# SAW LOG GRADE DEVELOPMENT IN NEW ZEALAND - A PERSONAL VIEW

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## INTRODUCTION

This paper is about communication and co-operation, two parameters very closely linked to the *"quality"* theme of the FIEA/LIRO Conference. The fact that logging research and wood processing sectors meet in a joint conference is in itself an encouraging sign of a desire to solve problems together.

My involvement in the New Zealand Sawmilling and Pulp and Paper Industries has given me the opportunity to study the variability of the resource and changes in log grades. This paper summarises observations made in a number of mills. The viewpoints expressed are largely my own personal conclusions after extensive discussions with Forestry and Forest Industry players.

The presentation does not cover the entire spectrum of grades but will focus mainly on domestic radiata pine grades for unpruned sawlogs, with additional references to export, pruned, plywood and pulp log grades.

## LOG GRADES AND THEIR DEVELOPMENT

### Definition

Log grade is understood as a particular log product cut from a tree according to specified rules.

### Why Log Grades?

Forestry Sector Participants have a number of reasons to aim for a segregation of trees into graded logs.

These reasons include:

1. A forest owner, having an interest to maximise the return from the mature forest, segregates logs to sell the available produce to the most lucrative markets.

2. The logging contractor wants clear, measurable instructions how to crosscut and present the logs to get maximum profit from his operations.

3. The purchaser requests a consistent product regardless of variable silvicultural regimes, regions, or logging crew performance, to achieve the planned production targets.

4. End-users of different processing options need to buy a product of consistent quality and appropriate dimension (length, cross section) to manufacture their range of goods.

Because these motivations are quite distinct, it is paramount that parties involved communicate regularly.

Traditional requests from the log user's side are for:

- Uniformity in size, length and shape
- Suitable and consistent quality
- Satisfactory presentation
- Fresh produce and appropriate identification

**FRI Log Grades**

In 1985 the FRI conversion planning team developed 11 national log grades for radiata pine pruned and unpruned logs (see Table 1).

The principal purpose of establishing grades was for strategic modelling and valuation of the resource (standing tree inventory).

J Vaney and I Whitehead later formulated Rotorua Conservancy Rules, combining the 1985 rules with specifications previously used by the sawmill industry. The rules appeared appropriate for the existing markets of the day and served the chosen purpose.

It is interesting to note that even today a few corporate and independent mills still use the 1985 grading rules, albeit with slight alterations and additions, adjusting the original rules to the reality of everyday log making and selling.

However, the original FRI grades appear not to have survived well the practical test of the logging environment. Perhaps they were too general (e.g. only one pulp grade), or were limited by excluding export markets (only one grade exported), or maybe lacked important industry parameters such as length, biological downgrading factors and log making defects. Incidentally it was the sawmill industry which was at that time against including length into the log grades.

**Table 1**

**FRI Log Grade Specifications 1985**

| GRADE | TYPE | SED RANGE (MM) | MAX. KNOT SIZE (CM) | SWEEP* (SED) | OTHER** |
|---|---|---|---|---|---|
| P1 | PRUNED | 400+ | N/A | 1/8 TO 1/2 | N/A |
| P2 | PRUNED | 300-399 | N/A | 1/8 TO 1/2 | N/A |
| S1 | UNPRUNED | 400+ | 6 | 1/8 TO 1/2 | N/A |
| S2 | UNPRUNED | 300-399 | 6 | 1/8 TO 1/2 | N/A |
| S3 | BOTH | 200-299 | 6 | 1/8 TO 1/2 | N/A |
| S4 | BOTH | 150-199 | 6 | 1/8 TO 1/2 | N/A |
| L1 | UNPRUNED | 400+ | 14 | 1/8 TO 1/2 | N/A |
| L2 | UNPRUNED | 300-399 | 14 | 1/8 TO 1/2 | N/A |
| L3 | UNPRUNED | 200-299 | 14 | 1/8 TO 1/2 | N/A |
| L4 | UNPRUNED | 150-199 | 14 | 1/8 TO 1/2 | N/A |
| I | UNPRUNED | 300+ | 14 | 1/8 TO 1/2 | >60% |
| R | BOTH | 100+ | N/A | 1 TO 4 | N/A |

