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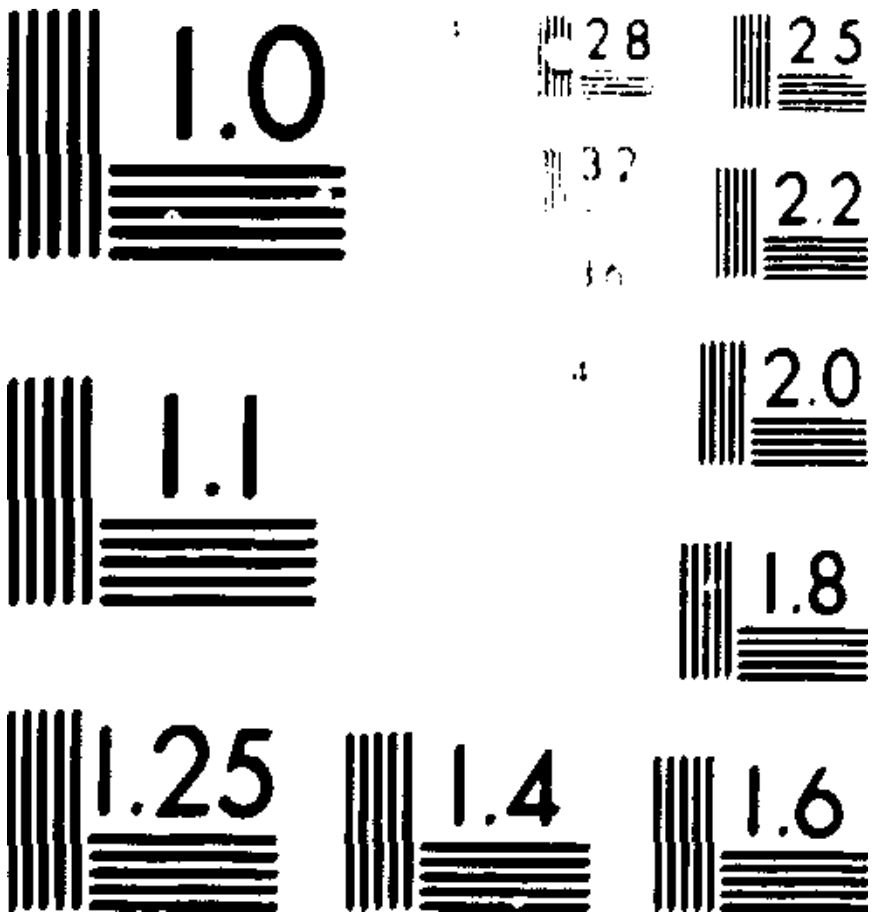

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WOOD AND RELATED ENGINEERING INDUSTRIES IN FINLAND *

prepared by the

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699

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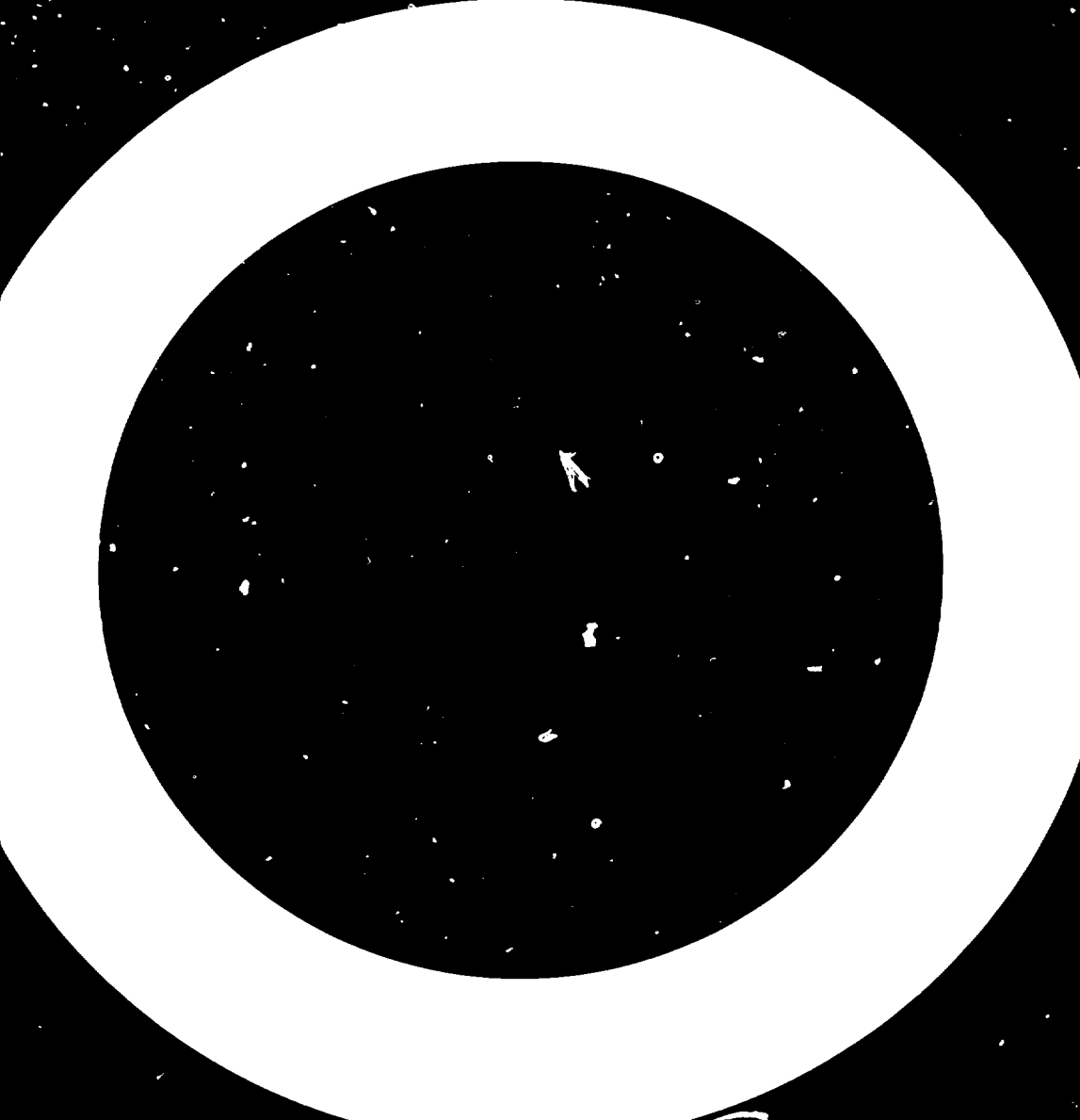
TABLE OF CONTENTS



PREFACE

This paper is intended to give an overall picture of mechanical wood industries in Finland, of their production capacity, technical standard and technology applied. The suitability of Finnish practices and equipment for developing countries is assessed based on experience of extensive projects. Finland's potential for machine and equipment deliveries, for engineering, construction, management and training services and for financing assistance is also described.

