FOREST INDUSTRY MACHINERY TASK FORCE REPORT

SYNERGY

A BONUS FROM CO-OPERATION

Industry, Science and Technology Canada
Industrie, Sciences et Technologie Canada

Canada

FOREST INDUSTRY MACHINERY TASK FORCE

S Y N E R G Y

A BONUS FROM COOPERATION

SYNERGY

A Bonus from Co-operation

"Synergy - Co-operative action of discrete agencies such that the total effect is greater than the sum of the effects taken independently"

Webster's New Collegiate Dictionary

September 1988

Disponible en français

Industrie, Sciences et Technologie Canada
Industry, Science and Technology Canada

FOREST INDUSTRY MACHINERY TASK FORCE

SYNERGY

A BONUS FROM COOPERATION

September 1988

The Honourable Robert R. de Cotret
Minister of Industry, Science,
and Technology
235 Queen Street,
Ottawa, Ontario
K1A OH5

Dear Mr. de Cotret:

On January 22, 1988, as recommended in the Federal Government's Canadian Forest Industry Policy, you established the Forest Industry Machinery Task Force comprising representatives of both Canadian machinery manufacturers and users of this equipment. You gave the Task Force the mandate to recommend mechanisms promoting the manufacture of Canadian innovative machinery and encouraging these manufacturers to position themselves at the leading edge of technology.

The ultimate objective is to place the total forest industry at the forefront internationally as an innovative, competitive industry.

On behalf of the Forest Industry Task Force, we are pleased to submit the results of our deliberations in the attached report: "Synergy - A Bonus from Co-operation".

The Government's early and positive consideration of the Task Force's recommendations will, we believe, put this vital process of technological "overleap" into action, and help realize the goal of making the Canadian forest industry and its Canadian equipment suppliers a major force in North American and world markets.

Yours sincerely,

Raymond R. Pinard
Executive Vice-President
and Chief Operating Officer
Domtar Incorporated

Lucien Bradet
Director General
Resource Processing Industries
Industry, Science and Technology

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A Bonus From Co-operation

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EXECUTIVE SUMMARY

A growing forest industry is essential to a healthy Canadian economy, accounting in 1987 for 15 percent of Canadian manufacturing gross domestic product (GDP); 13 percent of manufacturing employment, 21 percent of manufactured exports, and 17 percent of total exports.

The industry provides direct employment for more than 270,000 Canadians, and a further 540,000 jobs in areas such as machinery, chemicals, transportation and construction indirectly depend on the industry.

The forest products industry is Canada's most important export sector. Exports were valued at $20.8 billion in 1987. Since imports in this sector are minimal, forest products are the largest sectoral contributor to Canada's balance of trade.

The equipment sector does not share in the export strength of the forest products industry. Equipment imports represent 37 percent of the Canadian market for logging and forestry, 64 percent of the sawmilling and woodworking market, and 48 percent of the pulp and paper equipment market. Imports as a percent of the required total Canadian market are consistently increasing.

There are 200 Canadian forest equipment companies, employing 11,800 people. The value of shipments in 1987 of Canadian forest equipment companies was $988 million.

The Forest Industry Machinery (FIM) Task Force was given a mandate to recommend ways of encouraging and facilitating the development and manufacture in Canada of machinery and equipment that will contribute to the ability of the Canadian forest industry to keep pace with its competitors and position itself on the leading edge of forest industry equipment technology.

The Task Force, made up of representatives of equipment manufacturers and equipment users, studied the existing equipment supply and use situation in logging and forestry, sawmills and panelmills, and pulp and paper mills.

Several meetings were held from February to June 1988, and a range of organizations, companies and individuals were asked for their opinions and recommendations.

Studies were commissioned from the Forest Engineering Research Institute of Canada (FERIC), FORINTEK Canada Corp., and Woodbridge, Reed and Associates.

A survey of more than 400 forest equipment manufacturers and users was commissioned to determine the production and purchasing policies of forest industry equipment and the extent of Canadian research and development.

The Task force determined that the Canadian forest industry equipment sector has the potential to establish itself as a leading force in both the Canadian and U.S. markets and has made recommendations to achieve this objective. The Task Force is also of the opinion that a strong and healthy machinery and equipment supply sector is structurally foundational for the long-term maintenance of an internationally competitive and growth-oriented forest products industry.

The recommendations urge the forest products industry and its equipment suppliers to put increased emphasis on research, development, and innovation, and develop closer working relationships in the development and exploitation of technology.

The Task Force found that there is not enough emphasis in post-secondary institutions on forest product processes and equipment design, and recommends that more be encouraged.

Stronger links are needed between the forest industry equipment manufacturers and the industry's co-operative research institutions, such as FERIC, FORINTEK and PAPRICAN. The Task Force recommends that seminars and training programs held by the research institutions get wide publicity, and that regular consultations be held with forest industry equipment users and manufacturers.

The Task Force recommends that the federal and provincial governments and the forest industry build, on a capital cost-shared basis, a pilot plant providing state-of-the-art research and development facilities in pulping, bleaching and paper-making.

The Task Force recommends acquiring a mobile technical centre and a cold-room suitable for testing commercial equipment in arctic conditions.

The Task Force recommends establishing a new, government-funded risk-sharing program to provide repayable support for successful research, development, commercialization and first installation of innovative technology and equipment. Support could also be provided on a non-repayable basis for the construction or expansion of research facilities if similar facilities do not exist elsewhere.

The Task Force suggests that emphasis should initially be placed on the North American markets, to take advantage of the easy access to the U.S. market and to capitalize on the Canada-U.S. Free Trade Agreement before making a major commitment to overseas markets.

Changes are recommended in the treatment of tax credits for

research and development and more competitive export financing is recommended.

Establishment of a special forest industry equipment manufacturers subcommittee of the Forest Sector Advisory Council is recommended. This subcommittee will advise the federal government on problems and opportunities in the forest equipment industry and report annually on the progress in implementing these recommendations.

TASK FORCE RECOMMENDATIONS

Recommendation No. 1

That the Canadian forest products industry (individual companies, research institutes, associations), as an element in their corporate strategies, give high priority to developing and utilizing Canadian equipment.

Recommendation No. 2

That forest industry companies and Associations adopt a strategy to encourage universities and technical colleges to enlarge their formal teaching and R&D programs in forest industry machinery design and development, and product and process development, through funding "Chairs", grants, scholarships, bursaries, summer work programs, and other collaboration.

Recommendation No. 3

That the cooperative research institutions (FERIC, FORINTEK, PAPRICAN) create a stronger link with the machinery and equipment manufacturers through full memberships and representation on boards of directors and research program committees.

Recommendation No. 4

That research institutions, universities, and other qualified organizations provide and publicize seminars

and training programs for the forest industry equipment manufacturers and users.

Recommendation No. 5

That senior management of forest industry equipment manufacturers and users give high priority to R&D and innovation within their companies by doubling their current R&D expenditures.

Recommendation No. 6

That research institutions, universities, and industry develop collaborative programs on a shared-cost basis to allow companies to assign their research staff to work on company projects in other institutions.

Recommendation No. 7

That universities and cooperative research institutions adopt collaborative programs with the forest industry to permit inter-industry technology transfer of innovative technology developed by research in another unrelated industry.

Recommendation No. 8

That a task force of research and industry experts on composite wood products be established to identify the challenges and potential posed by the development of an increasing range of composite wood products, and to develop a strategy to place Canada at the leading edge of these developments.

Recommendation No. 9

That pilot plant facilities be constructed within three years on a capital cost-shared basis by the federal government, provincial government(s), and the forest

industry to provide state-of-the-art R&D facilities for pulping, bleaching, and paper-making.

Recommendation No. 10

That a mobile technical centre, and a large cold-room suitable for testing commercial-size equipment be constructed on a cost-shared basis by the federal government, provincial government(s), and the forest industry to provide state-of-the-art R&D facilities for the design and development of logging and forestry equipment.

Recommendation No. 11

That a government-funded program be established to share the risks (other than normal business risks) of development, commercialization, and first installation of innovative technology and equipment.

Recommendation No. 12

That a) government tax credits or grants be made available to both companies (equipment manufacturers and users) and R&D organizations for cooperative ventures.

b) increased tax credits be available for research undertaken jointly with universities or research institutions.

c) the definition of "research" for tax purposes should be reviewed to ensure that all R&D activities of equipment manufacturers are eligible.

d) the cost of obtaining international patent protection including the maintenance fees, be eligible for tax credit.

Recommendation No. 13

That the Canadian government strongly urge all concessional financing world-wide be eliminated. In the interim, Canadian export financing be competitive with other foreign countries.

Recommendation No. 14

That Statistics Canada be requested to report separate statistics for wood working machinery and sawmill machinery.

Recommendation No. 15

That membership of the Forest Sector Advisory Council (FSAC) be enlarged to include representatives of the forest industry equipment manufacturers. A special subcommittee of FSAC, including these manufacturers, be established to:

a) make recommendations to the Government on priorities for areas for technology enhancement in the forest industry, on the policies and programs to expand R&D activities, and on the issues and opportunities for the expansion of forest industry equipment manufacturing in Canada.

b) review and report annually to the Ministers on the progress of the various participants e.g. equipment manufacturers, equipment users, co-operative research institutes, universities and technical colleges, in implementing these Recommendations.

c) promote formal and informal networking between manufacturers, users, and co-operative research organizations.

d) encourage the development of educational and promotional campaigns in support of technology in the forest industry.

CHAPTER 1 THE FOREST INDUSTRY MACHINERY TASK FORCE

The creation of the Forest Industry Machinery Task Force is a key initiatives of the Canadian Forest Industry Policy announced by the federal government in January 1988.

As the forest industry emerged from several years of recession in 1986, the increase in profits began to fuel a renewal in capital investments for modernization and new capacity. These new investments have made major improvements in Canada's international competitiveness placing many mills in the state-of-the-art category. Various government programs have encouraged these investments to increase Canadian competitiveness and regional development.

During this time, the government was reviewing whether these industrial development programs made the best possible use of scarce funds, especially in view of the increasing demands for support from the booming forest industry.

In 1987, the Government announced the National Science and Technology Policy, and the decision was made to restructure the Department of Regional Industrial Expansion into the Department of Industry, Science and Technology. These decisions signaled a significant shift in industrial policy toward the use of government funds for enhancing the development of advanced Canadian technology, and its integration into a more competitive Canadian industry.

In line with this policy, the Minister of Industry, Science and Technology proposed a new direction for federal financial support. More financial support should be given to forest industry projects involving research and development of innovative technology, new product development, and market

development and diversification, rather than to projects using proven technology for modernization and increased capacity.

A cornerstone of this policy will be the stimulation and promotion of the Canadian forest equipment and machinery manufacturing sector. As part of the policy, the government approved the Canadian Forest Industry Strategy that recommended (in part) that the Minister "establish a task force of representatives of Canadian equipment suppliers and forest industry users to develop mechanisms to encourage the manufacture in Canada of advanced machinery and equipment and to achieve competitive overleap in technology application."

1.1 Task Force Established

The Forest Industry Machinery Task Force was established in January 1988 by the Minister of Industry, Science and Technology to suggest programs and initiatives to achieve this goal.

The Task Force's **mandate** was to:
recommend mechanisms to encourage and facilitate the development and manufacture in Canada of machinery and equipment that will allow the Canadian forest industry to not only keep pace with its competitors in the United States, Nordic countries and elsewhere, but to position itself on the leading edge of the technology used by this key sector of the Canadian economy.

1.2 Task Force Members

The Minister of Industry, Science and Technology created a task force of representatives of forest industry equipment manufacturers from the three principal sectors: logging and forestry, sawmill and panelboard, and pulp and paper, and also representatives of the Canadian companies that use this equipment.

The Task Force was co-chaired by Raymond R. Pinard, Executive Vice-President and Chief Operating Officer, Domtar Inc., and by Lucien Bradet, Director General, Resource Processing Industries, Department of Industry, Science, and Technology (ISTC).

