Improving profitability by optimising log-making

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Abstract

Since 1976 optimising log-making techniques have been used in New Zealand at the time of harvesting to improve forest profitability. Their first use was in preharvest inventory, where stems were described by size and quality independently of the subsequent prediction of log yield. As an appreciation of the impact harvesting techniques could have on the recovery of value grew, a system to assess the level of value recovery during log-making was developed. This system, called AVIS, has been used to set the bench-mark levels of recovery and is now being installed as a training and audit tool in the New Zealand forest industry. The potential improvement in profitability due to better log-making is between 5% and 15% of the gross revenue. Not all of this may be recoverable but with better supervision and control of existing systems the losses can be expected to be reduced immediately by 2% to 5%. By matching appropriate markets and log making strategies to the type of stands being harvested, there is the potential to make significant gains in profit using improved log allocation and harvest planning systems.

Introduction

The exotic forests established in New Zealand before 1940 were largely unmanaged. Harvesting practice concentrated on minimising costs. These forests, called the 'Old Crop', have almost all been clearfelled. The stands planted subsequently have received a wide variety of silvicultural practice in the form of thinning and pruning from an early age. Thus, as well as containing potentially more highly valued components than the Old Crop, they carry with them the expectation of higher per hectare returns. The motor-manual method is the most common and cost effective system of harvesting the 2-3m^3 average tree size from the post 1960s plantings of radiata pine. Trees are felled and limbed by chainsaw, extracted in long length to a landing (skidsite) and cut into their component log grades by the workers on the landing (skidworkers).

New Zealand log grades vary regionally and between companies. However the following criteria are generally used to identify grades:

- Pruned (i.e. all branches removed early in life of stand)
- Branch size if unpruned (usually in three divisions, e.g. 0-6cm, 6-14cm, 14+cm)
- Ovality (for peeler grades)
- Diameter (particularly of the small end)
- Sweep (i.e., stem curvature)
- Surface defects (scars, etc.)

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Usually four to seven log grades are cut at one site. The trend has been to increase the number of grades which increases the pressure on the skidworkers who are making the allocation decisions. It is more common now to cut all logs except pulpwood to fixed length intervals, usually with 30cm increments (e.g. 3.7m, 4.0m, 4.3m, 4.6m etc). In addition, there are often preferred lengths (e.g. 4.9m, 5.5m, 6.1m) within the allowed options, which further increases the complexity of the decision making required from the skidworkers. Below is an example of a set of log grades that might be identified at one site.

Grade	Min. s.e.d. *	Length
Pruned peeler	35cm	5.3m
Pruned sawlog	35cm	4.0-7.6m (0.3m.inc. †)
Export	20cm	8.1 and 12.1m
Unpruned sawlog No.1	30cm	3.4-6.1m (0.3m inc.)
Unpruned sawlog No.2	30cm	3.4-6.1m (0.3m inc.)
Unpruned sawlog No.3	20cm	4.9-6.1m (0.3m inc.)
Pulpwood	10cm	2.5-7.0m (random)

* s.e.d. = small end diameter
† (0.3m inc.) = incremental length steps e.g. 4.0, 4.3, 4.6 etc.

Role of Value Recovery

The first and most fundamental aspect of the research work into value recovery was to pinpoint where this work fitted into the overall scheme of harvesting principles.

After work had commenced and progress was being made a very simple and apparently obvious model became clear. Profitability of the harvesting operation was based on volume produced multiplied by its unit value minus the unit cost of production, or

$$PROFIT = VOLUME \times (VALUE - COST)$$

All three of the keystones of profitability interact so that increase in one can cause either increases or decreases in another.

In the harvesting of New Zealand plantation forests emphasis has tended to be on only two of the profitability factors: volume production and production costs. While it is certainly not true that the value of the produce has been ignored it is fair to say that it has not been given the attention that it deserves. Recent research work into log-making has indicated that it can be much easier to add $1 to unit product value than it might be to reduce $1 from unit costs.

Allocation options

Most trees can yield a wide variety of log products depending on the log grade specifications applied, the market demand, and hence the log-making decisions practised. It is incorrect to assume that a stand of trees contains the different log grades in a fixed percentage of the total volume. The percentage grade breakdown can and does change.

As an example Figure 1 shows a typical New Zealand *Pinus radiata,* 30 years old, 40 metres tall with a dbh of 50-60cm and pruned to 6 metres. This type of tree, with changes in quality up the stem, is likely to be encountered frequently over the next few years of logging.

