highlight options. Components of the two systems i.e. conventional and CPY, which are not affected are excluded from the analyses.

ASSUMPTIONS

There are many potential options for the conversion of a standing tree into component products. It is not feasible to cover all of the possibilities here therefore certain assumptions have been made to limit the alternatives.

Assumption 1. Type of material to yard

Stems could be transported to yard either trimmed or with branches. Although the possibility exists to process unlimbed stems at a central terminal and collect the residues as a fuelwood, this option is not examined. While there are facilities to process untrimmed material, particularly in Sweden and Finland, they use small first thinnings-sized stems. Without an existing facility processing larger untrimmed stems from which to base processing methods, this option must fall into the twin categories of speculative and high risk.

Assumption 2. Roading limits

The cartage of material to the yard is

assumed to remain off-highway for the duration of the trip. This implies that there will be no external restrictions on length configurations, allowing up to 20 metre lengths to be carted.

However, the current practice by Juken Nissho at Masterton to cart 15 metre lengths from Ngaumu forest to their local mill indicates that this assumption is not necessarily restrictive.

Assumption 3. Type of yard

Two main alternatives exist for the base structure of the central yard: sortyard or processing deck, i.e. low tech or high tech.

The sortyard, or low technology option, refers to a yard with similar operating characteristics of the Pacific-Northwest style yards where motor-manual systems predominate. This concept is more like a 'super-skid'.

The processing deck, or high technology alternative, is closer to the mill yard merchandising facility. The emphasis is on large-scale mechanised processing with multiple handling and slashing decks, and bin storage. This type of yard is closer to the German and limited yards of the southern USA.

The reluctance to embrace this type of merchandising technology is that it has not been applied to stems of the size and weight of radiata pine. This means that the type of technology adopted in the facilities overseas would have to be considerably 'beefed-up' to operate effectively. Construction costs would be in the order of $10 million, and would attract considerable annual maintenance costs. Additionally the risk associated with the sinking of such a large sum in a largely untried system should be sufficient to cause most prudent managers to hesitate.

For these reasons the sortyard style of yard has been adopted in this analysis, although the option of a 'lower' technology processing deck has not been ignored. It is probable that a "super skid" would be effective up to around 200-250,000 tonnes annual throughput. Above this figure the management of the number of men and machines required to process the higher volumes may become unwieldy.

CHANGES IN MATERIALS-HANDLING PHASES

Each of the major handling phases have been examined to determine what might be the important changes from a conventional to a sortyard handling system.

1. STUMP TO ROADSIDE/LANDING

Felling techniques have been ignored in this analysis. The combination of motor-manual or mechanical felling methods used will little affect any comparison. The main issues are the form in which the stem arrives at the next handling point. This could include the following possibilities.

1. Untrimmed, unprocessed, i.e. extracted after falling without any further treatment.

2. Trimmed, and unprocessed, i.e. manually or mechanically delimbed, but no processing decisions made.

3. Partially trimmed/processed, i.e trimming and/or the removal of a butt log.

Probably the most likely option is undertaking trimming for extraction, i.e. a traditional approach. However alternatives should not be ignored. For example, if roadside delimbing was used with a suitably large stroke unit, then it may be possible to put the processed stems from the delimber directly on to the back of a waiting trailer. This would eliminate a separate loader, although the issue of handling the smaller pieces, as discussed below, would still require resolution.

i. Impact of stem breakage

There is something of a dilemma with radiata pine as felling breakage creates numerous small, branchy, low-volume, low-value pieces. Assuming that there remains a desire to recover at least a portion of this material then it is likely that the best option is to delimb, store and transport these pieces as a separate entity.

If the main stems are to be extracted untrimmed, then the best option may be to extract the top sections in a dephased manner where merchantable tops are collected and processed, perhaps towards the end of the block in a 'salvage' operation, but before the main crew have departed, i.e. as part of an integrated operation.