Members of the Task Force are representatives of:

Logging and Forestry Equipment Manufacturers:

Paul Scott, Vice-President, Marketing, Timberjack Inc.
Robert Arcand, Vice-President, Harricana Metal Inc.
Gilles Filion, President, Industries Tanguay Inc.

Logging and Forestry Equipment Users:

Edward Boswell, Senior V-P, E. B. Eddy Forest Products
Magnus Ericson, Director, Operations Planning
MacMillan Bloedel Ltd.

Sawmill and/or Panelboard Equipment Manufacturers:

Fred Veuger, President & General Manager, CAE Machinery Ltd.
Arne F. Peterson (alternate J. Foster), President,
Precision Service and Engineering.

Sawmill and/or Panelboard Equipment Users:

Bertrand Perron, Vice-President, Plant and Forestry
Operations, Normick Perron Inc.
Ronald Neil (alternate L. Haines), Group Vice-President,
Coast Wood Products, B.C. Forest Products Ltd.
Gaston Malette, President, Waferboard Corp.

Pulp and Paper Equipment Manufacturers:

Tony Hooper, President and CEO, S.W. Hooper and Co. Ltd.
Tom Krieser, President and CEO, Hymac Ltd.

Pulp and Paper Equipment Users:

Peter Knorr (alternate R. Reis), Vice-President Marketing and Products, Millar Western Pulp Ltd.
Joseph Kneeland, President and CEO, Kruger Inc.

The federal government was also represented by Pat Lennon and Robert Samarcq, Director, Machinery Directorate, ISTC.

1.3 Task Force Scope

The Task Force first met in Edmonton on February 10, 1988 to decide on the scope of its study:

Logging and Forestry - Logging includes activities involved in harvesting trees to produce logs such as felling, bunching,booming, barking, chipping of logs and pulpwood, as well as thescaling and sorting of wood. Forestry activities involvesilviculture and reforestation, and to a lesser extent treenurseries, pest control, forest fire patrol and inspection, forest fire fighting and other forestry services. Road transportation is, however, excluded.

Sawmills and Panelboard Mills - These activities involve the manufacture of lumber, both rough and planed, lumber drying, shingles and shakes, remanufactured lumber products, veneer and plywood, waferboard, particleboard, and other panelboards and composite products.

Pulp and Paper Mills - This includes the production of various types of mechanical and chemical pulps and a wide range of paper and paperboard grades.

1.4 Task Force Activities

The Task Force held several meetings from February to June 1988, and asked a wide range of organizations, companies and individuals for their opinions and recommendations. Those making presentations to the Task Force are listed in Appendix 1.

Three studies were commissioned:

- The Forest Engineering Research Institute of Canada (FERIC) wasasked to study the forest harvesting and silvicultural methods and machines used in the four major regions of Canada, the forests of the United States, and other major industrial roundwood-producing countries.

- FORINTEK Canada Corp. was commissioned to identify the deficiencies, challenges, and needs of the sawmill machinery sector.

- Woodbridge, Reed and Associates (WRA) studied trends in the pulp and paper equipment industry and considered the effect of these trends on Canadian policy.

The Task Force also conducted a survey of more than 400 forest equipment manufacturers and users to establish current statistics on production and purchasing of forest equipment and to determine how much research and development is done in Canada. The survey methodology and results are in Appendix 2.

The Task Force members' knowledge and experience in the forest industry and the forest equipment industry proved especially valuable in determining the current state of the industries and their plans for the future.

CHAPTER 2 CANADA'S FOREST INDUSTRY

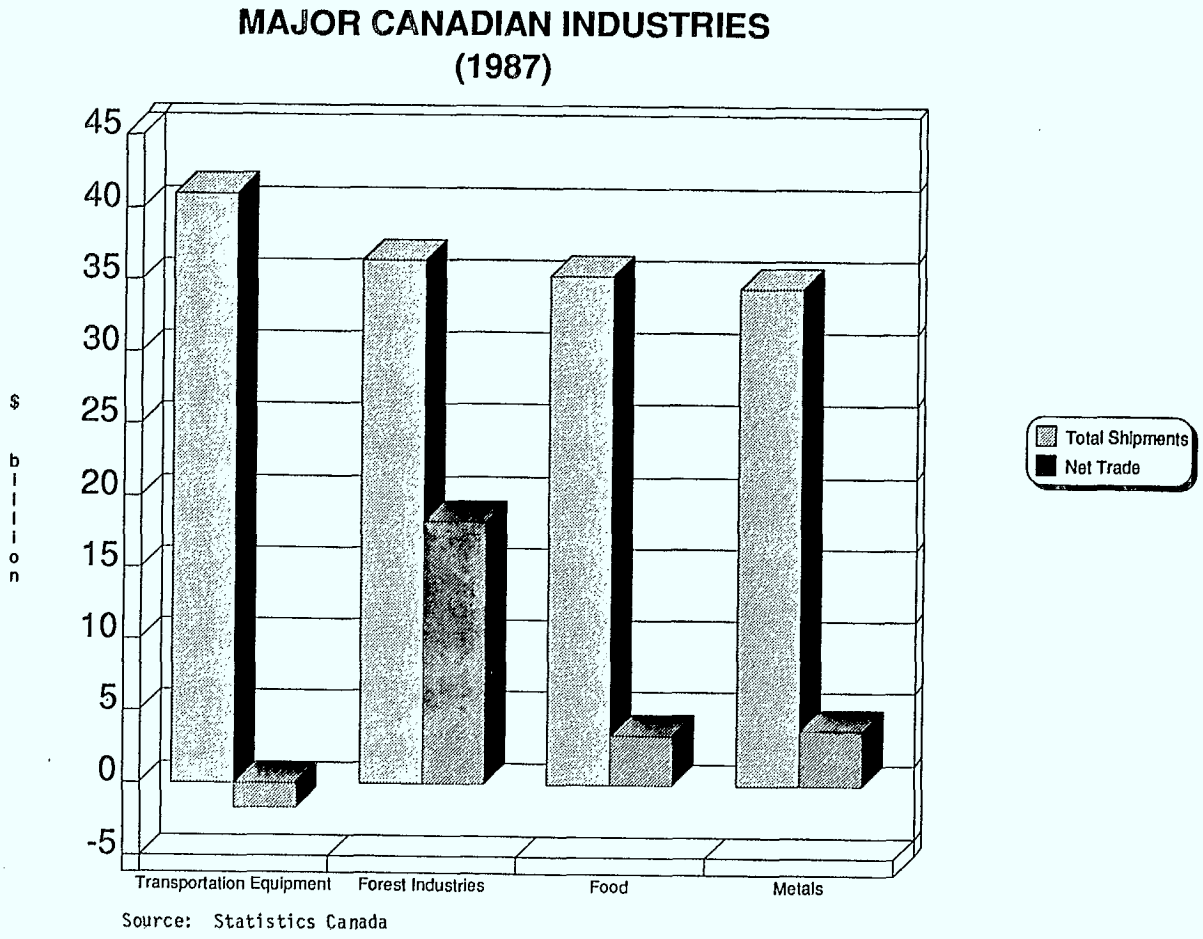
2.1 Significance

The combined activities of logging and forestry, wood products, and pulp and paper are a major contributor to the Canadian economy. In 1987 these forest industries accounted for:

- 15 percent of the total Canadian manufacturing GDP;
- 13 percent of manufacturing employment;
- 21 percent of manufactured exports; and
- 17 percent of total exports.

When compared with other major manufacturing industries, the forest industries ranked second (as measured by shipments), after transportation equipment (e.g. automotive, marine, aerospace) and followed by food industries, and metals and metal fabricating.

Figure 2.1



Source: Statistics Canada

However, when the contribution of the various sectors to a positive balance of trade is considered, the forest industries considerably exceed all others with a positive net trade (exports minus imports) of $18.3 billion.

The forest industries are Canada's most important export sector. In 1987 Canadian forest product exports were worth more than $20.8 billion -- about 17 percent of Canada's total exports -- making forest products the largest sectoral contributor to Canada's balance of trade, (as forest product imports are minimal).

About three-quarters of Canada's forest product exports go to the United States. Western Europe takes about 11 percent of the exports, and Japan about seven percent. Canada is the world's largest producer of newsprint and market pulp, and the third largest producer, after the Soviet Union and the United States, of softwood lumber.

Table A

CANADIAN FOREST PRODUCTS INDUSTRY

- 1987 Shipments - $36.4 billion
- 1987 Exports - $20.8 billion
- 1987 Imports - $2.0 billion
- 810,000 direct and indirect jobs

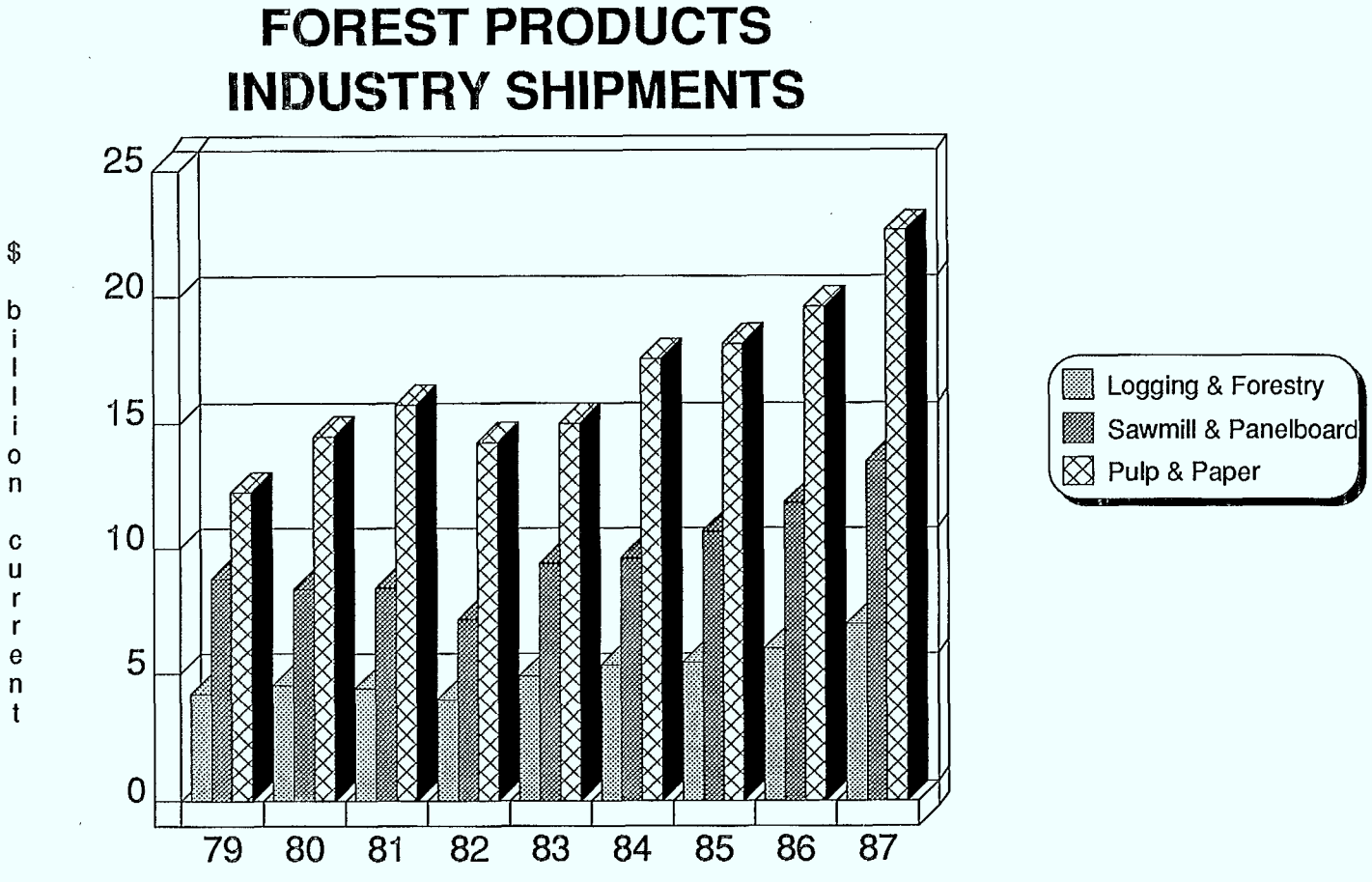
Subsector	Shipments ($ billion)	% of Total Shipments	Number of Direct Employees	Company Size
Logging & Forestry	N/A	N/A	46,000	Mostly Small
Sawmill & Panelboard	10.5	29	76,700	Small & Large
Pulp and Paper	17.3	47	81,400	Mostly Large
Converted Wood and Paper	8.6	24	65,900	Mostly Small
TOTAL	36.4	100	270,000	

Source: Statistics Canada

2.2 Cyclical Demand

In 1987 shipments of manufactured forest products were valued at about $36.4 billion. However, as the following graph shows, markets for forest industries are highly cyclical, reflecting the commodity nature of the major products: softwood lumber, panelboard, pulp, and newsprint, and the direct effect of economic cycles on demand for these products. These effects have been greater in the 1970s and 1980s than in previous decades. A serious decline in demand occurred in 1975, but an even deeper reduction occurred in 1981-82. The pulp and paper industry, especially in eastern Canada, began to recover by 1983 but certain portions of the industry did not emerge from low profits and heavy debt burdens until 1985-86.

