

# Project Development and Environmental Strategy for the Forest Sector

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## **Tumen River Area Development Issues**

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Project Development and  
Environmental Strategy  
for the Forest Sector

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## ABBREVIATIONS

AAC	Annual Allowable Cut
ADt	Air dry ton (90%) of pulp
AOX	Adsorbable organic halogens
BATEA	Best available technology economically achievable
BDMT	Bone dry metric tonne, equivalent to about 2.4 m <sup>3</sup> of softwood and 2.1 m <sup>3</sup> of hardwood
BOD5	Biological oxygen demand in five days
COD	Chemical oxygen demand
DPRK	The Democratic People's Republic of Korea
EIA	Environmental impact assessment
GOST	Russian Log Grading System
GJ	Gigajoule = 10 <sup>9</sup> joule
ha	Hectare
JAS	Japan Agricultural Standard
kg	Kilogram
KW	Kilowatt = 1000 watt
KWh	Kilowatthour
m <sup>3</sup>	Cubic metre Logs: solid cubic metre under bark
MW	Megawatt = 1000 kilowatt
MWh	Megawatthour
N	Nitrogen
NO <sub>x</sub>	Nitrogen Oxides
P	Phosphorous
PRC	The People's Republic of China
RF	Russian Federation
R.O.I.	Return on Investment = $\frac{\text{Profit} + \text{Interest}}{\text{Capital employed}} \times 100$
SO <sub>2</sub>	Sulphur dioxide
Sq.km	Square kilometre
Sq.m	Square metre
TREDA	Tumen River Economic Development Area
TRS	Totally reduced sulphur

## PREFACE

The five member countries - The People's Republic of China, the Democratic People's Republic of Korea, Mongolia, the Republic of Korea and the Russian Federation - have agreed to

proceed in the development of the Tumen River Area. The project is coordinated by the United

Nations Development Programme (UNDP) and is called Tumen River Development Programme

(TRADP). The identified sectors of industrial development include among others the forest sector.

Jaakko Pyyry Consulting Oy was assigned to identify investment objects in the region and to

prepare pre-feasibility studies of relevant manufacturing units to be presented to the Governments and the international community. A draft report was prepared for the Workshop on Industry, held in Seoul on November 8-10, 1993. This report presents the driving forces for development, the resource base and forest areas for industrial utilisation and elaboration of different investment options. An outline of an environmental strategy for the forest sector and forest industries is also presented. The report closes by describing the investment options in more detail and includes profitability studies of the most attractive industrial projects. The report was prepared under the supervision of Mr Richard Stauffer. We would like to thank Mr Stauffer, members of the National Teams, project officers and other consultants of TRADP for the fruitful teamwork when making development plans for the Tumen River Area.

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## INTRODUCTION AND OBJECTIVES

### INTRODUCTION

South-East Asia has over a long time been the fastest-growing economic area in the world.

There has lately also been steady and rapid economic growth in China. The present economic growth of China implies a rapid increase in consumption, including forest products.

The economic growth in Russia has been negative and there are only a few signs indicating a turn in the development. Siberia and the Russian Far East have a relatively small population, so the growth of domestic demand would only slightly affect the use of Siberian natural resources.

Consequently, the future development of forest products markets in Pacific Asia is encouraging with a view to investments in forestry and forest industries.

The demand/supply situation, which was rather well in balance in 1991, will change drastically during the ten year-period up to 2001. The demand is expected to double from the 150 million m<sup>3</sup> of roundwood equivalent to about 300 million m<sup>3</sup>. At the same time, the supply from the traditional sources is declining, mainly due to cutting restrictions on the West Coast of North

America and declining supply of tropical hardwood from South-East Asia.

The main deficit areas in 1991 were the USA, Japan and China. The areas with excess supplies

were Canada, the CIS and some other Pacific Rim areas. The deficit is forecast to grow in the USA, so that the total balance of North America would turn into a deficit. Other Pacific Rim areas, except Russia, are also turning into deficit regions. The changing pattern of wood supply and demand will create a planning gap in the demand/supply balance. This will cause structural changes in the markets for forest products; big opportunities to develop new raw material resources and changes in the traditional use of wood as well as substitutes for traditional products. The main driving force for the future development will be the Japanese market, which will account for the biggest share of the imports. If China is able to develop its economy at the same pace as at present, it will no doubt become a main market alongside Japan. The other present importers, South Korea and Taiwan, will generally show a steady growth and especially their sawn softwood imports will increase considerably from the present level. The Tumen River Economic Development Area (TREDA) with its surrounding forest resources has a competitive edge, compared with the expected competitors, through the relatively short distance to the growing markets.

#### OBJECTIVES OF THE PRESENT STUDY

The objectives of the studies are defined to be:

To make a proposal for development of forest industries in TREDA taking into consideration:

- a market-driven business concept for each of the selected projects,
- due consideration of environmental concerns,
- demonstration of raw material supplies in the context of cutting rights, forestry concessions, or firm contracts with wood suppliers;

To prepare and present well-justified specific investment proposals in the forest industry;

To prepare project profiles at the pre-feasibility level of the most attractive investment projects.

#### MARKET OPPORTUNITIES

This chapter deals with the markets for forest products, which are considered to offer the best opportunities for development of the area. For more details, see Inception Study, Business Opportunities in Forestry and Forest Industry Sector (52A1232-Ejpn-1).  
DEMAND/SUPPLY BALANCE IN THE PACIFIC RIM AREA

The Pacific Rim market is the main wood raw material importing region in the world. The total consumption of wood and wood products was 1.17 billion m<sup>3</sup> in roundwood equivalent in 1991 and the demand is forecast to grow to 1.37 billion m<sup>3</sup> in 2001, i.e. by 17%. The main deficit areas in 1991 were the USA, Japan and China. The areas with excess supplies were Canada, the CIS and some other Pacific Rim areas. The deficit is forecast to grow in the USA, so that the total balance of North America could turn into a deficit. Other Pacific Rim areas, except Russia, are also turning into deficit regions. Russia has vast under-utilized forest resources. See Table 2-1.

#### TABLE 2-1

#### DEMAND FOR DIFFERENT WOOD PRODUCTS

The main importer of sawn softwood in Pacific Asia has been Japan, accounting for almost all imports, but imports to other countries are expected to grow considerably. Sawn softwood demand in Pacific Asia is expected to grow by 2% annually, equal to a total increase from about 10 to more than 15 million m<sup>3</sup> between 1990 and 2000. It is estimated that sawn softwood imports between 1990 and 2000 will increase by 3.8 million m<sup>3</sup> in Japan, by 1.7 million m<sup>3</sup> in South Korea, by 0.6 million m<sup>3</sup> in Taiwan and by 0.4 million m<sup>3</sup> in China. Demand for sawn hardwood in Pacific Asia is expected to grow by 1% annually or by 2.5 million m<sup>3</sup> by the year 2000, but the net imports to the region are expected to increase considerably more, or about 3 million m<sup>3</sup>. The increase will mainly be covered by sawn tropical hardwood. See Figure 2/1.

#### FIGURE 2/1

Plywood is an essential material for building, furniture and joinery in Pacific Asia and the growth of demand is estimated at 2.5% annually. The consumption is expected to reach 19 million m<sup>3</sup> by the year 2000. The plywood production in the Pacific Asian countries is expected to decline by about 2 million m<sup>3</sup> by the year 2000. To meet the increasing demand in the Asian Pacific countries, the supplies from other than tropical countries must be increased. The main interest would be in hardwood plywood. See Figure 2/2

#### FIGURE 2/2

The demand for reconstituted wood panels in the Asian Pacific countries has been limited but is expected to grow by as much as about 5% annually during the 1990s. This indicates an increase of about 4 million m<sup>3</sup> to reach a total demand of 9 million m<sup>3</sup>.  
FIGURE 2/3

The demand for reconstituted wood panels has been dominated by particleboard and medium density fibreboard (MDF), which account for some 60% and 20%, respectively. Traditionally, the demand for particleboard has been covered by domestic production. As the domestic production of sawnwood and plywood in Asian Pacific countries has been reduced drastically, so has the wood waste for particleboard manufacturing. This will lead to increased net imports to meet the demand. So far, production and consumption of MDF have been limited. However, the declining availability of solid wood products, sawnwood and plywood from the South Sea countries will significantly improve the market potential for MDF. The estimated annual growth of consumption is 6% or an increase of 900 000 m<sup>3</sup> in the main consumer countries during the 1990s.

#### MAIN MARKETS FOR WOOD PRODUCTS IN ASIA

##### General

The main future wood products markets are Japan, South Korea, Taiwan and China. Of these four, the Japanese market is most important, not only because its imports are far bigger than the imports of the other countries but also because the Japanese market is used to softwood and hardwood products from temperate countries while the other countries, South Korea and Taiwan are more accustomed to using tropical hardwoods. While the softwoods and temperate hardwoods belong to the traditional timber trade in Japan, they are substitutes for hardwoods on the South Korean and Taiwanese markets. The increase in sawn softwood imports from 1990 to 2000 is expected to be some 6.5 million m<sup>3</sup>. The division of the increase is presented in Figure 2/4.

##### FIGURE 2/4

Demand for sawn hardwood is predicted to show a less favourable trend than sawn softwood, increasing by only about 1.5% annually. The total increase is expected to be 2.3 million m<sup>3</sup> of which tropical hardwood will account for most (85%). This is due to wood use

traditions and strong marketing. Japan is expected to account for most of the growth. Plywood imports to the main Asian Pacific countries, mainly Japan, South Korea, China and Taiwan, have increased from less than 2 million m<sup>3</sup> in 1985 to about 6 million m<sup>3</sup> in 1990. The clearly dominant exporter has been Indonesia. Imports are not expected to grow so fast in the future due to limited supply, i.e. possibly 5-10% per year depending on the supply. However, demand is increasing faster, which opens markets for new plywood sources and substitutes, like particleboard and MDF. The particleboard consumption in the main Asian Pacific countries is illustrated in Figure 2/5. The estimates show a very rapid increase in all of the countries.

FIGURE 2/5

The MDF consumption in the main Asian Pacific countries is shown in Figure 2/6. In percentages terms, the increase is rather high but in actual volumes the growth is more moderate due to the limited use of MDF in the past.

FIGURE 2/6

#### The Japanese Market

Japan has a dominant role as an importer of all wood products in the Pacific Asia. Japan's imports of softwood logs are 60-65%, of hardwood logs 50%, of plywood 55-60% and of sawn hardwood 45-50%, of the total imports to this area. Almost all of the present sawn softwood imports goes to Japan. Japan's consumption of particleboard is around 40% and consumption of MDF around 32% of the total consumption in this area. It would therefore be well justified to focus the production and marketing of wood products to the Japanese market. In the past Japan has mainly imported logs, which have been further processed in the country. Japan has been rather reluctant to import processed goods, partly because the country has wanted to protect its own industry and employment and partly because the Japanese standards and trade practices differ greatly from those of other countries. Because of the growing difficulties in purchasing logs, this trend is slowly changing. The high wage level in Japan compared with the wage levels in regions with a surplus of wood and transport cost of processed goods compared will speed up this change. A considerable change has already

happened in plywood and sawnwood is slowly following. The Japanese have not been entirely satisfied with the Russian quality and condition of sawlogs. The time period required to produce and transport the logs from the logging site to the Japanese market is very long and especially in the summertime the logs are easily discoloured on the way. Additionally, Japanese buyers do not like the Russian grading of logs according to the Russian GOST grades, but would like to buy logs graded according to the Japanese standard. Many problems could be avoided and some advantages gained by selling sawnwood instead of logs. The main barrier to sawnwood exports to Japan is the Japanese standard (JAS) which is used for grading sawnwood. Sawnwood, which is not graded according to this standard, can only be sold to the Japanese sawmills that resaw the goods into Japanese sizes and regrade them according to the JAS standard. However, this process is, like Japanese sawmilling, very expensive. The JAS standard can be considered a barrier, but also an opportunity for bigger sawmills which can achieve the right to grade according to the JAS standard. By sawing Japanese sizes directly and grading them according to the JAS standard, many middlemen and extra handling could be avoided and a considerable extra cost saved. To illustrate this difference, three alternatives for producing sawn wood for the Japanese market have been studied:

- Sawing of imported logs in Japan;
- Resawing and grading imported sawn wood;
- Producing Japanese sizes according to the JAS standard in Russia.

The total production cost in the first alternative would be about Y 40 000/m<sup>3</sup>, in the second alternative Y 43 000/m<sup>3</sup> and in the third alternative only Y 24 000/m<sup>3</sup>. The margin between the third and the first two alternatives would thus be almost 50%, which certainly will open a good marketing opportunity in the future. (Calculations not reproduced here). One possibility to avoid using the JAS standard is selling directly to the Japanese house factories, which can be more flexible in their production. Prefabricated houses have gained a rather big share of the total house production in Japan and thus offer a viable opportunity in the sawn timber market.

South Korea



Next to Japan, South Korea is an important and growing market for wood products in Asia. In 1990 South Korea was mainly importing hardwood logs, sawn timber and plywood. With the decreasing hardwood log supply, South Korea is expected to increase its imports of hardwood plywood and sawn timber as well as particleboard and an MDF. It will also become an important importer of sawn softwood. The imports of sawn hardwood are expected to grow from the present level of 0.6-0.7 million m<sup>3</sup> to about 1.2-1.4 million m<sup>3</sup> per annum in 2000. The imports of sawn softwood, which have been rather small, will increase to some 1.6-1.7 million m<sup>3</sup> by 2000. At the same time, the hardwood plywood imports will double from the present to well over 1 million m<sup>3</sup>. The particleboard and MDF will also double to some 1.2-1.4 million m<sup>3</sup> and 0.4-0.5 million m<sup>3</sup>, respectively by 2000. The growth of the South Korean market is very encouraging with a view to investments in mechanical wood industries in TREDAs.

#### Taiwan

Taiwan is the third major importer of wood products in Asia. In 1990 Taiwan imported only limited volumes of sawn softwood but is expected to import some 0.6 million m<sup>3</sup> in 2000. It is also expected to increase its import of softwood logs. The imports of hardwood plywood, which have been around 0.6-0.7 million m<sup>3</sup>, will possibly double. The imports of particleboard are expected to almost double to 0.5-0.6 million m<sup>3</sup> by 2000. The imports of MDF, which have been in the region of 0.1 million m<sup>3</sup>, will double by 2000.

#### China

If the economic development in China will continue at the same pace as at present, it will become one of the most important import markets for forest products in Pacific Asia. Imports of sawn softwood are expected to grow by about 0.4 million m<sup>3</sup> by 2000. The imports of sawn hardwood, which are about 0.6 million m<sup>3</sup> per annum at present will double. The imports of plywood are also expected to double from the present level of about 0.8 million m<sup>3</sup>. The particleboard imports are expected to grow about 0.5 million m<sup>3</sup> at present to 1.2-1.3 million m<sup>3</sup> in 2000. The imports of MDF will increase by about 50% to some 0.6 million m<sup>3</sup> in 2000.

#### CONCLUSIONS OF WOOD PRODUCTS MARKETS

The future development of forest products markets in Pacific Asia is very

promising and gives an excellent basis for the development and investment in forestry and forest industries in TREDAs. The demand/supply situation, which was rather well in balance in 1991, will change drastically until 2001, when the demand will be about twice the supply, or more than 300 million m<sup>3</sup> in roundwood equivalent (see Figure 1/1, Chapter 1). The main driving force for the future development will naturally be the Japanese market, which will account for the biggest share of the imports. The other present importers, South Korea and Taiwan, will generally show a steady growth, and their sawn softwood imports will even increase considerably from the present level. The future Chinese market is probably the most interesting. If the Chinese economy is developing at the same level as presently, it will be the biggest economy in 2000 and will no doubt develop into a main market alongside Japan. The greatest development in China will be experienced in pulp and paper products. The importing countries in Pacific Asia, the main potential markets for TREDAs forest products, have been mainly dependent on tropical hardwood and big coniferous logs for their raw material supply. The forest resources in TREDAs have a different composition than the previously used resources. The species and size of trees are different and the quality of wood is partly lower, especially the old growth forests which contain a great number of decayed trees. Now, when the availability of previous sources is drastically declining, an opportunity arises for other raw materials although it requires efficient marketing effort. Investors focusing on these markets now have an interesting and promising opportunity to secure their wood supply by investing in areas which have abundant forest resources, such as Russian Far East, or areas which have good prospects to develop their forest resources, such as the Jilin Province in China and the Rajin-Sonbong acacia in the Democratic Peoples Republic of Korea. The same applies to the companies in the wood deficit areas, wanting to secure wood products for their growing market, and to the companies in the USA, Europe and other countries, wanting to secure their present share of the market or to penetrate this promising market.

BLEACHED KRAFT PULP

Global Outlook for Bleached Kraft Market Pulp

In 1991 the total consumption of bleached kraft market pulp was 25.8 million tons. Bleached softwood kraft pulp (BSKP) amounted to 15.2 million tons and bleached hardwood kraft pulp (BHKP) to 10.7 million tons. The growth of these pulps is expected to be:

TABLE 2-2

Figures 2/7 and 2/8 illustrate the current production and consumption of BSKP and BHKP:

Production of BSKP is concentrated in North America and the Nordic countries, who are the main net exporters. Central Europe and Pacific Asia are the main deficit regions.

North America, Europe and Latin America are the main producers. Central Europe and Pacific Asia are the main importers.

FIGURE 2/7

FIGURE 2/8

The deficit of BHKP and BSKP in Asia is expected to grow in the future (Figures 2/9 and 2/10).

FIGURE 2/9

FIGURE 2/10

Asian Markets for Bleached Kraft Market Pulps

Because of the strong growth of paper production the demand for bleached softwood and hardwood kraft pulps will continue to grow in Asia-Pacific (Figure 2/11).

FIGURE 2/11

Some features of the world trade flows of BSKP and BHKP are:

Asia is a major deficit area in both BSKP and BHKP;

North America is the main exporter of these pulps to Asia;

Other major exporters to Asia include Brazil (Eucalyptus) and Chile (BSKP);

The role of Indonesia as an exporter of BHKP will grow in the 1990s. Both BSKP and BHKP would be potential products for the TREDATA project, due to the growing deficit of these pulps in the Asian-Pacific region and sufficient quality potential of the wood raw material resources. The main importers of these pulps would be Japan, South Korea, China and Taiwan (Figure 2/12).