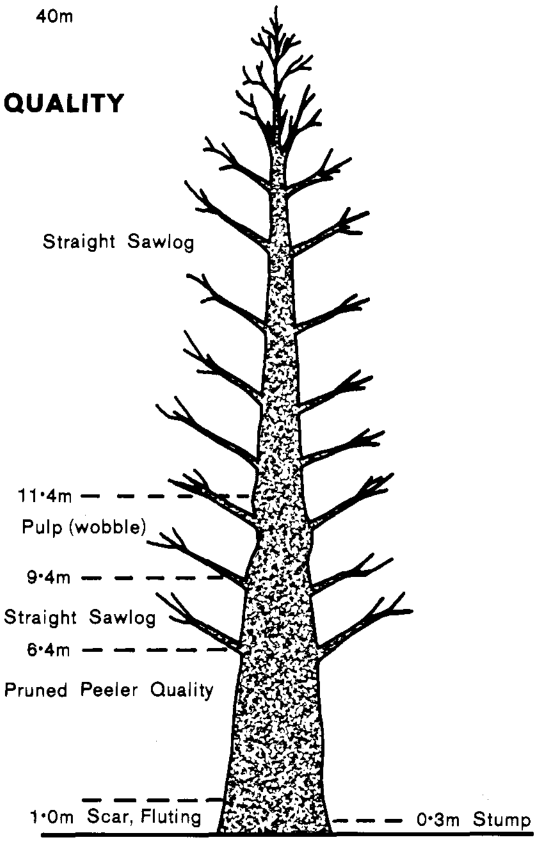


Figure 1: A typical New Zealand *Pinus radiata* which will be harvested over the next few years.

At the butt is a scar, possibly due to thinning damage, or some other defect, such as fluting, which downgrades the otherwise high-quality pruned peeler to pruned sawlog grade. Some wobble, sweep, or kink frequently occurs in parts of the stem (in this example between 9.3 and 11.3m) severe enough to downgrade potential sawlog material to pulp wood quality. The remainder of the stem is assumed to be of sawlog quality, limited only by the diameter of the stem being above minimum small end diameter constraints. For simplicity, no differentiation into qualities on the basis of branch size classes has been made. Note that this description is of the inherent quality features of the stem, and has not been modified by any log-making decisions.

When felled, on average (and with quite a bit of variability), a stem breaks at two-thirds total height, and quite often the diameter at the breakpoint is well above the minimum small end diameter of a sawlog. The delimbed stem with its component quality features, prior to cross-cutting, is shown in Figure 2. In this example the steam breakpoint is at 25 centimetres.

For each cutting pattern, the log-maker must identify and segregate the high-value pruned componentry into either peeler or sawlog grade. The next major decision is between the export and grade 1 unpruned sawlogs. Grade 2 sawlogs have similar dimensions to those in the grade 1 category but have lower quality specifications. The final choice is between the smaller dimension grade 3 sawlogs and the random length pulpwood grade.

Figure 3 shows three cutting patterns which result from optimising the total value of a stem based on the set of log grades shown above. In each pattern only the relative values of the log grades have been changed. In cutting pattern 1, where the value of pruned peeler logs and export sawlogs is high relative to other classes of material, the non-peeler grade material at the butt is wasted to make a valuable peeler log. To maximise the volume in the export sawlog, the 3 metre length of potentially sawlog grade stem immediately above the pruned zone is downgraded and incorporated into a pulp log because it is too short to make the minimum sawlog length of 3.4m.

Cutting pattern 2 is similar and would be used when only a small margin in value exists for peelers over sawlogs, insufficient to justify wasting the 0.7m length at the butt.

Cutting pattern 3 would be used when pruned or export material was only marginally more profitable than sawlogs, but a moderate differential occurred over pulpwood.

There are several other variations due to changing value alone; changing acceptable small end diameter, length, and quality requirements would result in many more.

Table 1 shows the total volume in each log grade for each of the cutting patterns above and illustrates the wide range in the percentage breakdown by log grade, resulting from the alteration of the relative values of the log grades.