Figure 2.2



Source: Statistics Canada

Over the past two decades wood products output has grown at average annual rates of 4 to 5 percent, while pulp and paper output has averaged 3 to 4 percent in the 1960s but only 1.5 to 2.0 percent in the 1970s and 1980s. In the next five years the Conference Board of Canada and ISTC suggest that wood products output will grow at an annual rate of 2.2 percent, and pulp and paper at a rate of 2.6 percent. This is slightly below the overall rate for the Canadian economy of 2.8 percent. However, this average disguises a forecast economic downturn (but not recession) in 1990-91, which will cause demand for forest products to remain steady but probably not decline.

2.3 Employment and Regional Impact

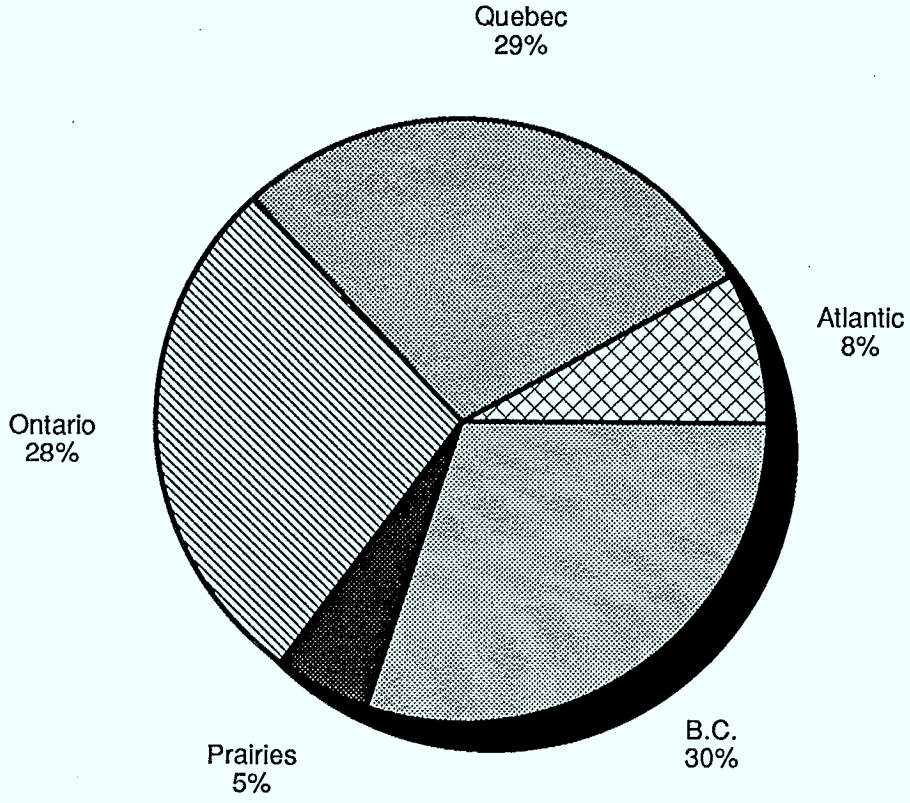
The forest industries provide direct employment for more than 270,000 Canadians with a further 540,000 jobs indirectly dependent on the sector in such supplying and consuming sectors as machinery, chemicals, transportation, printing, and construction.

The 1981-1982 recession exacted the worst toll on the forest industry since the Depression of the 1930s. The recession years were followed by five years of slowly recovering markets. Most companies made every effort to improve efficiency and productivity between 1982 and 1985, with the result that 35,000 jobs were permanently eliminated and capital intensity increased.

Forest industries provide the economic base for more than 300 single-industry towns. They are important to all provincial economies, with approximately 30 percent of national industry output distributed in each of Ontario, Quebec, and British Columbia. The Atlantic and Prairie provinces account for 8 percent and 5 percent respectively.

Figure 2.3

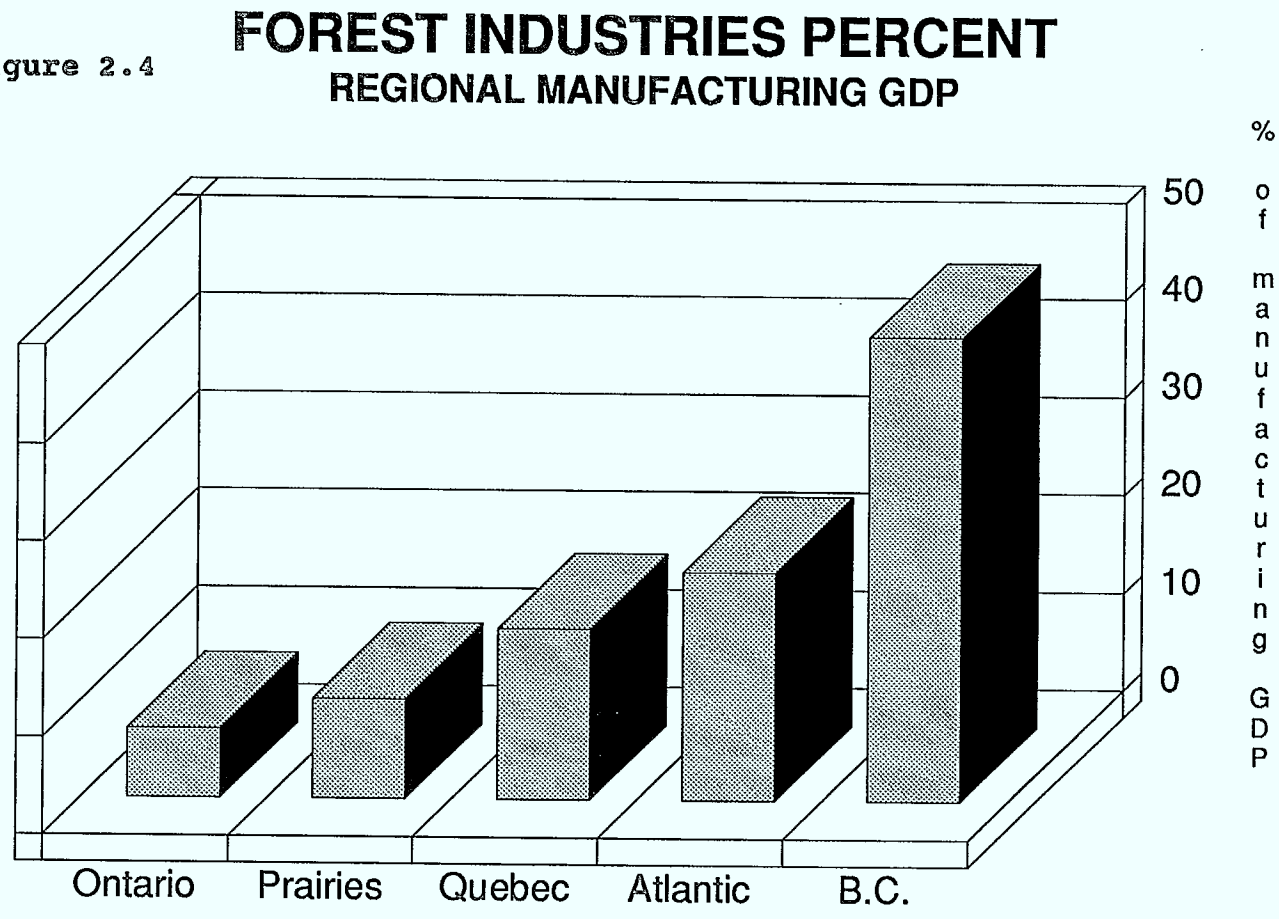
REGIONAL DISTRIBUTION OF PRODUCTION



Source: Statistics Canada

However, when viewed from the individual province's perspective, the forest industries are major contributors to each province's manufacturing gross domestic product.

Figure 2.4



Source: Statistics Canada

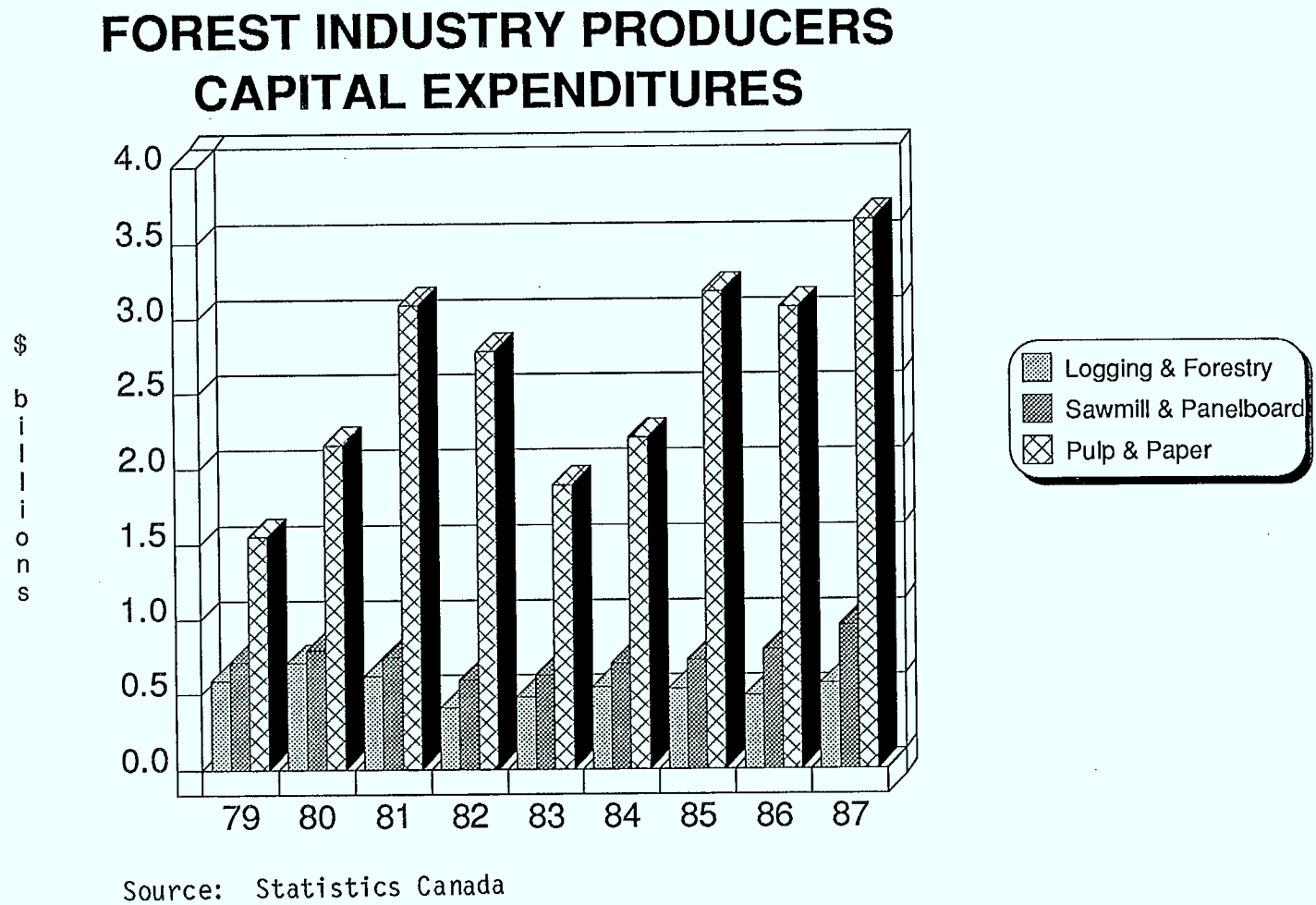
In terms of product, the pulp and paper industries are significantly more important in the Atlantic provinces, Quebec, and Ontario while in British Columbia and Alberta, wood products are predominant.