FIGURE 2/12

NEWSPRINT

Global Trade

World consumption of newsprint was 32 million tons in 1992. The demand is

expected to grow at about 2.0 t/a up to 2005. The main demand drivers are: increasing literary and educational levels, economic and advertising growth. Nearly half of world newsprint consumption is traded internationally. This is mainly due to the high concentration of production in Canada (30%) and the Nordic countries (14%), which in turn is largely exported to other countries (Figure 2/15). The developing Asian countries, with imports of 1.0-1.1 million tons of newsprint annually, depend on imports for nearly half of their consumption. This region as a whole represents an expanding market potential for newsprint suppliers. Today the main suppliers in the Asian markets are Canada, Scandinavia, South Africa, Japan and New Zealand. From a market point of view, newsprint could be an interesting market development alternative for TRED A. The mill would be located in the middle of the growing Asian markets. China especially would be an interesting export market for newsprint from TRED A. Sales Prospects for Newsprint to China In 1992 newsprint consumption in China was 520,000 tons, of which 60,000 tons was imported. The rest was covered by local production. Due to rapid economic growth the demand for newsprint is expected to grow at 4-5% per year or 21,000 - 26,000 t per year during the next ten years. The most potential export region for TRED A in China would be the North-Eastern part, covering the provinces of Heilongjiang, Jilin, Liaoning and part of Inner Mongolia. It is estimated that 60,000 - 70,000 tons of newsprint is consumed at present in this region. Other potential export markets for a newsprint factory in TRED A, would be, for example DPRK, the Russian Far East and Mongolia. The total demand in these areas is 15,000 - 20,000 t per year, which could be partly satisfied by a local new newsprint mill. According to the technical information on the raw material resources available, the quality potential for exports elsewhere is limited.

## FORESTRY DEVELOPMENT

### RESOURCE BASE

The People's Republic of China

#### Present Situation

The Heilongjiang and Jilin provinces are the main wood-producing provinces in China, with a total output of 17 million m<sup>3</sup>, which is about 19% of the total industrial roundwood production in

China. Most of the wood raw material from Heilongjiang and about half of the wood raw material from Jilin are, however, processed in other provinces. China is suffering from lack of lumber and paper products and the consumption of these products is rapidly increasing. China already imports some 9.6 million m<sup>3</sup> of logs annually. The estimate of the increase in paper consumption is 9% or about 1 million tons per annum. One million tons of paper means a wood consumption of approximately 2.9 million m<sup>3</sup> per year when considering a 50% recycling of paper. Instead of former state order quotas, increasing volumes of domestic wood raw material are sold through auctions. The demand/supply imbalance together with the price setting at auctions have led to climbing raw material prices. Local forest industries in Heilongjiang and Jilin are presently running at very low capacity utilisation rates, despite good demand for products, since they cannot afford the very high log prices of south-west China. The quality of logs is poor in Jilin and consists mainly of hardwoods (76%). Quality improves in the north (Heilongjiang) and the share of softwoods increases (40-70%). The existing pulp and paper industry in Jilin, which is 80% based on wood raw material, receives about 1 million m<sup>3</sup> or 50% of the raw material from Heilongjiang. It is not easy to increase the imported volume from the northern areas due to the high prices, difficult transport and lacking transport facilities.

**Future Prospects**

The establishment of new forest industry in the Chinese part of the TRED (Hunchun area) should be based on local raw material or imports from Russia. Use of local raw material presently sold to other provinces is theoretically possible but might seriously increase the supply/demand imbalance and affect the prices. The major part of the Changbai Shan forest area in the south-east of the province is mountainous, unproductive forest land, mainly with gentle slopes and an altitude under 800 m. The average growing volume is 65-75 m<sup>3</sup> of hardwoods, such as oak, birch, linden, maple, elm, poplar, ash, etc. The log quality is low, because of long-term selective cutting and exploitation of the resources. These forests should be restored to their former state by clear cutting and planting. It is estimated that this local resource base contains:

Within a radius of 100 km from Hunchun, a total area of 19,000 sq.km of which 685,000 ha is forest land with a growing stock of 52 million m<sup>3</sup>;

Within a radius of 200 km from Hunchun a total area of 41,000 sq.km of which

1,370,000 ha is forest land with a growing stock of 103 million m<sup>3</sup>.

Due to the low quality of the forests, the main output (80-90%) would be pulpwood, the

remaining logs being suitable for mechanical forest industries.

The Democratic Peoples' Republic of Korea

Present Situation

According to the statement of the DPRK forest authorities, there are no commercial forests on

the Korean side of TRED, an area of 621,000 sq.km.

The main commercial forests are located in the Paekmu Plate Range about 100 km west of

Chongjin and in the Kaema Plate Range, 200-250 km south-west of Chongjin in the Ryanggang

Province. Transport from these areas to TRED is difficult and expensive due to the mountain

range in between. Logging here is carried out under difficult mountain conditions.

The transport connections from these areas are built in the south-west direction, where the

main consumption areas are located.

The main wood-processing facilities are located in the South Pyongyang, South Hwanghae and

North Hwanghae provinces. The demand for wood in these areas is higher than the domestic

supply possibilities.

Future Prospects

On the basis of the above raw material situation, the DPRK forest authorities made the

following suggestions for raw material to the forest industry projects in the Rajin-Sonbong area:

10-15,000 m<sup>3</sup> of domestic hardwood sawlogs, mainly birch and oak for an integrated sawmill and furniture factory. The delivery will be guaranteed by the government.

The DPRK has a concession with Russia to harvest 2.3 million m<sup>3</sup> using their own

labour, mainly larch (70%), pine, spruce and some birch in the Khabarovsk and Amursk

areas. According to the agreement, the harvested volume is divided on cost basis

between the parties. Presently the Russians get 65-75% of the wood. The term of the

agreement has been 3 years, after which it has to be renewed. According to the Korean

authorities the concession has good possibilities for long-term continuation due to a real

lack of labour, which Korea is able to provide to mutual benefit.

The Korean representatives proposed an integrated forest industry unit to be built in the Rajin-Sonbong area, including both pulp industry and mechanical forest industry.

In order to invest in the proposed industry, the concession term should be lengthened and the volumes increased.

According to the Russian authorities, a long-term concession might be possible if it includes the following new obligations:

- factories to be built as joint ventures in which the Russians have part ownership;
- contract to include reforestation responsibility, which previously belonged to the Russians;
- contract to include responsibility to develop the social infrastructure;
- improvement of the skills of labour and harvesting technology.

According to the findings, the areas within a reasonable transport distance from the Rajin-Sonbong free economic zone contain extensive forests which are presently unproductive, due to long time selective cutting and exploitation of the forest resources. With proper and intensified management, these forest areas could form a basis for the future raw material for the proposed integrated forest industry in the Rajin-Sonbong free economic zone. However, a management plan for these areas is needed before any investment decision can be made.

The Russian Federation

Present situation

Khabarovsk Region

The forest area of Khabarovsk is about 50 million ha of which about 95% is production forest.

The main species are spruce and fir (about 40%), larch (about 40%) and deciduous forests (about 20%).

The annual allowable cut (AAC) is 20-22 million m<sup>3</sup>, of which only 5-7 million m<sup>3</sup> are presently harvested. The harvested volume was earlier up to 15 million m<sup>3</sup>, but has never reached the AAC. The main reason for decreasing volumes has been the loss of former Soviet Union markets but partly also lack of equipment and problems in transport facilities.

Primorsky Region

The total forest area of Primorsky Krai is 12 million ha divided into: 6.497 million ha of coniferous forest with a total growing stock of 1240

million m3 of which:

3.612 million ha of mature forest, total stock 729 million m3. Main species spruce and fir (2 million ha, total stock 523 million m3). Some larch in the northern parts;

2.343 million ha of cedar forest, protected from cutting (cutting allowed in mixed stands).

2.931 million ha of hard deciduous forest with a total growing stock of 320 million m3 of which:

1.239 million ha of mature forest, total stock 180 million m3. Main species oak, maple and elm. Maple most valuable for furniture;

1.680 million ha of soft deciduous forest with a total growing stock of 180 million m3 of which:

0.581 million ha of mature forest, total stock 90 million m3. Species aspen, poplar, birch, alder, limetree. Mainly used for chips, sawmilling, birch for plywood and aspen for wooden boxes.

Average growth is estimated at 2 m3 per ha. AAC is about 10.650 million m3 commercial wood

(could possibly be higher!). Present cutting about 4.6 million m3 with the following breakdown:

4.6 million m3 or 42% of AAC (10.650 million m3) on average;

3.5 million m3 or 52% of AAC (6.750 million m3) of coniferous forest;

0.9 million m3 or 34% of AAC (2.600 million m3) of hard deciduous forest;

0.2 million m3 or 11% of AAC (1.896 million m3) of soft deciduous forest.

Future Prospects

Especially the Khabarovsk but also the Primorsky region, have almost unlimited raw material

resources for the development of any kind of forest industries. The development is essential

and necessary for supporting the development of national economy.

According to discussions with the authorities, there is a great interest in joint ventures in logging

operations and investment in forest industries. There is, however, no interest in providing raw

material on a long-term basis for other countries, except if the industries in these countries are

on a joint-venture basis, in which the Russians are part owners. In that case, the Russians

would be interested in any investment in the free economic zones in TRED.

WOOD PROCUREMENT AND COST

Organizing Wood Procurement

There are three basic alternatives available for organising the raw material procurement:

Through the wood processor's own procurement organisation from established

concession areas;

Through co-operation with local harvesting organisations;



Through delivery contracts with local wood procurement companies. In the first case all investments (forest roads, equipment, camps etc.) must be provided by the wood processing enterprise. On the other hand, stumpages will be reasonable, long-term operation will be technically guaranteed and the most effective operation probably achieved. In the second alternative, the local partners would require their profit to be included in the million price, if they are not shareholders in the industrial enterprise. On the other hand, this would reduce the total investments in forest operations, because of existing harvesting resources. Investments in logging and reforestation cannot, however, be avoided, because the local entrepreneurs lack financial resources. In the third alternative the supplier will compare the delivery prices to those obtained from export markets to make the best profit. This raises raw material prices and may cause some uncertainty in long-term deliveries. Probably, the best solution is to find reliable local partners, to establish concessions, to create joint operational resources and then manage the forest resources in an efficient business-like manner. With this principle in mind we have calculated the wood costs for each industrial alternative. From the operational point of view, the circumstances in Jilin and North Hamgyong provinces are similar as well as those of the Primorsky and Khabarovsk regions, making the investments and operational cost levels comparable.

#### Concession Agreements

There should be incentives to support a long-term sustainable management for all parties involved. Concessionaires should have the long-term viability (20-50 years) of their concession, the government should receive sufficient revenue to continue its forest management operations and the local population should benefit from intensified forest management. A concession agreement has to include:

- Size and duration of concession or licence;
- Responsibilities and authority of the regional forest committee and responsibility of the concessionaires;
- Rights granted and rights withheld;
- Establishment or expansion of local wood-processing units;
- Felling, wood extraction and transport;
- Road construction and other required improvement of infrastructure;
- Forest management and reforestation;

Forest taxes, stumpage and other fees;  
Control, supervision and sanctions for disrespect of concession terms;  
Environmental considerations;  
Other general provisions like conditions for renewal and termination, applicable law and jurisdiction, etc.

National or provincial Forest Master Plans are the recommended tools in forming a proper guidance for forest management and concession legislation.

#### Management Plans

All the harvesting operations must be based on the sustainable management of forest

resources. Forests set aside for timber production shall also be able to fulfil other important

objectives, such as environmental protection and, to a varying extent, conservation of species

and ecosystems. Therefore a proper planning at national, forest management unit and

operational levels is needed, which makes it possible to set management objectives for each

forest (harvesting) management unit. This kind of management plan shall include:

#### Forest Resource Inventory

In order to ensure a sustained production of wood, a reliable method for controlling timber yield

should be adopted. The annual allowable cut should be set conservatively in the case of

absence of reliable data (Jilin and North Hamgyong). Regular reviews of AAC (5-10 yearly)

shall be organised to take account of replacement of original forests by managed forests.

#### Preparation of Working Plans

Working plans should include the following details:

sequence of annual harvesting areas and allocation of all-weather and dry-weather areas;

areas to be excluded from harvesting;

road and extraction track layout;

details of marking, harvesting and post-harvesting inventory;

silvicultural treatments such as required nursery production,

reforestation, treatment of

juvenile stands, thinnings and monitoring of results;

fire management plan.

#### Environmental Impact Assessment

Forest management operations can have important positive or negative environmental

consequences, both in the forest itself and outside. These consequences should be assessed

in advance of operations to ensure overall sustainability.

Wood Procurement in the Jilin and North Hamgyong Provinces

## Harvesting Method

Wood harvesting would be based on Chinese-made equipment. The following operations would be included:

Trees would be felled by chainsaws (e.g. GJ 85) and delimited by axes. Some contractors may also use manual crosscut saws for felling;

Tree-lengths (whole stems) would be skidded to the roadside by track-type skidders (J-50A) or by wheel skidders (J-80). On steep slopes, over 45%, where skidders cannot operate, manual dragging would be applied;

Tree-lengths would be bucked into logs and pulpwood at the roadside landing by chainsaws or manual crosscut saws.

For road transport 2- or 3-axle trucks equipped with 2-axle trailers would be used. Trucks would be loaded manually. When road conditions do not allow the use of trailers in the forest, timber would be transported by single trucks into intermediate landings and reloaded there onto truck and trailer combinations. The average road transport distance is expected to be 80 km. The load size for single trucks is 10 m<sup>3</sup>s and for truck and trailer combinations 16 m<sup>3</sup>s.

Road construction would include class 4 (fair weather roads) and temporary spur roads. Some

main forest roads may have to be upgraded to class 3. The density of permanent roads would

be 6 m/ha, and the requirement of temporary spur roads 20 m/ha. The availability of labour will

determine if manual or mechanised construction methods will be used.

Mechanised road

construction would use bulldozers, front-end loaders and dump trucks. The costs of class 4

roads is estimated to be 10,000 USD/km and the cost of spur roads 1,800 USD/km.

Construction of permanent roads would be contracted, and own equipment and labour would be used for making spur roads.

Initial Investment

For an annual harvest of 100,000 m<sup>3</sup>, the following initial investment would be required:

TABLE 3-1

## Unit Costs of Wood

An estimate of the unit costs including capital costs is presented in Table 3-2. Regarding the character of this operation, artificial reforestation will be done on all the logged areas. The cost of replanting one hectare is estimated to be USD 275, which means a cost of

about USD 4.2

per harvested cubic metre. Public and social charges in China to subsidise the community may be high but negotiable and thus not included in the wood price.

TABLE 3-2

Wood Procurement in the Primorsky and Khabarovsk Regions

Harvesting Method

The following options are available for wood harvesting:

- Russian tree-length system;
- semi-mechanised shortwood system;
- fully mechanised shortwood system.

The different systems are shown in figures. The Russian system is reasonably cheap and

trained personnel is available. The main problem may be that Russian equipment and spare parts for them will not be available.

The shortwood systems are based on Scandinavian technology. The semi-mechanised system

is cheap, but its high labour requirement and manual felling, delimiting and bucking in winter

conditions make it less attractive. The Mechanised shortwood system requires high

investments, trained personnel and advanced machine maintenance.

Investment Requirement

The investment requirements for the alternative systems are given below (annual cut

100,000 m<sup>3</sup>):

TABLE 3-3

Unit Costs of Wood

An estimate of unit costs including capital costs is presented in Table 3-4.

Russian stumpage

prices in concession logging have been rather low in recent years. The stumpage and forestry

fees paid to forest administration should cover the reforestation, which is not yet extensively

practised. In our estimate of wood costs in Russia we have assumed that stumpages will

approach the international level and make allowance for appropriate reforestation as well as

environmental protection.

Railway tariffs vary depending on if the destination of raw materials is domestic or for export. In

the case of unprocessed wood raw material export, a duty of USD 7.5/m<sup>3</sup> must be paid. This

makes a clear difference in raw material prices for domestic use and for export.

TABLE 3-4

Transport of Wood Raw Materials

The wood procurement will take place from three main areas:

Mixed hardwoods from the Jilin Province in China and the North Hamgyong Province in DPRK;

Softwoods and mixed hardwoods from the Primorsky (and partly Khabarovsk) region in Russia;

Softwoods from the Amursk region in Russia (concession areas of the DPRK).

The raw material resources from area 1 are near the planned free-trade zone and also the existing seaports in the Rajin-Nakhodka range. Raw materials and products can be transported

mainly by trucks but also railways can be utilised over larger distances (over 200 km) and

where two gauges exist to reach the port.

Areas 2 and 3 are totally dependent on the Russian railway system. The DPRK logging

concession is located about 1500 km north of TRED A. Resources from Primorsky Krai are

more favourably located to the development area (200-800 km). From the southern parts of

Primorsky Krai truck transport to the ports can be more economical than by railway. So far

railway freights in TRED A are low (USD 0.003 - 0.005/km/m<sup>3</sup>) thus offering attractive transport

to the ports. The development of the Far Eastern Region calls for a reasonable transport tariff

policy. However, the Trans-Siberian railway already tends to be congested, which is likely to

result in higher railway freights in the future.

The cost of transport is decisive when determining the locations of the proposed industries. A

high freight level will restrict the long transport distances of raw materials and favour transport

of ready-made products and, consequently, call for more labour and to build infrastructure near

the raw material base.

With the existing prices of railway freight the most attractive sites for export-driven wood

industries seems to be near the sea ports.

## FOREST INDUSTRY ENVIRONMENTAL STRATEGY IN TRED A

### THE FUNDAMENTALS OF AN ENVIRONMENTAL STRATEGY

There is growing pressure for new development projects to follow the principles of sustainable

development agreed at the United Nations Conference on Environment and Development

(UNCED) and to meet international environmental standards.

It has been decided that TRADP will integrate environmental considerations into the

development planning process from the beginning to reach good results with optimal use of resources. Especially the forestry and forest industries in the region will be developed on a sustainable basis, because the existence of wood industries depends on the sustained growth of forests and continuous supply of wood raw material. Since environmental aspects play an important role in forestry and forest industry, they must be recognised in the development process and later in corporate decision-making. However, this does not mean that the technical and economic angles affecting decisions could be neglected. Instead, an optimal balance between environmental, technical and economic issues should be found.

Due consideration of environmental aspects is thus necessary in both development projects and the running of forest industry. The environment can be seen as one aspect of decision-making which has to be managed. To be able to do this, a clearly defined strategy is necessary, which can turn the abstract question of environmental effects into a tangible part of decision-making. An explicitly thought-out environmental strategy also helps to anticipate the coming issues and to influence them instead of just reacting to them.