TABLE 1. Volume (m^3) by log grade for each cutting pattern

Cutting pattern	Peeler sawlog	Pruned	Export	Sawlog	Pulp
1	0.70	0	0.87	0	0.68
2	0	0.81	0.87	0	0.67
3	0	0.74	0.84	0.40	0.34

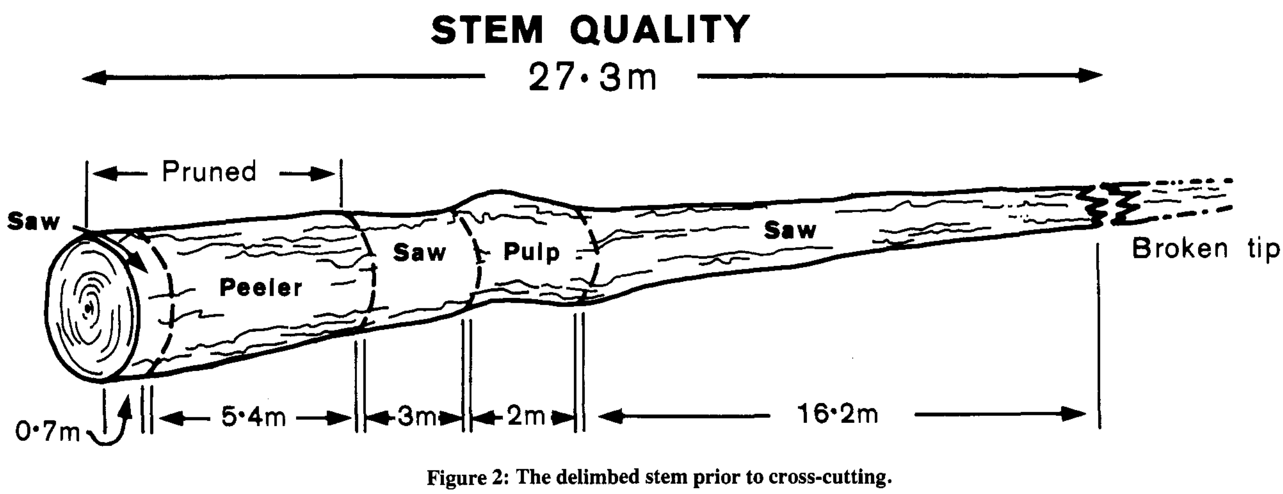
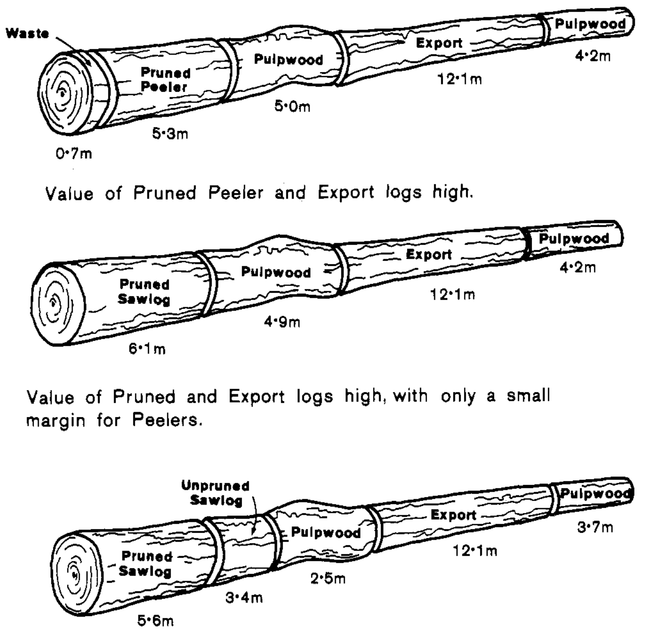


Figure 2: The delimbed stem prior to cross-cutting.



Value of Pruned Peeler and Export logs high.

Value of Pruned and Export logs high, with only a small margin for Peelers.

Pruned material only marginally more profitable than sawlogs.

Figure 3. Cutting patterns which optimise the total value of the stem.

Assessment of Potential Value Recovery Before Harvesting

In a harvesting situation where there is a wide differentiation in the values of log grades and where those values can change as a result of market demand, any inventory procedure which does not take these factors into account cannot accurately predict the potential merchantable volume by log grade. Conversely, with this information, planning for marketing and logging can relate the potential log grade yield of the stands to changes in market demand.

There is usually the flexibility to allocate specific logging gangs and cross-cutting strategies to certain stands and balance demand across the forest estate over the planning period. Thus it is important to assess the volume by log grades in a market-responsive and accurate manner, and then to cross-cut the logs from those stands maximising the value inherent in each stem.

A *Method to Assess the Recoverable Volume by Log Grade,* MARVL, was developed at FRI in 1976, and extensively tested. A production version was implemented in 1978; the method and accuracy were described by Deadman and Goulding (1979). MARVL remains the major preharvest inventory procedure in New Zealand.