2.4 Profitability and Capital Investments

The cyclical nature of the forest industries is reflected in variable profits. Since 1972 profitability has varied from -6 percent to +11 percent. Most recently industry profits showed major increases with profits after taxes in wood products almost doubling from $387 million in 1985 to $725 million in 1987. In pulp and paper, profits after taxes more than tripled from $727 million in 1985 to $2.4 billion in 1987.

Capital expenditures have also risen in line with profits. Wood products' capital expenditures increased from 1985 to 1987 to reach $639.5 million. The ISTC Capital Intentions Survey indicates over $1 billion will be invested in 1988. Pulp and paper companies capital expenditures increased from $2.0 billion in 1985 to $2.5 billion in 1987, with a further increase expected in 1988 to $3.2 billion. These capital expenditures represent all-time records for the sectors.

Figure 2.5



Source: Statistics Canada

Over this recovery period, the industry's investments have been heavily weighted toward production efficiency, cost reductions and the installation of state-of-the-art technology. In 1987, the acquisition of machinery and equipment accounted for more than 85 percent of total capital expenditures, which presents a significant, growing market for equipment suppliers.

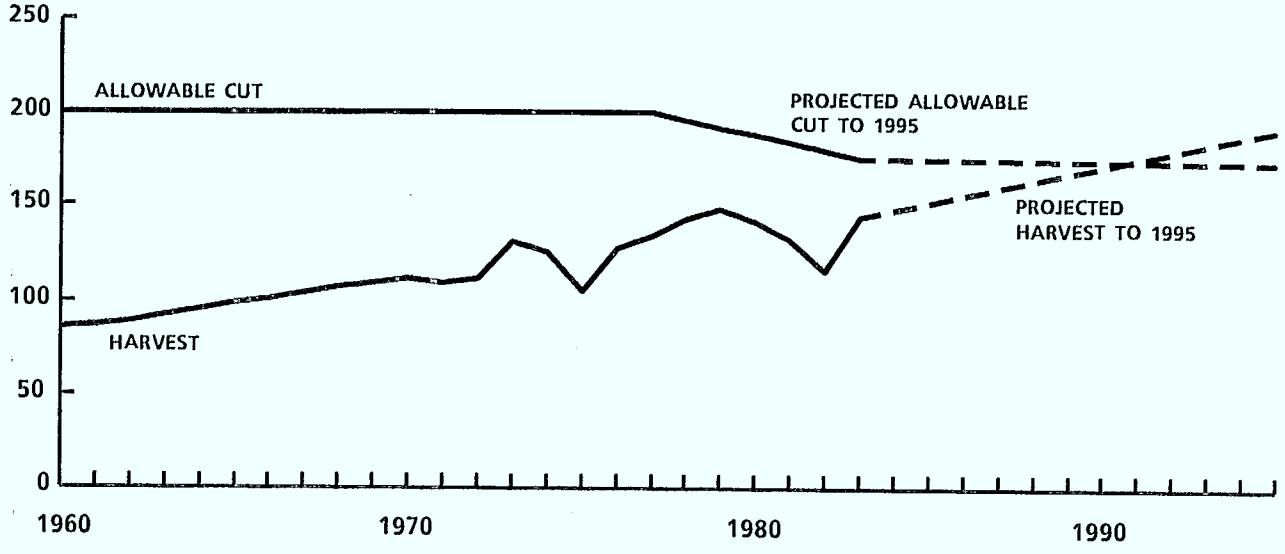
The Canadian industry faces a competitive challenge from new suppliers (who use faster-growing, lower-cost plantation wood) as well as from traditional competitors in the United States, the Nordic countries and Europe, who have become increasingly efficient with their more limited wood and energy resources.

In the face of this competition the Canadian industry is beginning to re-examine its traditional approach to research and technology development for the longer term. An important application of technology is to increase the productivity of the existing forest resource until reforested areas become mature. The allowable cut versus harvest of Canada's softwoods (Figure 2.6) indicates that projected harvests will not exceed projected allowable cuts until 1992. Significant difficulties, however, have been and are increasingly being experienced. In eastern regions major losses have occurred due to forest fires, budworm infestations, and extensive cutting with insufficient reforestation, causing wood to be transported major distances to mills. In British Columbia second growth is much less profitable and of poorer quality than original growth trees, to say nothing of the time required to grow to marketable diameters. Environmentalists are demanding that large areas be protected from all logging. The impact of declining wood availability, the pressures to reduce other costs such as energy and the need to deal with pollution, product quality and changing customer requirements means that Canada must develop technological solutions to these challenges to remain world competitive.

Figure 2.6

ALLOWABLE CUT VS HARVEST CANADA'S SOFTWOODS

(million cubic metres)



Source: Canadian Forestry Service

2.5 Renewable Industry Based on a Renewable Resource

The forest industry is not a "sunset" or "mature" sector. This false image is based on the idea that growth in traditional manu- facturing industries eventually stagnates as demand is satisfied by existing suppliers. Competition in these mature sectors shifts from innovative product development to volume production of standardized, cost-minimized, basic products. However in the last 10 years, the forest industry has had several innovative process and product development cycles that have accentuated market expansion so that the sector has not reached maturity.

To increase its competitiveness in this revitalized industry, Canada must adjust to the fact that the forest resources are limited, even though relatively inexpensive electrical energy and market advantages will continue to contribute to Canadian competitiveness. Innovations in other countries, which have already faced some of these problems, have resulted in new technology and products. While the growth of the volume of output may be constrained by the limits of the current forest resources, demand for forest products have continued to grow and new efficiencies and new products will change the industry's processes and markets. Over time, with proper forest management, forests will regenerate and continue to provide the basis for a dynamic Canadian industry.

Technological change has been rapid and has had a great impact on the industry. Products have changed, because of increased widespread use of offset and multi-colour printing, new packaging materials, laser printers and new paper for the computerized, but not paperless, office. In wood products, the substitution of waferboard/OSB for plywood, the development of laminated and composite products and application of computerized manufacturing have had major effects.

Research and development holds the key to successfully making these adjustments in partnership with Canadian equipment manufacturers. Making the best use of available wood has resulted in innovative mechanical pulping processes and the development of new sawmill equipment using advanced material saw blades, laser scanners and computerized optimizers. Energy conservation and pollution control technology have resulted in increased heat recovery and bio-technologies to treat mill waste. The need for more rapid forest renewal has lead to genetic engineering to develop stronger, faster-growing trees. Biotechnology has been used to develop pest and disease treatments.

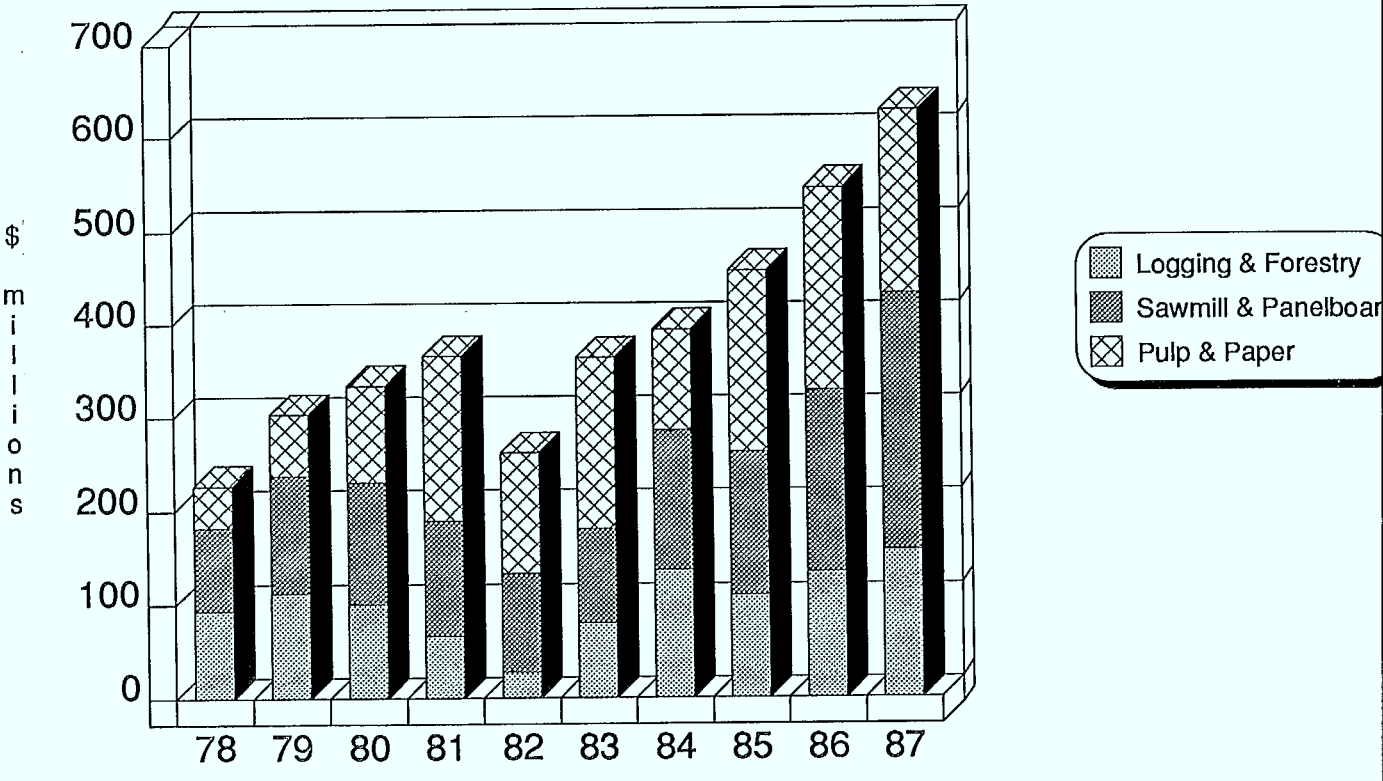
CHAPTER 3 CANADA'S FOREST INDUSTRY EQUIPMENT MANUFACTURERS

3.1 INTRODUCTION

The forest equipment sector does not share the forest industry's enviable export strength. During the 1980s forest industry equipment producers have had growth in shipments and exports, but there is an increasingly more significant portion of the domestic market served by imports.

Imports are about 55 percent of the total domestic forest industry equipment market; 37 percent for logging and forestry; 64 percent for sawmill and panelboard; and 48 percent for pulp and paper. Figure 3.1 shows that these imports have grown significantly in line with the growing Canadian demand for machinery and equipment. Given the further increase in forest industry capital investments, it is expected that orders booked for 1988 and 1989 will accentuate this trend.

Figure 3.1 FOREST INDUSTRY MACHINERY IMPORTS



Source: Statistics Canada

The Canadian forest industry equipment producers consist of about 200 various companies, from small to large size, mostly in Ontario, Quebec, and British Columbia. It is estimated that these machinery companies employ about 11,800 people. Table B indicates this is fairly evenly distributed across the three sub-groups.

