J. W. Gottstein Memorial Trust Fund

The National Educational Trust of the Australian Forest Products Industries

GOTTSTEIN
TRUST

THE GROWTH AND UTILISATION OF PLANTATION EUCALYPTS WITHIN EASTERN SOUTH AMERICA

CHALLENGES AND OPPORTUNITIES FOR THE AUSTRALIAN HARDWOOD FOREST INDUSTRY

STUART H. AUSTIN

2000 GOTTSTEIN FELLOWSHIP REPORT

JOSEPH WILLIAM GOTTSTEIN MEMORIAL TRUST FUND

The Joseph William Gottstein Memorial Trust Fund was established in 1971 as a national educational Trust for the benefit of Australia's forest products industries. The purpose of the fund is *"to create opportunities for selected persons to acquire knowledge which will promote the interests of Australian industries which use forest products for the production of sawn timber, plywood, composite wood, pulp and paper and similar derived products."*

Bill Gottstein was an outstanding forest products research scientist working with the Division of Forest Products of the Commonwealth Scientific Industrial Research Organization (CSIRO) when tragically he was killed in 1971 photographing a tree-felling operation in New Guinea. He was held in such high esteem by the industry that he had assisted for many years that substantial financial support to establish an Educational Trust Fund to perpetuate his name was promptly forthcoming.

The Trust's major forms of activity are,

1. Fellowships and Awards - each year applications are invited from eligible candidates to submit a study programme in an area considered of benefit to the Australian forestry and forest industries. Study tours undertaken by Fellows have usually been to overseas countries but several have been within Australia. Fellows are obliged to submit reports on completion of their programme. These are then distributed to industry if appropriate. Skill Advancement Awards recognise the potential of persons working in the industry to improve their work skills and so advance their career prospects. It takes the form of a monetary grant.

2. Seminars - the information gained by Fellows is often best disseminated by seminars as well as through the written reports.

3. Wood Science Courses - at approximately two yearly intervals the Trust organises a week-long intensive course in wood science for executives and consultants in the Australian forest industries.

4. Study Tours - industry group study tours are arranged periodically and have been well supported.

Further information may be obtained by writing to,

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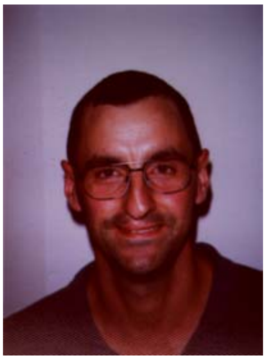

Stuart Austin is an Operational Manager with Big River Timbers Pty Ltd, of Grafton, New South Wales. He has a Bachelor of Applied Science from Southern Cross University, majoring in Coastal Lands Management.

He began his career as a Project Officer with Big River Timbers in 1994. Initially he was responsible for conducting in-house research and development and expanding the existing quality assurance program. Three years later he was appointed as the coordinator of the management operating system, responsible for staff development, production analysis and raw material stock management. Now as the Operations Manager he is responsible for establishing production schedules and the further refinement of manufacturing efficiencies.

On his Fellowship, Stuart undertook a detailed review of the existing value-added eucalypt plantation industry in Argentina, Brazil, and Uruguay. The definitive outcomes from the report should assist those sectors of the Australian hardwood timber industry confronted with new processing and quality issues directly linked to an ever-changing resource base.

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My Father John and My Fiancée Jodie: For your continued support and constant encouragement over this sometimes trying but memorable period.

I would also like to thank the many people who extended their hospitality and gave their valuable time during the study tour.

The following report has been dedicated to my late Mother who never tired of helping those in need and always encouraged me to strive in pursuit of my dreams.

EXECUTIVE SUMMARY

After enduring a number of resource and competitive challenges over the past 15 years the Australian native forest industry is fast approaching yet another turning point, the transition from a natural resource base to a predominantly plantation-grown resource.

Under the auspices of the Gottstein Fellowship, the author was able to visit a number of Countries within South America and examine a range of viable manufacturing facilities producing both value-added and structural grade products from plantation-grown eucalypts.

By careful examination of the methods and processes developed and implemented by the South Americans, Australia's timber industry can utilise its inherent advantages of technology, political stability, and land mass, to pursue the effective growing, processing, marketing and distribution of this resource.

It is hoped that the findings and recommendations within this report will assist industry in taking this progressive step and facilitate a smoother transition.

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1.1 Australia's Changing Eucalypt Forests

The forests and woodlands, which exist throughout the dry and remote island continent of Australia, have been steadily evolving over the past 60 million years.

The beginning of this evolution was defined by the separation of the Australian continental plate, which included Tasmania and the southern portion of New Guinea, from Gondwana some 60 million years ago (Florence, 1995). When the continent began its slow drift northward it was radically different from today's landscape. The climatic conditions at that time were humid and cool whilst the vegetation, which spread across the entire continent, was largely temperate rainforest dominated by gymnosperms, notably the conifers *Podocarpus*, *Dacrydium*, and *Araucaria* (Florence, 1995).

A 45 million-year journey north resulted in a change from a verdant continent to a largely harsh and arid land, frequented by drought and fire (Smith, 1999). While many of the plant species became extinct during this period, others proliferated, as closed forests were replaced with woodlands, grasslands and desert. These conditions ideally suited the expansion of the eucalypts and acacias, which went on to dominate the Australian landscape.

The evolution of Australia's highly endemic vegetation continued with the onset of even drier conditions and the increased incidence and spread of fire with the arrival of Aboriginal people 55 – 60 thousand years ago. Aboriginal fires burnt large areas of the landscape on a regular basis; there was no reason to put them out and nothing to stop them proceeding when conditions were suitable. According to Blainey (1975, cited in Gill, Groves, and Noble, 1981, p.471), 'fire was the core of their (Aboriginal) technology though, like the core of our advanced technologies, it was sometimes master as well as servant'. The effects these fires had on the eucalypt forests was far reaching, for it controlled the growth of woody shrubs and saplings which resulted in a wider distribution of open woodlands. Hiatt (1968) claimed that the Aborigines of the west coast of Tasmania extended their narrow coastal habitat by converting rainforest into more food productive sclerophyll forest by regular burning. Fire has subsequently become an integral part of the regeneration of eucalypt forests as it stimulates the opening of seed capsules and prepares a receptive seed bed by clearing undergrowth, improving nutrient availability and increasing light access.

These fire regimes all but ceased in the more productive coastal areas of the continent with the arrival of European settlers some 200 years ago. Following their arrival was an era of land clearing and controlled fires, which were lit to provide protection for new settlements and improve access to grazing land. The net effect of these actions and the changed burning patterns allowed the growth of thick forests of young trees together with an increasing shrub understory (National Association of Forest Industries (NAFI), 1999 [1]).

To date, some 500-600 species of eucalypts have been recognised (Florence, 1995) and they dominate the 156 million hectares of Australia's forests and woodlands (Resources Assesment Commission, 1992). According to Specht et al (1995), eucalypts are the most dominant species in 270 forest communities and occur as co-dominants in a further 15 forest communities. Currently, Australia has 43.8 million hectares of closed forest and open forest (NAFI, 1999 [2]). Some 22.3 million hectares of closed and open forest is either privately owned or lease-hold while the balance is public owned multiple use forest (11.0 million hectares), conservation reserves (8.4 million hectares), or other categories of public ownership (2.1 million hectares) (Bureau of Resource Science (BRS), 1998).

1.2 Changes in Native Forest Management and Resource Availability

In the early 1800s, basic regulations were in place to reduce the over-cutting of desirable species but these were basically aimed at procuring government revenue and were poorly enforced (Carron, 1985).

Silvicultural treatments to improve native forests were first introduced in the 1880s in the river red gum forests along the Murray River (Australian Science and Technology Heritage Centre (ASTHC), 1988). After flooding, large areas of regeneration appeared and to ensure that this would produce the highest quality resource, the larger trees with lower commercial value were thinned to concentrate growth in the residual stand.

In the late 1800s there arose a growing concern about felling practices, the frequency and intensity of fire damage, clearing of valuable forests for agriculture and the need to conserve timber resources. As a result, most of the Australian States had established Forest Services by the early 1900's (Florence, 1995), which set about the task of reserving crown land as State forest, protecting it from clearing and actively managing these forests for timber production. At this time, much of the forest estate was run down (Florence, 1995), and the nascent forest services faced an enormous task in restoring order to a previously over exploited resource.

The forest services sought to develop improved methods of management in the 1920s and 30s in order to ensure that forestry-related activities were carried out in a manner consistent with the base principles of sustainable yield forestry (ASTHC, 1988). The leading advocate for this change was the Western Australian Conservator of Forests, Charles Lane-Poole, who was successful in implementing this ideology and challenged others to follow.

Up until the 1950s and the introduction of clearfelling for even-aged stands (Florence, 1995), forest management remained closely linked to the selection cutting of uneven-aged stands. The conversion in a number of areas to clearfelling was undertaken to assist, particularly in wet sclerophyll forest, with the regeneration and also to ensure the development of a highly productive regrowth stand.

Historically, the main objective of the State Forest Services within Australia has been to manage public forests to optimise timber production. Since the advent of the modern environmental movement in the late 1960s however, there has been considerable change and a much greater emphasis placed on the non-timber values and in particular the conservation of flora and fauna habitat. In terms of forest management practices these changes have been significant, for very little had been done in terms of developing sophisticated silvicultural regimes for young regrowth forests when there had been no market demand for small piece sizes (McCarthy, 1994).

