

Profitable wood processing - what does it require? Good wood!

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Summary

The international forest products industry has traditionally used material selected specifically for particular end uses - the most obvious example being the distinction between hardwoods and softwoods. New Zealand has been blessed with an environment ideally suited to tree growth, and forest managers over time have done an excellent job of refining practices for the efficient production of healthy crops, developing systems to yield high volumes of wood from a relatively small land base. Unfortunately markets do not buy trees, and much less attention has been paid to the features which ultimately create market demand - wood product uniformity and performance. Any given stem of radiata pine contains a variety of "qualities" - some predictable and some unpredictable.

The challenge now for the industry as a whole is to overcome the apparent short-term focus on cash profit which has led to issues such as falling confidence in forestry, poor image for wood, and forest sales (largely to overseas conglomerates). It is time to apply the knowledge gained from years of research into the inherent qualities and breeding of radiata pine and channel effort into improving the wood quality delivered to log purchasers and end users. The highest priority should be given to:

- R&D to develop better segregation tools.
- Generic and company-specific market development to enhance the image of NZ forestry at home and abroad.
- Long-term breeding strategies to increase market acceptance and reduce variability.

Introduction

The forestry and wood products scene in New Zealand has changed dramatically over recent decades, from an atmosphere of optimism over the rapidly expanding plantation estate (1970s - 2000) and forestry dominance of the share market. Planning conferences were upbeat about the potential employment opportunities and processing expansion about to occur. Some companies even bought forests overseas to extend their resources. Now there is an aura of despondency within the industry about:

- the lowest rate of new planting for 15 years;
- falling export prices across the board;
- harvest reductions;
- receiverships;

- rural unemployment;
- conversion of forests to farms;
- failure to really develop offshore markets against competition from others;
- forestry returns at a historic low ("Green Death").

At the same time, the public perception is of an industry in disarray over issues such as "Leaky Homes" and lack of preservative treatment. A dramatic turnaround? Irrespective of the debate over poor company leadership (Gaynor¹) and "boom" or "bust" scenarios (Manley 2003), there are some fundamental wood quality issues which can, and should, be addressed to help turn the industry around.

There is no doubt that in international terms, the growth rates of our major species, radiata pine, are outstanding. This has been capitalised on in terms of the development of specialised management regimes, most of which concentrate growth on the pruned butt log. In theory this part of the tree yields 24% of the volume and 60% of the value (NZFOA 2003). The reality can be very different, depending on a multitude of factors, but the most consistent influence is variability of the wood quality itself. This is the dimension that has received too little attention in strategic planning.

Does the recent trend to overseas ownership of forests reflect a lack of local investment funds, poor stamina in the competitive environment of overseas marketing, or an inability to optimise integrated processes? As the larger corporates proceed to divest their forests in order to concentrate on wood processing, so do some of the smaller organisations also plan to enter into wood processing. The current trend is for fragmentation - presumably to "focus on getting it right". This may seem like good management logic, depending on what "it" is. If we are to nationally realise the benefits from forestry "it" has to be sector profitability.

Much of the existing forest is grown under a clearwood philosophy. This is arguably also a juvenile wood philosophy. In international markets the large size of the New Zealand radiata pine logs, and the low heartwood content, means overseas small log sawing technologies can often

¹ *Leadership in forestry doesn't cut it. New Zealand Herald, February 7, 2004.*

not be effectively used. Even if the logs can be diameter-sorted the logs are often too heavy for the high-speed machinery. The high sapwood and juvenile wood content also increase drying costs and lower recoveries. This means that radiata pine logs can be less economic to process than many other softwood species.

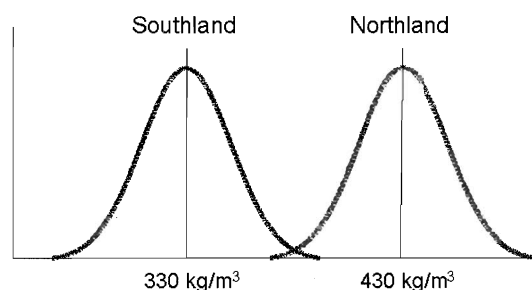
Continued investment in forestry and wood processing requires a good case that will only come from a long term outlook and commitment to improve the quality of the wood. There is no doubt that it can be best achieved by application of the knowledge of environmental and genetic influences on wood formation. Quality begins in the forest.