#### PRINCIPLES OF FORESTRY AND FOREST INDUSTRY ENVIRONMENTAL STRATEGY IN TREDA

The leading environmental guideline of any development project or industry should be to follow the principles of sustainable development and to avoid any destructive and irreversible environmental effects, e.g. loss of biodiversity, loss of fertile soils through erosion, or contamination of food chains with non-degradable toxic compounds. When establishing the environmental strategy, the whole production chain from raw material sourcing through production to end use and final disposal should be considered.

The authorities are responsible for implementing Environmental Impact Assessments (EIA) on all new projects and mitigating potential harmful environmental impacts. Usually the companies or the financing institutions will appoint an independent party to carry out the EIA.

The EIA shall cover the environmental management of the projects, the technology used in the project, the use of natural resources, the emissions and waste generation, and an overview of

the legislation and local regulations.

#### Principles of Forestry Development

Development of forest-based industries and development of forestry are interconnected in

several ways. From the environmental point of view, three connections are very significant: (1)

development of forest-based industries tends to increase pressures on the forests, (2) healthy

and well-growing forests are a prerequisite for the existence of forest-based industries, and (3)

forest-based industries can produce the funds needed for sustainable forestry development

including reforestation of previously degraded forests and conservation of biodiversity. These

three facts are often the starting point for an environmental strategy in developing forests and

forest industries.

The UNCED forestry principles and other ideals of forest development have been interpreted by

various organisations. Most of these interpretations stress the leading principles: (1)

maintenance of the natural productivity of the forest ecosystem, and (2) maintenance of

biodiversity.

The Forest Stewardship Council has presented a set of principles of good forest management.

The main ideas in these principles can be used also in the Tumen Project. The principles can

be summarised as follows:

A forest management plan must exist, stating objectives, means, responses to changing

ecological, social and economic circumstances;

The ownership of forests and areas for permanent forest cover must be defined;

Social and economic benefits should be shared equitably;

The rights of indigenous people and other forest dependent communities must be

protected based on consultations with the people;

Minimal environmental impacts in terms of wildlife, biodiversity, water resources, soils, and forest resources;

Harvesting rates must be sustainable in the long term;

All forest products and services must be taken into account, local value should be maximised;

The costs of forest products should reflect full costs of forest management;

Forest production should encourage judicious and efficient use of all forest products;

Forest plantations should not replace natural forest, but be used to complement and

reduce pressures on existing natural forests.

#### Forest Industry Specific Principles

As forest industry projects will be established in TREDAs at an early stage of development they

have a good opportunity to influence the general environmental development in the area.

Forest industry can generally be designed and operated without any significant environmental

impacts, if the following guidelines are observed:

- siting of the mills is based on proper consideration of environmental aspects;

- modern technology is used in the processes;

- appropriate environmental protection measures are applied.

#### ENVIRONMENTAL SCREENING AND MITIGATION, AND MANAGEMENT GUIDELINES FOR FORESTRY AND FOREST INDUSTRY PROJECTS

##### Forestry Operations

##### Potential Environmental Impacts in Forestry Operations

Large-scale forestry operations can have several adverse impacts on the environment.

Exploitative industrial harvesting has contributed to environmental degradation for instance in

tropical forests of many South East Asian countries, and in boreal forests in some areas of

Russia. On the other hand, careful management of forest resources has increased the forest

reserves and the sustained yield for instance in the Scandinavian countries, despite the

intensive economic utilisation of the forests.

Examples of possible adverse impacts of forestry operations can be listed as follows:

- erosion and land instability caused by logging and road construction;
- loss of nutrients and organic matter of the soil;

- changes in the hydrological cycle, resulting in excessive flooding and longer drought

- periods;

- accelerated sedimentation in rivers, lakes, reservoirs and coastal areas;

- changes in aquatic ecosystems caused by leaching of nutrients, and possible use of

- pesticides;

- damage to established conservation areas, or areas that would be important for

- conservation purposes;

- depletion or loss of genetic resources;

- destruction of supplies of food, fuel, and other forest products;

- social conflicts due to modification of existing land-use patterns, and changes in

- employment and income distribution;

- creation of access to otherwise inaccessible areas with possibilities for over-exploitation.

Some of these problems can already be seen in TREDAs according to the



environmental reports

prepared for TRADP.

Environmental Mitigation and Management in Forestry Development

Erosion, Water Balance, Nutrients

Maintenance of the ecological conditions in the area and the future productivity of the forests is

essential to the continuity of forestry activities. Forest management practices will be suited to

local conditions, so that no significant erosion or excessive changes in water balance and

nutrient leaching will occur. The following aspects shall be identified in the forest inventories

and addressed in the forest management plans:

- steep slopes (over 30%) will not be clear cut;

- degraded forests will be rehabilitated where possible;

- forest roads will be constructed so that erosion will be minimised

(consideration of the

slope, appropriate drainage, revegetation of roadsides, etc.);

- the size of clear-cut areas will be adjusted to suit the ecological situation;

- appropriate protection zones will be left along the lakes, rivers and smaller brooks;

- forests along eroding sea shore will not be clear cut;

- control of erosion and protection of vegetation will be considered in planning of skidding

methods and other transport of logs; rivers and brooks will not be used for skidding or

transport purposes;

- rapid reforestation will be secured through planting of trees without delay after harvest-

ing;

- wetlands, such as swamps, are left outside forestry operations;

- the green parts and smaller branches of the harvested trees are left in the forest to

minimise the amount of nutrients removed from the forests.

Proper consideration of these aspects in practice will be supervised in connection with the

follow-up activities of the forestry operations.

Biodiversity and Preservation of Nature

The issues of biodiversity in the project will be addressed in two ways: (1) securing a reason-

able share of protected areas in the region, and (2) applying forest management practices that

preserve biodiversity also in production forests.

The main contribution to nature and biodiversity conservation in the region is made by the

established Russian nature preserves. There are ten natural reserves in Primorsky Krai, six of

which are in the southern Vladivostok-Khasan region. The existing reserves close to TRED A

serve mainly as resting and breeding places for migrating birds, and spawning

grounds for fish.

Kedovaya Pad Reserve, relatively close to TREDKA, and Lazo and Sikhote-Alin Reserves, a few hundred kilometres away from the Tumen River, are important also for the Siberian tiger (*Panthera tigris altaica*), and the Amur leopard (*Panthera pardus orientalis*). The Siberian tiger has more or less become a symbol of the area and there are only about 150 tigers left. About ten years ago, the number was 300-400. Even more endangered but internationally less known, the number of Amur leopards is still decreasing. It is estimated that there are about 50 Amur leopards left.

The main threat against these cat animals has not been forestry or forest industry but illegal hunting. The tigers especially, are valuable quarry for these hunters. The most coveted part of the tiger is not the fur, but the teeth and the skeleton. Powdered bone is sold mainly to Thailand and China.

Both the tiger and the leopard appear to have adjusted to timber mills and secondary forest, and are often seen on roads and near gardens. Both species are highly dependent on their prey, mainly wild boar and red deer. Tigers may occasionally prey on roe, musk, sika deer, goral and elk.

There are plans to create yet another reserve in the Tumen River delta area. Demands have been raised for creation of new reserves in the inland forests of Primorsky Krai to protect the Siberian tiger, the Amur leopard and other values of the Far Eastern Taiga forests.

Other endangered species are the giant eagle (*Haliaeetus Belagicus*) and the yellow-throated marten. The giant eagle's distribution area is mainly along the coast line. The biodiversity issue must be seen in its entirety. Even if soft forestry may not endanger for example the Amur tiger itself, it may have an impact on the ecological chain. If forestry will change the living conditions for any part of the ecological chain, this will later also affect the tiger, in terms of limited availability of prey for the tiger.

The economic development in the region increases the pressure on the remaining natural areas, but increases the economic possibilities of forming new natural preserves for endangered flora and fauna. Especially, it is in the interest of the companies involved in the utilisation of the region's forests that a reasonable share of the forests (say, at least 10% of the

land area) is preserved in their natural condition, to preserve the biodiversity in its true meaning from the big mammals down to micro-organism level.

A leading idea in the TRED A forestry and forest industries development project is sustainable management of forests, using the experience gained elsewhere with methods adapted to local conditions. Major changes compared with the normal practices for instance in Russia, which affect biodiversity, include e.g. the following:

- "soft" logging methods using light machinery;
- increasing use of thinnings to produce wood and to enhance growth of remaining trees;
- smaller operation areas especially in final cutting;
- ensuring regeneration of forests by leaving seedlings and seed trees in the harvested areas, using artificial regeneration where appropriate and necessary;
- special biodiversity conserving management principles: maintaining a mix of tree species in all operations, leaving patches of old growth forests and ecological corridors, leaving decaying trees and some old trees unharvested, avoiding draining of wetlands, leaving riparian forests outside clear felling.

As a basis for these measures, environmental studies will be conducted in connection with the forest inventory, and the protection and mitigation measures will be incorporated in the forest management plans. In these studies special emphasis will be placed on identification of critical areas for endangered species, areas rich in biodiversity, and ecologically sensitive areas, which will be considered in the forest management plans.

#### Socio-Economic Impacts

In some areas of the forests there are people dependent on other forest products than wood. Especially hunting and fishing is important. The forest management will be planned so that the well-being of animal species important for hunting or other important living purpose is properly considered.

There may be religious or other cultural values which have to be taken into account when planning forest development. Forestry and forest industries have to be developed in co-operation with the local people and as a part of the socio-economic development of the area.

The proposed labour-intensive forestry operations and mechanical wood industries tend to favour the use of local workers, leaving some of the economic benefits to the local people.

## Environmental Issues in Different Forest Management Schemes

### Degraded Hardwood Forests in the Jilin Province, China

and in the Hamgyong Province, DPRK

The proposed forest management objective in these areas is rehabilitation of the forests mainly

by clearcutting in strips and planting. Steep slopes and forests in mountainous areas would be

left outside these operations.

Environmental aspects in forest management include the above-listed principles and guidelines.

Special attention should be paid to erosion control in slopes over 30% and on stream banks,

which should be left outside commercial cuttings and vegetation strengthened where

necessary. Needs and possibilities for afforestation of both protective and productive purposes

should be studied. Local demand for fuel wood and construction wood shall be recognised in

forest management.

Forests in the Amursk and Khabarovsk Province, Russia

The proposed development of wood harvesting operations in the forests of the Amursk and

Khabarovsk Provinces includes improvements in reforestation and other silvicultural activities.

There are some examples of less successful forest management operations in the region. With

the proposed measures towards more sustainable forest management the performance of

present harvesting operations can be substantially improved in an ecological sense and the

cutting volume could be even increased.

In this region many of the above environmental principles are applicable.

Especially the issues

of biodiversity conservation and erosion control are important. The Russian system of forest

categories and nature reserves should be developed further in cooperation with forestry

development planning. A clear system of protected areas, multi-purpose forests, and production

forests should be established based on a proper inventory of forest resources, ecological

conditions and biodiversity. Successful reforestation is important for erosion control and

sustainable yields in the region.

The needs of local people, such as need for fuelwood, construction wood, other products of the

forests, protection of migration routes of fish, improved infrastructure, and new job

opportunities, must be taken into account in the planning process.

Forests in Primorsky Krai, Russia

Primorsky Krai includes several types of relatively well growing forests. The

region's closeness to the core of TREDAs, and also other areas with growing wood demand, will increase the pressure on the forests of the region. At present the cuttings are less than 50% of the calculated allowable yield (based on a rather conservative estimate of 2 m<sup>3</sup>/ha per year). Recently foreign investors have invested in forest management and utilisation in the region. In developing the forestry in the region special emphasis must be placed on the environmental mitigation and management of the forestry operations along the principles and guidelines presented above. In this region the main environmental concerns are (1) preservation of biodiversity (including internationally known cases like the Siberian tiger and the Amur leopard), (2) control of erosion, and (3) protection of the migrating routes and spawning sites of anadromous fish (salmon i.a.). For preservation of biodiversity, it is important that the system of nature preserves and forest categories is further developed. Ongoing scientific research in the region will give valuable information on the ecological requirements of the Siberian tiger and the Amursk snow leopard, and this information should be applied also in the forest management planning. Sufficient areas (say at least 10% of the forest area) of natural reserves must be left outside logging operations. "Softer" harvesting and silvicultural systems should be applied especially in areas around protected reserves, and other areas where other uses of forests demand a multi-purpose forest management approach. Even in forests designated mainly for wood production, patches and corridors of natural vegetation should be left for instance along rivers and in wetlands. Erosion control and protection of migrating fish have to be taken into special consideration especially in the mountainous areas and along the eastern coast of the province. The above-listed guidelines for erosion control should be incorporated into forest management plans. For instance, in planning of harvesting, clear-cutting should not be allowed on steep slopes (> 30%) or along rivers and brooks (a protection zone of 10 - 100 m should be left). In planning of forest roads and other forms of log transport, the above mentioned erosion control and other environmental guidelines must be taken into account.

The material and cultural needs of local and indigenous people should also be respected when developing the forest resources in the region.

#### Mechanical Forest Industry

##### Potential Environmental Impacts

The environmental impacts of mechanical forest industries are generally rather small and do not create any major problems. The potential adverse environmental impacts of the mechanical

forest industry include:

- emissions of volatile organic compounds to the air;
- groundwater contamination by harmful substances;
- local dust problems;
- solid wastes.

##### Air Emissions

The air emissions come from three main sources. If the plant required a power boiler, the power boiler could be fuelled with wooden waste from the process. In case fossil fuel were used, the boiler would be the main source of sulphur dioxide air emissions. If wood residues were burnt in the boiler, dust would also be emitted from the boiler. Mechanical processing of wood under normal conditions creates emissions of wood dust. Finally, the use of solvents, impregnation agents and glue will cause emissions of different volatile organic compounds. The air emission control technology for the boiler is usually an electrostatic precipitator for dust removal. If oil with a high sulphur content is used and sulphur dioxide removal is required, the boiler can be equipped with a scrubber.

##### Process Effluent

Some waste water is generated in mechanical wood industry. The effluent amount is generally much less than in pulp and paper industry, but the toxicity of the effluent could be as high as for pulp and paper effluent. To avoid adverse effects on the recipient, some kind of effluent treatment is normally required. Usually, the water consumption is minimised already at the planning stage, but the remaining effluent will most probably require primary effluent treatment and in environmentally sensitive locations even biological treatment.

##### Solid Waste Handling

Solid waste of wood and residual glue can be disposed by burning. Residues containing toxic agents and non-combustible waste such as scrap batteries, used lubrication oil etc, are collected separately. Several of these wastes are normally recovered and regenerated in some

form. The recovery is usually made by external contractors and following the local stipulations.

#### Environmental Mitigation and Management

Chemicals used for wood preservation should not include harmful substances, e.g. chlorinated

phenols. The preservation agents should be handled and stored in areas where they cannot be

released to the environment.

Also resins and surface coatings used in the mechanical wood industry should be selected so

that no significant emissions of volatile organic compounds can result from their use.

Wood residues should be used for energy production, excluding wood which has been impreg-

nated with preservation agents containing heavy metals or chlorinated organic compounds.

Dust emissions from the mechanical forest industry should be properly addressed.

An EIA should be required for major mills.

#### Pulp and Paper Industry

##### Potential Environmental Impacts

The environmental impacts of the pulp and paper industry are related to impacts on receiving

waters, ambient air, noise emissions and production of solid waste.

##### Environmental protection

requirements in the pulp industry and emissions have changed significantly during the past 20

years. The development is shown in Table 4-1, in which the best pulp mills in operation at a

given time are briefly reviewed in regard to emissions. Possibilities of further improving the

situation are shown in Table 4-2.

#### TABLE 4-1

#### TABLE 4-2

Local conditions, the sensitivity of the environment and local rules and stipulations finally

determine the required level of environmental protection.

A stepwise improvement programme in line with economic growth and the financial

performance of an individual enterprise are also important for solving the environmental

problems in a balanced way.

The use of best available technology economically achievable (BATEA) should particularly be

fostered. The final mill concept will always be adjusted to the local conditions to find a

balance between environmental impact and economy. BATEA means that the mill's process

concept and process configuration corresponds to the at present technically

best available technology. The concept is not a particular process, but a combination of modern technologies, corresponding to the best proven technology. The additional words economically achievable means that the costs for construction, operation or maintenance do not exceed what is economically defensible.

#### Impacts on Water

All pulp and paper mills use big amounts of fresh water in the process, thus generating equal amounts of process effluent. The effluent consists of various environmentally harmful compounds. By making all possible water-minimizing measures already at the planning stage it is possible to minimize both the effluent amount and the content of pollutants. In a BATEA million with closed process water circuits it is possible to achieve the following discharge figures:

- susp. solids	kg per yearDt	1 - 2
- BOD5	kg per yearDt	0.5 - 2
- COD	kg per yearDt	14 - 25
- AOX	kg per yearDt	0.1 - 0.2

Figure 4/3 shows typical BOD loads from different pulp mills compared with BATEA. The typical BOD load from the Russian pulp mills are spread over a rather big range, from a few kg BOD per yearDt up to 28 kg per yearDt. The mills with the best performance are in performance-parity with any western million with good performance, but several Russian mills suffer from malfunctioning treatment plants and the range is subsequently rather big. North American mills operate under various conditions, as far as effluent guidelines are concerned. The federal guidelines in both Canada and the USA are rather loose in comparison to the state guidelines in certain states, i.e. British Columbia and Alberta in Canada and, Washington and Oregon in the USA. These particular states have imposed guidelines for pulp mills, which are stricter than for example in the Scandinavian pulp industry. Consequently, the typical North American BOD load range is quite wide, varying from 3 kg BOD per yearDt up to 15 kg BOD per yearDt for typical mills. Western Europe, meaning Germany, France, Belgium, Spain and Portugal, have also somewhat varying BOD loads, ranging from 3-10 kg BOD per yearDt, depending on local circumstances. An average load from a typical Western European pulp million



would be around

5 kg BOD per yearDt. The Scandinavian situation is close to the one in Western Europe, or

somewhat lower. In 1988 the situation was dramatically different with normal values around 20-

22 kg BOD per yearDt in Europe.

Japan has the strictest guidelines of the regions compared. The reason for this is that Japan is

densely populated and the country has limited fresh water resources.

FIGURE 4/3

#### Impacts on Air

The emissions to air of greatest environmental importance from kraft pulping are sulphur

dioxide, causing potential health hazards and acidification of the environment, and malodorous,

reduced sulphur compounds (TRS) such as hydrogen sulphide, causing health hazards in high

concentrations and annoying smell in low concentrations.