Over the past 20 years, as the wave of heightened environmental awareness spread throughout the wider community and forestry activities became increasingly politicized, substantial areas of native forest and woodlands were set aside in national parks and wilderness areas. As a direct result of these changes, and the subsequent loss of resource, increased pressures were mounted on the remaining stands of native forest to produce adequate volumes of quality raw material for industry. In order to alleviate this burden the Federal, State and Territory Governments in conjunction with industry have embarked on the Plantations for Australia : 2020 Vision which was launched in 1997. The aim of the project is to treble Australia's hardwood and softwood plantation forest estate from approximately 1 million hectares to 3 million hectares by the year 2020 (NAFI, 1999 [3]).

More recently, following the signing of the National Forest Policy Statement (NFPS) in 1992 between the State and Commonwealth governments, Regional Forest Agreements (RFA's) have been completed and are under negotiation in order to achieve and maintain 'sustainable forest management'. The key principle of the RFA process was to establish a 'comprehensive, adequate and representative' (CAR) system of forest reserves whilst providing industry with secure access to wood resources based on sustainable yields.

The change in public ideals and the subsequent development of Government policies have combined to significantly alter both native forest management and, to a far greater extent, the availability of this resource. Future management strategies will need to be based on a broader range of more intensive silvicultural practices in order to meet the needs of industry whilst maintaining environmental and ecological values.

1.3 Development of Australia's Native Forest Timber Industry

Timber harvesting and processing commenced in Australia with the arrival of European settlers in 1788. Prior to this period, and on a much smaller scale, the Aboriginal people utilised the native hardwoods for a range of implements, primarily for hunting, fighting and digging, and also for shelter (Australian National University (ANU), 1997).

The progress of the native timber industry over the past 200 years has been closely linked to the development and adoption of new energy sources and logging technology. Dargavel (1988) has identified three distinct periods of development in the native timber industry as being:

1. Manual production and the first sawmills (1788 – 1850), primary resources: red cedar, native softwoods, and eucalypts.

During this period trees were felled by axe or cross-cut saw and sawn into lengths with the use of a pit saw (ANU, 1997). Bullocks and horses were used to transport the timber to mills for final processing and then market. During this era harvesting was restricted to the more accessible forested areas.

2. Steam power and larger sawmills (1850 – 1945), primary resources: rainforest timber and eucalypts.

By the second half of the 19th century the timber industry had become well-established and was supplying an increasingly wide range of markets, both domestically and overseas (ASTHC, 1988). The development of steam power and improved road transport enabled higher levels of productivity and easier access to areas previously uneconomic to harvest (ANU, 1997). During this period the technological development of industry was slow due to the consistent supply of old growth logs (ASTHC, 1988).

3. Electrification and Diesel Power (1946 – 1990) primary resources: eucalypts, cypress pine and rainforest timbers.

Due to the rising costs and the declining availability of large, high quality hardwood logs in the mid 1950s, the industry began to undergo rationalisation and to introduce increased mechanisation and improve technology (ASTHC, 1988).

During the past twenty years however, the eucalypt timber industry has been faced with even greater change. Alterations in customer perception, as a result of successful softwood marketing, has forced eucalypts out of traditional domestic building products into appearance grade markets which compete directly with imported hardwoods. At the same time an increased recognition of non-consumptive forest uses in the wider community has resulted in industry being moved from basically an old-growth resource to regrowth or second growth forests. To date, progressive companies prepared to invest in new technology and change with the resource have been able to, over time, develop profitable markets and high quality products from the younger, lower quality, smaller diameter trees.

The predominant question remains, however, that if Australia's population maintains growth and living standards continue to improve, will there be further pressures from both domestic and international sources in the foreseeable future to progressively reduce the volume of timber harvested from native forests? As has already been the case in a number of other countries, after the implementation of strict forest policies, import restrictions and heightened consumer awareness there has been an unprecedented swing toward hardwood products from sustainable plantation forests.

Although Australia is the home of the eucalypts and has extensive experience in managing and processing old growth and regrowth resources, both forest growers and the timber industry in general have much to learn when it comes to commercially producing and marketing value added products from plantation grown eucalypts.

2.0 Development of Eucalypt Plantations Outside of Australia

2.1 World Distribution of Eucalypt Plantations

Eucalypts now exist extensively throughout many countries of the world. Broad environmental adaptability, economic value, and high growth rates have been some of the main reasons for the rapid and continuous spread of the genus (Tomaselli, 2000). The distribution and importance of eucalypts in plantation forestry has been reviewed elsewhere (Evans 1992; Savill and Evans 1986; Hillis and Brown 1978).

Eucalypt plantations now comprise around 10%, or 10 million ha, of the world's plantation forests, of which only 1% is within the species' native range (Kanowski, 1995).

The most important industrial eucalypt plantations by country are shown in Table 1.0 (below).

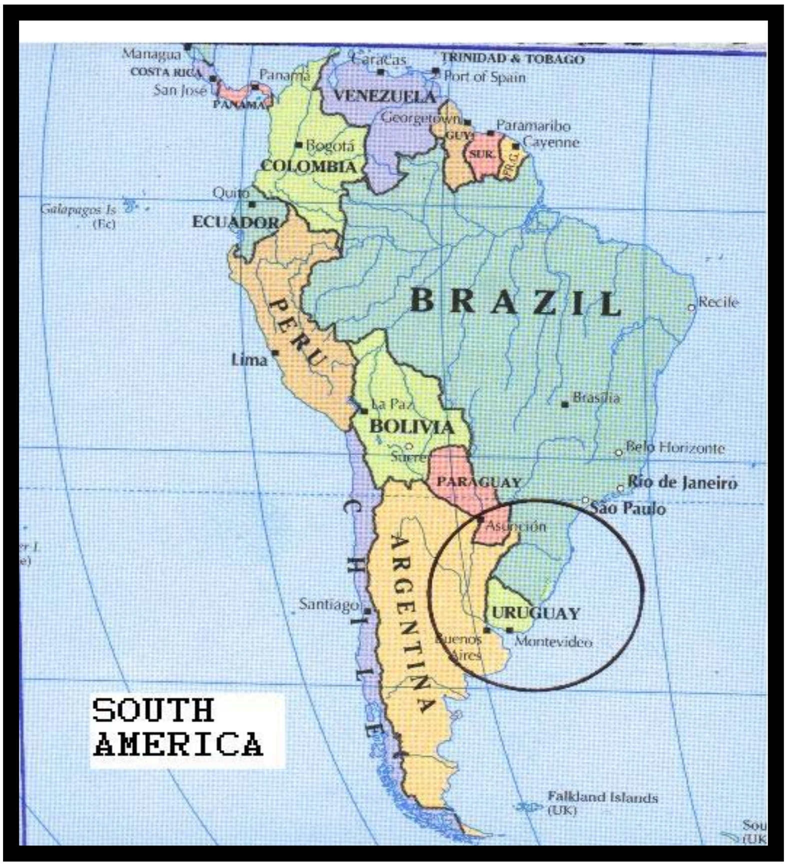
Table 1.0 Distribution of eucalypt plantations by country.

Country	Plantation Area in Hectares
Brazil	2,921,000
India	2,670,000
South Africa	557,000
Portugal	550,000
Spain	550,000
Chile	300,000
Australia	297,000
China	274,000
Argentina	242,000
Vietnam	202,000
Uruguay	176,000

Source: Vidgren (1999).

As is evident in Table 1.0, South America has by far the largest area of eucalypt plantations of any continent in the world. There are around 3.6 million hectares of productive eucalypt plantations in South America representing an important potential for the solid wood and engineered wood products industry. Of particular relevance to this paper are the South American Common Market, Mercado Comun del Sur (MERCOSUR) countries, of Brazil, Argentina and Uruguay.

Plate 1 : Map – Location of study area



Source: Collins World Atlas, 1998

2.2 Introduction and Expansion of Eucalypts within the MERCOSUR

In the MERCOSUR countries, the first eucalypt plantations were established over 100 years ago (Tomaselli, 2000). In the vast majority of cases, initial plantations were sparse and established for non industrial purposes such as fuel wood, wind breaks, fence posts, and other traditional local uses. In 1948, Cia Belgo-Mineira in Minas Gerais Brazil established the first industrial eucalypt plantations to provide wood for the charcoal-based iron and steel-making industry (Magahaes, 1993). Eucalypt plantings for pulp production began in earnest throughout South America in the early 1960’s (Tomaselli, 2000).

To further promote the expansion of plantations each, of the MERCOSUR countries implemented a range of fiscal incentive programs. In 1988 for example, Uruguay's government introduced significant plantation establishment subsidies and as indicated by Shield and Flynn (1999), this resulted in a "Green Rush". By continuing to attract substantial outside investment, Uruguay has been able to more than double its plantation estate over the past five years, 80% of which comprised of eucalypt species.

Although Argentina has not experienced the same rapid level of growth, its potential lies in the fact that that there are vast areas, of relatively inexpensive land, suitable for the farming of trees. Shield and Flynn (1999), state that the Argentine government has forecasted an ambitious but realistic planting rate of 100,000 hectares plus per annum.

Up until 1965, 80% of Brazil's 470 thousand hectares of eucalypt plantations were in the State of Sao Paulo (Couto and Better, 1995). Since that period however, significant plantations have been established to the north in the states of Minas Gerias, Bahia and Espirito Santo. Although not rapidly expanding in area, Brazil's now massive 2.9 million hectare plantation resource base will, with the aid of genetic improvements, yield far greater volumes of higher quality wood.