Variation in Wood Quality

Trees are individuals like people, and show similar types of variation - national, regional and individual. It is true that selected radiata pine can deliver excellent material for the gamut of major end uses, but the reality is that the final customers generally require a limited range of raw material characteristics, that may involve only a fraction of a single log, let alone a whole stem. The most obvious categories of pulplogs, sawlogs and pruned logs camouflage the fact that the actual end users require wood to meet performance criteria which are often not specified in the log descriptions. While the obvious things like stem form and branching are now well catered for, intrinsic wood quality remains a real issue.

Wood, as a biological material, responds to the environment in the way it grows. Surveys of wood properties have consistently shown that average wood characteristics vary under the influence of climate, silviculture and genotype (Cown 1999). Using the most extensively researched property (wood density) as an example, it has been shown that for trees of the same age the average density of stems from northern forests is about 25% greater than that from Southland (Fig. 1). While radiata pine is described as a medium-density softwood, logs in

Fig. 1: Average stem wood density at contrasting sites



fact can have density characteristics ranging from those of western red cedar to the southern pines.

Wood density is a property most people are now aware of since it is closely related to several important performance criteria: lumber stiffness, wood hardness and pulp yield. Fig. 1 indicates tree means, but these give no indication of the variability between trees or within logs and lumber, which adds further dimensions. Not only does wood density vary significantly, so do a number of other wood properties that impact end uses, and which vary independently from wood density. The average within-tree patterns for some of these are illustrated in Fig. 2, where the age-related biological patterns are apparent. Basically, all solid wood properties "improve" with crop age.

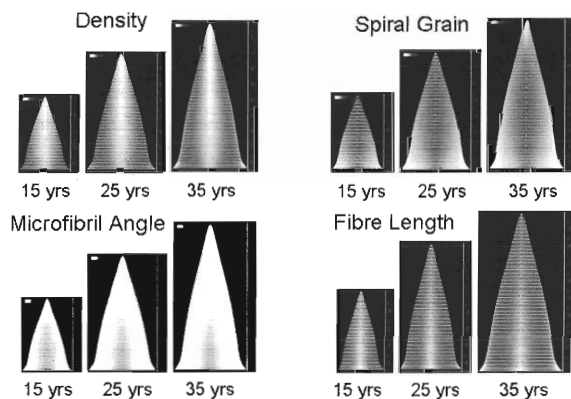
The above properties are given only as examples of properties which foresters are becoming more comfortable with as their understanding of juvenile wood increases. However, there are several others which are much less well understood. Good examples of characteristics now considered important are within-ring internal checking, compression wood and resin blemishes. All contribute significantly to losses in product recovery and in-service performance but have not been intensively investigated. We still do not know why and where they will occur.

The real issue with wood quality is that it is largely unseen by the grower. Apart from stem form and branching, wood quality only starts to become apparent during processing when the sawmiller starts rejecting material due to defects such as compression wood, resin blemishes and internal checks. Some wood quality problems only become apparent during the final finishing stages, or worse, in service (e.g. joinery) when a single performance claim can wipe out the profit from 100 or even 1,000 products. A recent visit by a Japanese plywood manufacturer confirmed that in his mill the recovery and performance of radiata pine was significantly poorer than Russian larch. While they wanted to use more radiata pine, they peeled to an 80 mm core and juvenile radiata pine was unacceptable even for central ply material. This has been an issue for about 30 years (at least one rotation) but we are no closer to alleviating the problem for a high value market.

Sawmills (closer to the market) have been grading lumber for decades but the importance of wood quality is really only now starting to be widely recognised in the forest. In recent years, tools have been introduced for log sorting using acoustics and some mills now have the capability to segregate material immediately following green processing, to improve drying. Companies

within the Wood Quality Initiative are putting a major effort into the development of field tools for identifying characteristics such as log stiffness. The processing end is well ahead of growers in implementing wood quality segregation.

Fig. 2: Variation in some important wood properties



Management of Wood Quality

Short term

For the next 25 years the trees to be harvested are already in the ground, and unless we do more to segregate on a quality basis, we are doomed to supply material only partly suitable for the intended process or product. Not all stems have characteristics ideal for a particular use, but the good news is that all forests can produce a proportion of good logs and tools are becoming available which allow better identification of wood quality earlier in the process cycle. Instead of relying entirely on the grading of lumber, the use of portable sonic tools such as Director HM200² (previously known as Hitman) and Surveyor IMC400³ are now becoming standard in some parts of the business for structural logs, and will soon be applied to standing trees. Research is continuing on better methods to identify internal defects such as knots, resin and internal checks, and the use of scanning systems will be common within 10 years in larger operations worldwide. The disposal of less desirable material will then become an issue that can be dealt with by cooperation between companies with different markets.