If the main stem section is extracted trimmed, then it is probably more efficient to extract the top section in a single pass.

ii. cable systems

Recovery and handling of stems by cable systems on steep country is not as flexible as with ground-based systems. Stems still have to be extracted to a landing, and, because of the more limited storage spaces typical at hauler sites, hot decks would be required.

While these features do not preclude hauler-extracted wood from being included within a centralised processing scenario, as many operations now use a form of CPY by transferring stems to a nearby landing for processing, they do restrict options.

2. <u>ROADSIDE/LANDING HANDLING</u>

Long trimmed stem sections arriving at a landing or roadside would not be too different from current practice. However, as there would be no further need for processing, the only activity necessary would be to stockpile and load these stems for transport to the yard. For ground-based systems the requirements for organisation of the landing would be much reduced compared to conventional operations. Stems could be stockpiled anywhere within reach of the loader systems. This has the added advantage of releasing the extraction system from the need to direct its load to manicured landings.

A system of 'warm' decking could be envisaged with the loader working behind extraction unit thus removing any interference between these two phases. The reduction in average haul distance and the elimination of interference at the deposit point should allow improved production from the extraction unit. It also will allow the opportunity to more easily split contracts.

If untrimmed stems are delivered to roadside many of the advantages still hold. A form of stroke delimber would be required although one capable of handling New Zealand's mature radiata pine is arguably yet to reach the market.

i. Processing at Roadside/Landing

Cartage to the log yard is assumed to be all off-highway. This allows some economies in transport to be obtained. However, while increased payloads can be accommodated, it is unlikely that the full length of the main butt section of stem from typical clearfell stands could be transported intact.

This butt section is about 25 to 30 metres long and would therefore require to be severed somewhere around 14 to 17 metres from the butt. It is possible that some guidelines might be adopted to assist in the placement of the pre-emptive cut, but given the background of a high number of log grades, and rapidly shifting priorities, it may not be possible to develop meaningful strategies.

To undertake this stem length reduction, a chainsaw operator would be required to work with the loader.

ii. Loader type.

A move to recovering stems from stockpiles would see a matching movement towards the use of hydraulic loaders. Their reach, and ability to handle large pieces efficiently, would give them significant advantages over rubber-tyred front-end loaders. These larger loaders would be particularly necessary at hauler landings, where stems would have to be regularly removed from within the landing chute.

The issue of handling the shorter segments resulting from felling breakage must still be resolved. They will need to be stockpiled at the roadside/landing edge independently from the main butt stem sections and, where appropriate, manufactured into final log grades so they can be trucked directly to consumers.

This combination of specialist off-highway and conventional on-highway units to handle the different products goes against the efficiencies of a single trucking fleet transferring all wood to a single destination. However, the high cost of taking small pieces to a yard for processing may necessitate this option.

McNeel and Nelson (1991), in an analysis of small-capacity sortyards (175,000 m³) of western British Columbia, highlighted the disproportion impact that small pieces (<0.5 m³) have on processing costs, (Figure 1). While there are major differences between the type of yard operating in that region and the conceptual yards proposed, this steep gradient of cost and volume should still hold. It is possible that the best alternative may still be for all of the raw material to go to the single site. For example, all pulpwood may be chipped in close vicinity to the yard.

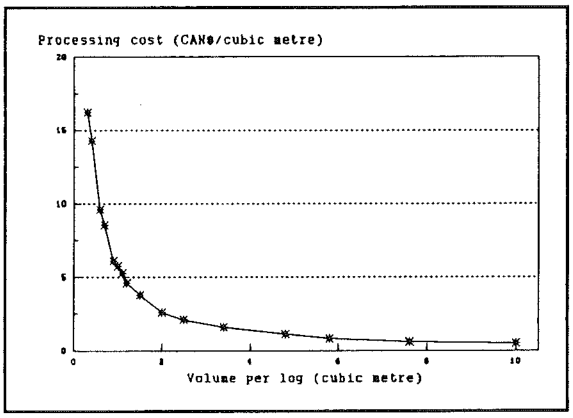

Figure 1: Relationship between piece size and processing cost for a Canadian sort yard (McNeel & Nelson)

3. TRANSPORTATION

The cartage of long sections to a central yard will undoubtably necessitate the need for some specialisation of the trailer unit. Because of the volumes moved, there would be sufficient work to attract contractors into obtaining such rigs.