The presentation has been prepared by the Ministry for Trade and Industry of Finland with the assistance of Jaakko Pöyry Consulting Oy, Helsinki.

i

FINLAND

Finland is the fifth largest country in Europe with a total area of 337 000 sq.km. About 10 % of the total area is water. Finland's nearest neighbours are Sweden, Norway and the Soviet Union. The population is 4.8 million of which 60 % live in towns. The capital city is Helsinki and it has a population of 480 000. Finland is a parliamentary democracy, and in foreign affairs a neutral country.

Finland's gross domestic product (GDP) at market prices was USD 28 billion in 1981, or USD 6000 per capita. Industry contributed 38 % to GDP, services 53 %, and agriculture and forestry 9 %. The economy is exported-oriented; over 30 % of the GDP goes for export as goods and services. Finland is a member of EFTA, has a free trade agreement with EEC, and bilateral trade agreements with most COMECON countries. In 1982 developing countries accounted for 7.8 % of imports and 8.8 % of exports.

The forest industry is the single, most important economic sector in Finland. It generates about 40 to 45 % of the country's export earnings, provides direct and indirect employment for 230 000 people, and has provided a sound growth base for engineering industries and services.

2 FORESTRY

2.1 Forest Area

Some 65 % of Finland's land area, or 19.7 million hectares, is covered by forests. Forests are the major natural resource in the country and hence forestry has always enjoyed high priority in the national economy and economic policy.

2.2 Forest Ownership and Administration

A special feature of Finnish forestry is that a great proportion (64 %) of the forests belongs to private, non-industrial owners; there are some 277 000 forest holdings. This has strongly influenced both forest legislation and administration in Finland.

The early laws aimed at preventing devastation of forests. Now they also stipulate principles and norms for proper forest management. The Ministry of Agriculture and Forestry and The National Board of Forestry are in charge of forest administration in general. The latter operates state forests and promotes private forestry. The private forest owners have several organizations and bodies to assist and guide the individual owners.

2.3 Wood Resources

The total standing volume of commercial wood is about 1600 million m^3 over bark, or on average 79 m^3/ha. The main species are pine (44 %), spruce (38 %) and birch (15 %), the rest being other broadleaved species.

Despite the intensive exploitation, the wood volume of Finland's forests has increased continuously and the allowable cut is now over 60 million m^3 a year. This growth has been achieved through efficient forest management and comprehensive national forestry programmes implemented since the 1950s.

The growth of forestry and forest industries relies on on national forest inventories, which were started already in the 1920s. A continuous inventory method was introduced in the early 1960s, and the entire country is now inventoried once every six years.

2.4 Forestry Operations

Silviculture has been the object of constant research, trial and practice in Finland in the past 40 years. Finnish soil preparation equipment and seedling planting methods are used throughout Europe.

The annual production of seedlings in Finland is about 190 000 million and some 120 000 hectares are reforested annually. In addition, Finland has some six million hectares of virgin peat-bog of which nearly 300 000 hectares a year are drained and planted. Because of the experience with peatlands Finns are experts in the conversion of swamplands to productive forests.

2.5
Forest Machinery

The forestry sector has provided a a good basis for developing management skills and competitive logging machinery and tools.

Finnish forest machinery and equipment manufacture covers virtually all operations from stump to mill, and Finnish machine designers and builders are well known throughout the world.

In addition to mechanized systems, the product range includes modern high-productivity hand tools, measuring devices, lumber-jack's personal requisites, safety gear, and other accessories.

2.6
Forest Research

Forest Research covers the whole range of forestry including soil science, silviculture, forest genetics, forest protection, forest inventory and yield, forest management, remote sensing, photogrammetrics, forest technology and forest economy.

2.7
Forest Education

The highest forest education is given at university level in the Forestry Department of the Universities of Helsinki and Joensuu. It produces professional or graduate foresters and forest scientists.

Forestry colleges train forest technicians for supervisory planning and other similar tasks in forestry. Foremen in forestry and sawmilling are trained in three schools.

Vocational training is given in forestry and in the use of forest machinery.

3 WOOD INDUSTRIES

3.1 General Structure

All sectors of forest industry are well established in Finland. Especially the primary forest industries are export-oriented large-scale industries. The total wood consumption (excluding wood residues) in 1981 and 1982 was divided as follows:

	1981		1982	
	million m^3 s. ob.	%	million m^3 s. ob.	%
Sawmills	18.7	39.9	15.5	36.0
Plywood industry	1.9	4.0	2.1	4.9
Particleboard industry	0.2	0.4	0.2	0.5
Fibreboard industry	0.2	0.4	0.2	0.5
Other wood industries	0.5	1.1	0.4	0.9
Total wood industries	21.5	45.8	18.4	42.8
Pulp and paper industries	25.4	54.2	24.6	57.2
Total forest industries	46.9	100.0	43.0	100.0

3.2 Wood Industries

3.2.1 Sawmilling

In Finland there are over 8000 sawmills with a total capacity of about 12.5 million m^3 of sawnwood a year. Most of the sawmills are very small; the 335 major mills registered as industrial sawmills account for about 90 % of the total capacity.

In 1980 Finland produced 10.2 million m^3 of sawnwood - the highest production ever reached. After that the production has dropped due to market fluctuation (Table 3-1). Traditionally, two thirds are exported, mainly to Western Europe, corresponding to 20 % of the area's total imports of sawnwood.

3.2.2 Plywood

Plywood manufacture was started in the 1890s, and there are now 28 plywood mills in operation. Their total capacity is 850 000 m^3/a. The peak production of 730 000 m^3/a was reached in 1973. After a drastic drop in the mid-1970s, the production has recovered, exceeding 600 000 m^3/a in the 1980s (Table 3-1).