² An acoustic system for log segregation. The Director HM200 measures the acoustic speed in logs and stems to assess wood stiffness and enhance product grade recoveries. <http://www.fibre-gen.com/WSMApage/0,11867,14703-0,00.html>

³ A system utilising acoustic and microwave technology to predict stiffness profiles from pith to bark. <http://www.fibre-gen.com/WSMApage/0,11867,14703-0,00.html>

Long term

Radiata pine is known as a pliable species, which can adapt to a range of growing environments and management regimes. However, the biggest single issue in utilisation is juvenile wood. It can be controlled to a limited extent through manipulation of stocking, but research has shown that many internal properties are heritable to a greater or lesser degree. This offers tremendous opportunities for those companies prepared to identify their long term markets and gear their operations to producing the optimum kind of wood. How many companies already think of markets in terms of intrinsic wood quality and the various means of achieving it? Few in my experience. Such planning will become necessary in a competitive environment, if only to reduce variability in log intake and subsequent processing losses.

Specific future markets cannot be assured, but we can be fairly certain that customers will want some generic wood qualities such as stiffness, strength and stability in use. All of these are known to vary significantly with site, silviculture and genetics, but even more importantly to be reasonably heritable. Companies in forestry for the long haul should have strategies to improve both the levels and uniformity of these properties. A single commercial focus on the volume of pruned wood will be to the detriment of these characteristics. Visionary leadership is required to develop robust company strategies that will satisfy both domestic processing and export scenarios. For example, who is putting effort into identifying breeds and management practices that can produce both stable clearwood from pruned butts, and stiff lumber from upper logs?

The structural problems are being addressed by Rubicon, who reported⁴ on a recent trial that "an average tree will start producing stiff wood at age 10; the clone started producing it at age three. Of the 26 boards available from [each of] the two logs, the Trees & Technology log produced 22 of structural grade, the other log only 11. These new technologies are interesting but the logs will not be available to the current generation of sawmillers, and markets have to be found for timber from [current] logs where only 11 out the 26 boards will be of structural quality".

Continued investment in forestry and wood processing requires a good business case, which will only come from a long term outlook and commitment to improve the quality of wood. There is no doubt that it can be achieved by application of the knowledge of environmental and genetic influences on wood formation. Quality begins in the forest.

⁴ The New Zealand Herald, January 27, 2004.

Many of these issues are now being addressed by Wood Quality Initiative Ltd., a new industry-Government Consortium focused on increasing the understanding of wood quality issues and the development of new tools for ensuring better management of quality.

Wood Processing

So how far does the radiata pine advantage get us? Evolving technology for material segregation will identify different grades of logs and lumber for processing, which will make processing more efficient; but who will pick up the tab for the downfall? Will New Zealand wood processors be competitive in future? I don't know. The optimistic early predictions that the world will be queuing at our borders has proven flawed, as we now realise there may not be a real shortage of economically available fibre, at least in the short term. The South Americans are increasingly competitive in world markets, and with pine products. Is New Zealand really a good place to manufacture wood products? Only if we build on our knowledge of wood quality.

From a processing point of view our trees have been planted and tended and their wood quality is fixed. Stem grading, crosscutting and log allocation are crucial in making sure that processors can extract the maximum value from each log. Only a few processors, such as sawmills and veneer mills, can currently afford to pay log prices that provide a reasonable economic return to forest growers. Others such as particle board and pulp mills rely on these higher paying customers to meet the owners' growing costs, and pay a price that barely covers harvesting and transport. Growers have a financial interest in ensuring that the needs of sawmillers are met and that good logs are not contaminated with bad ones. A small amount of unstable lumber or lumber with excessive defects can contaminate complete production batches or shipments.