Using modern technology, the following atmospheric emissions from the recovery boiler can be

reached:

particulates (after electrostatic precipitator)	<200 mg/m <sup>3</sup> <1 kg per yrDt
sulphur dioxide	<200 mg/m <sup>3</sup> <1.0 kg S per yearDt
nitrogen oxides (NO <sub>x</sub> as NO <sub>2</sub> )	<1.0 kg per yearDt

At these emission levels significant harmful effects on air quality can be avoided. Malodorous

emissions are difficult to prevent totally, and therefore, in the siting of the mill the possible

nuisance caused by the emissions in populated regions must be considered.

#### Noise

Noise abatement should be taken care of by choosing low-noise equipment and by insulation of

the noise sources. Noise must be taken into consideration when planning the mill site.

#### Environmental Mitigation and Management

In the TRADP, strict international environmental protection standards should be followed when

giving guidelines for the selection of processes and for the treatment of atmospheric emissions,

waste waters and solid wastes. The objective should be to promote only projects which would

comply with the environmental requirements in other industrialised countries.

A full environmental impact assessment (EIA) must be required for all major pulp and paper

mill projects to find the best alternatives and to define the detailed environmental mitigation

and management measures to secure that the mill does not cause significant

adverse

environmental impacts. The EIAs should be based on a good information of the existing situation in the region, international environmental standards, and thorough knowledge of the possibilities of modern technology to solve environmental problems.

#### ADVANTAGES OF TREDA FOR A FOREIGN INVESTOR

##### POTENTIAL INVESTORS

TREDA offers great opportunities for foreign investors due to its good raw material base, the unlimited adjacent markets for forest products and cheap and abundant labour. The main potential foreign investors in the area would have the markets for forest products but would be lacking wood raw material to satisfy the existing markets. This kind of investor would mainly come from Japan, South Korea, Taiwan and to some extent also from China.

Another potential foreign investor would come from a country which has good markets in the wood importing countries of Pacific Asia and would like to safeguard these markets. This kind of investor would mainly come from the USA, New Zealand, Australia, Canada and to some extent from Europe.

A third potential investor would be a machine manufacturer who would consider the area as a future potential market for his products and would see the investment as an opening to this market. This kind of investor would be limited and their share of investment small, probably 5-15%.

Venture capital investors could value TREDA as an attractive object provided that the know-how partners from the above groups would be found.

#### ADVANTAGES AND DISADVANTAGES OF TREDA

##### Advantages

TREDA offers many advantages for forestry and forest industry development. The forest resource base, especially on the Russian side, in the Primorsky and Khabarovsk regions, is enormous. At present about 20 million m<sup>3</sup> of the estimated AAG is unutilized. Also China and DPRK have resources which can be developed and improved with systematic forest management in order to create a basis for industrial development. The adjacent markets for forest products are very promising. Pacific Asia is presently considered the fastest growing area as far as the economic development and use of forest products are concerned. At the same time, roundwood exports from many of the former

exporting countries are declining rapidly and some of the surplus regions will even turn into deficit regions in the future. At the same time, the consumption of forest products is increasing in line with economic development and population growth. The labour situation in the area is very good. Especially Korea and China have abundant cheap labour with moderate training. Russia also has excess labour in Primorsky Krai that is partly well-trained in the wood industry because of the already existing industrial tradition.

#### Development Necessities

Foreign investors would duly consider the risks involved in the investments in the early stages

of evaluations. The main disadvantages are related to:

- lack of domestic funding;
- uncertain political and economic conditions;
- developing legislation;
- lack of infrastructure, particularly in the forest region;
- the suitability of the raw material to replace tropical hardwoods and big coniferous logs.

The legislation in these countries does not fully cover the interests of foreign investors. These include e.g. protection of ownership, free transfer of profits and capital, banking systems, licence regulations, settlement of investment disputes and equity policy and laws regulating foreign ownership. This situation is now improving in connection with the free economic zones but still requires the full attention of decision-makers in the TREDAs countries, since it is the most essential question when making investment decisions.

All of the TREDAs countries have deficient infrastructure. The poor infrastructure increases investment costs because the investors also have to invest in infrastructure and wood procurement. To attract foreign investors, it would be of utmost importance to improve the infrastructure by national funds and input and with foreign aid, if possible.

#### DEVELOPMENT OPTIONS

It would be in the interest of the TREDAs countries to process the raw material in the region and thus improve employment and gain value added. This is also the only way to utilise the low-quality raw material, especially in China and Northern Korea, but also part of the raw material in Russia. This is because the transport cost for this kind of raw material is too high in relation to the value of the wood.

The situation is different in Russia, which also has high-quality raw material for the mechanical

wood industry. National interests would, of course, also here favour processing of the wood domestically, but the investment needs of the industry are so huge that it will take a very long time before the production facilities can process the supply of raw material. Since the utilisation of the available raw material on a sustained basis is most important for the national economy, and to prevent further degradation of the old growth mature forest, it would be advisable to have an active industrial investment programme and export roundwood at the same time. This would also give the importing countries a chance to adjust themselves to the changing circumstances.

In the future, there will be a great pressure towards utilisation of the forest resources in the area. At present there is no clear strategy for the development of these resources. It would be of utmost importance to define the strategy in order to avoid environmentally negative impacts of forest utilisation, to safeguard biodiversity and to direct the sustained use of forest towards the welfare of people and development of the areas and countries. This would require a normal "Master Plan" which would define the framework for all forest utilisation.

#### SUPPORT PROGRAMMES

The industrial development programme for the forest industries is a large undertaking which can only succeed if the circumstances are made favourable for investments. This requires the full participation of the governments in the form of incentives, allowances and supporting programmes.

#### Forestry

Forest resources must always be utilised on an ecologically sustained basis. This can only be achieved if the utilization is based on proper forestry master plans on a regional basis and management plans on a forest area basis, taking into consideration the existing forests and their silvicultural and ecological development and the existing industry and its development needs.

These plans, especially master plans, have to be prepared on a national basis. Since a master plan is a large and expensive undertaking and it also has international interest, it can usually be financed by foreign development aid. A management plan is mainly necessary for the party who has the cutting right and for the government controlling the cutting. It

should therefore be financed by the party having the cutting right, but the cost should be considered in determining the stumpage fee. No cutting should be allowed without an approved management plan.

#### Infrastructure Requirement

An essential condition for attracting foreign investors is a well functioning infrastructure. The more deficiencies there are in the infrastructure, the more the investor has to invest in it, which makes the investment unattractive and economically less feasible. In industrial countries, the development of infrastructure is a national responsibility and the investor expects to have all the infrastructure, including available electricity and water, roads, transportation and communication systems and housing for employees etc. provided by the government. The UNDP development programme and agreements with the five member countries will help to improve the infrastructure and create favourable circumstances for investment and bring about a regional development which will attract foreign investment in forest industries.

#### Incentives for the Industrial Development

Different kinds of incentives are important to improve the interest in investments. These are e.g. the following:

- tax and investment incentives;
- building allowances;
- export and credit incentives;
- exemption from customs duties;
- training and employment incentives;
- transport subsidies.

Without well-planned incentives, allowances and subsidies, it would be very difficult to attract foreign investors to areas and projects which, although promising and attractive per se, have to be implemented in difficult and uncertain conditions.

## INVESTMENT OPTIONS

### BASIS FOR SECTORAL DEVELOPMENT

Because of the increasing consumption of wood products and the drastic decrease in supply, especially in North America and tropical Asia, the wood products demand/supply in Asia is expected to reach a state of imbalance in the near future. The prospects for forest products are excellent. All investments which can improve the supply of forest products would therefore be very attractive.

The Russian Far East, the Primorsky and Khabarovsk areas, have vast forest resources, Primorsky about 12 million hectares and Khabarovsk about 50 million hectares, with an AAC of more than 40 million m<sup>3</sup>. These resources provide a very good basis for investment in the forest industries. China and DPRK do not have appreciable unutilized forest resources, but through resource development and efficient forest management new resources could be made available also to forest industries. The wage level in TREDAs is moderate in comparison with competing countries and potential importing countries. The transport distance to the growing market is relatively short compared with the main competitors. TREDAs thus has rather favourable conditions for investment in forest industry.

#### SUMMARY OF INVESTMENT OPTIONS

Altogether 19 investment options have been identified for utilising the potential forest resources in the area:

- 1 Wood Chips Export Operation Based on Hardwood and Softwood Resources from the TREDAs and Hinterland;
- 2 Sawlog Export Operation Based on Softwood Resources from the TREDAs and Hinterland;
- 3 Hardwood Pulp Mill;
- 4 Softwood Pulp Mill;
- 5 Newsprint Mill;
- 6 Softwood Sawmill Based on Korean Logging Operation in the Khabarovsk Region;
- 7 Softwood Sawmill Based on Raw Material from Primorsky Krai;
- 8 Hardwood Sawmill Based on Raw Material from Primorsky Krai;
- 9 Hardwood Sawmill/Solid Furniture Component Factory;
- 10 Hardwood Flooring Block Factory Based on Raw Material from the Jilin Province;
- 11 Parquet Factory;
- 12 Hardwood Plywood Factory Based on Raw Material from Primorsky Krai;
- 13 Glue-laminated Beam Factory;
- 14 Joinery Factory;
- 15 Planing Mill;
- 16 Solid Wood Soft Furniture Factory;
- 17 Box Furniture Factory;
- 18 MDF Factory;
- 19 Particleboard Factory.

#### SELECTION OF THE MOST ATTRACTIVE DEVELOPMENT PROJECTS

##### CRITERIA FOR SELECTION

It has been agreed that the selected projects should have a sound, market-

driven business

concept with due consideration of environmental aspects. This means that the projects should be market (export) oriented and profitable. In planning of the forest operations and industrial units, environmental aspects should be considered in line with the principles and strategy presented in chapter 4. The projects should be environmentally safe and ecologically sustainable.

Additionally, forestry and forest industry projects are always resource-based, i.e. the availability of raw material and location of the raw material supply area is one of the major factors influencing the decision concerning the type and location of industry. Considering the above, the following criteria should be taken into account when selecting the most attractive projects and their location:

- availability and quality of raw material on sustained basis;
- demand and markets for intended products;
- existing infrastructure (roads, rail-roads, ports, electricity, availability of workers and their training level etc.);
- political and economic conditions;
- existing legislation and subsidies;
- profitability (R.O.I. and profit/sales);
- financing needs (investment cost and investment cost/sales revenue)

as well as

availability of funds for financing (interest of investors).

#### EVALUATION OF INVESTMENT OPTIONS

The investment options have been evaluated in terms of their return on investment (R.O.I), profit, sales revenue and investment cost. The ratio of investment cost/sales revenue is also important, because of the difficult financing circumstances in the project area. The smaller the investment cost in comparison to the annual sales revenue, the easier the financing.

#### Wood Export

The wood chips and sawlog export operations are very profitable and the investment cost is moderate. The investment cost/sales revenue ratio is only 0.6 in wood chips exports and 0.3 in sawlog exports. R.O.I. is 60.6% for wood chips and 114.4 for sawlogs. Profit before taxes is estimated at 32.3% of turnover for wood chips and 30.2% for sawlogs. Both investments would be very good and could even finance further investments in industrial units.

#### Sawmills

Sawmills offer relatively good investment opportunities. The big softwood

sawmillion (230,000 m<sup>3</sup> per year) gives a very good profitability, annual profit 40% of turnover and R.O.I. 36%. Also the investment cost/sales revenue ratio is rather good, 1.3. The smaller softwood sawmillion (60,000 m<sup>3</sup> per year) and hardwood sawmillion (30,000 m<sup>3</sup>) are not as profitable investments. R.O.I. is 18.9% and profit 24% of turnover for the softwood sawmillion and 19.5% and 27% for the hardwood mill, respectively. The investment cost/sales revenue ratio is also less favourable than for the big sawmill, 1.3 and 1.8 for the softwood and hardwood mills, respectively. Both are still relatively good investment opportunities.

#### Hardwood Plywood Factory

The hardwood plywood million gives an acceptable R.O.I. of 21% and profit of 29% of turnover

before taxes. The investment cost/sales revenue ratio is rather high 1.8.

#### Hardwood plywood

million would be a viable investment opportunity.

#### Panel Factories

The R.O.I. for the particleboard million is only 11.4% and the profit before taxes 11%, which are

not acceptable for economic investments. The MDF factory is somewhat better, giving a R.O.I.

of 18% and a profit before taxes of 24% of turnover. The investment cost/sales revenue ratio is

1.9 and 1.7 for particleboard and MDF, respectively. Investment in particleboard production

cannot be recommended but investment in MDF production is a viable opportunity, especially if

there are plans to invest in box furniture production.

#### Further Processing of Sawn Timber

Many of the further processing investments give a good R.O.I.: planing million 44%, parquet

factory 34%, joinery factory 34% and gluelam panels 25%. The profit is reasonable: planing

million 12% of turnover, parquet factory 16%, joinery factory 14% and gluelam panels 14%,

which are good considering the low investment cost. The investment cost/sales revenue ratio is

very good for all of them: planing million 0.3, parquet factory 0.6, joinery factory 0.5 and

gluelam 0.6. All of them are very good investment opportunities provided the basic industry,

sawmills, exists.

The hardwood flooring block factory gives a good R.O.I. of 29% and a profit of 43% of turnover,

but the investment cost/sales revenue ratio is rather high, 1.8.

The hardwood sawmill/joinery component factory gives a R.O.I. of only 13%, which is not



acceptable. The main reason for the low R.O.I. is the too small production unit. If the volume of the factory can be increased, the return would be better. The same applies to investment

cost/sales revenue ratio, which is quite high, 2.5. The profit is better, about 20% of turnover.

The investment can only be recommended, if the size of factory can be considerably increased.

#### Furniture Factories

The furniture factories give a good R.O.I., soft furniture 30% and box furniture 43%. The profits

before taxes are also good, 30% of turnover and 28% respectively. The investment cost/sales

revenue ratios are moderate, 1.1 for solid soft furniture and 0.5 for box furniture, using mainly

reconstituted panels as raw material. They give excellent investment opportunities, but cannot

be implemented before either MDF or particleboard products are easily available. They also

require a rather high training level and should therefore be postponed until both requirements are fulfilled.

#### Pulp and Newsprint mills

Pulp and newsprint mills are financially very big investments and also the investment cost/sales

revenue ratio is very high, for hardwood pulp 3.8, for softwood pulp 2.4 and for newsprint 2.9.

R.O.I. is rather low, for hardwood pulp 12%, for softwood pulp 34% and for newsprint 13%. The

profit for hardwood pulp is 26%, for softwood pulp 19% and for newsprint 25%. The softwood

pulp million is the best, but the figures refer to a very large million size, 500,000 t per year.

Because of the high investment cost and rather low return on investment, investment in these

industries cannot be recommended in the first stage.

Pulp mills have, however, very definite advantages in the development of forest resources:

they are able to utilise low quality raw material which often has only a limited market but

must be harvested in order to improve the forest resources;

they generate electricity not only for their own consumption but also for local use at competitive cost.

#### AREA AND LOCATION CONSIDERATIONS

Finding a suitable area for investments in forest industries in TRED A is a rather difficult

question because of the location of forest resources far away from the core area. Neither China

nor DPRK have appreciable forest resources in TRED A. Russia has vast resources but they

are on the outskirts of the TREDAs (Primorsky Krai) or immediately outside it (Khabarovsk, Amursk etc.).

At present the forest industry in Jilin, China, is suffering from lack of raw material due to the strong demand and very high prices for raw material sold to other parts of China. New industry based on the present raw material would seriously affect the prices and upset the raw material balance and profitability. New raw material could be made available for investments in forest industries through major forest improvement projects, which should be a part of the national reforestation policy. A national decision on reforestation would therefore be needed before any investments can be planned. However, if this prerequisite comes true, Hunchun would be a viable area for investment in forest industries.

Imports of raw material from Russia to China are theoretically possible, but in practice very difficult, since the Russians are not very keen to sell their raw material for processing in other countries and the cost of transport would be rather high. It would not be easy to find a profitable concept for investment in forest industry based on imported raw material. DPRK has only marginal raw material for new industry. This raw material could advantageously be used by rehabilitating existing industry in the area. The most likely object would in that case be a plywood factory in TREDAs.

DPRK has, however, long traditions in importing logs from Khabarovsk and Amursk regions. If the present concessions could be increased considerably and lengthened to contain a time period of 20-30 years, investment in forest industry on the DPRK side of TREDAs might be possible. Even then, the very long transport distance with high cost and risk of deterioration during transport, could form a serious drawback for the intended investments. The Russian land strip between China and the ocean, belonging to the core area of TREDAs, has environmentally sensitive spots and areas that are protected or intended to be protected.

No bigger industry should be built in this area. Since the industrial investments should be environmentally safe, there is no reason to locate new industry in this area, especially since the area is far away from the raw material and lacking necessary infrastructure. A good site for intended investments could be found on the southern coast of Primorsky Krai.

Reasonable volumes of raw material could be found in this area and the

infrastructure is satisfactory. There is a reasonable road and rail road network and export deliveries could be handled through the ports of Nakhodka or Vladivostok. Nakhodka port also has existing facilities for shipment of wood chips and logs. The training level of workers in Primorsky Krai is also higher than in other parts of TRED A or more northern areas in Russia. A labour shortage might be a disadvantage, though.

There are numerous access points from the sea to the forest resources and location of the wood processing units. Alongside with Primorsky Krai's east coast there are several small ports with an access to limited coastal forest resources.

Main accesses from the TRED A point of view in the order of importance are:

- 1 Vladivostok, Nakhodka, Vostochny
- 2 Zarubino, Posiet
- 3 Rajin and other DPRK ports

The railroad development plan in Hunchun-Zarubino area indicates good possibilities for location of forest industry there:

Zarubino would attract mechanical wood industry and wood export facilities if the port facilities in the Vladivostok region would not offer sufficient capacity and degree of service (presently very problematic);

The Hunchun region would offer a base for location of forest industries there based on the Chinese resources. The industry location on the Chinese side is less problematic from the technical point of view, but the export transport calls for assistance from the TRADP.

#### SELECTED MOST ATTRACTIVE DEVELOPMENT PROJECTS

##### General

The most attractive development projects would be a series of forestry and forest industry projects, based on a forest concession or concessions in Primorski Krai, or alternatively

Khabarovsk, and investments in wood industries exploiting these forest resources on sustained and environmentally safe basis. The proposed projects would form a long term industrial development programme which would be implemented in several stages, step by step.

