Project Development and Environmental Strategy for the Forest Sector

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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 m3 of softwood and 2.1 m3 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 = 109 joule
ha Hectare
JAS Japan Agricultural Standard
kg Kilogram
KW Kilowatt = 1000 watt
KWh Kilowatthour
m3 Cubic metre
Logs: solid cubic metre under bark
MW Megawatt = 1000 kilowatt
MWh Megawatthour
N Nitrogen
NOx Nitrogen Oxides
P Phosphorous
PRC The People's Republic of China
RF Russian Federation
R.O.I. Return on Investment = Profit + Interest x 100 / Capital employed
SO2 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 P”yry 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.
Jaakko P”yry Consulting Oy
Jouko Virta Jyrki Set„l„

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
m3 of roundwood equivalent to about 300 million m3. 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 m3 in roundwood equivalent in 1991
and the demand is forecast to grow to 1.37 billion m3 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 m3 between 1990 and 2000. It is estimated that sawn softwood
imports between 1990 and 2000 will increase by 3.8 million m3 in Japan, by 1.7 million m3 in
South Korea, by 0.6 million m3 in Taiwan and by 0.4 million m3 in China.
Demand for sawn hardwood in Pacific Asia is expected to grow by 1% annually or by 2.5 million
m3 by the year 2000, but the net imports to the region are expected to increase considerably
more, or about 3 million m3. 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 m3
by the year 2000. The plywood production in the Pacific Asian countries is expected to decline
by about 2 million m3 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 m3 to reach a total demand of 9 million m3.
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 m3 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
m3. 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 m3 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 m3 in 1985 to about 6 million m3 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 percen-
tages 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/m3, in the second alternative Y 43 000/m3 and in the third alternative only Y 24 000/m3. 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 m3
to about 1.2-1.4 million m3 per annum in 2000. The imports of sawn softwood, which have been
rather small, will increase to some 1.6-1.7 million m3 by 2000. At the same time, the hardwood
plywood imports will double from the present to well over 1 million m3. The particleboard and
MDF will also double to some 1.2-1.4 million m3 and 0.4-0.5 million m3, respectively by 2000.
The growth of the South Korean market is very encouraging with a view to investments in
mechanical wood industries in TREDA.
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 m3 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 m3, will possibly double. The imports of particleboard are
expected to almost double to 0.5-0.6 million m3 by 2000. The imports of MDF, which have been
in the region of 0.1 million m3, 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 m3 by 2000. The imports
of sawn hardwood, which are about 0.6 million m3 per annum at present will double. The
imports of plywood are also expected to double from the present level of about 0.8 million m3.
The particleboard imports are expected to grow about 0.5 million m3 at present to 1.2-1.3 million
m3 in 2000. The imports of MDF will increase by about 50% to some 0.6 million m3 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
TREDA. 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
m3 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 TREDA forest products,
have been mainly dependent on tropical hardwood and big coniferous logs for their raw material
supply. The forest resources in TREDA 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 TREDA 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 TREDA. The million would be located in the middle of the growing Asian markets. China
especially would be an interesting export market for newsprint from TREDA.
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 TREDA 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 TREDA, 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 million
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 m3, 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 m3 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 m3 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 m3 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 TREDA (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 Chan forest area in the south-east of the province is mountain-
ous, unproductive forest land, mainly with gentle slopes and an altitude under 800 m. The
average growing volume is 65-75 m3 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 m3;

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 m3.
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 TREDA, 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 TREDA 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 m3 of domestic hardwood sawlogs, mainly birch and oak for an integrated
sawmillion and furniture factory. The delivery will be guaranteed by the government.

The DPRK has a concession with Russia to harvest 2.3 million m3 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 m3, of which only 5-7 million m3 are presently harvested. The harvested volume was earlier up to 15 million m3, 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 TREDA.

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 extensified 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 delimbed 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 m3s and for truck and trailer combinations 16 m3s.

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 m3, 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, delimbing 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 m3):
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/m3 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 TREDA. 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 TREDA are low (USD 0.003 - 0.005/km/m3) 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 TREDA

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 dec-
ision-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 environ-
mental 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 TREDA 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 TREDA 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 harvesting;
- 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 reasonable 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 TREDA serve mainly as resting and breeding places for migrating birds, and spawning grounds for fish.

Kedovaya Pad Reserve, relatively close to TREDA, 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 been 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 TREDA 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 spe-
cies 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 TREDA, 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 m3/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 environ-mental 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 million 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 defendable.

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/m3 <1 kg per yrDt
sulphur dioxide	<200 mg/m3 <1.0 kg S per yearDt
nitrogen oxides (NOx as NO2)	<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 million 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 million 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 million projects to find the best alternatives and to define the detailed environmental mitigation and management measures to secure that the million 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 m3 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 TREDA countries, since it is the
most essential question when making investment decisions.
All of the TREDA 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 infra-
structure by national funds and input and with foreign aid, if possible.

DEVELOPMENT OPTIONS

It would be in the interest of the TREDA 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 m3. 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 TREDA 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.
TREDA 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
TREDA and Hinterland;
2 Sawlog Export Operation Based on Softwood Resources from the TREDA and
Hinterland;
3 Hardwood Pulp Mill;
4 Softwood Pulp Mill;
5 Newsprint Mill;
6 Softwood Sawmillion Based on Korean Logging Operation in the Khabarovsk Region;
7 Softwood Sawmillion Based on Raw Material from Primorsky Krai;
8 Hardwood Sawmillion 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

m3 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 m3 per year) and hardwood sawmillion (30,000 m3)
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 TREDA 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 TREDA. Russia has vast resources but they
are on the outskirts of the TREDA (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 TREDA.
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 TREDA 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 TREDA,
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 TREDA 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 TREDA 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. Reha-

bilitation 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 influence. 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 million

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 m3. The average growing volume is 65-75 m3 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 m3 capacity
and a hardwood sawmillion 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 m3, this would give a basis for a
development project on the DPRK side of TREDA, 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 defi-
ciencies 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 TREDA.
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 TREDA 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 TREDA.
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 TREDA. 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 TREDA, 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 m3;
2 Softwood sawlog export operation, with an annual capacity of 500,000 m3;
3 Modern, big softwood sawmill, with an annual capacity of 230,000 m3;
4 Medium size hardwood sawmill with an annual capacity of 30,000 m3;
5 Hardwood plywood factory, with an annual capacity of 25,000 m3.

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 TREDA 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 TREDA 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 m3 being loaded every year, offering a combined annual output capacity of about 750,000 m3. 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 m3/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 m3/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 m3/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 m3 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 m3
- 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 m3 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 m3. 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 m3). 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/m3.
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 m3
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 m3/a with 190,000 m3 from the big log line
and 40,000 m3 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 m3.

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 m3
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 TREDA. 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 m3 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 m3 or 10% of the annual production.
The total capacity of the mill would be 25,000 m3 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 m3.
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 m3
- 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 m3.

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 m3
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 m3
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 lamparguet 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 m3.

Products

The factory will produce 10,000 m3 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 m3
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 m3
- 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 smoothening 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 m3
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 m3 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 m3. 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 m3
- 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 precut 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 precut 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 TREDA 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 m3.

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 TREDA.

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 m3

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 TREDA 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 TREDA 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 m3 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 TREDA. Essential for the factory is avail-
ability 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 m3.

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 TREDA.

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 m3
- 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 TREDA 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 m3/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 TREDA 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 m3/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 m3/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

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