* *SWEEP VARIABLE ACCORDING TO LOG LENGTH CLASSES (<3.7, 3.7-4.8, 4.9-7.6, >7.6 M)*

** *INTERNODE LENGTH > 0.6M+ FOR MINIMUM 60 % OF LOG LENGTH*

**Log Grade Developments in the Industry**

During the 1980's, with the change in the resource and expansion into new markets, the sawmill industry saw the need for log specifications. The response came in a variety of ways:

- Some mills reverted to "*run-of-bush*"
- Corporate companies developed their own grades (and are still at it I might add)
- Other purchasers stayed with in-house grades that they had developed before FRI times.

Different log grades were not only developed between companies or individual mill sites, but also for different purposes.

Initially, in a fairly stable domestic market (before 1990), the focus was to arrive at log grades for the appropriate equipment of the large sawmills; the smaller sawmillers had to make do with these grades, suitable or not.

Export log grades into Asian markets brought to the scene different requirements: very stringent conditions on length proportions, a more limited selection of lengths per grade and priority on average diameter. Less emphasis was placed on quality. The latter could be for a number of reasons:

- Long logs are generally of better quality
- Logs can be segregated economically at the port of entry in large volume batches
- The traditionally low value end use in the overseas markets does not require a specific quality product.

In the last two years diameter ranges have been narrowed down to get more uniform shipments and quality seems to have become more of an issue.

Additionally, a number of oversize grades have been introduced, often containing a large portion of high value wood as well as the first end-user specific grade for the production of Japanese flitch.

In the last three years, purchaser and end-user have greater participation in the designing of log grades, generally leading to an increase in minimum small end diameter, a tightening of the sweep specifications, and price differentiations between long and short (mill length) sawlogs. Market changes, both domestically and internationally, have in the last eighteen months highlighted the need for much more end-user focussed log grades. One domestic example is the customer resistance to dead knots in particular framing products; another for export is the design of shop grade specifications for US market, in mainly one length and with an emphasis on long clear lengths between the branches.

**The Situation Today**

A typical log grade specification today can feature some or all of the following parameters:

Dimension Standards - namely:

- a minimum small end diameter (SED), a maximum diameter within a log, average SED
- set length proportions in nominal lengths, a maximum proportion of logs under 4.9m long, length cutting accuracy clauses, the ratio of mill length and double length logs desired

Quality Standards - namely:

- maximum branch size and frequency
- sweep and wobble restrictions
- limited or prohibited natural defects such as decay, stain, insect damage
- limited or prohibited manufacturing blemishes like splits, draw wood, shatter
- limitations on the log form (ovality, fluting, nodal swelling)

Despatch standards - namely:

- strict presentation rules on trimming and end cutting
- specific loading instructions
- clear identification standards (crew number, felling date, log grade)

The expansion into additional markets has led to a much larger number of log grades. It is not unusual that a forestry company produces in excess of thirty sawlog grades at any one time. This must be a logistical nightmare, or to put it in TQM terms "*an enormous opportunity*".
With continuous changes in log grade combinations on any one skid it cannot be excluded that the integrity and uniformity of individual grades could be jeopardised.

The development of company specific in-house grades have resulted in confusing variations of these parameters, even in log grades of the same name. A number of forestry companies guard their log grades very closely, particularly for export. Due to these latter developments a comparison of individual log grades is not an easy task, whilst a national comparison is just about impossible.