The method has two distinct phases. During the field procedure each tree sampled is assessed for quality changes up the stem, objectively and independently of the length and diameter requirements of the logs to be cut on the landing. The prediction of log grade yield is made subsequently by the analysis program, and is a function of both the inventory data and a set of log grades with their values.

The central routine of the inventory analysis program is the optimal bucking algorithm of Pnevmaticos and Mann (1972), modified to work in a production environment, which is used to "mimic" the log identification procedure of a skilled forest worker and hence predict the yield of logs from each tree assessed in the field. A feature of the system is its ability to re-analyse an inventory several times, varying the cross-cutting strategy by changing the physical dimensions, acceptable stem qualities, and relative values of each log type to be "cut" from the trees. It has been used extensively to market stands and logs from stands, to plan logging operationally and to set a standard of what quantities of logs *ought* to be obtained compared with what actually have been obtained.

MARVL was originally implemented in COBOL on the ICL 2980, and has been converted to run on DEC VAX equipment. It consists of a data verification program and an analysis program. The program supports the use of either area plots or angle gauges, and simple random, stratified random, or double sampling schemes. More recently it has been upgraded and written in PASCAL to run on IBM AT compatible microcomputers. Data entry modules have been written for in-forest use on the Husky Hunter, a robust, waterproof micro used as a data logger.

At times actual results of the percentage distribution of volume by log grades differed from that predicted even though the total recovered volumes matched closely. In many cases the cause of the discrepancy was attributed to the fact that conditions changed between the time of the inventory and logging. In other cases, "poor" inventory practice was blamed. Because the stands had been harvested by the time a reconciliation was made, there was little that could be done to discover the true cause of what was usually a shortfall in the expected total value, or to correct the practice.

New Zealand Purpose-built Log-making Optimiser

The first work directed specifically at investigating the log-making process was carried out under the direction of the Forest Research Institute in 1979 (Ferrow and McEwen, 1979). A sample of 120 radiata pine stems was measured by the MARVL inventory method and compared with estimates of the outturn of the logging crew.

The trial highlighted the losses in value that occurred in larger-sized trees of radiata pine from felling to the final allocation phase in the forest. Overall, 34% of the potential profit from the stems sampled was found to have been sacrificed in the allocation process; if this could be avoided, the current profit levels would thus increase by 52%. Much of the loss came from the inappropriate choice of cutting mix to match the type of stands being harvested. Losses specifically from the operational log-making phase were calculated at a minimum of 7% of the potential value.

MARVL was developed for use with standing trees. It is a full inventory system, with different optional sampling schemes. Because of stem breakage, errors in the visual estimation of changes in grade up the standing stem, and the use of average stem taper and dbh/tree-height equations, predictions of the log yield from any one individual tree are unlikely to be accurate compared with the average estimate for the whole stand. To compare actual log-making practice with the desirable practice, it was necessary to develop a customised tool to apply to single trees as they were being cross-cut in the forest.

Actual measurements of lengths, diameters, and quality parameters were necessary to remove any debate over the uncertainty of results due to estimation. This is especially true with respect to lengths between stem quality changes, and diameter limits.

Development of a specific tool to analyse single trees in the forest commenced in 1981. By 1982 a system had been developed that accomplished the initial objectives of the project. The system was named AVIS, an acronym for *Assessment of Value by Individual Stems.* Research consisted of both computer program development and operational field trials to produce a system that would work in the practical logging environment. A system was developed that allowed the measurement and entry of the dimension and quality characteristics of a stem, produced a value optimal cutting solution based on actual site prices, and summarised the results of a sample of stems in the form of an audit of the log-making practice (Geerts and Twaddle, 1984).

The first major field trial was then undertaken to test the system. A typical clearfelling harvesting operation was selected and a 350 tree sample of stems was measured for dimension and quality features in the stand, after felling but before extraction to the landing. After the stems were extracted, the log grades and lengths were recorded. At the end of the measurement period the information recorded on the field forms was returned to the office and run through the optimising program. A value optimal cutting solution for each measured stem was calculated and compared with the solution achieved by the workers on the landing. The results showed a total of 26% loss in potential value for the measured sample of stems.

A second trial commenced soon after with the same crew and in the same stand to see if the level of loss detected in the first trial could be reduced. Before taking the measurements, the skidworkers received training in log-making procedures, some of the work pressure from extraction machines was removed, and more suitable tools were provided to assist the workers in their decision making.