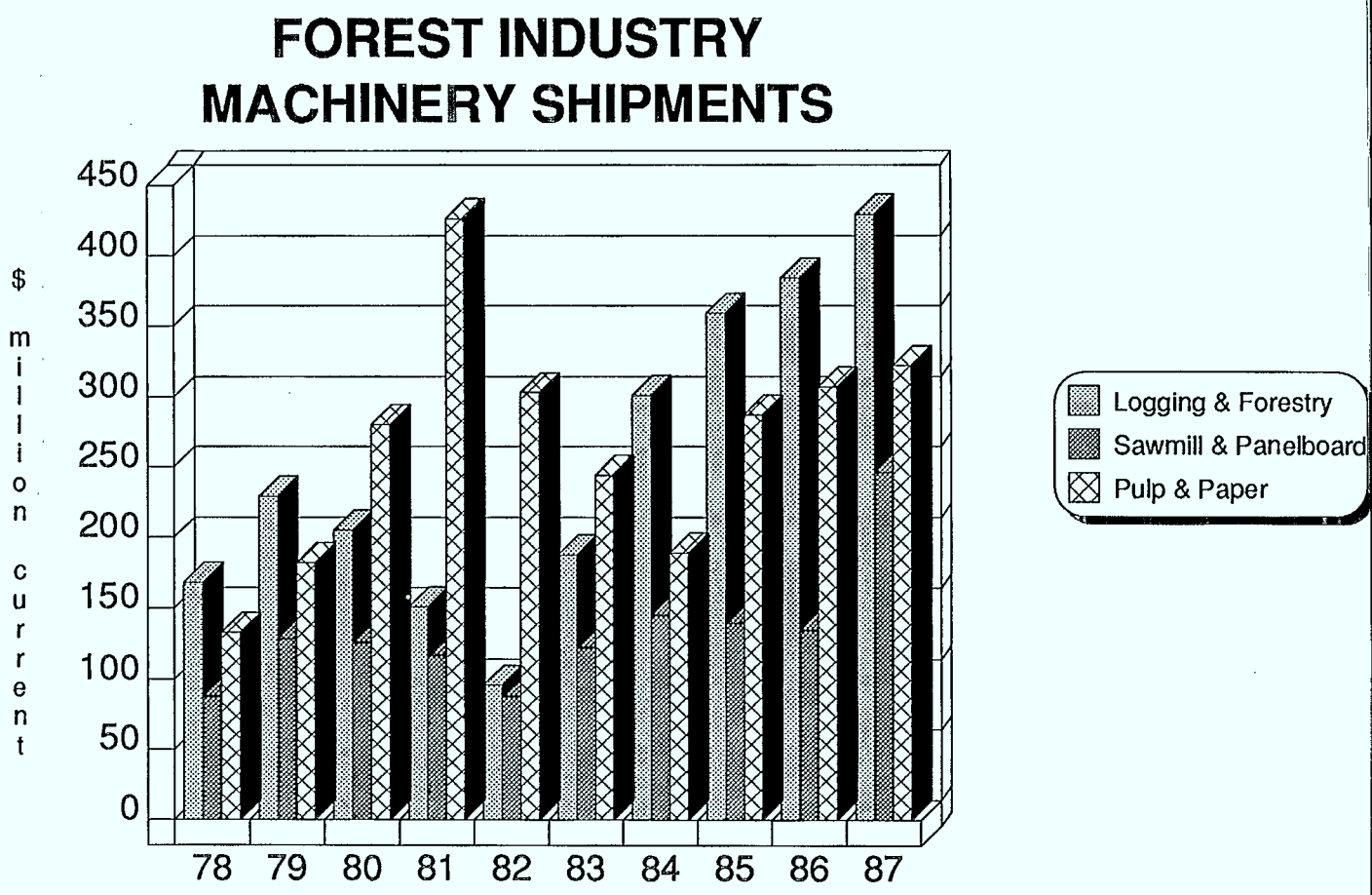
TABLE B

Forest Industry Equipment Manufacturers

	No. of Companies	Employment	1987 Shipments
Logging/Forestry	54	4,100	$430 million
Sawmill/Woodworking Panelboard	96	3,700	$246 million
Pulp and Paper	50	4,000	$322 million
Total	200	11,800	$998 million

While the logging/forestry and the sawmill/woodworking companies are largely Canadian-owned (with some large foreign-owned subsidiaries in Canada), the pulp and paper machinery companies are mostly foreign-owned. In 1987 total shipments reached almost $1 billion, which was a record high for all producers except pulp and paper, where the peak was $427 million in 1981, just before the recession. (See Figure 3.2)

Figure 3.2



Source: Statistics Canada

3.1.1 Global Manufacturing/Marketing Strategies

The Canadian forest industry equipment manufacturers, whether Canadian- or foreign-owned, must compete at home and abroad with large foreign competitors who have access to multi-country marketing and manufacturing, large R&D budgets and financial strengths able to accept the high risks involved in new product and equipment development. The reasoning of the multinational equipment manufacturers is simple: if you want to be a global marketer, then you must offer global service.

International co-ordination of the rules of business, and pressure to liberalize global trade under the General Agreement on Tariffs and Trade (GATT) are major influencing factors in the establishment of a new global trading environment.

During the 1980s one of the major international trends in the equipment supply industry has been the growing consolidation of the industry through mergers and acquisitions. Large companies have joined forces through mergers, acquisitions, joint ventures and/or licensing arrangements. The industry today is global, not regional as it was ten to fifteen years ago.

The cyclical nature of the forest industry and its equipment suppliers is one reason companies have become global marketers offering global services. This has meant offering more than one product line in more than one country to potential customers.

The globalization of the industry has been better understood and implemented by the Finns and the Swedes. Finnish manufacturers have paved the way for international co-operation with other Nordic equipment suppliers, with resulting economies of scale and improved market penetration in North America, Europe, and the rest of the world.

U.S. companies have not been able to pursue mergers to the same extent as Nordic firms because of the constraint of U.S. anti-trust laws. Generally Canadian equipment manufacturers are too small to make international acquisitions or become the nucleus of conglomerates, given limited financial resources. Many have been acquired and some are establishing niche marketing strategies. Both moves tend to lessen the major trust required to compete globally.

3.1.2 Competitive Financing

It is becoming harder for Canada to get overseas contracts because of lack of competitive financing compared with other nations. Most foreign countries specify local manufacturers when financing is from government sources. Often a Canadian subsidiary, especially in pulp and paper equipment, is just one of several foreign subsidiaries and it is the foreign parent who determines the source of any export jobs. Financing available from the Export Development Corporation is not as attractive as that offered by some other country's financing organizations. This is because Canada is committed to comply with international agreements that purportedly prohibit cut-throat export credit competition. However, many developing countries such as Brazil are apparently not similarly restrained.

The last major overseas job awarded to a Canadian consortium was the South Sabah kraft pulp and fine papers complex in Malaysia (awarded in 1986). Klockner Stadler Hurter Ltd., a Montreal consulting engineering firm, won the $420 million turnkey contract to design and build the mill. It beat competition from 30 other contenders, and the key to winning the contract was a three-part financing package of long-term credits from the Austrian, West German, and Canadian governments.

With technology, price, delivery and reliability being generally equal, the most important factor in major purchasing decisions is financing.

For projects in North America, other countries can offer their machinery exporters financing rates of between five to six percent below the Canadian prime rate, with little or no repayment in the first two years. For example, Voith's manufacturing plant in Brazil uses government export credits to

export not only to other countries in competition with Canada, but also into the Canadian domestic market.

As reported by Woodbridge, Reed and Associates to the Task Force:

> "A Voith Duoformer from Brazil was partially financed through Brazilian government export credits. By purchasing the machine offshore, (the Canadian mill) was able to finance 50 percent of the $44 million project cost at 8 percent interest rates, repayable in 16 semi-annual payments starting one year after delivery. This financing reduced the cost of borrowing by $7.5 million. Another Voith machine is being similarly financed at interest rates of 6.5 percent, also repayable over eight years."

Canadian engineering consultants often complain that the Canadian government requires too high a level (e.g. 70 percent) of Canadian content to be eligible for government funding assistance.

3.1.3 Duty Remission Program

The Duty Remission Program was instituted by the federal government to reimburse companies for the duty otherwise payable on imported goods (machinery) if such goods are not available from production within Canada. The objective is to increase efficiency throughout Canadian industry by enabling users to acquire production equipment at the lowest possible price. At the same time, the program affords Canadian manufacturers tariff protection on the machinery and equipment they produce as soon as they can supply the equivalent machinery.

All items entering Canada must be assigned a tariff classification by Revenue Canada. Items classified under the Machinery Program come under special review. If the item is classified as falling under the Machinery Program, the customs officer at the border will compare the item against the D8-5-1 list to determine if duty remission applies or not. This D8-5-1 list has been made up on the basis of availability from Canadian sources as determined by the Department of Industry, Science, and Technology (ISTC).

If there is any question whether the item is available or not from within Canada, the importer can submit an application for duty remission (before or after importation). These applications are submitted to Revenue Canada, which evaluates if there is sufficient basis for a further review of availability by ISTC. There is also an appeal process established for review of the decisions concerning eligibility for duty remission.

Approximately 11,000 applications are received annually by Revenue Canada, of which approximately 1,350 are from forest industries. About 9,000 of these applications are reviewed annually by ISTC, of which approximately, 1,100 are from forest industries.

To determine if any Canadian-based company has the capability to produce a reasonably equivalent product with more than 50 percent Canadian content, an ISTC technical officer considers real versus believed capability, the determination of special end use, effective date of availability, the equivalence of different products, the real level of Canadian content, whether a facility transfer is involved, and the equivalence (size, speed, finish, special) of similar products.

Following a determination, a company can appeal the decision

by supplying additional information, and/or resubmitting for reconsideration.

The following table shows that in 1986 the rate of duty on forest industry equipment imports was 8.6-9.9 percent totalling $66.1 million on imports of $694 million. Between 17 percent and 36 percent of this duty was remitted as a result of the Duty Remission Program.

TABLE C

DUTY REMISSION ON FOREST INDUSTRY EQUIPMENT

(Percent of imports duty-free)

	Imports 1986 $ M	1986 Duty Rate	Total Duty 1986 $ M	Duty Remitted 1986 $ M	Percent Duty ($'s) Remitted
Pulp & paper	365	9.9%	36.1	6.1	17%
Logging & forestry	129	9.9%	12.8	2.7	21%
Sawmill and woodworking	200	8.6%	17.2	6.2	36%
Total	694		66.1	15.0	

Once the Free Trade Agreement is passed by both Canada and the United States, logging and forestry equipment will be duty-free on January 1, 1989. Sawmill, panelboard, pulp and papermaking equipment will be duty free gradually in five equal steps by January 1, 1993. However, the current tariffs will still apply to other countries.

The Task Force discussed the impact of the duty remission program on the development of the Canadian equipment industry. It was recognized that, in the past, there have been differences of opinion between the forest industry producer seeking to import duty-free foreign equipment and Canadian equipment suppliers who claim to manufacture equivalent equipment in Canada. However,

since the Canada-U.S. Free Trade Agreement will eliminate duties on a large percentage of imported equipment, it was recognized by the Task Force that the Canadian industry would have to become internationally competitive, without tariff protection. The continuation of the Duty Remission Program for imports from countries other than the United States would, therefore, be of importance and of benefit to the Canadian machinery manufacturers.

3.1.4 "If It's Foreign, It's Probably Better"

Many of the Canadian equipment suppliers surveyed for the Task Force were concerned by a perceived attitude, or bias, on the part of Canadian forest product companies, particularly pulp and paper companies, against domestically produced machinery and equipment. Typical of such an attitude was, "if it's foreign, it's probably better." While not necessarily the final deciding factor in sales, it seems to affect the ability of Canadian suppliers to get initial serious consideration of their products. However, the responses indicated that competitive factors, not just a bias accounted for their choice of foreign equipment. When asked why foreign machinery suppliers are preferred, the following comments were typical:

- better pricing (price, terms);
- better technology;
- failure of Canadian manufacturers to incorporate the latest innovations;
- Canadian industries in this sector do not spend enough time and effort on creating new technology; they gain it by osmosis;
- foreign equipment is more modern and efficient; and
- reputation, service, better quality.