As the units would be operating continually off-highway there would be the opportunity to equip them with a drive system matching the terrain.

An aspect of cartage which may create

difficulties in the ability of overlength rigs to adequately negotiate horizontal curves on roads not designed to cope with such log lengths. This may require that realignment is undertaken on some critical points. In addition, the potential increased over-hang from stem length cartage may impair on-coming traffic safety. Other traffic may be need to be restricted from using certain highway stretches on which oversized stems are being hauled.

i. Cartage additional distance

Normally there is more than one exit from a forest and truck contractors chose the most efficient way to travel from the landing to the unloading point. If all material is to go to a central point then the opportunity for variation is limited.

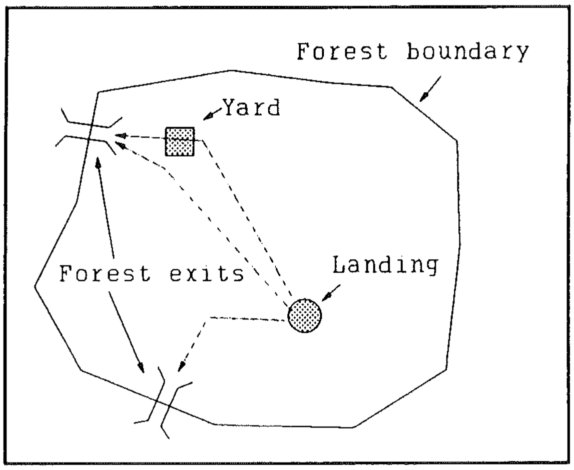

Figure 2: Yard and forest exit location in fluences the amount of extra cartage.

It is possible that a proportion of back-tracking may occur, i.e. logs will not take the shortest route from the forest. Additional costs in transport will therefore accrue to the yard option.

4. YARD CHARACTERISTICS

Because of the size of yard throughput envisaged within this scenario, about 500,000 cubic metres per year, it is likely that some component of mechanisation could be adopted within the yard to assist in log manufacturing. Some form of live chain deck could be envisaged where logs were dumped onto a low capital deck and cutting done with circular saws. Such systems are used on the Pacific Northwest in some sawmill yards where long logs are recut into shorts before entering the sawmill.

The installation can be relatively low cost, about $500,000 but with that it also has sorting limitations. It does, however, allow for some mechanised handling at a reasonable cost.

i. yard size

A processing yard must be of sufficient size to incorporate all of the following features;

a) weighbridge, access roads, truck turn-around space
b) administration buildings, vehicle service/storage
c) stem processing
d) log storage
e) debris treatment/disposal (off-cuts and bark)

As there is no existing model from which to assess the desired yard size to handle 500,000 cubic metres of long-length radiata pine, some estimates are drawn from overseas experience. The FERIC sortyard manual offers the best information on likely yard sizes although this requires some interpretation because of the different nature of the operations within these yards. (Sinclair and Wellburn, 1984). These FERIC data indicate that above about 200,000 m^3 per year the required sortyard size is around 8 hectares.

Because of the greater problems experienced with species variety and stick scaling in these sortyards, the New Zealand equivalent might be expected to operate on a reduced area. An area of about 5 hectares was estimated to be needed to cope with an annual throughput of 500,000 m³.

With varying demands on the sorts required to be produced from a yard, the yard site should not be limited so that should expansion be necessary it could be accomplished without interrupting on-going activities.

ii. Cost of operation

Again, the FERIC information gives an idea of operating costs. Adjusting these figures for exchange rates and inflation gives a total owing and operating cost of $7.88 per m³ (Walker, 1988). This is close to the A$7.76 cost for a merchandiser-style yard in South Australia processing up to 216,000 m³ per year (Bankes, 1988).