The results from a similar-sized measurement revealed a reduction to 11% loss in the total potential value. Most of this improvement was attributed to a growing awareness on the part of the workers that their decisions had an important effect on the final value. Previously they had been given little assistance in choosing cutting strategies because the supervisors concentrated more on ensuring volume production targets were being met.

The results of the trial provided a justification to continue development of the tool. Changes were made to data collection procedures and enhancements made to the program. To determine typical levels of value losses in clearfell harvesting a series of trials was undertaken in different conditions.

These trials were carried out with both ground extraction and cable crews mostly in radiata pine stands but also occasionally in *Pinus nigra* stands. Results varied but typically the levels of value losses were from 5% to 15%. Not all of this could be recovered but with better supervision and control of existing systems the losses were expected to be reduced immediately by 2% to 5%. Each 1% improvement in the level of value recovery is estimated to improve the profitability of a clearfelling logging operation producing about 40,000 to 50,000 tonnes per year by $NZ25,000 to $NZ30,000.

Because improved value recovery can have a major impact on profitability, trials have continued up to the present date. Some are undertaken as demonstrations to illustrate the technique and the results. Others are done as consultancy projects.

Identified Main Causes of Value Loss

As a result of the investigations carried out using the value audit procedure, a number of causes, some already obvious, were identified as being those which most influenced the level of value recovery during log-making.

1. Complexity of specifications
There is a trend to require logs to be manufactured on the landing to more precise specifications – a trend most noticeable with regards to length requirements. In the past it was not an uncommon occurrence for logs to be cut in completely random lengths between a stated maximum and minimum. Now more often logs must be cut in fixed increments between a maximum and minimum. It is also likely that there will be preferred lengths within these options.

2. Unquantified or imprecise specifications
Log specifications in New Zealand have also suffered from the problem of a lack of standards. When a grade is in low demand the specifications for that grade are arbitrarily tightened by an often unquantified amount. Conversely the opposite can happen if demand for a grade is high. The skidworkers can therefore be given general instructions only about log specifications as management retains an excessive degree of flexibility.

The results of this practice are seen in the unquantified specification of some grades. Shape and sweep are the two most regularly affected log parameters. Terms like 'straight' and 'round' are seen in some sets of specifications. The problem with log specifications which are too broad is that the skidworkers can either be too strict or too loose in their application of the specifications, and either way value can be lost, immediately in the mis-cutting of products, or later from customer dissatisfaction.

3. Number of log grades
It can be expected that the more options or log grades that must be cut from a stand, the more chances there will be for allocation errors and, therefore, value losses. Results from study trials have not been tested specifically for this feature. In fact, in one of the most complex cutting patterns requiring 10 different grades each including various preferred lengths, a particularly skilled worker undertook the allocation decisions and incurred only a 7% value loss, indicating that the experience of the individual making the cutting decisions is very important.

4. Production pressure
The general attitude of most logging personnel and managers is that high production is the key to profitability. This is often at the expense of value, as cutting for quality can sometimes take a little extra time.

5. Lack of incentives
Most production targets for New Zealand for logging contractors are based solely on volume. Other than the supervisor visually checking skidworker performance there are little formal requirements for the contractors' crews to maximise value recovery. There is a trend to pay some form of bonus for higher grade material but this bonus goes to the prime contractor who may or, more frequently, may not, choose to pass on some of this reward to his crew.

6. Lack of training
Both the logger and the supervisor who controls the operation receive little if any formal training on how to cut stems to maximise value recovery, the main reason being the lack of any easily applied way of finding a good cutting solution quickly in the field. As supervisors are not confident in the area of log-making they tend to maintain an overview rather than check on the detail of decisions. Skidworkers develop what skills they can on a casual basis and there is no systematic or objective way of identifying why some skidworkers maintain a high level of value recovery.

7. Lack of decision aids
Often the decision as to what log type to cut from a given section of stem requires information, most commonly about log values and volume, that the skidworker does not have readily available. The skidworker could be encouraged to make more appropriate choices if managers took a more active role in the decision-making process by providing the workers with specific guidelines.

As well as allocation aids, correct log-making tools are often missing (Twaddle, 1986a). Effective log-making requires the skidworkers to produce logs which meet physical dimensions and to maximise value recovery. In spite of the close specification of log parameters, few tools are provided to skidworkers to help them measure logs or undertake the allocation process. For measuring length, lineal spring-loaded tapes are commonplace, but nothing is provided for measuring log diameter, branch sizes, or ovality, all of which feature prominently in most New Zealand log specifications.

As an auditing tool, AVIS was able to target specific areas for improvement. The key areas for improving recovery were: the training of key personnel, the provision of decision aids, and the use of incentives. A readily-available log-making optimisation procedure could potentially assist in all of these areas.