On average 85 % of the production is exported. Finland is one of the world's leading exporters of plywood. Finland's plywood industry is largely based on birch and its excellent properties. Owing to the dwindling supply of birch, spruce has been used as a supplementary raw material in plywood in recent years.

Different types and grades of high quality, phenol glued panels are produced. At present over 60 % of the production is converted and further processed.

3.2.3
Particleboard

The particleboard industry is the youngest of the wood-based panel industries in Finland, with the first mill built in 1955. In 1976 the total capacity of the country's 15 mills was about 1.2 million m^3/a. In recent years some of the older mills have been closed down; at the moment only 10 mills are operating, with a total capacity of about 850 000 m^3/a.

The peak particleboard production (842 000 m^3/a) was reached in 1973. After that, the production has fluctuated between 530 000 and 800 000 m^3/a, depending on the market (Table 3-1). Over 40 % of the production has been exported, mainly to England and other Western European countries.

With few exceptions the Finnish particleboard mills are integrated with other wood industry units, mainly with plywood mills. So most of the wood raw material is wood residues, the share of primary roundwood being less than 25 %.

Over 90 % of the production is ureaformaldehyde glued standard particleboard, but the share of special products is increasing. About 30 % of the production is converted and further processed.

3.2.4
Fibreboard

The first fibreboard mill was started in 1931. Today there are five fibreboard mills in operation with a total capacity of 380 000 m^3/a (300 000 ton/a).

Like the other wood-based panel industries, the fibreboard industry has declined since 1973 when the total production was 396 000 m^3/a. The production figures for the last two years are shown in Table 3-1. Before the world recession in the 1970s, over 60 % of the production was exported; in the last few years only some 45 to 50 %.

The fibreboard mills are mostly integrated using wood residues as raw material. Some 40 % of the raw material is roundwood, mainly birch and aspen.

Both softboard and compressed fibreboards are produced. About a half of the production is converted into special products.

Table 3-1
Production and Exports in 1981 and 1982

	Number of mills	Production		Exports	
		1981	1982	1981	1982
			- 1000 m^3 -		
Sawnwood	...	8260	7300	5411	4600
Plywood	28	603	596	534	518
Particleboard	10	707	636	342	239
Fibreboard	5	223	202	110	62

3.3 Wood Products Industries

Because of the country's vigorous sawmilling industry, Finland has long traditions building with wood and manufacturing wood products.

3.3.1 Prefabricated Houses

At present 40 to 50 firms manufacture prefabricated wooden houses, holiday houses, saunas etc. The production of permanent prefabricated houses has varied between 5000 and 6000 single-house dwellings and over 2000 attached-house dwellings per year. The total production value of the prefabricated house industry is about USD 200 million/a (Table 3-2). Most (50-70 %) of the production is used in Finland, although houses have been delivered to Scandinavia, Western Europe, the Soviet Union, Middle East, Japan etc.

3.3.2 Joinery

Some 100 to 120 major companies produce joinery products such as wooden windows, doors, kitchen cabinets, cupboards, trusses, glulams etc. Due to the decline of building activity, the production of major joinery products has stagnated at 3.5 to 3.8 million units a year, the corresponding production value being some USD 300 million/a (Table 3-2). Most of the production is delivered to the domestic markets, the share of exports being less than 10 %.

3.3.3 Furniture

According to industrial statistics there are some 240 companies (excluding the smallest carpenters' shops) manufacturing non-metallic furniture, the total production value being USD 422 million in 1981 (Table 3-2) and total employment about 11 500 people. The most important product groups are chairs and sofas, kitchen cabinets and cupboards, and tables and book shelves. About 35 to 40 % of the production is exported, mainly to Scandinavia, the Soviet Union and Western Europe.

Table 3-2
Production and Export Value in 1981 and 1982

	Number of companies	Production 1981	Production 1982	Exports 1981	Exports 1982
		- million USD -			
Prefabricated houses	40 to 50	180	238	61	112
Joinery	100 to 120	302	340	20	16
Furniture	240	422	N.A.	146	135

3.4
Pulp and Paper Industry

The pulp and paper industry in Finland was established in the 1880s. The mills produce mechanical and chemical pulps, paper, board and a variety of converted paper and board products.

In addition, several by-products and chemical products such as turpentine, resin, alcohol etc. are produced.

The number of mills, their production and exports in 1981 and 1982 are listed in Table 3-3.

Table 3-3
Pulp and Paper Mills and their Production in 1981 and 1982

	Number of mills	Production 1981	Production 1982	Exports 1981	Exports 1982
		- million tons -			
Pulp	52[1)]	7.3	6.7	1.7	1.4
- sulphate	18	3.8	3.5	1.3	1.1
- sulphite	10	0.6	0.6	0.4	0.3
- half chemical	4	0.4	0.3	-	-
- groundwood	20	2.5	2.3	0.0	0.0
Paper	30	4.6	4.4	3.7	3.7
- newspaper		1.7	1.5	1.5	1.3
- other papers		2.9	2.9	2.2	2.4
Board	16	1.5	1.5	1.1	1.2
Converted products		0.7	0.7	0.4	0.4
By-products		0.2	0.2	0.05	0.05

1) Most of these mill produce pulp and groundwood for integrated paper mills. Excess production only is exported.

3.5
Integration

A special feature in the Finnish forest industry is that most of the bigger mills are integrated to promote efficient use of available wood resources. Typical integrates are:

- sawmill + plywood mill
- plywood mill + particleboard mill
- sawmill + fibreboard mill
- sawmill + joinery plant or prefab housing plant
- sawmill + pulpmill (+ papermill)
- particleboard mill + furniture plant

As a general rule, chips from sawmilling and sometimes from plywood manufacture are used as a raw material in pulp industry. Sawdust is used in pulp, panel products or as a fuel. Bark is used as fuel in most cases. Sanding dust from panel industry is also used as fuel.

Unintegrated mills sell their chips, sawdust and sometimes also bark to mills nearby.

3.6
Economic Role of Wood Industries

The mechanical wood industries account for about 40 % of industrial wood processing and for over 50 % of the total employment provided by Finland's forest industry. The forest industry generated in total about 40 % of Finland's export earnings in 1981, the mechanical wood industries' share of this being about a quarter.

Table 3-4 shows Finland's forest industry role in the world markets. (For comparison one should remember that the population of Finland is only 0.11 % of the world's population and about 0.9 % of that in Europe.)