The Canadian forest industry equipment sector has the potential to establish itself as a leading force in both the Canadian and U.S. markets. The initial emphasis should be on the North American markets to capitalize on the easy access to the U.S. market, and the Free Trade Agreement before making commitments to service offshore markets.

The government can help facilitate this renewal by providing a co-ordinating role in export financial support and technology application.

3.2 LOGGING AND FORESTRY MACHINERY

Logging and forestry equipment is the machinery, equipment and tools used to harvest commercial wood, process it for use by manufacturers of solid wood or paper products and to reforest and maintain growing timber stands.

Canada has a small but dynamic logging and forestry machinery industry that is mostly Canadian-owned. Ten companies have reported annual sales of more than $10 million. This machinery sub-group has been very innovative in developing and adopting products to Canada's forest harvesting needs.

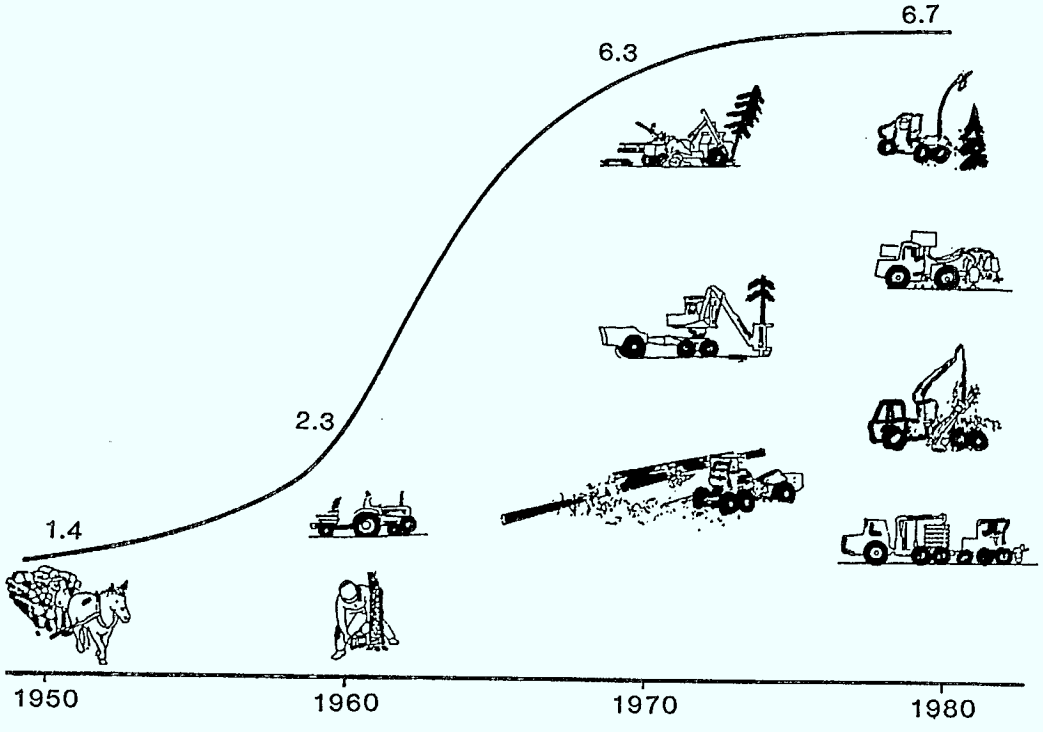
It manufactures and assembles skidders, forwarders, feller bunchers, slashers, log loaders and large cable cranes. Some companies have specialized in manufacturing attachments for mounting on imported carriers (tractors and excavators). These are mass-produced in the United States and Japan. Since Canadian equipment often incorporates 30-40 percent imported parts and components, cost controls and export competitiveness are dependent on currency exchange rate movements. The logging and forestry equipment industry also makes custom-built machines for local situations and auxiliary equipment, such as trans-

portation equipment, wire rope, special tires, chokers and firefighting equipment.

Factors included in selecting logging equipment include tree size; terrain; climate; labour rates, skills and availability; machinery cost and availability; land ownership and size of cutting area; mill requirements; and forest and highway regulations. Figure 3.3 demonstrates the substantial increase in productivity that has resulted from mechanization of logging and shows some of the equipment used.

Figure 3.3

Productivity Increase With Mechanization
(cubic metres per man day)

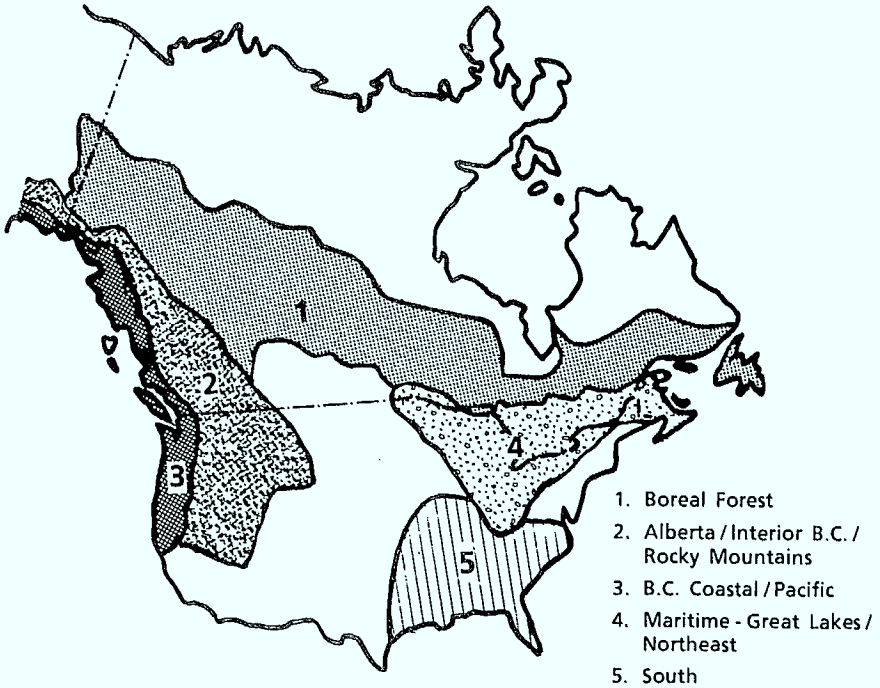


Source: Skogsarbeten - 1985.

Different forest regions in Canada have developed localized equipment systems to best meet their specific needs. Machinery in Canada differs according to the major forest types: Maritime and Great Lakes, Boreal or Northern, Alberta-B.C. Interior and B.C. coast. Some machines are common to all forest regions, but each has its own, special requirements. As indicated in Figure 3-4, the U.S.-Canadian border does not discriminate. U.S. forest types are similar to adjacent Canadian forest, creating a potential North American market for certain machines.

Figure 3.4

FOREST TYPES IN NORTH AMERICA



Source: FERIC

The northern forests of Sweden, Finland and the Soviet Union are similar to Canadian Boreal forests; their southern forests are similar to Canadian Maritime and Great Lakes forest.

Both Sweden and Finland have logging research institutes. These institutes have forest industry members and collectively they work with local machinery manufacturers. In Finland, forest industry producers and forest equipment manufacturers are often owned by the same parent company. The governments give a high priority to the forest companies and their equipment suppliers and strongly encourage research and development. There tends to be an integrated network of machinery users, manufacturers, research institutes and government. All parties work together to develop the most efficient machines for their own forest industry and to promote their export.

During the 1960s and 1970s the North American and Scandinavian equipment industries developed reliable harvesting machines that could accomplish tree harvesting and log cutting in one series of actions. This approach resulted in machines that were not always able to operate in all terrains and environments and were too costly and complex to be purchased and maintained by smaller owner-operators.

In view of the Canadian trend in the 1970s toward contract logging to smaller owner-operators and the preference in some areas for hauling longwood to the mill rather than cut-to-length shortwood, Canadian manufacturers continued to produce a range of attachments that could be mounted on carriers. Such carriers are the most expensive section of the equipment and, most of the time, should be purpose-built to fit all variations of the working conditions. New regulations to reduce ground disturbance and help regeneration will increase their demand. Developments and improvements should continue to be made to the purpose-built machines and in the long-term, these will increase their share of the market.

The appeal of the "attachment approach" in other forest regions such as the United States, Europe, Australia and New

Zealand may be sufficient to justify some competitive new basic carriers, which are simple but multi-functional when combined with a variety of attachments.

Due to its climate and geography, Canada has become a world leader in designing and manufacturing equipment for cold-weather transportation and forest firefighting. This has been as a result of extensive research and development by equipment manufacturers. Such competitiveness could also be achieved in other areas of forest industry equipment.

3.2.1 Prospects for the Future

In considering the needs for research and development, new technology and innovation for the development and design of forestry equipment, the Task Force identified, with input from FERIC as well as the industry survey, several prospects for the future. These include:

1. Silviculture equipment is a relatively new area where even Scandinavian expertise is not well developed. Canada's specific silviculture machine needs must be more clearly defined in order to develop and manufacture new equipment. A better prime mover designed for silviculture is needed. An efficient row-spacing machine to thin dense fir and pine stands and better mechanized planters for gentle terrain is needed to free labour to hand-plant steeper, more difficult terrain.

2. More semi-automation of equipment, such as yarding cranes, loaders and delimbers, would increase speed and efficiency and free the operator to concentrate on the movement of the machine and the grappling of trees.

3. Improved sensitive-site carriers and equipment are needed for use on environmentally sensitive terrain as well as steep slope harvesting such as cable-logging methods and

equipment. Innovative, low ground pressure and higher productivity machines are required.

4. Remote scanners to automatically measure tree diameters and lengths will allow for more efficient delimbing and bucking so the most valuable timber can be extracted.

5. Hand-held portable scanners to detect rotten wood to be discarded, but to retain valuable old-growth, high-grade timber, are needed. Experimenting with ultrasound scanners for sawmills is being done by FORINTEK in co-operation with medical scientists with expertise in human ultrasound scanners. Similar experiments are needed for logging operations.

6. Robotics and walking carriers may be more efficient than tracked or wheeled vehicles in certain terrain, but they require the complete focus of the operator, who cannot control both the forestry functions of the boom and the four legs. Further knowledge about the walking function could help to modify these types of robotics for forestry operations.

7. Improvements are needed to increase the efficiency and productivity of attachments and to enable basic carriers to be adapted for various forest types and terrains.

3.3 SAWMILLING AND WOODWORKING EQUIPMENT

Sawmilling equipment is used to process logs, which are usually tree length, into lumber that is sawn, edged, trimmed, sorted, planed, dried, etc. It is also used to produce shingles and shakes, solid siding, panelling, posts, railway ties, etc. Examples of equipment include log handling, slashers, debarkers,

band saws, canters, edgers, chippers, planers, sorters, kilns and waste wood energy systems.

Woodworking equipment takes lumber and produces furniture components, remanufactured lumber, woodwork and mouldings, roof trusses, doors and windows, fencing, wooden handles, etc. Equipment used include saws, planers, routers, sanders, lathes, jointers, etc.

About 55 Canadian companies produce sawmilling equipment and 32 companies manufacture woodworking equipment with some 2,600 and 750 employees, respectively. Sawmill equipment companies are concentrated in British Columbia, and Quebec while the woodworking sub-group is mainly in Ontario and Quebec. Most firms are Canadian-owned but there are a few large foreign-owned firms such as Kockums Can-Car (U.S./Sweden) and Nicholson-Murdie (U.S.).

The sawmill equipment sector can be divided into two separate groups based on locations and products. The first group includes all the British Columbia establishments plus one in Alberta. This group produces equipment for major sawmills processing medium- to large-diameter logs. The equipment includes a range of products, such as ring debarkers, log carriages, band saws, Chip-N-Saw, chipper canters, edgers, trimmers, lumber sorters, and dry kilns. The natural export markets for this line of products are north west United States, south east United States, New Zealand, Australia, South Pacific regions and Chile.

The second group includes all establishments in eastern Canada. The range of products of this group (debarkers, chipper-canters, log carriages, band saws, edgers, etc.) is generally suitable for processing very small-diameter logs in high-volume sawmills or average log sizes in small sawmills. The

natural export markets of this group are north east and south east United States, Europe, and Central and South America.