Other projects, which on certain conditions could be attractive, are examined in chapter 7.5.

An alternative to new industries could possibly be rehabilitation of some existing industries, e.g. sawmills, plywood mills and furniture and other further processing

industries, in the area. Rehabilitation of existing industries, however, has been outside the scope of this study. This alternative should therefore be assessed before a decision on new industry is made.

#### Raw Material Base

Since the selected projects would be resource-based, the final composition or type of industry

cannot be decided before the forest resources available for the intended projects are known.

The first phase in the project should therefore be an identification of the raw material base for

the investment. As discussed in chapter 3, there are basically three alternatives for organising

the raw material procurement:

through the processor's own procurement organisation from established concession areas;

through co-operation with local harvesting organisations from joint concession areas;

through delivery contracts with local wood procurement companies, concession owners.

The third alternative would raise log prices, since the supplier would base them on existing

export prices. The profitability of the project would thus be considerably lower. This type of

procurement would also mean risks in ensuring timely deliveries which would be difficult to influ-

ence. In big investments, this kind of uncertainty cannot be accepted.

The two first alternatives would be feasible. Since a project in Russia would necessarily need a

Russian joint venture partner, the second alternative should be recommended. The best

solution would then be to find reliable local partners, establish a concession together and create

operational resources together in the most optimal way. The local partners should have the

main responsibility for wood procurement. This means that they should have the necessary

capabilities to handle this part of the operation.

Possible joint-venture partners on the Russian side could be one or several of the lesproms or

lespromhoses in the area, e.g. Primorsklesprom and Ternejles in Primorsky Krai and

Dalilesprom in Khabarovsk.

#### Project Stages

The actual project or projects should be divided into three stages according to Table 7-1.

#### TABLE 7-1

The first stage of the project, after securing raw material through a concession and building up

a procurement organisation and facilities, should be to start the export of logs and chips. As can be seen from the pre-feasibility studies, both of these operations are very profitable. So, while the project would develop forest operations, it could also earn necessary funds for industrial investments.

One question is of course whether the industrial investments are necessary, since exports of raw material are so profitable. From a national viewpoint it is always wise to process raw materials domestically and this way contribute to national development. This would create employment and increase incomes through value added. An overall advantage would also be the lower transport cost, when the wood waste of industrial production is not transported to the buyer. Exports of raw material might also be a more risky business in the long run, since the wage level in importing countries tends to be rather high compared to the wage level in Russia.

The general development is thus expected to go in the direction of importing basic forest industry products instead of raw material.

The second stage in the project would be to invest in primary industrial units. The best alternatives (see chapter 7.2) would be:

- investment in softwood sawmill; and/or
- investment in hardwood sawmill; and/or
- investment in hardwood plywood mill

The selection between these three alternatives is dependent on the volume and type of raw material available. With the investments in these industries, the exports of logs would cease or decrease. The exports of chips would continue, since no industry using chips as raw material has been suggested.

The third stage in the project would be to invest in further processing of sawn timber. Many of the possible alternatives are very profitable and should be implemented in due course after getting the basic industries in satisfactory and full production. The possible alternatives would be the following:

For softwood sawn timber:

- planing mill; and/or
- joinery factory; and/or
- glue laminated panels and beams.

For hardwood sawn timber:

- planing mill; and/or
- flooring block factory; or

parquet factory; and/or  
furniture component factory.

Further processing of sawn timber can of course be implemented alternatively:  
as the third stage, after completing the two first stages; or  
as an independent option based on existing raw material supply from  
the existing local  
industry.

#### Time Schedule

The project can be divided into the following phases:

1st Phase, Preliminary Identifications, 2-3 years

Finding a joint venture partner in Russia, identification of forest  
area, inventory of forest  
resources, pre-feasibility and feasibility studies, investor identification  
and investment  
decision.

2nd Phase, Log and Wood Chips Export, 1-3 years

Forest management plan, implementation of log and wood chip exports,  
feasibility  
studies for industrial investments, environmental impact assessment,  
investment  
decisions for industry.

3rd Phase, Basic Industry, 2-3 years

Investment in basic industry, feasibility studies for further  
processing, investment  
decisions for further processing units.

4th Phase, Basic and Further Processing Industry

Investment in further processing industry. Project completed.

#### OTHER DEVELOPMENT OPPORTUNITIES

Besides the most attractive development projects, there are also possible  
projects both in China  
and DPRK in the long run, provided that the raw material supply can be solved  
on a long term  
basis.

#### Project Opportunities in China

##### Raw Material Base

The major part of Changbai Chan in the south-east of the Jilin province is  
unproductive forest

land. Within a radius of 100 km from the city Hunchun, an area of about  
19,000 sq.km, there

are 685,000 ha of forest land with a growing stock of 52 million m<sup>3</sup>. The  
average growing

volume is 65-75 m<sup>3</sup> of hardwoods, such as oak, birch, linden, maple, elm,  
poplar, ash etc. The

log quality is low, because of long term selective cutting and exploitation  
of the resources.

This raw material would mainly (80-90%) be pulpwood, suitable for wood based  
panels or

mixed hardwood pulp. Besides pulpwood, the forests would yield about 10-20%  
of logs for

hardwood sawmill/further processing.

To make this raw material available for industrial use, a forest improvement

project would be needed. This would require a national decision and possibly foreign financing for implementation.

The area needed for the forest improvement project should be at least 100,000 ha to yield enough raw material on a long term basis (30 years) for a MDF factory of 100,000 m<sup>3</sup> capacity and a hardwood sawmill with further processing.

DPRK

Raw Material Base

DPRK has long traditions of using forest concessions in Amursk and Khabarovsk regions in

Russia. The present agreement is on a short term basis and the harvested volumes are needed

for the existing industry in DPRK.

If these concessions could be negotiated to cover a longer period, minimum 20 years, and the

volumes could be increased by e.g. 300,000 - 400,000 m<sup>3</sup>, this would give a basis for a

development project on the DPRK side of TRED, including possibly a softwood/hardwood

sawmill and some further processing, such as a planing mill, furniture component factory and/or

glue laminated beam factory.

## PROJECT IMPLEMENTATION

### IDENTIFICATION OF FOREST AREA/CONCESSION AGREEMENT

Before any actual project plans can be made, the forest area has to be identified and a

preliminary agreement about a concession reached. This means that also the potential Russian

joint venture partner has to be found.

To acquire a concession the following procedure is necessary:

1 A written application is given to the forest owner, Federal Forest Service

represented by Regional Forest Committees. The application must contain technical and economic details, extraction systems, annual harvesting volumes and areas etc.

2 The forest owner prepares a licence together with the applicant within one month.

3 The licence is then approved and confirmed by the representative of the (City) Council.

4 The licence will be approved by environmental authorities.

5 Finally, the lease agreement is written on the basis of the licence.

A lease agreement will contain:

information about the forest areas;

type of silvicultural obligations of the lease holder;

the rights and obligations of the forest owner and the lessee concerning the use of forest, reforestation and forest improvement work;  
financing of reforestation and forest improvement;  
planning and approval of work done for reforestation and improvement;  
compensations for negligence against the agreement;  
rent for the concession;  
other conditions.

Leases over 5 years require preparation of a management plan within one year from the time of agreement. This plan is approved by the district authorities responsible for forestry and the environmental authorities.

In theory, obtaining a concession is a clear and well defined operation. The bureaucracy is, however, still existing and quite detailed information is needed for the application. Selection of potential concession areas is also a time-consuming task. Therefore, enough time has to be reserved for this phase of the project, possibly 1-2 years.

#### PLANNING PROCESS

After securing the raw material base through a concession or other delivery agreements, a proper study concerning the investment options and planning of the project(s), has to be done.

The final selection of the most attractive investment options is done at this stage.

The studies follow the line of pre-feasibility studies and the objective is to collect and check the basic information on the local conditions for final calculations as a basis for the investment

decision. Studies and planning are required in the following areas:

- Forest Management;
- Industrial Investment;
- Transportation and Infrastructure Development;
- Environmental Protection Strategy and Impact Assessment;
- Training and Personnel Development;
- Fiscal Payment and Taxes;
- Estimate of Cost and Profitability;
- Time Schedules;
- Feasibility Studies.

#### Forest Management Plan

Concessions, which are longer than five years, require a proper management plan. The management plan should include:

- resource inventory, including growing stock of different species and grades with an estimation of annual allowable cut by area on a sustained basis;
- annual working plans, including terrain and other operational conditions, wood harvesting and transport technology, annual harvesting areas and volumes ,



development of forest roads and infrastructure, details of marking, harvesting and post-harvesting inventories, forest protection and biodiversity conservation; wood cost calculations, including investment requirements for infrastructure and roads as well as logging and transport equipment, operating cost and finally wood cost at million

Part of this information, mainly concerning the resource inventory and wood cost, is needed for the feasibility studies. The remaining information can be connected to the actual Forest Management Plan, which is part of the project planning and done when the investment decision has been made.

#### Industrial Investments

The studies concerning industrial investments should include:

million site selection, with specific reference to forest area, existing industry and infrastructure like access to roads, ports, industrial services, power supply, water availability, communications etc. as well as linkages with other industrial and economic development programmes;

scheduling, with target time schedule for project development, including construction, machinery procurement and installation and start-up.

#### Transport and Infrastructure Development

Transport and other infrastructure in connection with investments is crucial due to the deficiencies in the region. The status of infrastructure and priority development needs must

therefore be properly assessed. This would include the following:

Transport network, including:

- transport infrastructure, services and equipment in the possible locations of new industries;

- port alternatives, i.e. potential of the existing ports to facilitate forest industry development;

Energy supply, including:

- supply of power/sale of power;

- supply of heat and fuels, if needed.

#### Environmental Protection Strategy and Impact Assessment

Big investments in forestry and forest industries require an environmental impact assessment

and protection strategy in order to avoid negative consequences of poor environmental

performance. The assessment should include both the forestry operations and the industry, covering:

- environmental conditions;
- allowable pollution loads and suggested abatement technology;
- potential harmful effects of pollution;
- measures to mitigate environmental effects.

#### Training and Personnel Development

A proper study of the training needs is very important, especially for investments in areas which do not have an industrial tradition or industries with new technology. The study should include:

- estimate of available personnel and their training level;
- estimate of required training level;
- establishment of training needs for different levels of the organisation, workers, foremen, administration and management;
- tentative training plan with required theoretical and practical training time, preparation of training material, teachers and time schedules;
- training system and organisation.

#### Estimate of Cost and Profitability

A reliable assessment of the manufacturing cost will be essential to evaluate the international competitiveness of the industry. The manufacturing cost would be calculated on the basis of conceptual process designs, unit costs, consumption figures and anticipated productivity. The costs would be divided into two major groups:

- variable cost, including wood, chemicals, fuels, purchased energy and operating materials (variable part);
- fixed cost, including personnel cost, operating and maintenance materials, other fixed costs and general overhead costs.

The profitability analysis would be based on cash-flow calculations before taxes over a fifteen year economic lifetime of the industry. The result would be expressed as Internal Rate of Return (IRR). A realistic production development curve during the start-up time would be determined for the calculation.

The basic profitability estimates would be made using the constant prices reflecting the cost and price level of the time of calculation. The sales prices would be based on trend prices.

The effects of price and cost changes and production rate on the profitability would be demonstrated by a sensitivity analysis in order to assess the critical factors of the investment. The key variables would be sales price, cost of raw materials, cost of energy, total variable cost, total fixed cost, capital cost and production levels and operating efficiency. It is of utmost importance to establish realistic estimates of total capital

requirements for the industry projects. The capital requirements would be based on the pre-engineering and include machinery and equipment, buildings and construction, forestry and wood procurement, pre-operational expenses, working capital and financing charges and fees.

#### Time Schedules

Preliminary time schedules would be required for each activity and a master time schedule for the whole project.

#### Feasibility Studies

When all the information has been collected, the feasibility studies for potential industries can be made.

The final investment decision is made on the basis of feasibility studies.

## INTRODUCTION TO THE PROJECTS

### EARLIER STUDIES

The selection and prioritizing of the recommended projects was based on two early studies:

Inception Study concerning the business opportunities in the forestry sector, which was handed over on April 16, 1993 (not included here); and

Project Development and Environmental Strategy for the Forestry Sector. The draft report was presented in the Workshop on Industry, held in Seoul on November 8-10,

1993, and the final report was submitted to Working Group IV in mid-May, preceding

PMC V in August 1994. (This study has been included in its entirety as the first part of this report.)

These studies considered the background and basic conditions for industrial projects in the forestry sector in the Tumen River Economic Development Area (TREDA), such as forest

resources, markets for forest products, infrastructure and advantages of TREDA for foreign investors. Environmental strategy was also reviewed in detail.

The second study handled additionally the selection of the most attractive projects. This was done by analyzing various investment opportunities on the basis of pre-feasibility studies.

### THE FINAL STUDY

The objectives of this study were:

to prepare and present well-motivated specific investment proposals for the forest industry;

to prepare project profiles at pre-feasibility level of the most attractive investment

projects;

to present the above-mentioned projects taking into consideration  
- a market-driven business concept for each of the selected  
projects,

- due consideration of environmental concerns,  
- demonstration of raw material supplies in the context of  
cutting rights, forestry  
concession, or firm contracts with wood suppliers.

The selected most attractive investment proposals for the forest industry  
follow this

Introduction. They are:

Case No. 1 Wood Chips Export Operation Based on Hardwood and  
Softwood

Resources from Primorsky Krai

Case No. 2 Sawlog Export Operation Based on Softwood Resources  
from Primorsky  
Krai

Case No. 3 Softwood Sawmill Based on Raw Material from  
Primorsky Krai

Case No. 4 Hardwood Sawmill Based on Raw Material from  
Primorsky Krai

Case No. 5 Hardwood Plywood Factory Based on Raw Material from  
Primorsky Krai

Then follow the pre-feasibility studies of all the other investment  
opportunities studied under this

project. These projects are the following:

Case No. 6 Planing Mill

Case No. 7 Joinery Factory

Case No. 8 Glue-laminated Beam Factory

Case No. 9 Parquet Factory

Case No. 10 Hardwood Sawmill/Solid Furniture Component Factory

Case No. 11 Hardwood Flooring Block Factory Based on Raw

Material from the Jilin  
Province

Case No. 12 Softwood Sawmill Based on Korean Logging Operation  
in the  
Khabarovsk Region

Case No. 13 Solid Wood Soft Furniture Factory

Case No. 14 Box Furniture Factory

Case No. 15 MDF Factory

Case No. 16 Particleboard Factory

Case No. 17 Hardwood Pulp Mill

Case No. 18 Softwood Pulp Mill

Case No. 19 Newsprint Mill

Projects 6-9 would be natural continuations of the proposed five most  
attractive projects and

based on further processing of the products from these industries. The Solid  
Furniture

Component Factory, Project 10 and the Hardwood Flooring Block Factory,  
Project 11, could

also be implemented as a second stage for the proposed five most attractive

projects. All these projects, 6-11, can of course also be independent projects based on raw material available in the area or integrated with the present primary industry. The primary projects, Cases 1-5, are based on raw materials mainly available in Primorsky Krai, and their natural location would therefore be in the Russian territory: close to the forest resources, near different ports in the surroundings of Vladivostok or near the ports in TRED A. Projects 6-11 and 13-14 require a secured supply of processed raw material, and their location would therefore depend on the availability of the suppliers and possibilities of arranging the logistics and trade connections. The mills could be located in TRED A providing that the infrastructure is being developed according to the project requirements. According to the available plans and studies, there should be no major obstacles to fulfilling the requirements. The natural location of Project 12 is on North Korean territory, as it is a development of the traditional North Korean - Russian forest operation. The panel projects, Cases 15 and 16, are mainly intended to use wood raw material of secondary quality and can therefore be based in any location where such raw material is richly available. Such resources are found both on the Russian and the Chinese side. The mills can therefore well be located in TRED A. The pulp and paper projects, Cases 17-19, present the highest infrastructure requirements and requirements concerning the location factors. The hardwood pulp mill project is based on raw material typically available in China's coastal provinces and some parts of Primorsky Krai. The newsprint mill is intended for the domestic markets in China. These two projects can well be located on the Chinese side of TRED A. The softwood pulp mill requires large quantities of softwood which are only available in Primorsky Krai and other Russian regions. Its location on Russian territory is therefore motivated.

## PRESENTATION OF MAIN PROJECTS

### GENERAL

A series of five projects has been selected as the most attractive projects for implementation.

The projects are located on the Russian side of TRED A, Primorsky Krai or alternatively

Habarovsk Krai, and based on forest concession. These projects are:

- 1 Hardwood and/or softwood wood chips export operation, with

an annual capacity  
of 750,000 m<sup>3</sup>;

2 Softwood sawlog export operation, with an annual capacity of  
500,000 m<sup>3</sup>;

3 Modern, big softwood sawmill, with an annual capacity of  
230,000 m<sup>3</sup>;

4 Medium size hardwood sawmill with an annual capacity of  
30,000 m<sup>3</sup>;

5 Hardwood plywood factory, with an annual capacity of 25,000  
m<sup>3</sup>.

The projects are resource-based, i.e. they depend on the availability of raw material, and therefore they are also interrelated. The species and quality of the raw material, which will be known only when the concession has been identified, will determine which kind of operations can be implemented. The general composition of the forest in the area apparently makes all of the suggested projects possible and attractive. On the other hand, all the various raw materials harvested from the concession have to have a market outlet. The projects will be implemented on a sustained and environmentally safe basis, and they will thus improve the general condition of the forest and also generate funds for environmental work in the area.

#### JUSTIFICATION

The selection of the projects is based on the following criteria:

Large unutilized forest resources with suitable raw material for the proposed industries in Primorsky Krai and Habarovsk of the Russian Far East;

Great demand and favourable future market prospects for the intended products in the nearby Asian markets, especially in Japan, South Korea, Taiwan and China;

Existing infrastructure, i.e. roads, railroads and port facilities. The infrastructure is at present deficient and overburdened but generally better than in other parts of TRED A and can be more easily improved to correspond to the requirements of the proposed industries;

Good profitability of the proposed projects. Also the financing of the projects should be easy partly due to the strong and increasing demand for the intended products as well as the valuable forest resources;

The political and economic conditions in the area are slowly improving, thus limiting the risk of the proposed projects.

#### PROJECT STRUCTURE

Before the projects can be started a suitable concession area has to be found

and assessed.

Also the joint-venture partners have to be identified, i.e. a local entrepreneur and a foreign investor.

The next step would be to prepare a forest management plan for the concession and to prepare feasibility studies for the intended investments.