Program Implementation

AVIS was written in FORTRAN and implemented on DEC VAX equipment and IBM AT compatible microcomputers. It consists of a suite of programs to facilitate data entry, analysis, and reporting.

The disadvantage of having the AVIS program on an office-bound computer, whether main frame or micro, is that it is difficult to demonstrate alternative optimal cutting patterns to workers in a believable environment (i.e., out in the forest, in the rain, the mud, dust, and noise). In 1986 a version of AVIS was therefore rewritten in PASCAL for the Husky Hunter, which is capable of being used on the landing during logging operations. The program is readily transportable to other machine types and has been programmed to achieve the solution time in a realistic level of three to eight seconds per tree (Twaddle and Threadgill, 1986; Threadgill, 1987).

The system on the Husky was tested in the field; modifications were made as a result of those trials and it is now in a stable form. AVIS is used to demonstrate to workers in the field the immediate effect on value of their cutting decisions. The impact of having results immediately available is high and leads to constructive discussion between the skidworker and management. It is not intended that every stem should be measured as an 'on-line' production aid, but rather that the system should be used as a tool by supervisors to train and audit log makers.

A sample output taken from a recent field application of AVIS is given below (Figure 4). In this case the log grades able to be produced from the stem were a combination of export logs, sawlogs, and pulpwood. The output contains the lengths, grades, and most importantly, the volume and values of the two sets of cutting decisions. The output shows the three screens which summarise the results of a stem measurement.

Screen one gives the generated value optimal cutting solution. Two export logs and one pulp log produce a total stem value of $103.20.

The skidworker's solution to the same stem is shown in screen two. In this case the skidworker has missed a high value export log and cuts instead a lower value sawlog. This has resulted in a value loss which can be displayed as in screen three.

SCREEN ONE

Stem number: 8

Optimal solution

CUT	SED	LEN	CUM.LEN	No	LOG TYPE	VOLUME	VALUES
1	275	12.1	12.1	1	Export	1.08	73.24
2	226	8.1	20.2	2	Export	0.41	25.48
3	113	10.8	31.0	6	Pulp	0.25	4.48
					TOTAL	1.74	103.20

SCREEN TWO

Skid solution

CUT	SED	LEN	CUM.LEN	No	LOG TYPE	VOLUME	VALUES
1	275	12.14	12.1	1	Export	1.08	73.24
2	227	6.12	18.2	4	Sawlog	0.34	9.08
3	184	7.22	25.4	6	Pulp	0.23	4.37
RE	113	5.52	31.0	6	Pulp	0.09	1.57
					TOTAL	1.74	88.26

SCREEN THREE

Solution Comparison

Optimal value	$ 103.20
Skid value	$ 88.26
Difference	$ 14.94
Value loss	14%

KEY

CUT :	The log number
RE :	rest of stem
SED :	small end diameter (mm)
LEN :	*Log length (m)*
CUM.LEN :	Cumulative length (m)
No :	Log grade identifier
LOG TYPE:	Log grade name
VOLUME:	Log volume in m^3
VALUE:	Log value in $

Figure 4. AVIS output screens.

Treatment of Mis-cut Logs

The New Zealand forest industry has recently paid close attention to log grading (Whiteside and Manley, 1987) and has log specifications addressing length, diameter, and quality parameters. Logging crews are expected to cut closely to the specifications but formal monitoring of outturn is not common.

The results from the use of AVIS showed a surprising proportion of the logs produced on the landing to be out-of-specification (Twaddle, 1986b). About 20% to 30% of the logs produced on the landing do not meet the strict interpretation of specification in one of the following parameters:

Length
Diameter (usually below minimum at the small end)
Quality (contains some undesired quality feature)
Sweep

The workers on the landing can often apparently produce more of the premium grades than an analysis of the stem dimensions and qualities show is possible. The is due to cutting some logs with non-permitted features. As the proportion of these log grades is sometimes high, the sum value of the worker's solution (if the same unit values are used as in the optimal solution) can exceed that produced by the value optimising aid.

To show a worker that it is possible to beat the computer's solution by cutting out-of-specification is detrimental to the objective of the system. To overcome this problem a set of user inputted values are used to reduce the value of logs identified by the program as being out-of-specification in any of the above log parameters.