3.0 Plantation Resource Utilisation

Over the past decade there have been substantial changes in the way in which forest based industries in the MERCOSUR view their plantation resources. Due to an over supply of eucalypt pulp on the world market, disappointing profits from pulpwood-only plantations, and the substitution of charcoal with imported coke for the production of iron, there are now vast areas of maturing plantations without a designated market. In effect, this has prompted the forest industry to begin developing new genetically improved resources and a range of different outlets for its timber resources.

3.1 Uruguay

Forest industry development in Uruguay is still very much in its infancy, however with plantations expanding at a rate of 40,000 ha / year the country will no doubt be a forest products power of the future. The overriding challenge facing Uruguay is whether or not it can attract enough companies to consume the resource when the most likely markets will be export-oriented.

3.1.1 URUFOR S.A. (Otegui Group) Sawmill

The Urufor S.A. Industriars Forestales (Otegui Group) sawmill located in the Central North of Uruguay at Rivera was one of the first large sawmills to begin processing plantation-grown eucalypt logs. The mill began sawing eucalypt logs in June of 1992 and utilises wood grown by Compania Forestal Uruguaya (COFUSA), which is the plantation investment company of the family company, Otegui Haos. S.A. The mill's annual log intake is in the order of 96,000 m^3, of which 85% is *Eucalyptus grandis*, and the remaining 15% is plantation pine. In terms of haulage, 80% of the mill's resource lies within a 50 kilometre radius. All logs delivered are in 4.5 metre lengths with the bark left on to minimise splitting. Each load delivered passes over a weigh-bridge which enables management to closely monitor stocks. Once in the yard the logs are kept under constant irrigation to reduce recovery losses from end splitting. Before sawing, the logs are sorted into diameter classes and debarked with a ring debarker which utilises a cutter or scriber head. The average log diameter was approximately 35cm to 37cm, centre diameter under bark (CDUB), any logs over 45cm CDUB could not be processed due to sawing limitations.

Urufor's sawmill is a single-line mill which utilises a twin bandsaw with a spiked chain in-feed for log reduction followed by a multi-arbor gang saw for centre cant sawing. The sawn boards are further processed by a multi-edger which has laser guides for accurate sizing. The mills average green-off-saw recovery was suggested to be between 45% and 48%. Direct kiln drying is practised by Urufor with encouraging results. Kiln residence times were not discussed in detail, however it was indicated that boards with a nominal thickness of 32 mm took approximately 23 days to reach a moisture content of between 8% and 12%. In order to minimise warping degrade in the young sawn material during drying, a restraint was employed to hold the material straight and flat. Although pallet grade material currently dominates production, the volume of material going into finger jointed appearance-grade products has doubled over the past 3 years. With higher quality resources coming on line in the next 5 to 10 years due to altered plantation management regimes, the opportunity will exist to manufacture and export far greater volumes of value-added products.

Plate 2 : URUFOR drying kilns

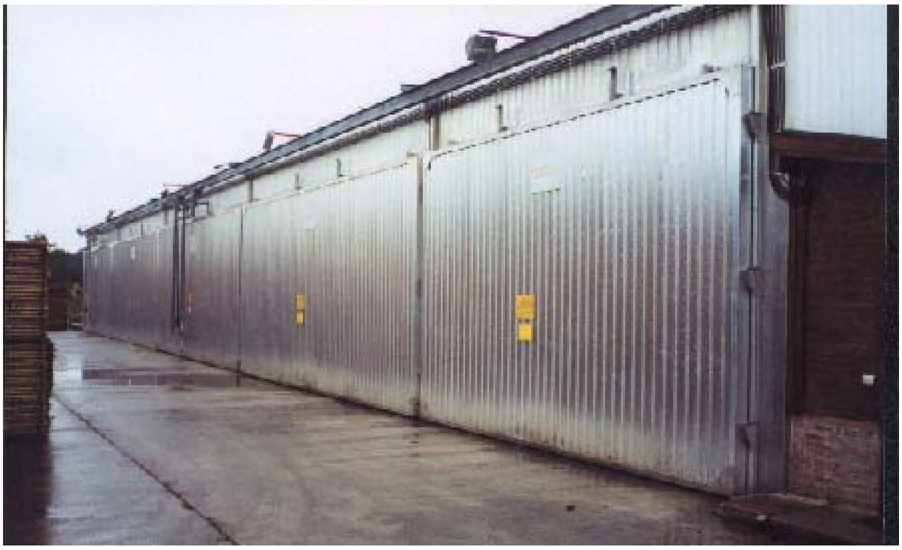


Plate 3 : Inspecting finger jointed *E. grandis* flooring

3.1.2 Southern Cross Timber S.A. Sawmill

The second mill visited by the author was the Southern Cross Timber S.A. sawmill located in the Central West of Uruguay at Young. The new state-of-the-art green mill began processing plantation eucalypts in October of 1999 and has the capability to economically saw logs down to a small end diameter of 18cm. Raw material for the mill is drawn from privately-owned plantations of predominantly *E. grandis*, which were originally established for pulpwood exports. Southern Cross Timber's annual log intake is in the order of 35,000 m^3, based on the current 8 hour shifts being worked. Due to the mill's central location the average haulage distance was estimated to be only 35 kilometers. Logs are delivered to the mill yard in short lengths and once they have passed over the company's weigh-bridge they are placed directly under misting sprays to minimise end splitting. Before the logs enter the mill they are passed through a merchandiser, which grades the raw material into various diameter and roundness classes. The average log diameter into the mill can vary greatly however, the year to date figure was in the order of 33cm CDUB.

The Southern Cross sawmill utilises an A. Costa high speed sawing system with in line computer-optimisation. Depending on the initial log diameter, green-off-saw recovery can range between 38% up to 49%. Currently 100% of the mill's production goes into pallet and case grade material, the greatest proportion of which is exported to Italy. As markets grow however, the Company has indicated it will look to install kilns and re-manufacturing equipment to further develop value added products from the low grade plantation resource.

Plate 4 : Southern Cross S.A. saw-line

The next three mills visited were in relatively close proximity to the city of Paysandu, which is situated in the West of Uruguay.

3.1.3 Delamonte S.A. Sawmill

Not unlike the Urufor S.A. mill in Rivera the Delamonte S.A. sawmill was one of the first large mills to begin processing plantation eucalypts. The mill has now been sawing eucalypts for approximately 5 years and continues to draw logs from its own mixed plantations. In order to minimise log degrade through splitting, Delamonte S.A. ideally process their hardwood quota during the cooler, slow-growth months and then transfer to pine through summer when markets conditions permit and log reactivity increases. Currently the mill processes somewhere in the order of 19,000 m^3 per annum of eucalypt logs between 18cm and 35cm CDUB. Due to the central location of the mill in terms of the company's plantation resource, the logs are barked in the bush and are processed immediately. Before processing the logs are sorted by diameter into two classes, over and under 40cm CDUB.

Italian machinery features in the Delamonte sawmill which utilises a single band head-rig to breakdown the over 40cm logs into slabs and a twin band log reduction system in-line with a multi-saw to process the under 40cm logs and re-saw the slabs. Green-off saw recovery is reported to be in the order of 43%. The dominant product line is pallet-grade material for export to Italy. However, over the past two years the mill has been producing increasing amounts of kiln-dried and dressed products for domestic markets.

3.1.4 Caja Bancarias S.A. Sawmill

The Caja Bancarias sawmill, commissioned in the early 1990's was originally designed to process a 50:50 mix of both pine and eucalypt logs. Due to the unforeseen differences between the two resources, principally the highly reactive nature of the plantation eucalypts, management at the mill had all but abandoned the sawing of this resource by the mid 1990's. The Company continues to process approximately 2,500m^3 of log per month of which 80% is *Pinus elliottii* and the remaining 20% *E. grandis*. The average diameter of hardwood logs into the mill varies considerably from month to month due to the age of the plantation being harvested. However, it was indicated that the year to date figure would be approximately 35cm CDUB.

The Caja Bancarias mill utilises a twin-line sawing system which was designed and manufactured in Chile. Kilns are in operation at the site, however they are used exclusively for the drying of *Pinus* timber. An estimated 75% of the mill's current production is sold into markets throughout the surrounding MERCOSUR countries, and the remainder is sold locally.

3.1.5 Raiges S.R.L Sawmill

The Raiges S.R.L. Industria de la Madera facility was the last site visited in the Paysandu area. In terms of the ratio of species processed this mill was very similar to the Caja Bancarias operation, although the similarities end there. The diverse number of products manufactured on site from relatively low-grade logs was staggering. The range of value added products included; edge-glued panels, finger-jointed boards, palings, clothes pegs and even basic wooden chairs. As expected from an operation of this nature, only minimal amounts of raw material went out of the facility as waste. It was also interesting to note that the company had established a 30 hectare plot of white cypress pine, *Callitris glauca*. Results to date indicate that the species is not suited to the area because of extremely low growth rates.

3.2 Argentina

Argentina is currently much further down the developmental path than Uruguay, in terms of both infrastructural improvements and industrial capacity, but it is still at least 10 years behind Brazil (Flynn, 1996). At present, only a very small percentage of millers in Argentina kiln dry hardwood timber for the production of value added products. The vast majority of existing production goes into packing boxes for the fruit industry and pallet-grade stock.

The first two mills visited in Argentina were in the Entre Rios region close to the major city of Concordia.