Estimates of running a stem processing yard in New Zealand vary, however, all tend to hover around approximately $4 per m³. It would be reasonable to assume that economies-of-scale will not greatly affect this cost.

PROJECT ANALYSIS

A spreadsheet has been developed at LIRO to incorporate the various cost elements to be considered within a centralised processing versus conventional processing comparison.

The main assumptions were the following:

- wood harvested from a single forest
- trucking off-highway to the yard
- review period was for 10 years
- interest rate of 10%
- processed volume building up rapidly to 500,000 tonnes per year
- yard size of 5 hectares

A standard PNW (Present Nett Worth) analysis was undertaken, discounting all future additional costs and revenues back to a base year at a 10% discount rate.

The financial areas focused on the main cost/benefit areas of the CPY option as compared to a conventional operation. These are expanded below.

<u>Costs</u>

i. yard construction. Formation of a five hectare site, base stabilisation, paving of 25% of the site, weighbridge construction, land rental, annual yard maintenance, provision for a log deck.

ii. yard operation. Contract rate of $3.50 per tonne is assumed, including some economies-of-scale and the benefits of a merchandiser deck.

iii. Extra cartage costs. Premium of 3¢ per tonne/km for off-highway units, and the impact of cartage of additional distance to yard (back-tracking).

iv. Improvements to roads. Extra work on alignment and bridging to allow the transportation of longer lengths.

v. Pre-emptive cutting. Cutting stems to allow cartage to the yard will reduce potential stem value (Twaddle and Murphy, 1992). A loss of 2% of average stem value was assumed.

vi. Carting of residues. The production of logs in the forest means that all residues are left at the manufacturing site. In a CPY additional residues would be carried to the yard at an assumed rate of 1.5% of total carted volume.

Benefits

i. Most landings for ground-based systems could be eliminated, and stems extracted to roadside, reducing landing construction outlay. Assumed 75% of landings not required.

ii. Reduction in logging rate. Removal of the log-making task from the logging operation will allow for some efficiencies. A $1.50 per tonne benefit is assumed.

iii. Improved log-making. Making the log making decisions within the more controlled conditions of a CPY should allow for better decisions. An increase of 5% in total product value is predicted.

iv. Specialist product cutting. The CPY will allow the production of specialist lines not able to be handled in conventional operations. A benefit of $0.25 per tonne processed is assumed.

v. Sale of residues. The yard will accumulate a significant quantity of residues in the form of off-cuts and bark which can then be on-sold. The volume is residues is estimated at 1.5% of total handled volume, and the residue value is $5.00 per tonne.

vi. Other benefits attributed to a CPY option include the additional forest productivity derived from not degrading forest sites in landings. A gain of $500 per landing was assumed.

Table I PNW analysis of generalised CPY example, @ 500,000 tonnes per year.

ADDITIONAL COSTS		
Yard construction	2,067,000	
Yard operation (@3.50 per tonne)	11,144,000	
Extra cartage costs	1,203,000	
Improvements to roads	254,000	
Pre-emptive cutting	2,770,000	
cartage of extra residues	47,000	
Total		17,486,000
EXTRA BENEFITS		
Reduction in skidsites	285,000	
Reduction in logging rate	4,155,000	
Improved log-making	6,924,000	
Improved inventory control	2,216,000	
Specialist product cutting	692,000	
Sale of residues	208,000	
Other benefits	253,000	
Total		14,480,000
ADDITIONAL COSTS ABOVE BENEFITS		$3,006,000

To adopt a radical departure from conventional harvesting systems to a central processing option appears to require additional justification than a straight economic decision. Perhaps concerns over the need for improved customer service, the opportunities to respond rapidly to market fluctuations or undertake some form of processing not economic or possible in the forest, may sway a decision towards the use of a CPY.

However, because of the risk of such a new venture of the scale reviewed, a significant positive return would normally have to be shown to convince any prudent financial manager to proceed with yard development.

SUMMARY POINTS - ADVANTAGES OF CPY

1. Elimination/reduction of formed skidsites (cost of forming skids and their subsequent rehabilitation, more area retained in productive forest).