Sawmill equipment producers currently benefit from currency exchange rates, which increase their competitiveness in Europe and Asia and, to a lesser extent, in the United States. The innovativeness of this sector in its range of machinery, ability to adapt, close relations with the Canadian sawmill industry and production facilities, means that it has the essential requirements to continue to develop and adapt new products to maintain its market share in Canada.

About three-quarters of the companies do their own research and development in Canada but, because of the relatively small size of the Canadian industry, the value of this R&D does not compare well with our competitors.

Canadian sawmill equipment manufacturers face challenges, but also have abundant opportunities. Technologically innovative foreign manufacturers using the latest computerized technologies have been penetrating the Canadian market posing a serious competitive challenge for Canadian suppliers.

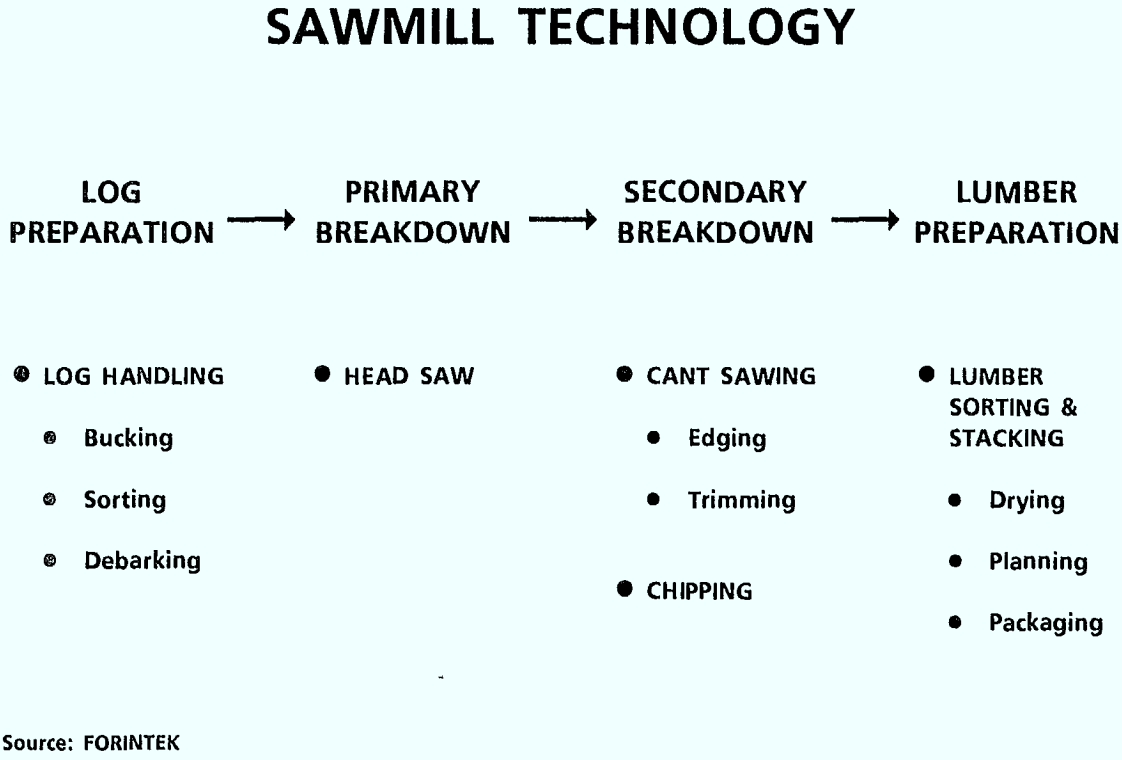
In the early 1990s lumber markets are forecast to grow more rapidly for non-residential construction and renovations, although residential will continue to predominate. The product mix and quality preferences will begin to change with this market share shift. Equipment manufacturers will be forced to develop new processes and products better suited for customers' specific needs. Opportunities also exist for import substitutions, smaller-scale equipment for smaller mills and lower-cost technology. These market niches will have to be identified and actively pursued.

Increased investment in research and development will be of fundamental importance for Canadian manufacturers to deal with the challenges and to capitalize on the opportunities.

3.3.1 Sawmill Technology

Sawmilling involves a series of machine centres, from log preparation to lumber preparation, as shown in Figure 3.5.

Figure 3.5



Source: FORINTEK

The abundant, high-quality timber resource that has been traditionally available to Canadian sawmills meant that the industry has not concentrated as much effort on obtaining the maximum product and value from each log as has the European industry. In addition, the predominant demand for commodity grades and sizes have made it easier to produce these standard products at maximum speed and capacity. This volume production

perspective has meant that the processing equipment criteria have focused on a constant through-put of short logs, free of crook, bends or rot.

The technology already exists to automatically scan and sort logs according to quality, size classes, and desired cutting patterns to extract the product required by customers or for the optimal value given current market prices. The basic premise is that each log has an individual shape and that once scanned, the computer constructs a two- or three-dimensional image of the log. A specific solution can then be obtained for optimal sawing of the log for either standard or special products. The computer takes the shape of the log and translates this into sawing and edging solutions that are tagged to the log using pulse counters through each processing centre from log sorting, bucking and debarking through the sawing and subsequent breakdown, edging, trimming and finally lumber sorting.

According to Roy Murphy, a consulting engineer with Mid-South Engineering, (Forest Industries, March 1988), a range of equipment is being applied to sawmills. This equipment including full axis scanners, proximity sensors, photocell controls, programmable controllers, operations sequencing, pulse counters, computerized hydraulic positioners, etc. allows the sawmills to operate at high-speed and volume and incorporates product flexibility and maximum value extraction.

The B.C. Interior has tended to adopt this computer optimizing, sorting and sawing technology more readily than eastern Canada. The ability to match log size to diverse end-product specifications is a major advantage and makes these systems attractive to sawmills seeking to diversify their products and to meet differing and stringent product quality specifications for such markets as Japan and Europe.

New technology is also being applied to the saws. It includes the use of new alloys for saw blades, better grinding techniques for saw teeth, new advanced materials such as carbide and stellite saw tipping and laser guiding for saws.

The energy efficiency of kiln drying is also being rapidly improved through the use of wood-waste thermal-oil systems, reburning of hot combustion gases, use of heat exchangers and better fans and venting. The use of new moisture sensors to ensure that lumber is not over- or under-dried is also being introduced.

Wood chips are another key product of a sawmill that are essential to the profitability of the operation and allow maximum utilization of the wood resource. In Canada revenues from wood chips can make up about 30 percent of total sawmill revenues. Wood chip quality is important for pulp production and chips should be cut to specific standard sizes acceptable to pulp manufacturers. Bark, over- or under-sized chips and fines must be minimized. Chipper efficiency and accuracy is thus essential to sawmill efficiency.

3.3.2 Remanufactured Lumber

These operations involve the further processing of a primary lumber into a more finished product and their output is used by subsequent secondary manufacturers who produce a finished end-product. The remanufacturing can occur as part of a primary operation or it can be in separate, independent processors. These operations have evolved as a result of the shrinking availability of high-grade logs and will become increasingly important as an outlet for non-standard lumber from high-yield operations. They can produce cross-sections of wood in length and grade, by putting small pieces together to make larger pieces through finger-jointing and edge-gluing. It can also involve

cutting, trimming, dressing, profiling, sorting and selecting by grade or size, locating and, generally, enhancing wood to make it more valuable and suitable for further manufacturing. For example, the production of finger-jointed lumber to be used by window frame manufacturers creates a product more suited to the end use because it is less likely to warp. Other examples include edge-glued boards for furniture components, turning squares, cut-to-size furniture stock, flooring and decking, strip panelling, wood packaging and a wide range of lumber and wood sizes suitable for non-commodity products.

As the availability of high quality wood continues to shrink, technology will increasingly allow its replacement with "designed" wood products, which are not only economical to produce but, in some cases, are an even better product. Advanced technology will be needed for scanning and sorting for specialty lumber, highly flexible and accurate automatic sawing and trimming, programmable controls, special machines for gluing, laminating, impregnating, and specialized planing and sanding equipment. Potential exists for the Canadian sawmilling and woodworking equipment industry to find niche markets in this growing sub-sector of the lumber industries in North America, Japan and Europe.

3.3.3 Prospects for the Future

In looking forward at the kinds of technology and equipment that are over the horizon in the sawmill sub-group, the following developments have been identified by FORINTEK and by the industry survey respondents:

1. The latest scanning technology involves fullstem, two-axis scanners capable of constructing a three-dimensional image of log diameter, length, taper, crook, etc. However, the ability to detect the internal structure of the log, including rot, knots, density, grain structure, stones or

metal and other defects, is the next step. It is estimated that the value of sawmill output can be improved by as much as 15 percent with internal scanning for defects. Development and testing is under way on the use of such detection methods as gamma radiation, x-ray computer tomography and nuclear magnetic resonance. Defect detection, scanning, which determines grain direction and colour, can improve product value decisions in automatic grading.

2. As scanning data improve, the optimization programs at each phase of production will have to become more complex and accurate. Simulation of sawmill processes will be necessary to optimize and integrate mill-wide production controls. Data banks of the latest sawmill technologies and equipment will be required to simulate sawmill processes as well as laboratory and field tests of prototype equipment. New analytical techniques for designing saws and sawing systems will be needed and will provide the basis for more automated sawing operations and maintenance.

3. Saw technology will continue to improve through the development of new alloys for saw blades, better grinding techniques for saw teeth, more effective levelling and tensioning machines, and new saw guide systems. Saw kerf will be reduced in high feed/speed operations. Indeed, sawing accuracy will be improved to a level that may allow the elimination of planing. Higher lumber yields can be expected as a result of these developments. Furthermore, training and retraining sawfilers in saw maintenance and preventive maintenance will be important in introducing the new saw technology.

4. Traditionally the most unproductive and labour-intensive section of a sawmill is sorting and stacking. About 80

percent of the larger Canadian softwood lumber producers have installed mechanical sorting and stacking equipment to keep labour costs down. Mechanical sorters are a major capital expenditure.

Canadian manufacturers have captured a major share of the sorting and stacking market. The application of new scanning technology and computer vision programs to locate and identify defects in the lumber will become part of automated lumber sorting and grading systems. When colour scanning is available, new accuracy in lumber grading will be possible.

5. Domestic dry kiln manufacturers will likely face increased competition from United States and Scandinavian companies who, through in-house and cooperative research, have developed new and innovative approaches to kiln design and performance. However, Canadian technology is expected to continue to be in the forefront of wood waste combustor-thermal oil systems for kilns. Computer controls will continue to be developed. To efficiently dry lumber, a presort prior to normal kiln drying can prevent a mix of lumber which can insufficiently dry wet pieces and over-dry already dry wood. A Canadian green lumber moisture sensor is currently in the advanced prototype stage. Once commercialized, it should gain wide acceptance for presorting green lumber into common moisture groups for more efficient kiln drying. Infrared and other remote moisture sensors are preferable because invasive detectors which insert prongs into the wood are not practical for high speed operations.

6. Improvements in debarking technology will continue to emphasize the removal of more bark and less wood fibre from the log. Pressure sensors, bark thickness sensors, or other

devices will be required to read the thickness of bark just ahead of the barking arm to allow continual fluctuation of debarking arm pressure. These developments are expected to improve the quality of the debarking procedure as well as the quality of pulp chip end-products.

3.4 COMPOSITE WOOD PRODUCTS

Some of the most dramatic innovations and technological changes in the forest industry are taking place in the composite wood field, although Canada's equipment supply capability for this technology is limited.

Canadian-produced composite wood products include plywood, waferboard, particleboard, hardboard and various other fibre boards. There is a limited supply of waferizers, raw material handling equipment, drying and glue-blending, press parts and panel-handling equipment produced in Canada. The bulk of panel-board equipment, such as glue preparation, forming line and panel-finishing machinery, is imported. Particle board initially used European technology, which accounts for the practically exclusive use of European equipment for forming lines.