Table 3-4
Finland's and the World's Forest Industries in 1980

	Sawn softwood	Plywood	Particle-board
	- 1000 m^3 -	- 1000 m^3 -	- 1000 m^3 -
Production			
- whole world	322 445	40 275	40 330
- Europe	70 155	3 615	24 019
- Finland	10 152	639	809
Finland's share (%)			
- of global production	3.1	1.6	2.0
- of European production	14.5	17.7	3.4
Exports			
- whole world	65 184	6 908	5 480
- Europe	22 339	1 470	4 821
- Finland	6 898	531	374
Finland's share (%)			
- in global exports	10.6	7.7	6.8
- in European exports	30.9	36.1	7.8

Fibre-board	Wood pulp	Paper and paperboard	Total forest products
- 1000 m^3 -	- 1000 tons -	- 1000 tons -	- bill. USD -
16 514	126 755	174 186	
4 525	30 832	50 057	
298	7 440	5 923	
1.8	5.9	3.4	
6.6	24.1	11.8	
2 133	21 173	35 106	54.48
1 302	7 139	13 093	24.32
119	1 899	4 868	5.47
5.6	9.0	13.9	10.0
9.1	26.6	37.2	22.5

4 FINNISH WOOD INDUSTRY TECHNOLOGY

The techniques applied and the technical standard of the major wood industries in Finland are briefly reviewed and the suitability of Finnish techniques for developing countries discussed in the following.

4.1 Sawmilling

4.1.1 Finnish Technology

The Finnish sawmilling industry is very heterogeneous, ranging from small mobile circular sawmills to large-scale, highly mechanized and automated modern mills.

Simple mobile or permanent circular sawmills are common in producing sawnwood for local needs, while the commercial sawmills have traditionally used framesaws. In recent years other sawmill types have gained ground: modern circular sawmills in smaller and medium size mills (capacity 15 000 to 35 000 m^3/a in one shift), and chipper canter bandsaws, and combinations of different machine types in bigger sawmills (50 000 to 100 000 m^3/a in one shift). At the same time the average size has increased, the biggest sawmills having an annual capacity up to 350 000 m^3 of sawnwood.

The main features of industrial sawmills are:

1 Logs are delivered to the mills as ready-made sawlogs which are first sorted by top diameter into diameter groups with 2 cm or smaller intervals. In the most modern sorting lines the logs are measured and graded automatically according to dimensions, length, quality and sweep. So every log size and quality group can be sawn in an optimum way and with maximum yield. With these measures a sawnwood yield of almost 50 % can be reached despite the very small average log size (Ø 19-21 cm).

2 Because chips made of residues and even sawdust are used for pulp and wood-based panels the sawlogs are debarked before sawing.

3 The traditional framesaw line consists of two framesaws and two board edgers. The modern sawing lines are based on chipper canter technology combined with bandsaws or circular saws. Various combinations are also used, such as a framesaw line for bigger logs and a chipper canter -circular saw line for smaller logs. Special attention is paid to sawing accuracy, surface quality and yield. Sweep sawing, and automated infeed of cants and automated edgers are increasingly applied to improve yield.

4 In the smaller and older mills sawnwood handling is still fairly labour-intensive, though mechanized and automated systems are used for green sorting, trimming and grading, and length sorting in modern sawmills.

5 Normally, the whole production is artificially dried in efficient dry kilns. Automated systems are often used for controlling the drying conditions.

4.1.2
Developing Country Applications

Finnish sawmilling techniques based on small sized softwood logs are not always best suited for the conditions prevailing in most developing countries utilizing large sized logs. They can best be applied in processing plantation grown logs. The technical standard of the equipment can be adjusted to the local conditions by varying the degree of mechanization and automation according to the requirements.

Generally simple mobile or stationary circular saws can be used everywhere e.g. for sawing thinnings from plantations or for producing sawnwood for local needs. This type of sawmills are flexible and independent of electricity supply.

More advanced Finnish type circular sawmills can be built for higher production in conditions where enough qualified personnel is available and other preconditions for operation, such as adequate raw material supply, electricity, and markets, are available.

Gang framesaws have proven suitable for sawing small and medium sized logs (up to 50 - 60 cm in diameter) also in developing countries. Framesaws are simple and relatively easy to maintain. Saw blade maintenance is easy compared with circular saws or band saws. The frame saw produces high quality sawnwood with good rate of recovery. No special skills are required to operate the machinery. So the Finnish framesaw technology is often very suitable for sawing plantation-grown wood or small-diameter wood from indigenous forests. The technical level of a framesaw line can be varied widely according to local requirements and conditions.

More advanced Finnish techniques could be used in high-capacity mills and more developed areas, although the latest innovations and developments hardly can be regarded suitable for developing countries.

Except in the sawing process itself, Finnish technology and experience can be utilized in log handling, sawnwood and residue handling, kiln drying and the use of residues as fuel.

4.2
Plywood Industry

4.2.1
Finnish Plywood Technology

The Finnish plywood industry is based on birch with fairly small log size. This is reflected in the manufacturing techniques and machinery used.

The average size of Finnish plywood mills is relatively high or about 30 000 m^3/a. The highest total production capacity, including blockboard, laminboard etc. is 80 000 m^3/a.

Most of the mills are fairly old but almost all of them have been renovated in recent years. Labour-intensive methods have largely been replaced by modern mechanized and automated systems, and new, more efficient production lines and equipment have been introduced. As a result of this development, the most efficient mills use less than 10 manhours per m^3 of plywood.

Typical features of Finnish plywood mills are:

1 Logs are often stored and handled in water. Logs are heated up in special pools or vats to improve the quality of peeling. In wintertime heating is imperative to provide unfrozen logs in peeling. Most of the heat energy comes from waste heat recovered from veneer dryers.

2 Logs are debarked so that veneer residues from peeling can be used as raw material for pulp and panel products. Bark is used as fuel.

3 Logs are bucked into peeler blocks on mechanized cross-cutting lines. One mill can have up to five different block lengths, and therefore, the modern mills have automated optimizing equipment for cross-cutting, which accurately measures the incoming log.

4 High-speed veneer lathes with automatic block charger and centering device are used for peeling. Combined green veneer lines with tray conveyors, automated veneer clippers, and sorting and stacking units are common.