Nevertheless, the Industry has come a long way. The 1983 Rotorua Conservancy Rules stipulated: *"logs must be graded as they lie on the skids on the basis of visible defects"* and ...*"ugliness is not a defect: fluting, ovality, nodal swellings are not factors for downgrading"*. Ten years further on the focus is much more on the customer, thanks to the efforts of dedicated people mainly from the forestry side. The change of the resource from the stable "Old Crop" to the more variable "Young Crop" has also greatly influenced the development of more specific grades.

## DOES THE CUSTOMER GET WHAT HE WANTS ???

**Not quite !!!**

With log grades specified in much more detail than the FRI rules, it could be assumed that all problems have been resolved. This is not true. A large number of facts cause logs of the same grade to vary greatly, for example:

*stand age and stocking,*
*tending regime and site index,*
*logging crew performance,*
*geographical location,*
*location of log within tree.*

D Cown stated at last years' FIEA conference that "*average properties play down the variation of the resource an awful lot*". I tend to agree. It is these variations which can make a sawmillers life quite difficult.

**Examples of the "Log Grade Variability"**

Log resource control has given me a number of insights over the years. The examples quoted here highlight some variations observed. While many a lesson was learnt it is fair to say that many questions arose at the same time. Does the purchaser know what he wants? Does he define it accurately and appropriately?. Do the parties work together? Are forest owners and logging contractors flexible enough to accommodate requests for changes?

Graph 1 shows an example where the supplier and purchaser agreed at a *"run-of-bush"* specification from a large forest. During a number of months, conversion to sawn timber dropped constantly without apparent change in cut pattern or mill performance. An analysis of log data from continuous sampling indicated that log volumes delivered from two distinct regions in the forest had changed during that time. Connected with the regional shift was a drop in average log volume by over 30%, a deterioration in log form and an increase in the number of substandard logs. This sufficiently explained the observed drop in sawn conversion.

The "*run-of-bush*" grade can still be a feasible option as it offers a good mix of size and quality. But the purchaser has to ensure where the supply comes from, what silvicultural treatment has taken place and how old it is. In short, he must have a good appreciation of its variability.

**Graph 1**

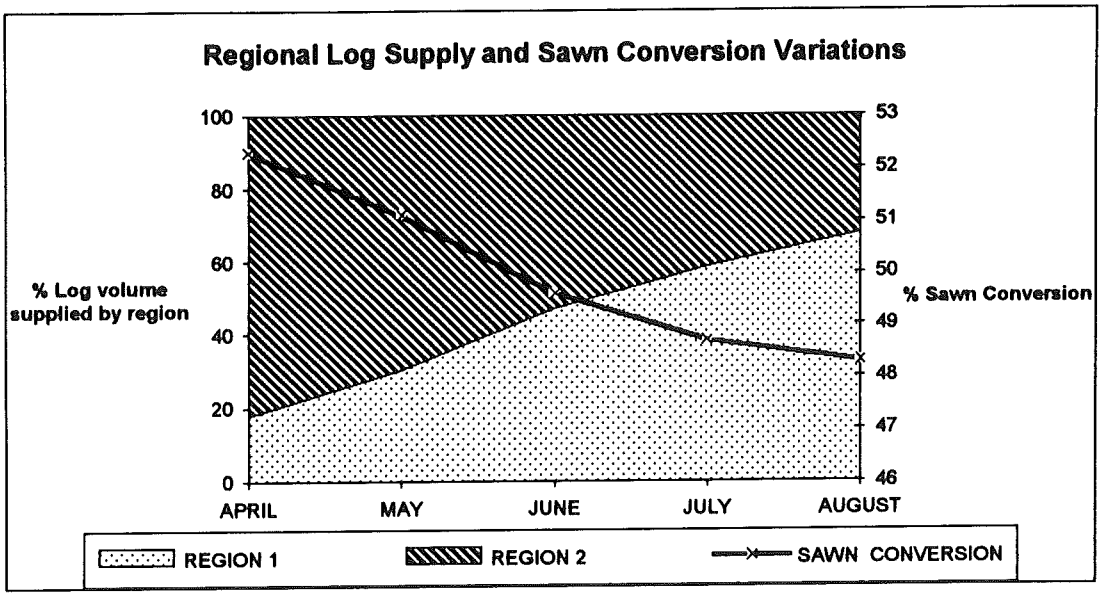



Table 2 shows results from a log study (unpruned stand) looking at log characteristics usually not covered by grades. Some variations observed were quite unexpected. The results suggest that logs within one and the same log grade can vary considerably in quality. All these factors have an impact on sawn conversion, grade recovery, or both.