Getting an economic return from the available log supply is a challenge facing growers and sawmillers, as they have to match the market demand in terms of grade and size with the quality zones in the logs. Grade recovery is crucial to the profitability of sawmills. If the logs are not capable of yielding the required grades, or if log quality is too variable, the processors cannot make quality lumber products. For example, variability in the defect core diameter and other problems such as resin pockets, resin streaks, compression wood and internal checking can mean that a sawmill will recover only a portion of the potential clearwood from the pruned zone of a log. The mills that are successfully processing pruned logs are very discerning about where they

source their logs, and they continuously monitor the grade recoveries from different log sources.

The recovery of structural lumber grades is also an issue, as based on recent industry data, only about 10% of the New Zealand harvest will produce good structural logs⁵. The result is a shortage of sawn lumber meeting international structural strength and stiffness requirements. The problem has been hidden for many years, with some producers claiming engineering properties that could not actually be met using the available resource. This misinformation combined with the "leaky homes" syndrome has lead to a serious lack of confidence in wood. For example, truss and frame manufacturing plants are now being set up nationwide using galvanised steel in place of standard lumber. It is interesting to note that foresters tend to view steel framing as their main threat, while the statistics show that timber framing is actually losing market share to concrete. Overseas, the situation is similar in that building industries are turning to substitutes in many areas. Recent examples are the use of wood-plastic composites for roofing, decking and window joinery (see later).

The classic solution to variable wood quality has been the development of sophisticated engineered wood products, and this is one of the few areas in which processors have recently invested in New Zealand. Two LVL plants have been built, one in Whangarei⁶ and one in Nelson⁷. The Nelson LVL plant can process 200,000 cubic metres of logs per year and cost \$80 million. Because it randomises wood defects LVL can tolerate large knots but stiffness is still an important property. Both plants have been located in areas of relatively high wood density.

Marketing

All markets, by their nature, vary in profitability when subject to short-term fluctuations in demand, exchange rates, transport costs, etc. The one thing that is certain is that customers will continue to require uniform wood with a specified range of quality. Most international buyers have their benchmark species and offers from radiata pine suppliers are compared against those benchmarks. For

⁵ Information about structural logs is not generally available but Fletcher Challenge Forests reported in 2001 that 9% of their harvest volume will be structural logs. Fletcher Challenge Forests, *Annual Review 2001*. Supplementary Forest Information, p.16.

⁶ Carter Holt Harvey Futurebuild LVL, Marsden Point. Part of International Paper, USA.

⁷ Nelson Pine Industries, part of the Sumitomo Forestry Company, Tokyo, Japan.

mouldings in the USA the benchmark is Ponderosa pine, for framing the benchmark is Oregon (Douglas fir) and for joinery Scandinavian spruce is often used as a standard. The grade of radiata pine offered must perform as an acceptable substitute in terms of appearance, stability, strength, stiffness, machinability and durability. Radiata pine has been rated the best machining species in tests, but fabricators are often reluctant to use radiata pine because of stability problems caused by a few rogue pieces. Trying to sell radiata pine as a structural lumber, when its engineering properties are well below the market benchmark or highly variable, is a recipe for discounting. Marketing lumber is an expensive business, as we have seen with Fletcher Challenge Forests having to buy into distributors such as American Wood Mouldings and The Empire Company in order to get access to home improvement chains in the USA.

In a rapidly growing market such as the USA where the consumption of mouldings and millwork has more than doubled over the last decade it is easy to forget about substitutes. The big picture is that wood is constantly losing market share to substitute products. For instance, in recent years we have seen the market share of lumber eroded in the USA by such products as:

- Plastic mouldings. A number of companies such as ABTCO⁸ (Louisiana Pacific) are producing high quality mouldings such as ULTRA™, Affinity®, Cameo™, OakTrim and PinePlus™ Mouldings. *"LP's prefinished woodgrain mouldings offer a variety of styles, colors and grain patterns for you to choose from. All styles feature the beautiful, natural appearance of hand-finished wood at a fraction of the cost, and with a fraction of the work"*. Other companies such as Marley also now produce realistic looking plastic mouldings.
- Composite decking⁹: Produced by a number of companies, including ABTCO. Often recycled plastics are used in the manufacturing process, which means the processor is paid to take the raw material. These products are described as:
 - o Having the rich look of weathered wood with true low maintenance.
 - o Strong and durable. Composite Decking makes splitting, splintering, warping and cupping a thing of the past.
 - o Environmentally friendly. Made with recycled wood and polymers. Does not contain CCA.
 - o Easy installation. Cuts, drill and fastens

similar to wood, using conventional tools.