The projects proper should be implemented in two stages:

In the first stage, exports of wood chips and logs should be started. These operations should go on for at least two years until the necessary investments in industries utilising the raw material have been implemented. Since these operations are very profitable, they could also continue for a longer time thus generating financing for the industrial investments.

In the second stage, the softwood sawmill and/or hardwood sawmill and/or hardwood plywood mill would be built. When the softwood sawmill has started operation, the log exports would cease. The chips export operation would of course continue with roundwood raw material from the forest, since there are no industries proposed for this type of raw material. Additionally the chips from the industries would be exported.

In the third stage, which is not included in the present proposal, further processing of sawn timber could be started in the sawmills. This could include planing mills, joinery factories, flooring block or parquet factories, glue-laminated beams and panels and furniture component factories.

#### CASES

##### Case No. 1

##### Wood Chip Export Operation Based on Hardwood and Softwood Resources from Primorsky Krai Business Rationale

The interest towards long and short fibre wood raw material for production of paper has increased and new sources are being evaluated especially to fulfil the demand gap in the Far East. When new volumes of a high quality wood raw material are introduced to the market and the prices are competitive, a certain demand can surely be expected in Japan, South Korea and Taiwan. In this case the main competitive edge is the short sea transportation from the supply area to the market, which can mean only about a half of existing average wood chip freights.

The nearer source will also improve the flexibility of deliveries resulting

gradually to smaller size of vessels and lesser investments to big size wood chip carriers and receiving facilities.

#### Description

The objective of the project is to design and build a low-cost wood chipping plant suitable for local conditions in TRED A to process local hardwood and softwood into industry grade chips as well as to store the chips in a way permitting quick and competitive loading onto ships.

The chip terminal will be designed to permit a total of 17 wood chip carriers with a capacity of 45,000 m<sup>3</sup> being loaded every year, offering a combined annual output capacity of about

750,000 m<sup>3</sup>. The hardwood logs will be cut into lengths 2-3 m and softwood, depending on

harvesting and transport techniques, into lengths 2-6 m.

The logs will be unloaded from the railway wagons and log trucks by excavators fitted with grab buckets and unloaded directly to receiving deck or placed into the intermediate storage of logs.

From the intermediate storage, the logs will be transferred by two log stackers into the chipping process.

The logs will be debarked at the chip mill using a debarking drum with a capacity 200-250 m<sup>3</sup>/h.

The bark obtained from the debarking operation will be stored and subsequently loaded onto a truck with a full trailer and distributed to local farmers and communities as a soil conditioner material.

According to the modern way of thinking, it is extremely important to maintain high quality wood chip characteristics by ensuring the optimum chip length and thickness.

Chipping will be done by a horizontally feeded steel disc chipper with a capacity of 250-500 m<sup>3</sup>/h.

The required power is taken from 2 x 500 Kw squirrel cage motors.

Chips will be screened using a 3-level screen to separate oversized fraction and sawdust. The

oversized fraction will be chipped and returned to screening. Sawdust will be mixed with bark.

Screening capacity needed is 600 loose m<sup>3</sup>/h.

Accepted chips will then be moved to storage by a belt conveyor. The heap will be achieved

with a slewing stacker conveyor with adjustable height of fall to ensure that free fall is as short

as possible to minimize dust formation.

Solid impurities will be removed from the washing water by a dewatering conveyor and any

sand in a sedimentation basin. No other treatment will be carried out with



some of the water

being led to the sewage.

From the chip storage, chips are fed by two chain reclaimers onto a belt conveyor line. Chips

will be pushed onto the chain reclaimers using two bulldozers.

Chips will be loaded onto the ships by a telescopic belt stacker which is capable of loading

three holds of a ship while the vessels remains in position. The unit comprises a telescopic

chute with a spreader at the tip.

As the capacity of one vessel is 100,000 loose m<sup>3</sup> and 20% of the working hours are used for

moving the ship, the time required for loading a vessel is about 80 h or 3« days.

Location

The chip mill site will be selected in the immediate vicinity of the existing ports so as to permit

good railroad and road connections. Required minimum space for the operation with raw

material and product stock is about 5 hectares. Optimal port should have draught 11 meters,

but also shallower ports can be accepted, because of short sea transport to the market.

Raw Material

Operation will use mixed hardwood and/or softwood species from Primorsky Krai and possibly

Jilin.

Products

The product will be high quality, bark free and screened wood chips with good yield properties

in pulping.

Markets

The total production is planned for export mainly to Japan. A certain share of chips can be sold

to South Korea and Taiwan.

Integration

Improved profitability is achieved if the operation is integrated to sawmilling industry.

Investment Cost

The total investment cost is USD 19.3 m, of which the fixed investment USD 12.8 mill and the

working capital USD 6.5 m.

Time Schedule

The total investment will take 18 months after the investment decision is made and the

financing secured.

Profitability

The summary of main annual indicators is as follows:

sales volume

750,000 m<sup>3</sup>

sales revenue

32.25 m USD  
total manufacturing cost excluding depreciation  
25.64 m USD  
gross margin  
6.61 m USD  
in per cent of net sales  
20.55  
straight line amortisation time  
3.5 years

#### Case No. 2

#### Sawlog Export Operation Based on Softwood Resources from Primorsky Krai Business Rationale

The wood supply from natural forests consists of a variety of different wood species and log qualities. Part of the wood is of the highest value when exported to wood-deficit countries like Japan and South Korea. Profitable exports usually require sorted, high-quality logs, as the low prices of low-quality logs do not warrant the expensive handling and transport costs. Exported logs are used at the destination for production of sawnwood, veneer and plywood for special purposes.

The location of the log loading port must be carefully selected, as the general cargo ports are too expensive for this kind of operation.

#### Description

Logs are transported to the port area by truck or railway if the distance is longer. Six log stackers are needed for unloading the incoming trucks and railway cars, for taking logs from the sorting plant to the bundling station and for loading the vessels. The logs are measured and sorted by species and qualities. The log sorting plant is recommended to have 60 sorting pockets, because of several tree species and quality categories. After sorting, the pockets are emptied to the bundling station. Logs are then bundled into packages of about 15-20 m<sup>3</sup> to make the loading of ocean going vessels faster and easier.

The bundling is proposed to be made with sealed steel band.

The optimal scale of log export operations is around 400-500,000 m<sup>3</sup>. In this range, the expensive log sorting plant is sufficiently utilized and log transport distances are not too long.

This export volume means a time span of 5.3 days between shipments (average 7500 m<sup>3</sup>). With log export as the final target the log sorting plant can be located at port. If a sawmill will be built

later, the log sorting plant should be located at the sawmill site. For one vessel an average of 600 bundles/5.3 days (i.e. one vessel) have to be handled. It means 150 bundles per working day and 12.5 bundles per effective working hour (12 hrs/day), which gives 5 minutes/bundle.

For the maximum capacity we need one log sorting plant (capacity 8000 logs/shift), two hydraulic bundling stations, two sets of tensioners, lockers and dispersers plus one set as a spare. A compressed air with two filter - regulator - lubricator assemblies must be included.

Prior to the arrival of the vessel a minimum of 800 bundles have to be ready, preferably more.

The storage should be at least 3 bundles high to reduce the storage area in the port and to

reduce the transport distance. For efficient handling, heavy log stackers should be used. The

method and number of units for transport to the quay side depends on the local conditions like

ground and quay conditions, distance from storage to quay and possibility of intermediate

storage on or close to the quay.

An administration building is proposed to be built in the sorting and bundling area. This building

will also comprise a maintenance section for the trucks and loaders, a small repair shop and a

storeroom for spare parts.

Bundles are loaded by heavy port cranes or by the vessel's gantry cranes.

Specially designed

frames with hooks to lift 2-3 bundles at one time should be used.

Loading of vessels is performed by the local port. The cost of loading and port dues are

estimated to be USD 9/m<sup>3</sup>.

#### Location

The sawlog export operation will be located considering economically best location with respect

to the raw material sources, railroad connections to exporting port, ready infrastructure and

labour availability and would be adjacent to any of the present ports in Primorsky Krai. One of

the key factors of a profitable project is an existing port with 8 m draught and availability of

space for log storage adjacent to the quay.

#### Raw Material

The operation will use softwood logs from Primorsky Krai. Additional volumes can be brought

also from Habarovsk area.

#### Products

The products will be I, II and III grade (GOST) softwood logs and pulpwood.

Estimate is 45%

premium quality logs, 35% III grade logs and rest pulpwood.

#### Markets

The production is planned for export to Japan, South Korea and China.

#### Integration

Improved profitability is achieved if the operation is integrated to a wood chip export operation or to a pulp mill.

#### Investment Cost

The total investment cost is USD 9.8 million of which the fixed investment USD 3.3 million and the working capital USD 6.5 million.

#### Construction Time

The total investment will take one year after the investment decision is made and the financing secured.

#### Profitability

The summary of the main annual indicators is as follows:

sales volume	
500,000 m <sup>3</sup>	
sales revenue	
34.43 m USD	
total manufacturing cost excluding depreciation	
22.95 m USD	
gross margin	
11.48 m USD	
in per cent of net sales	
33.3%	
straight line amortisation time	
0.9 years	

#### Case No. 3

##### Softwood Sawmill Based on Raw Material

from Primorsky Krai

##### Business Rationale

The consumption of wood and wood products is increasing in the whole Pacific Asia. At the same time the main importers, Japan, South Korea and Taiwan, have to find substitutes for the strongly decreasing export of coniferous raw material from North America and deciduous raw material from the South-East Asian countries. The raw material of Russian Far East is a

suitable substitute for these high quality raw materials.

Sawmilling in Primorsky Krai would be very competitive compared to sawing in the potential

importing countries Japan, South Korea and Taiwan.

Due to the cheap labour, the sawmilling cost would be very favourable compared to sawing in

the importing countries. By transporting dry sawn timber instead of sawlogs, the transportation

cost can be minimized and the present serious problem of discolouration in the summer time

can be avoided.

The sea transportation is shorter and cheaper than from any competing countries. Short transportation improves the flexibility and makes big and specialized vessels unnecessary.

#### Description

The sawmill will be an automatic sawmill with Scandinavian type of technology which is suitable

for sawing Russian coniferous raw material from Primorsky Krai.

The sawmill will have two sawing lines, one for big logs and one for small logs. The big log line

will handle logs with 18 cm and more in top end diameter and the small log line will handle logs

14-17 cm in top end diameter.

All logs are sorted into classes according to the small end diameter. The sorted logs are

transported to the infeed decks of each sawing line and debarked by a ring debarking machine.

The big log sawing line will consist of a primary break-down unit with a reducer and quad band

saw, a secondary break-down unit with a reducer and quad band saw followed by a three band

resaw. Additionally the sawing line would have three edger optimizers.

The small log sawing line will consist of two reducer units and a circular resaw.

The sawn timber would be trimmed and sorted by a green sorting line and dropped

automatically into live bottom bins. The bins are emptied on a conveyor and conveyed to a

sticker stacking machine which will form the stickered kiln loads.

Kiln drying takes place in low temperature progressive type, automatically controlled kilns. The

dry kiln loads are transported by traverse conveyors to the dry sorting.

The dry sawn timber is quality graded in an automatic grading line and packaged for

transportation and delivery to the customer.

The total capacity of the sawmill would be 230,000 m<sup>3</sup>/a with 190,000 m<sup>3</sup> from the big log line

and 40,000 m<sup>3</sup> from the small log line.

#### Location

The sawmill will be located in Primorsky Krai considering economically best location with

respect to the raw material sources, railroad connection to exporting port, ready infrastructure

and labour availability.

#### Raw Material

The sawmill will use spruce and fir logs from Primorsky Krai. The annual consumption is

451,000 m<sup>3</sup>.

#### Products

About 70% of the sawn timber production will be export quality, graded

according to the customers requirements. About 30% domestic grades. About 25% of the production is planned to be further processed in planing mill.

#### Markets

The main exporting country would be Japan with South Korea and Taiwan as other potential customers.

#### Integration

The expected favourable development of the wood and wood products consumption and markets will make a strong integration of sawmilling and the forest operation possible. The estimated pulp wood, about 50% of the output from the forest operation, and the sawmill residue can be combined into a profitable pulp chip production and export.

#### Investment Cost

The total investment cost is USD 68.5 million of which the fixed investment is USD 61.3 million and required working capital USD 7.2 million.

#### Construction Time

The construction time is two years after the investment decision is made and the financing secured.

#### Profitability

The summary of annual indicators is as follows:

sales volume

230,000 m<sup>3</sup>

sales revenue

44.665 m USD

manufacturing cost excluding depreciation

22.521 m USD

gross margin

22.144 m USD

in per cent of net sales

49.6%

straight line amortisation time

4 years

#### Case No. 4

Hardwood Sawmill Based on Raw Material from Primorsky Krai

#### Business Rationale

The consumption of wood and wood products is increasing in the whole Pacific Asia. At the same time the main importers, Japan, South Korea and Taiwan, have to find substitutes for the strongly decreasing export of tropical hardwoods from South-East Asian countries. The hardwood of Russian Far East is a suitable substitute for these high quality raw materials.

Sawmilling in Primorsky Krai would be very competitive compared to sawing in

the potential importing countries Japan, South Korea and Taiwan. Due to the cheap labour, the sawmilling cost would be very favourable. By transporting dry sawn timber instead of saw logs, the transportation cost can be minimized and the deterioration of log quality during the long transportation avoided. Hardwood sawmill also forms a basis for developing competitive further processing industries with value added production in TRED. Transportation cost can also be decreased by transporting components instead of sawn timber.

#### Description

The sawmill is a semi-automatic bandsaw mill suitable for sawing mixed hardwood sawlogs from Primorsky Krai.

The logs are delivered to the sawmill in lengths varying from 1.8 m to 6 m, sorted by species.

The small and straight logs are debarked with a ring debarker and the large and curved logs by a rosser head debarker.

The main break down is done by a bandsaw headrig and a log carriage. The resawing is done

by two band resaws with merry-go-round conveyors and infeeding and setting devices. Board edging takes place by two manually controlled edgers.

The sawnwood is collected on a green sorting table, trimmed with a two saw trimmer and sorted

by dimension in manually stickered kiln loads.

The stickered kiln loads are transported by fork lift truck, loaded on kiln carriages and moved

into the compartment kilns by traverse conveyors. The compartment kilns are low temperature

dryers where drying conditions are automatically controlled according to the selected kiln

schedule. Dried kiln loads are moved by traverse conveyors to the dry grading plant.

The grading plant consists of equipment for unloading the kiln loads and separating and

collecting of sticks and a two-saw trimmer. Trimming, grading, pulling of timber on carriages

and packaging are done manually.

The storing of packages is done by a fork lift truck. The size of storage corresponds to about

15% of the annual production.

The total capacity of the sawmill would be about 30,000 m<sup>3</sup> in two shift operation.

#### Location

The sawmill will be located in Primorsky Krai considering economically best location with

respect to the raw material sources, railroad connection to furniture

factories and exporting port,  
labour availability and ready infrastructure.

#### Raw Material

The sawmill will use mixed hardwood species from Primorsky Krai. The main species are oak, birch, maple elm and ash. The annual consumption is 55,800 m3.

#### Products

About 70% of the sawn timber production will be components for export and local furniture manufacturing and 30% normal sawn timber for export and local construction.

#### Markets

The share of domestic market is estimated at 60% of which the furniture components make about 35-40% and normal sawn timber about 20-25%. The share of export is planned to be 40%, mainly furniture components.

#### Integration

Integration in wood harvesting is necessary in order to direct different raw materials (plywood logs, pulpwood etc.) to the best suited industries.

#### Investment Cost

The total investment cost is USD 12.2 million of which the fixed investment is USD 11.1 million and required working capital USD 1.0 million.

#### Construction Time

The construction time is 18 months after the investment decision is made and the financing secured.

#### Profitability

The summary of annual indicators is as follows:

sales volume	30,000 m3
sales revenue	6.278 m USD
manufacturing cost excluding depreciation	2.987 m USD
gross margin	3.290 m USD
in per cent of net sales	52.4%
straight line amortisation time	5 years

#### Case No. 5

Hardwood Plywood Factory based on

Raw Material from Primorsky Krai

#### Business Rationale

The raw material base of Primorsky Krai offers an access to good quality hardwood logs, mainly oak and birch.

The consumption of plywood is increasing in the whole Pacific Asia. At the same time the



availability of plywood and plywood logs, especially in the tropical hardwood areas, has been strongly decreasing. Birch and other hardwood plywood from the Russian Far East would be very suitable substitutes for tropical hardwood plywood. Due to the cheap labour, plywood production in Primorsky Krai would be very competitive compared to plywood production in the main importing countries, especially Japan which is the most potential buyer. Due to previous experience in plywood manufacturing, the quality of plywood can be kept on international level. By transporting plywood instead of plywood logs, the transportation cost can be minimized and the deterioration of log quality during the long transportation avoided. As an alternative to the new plywood mill, rehabilitation of the existing mill can be considered.

#### Description

The plywood mill will be a semi-automatic, medium labour intensive plywood mill.

The logs would be delivered to the mill in lengths varying from 2.5 m to 6 m. The log yard would be covered by asphalt and the logs stored in piles by front end loaders and sprinkled during warm season.

The logs are heated in a log basin and moved by conveyors through the basin to ring debarkers and to bucking and peeler blocks.

The peeler blocks are charged automatically by micro processor controlled device and peeled in a line equipped with a lathe, multiple tray conveyor, a high speed clipping machine and a green veneer stacker. Peeler cores and waste veneer are chipped, screened and conveyed into an open storage with concrete walls.

The veneer sheets are fed through a steam heated, multi deck, roller type drying machine and graded immediately after drying in a stacking line.

Random-width veneers are joined and spliced into full size sheets in composer machines,

clipped to required lengths, stacked on lift tables and moved to intermediate storage. The plant

contains also a scarf jointing line in which the veneer sheets can be lengthened in lengthwise

direction. Veneer patching takes place in automatic patching machines. Dry veneer waste and

trimming ends of plywood are chipped and used as fuel in the steam boiler.

The plywood is formed in three lay-up stations. Phenolic resin adhesive is applied by roller type

spreaders equipped with automatic veneer sheet feeders. The laid-up plywood is pre-pressed

and moved to hot press. The multi opening press is heated by steam and equipped with charging, discharging and control system.

The plywood sheets are trimmed in separate line and sanded in another line consisting of a wide belt sander and a grading and patching line.