How can this affect a particular log purchaser? For instance, where export and local grades are initially being produced from a stand followed by a period with an entirely domestic cut in the same location, the quality of the logs and mill recoveries in the sawmill can vary a lot. Perhaps the results shown in Table 2 are also an explanation of why export customers prefer long logs, typically cut from the lower part of a tree.

The findings further put a question mark on the selection of appropriate characteristics to define log grades.

**Table 2**

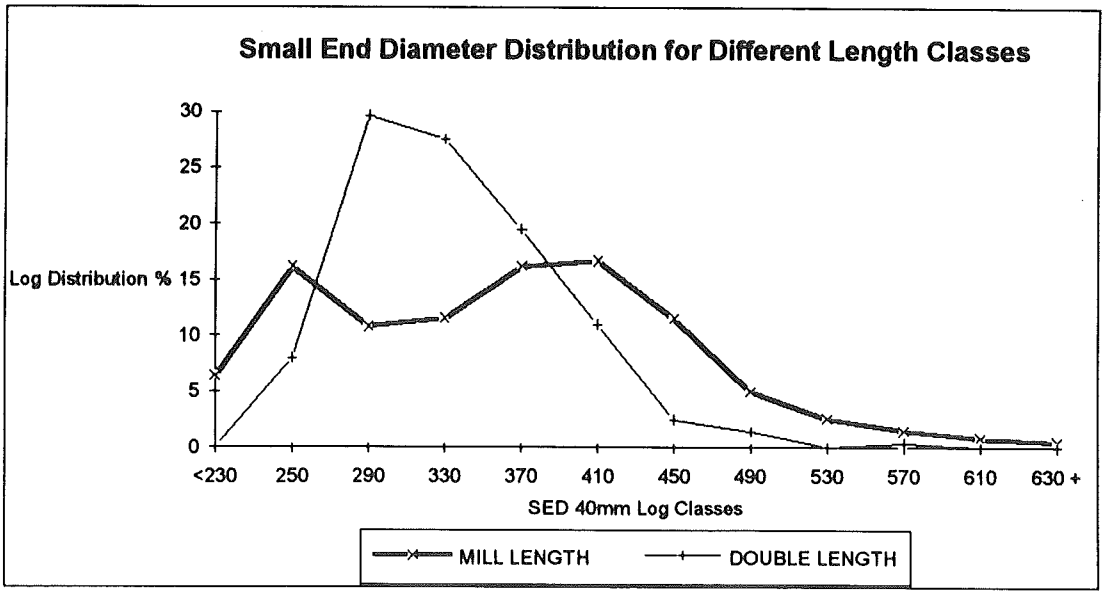
**Changing Log Characteristics Within a Tree**

| AVERAGE VALUES | BUTT | LOG 2 | LOG 3 | LOG 4 | LOG 5 | DIMENSION |
|---|---|---|---|---|---|---|
| TAPER | 9.8 | 6.7 | 7.6 | 8.6 | 9.9 | mm/m |
| SWEEP | 5.1 | 3.8 | 3.9 | 2.4 | 2.7 | mm/m |
| BRANCH INDEX | 3.0 | 3.9 | 4.8 | 5.6 | 5.5 | cm |
| INTERNODAL INDEX | 3.4 | 2.2 | 2 | 1.3 | 1.6 | m |
| NO OF WHORLS | 6.2 | 7.5 | 8.2 | 9.7 | 10.3 | n |
| BRANCHES PER WHORL | 4.5 | 4.1 | 4.1 | 4.3 | 4.7 | n |
| WOOD DENSITY | 428 | 421 | 418 | 412 | 410 | kg/m3 OD |