5 Peeling and veneer drying are often combined into a line, where the veneer from the lathe goes via a tray conveyor to a continuous dryer and then to dry clipping, sorting and stacking. In addition to these lines, separate roller dryers with mechanized or manual infeed are still used.

6 Dry veneer handling, i.e. splicing, scarf jointing and patching are of special importance in Finland because of the small size and relatively low quality of logs. The trend is to build mechanized and automated lines for these operations, too, to improve the yield and reduce operating costs. However, in most cases, dry veneer handling still requires a lot of manual work.

7 Plywood assembling and pressing do not differ from general practice elsewhere, but manual work has been minimized with infeed and outfeed devices whenever possible. Automated systems for assembling and pressing have been developed recently. Cold pre-pressing is common practice in Finland, where practically all plywood is glued with phenolic resin.

8 Sanding and trimming are normally done on mechanized lines. Upgrading, i.e. face repair, is still done manually in most mills.

9 Over 60 % of the production is further processed to produce film- and laminated-faced plywood and other special products. The mills normally have separate mechanized production lines for these purposes.

Most of the machinery used in the plywood mills is of Finnish design and made.

4.2.2
Developing Country Applications

In principle the Finnish plywood techniques are normal hardwood techniques applicable all over the world. They are also well suited for softwood, because about one third of the raw material used is spruce. A special feature is the small size of the peeler blocks, which makes it especially suitable for conditions where log sizes are diminishing. The small log size requires fast centering and charging equipment ahead of the peeler to ensure adequate output. These have been developed in Finland and they are universally applicable for peeling small logs.

Big and heavy logs normal in tropical countries require different techniques and more heavy equipment in log handling and peeling. When peeling big logs, the tray system used in Finland must be replaced by reeling. However, reeling is also known in Finland; earlier, before the efficient tray system was developed it was in common use here.

After peeling and green veneer handling, the basic manufacturing process is very similar everywhere in the world. This means that the Finnish systems can be applied, too, provided that they are adjusted to the local conditions, especially

the degree of mechanization and automation. However, this should not be difficult because the more labour-intensive and simple methods are still in use in some mills. Examples of such methods are manual infeed and outfeed of dryers, manual sorting of dry veneer, manual patching of veneer, labour-intensive lay-up stations etc.

4.3 Particleboard Industry

4.3.1 Finnish Particleboard Technology

Most of the Finnish particleboard mills rely on standard German particleboard techniques, though some of the mills are based on completely Finnish design and use Finnish main machinery.

The average capacity of the Finnish particleboard mills is about 85 000 m^3/a, the biggest single line having a capacity of about 240 000 m^3/a. Most of the mills produce normal flat pressed 3-layer or graduated board; there is only one special line for manufacturing thin particleboard with a calender process.

The technical details of manufacturing vary according to the mill type and manufacturing method used, and the size and age of the mill. As the older mills have been renewed, all the mills are relatively modern. In forming and pressing, however, varying methods are used including multi-opening and single-opening presses and conventional caul systems, wire belt systems and caul-less systems.

Many of the mills have special lines for manufacturing painted and film-faced panels, tongued and groved flooring panels, and components to furniture factories.

Most of the mills are integrated and use wood residues from other processes. This naturally has some consequences in the manufacturing process, especially in wood handling and particle preparation. Wood is normally delivered to the particleboard mill in the form of chips or roundwood, and solid residues are chipped before flaking. This is the only practical way especially in the bigger mills for handling different types of wood raw material. For drying, normal flue-gas dryers with combined oil and sanding dust-burning are mainly used.

4.3.2 Developing Country Applications

Particleboard manufacture is a processing industry in which highly simplified and labour-intensive methods cannot be

adopted in all stages of production without risking smooth operation and the quality of the product. Therefore, the basic technology has been the same even in the developing countries, although simple methods and proven systems are to be preferred. This applies especially to the relatively small mills, which are the only acceptable type in most developing countries.

The techniques used in the smaller and older Finnish particleboard mills can be regarded suitable for developing countries with some minor modifications related to the degree of mechanization and automation. Special features, such as flaking of random length wood, drying with steam heated dryers, and simplified particle preparation and other processes which might be necessary in developing countries are also known in the Finnish particleboard industry

4.4
Fibreboard Industry

4.4.1
Finnish Fibreboard Technology

All Finnish fibreboard mills use the wet method to make softboard (three lines) and compressed fibreboard, hardboard and medium density board (five lines). One mill produces compressed fibreboard from softboard with dry pressing, but the manufacturing of MDF panels with the dry method has not yet started in Finland.

All the mills are very old; even the youngest production lines date from 1959. Several renewals have, however, been made so that the mills represent relatively efficient modern technology. The average size of the hardboard mills is about 38 000 m^3/a and that of the softboard mills 45 000 m^3/a (15 000 ton/a).

The manufacturing methods and equipment are commonly known and similar to those of other mills in Scandinavia. The fibreboard mills are integrated and use mainly wood residues as raw material. All the mills produce several grades and qualities. For instance some of the hardboard mills specialize in producing door-sized panels while most of the production is for building and common uses. Softboard mills also produce bitumen impregnated insulation board for house construction.

All the mills have special lines for converting and further processing, including painting, overlaying, embossing and machining lines.

4.4.2
Developing Country Applications

The fibreboard industry relies on certain basic techniques. Some special small-scale systems for developing countries have, however, been developed though they have not been very successful, nor very widely used.

The Finnish fibreboard mills are designed for large-scale manufacture, so the techniques used are suitable for medium size or big mills in developing countries.

4.5
Wood Products Industries

4.5.1
Finnish Practice

The techniques used in the Finnish wood products industries range from simple manual systems to modern, highly mechanized systems. The scale of operations varies from small family enterprises to large industrial units employing several hundred people.

Serial production systems are applied for industrial manufacture of standard products, such as doors, windows, furniture etc. Most processes are mechanized and modern special machines are used e.g. for wood preparation and machining, for panel veneering and overlaying, for edge lipping and bonding, for painting and lacquering etc. Most of the mills use so-called single machine systems, and combined production lines are found only in the biggest and most modern mills, e.g. in some door and furniture factories.

The prefabricated house factories produce building elements using mostly small elements. The wall size and cubicle element systems which represent a considerably higher degree of prefabrication are not very common.

The degree of finishing of doors and windows is very advanced, and they are generally delivered as complete sets with frames, glasses, hinges and fitments, and with painting or other surface treatment.