2. Improvements in production of the extraction phase of recovery as roadside decking on flat country could be used (reduction in average haul distance), and delays associated with landing activity interference would be eliminated.

   With mechanisation of felling it may be possible to operate without workers being on the ground thus deriving the twin benefits of lower exposure to hazardous conditions, and the ability to continue operating in more extreme conditions, particularly wet weather.

3. A loader working to stockpiles and undertaking a minimum of sorting would be able to maintain a high production level. It is possible, under certain circumstances, that a large loader may be able to service more than one extraction crew. The logging contract would be more easily split into extraction to roadside/landing, and loading.

4. Log-making would occur under more controlled conditions, assisted where possible, by computer aids. The level of value recovery would rise, as would the general quality of the log products produced, (closeness to specification).

5. Inventory control should be enhanced. It may be possible to more closely match export size requirements.

6. There is the opportunity to undertake further activities in a yard, such as the production of specialist products. Also for export logs the opportunity to carry out debarking, sapstain treatment, and to electronically scale and automatically tag (c.f. the manual system now used at ports)

7. Customer liaison would be improved. Potential customers would be able to easily go to the point-of-manufacture for discussion of their needs.

8. Residue recovery (chipping/hogging on-site) may be possible, with sales of this material to local markets.

9. In a larger yard the pulpwood may be chipped on-site in a satellite facility incorporating drum debarking. This would eliminate roundwood handling problems.

SUMMARY POINTS- DISADVANTAGES OF CPY

1. Most clear-fell stems must be cut before loading. Evaluations of the effect this has on log value indicate that 1% to 4% of total value can be lost.

2. Transport rigs would need to become more specialised, therefore less flexible, i.e. they could not necessarily go on-highway. Cartage rates for this consistent over-length off-highway run from the woods to the mill may be 2¢ to 4¢ above standard on-highway rates.

3. If the yard cannot be sited at the mouth of an exit position from the forest then wood may have to be carted extra distance, thus occurring

additional cost. Also, if wood has to be carted to the yard for processing that otherwise would have be taken an alternative direction, then similarly additional transport costs will be incurred.

4. Processing at a yard requires that the stems be unloaded from a truck, cut into the appropriate log assortments, then reloaded on to truck/rail. These are two extra functions not incurred in conventional operations. Not only do they add cost, but with each handling operation additional damage to the logs can occur.

5. Considerable investment will have to be made on the construction of a yard. This investment implies sunk capital at the beginning of the project, little of which can be recovered if the project is unsuccessful.

DISCUSSION

Centralised processing is frequently discussed as a materials-handling option in New Zealand, but seldom practised. Part of the reason for its lack of application must be an unwillingness to depart from the conventional well-tested handling procedure. However, a considerable drawback to the option is the limited economic justification for its usage. As the above example shows, it is difficult to contemplate an alternative method without a heathy expectation of returns. Even with considerable manipulation of this analysis with optimistic benefit levels and cost impacts it is still difficult to generate a positive Present Nett Worth.

In spite of this there may still be some circumstances where larger scale central site processing can be justified. It is likely that some or all of the following conditions will have to apply.

a. Production of some high value log products.

b. Several log types to be produced (at least 10) from an forest area where landing surface conditions are often difficult, and construction costs high.

c. The yard can be located were back-tracking of material is restricted.

d. Yard construction costs can be kept to under $1 million, and preferably under $500,000. Handling costs within the yard do not exceed $3.50 per tonne.

e. Further processing occurs at the yard.

Previous CPY's appeared to be of most benefit to the log purchaser. They obtain a lower cartage cost, and a more secure source of logs. The log seller may not be able to obtain the same rewards. Therefore, unless a yard is sited in a location where a substantial portion of the incoming volume is consumed then it is probably difficult to justify a CPY unless it is for reasons other than those covered above.

Without a set of circumstances occurring which include; high value log products, multiple log grades, difficult winter logging conditions, high cost roading, further yard processing, it is unlikely in the foreseeable future that New Zealand will widely adopt the concept of centralised processing.

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