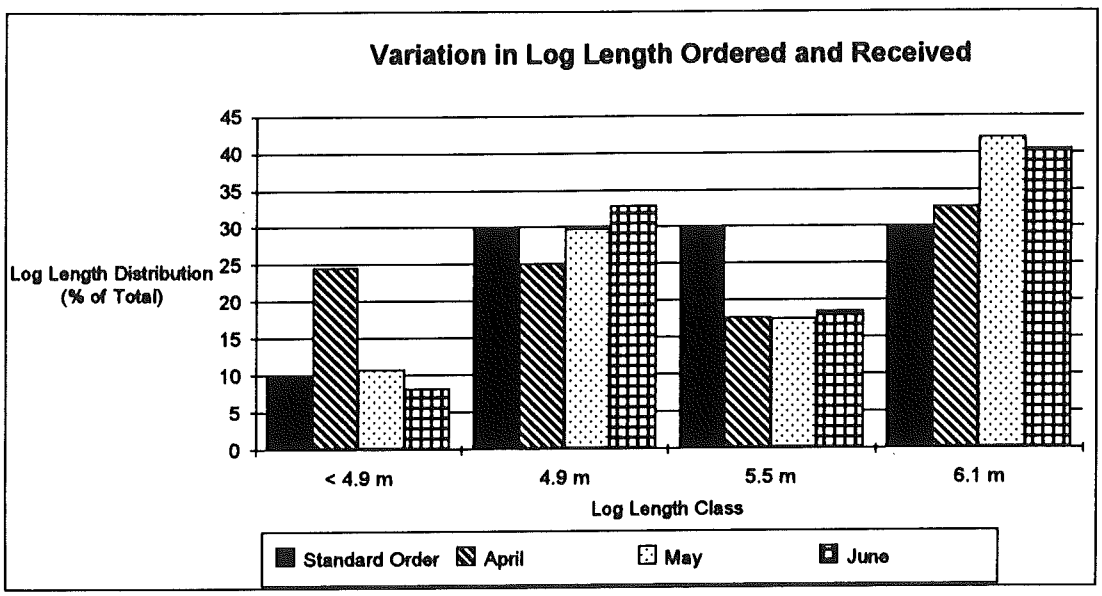
ALL LOGS 5.5 M STANDARD LENGTH

Graphs 2 and 3 show how much diameter and length distributions can vary even within a tightly specified grade.