3.2.1 Aserradero Ubajay Sawmill

The Aserradero Ubajay mill began sawing plantation eucalypts in the mid 1990's and draws eucalypt logs from both privately-owned plantations and also from its own 3,000 hectare resource which is located in close proximity to the mill. Annual log intake was in the order of 40,000m^3, of which 85% was *E. grandis* and the remaining 15% *E. dunnii*. In terms of log diameter the average was estimated to be 42cm CDUB. Once again, to reduce end checking, the bark was left on the logs until required for processing. The mill currently utilises a large, Italian-made, twin band head rig for primary log reduction. There were no kilns in operation at the site because all of the timber produced went into pallet-grade and cable-spool stock. At present there are no definite plans to expand the business into kiln-dried products due to the low quality of the available resource.

Plate 5 : Twin band head-rig for primary log reduction

3.2.2 Fracalosa S.A. Sawmill

Although relatively small, with an annual log intake of only 20,000m^3, the Fracalosa S.A. mill was impressive in the range of value-added products they were manufacturing from air-dried plantation *E. grandis*. The clear or select-grade lengths were incorporated into tongue and groove products including flooring, ceiling boards, and wall panels, whilst the lower-grade materials went into packing boxes for the local citrus industry. The Fracalosa mill clearly demonstrated the fact that profit is not always directly linked to volume.

The remaining three mills visited in Argentina were in the northern provinces of Corrientes and Misiones which are bordered by Paraguay in the North, Brazil in the East and Uruguay in the South.

3.2.3 Forestadora Tapebicua Sawmill – Plywood Mill

The Fletcher Challenge facility located at Gdor. Virasoro in the Corrientes province is one of, if not the, largest manufacturer of value added-timber products in Argentina. The Forestadora Tapebicua mill is an integrated operation, producing both kiln-dried timber products and also a variety of structural and decorative plywoods. Involvement with forestry-related activities began in 1974 and was primarily focused on developing *E. grandis* plantations. To date the Company manages 6,000 hectares of plantations, 2,500 hectares is *E. grandis* with the remainder predominantly *P. elliottii*. At present, after the second commercial thinning at 9 years and 4 separate levels of pruning the *E. grandis* plantations are clear-felled at 14 years.

The Tapebicua mill was built in 1994 and has been sawing a mix of both eucalypt and pine. Log intake at existing levels of production would be 110,000 m^3 per annum, with 90% being *E. grandis* and the remaining 10% a mix of *P. elliottii* and *P. taeda*. Logs are segregated by diameter and delivered, in either 3.05m (10’) or 3.91m (13’) lengths with the bark intact to minimise end splitting. Before entering the sawmill, the logs are end docked if necessary and then passed through a ring debarker. The mill has two saw lines, one which processes smaller short length logs from thinning operations, 16 – 20cm CDUB, whilst the other processes larger, longer length logs ranging between 20 and

32cm CDUB. Each of the lines has a double saw headrig for primary breakdown, the small line uses twin circular saws, whilst the larger line uses twin band saws. The central cants are then fed into multi-arbor saws, edgers and finally trimmers before the boards are carefully graded and stacked. In terms of green-off-saw recovery the mill averages between 42 and 44%.

After 3 months of controlled air drying 70% of the timber is then kiln-dried in one of the company's Nardi kilns down to a moisture content of approximately12%. Direct kiln drying has been trialed by Tapebicua, although the amount of degrade experienced and subsequent losses in recovery have halted any further investigations. Tapebicua's remanufacturing plant also began production in 1994 and currently processes 850m^3 per month. Principal product lines include T&G flooring and wall paneling, moulding, and surfaced timber. KD boards, dried and dressed, range in thickness from 15mm up to 25mm, in width from 100mm up to 150mm, and in length from 600mm up to 3650mm. In the short to medium term there are no plans to increase the mill's level of production. However, with 160 employees there have been considerable efforts made to become more cost-efficient and competitive.

Plate 6 : No.2 small log saw-line - Tapebicua

Plate 7 : Tapebicua – Air drying sheds

Tapebicua's plywood mill commenced operation in 1997 and after a less than desirable beginning, with low levels of productivity and high labour costs, has managed to prosper and continue growing with the aid of new products and improved levels of manufacturing efficiency. The plywood mill's current log intake was said to be 52,000 m^3 per annum, 100% of which was plantation grown *E. grandis*. The average diameter of the butt section veneer logs was approximately 44cm CDUB and the observed log quality was far superior to that of the saw logs. Bark was again left intact, however to further minimise end splitting in the veneer logs a coating of wax was applied in the mill yard. Rather than steaming the logs prior to rotary peeling, which was reported to exacerbate end splitting, Tapebicua now process all billets at ambient temperature. The machinery used to process the predominantly 2mm veneer included; an eight foot Colombo–Cremona rotary veneer lathe, a conventional Babcock veneer drier with a four bin stacker, an OLM layup line and prepress, two Siempelkamp multiple daylight hot presses one with 20 daylights the other with 15, and lastly an IMEAS sanding line. Currently 95% of the plywood produced is 2400mm (8 feet) long by 1200mm (4 feet) wide and possesses a phenolic-based glue line which is water-resistant. The range of plywood products being manufactured was 95% 8x4 and included; form ply or film faced plywood, siding/bracing plywood, and lastly T&G plywood panels for flooring.

Plate 8 : Eucalypt structural plywood

3.2.4 Maderas Selectas Veneer Mill

The first of the mills visited in the Misiones province was the small Maderas Selectas S.A. veneer operation. The Company manufactures both sliced and rotary-peeled veneers ranging in thickness from 0.6mm up to 1.3mm. Although the majority of logs are currently obtained from surrounding native forests, the mill is now considering a move toward plantation eucalypts in order to broaden its resource base. As a result of continued effort, substantial export markets have been developed and Maderas Selectas is now looking to supply greater volumes of face veneer into the growing overlaid furniture market in Brazil.

3.2.5 Henter I.C.S.A Veneer and Plywood Mill

The Henter I.C.S.A. veneer and plywood mill was the second plant visited in the Misiones province. The operation began production in 1972 but has only been producing veneers and plywood from plantation eucalypts since 1990. The mill does not own any timber resources and subsequently relies on local landowners and forest growers for supply. The annual log intake is in the order of 30,000 m^3 and of this 85% would be *Araucaria angustifolia* pine and the remainder a mix of local species and plantation eucalypts, predominantly *E. grandis*. Machinery in the mill was relatively old and mainly of Italian design. In manufacturing veneer and plywood, Henter utilised two Italian rotary veneer lathes, a defect clipper, three chain mesh driers, two glue spreaders and three multi-daylight hot presses. Henter manufactures both furniture-grade plywood which has a urea based glue line, and structural-grade plywood in various thicknesses with a phenolic glue line.

3.3 Brazil

In terms of forest area and value added production Brazil is the undisputed regional leader when it comes to plantation eucalypts. The outlook for solid wood and engineered products in Brazil looks exceedingly bright, although the industry's true potential will not be realised until silvicultural practices and a significant portion of the resource base are altered to match the relatively new higher-value end uses.

3.3.1 IKPC – Klabin Eucalypt Plantations

The extensive mixed plantation forests of IKPC – Industrias Klabin de Papel Celulose S.A., are the principal raw material supply for the secondary processing plants visited in the Southern Brazilian State of Parana. Klabin was the first company in the pulp and paper industry in Latin America to receive International Certification from the Forestry Stewardship Council (FSC), following rigorous auditing by SmartWood. Currently in Parana, Klabin manages 230,000 hectares on which it maintains 124,000 hectares of planted pine, *Eucalyptus* and *Araucaria* forests as well as 92,000 hectares of permanently protected native forests. Of the total plantation estate approximately 25% or 35,000 hectares is *Eucalyptus* which is predominantly *E. grandis*.

The company also runs a world-class nursery which produces 15 million seedlings per year and 1.5 million cultured cuttings from improved families and clones. Shield and

Flynn (1999), noted that much of Klabin's original *E. grandis* seed source came from Coffs Harbour in Northern NSW. Clones presently account for 15% of the total annual plantation and it is expected to increase to a maximum of 50% of the plantation program by 2005. In addition to the cultured cutting process, the micropropagation technique has also been in use since 1986 for eucalypts. Klabin's micropropagation laboratory currently has the capacity to produce a hundred thousand plantlets per annum.

The rotation age of eucalypt plantations, predominantly *E. grandis*, for pulp production is approximately 21 years, with thinning at 7 year intervals. Saw-log stands are clear felled at 20 years with two separate thinning and pruning operations. Klabin reports an average breast height diameter at this age of about 45cm and an average merchantable length of between 24m and 26m. Updated harvesting techniques are being used with substantial investments in labour training and modern equipment including feller-bunchers, harvesters and skidders. Another feature of the plantations was the quality of the road network which allows work to continue in extremely adverse weather conditions 24 hours a day, optimising the utilisation of the resource. Klabin currently supplies the local market with approximately 70–80,000 m^3 of logs per annum and has only agreed to continue this supply for the next 10 years, for the company is now looking to further value-add to its own certified plantation resource.

The following are reported by Shield and Flynn (1999, p108) as average prices for unpruned *E. grandis* sawlogs in Southern Brazil, delivered to a central sort yard in Parana State, in 1999.

Small End Diameter	US $ per ton
24-30cm	$18-19
31-40cm	$26-27
> 40cm	$32-33

As previously mentioned, each of the following processors relies solely on Klabin for the supply of their eucalypt logs. The industrial estate in which each of these companies operate consists primarily of secondary wood processing facilities and lies just 5 kilometers from the town of Telemaco Borba and 35 kilometers from Klabin's plantations.