- o Will not warp, splinter, blister or peel.
- o Will not check, rot or decay.
- o Resistant to termites and other wood boring insects.
- o Excellent traction - wet or dry.
- o Will never have to paint, stain or seal.
- o Can cost less than wood over time.
- o Wood like finish that will last year after year.

In summary we have many producers looking to export, a raw material that is highly variable in quality, markets that are geographically and culturally diverse, and wood substitutes that are biting at our heels. It would seem logical for us to consider a collaborative marketing approach, to focus our efforts and gain strength. However, our experience of co-operative marketing in New Zealand has been patchy.

The tourism and dairy industries have some parallels to forestry in that there are a few large players and many small ones, and the Government has maintained a high profile in supporting these sectors. There have been several attempts to initiate a collective approach to market development in forest products, but these initiatives seem to lack sufficient long term support from the industry, and consequently from the Government. Who remembers "Flying in Formation" in the 1990s, and Wood New Zealand? While other major forest growing countries like Canada and Scandinavia can manage collective marketing, we appear to have a stubborn independent streak that prevents us from admitting that we can be more successful working together. Is it seen as a sign of weakness? The reality is that we MUST export, and the only sensible way to do it in a highly competitive environment is to take advantage of any Government support while it is offered and do it as an industry.

Hobby horse - Research & Development

New Zealand has benefited from a long history of Government-sponsored forest and wood products research: FRI was once regarded as a world leader in integrated forest management research. That work laid the foundation for the knowledge that real improvements can be made through siting, silviculture and tree breeding to target specific wood properties and reduce the "normal" variability of radiata.

The signal has been now been given by Government that future support for applied research will be dependent on transparent industry support. Since tree manipulation (particularly wood quality) is a very costly and

⁸ www.lpcorp.com/prod/moulding/products/interior.asp

⁹ www.abtcodecking.com/products.htm

time-consuming activity, this means that companies dedicated to improving wood quality should either be seen to be doing it themselves or become members of consortia such as the Radiata Pine Breeding Company and the Wood Quality Initiative. The Government will only support research that the industry is prepared to spend its own money on.

Conclusions

In recent years, the science of forest management has been superseded by a focus on asset management. While it is necessary for individual companies to earn a return on investment, we seem to have collectively lost confidence in the long-term management of a very significant natural resource for future national benefits. Foresters have taken advantage of the rapid growth of radiata without being encouraged to make the adjustments required to improve, or even maintain the intrinsic wood quality required by end users.

History indicates that, despite the natural advantages of a fast growing, pliable species on relatively short rotations, New Zealand companies (and organisations) are very reluctant to work together to achieve the common goal of prosperity for all. Indeed, some individual companies have taken it on themselves to dismantle what hard-won integration they had, and to compete aggressively with each other in domestic and export manufacturing markets to the extent that customers are increasingly confused about products and performance.

Even with help from the Government, examples of industry cohesion such as Wood New Zealand and the Wood Processing Strategy have been hampered due to poor commercial and public support. The elimination of juvenile wood should be a goal of the whole New Zealand sector, but will require a major collective effort. We all know that some of the relatively new players (e.g. Chile) are capable of achieving major advances in forest management, and it would be disappointing if this were to be done by piggy-backing on our expertise.

There are some bright spots on the horizon, such as the Forest Industries Framework Agreement proposal (FIFA) to utilise Kyoto credits to support industry-wide activities (Thorpe 2003). Another is the suggestion of an industry levy on log sales to fund market development and R&D. The Government is still prepared to support collective initiatives but they require commitment from industry players to really succeed. Interestingly, the Wood Quality Initiative is an early example of a "consortium" that has attracted wide industry support.

On the face of it, the New Zealand forestry sector has "dropped the ball" after a very promising start. The challenge of processing and marketing the large resource has proven to be beyond the ability of local companies. If the industry does not get its act together and start to produce quality products consistently, wood might find itself where wool was in the 1950's and experience constant market and price erosion. A collective effort is now required to address the fundamental issue of dealing with variable wood quality.

High on the priority list for such joint initiatives should be:

- "Fly in Formation" again - promotion of NZ forestry and forest products domestically and internationally.
- Development of tools for tree, log and lumber segregation.
- Support for research consortia - for example, a Wood Processing Initiative to capitalise on the new knowledge gained from the Wood Quality Initiative.

What better use for the Commodity Levy now under discussion?

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