**Graph 2**



**Graph 3**



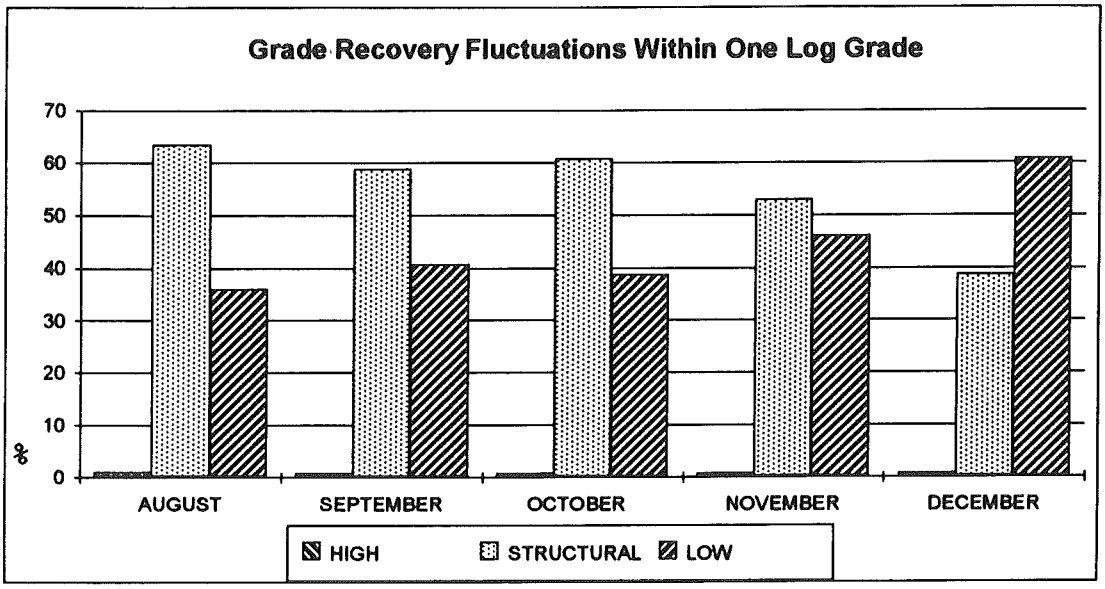

In connection with export parity pricing, supplier and purchaser agreed to include an average SED and defined length proportions (e.g. 30% 6 m, 30 % 5.5 m etc.) into the log grade. The purchaser assumed this would resolve past problems with changes in log size. Scanner measurements and manual random sampling over several months suggested a different story:

- totally different diameter distributions between mill length and double length logs
- unexpected variability in log lengths received, in terms of monthly deliveries as well as in terms of the ordered proportions.

Similar variations have been observed from day to day. My suggestion is that this variability, or the lack of warning in advance of such changes, seriously affect the profit potential of local sawmills (increased stocks, delayed orders, cut pattern changes etc.). A narrower diameter range per log grade will cut down considerably on size variation. Restriction of log lengths per grade or delivery of logs in one length (as for export) could both help to control the length problem.

Graph 4 shows grade recovery fluctuations from a mill purchasing its entire supply in one "specific" log grade from a single supplier. In the first three months, grade recoveries were fairly balanced but deteriorated badly in the subsequent two periods, with a sharp increase in low grade material. The consequences for the mills profit are quite obvious. Saw patterns and processing patterns did not change markedly in that period. An analysis of the resource brought no quick answers. The only change observed was a decrease in average diameter by around 10 mm, not considered a significant factor. Other possible variables (changed stand age, tending regimes) have in the past not been regarded as important enough to monitor. This experience suggests specifications need to be reviewed to give more specific answers.

**Graph 4**




**The Need to Check the Supply**

There is much more variation within the resource than meets the eye. Log grading has taken some variation out but new problems keep appearing. With the recent increase of log prices consistency and suitability of the raw material has become an even more pressing issue. The increased share of the resource as a percentage of total processing cost, from 50% to around 70% in the past two years, leaves little room to absorb resource variations.

Unless a buyer checks the logs he never will know if he gets what he wants. The first step to improvement is therefore to assess the situation (TQM problem solving steps). ISO 9000 certification further emphasises the need to control the raw material.

Unless four important steps are followed in the procurement of raw material I doubt that any customer is able to know that he gets the most suitable logs for his equipment and product range. These steps are:

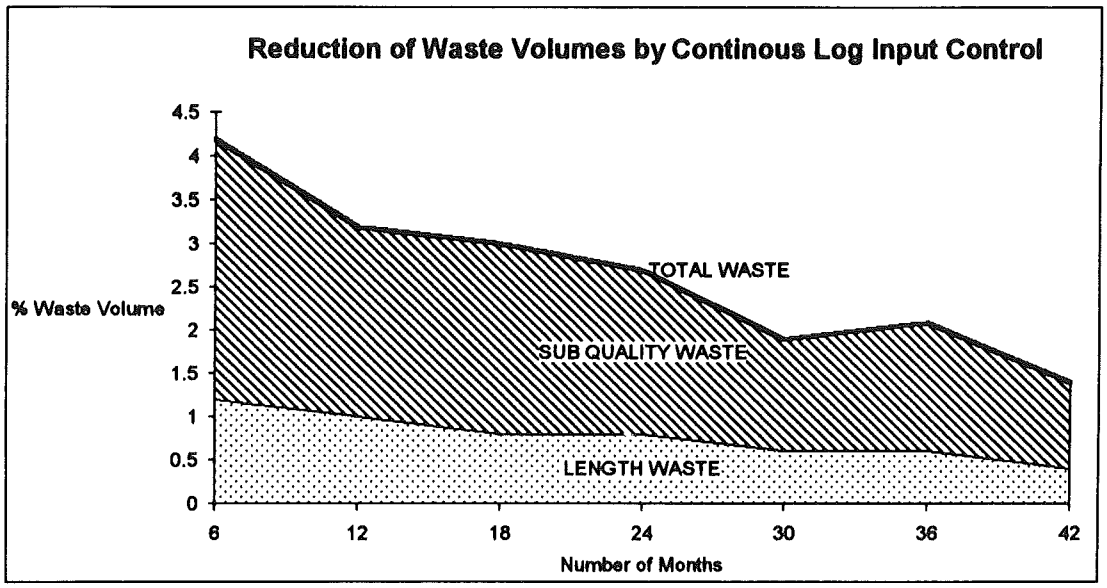
1. Agree to and write down log grade specs.
2. Regularly check logs for compliance to specs.
3. Review suitability of specs for mill performance and product suitability.
4. Communicate all results to supplier and contractors.

Graph 5 shows that checking the resource can be rewarding if done on an ongoing basis. The emphasis, in this instance, was on reducing the frequency of substandard logs in co-operation with the log supplier. Over a four year period the quality and length accuracy of logs improved considerably. Using today's prices this resulted in savings of over $\$1/m^3$ for every log processed by converting the resource into high value sawn timber instead of chips. The savings do not take into account gains made by reducing downtime and equipment damage, often caused in a mill by processing crooked or damaged logs, nor any spin-offs in gaining a better knowledge of the resource.

A fair amount of variation between different logging crews was observed. The lowest performers had typically 2-3 times more logs

rejected and delivered up to 50% more logs outside the agreed length limits compared with top performers. I always found it intriguing that a large number of sub-standard logs were not identified with a gang number.

**Graph 5**




## THE FUTURE OF LOG GRADING

### Log Grading is Here to Stay

A survey, carried out by Briggs in 1992 in Australia, showed that *'Quality Control'* and *'Customer Satisfaction'* always ranked in the top 5 factors (out of 50) important for the future of the logging industry. The emphasis on maximum volume output had been succeeded by the quality and customer focus. A similar development has taken place in the wood processing industry. Many forest industry participants are moving towards certification to international quality standards. Some are further down the track than others.

Log grade developments and log input control achievements over the past ten years suggest industry has made steady progress towards matching the resource more closely to the end-use. Yet a number of observations suggest that the current log grades still leave a lot of room for variability that will affect the processors' performance. Some important quality parameters for specified end-uses are missing, such as knot frequency and distribution, distinction between live and dead knots, wood density, spiral grain (large rings in core), number of whorls, restriction in core wood, minimum tree age.

It is likely that additional forest information needs to be considered such as stand age, log position within a tree and stand history to reduce within-grade variability. Where variability cannot be reduced a better understanding of its extent is required. Such developments are already taking place in the pulp wood sector and I believe the solid wood processing industry needs to go down this road. Consequently, there is a need for ongoing research into the log resource and its effect on the finished product.

**An Integrated Approach**

The current environment is supportive of co-operation and co-ordination. Due to the guarded business interests of individual companies, a joint log grade development is less likely to take place on a national basis but more so by way of individual partnerships between end-user, processor and forest owner. Such an approach is described by Luhr (Ref 4) for the Swedish industry. It requires a joint long term commitment by all parties for it to work. Similar efforts are known to be under way in some corporate companies here in NZ.