Common value reduction figures used are:

Length	[L]	10%
Diameter	[D]	15%
Sweep	[S]	20%
Quality	[Q]	25%
Multiple	[M]	33% (two or more errors)

An example of how this system works is given in Figure 5. In the 'Skid solution', the first two logs have an alphabetic code displayed just to the right of the log VOLUME number. This indicates that these logs have been cut out-of-specification. The Q means the export log has an inappropriate quality feature included within its length, and the L indicates that the sawlog has been cut outside the limits for allowed length. Both the values of these logs have been reduced according to the reduction factors shown above.

Even with these value reductions it is possible that if more extreme errors are made the skid solution may better the computer-optimal solution; if this is the case, the displayed summary of results is presented so that the difference between the two solutions is 0 if the achieved solution exceeds the optimal.

The financial penalty imposed on the out-of-specification logs cut by the worker in this case is not severe. The wood flow in different organisations means that the costs of mis-cut logs vary.

There is little industry knowledge on the true cost of out-of-specification logs in New Zealand. Financial penalties are for the most part mainly guesswork. A project is underway at the

FRI which aims to find out how to put more objectivity into what is now mainly a subjective process so that the true impact of out-of-specification logs can be included within AVIS.

Management Reaction

In retrospect the most quickly completed part of FRI's project on improving log-making may have been the production of the software package.

Company co-operation in undertaking the value recovery trials has always been good with access to logging crews being made readily. The results of the studies are always made available to the collaborating organisation. However, while there has been a high immediate interest in the results seldom has this resulted in prompt action – an initially disappointing response, but it is realised that an emphasis on value recovery will not happen overnight.

Value recovery, if it is not regularly measured, is not in the forefront of day-to-day management decisions. Provided there is nothing drastically wrong, value recovery can be ignored because the losses are "hidden". While production targets generally feature in the regular weekly or monthly assessments of performance, value recovery does not, and so the manager has no way of knowing whether or not a logging crew may be performing poorly. There appears to be some reluctance to begin to build management control systems similar to those that monitor volume and costs for value recovery.

One valid management concern which has caused some hesitation to embracing log-making optimising in New Zealand is related to fluctuating demand and prices. Some managers argue that single tree optimisation models such as AVIS can cause anomalies in production as certain supply commitments must be met regardless of the current relative log grade prices. This criticism has not been disregarded and a suitable mechanism which can adjust relative log prices to match available product and supply commitments is under investigation.

Future Development

In the immediate future, work will be concentrated on continuing the implementation of the system throughout New Zealand. During the operational testing of this project, problems were discovered and corrected which if they had been allowed to remain would have prevented the system from being of practical value. The continued involvement of researchers in the operational use of the systems is vital.

There are three areas which require further development. The current AVIS system is not seen as being used for log-making for every single tree. Developments in the use of electronic scaling on the skids may mean that this could eventuate. Until then, the skidworkers will continue to rely on training and a set of simplified instructions supplied by logging management which will tell them when to cut which log grades in preference over others, how much low-valued material can be wasted to maximise higher-valued material, and how much higher-valued material can be incorporated into lower-valued log grades to minimise waste. A systematic procedure which enables the logging supervisor to take a list of log grades and values and routinely produce such a set of instructions is required. Possibly the concept of an "expert system" may be of use.

The AVIS system allows the manager to value the log grades in two ways: a relative value is used by the optimal bucking algorithm for decision making, and a market value for calculating the gross return for each log. These values are the same when there are no constraints on the volume of any one log grade being produced, but differ if, for example, only one or two truckloads per day are required and current daily production could easily exceed that. How to incorporate quantity constraints in a changing environment is the subject of current investigation.

FIGURE 5
HANDLING MISCUT LOGS

Stem number: 14

Optimal solution

CUT	SED	LEN	CUM.LEN	No	LOG TYPE	VOLUME	VALUE$
1	378	4.0	4.0	5	Sawlog	0.50	12.61
2	348	4.0	8.0	5	Sawlog	0.41	10.27
3	237	12.1	20.1	1	Export	0.82	55.46
RE	151	9.7	29.8	6	Pulp	0.31	5.49
					TOTAL	2.04	83.83

Skid solution

CUT	SED	LEN	CUM.LEN	No.	LOG TYPE	VOLUME	VALUE$
1	303	12.10	12.1	1	Export	1.26 Q	64.45
2	255	6.03	18.2	3	Sawlog	0.38 L	9.23
RE	151	11.67	29.8	6	Pulp	0.39	7.06
					TOTAL	2.04	80.74

Solution Comparison

Optimal Value	$ 83.83
Skid value	$ 80.74
Difference	$ 3.09
Value loss	4%

The third area of development is to improve operational and mid-term harvest planning systems, to ensure that log-making strategies, stands, and market demands are matched to maximise profit. Now that New Zealand has the systems to assess the potential of stands to yield different quantities of log grades as a result of different log prices, and to audit and improve practice to ensure maximum value recovery from log-making, there are likely to be significant gains made by improved harvest planning systems.