Plywood sheets are packaged, wrapped, strapped and transported for storage with fork lift

trucks. The capacity of storage sheds is about 2500 m<sup>3</sup> or 10% of the annual production.

The total capacity of the mill would be 25,000 m<sup>3</sup> of plywood with 10 mm average thickness working in two shifts.

#### Location

The plywood mill will be located in Primorsky Krai considering the economically best location

with respect to the raw material resources, railroad connection to the exporting port, labour availability and ready infrastructure.

#### Raw Material

The plywood mill will use hardwood logs. mainly oak and birch, from Primorsky Krai. The annual consumption is 80,600 m<sup>3</sup>.

#### Products

The plywood will be high quality interior type of plywood for interior decoration and furniture manufacturing.

#### Markets

About 80% of the plywood would be sold for export, mainly to Japan. The remaining 20% would be sold to local furniture manufacturers and construction.

#### Integration

Integration, in some way or other, with other industries using hardwood raw material is essential in wood procurement to assure good quality raw material.

#### Investment Cost

The total investment cost is USD 23.8 million of which the fixed investment is USD 22.5 million and required working capital USD 1.3. million.

#### Construction Time

The construction time is two years after the investment decision is made and the financing secured.

#### Profitability

The summary of annual indicators is as follows:

sales volume

25,000 m<sup>3</sup>

sales revenue

11.925 m USD

manufacturing cost excluding depreciation

6.175 m USD

gross margin  
5.750 m USD  
in per cent of net sales  
48.2%  
straight line amortisation time  
6 years

#### Case No. 6

#### Planing Mill

#### Business Rationale

A planing mill with resawing facilities is an integral part of a sawmill improving the customer service.

Increasing building and construction activity in Pacific Asia provides a good opportunity for market value-added products and thus to improve the profitability of the sawmill.

By using partly the same administration and production facilities as the sawmill and by planning the production according to the end-use requirements of various products, the planing mill can be very profitable.

#### Description

The planing mill will receive sorted and graded sawn wood from the sawmill. The quality and moisture content of sawnwood corresponds to the requirements for planed products.

The planing mill will have a covered storage for sawnwood which is used as a buffer storage for raw material for planing. Humidity in the store is controlled to keep the moisture content of wood on desired level.

From the storage sawnwood is taken into processing. A resawing and crosscutting unit is placed before the moulder to allow resawing and crosscutting before planing. This unit can also be operated separately from the moulder. After planing machine is a sorting and packaging unit.

Planed timber will be sorted and trimmed, bundled and wrapped with plastic cover to avoid changes in the moisture content of planed product. Finished products will be stored in a covered dry storage until delivered to customers.

The mill will not have dry kilns because the proposed sawmill will be able to deliver sawn timber which has suitable moisture content for planing and planed products. The planing capacity of the mill would be 15,000 cu.m of planed wood in two shifts annually.

#### Location

The planing mill will be located close to any of softwood sawmills so that it is an operational part

of the sawmill.

#### Raw Material

The factory can use all softwood species, i.e. pine, spruce, fir and larch, as raw material. The species and grades are selected according to the end-use requirements. The raw material will be delivered dried to a special moisture content. The raw material consumption will be 20,000 m<sup>3</sup>.

#### Products

The planing mill will produce planed and moulded wood for construction purposes, interior decoration and weatherboards as well as simple components for joinery.

#### Markets

The share of the export market is estimated at 70%, mainly to Japan, South Korea and Taiwan. About 30% will be sold to the domestic market.

#### Integration

The planing mill can be integrated with any sawmill with big enough production. As part of a sawmill, some administration, operating and investment cost can be saved.

#### Investment Cost

The total investment cost is USD 1.3 million of which the fixed investment is USD 0.9 million and required working capital USD 0.4 million.

#### Construction Time

The construction time is 12 months after the investment decision is made and financing secured.

#### Profitability

The summary of annual indicators is as follows:

sales volume	15,000 m <sup>3</sup>
sales revenue	4.174 m USD
manufacturing cost excluding depreciation	3.603 m USD
gross margin	0.660 m USD
in per cent of net sales	15.8%
straight line amortisation time	2.5 years

#### Case No. 7

##### Joinery Factory

##### Business Rationale

A Joinery factory would have a good opportunity to operate in the area where the economical growth is fast. Normally such area provides a good demand for all kind of building materials and components because of high rate of construction works. The high and

increasing number of housings starts in the area and customer countries provide a good market for windows and other building components. Joinery factory provides a good possibility to increase the value of sawn wood and improve the economical value of local industry. The process is quite simple but produces high value products.

#### Description

Sawn wood will be supplied graded and dried by softwood sawmillers. The raw sawn timber will be kept in a covered storage until it is taken in to use. Raw material will be precut to required component sizes with a multiple resaw and crosscutting saw. The mill will have two fourside moulders. One for shutter components and one for frame woods. The frame wood is glue laminated from smaller components to avoid twisting of wood material. For gluing of frame components the line has a glue spreader and pneumatic clamping machine. After composing, the frame components are moulded to final shape and ends are tenoned. Precut components for shutters will be moulded and tenoned straight after cutting. Hollows for locks and hinges are machined with mortizers and milling machines. After machining, the components are taken for combining to frames and shutters in a frame clamp. Frames and shutters will be painted or dipped in wood preservative for colouring or protecting against discoloration and deterioration of wood. Fittings will be fixed beforehand or after painting. After sealing and fixing glasses, the shutters and frames will be combined together and packed for transportation to customer. For storing of finished products the factory will have a covered storage.

#### Location

The factory would be located in an area with good transport connections to the raw material suppliers and customers.

#### Raw Material

The joinery factory uses different kinds of softwood species mainly spruce, pine and larch to produce windows. The raw material will be graded and dried in the sawmills according to the requirements of joinery products.

#### Products

The factory will produce mainly window elements produced from softwood species. The window element includes the frame and shutters with fittings and glass. Production of panelled wooden

doors is also possible. The factory has facilities to paint or treat the window elements with wood preservatives.

#### Markets

The share of domestic market is estimated to be 80% and export 20%.

#### Investment Cost

The total investment cost is USD 2.1 m, of which the fixed investment is USD 1.4 m and

working capital USD 0.7 m.

#### Construction Time

The investment will take 14 months after the investment decision is made and the financing is secured.

#### Profitability

The summary of indicators is as follows:

sales volume

25,000 units

sales revenue

4.1 m USD

total manufacturing cost excluding depreciation

3.2 m USD

gross Margin

0.9 m USD

in % of net sales

21%

return on Investment

34%

#### Case No. 8

##### Glue Laminated Beam Factory

##### Description

Glue laminated beams are produced from dried and specially selected raw material. The factory

has a covered storage for raw material for maintaining the desired moisture content of raw material and keeping a buffer stock of raw material to secure the continuous operation of the mill.

The factory has two alternatives concerning raw material to produce glue laminated beams.

Either it produces beams from trimmed one length sawn wood or finger jointed wood. The way

of the production can be selected according to the end use of the beams and customers requirements.

The production line has cross cutting and finger jointing machines. These machines make it

possible to produce glue laminated beams from cheaper raw material without decreasing the

strength of the products decreases. Trimmed raw material either from the storage or from the

finger jointing line will be taken to the calibrating planer and thereafter

to glue spreader. After the glue spreader is a composing table where beams are prepared for pressing. After that beams are fed into the press and at the same time the previous set is taken out. The final size and surface of the beam are finished in a planer. For storing and transportation, beams are wrapped with plastic to maintain the moisture content of the beams and the colour of the wood. The factory has also a covered storage for processed beams where they are kept until delivery.

#### Location

The factory would be located in an area with good transport connections and where softwood raw material is easily available from one or several sawmills.

#### Raw Material

The factory uses softwood species, such as pine, spruce and larch, to produce glue laminated beams. Species are selected according to the end uses. The raw material will be delivered to the factory dried and specially graded for the purpose.

#### Products

The products are glue laminated beams for house building as load supporting members of construction. The beams will be veneered when used in visible construction with decorative requirements. Additionally to producing construction beams the factory can produce glue laminated components and solid wood panels for joinery purposes.

#### Markets

The share of domestic market is estimated to be 30% and export 70%.

#### Integration

The factory can be an independent company or an operational part of a softwood sawmill.

#### Investment Cost

The total investment cost is USD 3.1 m, of which the fixed investment is USD 2.7 m and working capital USD 1.0 m.

#### Time Schedule

The investment will take 10 months after the investment decision is made and the financing is secured.

#### Profitability

The summary of main annual indicators is as follows:

sales volume	10,000 m <sup>3</sup>
sales revenue	4.9 m USD
total manufacturing cost	3.7 m USD
gross Margin	

1.2 m USD  
in % of net sales  
23%  
in % of total investment  
32%  
profit before taxes  
0.7 m USD  
in % of net sales  
14%  
return on Investment  
25%

#### Case No. 9

#### Parquet Factory

#### Business Rationale

The economic development and consequently increasing number of housing starts will provide a good market for parquet.

Parquet flooring is a value-added product for a specific end-use, flooring. The process is rather simple but increases the value of products considerably.

#### Description

The parquet factory will produce solid wood parquet blocks from unedged sawn wood or from

raw blocks. The mill will receive dried raw material from hardwood sawmills. To secure continuous operation the factory has a covered storage for buffer volume of raw

material. In the case of unedged sawn wood the raw material is taken for splitting and cutting to

the block preparation unit which has multiple circular saws for the operation. After cross cutting

is parquet planer. Raw blocks are taken to the planer from the preparation unit or from storage.

Planer is used to smoothen and calibrate the blocks and when needed to cut tongues and

grooves. After planing machine blocks are trimmed to required lengths and the ends are

tongued and grooved with a double end tenoner. For lamparquet there will be a splitting saw.

Processed blocks will be sorted, packaged and wrapped with plastic to avoid increase of the

moisture content of the blocks. Packages are stored in covered storage until delivery to

customers.

#### Location

The factory would be located in an area with good transport connections and where hardwood

raw material is easily available from one or several sawmills.

#### Raw Material

The factory will use unedged sawn timber or raw blocks in the production. The raw material will

be provided by several sawmills. The annual consumption will be 14,300 m<sup>3</sup>.



## Products

The factory will produce 10,000 m<sup>3</sup> of solid wood parquet annually which is equal to 400,000 - 500,000 sq.m of flooring.

## Markets

The share of the export market is estimated at 70% consisting of high value species and qualities. Lower qualities, about 30%, are sold to the domestic market.

## Integration

No integration is necessary. Integration with sawmilling is possible and would bring some advantages.

## Investment Cost

The total investment cost is USD 1.7 m of which the fixed investment is USD 1.2 m and required working capital USD 0.6 m.

## Construction Time

The construction time is 10 months after the investment decision is made and financing secured.

## Profitability

The summary of annual indicators is as follows:

sales volume	10,000 m <sup>3</sup>
sales revenue	2.961 m USD
manufacturing cost excluding depreciation	2.288 m USD
gross margin	0.673 m USD
in % of net sales	22.7%
straight line amortisation time	3 years

## Case No. 10

### Hardwood Sawmill/Solid Wood Furniture

#### Component Factory

#### Business Rationale

The harvesting of the mixed hardwood rehabilitation areas will produce besides pulpwood also a certain volume of sawlogs which are suitable for value added products. The economic development and consequently increasing number of housing starts will provide a good market for joinery and furniture products. Precut components are value added products of sawn timber which are mainly used for furniture manufacturing. The process is rather simple but increases the value of products considerably.

#### Description

The factory will produce precut hardwood components and sawn wood for

furniture

manufacturing and other purposes.

The sawing line consists of a debarker, headrig bandsaw with the log carriage, band resaw with merry go round conveyor system and board edger. For sawn wood there will be two cross cutting saws.

Components and export of sawn wood requires certain moisture content of wood and for that

purpose the factory will have a drying kiln.

The component line has multiple circular saw and band resaw for splitting of blanks. Cross

cutting is done with one single and one multiple circular saw.

Logs will be debarked and then sawn on the band saw line. Centre pieces of logs will be used

for component production or for construction wood depending on the quality of the log. Side

boards will be edged and trimmed and the use depends on the quality of boards.

After sawing, goods are dried to the required level of moisture content.

After drying, blanks for

component production are delivered to the component preparation unit and normal sawn wood

is sorted, packaged and kept in storage until delivery to the customers.

To secure continuous production of components the factory has a covered storage for buffer

volume of raw material. The sawn wood is delivered unedged to the component factory. From

the storage wood is taken for splitting and cutting at the component unit.

After preparation the

precut components will be sorted, packaged and wrapped with plastic to avoid increase of the

moisture content of the components. Packages are stored in covered storage until delivery to

customers.

Location

The factory would be located in an area with good transport connections and close to the raw

material sources.

Raw Material

The factory uses different kinds of hardwood species, such as oak, maple and birch. The

components will be produced of special dried sawn timber.

Products

The mill will produce precut sawn wood components for furniture manufacturing and other

purposes according to the customers requirements.

Markets

The share of export market is estimated at 40% and domestic market 70%.

Integration

Integration in harvesting is necessary.

### Investment Cost

The total investment cost is USD 6.1 m of which the fixed investment is USD 5.8 m and required working capital USD 0.3 m.

### Construction Time

The construction time is 12 months after the investment decision is made and the financing secured.

### Profitability

The summary of annual indicators is as follows:

sales volume	
10,000 m <sup>3</sup>	
sales revenue	
2.396 m USD	
manufacturing cost excluding depreciation	
1.110 m USD	
gross margin	
1.287 m USD	
in per cent of net sales	
53.7%	
straight line amortisation time	
8 years	

### Case No. 11

Hardwood Flooring Block Factory Based on Raw Material from the Jilin Province

#### Business Rationale

The pulp wood harvesting area contains, besides pulp wood logs, also a certain volume of saw

logs which can be used for value added wooden products. The price of raw material would

possibly be lower when selected from pulp wood harvesting.

The high and increasing number of housings starts in the area and customer countries provide

a good market for parquet and hardwood sawn wood.

Parquet blocks are value added products of sawn wood and can be used directly for the end

use. The process is quite simple but produces high value products. Parquet mill can utilize logs

which are not suitable for ordinary sawing process and long sawn timber. This improves the

economical use of the local forest resource.

#### Description

Logs transported to the sawmill will be sorted to parquet logs and saw logs.

The sawing line consist of a debarker, headrig bandsaw with log carriage, two band resaw with

merry go round conveyor system and board edger. Trimming will be done with two cross cutting

saws.

Parquet factory and export of sawn wood requires certain moisture content of wood and for that

purpose the factory will have a drying kiln.

Parquet block line consists of multiple circular saw for splitting of blanks and multiple cross cut circular saw for cutting of strips. Further processing of the blocks is done by a parquet planer and double end tenoner.

Logs will be debarked and then sawn on the band saw line. Centre pieces of logs will be used for parquet production or for construction wood depending on the quality of the log. Side boards will be edged and trimmed.

After sawing, the goods are dried to the required level of moisture content. After drying, the

blanks for parquet production are delivered to the parquet mill and normal sawn wood is sorted

packaged and kept in storage until delivery to the customers.

To secure continuous production of parquet blocks the factory has a covered storage for buffer

volume of raw material. The sawn wood is delivered unedged to the parquet factory. From the

storage, wood is taken for splitting and cutting to the block preparation unit with multiple circular

saws. After cross cutting raw, the blocks are taken to the planer for smoothing and calibration

of the blocks. Blocks are trimmed to required lengths with the double end tenoner. The same

machines can be used to mill tongues and grooves around the parquet blocks when required.

Processed blocks will be sorted, packaged and wrapped with plastic to avoid increase of the

moisture content of the blocks. Packages are stored in covered storage until delivery to

customers.

**Location**

The factory would be located in an area with good transport connections from the forest and

customers.

**Raw Material**

The parquet factory uses different kinds of hardwood species mainly oak and birch to produce

blocks. The raw material will be selected and dried from the sawmill's production.

**Products**

The factory will produce uncoated parquet blocks which are planed, tongued and grooved for

installation on the floor. The factory could also produce raw blocks to be used for different type

of parquet models.

**Markets**

The share of domestic market is estimated to be 60% and export 40%.

**Integration**

The factory is an operational part of a hardwood sawmill which is integrated

to the same logging operations as the hardwood pulp mill.

#### Investment Cost

The total investment cost is USD 6.5 m, of which the fixed investment is USD 6.1 m and

working capital USD 0.4 m.

#### Construction Time

The investment will take 14 months after the investment decision is made and the financing is secured.

#### Profitability

The summary of indicators is as follows:

sales volume

15,000 m<sup>3</sup>

sales revenue

3.6 m USD

total manufacturing cost excluding depreciation

1.2 m USD

gross margin

2.4 m USD

in % of net sales

67%

return on investment

29%

#### Case No. 12

Softwood Sawmill Based on Korean

Logging Operation in the Khabarovsk Region

#### Business Rationale

The consumption of wood and wood products is increasing in the whole Pacific Asia. At the

same time the main importers, Japan, South Korea and Taiwan, have to find substitutes for the

strongly decreasing export of coniferous raw material from North America and deciduous raw

material from the South-East Asian countries. The raw material of Russian Far East is a

suitable substitute for these high quality raw materials.

The Korean harvesting concession in Khabarovsk/Amursk area gives a good opportunity for

investment in forest industry in Rajin-Sonbong free economic zone. The cheap labour cost in

logging makes raw material cost competitive despite the long transportation.

Sawmilling in Rajin-Sonbong area would be very competitive compared to sawing in the

potential importing countries Japan, South Korea and Taiwan.

Due to the cheap labour, the sawmilling cost would be very favourable. The sea transportation

is shorter and cheaper than from any competing countries. Short

transportation improves the

flexibility and makes big and specialized vessels unnecessary.

#### Description

The sawmill is a semi-automatic reducer bandsaw mill suitable for sawing coniferous logs from Khabarovsk area.

The logs are sorted into classes according to top end diameter. The sorted logs are transported to the infeed deck by fork-lift truck and debarked by a ring debarking machine.

The sawing line will consist of reducer quad bandsaw unit with merry-go round and intermediate storage for blocks. Additionally the sawing line will have one two circular edger.

The sawn timber is collected on a green sorting table, trimmed with a two saw trimmer and sorted in manually stickered kiln loads.

The stickered kiln loads are transported by fork lift truck, loaded on kiln carriages and moved

into the compartment kiln by traverse conveyors. The compartment kilns are low temperature

dryers where drying conditions are automatically controlled according to the selected kiln drying

schedule. Dried kiln loads are moved by traverse conveyors to the dry grading plant.