3.3.2 CASCOL Industria Madeireira Sawmill

Although small by Brazilian standards, the Cascol Industria Madeireira operation is representative of a number of southern eucalypt sawmills. The two principal species processed are *E. grandis* and *E. dunnii*, of which *E. grandis* is preferred due to its colour and reduced level of reactivity in sawing and drying. Annual log intake reached 28,000 m^3 in 1999 and is forecast to steadily increase until 2002. Average log diameter, year to date, was estimated to be 41cm CDUB, although this may fall dramatically in future if Cascol has to rely on shorter-rotation wood lots for supply. The mill utilises a single band head-rig and frequently turns the log to reduce splitting. At present Cascol manufactures a range of air-dried and kiln-dried board products, finger-jointed edge-glued panels, and broom sticks. As a result of the company achieving SmartWood certification in 1999, it is now able to export, predominantly into the lucrative European market, 65% of current production. In the future, pending supply issues, the company plans to maintain growth by focusing on the export market.

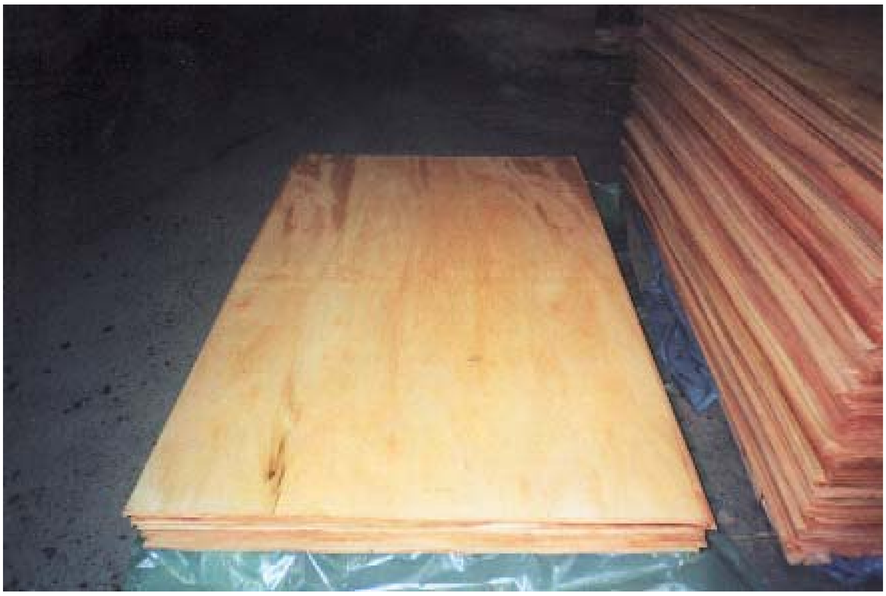
3.3.3 Paledson Madeiras Sawmill

Paledson Madeiras was the next mill visited and the first in Latin America to gain certification from SmartWood/FSC in 1998. In terms of production the Paledson mill began sawing eucalypts in 1994 and consumes approximately 17,000 m^3 of logs per annum, the majority of which is *E. grandis*. Log quality and diameters are very similar to those being processed by the Cascol Industria Madeireira facility . Green-off-saw recovery at the sawmill was suggested to be between 45 – 48 %. However, the trade-off for the higher recovery has been lower levels of production. The mill utilises a 15 day kiln schedule to dry its green sawn timber down to a finished moisture content of between 10-12%. Paledson currently has two distinct product lines, the first of which is wooden dowels and the second is kiln-dried timber, all of which is on sold to remanufacturing plants or furniture companies. Like many other certified manufacturers, however, Paledson is now looking to expand its product range and sell value-added products in export markets.

3.3.4 Madeiras Guamiranga Veneer Mill

Currently, the largest manufacturer of rotary peeled eucalypt veneer in Southern Brazil is Madeiras Guamiranga Ltda. The mill began operations in the early 1990's and currently peels a 60:40 mix of *E. grandis* and *Araucaria angustifolia*. Guamiranga produces around 1,200m^3 of rotary-peeled veneer per month of which around 750m^3 is eucalypt. The clear butt section veneer logs arrive at the mill from Klabin within 2-4 days of felling, which is said to greatly reduce the potential for splitting. Upon arrival the debarked logs are cut into multiple lengths, placed under tarps and exposed to raw steam for a period of 3 days. After the heating and conditioning process the billets are rotary-peeled at a thickness of 2.4 mm and hand-reeled for defect clipping. The veneer is then run through a conventional jet box drier in order to arrive at a final moisture content of between 8% and 10%. Although the majority of the mill's production is currently sold within Brazil, a greater percentage is being channeled into export orders for decorative panels and the company is now looking at manufacturing its own plywood products.

Plate 9 : Rotary peeled *E. grandis* veneers



3.3.5 Other Manufacturers of Sawnwood Products in Brazil

Although not visited by the author, the following mills have been included in this summary to further highlight Brazil's potential in becoming a market leader in terms of developing, manufacturing and marketing value-added products from certified eucalypt plantations.

Two companies which have only recently built new sawmilling facilities in the Brazilian State of Bahia are Caf Santa Barbara, a subsidiary of the Belgo Mineira steel group, and Aracruz Wood Products which is a division of Aracruz Cellulose, a leading producer of hardwood pulp.

3.3.5.1 Caf Santa Barbara Ltda Sawmill

The Caf mill, which relies on its own medium-quality eucalypt plantation resources for raw material, has been specifically designed to process logs down to a small end diameter of just six inches or approximately 15cm. Shield and Flynn (1999) reported that the sawmill project cost US$ 5-6 million and will be operated by just 8 employees (within the mill), running predominantly Moosemayer machinery to produce 3,000m^3 per month in one shift. Currently only domestic markets have been targeted, although with the introduction of a re-manufacturing line to produce dressed and moulded products, opportunities to export will no doubt be thoroughly pursued.

3.3.5.2 Aracruz – Tecflor Industrial S.A Sawmill

Aracruz on the other hand manages a select portion of their 160,000 hectares of eucalypt plantations on a longer rotation to produce larger, high quality saw logs. The designer trees have been specifically developed by the company's research and technology centre to provide improved off-saw yields and a superior quality sawn product. The Aracruz Wood Products manufacturing facility is a US$52 million high-tech sawmill with the capacity to produce 75,000m^3 of timber per annum. Plans are currently in place to add a second production line, increasing the total output to an estimated 100,000m^3. The Tecflor sawmill makes use of the latest US designed equipment and technology to maximise both production and product quality. At the centre of production are two large band-saws with six foot wheels and 10” saw-blades. One saw acts as the head-rig whilst the other as a resaw, processing cants into raw timber which is then fed into gang saws, edgers and trimmers. In contrast to Caf much of Aracruz’s timber is aimed at export markets particularly in Europe and North America. Long-term plans include the installation of a veneer-slicing line and facilities to produce both finger-jointed and edge-glued panels.

3.3.5.3 FLOSUL Madeiras Sawmill

From humble beginnings as an industry pioneer in the early 1980’s the Flosul sawmill has grown, like most other sawmills in South America, in stages, and is now leading the way in terms of manufacturing value-added products. Flosul’s 6,000 hectares of eucalypt plantations have been genetically improved over this period and are now receiving intensive management designed to produce larger diameter, less reactive logs. The mill currently processes 70,000m^3 of logs per annum, with predominantly Brazilian sawmilling equipment including Schiffer bandsaws and Dambroz resaws (Flynn, 1999). Lumber from the mill is dried in one of Flosul’s eight Nardi driers, each with a capacity of 75m^3 (Flynn, 1999). If the sawmill remains in front of the re-manufacturing plant the green sawn timber is air-dried for several weeks first, which in effect shortens the kiln residence time from 12 to 16 days down to 8 to 12 days (Flynn, 1999). In comparison to the sawmill, the re-manufacturing plant contains mostly new Italian equipment including an A.Costa moulder, Cursal optimizer, Sermac fingerjointer, Orma single daylight hotpress, and a DMC sander (Flynn, 1999). Whilst edge-glued panels are the company’s principal product, tongue-in-groove flooring production is also growing. Although local furniture manufacturers utilise the bulk of production, Flosul also exports into the European market and are now, as reported by Shield and Flynn (1999), in the process of certifying their plantations under the FSC’s Smartwood scheme.

4.0 Plantation Eucalypts : Lessons Learned

4.1 Is Coppicing a Viable Alternative?

Coppicing is one of the oldest forms of regenerative strategies used in forest management today (Sivell, 2000). The practice relies on a tree's ability to produce vigorous regrowth stems from the stump after harvesting has occurred.

During the 1970's and 1980's the majority of forest companies in Brazil and Argentina used the eucalypts' natural ability to sprout and adopted a coppicing system of re-establishment (Couto and Better, 1995). Over the past 10 years in the areas visited, however, there has been a distinct move toward the renewal of eucalypt stands after the first harvest. A summary outlining some of the advantages and disadvantages associated with each of the establishment techniques is given below.

4.1.1 Coppicing Eucalypts

The benefits of coppicing eucalypts include;

- Forest growers are able to eliminate establishment costs for coppice rotations.
- Due to the existing root mass coppice rotations experience rapid juvenile growth.
- Plantation maintenance costs in the first three years are considerably lower.
- There are obviously reduced levels of environmental disturbance.

Some disadvantages with coppiced eucalypt rotations are;

- Coppiced stands, particularly at the outer extremities, are very susceptible to wind damage.
- There is a moderate to high risk of fungal build up in the stump.
- Not all stumps will coppice, which results in under stocking in successive stands.
- Most of the coppice stems have to be manually removed from the stump in order to improve the trees' yield potential.
- A noticeable percentage of logs will exhibit butt sweep.