Summary

The development of the MARVL inventory package enabled the New Zealand Forest Research Institute to obtain skills in the manipulation of dynamic programming log bucking optimisation routines. This experience was used to produce a tool specifically aimed at quantifying value losses during log-making and to undertake a research project on improving value maximisation during harvesting.

A key advantage in a value awareness approach during harvesting is that because of the low costs of implementing schemes, most of the extra revenue earned is added directly to profit.

An infield computerised approach to log-making offers the skidworkers the opportunity to develop skills and enhance their job satisfaction. While log-making has a very important role in the profitability of the harvesting process it is often looked upon by those involved as being one of the most easily learned and least preferred tasks within the logging crew. Expanding the role of the job should raise the status of those involved and hopefully attract the more capable.

The use of an objective mechanism to locate and demonstrate a suitable tree-cutting pattern rather than relying on subjective opinion means that training and skill development can be undertaken on a rational basis.

As well as a training aid the potential is now available to incorporate value recovery as a part of an incentive payment system. Regular measurements of performance could develop expected base performance levels against which bonus payments and/or penalties applied for achievements above or below the base level.

Computer-based aids will be of increasing use in the field as the power of smaller units inevitably expands. Product value maximisation is one example where a research effort is able to demonstrate worthwhile returns for a relatively modest investment.

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Giant wooden tank constructed

A giant wooden reservoir is currently being built at Te Puna to support Tauranga's reticulated town water supply.

The reservoir is believed to be the largest wooden tank ever constructed in New Zealand.

With a capacity of 1500 cubic metres (330,000 gallons), the reservoir is 19.5 metres in diameter and six metres high.

The site on the corner of Crawfords Road and Junction Road was prepared by the Tauranga County Council, who laid ground pipes and undertook hardfill compaction of the ground.

The contracting company then erected the straight-sided barrel of the reservoir, using 450 six metre lengths of 150mm x 75mm tongue and groove pine. All timber is treated to ground retention standards.

The roof, constructed on the road adjoining the reservoir, was lifted into place by crane on March 31.

Two 50-tonne cranes, the biggest mobile cranes in the Bay of Plenty, worked in unison to lift the 20-metre diameter roof into place. The cranes each raised the end of a beam to which ropes supporting the roof were attached.

The tank was constructed by Timbertank Enterprises Ltd, who have previously provided large wooden tanks for town water supply in areas such as Ohope, Whangamata, Whitianga, Coromandel, Pauanui and Te Awamutu.

"People sometimes need convincing that timber can be used to build large permanent structures," says Timbertank's Managing Director, Morton Jordan.

"Over the past few years we've built dozens of reservoirs – perhaps as many as 200 – for town water supply," says Mr Jordan.

"Their design, with its PVC liners and wire cables, is unique to New Zealand. And they are environmentally so acceptable."

The life expectancy of a Timbertank is in excess of 70 years, at which time the galvanised steel cables may need replacing.

Portable satellite positioning system

At $14,000 to $20,000 and steadily reducing, the latest satellite positioning system brings a new dimension of accuracy to surveyors, topdressing pilots and forestry managers, according to Greg Clout, AWA Business Unit Manager Marine, the sole New Zealand distributors of the Trimble Navigation Global Positioning System (GPS).

SatNav (Satellite Navigator) was introduced in the early 1970s and has been the most accurate method of position finding until now. However, position is only calculated on average once every 90 minutes and accuracy is at best 200 metres providing the vessel or vehicle does not move for the 15-20 minutes it receives and calculates its position. In addition, the satellites that SatNavs use will be turned off in 1996, making all SatNavs obsolete.

Superseding SatNav is Global Positioning System (GPS), an impressive and immediate technological advancement. Within the next three years, 21 satellites will be orbiting the earth to provide continuous, world-wide, all-weather three dimensional navigation, positioning and timing.

Using the principle of 'ranging' – that is, measuring the distance from a position on earth to the positions of three of these satellites – GPS can determine the position of an object with an accuracy of better than 15 metres, the information being updated every second.

Trimble is constantly developing new models such as the Path finder, a waist-mounted unit for the bush walker, surveyor or forestry worker, and a hand-held unit with built-in antenna, both built to military specification.