The grading plant consists of equipment for unloading the kiln loads and separating and

collecting of sticks and a two-saw trimmer for the sawnwood. Trimming, grading, pulling of

timber on carriages and packaging are done manually.

The capacity of the sawmill would be about 60,000 m<sup>3</sup> in two shift operation.

Location

The sawmill will be located in Rajin-Sonbong free economic zone.

Raw Material

The raw material will come from the Korean harvesting operations in Khabarovsk/Amursk area.

The annual raw material requirement is 117,000 m<sup>3</sup>. The volume of present agreement has thus

to be increased and the term lengthened.

Products

The sawmill will produce mainly export quality sawn timber graded according to the customers

requirement. About 30% of the production will be further processed in local factories (furniture

components, joinery, glue laminated beams etc.).

Markets

The main exporting ,markets would be Japan, South Korea and Taiwan. Export share will be

about 60-70%.

Integration

Integration in harvesting is necessary in order to direct different wood qualities to the best

suited industries.

Integration in further processing in some form would be desirable in order to

add value to the products and to employ people.

#### Investment Cost

The total investment cost is USD 21.0 m of which the fixed investment is USD 19.1 m and required working capital USD 1.9 m.

#### Construction Time

The construction time is two years after the investment decision is made and the financing secured.

#### Profitability

The summary of annual indicators is as follows:

sales volume

60,000 m<sup>3</sup>

sales revenue

11.625 m USD

manufacturing cost excluding depreciation

6.025 m USD

gross margin

5.600 m USD

in per cent of net sales

48.2%

straight line amortisation time

5 years

#### Case No. 13

##### Solid Wood Soft Furniture Factory

##### Business Rationale

A furniture factory would have a good opportunity to operate in the area where the economical growth is fast. Normally such area provides a good demand for all materials used in house building. The economic development and consequently increasing number of housing starts will provide a good market for furniture. The forest resources of the area provides good basis for furniture manufacturing. The production would be competitive due to cheap labour and short sea transport to export market.

##### Description

The factory will have a storage for buffer volume of materials to secure the continuous operation of the mill.

The mill will have a component preparation unit with resawing and cross cutting facilities. Raw materials precut to required component will be taken to processing lines. The processing unit will have two different lines. One of the lines will produce solid wood panels for table tops and chair seats. The other line machines smaller parts of furniture. Machining of components will be followed by finishing and coating. Coated components will be combined with

upholsteries to furniture sets. Sets will be packed, wrapped and protected against shocks during transportation.

The factory will have a covered storage for finished products.

#### Location

The factory would be located close to good transport connections to the raw material suppliers and customers.

#### Raw Material

The furniture factory uses different kinds of wood species available in the area, depending on the demand and design of products. The factory purchases its raw material from the sawmills specially dried and graded. Supply of wood raw material would include also pre-cut wood components. Upholsteries will be purchased from sub contractors.

#### Products

The factory will produce wooden dining sets and living room sets, such as tables and chairs.

Chairs will be equipped with upholsteries on the seats and back rests.

Manufacturing of small cabinets and office tables using solid wood will be possible too. Products will be coated with paint or lacquer. The furniture will be knock-down models.

#### Markets

The share of domestic market is estimated to be 60% and export 40%.

#### Investment Cost

The total investment cost is USD 2.9 m, of which the fixed investment is USD 2.5 m and working capital USD 0.4 m.

#### Construction Time

The investment will take 12 months after the investment decision is made and the financing is secured.

#### Profitability

The summary of indicators is as follows:

sales volume	
10,000 furniture sets	
sales revenue	
2.4 m USD	
total manufacturing cost excluding depreciation	
1.3 m USD	
gross margin	
1.1 m USD	
in per cent of net sales	
46%	
return on investment	
30%	

Case No. 14

Box Furniture Factory

Business Rationale



A box furniture factory would have a good opportunity to operate in the area where the economical growth is fast. Normally such area provides a good demand for all kind of building materials and components because of high rate of construction works. Availability of PVC or melamine coated particle-board and MDF is, however, a prerequisite for the investment.

#### Description

The factory will have a storage for buffer volume of materials to secure the continuous operation of the mill.

Raw material will be pre-cut to required component sizes with a panel saw.

After cutting the

components are taken for edge banding and boring. Components are combined to box units in a cabinet press and the back of cabinets and fittings are fixed at the same time.

Doors will be equipped with hinges in a hinge inserting machine and fitted to box units after pressing. Combined cabinet units will be wrapped and protected against shocks during transportation. The factory will have a covered storage for finished products.

#### Location

The factory would be located close to good transport connections to the raw material suppliers and customers.

#### Raw Material

The joinery factory uses mainly melamine coated particle board to produce cabinets. The back of cabinets will be made from hardboard. PVC-band will be used for edge banding to cover the visible cutting surfaces of cabinet components.

Doors will be made for standard cabinets from melamine or PVC coated particle board.

Veneered particle board or painted MDF is used for doors also. Solid wood panel doors are used for high quality cabinets. Particle board will be supplied coated from manufacturers and

MDF and solid wood doors from subcontractors.

#### Products

The factory will produce cupboards, wardrobes, utility cabinets and shelving units for household needs.

#### Markets

The share of domestic market is estimated to be 80% and export 20%.

#### Investment Cost

The total investment cost is USD 1.7 m, of which the fixed investment is USD 1.0 m and working capital USD 0.7 m.

### Construction Time

The investment will take 12 months after the investment decision is made and the financing is secured.

### Profitability

The summary of indicators is as follows:

sales volume	40,000 units
sales revenue	2.2 m USD
total manufacturing cost excluding depreciation	1.4 m USD
gross margin	0.8 m USD
in per cent of net sales	37%
return on investment	43%

### Case No. 15

#### MDF Factory

#### Business Rationale

The main criteria for a competitive MDF factory are cheap raw material and easy access to the markets.

There is plenty of unutilized hardwood raw material in TREDA which could form a cheap raw material base for panel board industry.

The strong development of furniture industry in the Pacific Asia will create a big demand for suitable raw materials (MDF, particle board, plywood and veneer) thus the outlook for these industries is very bright. MDF is a suitable substitute for declining plywood supply.

The transportation cost from TREDA to potential markets is competitive. Panel board industry is essential for development of own furniture industry in the area.

#### Description

The MDF factory will be an automatic, high quality, medium density fibreboard mill.

The raw material is delivered to the mill in the form of chips and stored by bucket loaders. From the storage the chips are led by infeed conveyor through screening into a washing station where stones, sand and other contaminations are removed.

The chips are treated in a pressurized steam chamber to plasticize the wood. The steam

treated material is then fiberised in a defibrator.

Resin and additives are injected into the fibre stream by automatically controlled glue mixing

and dosing devices. The fibres are then dried in a hot air tube system and led into the dry fibre

silo.

The fibre mat is formed by a forming machine and compressed on a line with a continuously operating prepress. The fibre matt density on the line is controlled by controlling device and cut to desired size. The hot press can be either a multi opening or large single opening or continuously operating press. The boards are cooled in a cooling star. After cooling the boards are trimmed to final size and put in an intermediate storage for normalizing. Grading takes place in a separate line with grading and stacking devices. The boards are wrapped, strapped and moved into storage by fork lift trucks. The size of storage corresponds with about 10% of the annual production.

#### Location

The MDF factory can be located anywhere in the TRED A area. Essential for the factory is availability of cheap raw material, wood waste or other material, and cheap transportation to markets.

#### Raw Material

The mill will use cheap, low quality wood, mainly hardwood waste, as raw material. The annual consumption is 167,000 m<sup>3</sup>.

#### Products

The mill will produce boards of 16 mm average thickness. The production will be used for furniture manufacturing, construction and audio-visual equipment.

#### Markets

About 80% of the production will be sold to export. The main exporting countries would be Japan, South Korea and Taiwan. About 20% of the production will be used locally or regionally in furniture production in TRED A.

#### Integration

Commercial integration with forest and forest industry companies and organisations is necessary in order to get cheap raw material e.g. logging. sawmill and plywood industry waste.

#### Investment Cost

The total investment cost is USD 44.1 m of which the fixed investment is USD 42.0 m and required working capital USD 2.1 m.

#### Construction Time

The construction time is two years after the investment decision is made and the financing secured.

#### Profitability

The summary of annual indicators is as follows:  
sales volume

100,000 m<sup>3</sup>  
sales revenue  
23.000 m USD  
manufacturing cost excluding depreciation  
12.500 m USD  
gross margin  
10.500 m USD  
in per cent of net sales  
45.7%  
straight line amortisation time  
5 years

Case No. 16

Particle Board Factory

Business Rationale

The main criteria for a competitive particle board factory are cheap raw material and easy access to the markets.

There is plenty of unutilized hardwood raw material in TRED A which could form a cheap raw

material base for panel board industry.

The strong development of furniture industry and increasing construction and building activity in

the Pacific Asia will create a big demand for suitable raw materials (MDF, particle board,

plywood and veneer) thus the outlook for these industries is very bright. The transportation cost

from TRED A to potential markets is competitive.

Panel board industry is essential for development of own furniture industry in the area.

Description

The particle board factory will be an automatic, high quality particleboard factory with an annual

production of 200,000 m<sup>3</sup> working in three shifts. The mill will employ 111 people.

The raw material is delivered to the mill as chips or round wood. The chips are stored by bucket

loaders. The roundwood is taken by front end loaders to the chipper. All the chips are screened

and conveyed into the chip silo.

The particles are processed in knifering flaking machines and conveyed into a silo.

The particles are dried in drum-type driers. After drying the particles are classified by screening

into surface and core particles and conveyed into silos.

Surface and core particles are discharged from silos and blended in two separate blending

machines. Resin and additives are dosed using automatic glue mixing and dosing devices.

The particle mat is formed by a forming machine and cut to desired length.

The density of the

mat is automatically controlled. The hot press can be either multi opening,

large single opening

or continuously operating press. After pressing the boards are cooled in a cooling star.

After cooling the boards are trimmed to final size and put in intermediate storage. Sanding and grading takes place in a separate line consisting of a wide belt sanding machine and grading and stacking devices.

The board stacks are wrapped, strapped and moved into storage by fork lift trucks. The size of storage corresponds to about 10% of annual production.

#### Location

The particle board factory can be located anywhere in TRED A. Essential for the factory is availability of cheap raw material, wood waste or other material, and cheap transportation to markets.

#### Raw Material

The mill will use cheap, low quality wood, mainly hardwood waste, as raw material. The annual consumption is 294,000 m<sup>3</sup>.

#### Products

The mill will produce boards of 16 mm average thickness. The production will be used for joinery, furniture manufacturing, and building construction.

#### Markets

About 70% of the production will be sold to export. The main exporting countries would be Japan, South Korea and Taiwan. About 30% of the production will be used locally or regionally in furniture production and building construction in TRED A.

#### Integration

Commercial integration with forest and forest industry companies and organisations is necessary in order to get cheap raw material e.g. logging, sawmill and plywood industry waste.

#### Investment Cost

The total investment cost is USD 51.8 m of which the fixed investment is USD 48.5 m and required working capital USD 3.3 m.

#### Construction Time

The construction time is two years after the investment decision is made and the financing secured.

#### Profitability

The summary of annual indicators is as follows:

sales volume

200,000 m<sup>3</sup>

sales revenue

29.000 m USD

manufacturing cost excluding depreciation

18.955 m USD  
gross margin  
10.045 m USD  
in per cent of net sales  
34.6%  
straight line amortisation time  
9 years

Case No. 17

Hardwood Pulp Mill

Business Rationale

The demand for bleached hardwood pulp is growing in China and in the near export markets in Japan, Taiwan and South Korea. The demand would be mainly satisfied with the new capacity under construction or planning in South America (Brazil, Chile) and in South-East Asia (Indonesia). In this balanced supply situation a local supplier of hardwood pulp has a possibility of competing successfully providing that the main cost factors, cost of wood and capital costs, can be kept internationally attractive. The availability of cheap wood from possible forest regeneration projects in China and Russia combined with low level of salaries and wages are the main technical factors making this project rationale.

Description

The planned pulp mill facility is designed for using local mixed hardwoods as raw material for production of fully bleached market pulp. The mill design concept follows the traditional patterns

where the following features have been important:

the mill operates 350 days per year;

the scale must correspond to the biggest Chinese pulp mills in operation or under construction (min. 100,000 t/a);

in order to achieve the important effect of scale, the capacity is suggested to be at minimum 150,000 t/a;

the mill size must correspond to the practical possibilities in obtaining wood from China,

therefore bigger than 150,000 t/a cannot be planned in the initial phase;

the mill design must be simple to achieve the lowest possible investment demand;

the environmental emissions into water are suggested to be controlled by effective

external purification plants;

the mill must be energy-efficient and minimum quantities of external energy must be needed.

Following the principles, the mill is designed in the following way:

Location

The mill location is determined by the location of the forest resources, export connection, railways, and availability of water source and recipient of treated effluents. Such a place can be found in TREDAs between the Chinese forests and export ports.

#### Raw Material

The operation will use mixed hardwood species from the Jilin (and Primorsk) region(s) about 675,000 m<sup>3</sup>/a.

#### Products

The product will be fully bleached environmentally friendly hardwood market pulp.

#### Markets

A split market structure is envisaged: domestic markets in China and export markets in Japan, South Korea and Taiwan.

#### Integration

The heat and power generation can be integrated providing for the municipality district heating and power (0-100 MW).

#### Investment Cost

The mill investment is USD 237 m, infrastructure investments about USD 30 m and working capital requirement USD 11 m. The total capital demand is USD 278 m.

#### Time Schedule

The pulp mill projects usually require a long preparatory phase (2-4 years) before the investment decision can be made. The actual implementation time is 2.5-3 years.

#### Profitability

The summary of main annual indicators are as follows:

sales volume	150,000 ton
sales revenue	73.5 m USD
manufacturing cost excluding depreciation	29.3 m USD
gross margin	44.2 m USD
in per cent of net sales	60%
straight line amortisation time	6.3 years

#### Case No. 18

##### Softwood Pulp Mill

##### Business Rationale

The demand for bleached softwood pulp and export to Japan, Taiwan and South Korea is steadily growing. Traditional softwood producers are in the northern hemisphere with the exception of New Zealand and Chile. Russian forests can provide softwood

pulpwood in large quantities, at a competitive price and of good quality. A Russian export pulp mill located at the coastal area would be cost competitive in the nearby export markets.

#### Description

The planned pulp mill facility is designed for using local softwood species as raw material for production of fully bleached market pulp. The mill design concept follows the modern patterns

where the following features have been important:

- the mill operates 350 days per year;

- the scale must correspond to the biggest pulp mills in operation or under construction (min. 400,000 t/a);

- in order to achieve the important effect of scale, the capacity is suggested to be at minimum 500,000 t/a;

- the mill design must be modern to achieve the lowest possible production cost, easy maintenance and good quality of the product;

- the environmental emissions into water are suggested to be controlled by the process-

- internal measures and completed by an effective external purification plant;

- the mill must be energy-efficient and minimum quantities of external energy must be needed. In normal operation the mill is energy-excessive which can be sold.

Following the principles, the mill is designed in the following way:

#### Location

The mill location is determined by the location of the forest resources, export connection,

railways, and availability of water source and recipient of treated effluents. Such a place can be

found in TREDAs between Primorsky Krai forests and export ports.

#### Raw Material

The operation will use softwood pulpwood and sawmill residues from Primorsky Krai about

2,750,000 m<sup>3</sup>/a.

#### Products

The product will be fully bleached environmentally friendly softwood market kraft pulp.

#### Markets

The production is mainly intended to the export markets in Japan, South Korea and Taiwan.

#### Integration

The heat and power generation can be integrated providing for the municipality district heating

and power (50-200 MW).

#### Investment Cost

The mill investment is USD 573 m, infrastructure investments about USD 60 m and working

capital requirement USD 44 m. The total capital demand is USD 678 m.



## Time Schedule

The pulp mill projects usually require a long preparatory phase (2-4 years) before the investment decision can be made. The actual implementation time is 2.5-3 years.

## Profitability

The summary of main annual indicators is as follows:

sales volume	500,000 ton
sales revenue	285.0 m USD
manufacturing cost excluding depreciation	126.4 m USD
gross margin	158.6 m USD
in per cent of net sales	56%
straight line amortisation time	4.3 years

## Case No. 19

### Newsprint Mill

#### Business Rationale

The paper demand is growing in China and the northeastern provinces are becoming an important newsprint consumer. Chinese emigrants are considering investment opportunities in the paper sector in the southern provinces of China, the northern provinces are not yet attractive enough. This proposal is based on innovative technology using hardwoods as raw material for newsprint manufacturing which can be sold in the domestic markets for newspapers and magazines and as wrapping paper.

#### Description

The planned newsprint mill is designed for using soft hardwoods as raw material for production of standard newsprint for the domestic markets. The mill concept is partly traditional (paper machine) and partly innovative (manufacturing of chemi-thermomechanical pulp of hardwoods).

The following features are important:

- the mill operates 350 days per year;
- the scale must correspond to the biggest Chinese paper mills in operation or under construction (min. 70,000 t/a);
- in order to achieve the important effect of scale, the capacity is suggested to be at minimum 120,000 t/a;
- the mill size must correspond to the practical possibilities in obtaining wood from China, therefore bigger than 120,000 t/a cannot be planned in the initial phase;

the mill design must be simple to achieve the lowest possible investment demand;

the environmental emissions into water are suggested to be controlled by effective

external purification plants;

the mill consumes a lot of power and the power supply must be secured.

#### Location

The mill location is determined by the location of the forest resources, railways, and availability of water source and recipient of treated effluents. Such a place can be found in TREDA.

#### Raw Material

The operation will use selected hardwood species like poplar and other soft hardwoods from

the Jilin area and Primorsky Krai about 348,000 m<sup>3</sup>/a.

#### Products

The product will be standard newsprint for the domestic markets.

#### Markets

The total production would be sold in the domestic markets in China.

#### Investment Cost

The mill investment is USD 161 m, infrastructure investments about USD 20 m and working

capital requirement USD 8 m. The total capital demand is USD 189 m.

#### Time Schedule

The paper mill projects usually require a long preparatory phase (1-3 years) before the

investment decision can be made. The actual implementation time is 2 - 2.5 years.

#### Profitability

The summary of main annual indicators is as follows:

sales volume

120,000 ton

sales revenue

64.8 m USD

manufacturing cost excluding depreciation

28.7 m USD

gross margin

36.1 m USD

in per cent of net sales

56%

straight line amortisation time

5.2 years

-for-the-forest-sector/

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