The furniture plants produce standard and special furniture using solid wood and wood-based panels, mainly particleboard as raw material. The manufacturing practices and methods vary in a wide range.

4.5.2
Developing Country Applications

The manufacturing methods and systems of the Finnish wood working industries are, of course, suitable also for the developing countries. The systems to be applied have to be chosen based on the local conditions, technical skills of the personnel etc.

5
WOOD INDUSTRY MACHINERY AVAILABLE FROM FINLAND

5.1
General

Some of the biggest companies also have their own engineering works, and they can supply a wide range of machines and equipment needed for the construction of various forest industry mills. In other words, they can use their production plants as mill scale laboratories.

There are also several independent engineering firms specialized in wood industry machinery and the products have been successfully used in Finland and abroad, including developing countries. For example, Finland is today one of the leading paper machine manufacturers in the world.

5.2
Process Machinery

5.2.1
Sawmilling

Being one of the world's main producers of coniferous sawnwood with easy access to practical know-how, Finland has developed advanced sawmilling technology. The manufacture of machinery and equipment for the sawmilling industry covers a complete range of products from single machines to process lines and complete sawmills. The emphasis is on small and medium size log technology, accurate sawing, high recovery and productivity. In recent years machinery for large-diameter logs has also become available.

The equipment manufactured in Finland includes low capacity and simple, manually operated, labour-intensive designs, well suited for low technology areas, as well as sophisticated automatic and computerized systems for high-capacity sawmills.

The product mix covers, besides the main process, a wide range of auxiliary equipment. Typical process machinery and equipment available include:

Log handling

Sorting lines, debarkers, scanners, metal detectors, conveyors, bridge and other types of crane and hoist.

Sawing

Mobile circular saws, circular saw lines, framesaws, bandsaws, edgers, conveyors, and combinations of the above-mentioned equipment to form complete production lines for various wood raw materials, capacity and technical requirements.

Green lumber handling

Green chains for manual sorting, automatic green sorting lines, various types of trimmer, sticker stackers.

Drying — Prefabricated compartment and progressive dry kilns of various sizes, dry kiln equipment for locally built kilns, semi-automatic and automatic kiln programmes. Heating by steam, hot water or electricity. Heat pumps designs also available.

Dry lumber handling

Manual, semi-automatic or automatic trimming and grading plants, length sorters, package stackers, strapping and wrapping equipment, stress graders.

Residue handling

Bark shredding and pressing equipment, chippers, screens, belt, chain ,vibrating and pneumatic conveyors.

5.2.2
Plywood Machinery

The manufacture of plywood machinery in Finland has a long history and good reputation. The Finns have developed advanced technology for small diameter peeler logs, which because of the dwindling supply of large-diameter logs is becoming more interesting for the plywood industry in whole world.

Although machine manufacture and design originate from the Finnish plywood mills, special designs for big tropical logs and tropical conditions have been developed and delivered to Asia, Latin America and Africa.

The range of machinery for the plywood industry available in Finland includes:

Log handling

Debarkers, cross cutting saws, all necessary conveyors and lifting equipment.

Peeling — Lathe chargers for small and large logs; lathes for block diameters from 150 mm to 1600 mm and block lengths from 950 mm to 3300 mm; single tray, multi-tray and reeling systems for green veneer; clippers.

Drying — Roller dryers, continuous dryers and combinations of these with manual or automatic infeed; and outfeed and automatic clipping, sorting and stacking systems; heating of dryers with steam, gas or flue-gas.

Veneer handling

Scarf-jointing and patching.

Pressing — Glue preparation systems; manual and automatic plywood gluing and assembling stations; pre-presses; hydraulic multi-opening hot presses with manual, semi-automatic or automatic infeed and outfeed systems.

Finishing — Trimming, sanding and sorting lines for pressed plywood.

The Finnish plywood industry's need to diversify its production programme towards converted semi-finished and finished products has resulted in the manufacture of machinery for these purposes. The range of other machinery and equipment available in Finland includes blockboard machinery; machinery for overlaying, veneering and laminating; lines for making king-size panels; and special sawing and machining lines. The overlaying and laminating lines may have a multi-opening press or a single-opening press. The length of a single-opening press may vary from 2.6 m to over 20 m.

5.2.3
Particleboard Machinery

The manufacture of particleboard machinery started in the late 1950s', growing into an export industry with a firm foothold in the international markets with reference plants in Europe and Asia.

The process designs vary from small and simple systems with a daily capacity of 50 m^3 to highly mechanized and automated large-scale units.

The range of machinery for the particleboard industry includes:

Particle preparation

Debarkers, chippers, flakers, screens, storage silos with outfeed equipment, and mechanical and pneumatic conveyors, including metering devices.

Drying — Particle dryers using fuel-oil and sanding dust as fuel, dry particle classifying and screening equipment, and storage silos.

Gluing — Storage tanks, glue mixing and metering equipment and systems, glue blenders.

Forming and pressing

Complete forming stations, forming conveyors with belt, caul, wire-mesh or caulless systems, hydraulic pre-presses, single-opening or multi-opening hot presses with infeed and outfeed equipment, necessary automation.

Finishing Trimming and sanding lines, sawdust and sander dust collection and handling systems, packaging systems.

Converting lines, such as painting, priming and overlaying of particleboard, are also available.

5.2.4
Other Wood Products Industries

Finland's engineering industry has developed a wide range of machinery and equipment for other wood products industries. The products include single machines and complete lines. In general, the most common basic equipment is manufactured in Finland while the most advanced special machines are imported. So the Finnish suppliers can deliver most of the machinery and equipment needed for the wood products industries.

The products and processes supplied by the Finnish engineering industry include:

- planing and moulding machines and lines
- stress-grading plants for sawnwood
- production lines for joinery and furniture plants such as:
  - cross cutting lines
  - rip-saw lines
  - drilling lines
  - grooving lines
  - panel sawing lines
  - panel veneering and overlaying lines
- finger-jointing lines
- production lines for roof trusses
- machines for the manufacture of glue-laminated wooden beams
- machinery and equipment for pre-fabricated wooden house elements
- pressure impregnation plants

Because Finland traditionally has used wood in housing, it can also offer extensive know-how in this field.