Although coppicing is now primarily confined to community forest fuelwood projects, companies such as COFUSA in Uruguay and the Argentine research agency Instituto Nacional de Technologia Arropecuaria (INTA) are once again evaluating the potential of coppiced *E. grandis* rotations for solid wood products.

4.1.2 Seedling Stock

The advantages of replanting seedling stock include;

- The ability to select quality genetic material which results in single stemmed trees of good form.
- Establishing exact stocking rates which results in relatively even stand development.
- Gains through recent tree breeding programs can be implemented.

The downside to re-establishing with seedlings include;

- Relatively high establishment and maintenance costs.
- Greater levels of environmental disturbance with site preparation etc.
- Higher levels of susceptibility, particularly in terms of moisture stress due to the trees juvenile root mass.

In summary, advantages do exist in terms of allowing eucalypts to coppice after harvest, however the vast majority of plantation owners in the regions visited have identified a clear economic benefit in replanting seedlings. The principal reason given was that seedlings allow forest growers to implement and assess progressive genetic improvements that may significantly improve both yield and log quality.

Plate 10 : Klabin seedling nursery

4.2 Pruning Stems to Maximise Clearwood Volumes

During the preliminary stages of the commercial utilisation of plantation *E. grandis*, prior to silvicultural treatments of any significance, Scott (1940, cited in Maree and Malam 2000) found that dead knots "accounted for more wastage of otherwise perfect material, than any other blemish". More recently, experience has also shown a number of South American value-added manufacturers that knots and knot-related defects are one of the highest priority factors influencing the profitable conversion of *E. grandis* stands into high-quality, final products.

As a direct result of the growing demand for knot-free clearwood, forest growers throughout the Mercosur have been responding to the differential in demand by implementing a range of prunennial management regimes.

In Uruguay, silvicultural management entailing high, early pruning commenced on a significant scale only as recently as 1992 (Shield and Flynn, 1999). To date, companies such as Compania Forestal Uruguaya (COFUSA) continue to implement aggressive pruning regimes in order to produce the maximum amount of clearwood which in turn limits the diameter of the knotty core. COFUSA's existing schedule entails:

Stand Age	**Pruned Height**
At age 2 years	stems pruned to 2 - 3m
At age 3 years	stems pruned to 5 - 6m
At age 4 years	stems pruned to 7 - 8m
At age 5 years	selected stems pruned to 10m

Plate 11 : High pruned *E. grandis* plantation - Uruguay

Brazilian companies, including Klabin and Aracruz, have also altered their silvicultural practices for solid wood production over the past five years and now incorporate multi-lift pruning as a fundamental component in delivering quality raw material for higher value end uses.

4.3 Forest and Forest Products Certification

In brief, the certification of forest management involves an independent third party audit of forest management practices, whilst the certification of timber products involves the clear and distinct labeling of products derived from forests certified as being sustainably managed (Lang, 1999).

Kiekens (1999) noted in the Engineered Wood Journal that the concept of "timber certification" emerged in the late 1980's after environmental groups including the World Wildlife Fund (WWF) approached the International Tropical Timber Organization (ITTO) to initiate an international labeling scheme for tropical timber. Due to a limited response from the ITTO the WWF and other environmental groups began work on establishing the Forest Stewardship Council (FSC). By the mid 1990's, the FSC came into being and accredited four certifiers including Smart Wood and Scientific Certification Systems in the United States, and SGS-Forestry and Soil Association in the United Kingdom, that audited the forests and awarded certificates (Kiekens, 1999). An interesting point to note is that each of these certifiers had previously been involved in the field of forest management auditing and collaborated in the formation of the FSC.

Currently, a total of 18 million hectares, or just 0.6 percent of the world's forests, have been certified by the FSC, and 75 percent of that is located in three countries: United States, Sweden and Poland (Lang, 1999).

As was indicated earlier in the paper, a number of the larger Brazilian forest growers and forest products manufacturers have now achieved certification under the Smart Wood accreditation program. As a direct result, each of the manufacturers have reportedly experienced significant growth in export sales of certified products, particularly into the Western European market, where customer priorities tend not to be based solely on price and quality. In order to maximise this opportunity, various companies are now looking to modify their existing product range to better suit this market. Principally, certification has been utilised by South American manufacturers as a tool to penetrate export markets and to date this tactic has proven to be very rewarding. The predominant question remains however, that if Brazil did not have the global "reputation" of a seemingly poor forest manager would the benefits of certification been so positive?

Although the FSC dominates the internationally-accepted certification schemes, there is a growing push from industry and governments alike to develop a system of certification that is more closely tied to the open and transparent standards development work of the

International Standards Organisation (ISO), in particular the ISO 14000-series. Critics of the FSC question its mandate, accountability and motives, whilst others see the FSC as an independent non-government organisation which awards its seal to responsible forest managers who ensure timber harvesting is ecologically sound, and socially and economically beneficial.

To date, certification has been predominantly market driven and related to markets which both favour and can afford products from sustainably-managed forests. As consumer awareness grows and the global appreciation of certification systems, whether they are ISO or FSC based, continues, the market acceptance of accredited timber products may well turn into a market demanding these products. The underlying benefit of certification is that it would introduce independent third party audits of forest management practices, which "should" in turn contribute directly to the restoration of the public's confidence in forest based industries.

4.4 Plantations with Added Biodiversity

In order to combat concerns surrounding plantations as large-scale monocrops and reduce the use of harmful and costly pesticides, a number of forest growers, particularly in Brazil, have been incorporating progressively larger areas of remnant vegetation into their new plantation estates. One such company is Klabin, who now have 38% or 92,000 hectares of their forested land permanently reserved as native forest. The distribution of the preserved forest, among the planted stands of *Pinus*, *Araucaria* and *Eucalyptus*, is crucial to the area's ecological sustainability. Each of the strategically-remaining areas provides watershed protection and a genetic bank, which alternatively offers a natural defensive system for the planted forests.

Plate 12 : Klabin's mixed-species plantations

4.5 Alterations in Forest Ownership

In South America, as in other developing countries, there has been a noticeable amount of pressure placed on industry to reduce the amount of harvesting in native forests. As a direct result, there has been a major shift toward privately-owned and operated plantations. In each of the countries visited the vast majority of hardwood mills either had direct ownership of or shares in plantations, which were being developed to suit end product requirements. If Australia's native forest industries are to become globally competitive in timber products, they too must become, over time, forest owners.

4.6 Financial Incentives for Plantation Establishment

Fiscal incentive programs throughout the countries of the MERCOSUR have been fundamental in the rapid and continued growth of eucalypt plantations.

Brazil's incentive program to bolster plantation establishment began in 1966 and was primarily aimed at encouraging reforestation in the southern part of the country, and to provide a reliable source of raw material for a number of industries (Shield and Flynn, 1999). The program ran until 1987 and has assisted Brazil in becoming a world leader in plantation forestry. Couto and Betters (1995) have noted that the most successful of these projects had a direct link between timber production and its immediate use as a raw material, for example the Klabin plantations in the State of Parana.

In contrast, Argentina has been implementing various economic incentives since 1948 (Shield and Flynn, 1999). The success of these programs remained in question until the 1990's when these incentives were critically reviewed and considerable investment came through from various Chilean companies including Arauco and Compania Manufacturera de Papeles y Cartones (CMPP). Today, the Forestry Promotion Bill (1997) continues to offer attractive tax breaks and subsidies for foreign investors interested in establishing plantations within Argentina. As a result, the government has forecasted that an average of greater than 100,000 hectares will be planted each year between 2000 and 2009 (World Rainforest Movement, 1998).

The Uruguayan Government has also realised the socioeconomic benefits of plantation forests and in 1988 initiated a program of fiscal incentives to promote plantation projects. This included the exemption of land taxes for plantation areas; no tax on capital gains from plantations; reduced interest loans; duty free importation of plantation equipment; and finally subsides of up to 50% of the establishment costs for reforestation. As previously indicated, the results of this scheme were staggering, for within 10 years of its inception, the plantation base had increased by an estimated 300,000 hectares and continues to expand at more than 40,000 hectares per year (McKinnie, 1999).

4.7 Plantation Locality

To date, a number of eucalypt reforestation projects throughout the MERCOSUR have failed due to poor planning and land acquisition practices. The principal reason for this is that most of the companies wanted the largest tracts of land for the lowest possible price to improve their return on investment (Couto and Betters, 1995). More often than not, little attention was paid to the more important details such as the physical and chemical properties of the soil, precipitation rates, infrastructure, existing vegetation types and proximity to industry (Couto and Betters, 1995). Consequently, plantations such as those in Mato Grosso do Sul were abandoned. As is evident from this information, one of the key components in plantation establishment programs is the designation by government of appropriate land for plantation establishment.

4.8 Social Commitment and Community Interaction

For a long period of time, forest companies within the MERCOSUR did not realise the importance of establishing and maintaining effective public relations with regional communities. Initially, large-scale plantations were well received for they boosted employment and injected much needed capital into struggling local economies.

Over the past 10 years however, there have been growing concerns regarding both the social and environmental impacts of the widespread plantations. The majority of companies are now faced with mounting pressure from nongovernment organisations (NGO's) and in Brazil particularly, with changes in forest legislation at both state and federal levels. To arouse disharmony within the wider community the World Rainforest Movement has described Brazil's plantations in a number of forums not as forests but as "large-scale, rapid growth tree monocrops" (WRM, 1998).