An integrated approach is, in my view, paramount on two fronts:

- identification of suitable log grades by end-use in the existing forests
- growing of a desirable future resource

**End-user Specific Log Grades from Existing Forests**

The following outline of project steps is suggested:

1. Processor and forest owner jointly decide on a market segment that is sustainable from both the current resource capabilities and processing capacities point of view (volume, quality price, cost considerations).
2. Processor targets specific end-users in the selected market segment and, with end-users, jointly define product and processing requirements. There is a strong plea for a limited number of products to succeed with such an approach.
3. Forest owner, end-user and processor define jointly the characteristics that are required to match, optimally, the raw material and end product.
4. All parties, including logging contractors, design and test realistic and product specific log grades.
5. Forest owners commit to and confirm consistent availability of raw material in terms of volume and quality of agreed grades.
6. Once production has started, all parties communicate regularly on performance within their area of responsibility and work together to solve problems in a co-operative team approach.

The two major challenges to achieve success are:

- Wood processors need to spend far more time to getting to know their major cost item, instead of putting the onus on the supplier and they need to involve the end-user.
- Forest owners have to improve their effort to treat the processing industry as equal partners in the business by meeting to discuss market strategies and co-operation, rather than to simply command export prices .

  It is likely that such a system is more successful in a corporate environment where big volumes are involved. Smaller players in the industry will need to pull together to gain enough '*critical mass*' to negotiate, or alternatively associate themselves with the larger mills, e.g. by way of toll cutting etc.

**Growing of the Future Resource**

The entire forestry sector, from the grower through to the marketer and including all processing options, needs to participate jointly to determine what trees are to be grown in future plantations. The vast improvements in tree genetics over the past few years have

opened up the options immensely to either breed trees or to tend stands for specific end uses.

A list of opportunities assisting the solid wood sector would be:

**Uniformity**:

Striving for uniform distribution of density across the radius, especially for structural products.

Ring width uniformity from the inner to the outer part of the radius. Wide rings are more useful for clears and cutstock, smaller rings for structural end use.

**Specialisation**:

Breeds with long internodal lengths.

Strains with mainly naturally durable heartwood at an early age.

Small knotted trees of high density for structural use.

Types with permeable juvenile wood (easy to treat) independent of age.

**Improvements**:

Minimising the occurrence of spiral grain and core wood.

Maximising sapwood within a tree to achieve drying uniformity.

## SUMMARY

Log grades have largely been accepted by the industry as a suitable way to segregate the available resource into more specific log products.

Due to the development of in-house grades and the expansion into different markets, the number and variability of log grades has grown to the extent that comparability is quite impossible.

Despite these log grade developments many customers are disappointed and confused with the daily variability of the resource. Regular checking is imperative to get a better understanding.

Cooperation and coordination between end-user, processor, log maker and forest owner are crucial to solve some of the problems highlighted. Jointly designed log grades will assist substantially to enable the processing industry to stay profitable while paying market competitive prices.

All processing options should pull together to plan desirable characteristics for the future resource.

Obviously, a joint approach to resource optimisation is only one of the building stones to success. Others, of equal importance are good planning and quality systems, good marketing and logistic skills, as well as efficient and economic distribution.

Let us take up the challenge together to give the entire NZ Forestry Industry an even brighter future up to the year 2000 and beyond!

## ACKNOWLEDGMENT

I would not have been able to write this paper without the ongoing support and assistance of some people very committed to the Forest Industry Sector. In particular I would like to thank Allen Mayo for giving me the opportunity to research the log supply in detail over a number of years. I am very grateful for the co-operation and feedback received from Tasman Forestry and from Forest Products Kinleith region over the years. The team at the Ministry of Forestry has done a tremendous job editing the paper and producing the graphs. But more than anything else I must be thankful

to the one and only great Creator who has led me ably at times when I couldn't see the wood for the trees.

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## List of Graphs and Tables