5.3
Auxiliary Machinery

A wide range of auxiliary machinery is available including most of the equipment needed for complete wood industry mills and plants:

- mobile equipment for handling logs and finished products
- a wide variety of cranes and lifts
- residue handling systems, including conveyors, chippers, screens, dust collectors, silos
- oil-fired boilers
- bark- and wood-fired boilers, including fuel handling systems
- heating and ventilation systems
- air compressors and pneumatic equipment and systems
- hydraulic equipment
- electrical systems, motors, transformers, instrumentation
- systems for process control, automation, recording and production planning etc.

5.4
Machine Purchase Contacts

General advice and information of Finnish machine supplies can be obtained from Suomen Ulkomaankauppaliitto (the Finnish Foreign Trade Association) and other institutions and central organizations listed in Appendix I.

Ordinary purchase enquiries can be directed to the sales organizations of the machine suppliers or directly to individual machine suppliers.

6
TECHNICAL SERVICES AND TRAINING

6.1
Consulting Engineering Services

The Finnish design engineering companies, various technical and management consultants, and other specialists can provide a complete range of services needed in any industrial project.

The major forestry and forest industry consultants can handle an industrial project from start to finish, i.e. from preliminary investigations and project identification studies to implementation, start-up and training. The study services cover e.g. the following:

- Master plans for countries and regions including forestry, production and market aspects to formulate a development strategy for the area in question.

- Corporate plans for individual enterprises.

- Pre-feasibility and feasibility studies for any size of project.

- Separate forestry and market research.

- Mill development and improvement studies.

The design engineering services offered by forest industry consultants and specialized engineering consultants cover:

- process engineering
- mill design
- civil engineering
- mechanical, electrical and piping engineering
- energy generation design and engineering

Services for construction and installation of mills include:

- project and construction management
- procurement
- cost control
- start-up services
- training of mill personnel
- mill management services

In addition to the larger companies there are many specialized design engineering companies and consultants with extensive experience in specific fields of wood processing and related services.

Finnish consulting companies have performed various types of study assignment all over the world. The services have been financed by international institutions, governments and wood industry enterprises. In recent years, Finnish consultants have been particularly active in Africa, Asia and Latin America. They have designed wood-processing facilities, including major pulp and paper mills, in over 40 countries.

6.2
Turn-Key Deliveries

The largest machine suppliers are capable of delivering equipment for complete mills and plants including all the technical services needed for construction, installation, start-up and construction management, i.e. on a turn-key basis. At the moment, there are a few such projects, on a joint-venture basis, under construction or development in Latin America and Asia.

6.3
Research

Research work in forestry and forest industries has a long tradition in Finland. It covers every possible aspect of forestry from soil science and forest inventories to forest operations and economics of forestry. Services in this field have also been provided for developing countries.

The Forest Products Laboratory of the Technical Research Centre of Finland (VTT) carries out research and development of the raw materials, manufacture, properties and use of sawnwood, wood-based panels, other wood industry products, and investigations related to gluing and finishing of wood and wood products. In addition to the research financed through the state budget, the laboratory carries out commissioned research work for individual enterprises in Finland and abroad.

Research in the field of forest based industries is also carried out by the Helsinki University of Technology (Department of Forest Products), University of Helsinki (Laboratory of Wood and Polymer Chemistry), Åbo Akademi and University of Oulu.

In addition to the above research institutes and universities, many forest industry companies have their own research facilities, which are mostly confined to their own interests, but may be available for external work, too.

Examples of research work carried out in Finland for foreign companies:

- Suitability of larch for plywood

- Suitability of several hardwood species and a mixture of them for particleboard.

- Suitability of vine stems for particleboard.

- Suitability of hemp waste for particleboard.

6.4
Research Example

An good example of a research project in which a consulting company, VTT and private industry cooperated is a study on the suitability of a Latin American hardwood species for plywood.

The project was started by laboratory tests of the species. The consultant coordinated the whole work and arranged for the transport of the raw material to Finland. VTT then carried out the actual laboratory tests, which included:

- Peeling tests with different knife settings and log steaming arrangements. Three different thicknesses were tested.

- Veneer drying in different temperatures with observations on drying defects.

- Gluing tests to optimize glue spread and pressing conditions.

- Testing of pressed plywood including strength properties, glue line properties and boiling tests.

Tentative estimates of the recovery were also made. Then, the consultant evaluated and reported the results to the client.

Because the laboratory tests and their interpretation were encouraging, the client wanted to carry out mill scale tests to confirm that the laboratory tests were applicable in mill conditions, too. At this stage, the consultant arranged and coordinated all the practical work required to carry out the mill tests. This included:

- Estimate of wood volume required.

- Shipping instructions and transports in Finland.

- Arrangements with VTT for tests during the mill runs and for tests of finished plywood.

- Arrangements for the mill run in a mill with suitable machinery.

- Planning the mill test project.

The actual mill tests were carried out by the mill personnel under the supervision of the consultant using mainly the production conditions identified during the laboratory test phase of the project.

The results of the mill tests and subsequent laboratory tests were combined into a report. The results included among other things:

- Evaluation of the quality of peeled veneer.

- Evaluation of the quality of dried veneer including cracking, discoloration shrinkage, moisture content, face and core quality distribution.

- Veneer recovery after peeling and drying.

- Gluing and pressing conditions and observations.

- Quality distribution of finished plywood.

- Total wood balance of production and its evaluation considering the long transport distance of logs.

- Laboratory tests of the gluing and strength properties of finished plywood.

In addition to the test results the client received a few cubic metres of plywood to test it in practice in his own industry.

The overall results were so encouraging that the client is now studying the feasibility of the project.

6.5
Education and Training

The highest level of education in wood industries is given in the Helsinki University of Technology. The university is divided into 10 departments, one of which is the Department of Forest Products, founded in 1942. At present the department has five laboratories headed by professors:

- Pulping Technology
- Wood Chemistry

- Paper Technology
- Printing Technology
- Mechanical Wood Technology

The annual enrolment of the department is about 60, divided fairly evenly among the five laboratories. Several foreign students, also from developing countries have studied in the Department of Forest Products.

A lower level of technical education is given in technical colleges and technical schools, which train engineers and technicians for supervising, planning and other tasks specifically in the mechanical wood industry.

Finland with its long tradition and well established vocational training system can also provide training services needed in new mills.

The National Board of Vocational Education which is in charge of technical and vocational education in Finland, has a special department for forestry and mechanical wood industry.