To rectify the situation, companies such as Klabin in southern Brazil have introduced world-class environmental and social programs. The environmental education programs are aimed at developing awareness within the community by highlighting the benefits of forestry activities in terms of both conservation and the economy. Klabin's social program supports approximately 3,000 employees and their families and there are 5 forest villages where quality housing is provided along with schools and health care facilities.

4.9 Designer Tree Plantations

Since the establishment of eucalypt trees in commercial stands, South American foresters have primarily endeavored to improve plantation returns through increases in forest productivity. Over the past 15 years however, as the demand for value added wood products slowly increased, there has been a noticeable shift in plantation objectives to incorporate a number of wood quality parameters. Today, the vast majority of higher value forest growers within the Mercosur, including each of those mentioned above, are aiming to produce wood of predictable and uniform quality that conforms directly with processing and market requirements, hence the term "designer plantations".

In regard to desirable log properties, the following characteristics were indicated as having the highest priority; 1) stem straightness, 2) medium to high basic density, 3) low density variation from pith to bark, 4) uniform wood colour, 5) even grain, 6) freedom from end splitting and 7) small branch / knot size.

Desirable processing properties as indicated by the majority of value added manufactures included; 1) high dimensional stability, 2) minimal drying degrade, 3) moderate hardness, 4) high durability, 5) good gluability, and 6) high strength and stiffness.

As global competition increases and margins at the lower end of the market continue to decline both forest growers and manufactures alike will need to produce versatile, high quality products much more consistently if they are to remain competitive.

4.10 Preferred Species for Solid and Engineered Wood Products

Despite the vast range of eucalypt species introduced into MERCOSUR plantations, recent industrial trends favouring the use of young eucalypts for solid and engineered wood products have tended to focus primarily on *E. grandis* as a base resource (Tomaselli, 2000). The factors promoting the preferred raw material are directly linked to the silvicultural response, basic wood properties and processing characteristics of the species. The South American plantation grown *E. grandis* produces a medium density wood, with straight and relatively uniform grain, which ranges in colour from cream in the sapwood to reddish pink in the heartwood. Due to relatively low levels of extractives, *E. grandis* also lends itself well to gluing and finishing. These properties were fundamental in producing a range of products for widely varying markets.

Plate 13 : Freshly harvested E.grandis logs

4.11 Raw Material Handling

In Uruguay, Argentina, and Brazil there were numerous systems in use to minimise log degrade and maximise the recoverable volume of raw material prior to processing. The sophistication and mechanisation of the systems were highly dependent on the availability and cost of labour, the scale, and the world competitiveness of the company. The following sections highlight some of the key components of the more successful systems observed.

4.11.1 Seasonal Harvesting

As indicated, the Delamonte sawmill, based in Uruguay, ideally harvest their hardwood quota during the cooler, slow growth months which were said to correspond with lower levels of internal growth stresses and subsequently reduced amounts of log end splitting. The concept of being able to switch from pine to hardwood with the change in seasons has two benefits for the company. Firstly, Delamonte can optimise the return from their hardwood plantations and they also have the luxury of pursuing two totally different markets, with expanded product diversification.

4.11.2 Harvesting

Harvesting methods observed in the study area relied primarily on the use of chainsaws for felling, delimbing, and cutting logs to length. In some instances fallers had the assistance of small agricultural tractors fitted with a hydraulic boom to aid in the directional falling of trees. Even with this aid however, extensive limb damage occurred within the residual stand. Major Brazilian stake-holders such as Klabin and Aracruz are now looking to fully automate their thinning and final clear-fall operations through the implementation of mechanical harvesting systems. By following this path, stem damage will be greatly minimised, the risk of serious injury reduced, and the efficiency and productivity of forest operations will be dramatically improved. The added benefit of utilising mechanical harvesters is that individual trees can be lowered to the ground and directionally fallen, greatly reducing the potential development of end splits and internal shakes.

4.11.3 In-stand Transport

In the operations visited, the majority of logs were extracted with the bark intact, in whole tree lengths, utilising converted farm tractors or rubber-tyred skidders. The benefits of taking the next step and utilising set log-length forwarders in a mechanised harvesting system are now being considered by some of the major Brazilian companies such as Klabin and Aracruz. This is primarily targeted at reducing the environmental and growth rate impacts of soil compaction, and improving operational productivity. There are also substantial benefits for companies planning to establish coppiced rotations, for stump damage is also minimized with the utilisation of this equipment. The bark is retained to protect the logs from handling damage and maintain internal stability, subsequently reducing the extent of end splitting whilst in storage.

4.11.4 Short-Wood Haulage of Plantation Logs

In contrast to Australia's predominantly long regrowth hardwood logs, i.e. over 10 metres, the vast majority of plantation logs in the study area, irrespective of diameter or grade, were forwarded to mills in lengths of less than six metres. Due to the nature of this system, logs were either manually cross cut with chainsaws at the landing or batch loaded into V-shaped bunks where they are cut with the use of a large, length sensing, mobile, hydraulically-powered LM saw or slasher. As to whether this style of transport has carried over from the days of pulp production was not clear. Evidence existed at a number of manufacturing facilities, including the Argentine based Tapebicua and URUFOR mills, that multiple crosscutting before processing was not conducive to achieving optimal processing recoveries, due to the increased incidence and severity of end splitting. Rather than reviewing alternative methods of log length transport and the cost versus benefits of in-line crosscutting prior to processing, the majority of companies visited were looking to genetically minimise splitting in the log resource.

Plate 14 : Current form of log haulage

4.11.5 Central Tyre Inflation Systems (CTIS)

The use of CTIS was particularly evident in Brazilian forests where the vast majority of log haulage vehicles were fitted with this technology. CTIS allow tyre inflation pressures, hence ground contact pressure, to be varied whilst a vehicle is in motion. The direct benefits of this system for forest growers include an extended harvest period due to improved levels of drive axle traction, reduced road establishment costs, lower levels of rutting and subsequently minimal amounts of costly road maintenance. Log haulage companies also benefit from CTIS for they decrease tyre wear, increase traction, improve a vehicle's mobility, and reduce vibration which in turn minimises vehicle damage and related maintenance costs.

4.11.6 Tare Weight Reductions to Improve Payloads

As in Australia, major log haulage contractors in South America are investigating and implementing new truck components in order to improve payload capacities. Two of the more commonly implemented components identified were air bag suspension systems, replacing leaf spring configurations, and also combination steel and aluminium bolsters. By eliminating heavy steel leaf springs the overall vehicle tare weight is considerably reduced, tyre life is extended, fuel costs are lowered and trailer maintenance is minimised. As well as being significantly lighter than standard steel, Klabin's hauliers commented on the durability of the combination bolsters which tend to flex rather than bend which in turn greatly reduces bolster maintenance, enhances safety and improves trailer availability.

4.11.7 Log Storage

During the study tour the author observed three commonly implemented mechanisms to reduced log degrade whilst in storage.

The first and probably the most cost effective method employed by a number of mills, including those sourcing logs from Klabin, was to dramatically reduce storage times during the drier months of the year, and hence the time for logs to degrade. For a number of the smaller mills including Paledson, the time from stump to saw could be as little as 3 days.

The Southern Cross and Urufor sawmills however, choose to implement log cradle irrigation systems in order to reduce log degrade. The principal idea in both situations was to maintain the moisture gradient within the logs from pith to bark and also from end to end, which was said to alleviate internal stresses and subsequent losses from end splitting.

The third mechanism employed to minimise log deterioration, particularly from end splitting, was the application of a white, waxy end sealant. By limiting the amount of moisture loss from their logs, mills such as Tapebicua, obtained similar results to those above without the hassles associated with the management of wastewater.

4.11.8 Log Debarking

Rather than debarking plantation grown hardwood logs within the stand, the bulk of the facilities reviewed had introduced mill yard debarking and merchandising lines. Common components in most of these lines were either single ring debarkers fitted with rotary cutting heads or tandem ring debarkers. Tandem rotor configurations were installed where there was a need to remove stringy bark fibers. As well as having slitter knives, the secondary ring on this equipment has conventional scrapers to assist with bark removal. The distinct advantages in utilising this type of machine include minimal amounts of cambial damage, recovery improvements particularly for rotary peeling, and improved levels of energy efficiency for there is very little impact to remove the bark.

4.11.9 Mill Yard Log Grading

In-line with practically all the debakers were various types of log scanning and merchandising systems. The accuracy, feed rates, and automation of these lines varied greatly between locations. The high speed, small diameter Southern Cross sawmill situated in Uruguay scanned logs three dimensionally to determine form and sweep direction before merchandising on the basis of diameter classes. The URUFOR sawmill, which processes larger logs, with an average diameter of 36cm CDUB, sorted purely on diameter. By sorting prior to processing, the majority of mills have noted improved levels of both recovery and throughput, for sawing patterns can be preset and line speeds altered to match the incoming log diameters.

4.12 Process Alterations to Improve Productivity and Quality

In order to combat small average diameters and high levels of internal growth stress within the fast grown plantation eucalypts, South American processors have, through necessity, developed a number of modified processing techniques. As with the raw material handling the level of sophistication was highly dependent on the size and structure of the individual organisations. The following sections outline some of the fundamental principles behind the process alterations and the modified techniques employed to more efficiently process the plantation resource.

4.12.1 Sawn Wood Processing

Over the past 10 years the sawmilling industry within the MERCOSUR has undergone substantial change. Whilst some mills have closed, others have upgraded and been able to rapidly expand by adapting their saw lines to suit resources and produce quality products for a range of growing markets. At different ends of the spectrum are companies such as the Argentine-based Urufor sawmill who are processing small logs primarily for the domestic market, and the Brazilian-based Aracruz sawmill which processes larger logs for predominantly select export markets. At present both ventures seem equally viable, given the available resource and level of capital investment.