There is a special Forestry Training Programme for Developing Countries attached to the National Board. The programme has been set up in cooperation with FINNIDA. This programme runs special courses and seminars in the fields of forestry and mechanical wood industry for representatives of developing countries both at Finnish institutes and abroad. The training can be divided into the following groups:

- Seminars, 3 to 5 each year, which last 1-4 weeks and include some practical training. The topics of the seminars vary according to the needs, but in general they cover subjects from tree planting to marketing of wood products.

- Courses of 4-7 months, including in-plant training are organized annually. They cover mainly sawmilling and wood-based panel technology and are directed to train technical managers.

- Special training is organized for specific groups. These courses last from 2 days to 1.5 year, depending on the purpose and subject.

The Lahti Institute of Technology has organized annual furniture and joinery seminars in collaboration with the National Board, UNIDO and FINNIDA.

Specific training programmes can also be incorporated in bigger mill projects, including specific training in Finland given by the major machine suppliers with the assistance of training institutes and specialized training consultants. The training includes on-the-job training at the mill site during erection and start-up. These training programmes can be arranged for all levels of personnel from machine operators to mill management.

7
EXPORT FINANCING AND DEVELOPMENT COOPERATION

Finland has some special banks and funds for financing Finnish exports and projects in foreign countries. In addition, the Finnish Government can provide soft loans or grants for countries included in the development cooperation programmes.

7.1
Financing

Finnish Export Credit Ltd. is a financing corporation which promotes exports of goods, services and know-how of Finnish companies by granting export credits and other forms of finance. In 1981 the corporation financed 337 export deals with a total value of about USD 380 million, of which 17 % was with developing countries.

The Nordic Investment Bank, set up in 1976 by five Nordic countries, gives loans and guarantees for investment projects inside member countries and joint Nordic ventures in third countries. Up to the end of 1981, the Bank had financed 9 projects outside Nordic countries, most of them in developing countries.

FINNFUND (The Finnish Fund for Industrial Development Co-operation Ltd.) is an independent joint stock company established in 1980. Its purpose is to contribute to economic and social development in developing countries by participating in their industrialization. FINNFUND promotes the initation, establishment and expansion of joint venture enterprises in developing countries, in cooperation with local and Finnish partners. In addition to contributing equity financing and granting loans to joint ventures in developing countries, FINNFUND also participates in the financing of feasibility studies relating to the establishment and development of potential joint investments. During its three years of operation, FINNFUND has participated in 10 projects including wood industries.

7.2
Development Cooperation

Development cooperation is a part of the foreign policy of Finland, and Finland has accepted the target of 0.7 % of GNP for official development aid, but has not set a specific date for reaching that target. The Finnish development aid is administrated by the Ministry for Foreign Affairs, Finnish International Development Agency (FINNIDA).

Development aid appropriations for 1983 are about USD 172 million. About 36 % of them are for multilateral aid to be distributed through various UN social development programmes, international financial institutions, and through food and humanitarian aid arrangements.

Bilateral appropriations amount to USD 109 million in 1983. They are provided mostly on a grant basis in the form of commodities, personnel assistance, consultancy and other services, training and financial resources. Long-term low-interest credits are also extended.

Finland has bilateral development cooperation on a project basis with a large number of developing countries. Most of the current aid goes to the following programme countries: Egypt, Kenya, Sri Lanka, Tanzania, Vietnam and Zambia.

APPENDIX I LIST OF SELECTED ORGANIZATIONS AND INSTITUTIONS

1
GOVERNMENT ORGANIZATIONS

	Address/Postal address	Telephone
The Ministry for Trade and Industry	Aleksanterinkatu 10 00100 HELSINKI 10	90-1601
The Ministry for Foreign Affairs, Finnish International Development Agency (FINNIDA)	Mannerheimintie 15 C 00260 HELSINKI 26	90-406 077

2
WOOD AND WOOD PRODUCTS INDUSTRIES

The Central Association of Finnish Forest Industries	Eteläesplanadi 2 00130 HELSINKI 13	90-171 596
The Finnish Sawmill Owners' Association	Fabianinkatu 29 C 00100 HELSINKI 10	90-661 801
Finnish Sawmills (Association)	Säästöpankinranta 4 C 24 00530 HELSINKI 53	90-711 088
Federation of Finnish Wood Panel Industries	Opanstinsilta 8 B 00520 HELSINKI 52	90-141 122
* The Association of Finnish Plywood Industry		
* The Finnish Particle Board Association		
* The Wallboard Association of Finland		
The Prefabricated Wood Housefactories Association	Mannerheimintie 40 D 00100 HELSINKI 10	90-492 742
The Finnish Joinery Factories Association	Mannerheimintie 40 D 00100 HELSINKI 10	90-407 688
The Finnish Glulam Factories Association	Mannerheimintie 40 D 00100 HELSINKI 10	90-407 688
The Finnish Wood Preservation Association	Mannerheimintie 40 D 00100 HELSINKI 10	90-492 762
The Association of Furniture and Joinery Carpenters	Mannerheimintie 40 D 00100 HELSINKI 10	90-498 995

3 PROMOTION AND SALES ORGANIZATIONS	Address/Postal Address	Telephone
The Finnish Foreign Trade Association	Arkadiankatu 4-6 B 00100 HELSINKI 10	90-69 591
Federation of Finnish Metal and and Engineering Industries	Eteläranta 10 00130 HELSINKI 13	90-170 922
METEX Corporation	Ruoholahdenkatu 4 00180 HELSINKI 18	90-694 4011
4 TRAINING AND RESEARCH		
National Board of Vocational Education Dept. of Forestry Training	Hakaniemenkatu 2 0053 HELSINKI 53	90-7061
Lahti Technical Institute	Ståhlberginkatu 10 15110 LAHTI 10	918-468 11
Kotka Forest Industry Institute	Kymenlaaksonkatu 48100 KOTKA 10	952-121 08
Technical Research Centre of Finland, Wood Products Laboratory	Puumiehenkuja 2 A 02150 ESPOO 15	90-4561
5 FINANCING		
The Finnish Export Credit Ltd.	Eteläesplanadi 8 00100 HELSINKI 10	90-177 171
Nordic Investment Bank	Unioninkatu 30 00170 HELSINKI 17	90-180 01
FINNFUND	Unioninkatu 30 00170 HELSINKI 17	90-171 202