The Urufor saw line, originally designed to cut pallet grade material from an non-thinned and non-pruned small diameter resource, utilises twin band saws for primary log reduction followed by a multi-arbor saw for center cant re-sawing. This sawing strategy is highly productive and is intended to reduce stress equally on both sides of the log, aiding in the production of timber free of spring – a defect commonly associated with fast-grown plantation logs.

As previously mentioned, Aracruz manage a portion of their plantation resource on longer rotations and as a result have implemented a highly efficient saw line with the capability to handle logs up to 85cm in diameter (Shield and Flynn, 1999). To accommodate the larger logs and produce the highest quality boards, the Tecflor sawmill utilises two large band saws – one acts as the head rig for primary log reduction whilst the other as a cant resaw. Both saws are laser-guided for cutting precision and otimal output.

In general terms, the technology to efficiently saw plantation eucalypts does not seem to be a major limiting factor – it is the resource characteristics which are determining end product quality and subsequently operational viability.

Plate 15: Multi arbor saw outfeed

4.12.2 Batching Green Material

A problem commonly faced by sawmillers and veneer manufactures alike when processing plantation eucalypts is the wide variation in drying properties. To overcome this problem the more progressive mills visited were reviewing various processes to match material of like characteristics, particularly density and moisture. By batching timber and veneer before drying, average kiln residence times could be reduced and final product degrade minimised.

4.12.3 Drying Techniques

As in Australia, the hardwood sawmilling industry within the MERCOSUR is shifting away from the traditional base of structural grade timber towards kiln-dried value-added products.

Of the mills visited by the author the majority were air drying their sawn timber for a period of time before kiln drying. The length of time for air drying varied from location to location and according to seasonal conditions it could take between 5 and 8 months for 38mm timber to reach a moisture content below fibre saturation point. To prevent excessive moisture absorption and damage from direct sunlight, mills such as Tapebicua have constructed air drying shelters with iron roofing and elevated bases. All of the air drying yards visited were tidy, well drained and had stacks of timber raised well above ground level.

The kilns being utilised were essentially conventional compartment type units with internal fans and were heated with steam from predominantly wood-fired boilers.

One of the few mills practising direct kiln drying was the Urufor sawmill in Uruguay. To reduce excessive movement within the timber whilst being dried the slings were placed under hydraulic pressure and strapped before being charged. As previously mentioned, a residence time of approximately 23 days was required to dry 32mm boards down to a moisture content of approximately 12%. By implementing this process Urufor has been able to significantly reduce inventory costs in air dried timber stocks.

4.12.4 Value Added Shorts

In order to obtain premium returns on short lengths of clear material, there are a growing number of manufacturers within the MERCOSUR incorporating remanufacturing lines into their mills. Consisting primarily of docking saws, finger jointers, and planners, manufacturers are looking to improve the recoverable volume of material from kiln dried boards and also improve profit margins. Companies including the Brazilian-based Paledson are also constructing a secondary remanufacturing line to produce edge-glued panels for bench tops and stair treads.

4.12.5 End Product Grading

To date, online stress grading has been mainly the role of traditional mechanical stress grading machines. The relatively simple process involves the physical bending of a length of timber to determine its stiffness, or modulus of elasticity (MOE), and subsequently its structural grade.

In order to improve both the cost effectiveness of this process and the marketability of finished products, manufacturers, including Aracruz and Tapebicua, are looking to implement forms of electronic grade. The systems under review are based primarily on either X-ray or microwave technology. The benefits of this technology are twofold; firstly it allows for high speed in-line product grading as physical contact is not required, and secondly by looking into the sawn wood or engineered product the nature and size of defects can be accurately determined. The ability to more efficiently detect undesirable internal defects within products should allow manufacturers to proceed into new markets with a quality edge and a higher level of confidence.

4.13 Market Growth

Since the early 1950's companies within the MERCOSUR region of South America have been sawing plantation eucalypts and producing composite panels with *Eucalyptus* fibre (Shield and Flynn, 1999).

Until only recently however, the sawn component has been primarily confined to local consumption and traded at low prices as construction and pallet grade material. In countries such as Brazil eucalypt products compete directly with tropical timbers, which are relatively abundant and widely available. In Uruguay and Argentina there has been a greater penetration of sawn plantation eucalypt products due to the apparent lack of locally supplied alternatives. In general terms, manufacturers have obtained greater market share by offering a wide range of higher-quality dried and dressed products at very competitive prices.

As indicated by a number of the larger manufacturers, penetration into the international markets particularly North America and Europe has not been an easy task. Timber markets tend to be very traditional and clients may have several domestic alternatives from which to choose (Tomaselli, 2000). Apart from competing directly with other tropical and temperate hardwoods, exporters are also endeavoring to overcome the market place perception that eucalypt products possess highly variable mechanical properties. On the flip slide however, there is a growing demand in a number market sectors for certified products from plantation forests which will no doubt facilitate greater market penetration in years to come.

As stated by Simula and Tissari (1998, cited in Tomaselli, 2000), the marketing challenge for eucalypt exporters is to clearly identify where the competitive advantages can be found, and how they can be best utilised. As history has shown competitiveness in the market place cannot be based purely on price, it has to be combined with continuity of supply and consistent product quality. At present raw material quality, in log form, is the major limiting factor holding back processors within the MERCOSUR.

5.0 Summary

5.1 Observations

- There is growing pressure within Australia and abroad to halt logging in native forests.

- A significant downsizing of the hardwood sector occurred within Australia when the resource base altered from old growth to smaller diameter regrowth.

- Eucalypt plantations now make up 10% of the world's plantations and the proportion is rapidly growing.

- The Continent of South America currently has the largest area of eucalypt plantations in the world at around 2.92 million hectares.

- The silvicultural management of recently established eucalypt plantations within South America has tended to be quality-oriented rather than volume-based for pulp production.

- Within the countries of the MERCOSUR there is growing foreign interest in developing and manufacturing engineered wood products including oriented strand board (OSB), plywood and laminated veneer lumber (LVL) from plantation eucalypts.

- Companies reestablishing plantations for sawn timber products are utilising seedling stock rather than coppiced rotations in order to obtain growth and quality benefits from genetic breeding programs.

- The majority of eucalypt forest growers throughout the study area conduct aggressive pruning regimes in order to minimize the diameter of the knotty core and increase the volume of clearwood for value-added products.

- Certified forest products are now well established in the global market and are making in-roads in restoring consumer confidence in forestry based industries.

- Progressive forest growers including companies such as Klabin in Brazil are now incorporating remnant vegetation into the marginal areas of their eucalypt plantations to improve watershed protection and provide a genetic bank for natural defensive systems.

- In order to match raw material requirements with processing facilities and target markets South American manufacturers are now well underway in establishing their own designer tree plantations.

- Financial incentive programs throughout the countries of the MERCOSUR have been fundamental in the continued growth of eucalypt plantations.

- Companies investing in broad acre plantations have realised the beneficial implications of establishing and maintaining high levels of public relations with regional communities.

- To date, the quality of South America's plantation eucalypts has been the main factor limiting the production of high-value products, not the availability of appropriate conversion technologies.

- As living standards and wage rates gradually improve throughout South America and shipping costs to export markets increase, the current price advantage may well dissipate in years to come.

- The following factors have been noted as being critical in determining the profitability of eucalypt plantations; site quality, genetic stock, silvicultural management, scale, financial attractiveness, advantages in the market place i.e. FSC certification, a sound marketing plan, and lastly the proximity and suitability of processing technology.

5.2 Recommendations

Resource

- To become increasingly efficient at manufacturing products of consistent quality Australian forest product manufacturers will need to gradually become forest owners.

- Australian tree breeders will need to work more closely with industry to determine the properties critical in maximising end-product quality across a range of species.

- Coppicing of improved plantation eucalypts within Australia needs to be thoroughly evaluated to determine any possible productivity improvements.

- Research is required on the economic viability of alternative silvicultural techniques aimed at enhancing the production of value-added products.

Processing

- Further research into the high-speed sawing and rotary peeling of plantation eucalypts is required in order to produce appearance grade products.

- Detailed studies into the direct kiln drying of low density plantation eucalypts need to be undertaken.

- The development of cost-effective in-line processes to determine like-characteristics within green sawn timber requires further investigation.

Marketing

- A greater number of value-added manufacturers in the Australian hardwood industry need to unite and market products under a single banner in order to be competitive on the world market.

- The Australian native hardwood industry and appropriate government agencies need to pursue the certification of forestry management practices under an internationally recognised scheme to improve export opportunities.

- More information is required on the wood properties of young eucalypts and how these relate to current performance-based standards for different end use applications.

General

- Australian researchers and industry representatives alike need to build on existing relationships with international organisations dealing with plantation eucalypts so that research efforts are not being duplicated.

- Collaboration between researchers and industry needs to be further encouraged to ensure research relevance and the application of results.

5.3 Conclusion

A number of significant changes have occurred in the direction of the Australian native forest timber industry in recent years due namely to changes in public perception, resource availability and increased competition from exotic species. As an added challenge, pressure is now mounting on the hardwood industry to respond to both domestic and international trends and become more reliant on sustainably-managed plantation resources. By careful examination of the methods and processes developed and implemented by the South Americans, Australia's timber industry can utilise its inherent advantages of technology, political stability, and land mass, to pursue the effective growing, processing, marketing and distribution of this resource.

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