However, with the growth of waferboard and oriented strand board, Canadian equipment manufacturers are obtaining an increasingly larger share of the market. For example, one company, CAE Machinery Ltd., as a result of marketing strategies and also as a result of investing 5 percent of sales revenues in research and development, has captured 80 percent of the waferizer market.

The innovation and technological change in composite woods focuses on expanding the uses for certain species, improving product yield from existing wood supplies, creating or engineering wood-based beams and planks which are larger than

most existing timbers, and developing more dimensionally stable, moisture-resistant panels.

FORINTEK is doing research to improve the quality and production of laminated veneer lumber (LVL) and laminated veneer poles (LVP) using rapidly growing, under-utilized aspen. LVL would have superior, more consistent physical and fire resistance performance characteristics. It would be ideally suited for the curvilinear shapes from Computer Aided Design (CAD). New types of parallel-laminated lumber are already being produced (MacMillan Bloedel's Paralam), using what until recently had been waste clippings from veneer plywood production.

Wood-densifying processes are being developed that can convert low-valued species such as poplar to denser wood, with properties similar to oak, walnut or birch.

Integrating wood cellulose fibres with other reinforcing fibres can create new composite materials with strength, flexibility, and water and fire resistance. The composite wood product would be suitable for uses ranging from decoration to replacement of steel and concrete in buildings.

Moulded wood-fibre producing equipment is also being designed and built to create wood that competes with plastic for such things as automotive panels, dashboards, seat backs and high-insulation window and door frames.

Phenol-based adhesives are a major cost factor in composite wood production, and costs are increasing. The phenol-formaldehyde glues are also health and environment concerns. FORINTEK is working on replacement glues derived from lignin, now a waste product in chemical pulping. FORINTEK is also doing basic engineering system design for mill trials of a production line steam treatment for wafers, to produce a more stable

waferboard without springback and thickness swelling from contact with moisture.

3.5 PULP AND PAPER EQUIPMENT

3.5.1 Trends in the Pulp and Paper Industry

For many years the Canadian pulp and paper industry has held an enviable cost position in relation to major world producers of commodities, such as bleached chemical pulps and newsprint. This competitive edge was primarily due to the availability, quality and reasonably priced softwood fibre resource and a pulping and paper making technology that favoured the use of northern softwood trees such as black spruce and balsam. Of equal importance was the proximity to the world's single largest market for these products, the United States.

Today the situation has changed significantly. Canadian wood costs are significantly increasing as available forests diminish. Readily available commercial size trees are becoming increasingly scarce as reforestation and protection against fire and pests have not kept pace with losses. Second-growth trees are not of the same quality as original growth. The technology has evolved to a point that other fibres such as hardwoods, southern pine and eucalyptus can be adequately used or are even preferred, bringing about a drastic change of position with respect to availability and cost of the raw wood supply. New suppliers are emerging from non-traditional areas such as Latin America.

Markets have been changing, demanding lighter and higher quality paper products. This, combined with the need to make more efficient use of the resource, has led to a series of specialized products each aimed at satisfying a specific need of the advertiser/printer or paper converter.

Through a major portion of this period, Canadian producers did not experience the same constraints faced by their European competitors. Commodity products such as kraft pulp and newsprint generated a good rate of return and could be exported to the United States duty-free. This removed the incentive to invest in new processes and products. However, as wood supplies quickly approached their limit and new products and suppliers began to encroach on traditional Canadian markets, Canadian producers have been compelled to enter into a phase of adjustment.

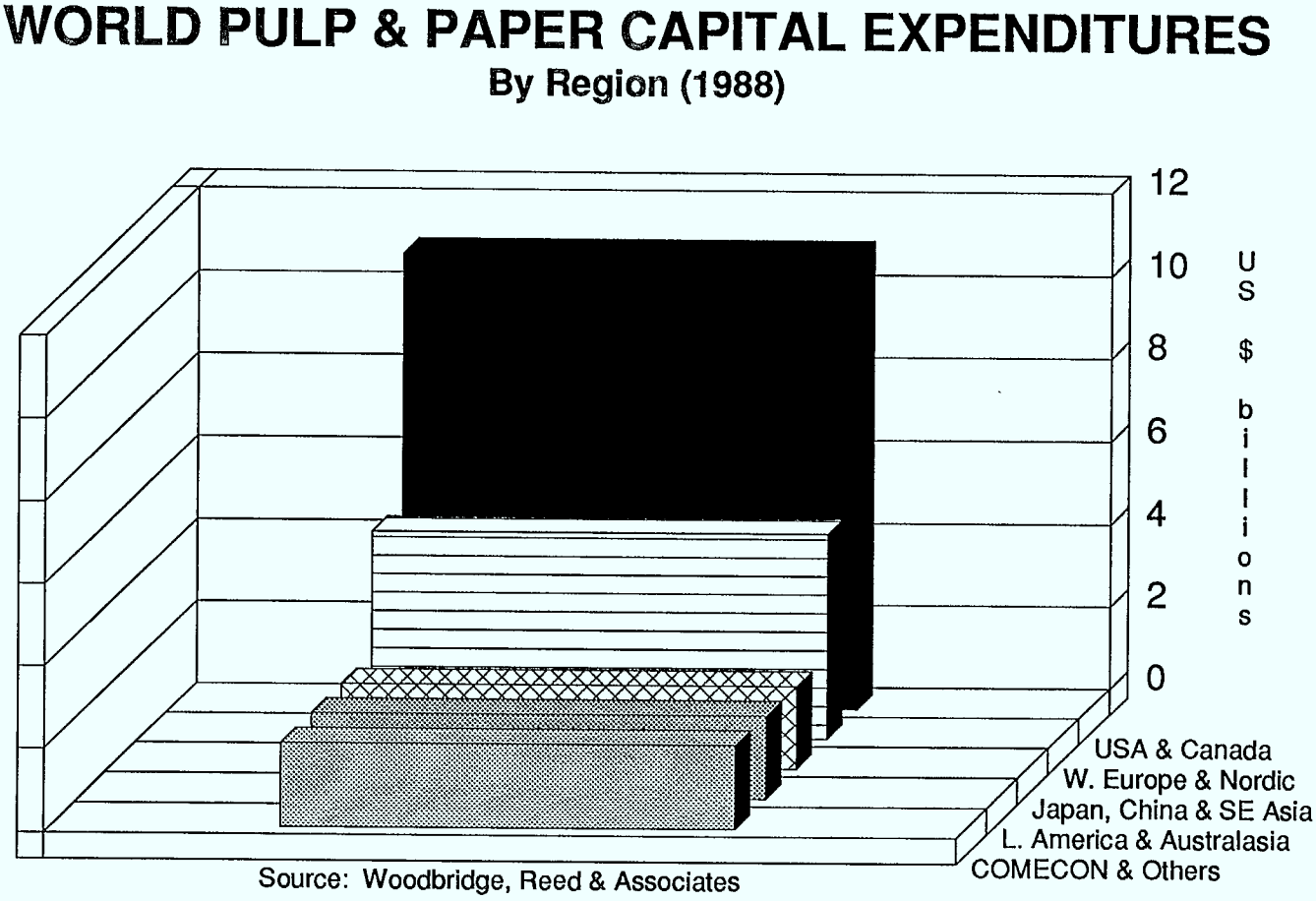
Older, less efficient paper machines are gradually being converted or replaced with new technology to produce higher valued and/or specialty products. New world-scale machines are being installed to serve commodity markets. Obsolete pulping processes are being replaced by modern higher yield processes to enable better utilization of the wood resource. Developments in thermo-mechanical pulp (TMP) and bleached chemical thermo-mechanical pulp (BCTMP), in which Canada is a world leader, are examples of such initiatives. This trend will certainly continue into the next century, taking advantage of the opportunities as they present themselves.

3.5.2 Pulp and Paper Equipment Markets

Woodbridge, Reed and Associates of Vancouver, which prepared a study for the Task Force on the pulp and paper supply industry, estimates world capital spending in the pulp and paper industry at about US $22 billion in 1988.

When construction and engineering costs are removed, this represents an estimated world market of about US $10 - 15 billion for pulp and paper equipment alone.

Figure 3.6



This figure cannot be taken in isolation as representing an exclusive potential export market for a Canadian supplier, since existing suppliers have many advantages. In some areas forest product companies do much of the equipment development themselves, or buy from local manufacturers who have significant cost advantages.

The world market is dominated by equipment suppliers who supply all major and ancillary equipment. This sector:

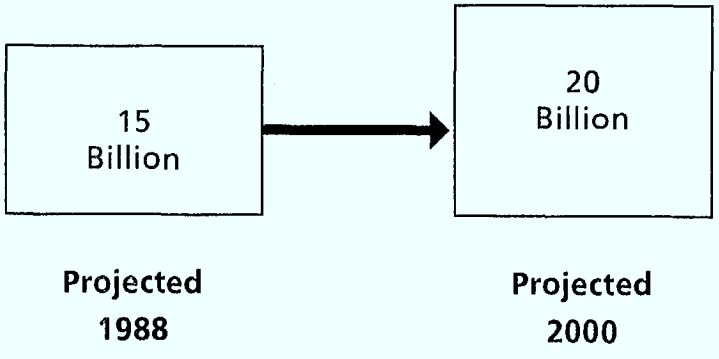
- is the most active in process, product, and equipment research and associated development;

- is very large, concentrated, and highly integrated with manufacturers of equipment for several industries enabling them to achieve scales of economics not otherwise possible;
- is global in outlook and is aggressively serving the world's marketplace;
- is integrated, at least in the Nordic countries, with test-bed and pilot plant facilities; and
- is cultivated, in some countries, by government programs and attractive export financing assistance.

Projected world capital expenditures on capital equipment by the year 2000 on pulp and paper is likely to be about $12 - 20 billion; a huge, and very significant market. This is a sizable prize to pursue. It is roughly equivalent to the net sales value of all newsprint produced in the world today.

Figure 3.7

World Pulp and Paper Capital Equipment Expenditures



Source: Woodbridge, Reed & Associates

Canada's ability to improve its share of the world equipment market will be a reflection of its contribution to the relative competitiveness of the Canadian pulp and paper industry.

3.5.3 Canada's Pulp and Paper Equipment Manufacturers

The Canadian pulp and paper equipment producers evolved to serve the domestic paper industry whose major products are market chemical pulp and newsprint. As a result, expertise and technological strength has been developed in chemical pulping and newsprint, while other fields such as paper finishing, coating and super-calendering machinery have not become highly developed. In recent years Canadian knowledge and equipment supply capabilities have also extended into fields such as thermo-mechanical pulping (TMP), bleached chemi-thermo mechanical pulping, computerized control systems, sensors and other software.

These manufacturers consist of about 50 companies that employ about 4,000 people. Most are located in or near the urban centres of Ontario (30 percent), Quebec (65 percent) and British Columbia. In 1987 total shipments were about $322 million with domestic shipments of $215 million and exports of about $107 million. About half of these equipment firms supply other industry sectors with products such as boilers, liquid/solid separators, pumps and controls.

These equipment companies are largely foreign-owned with their Canadian subsidiaries accounting for about 80 percent of the Canadian industry's shipments. This ownership situation results from a series of branch plant establishments or purchases of Canadian subsidiaries during the 1950s and 1960s. The branch plants were originally established to serve the Canadian market and bypass tariffs. Recently this trend has continued with a

number of successful Canadian firms being acquired by larger foreign parents.

Over the past five years more European suppliers -- particularly Swedish and Finnish -- have established branch offices in Canada. It is unlikely that this was done in anticipation of the Free Trade Agreement, but there is no doubt they were shrewd enough to realize that a North American base was essential if they were to sell equipment on this side of the Atlantic on the same basis as domestic companies.
Although design research, development and technical standards are usually all established in their own domestic home base, they successfully claim a "made in Canada" status even if only partly manufactured in Canada.

With the Free Trade Agreement, these companies are now in a good position to serve the entire North American market. By serving both Europe and North America, these manufacturers can maintain flexibility in periods of currency fluctuation.

As a result of the relatively narrow range of products made in Canada and with major foreign competitors in all Canadian products areas, imports have always had a significant share of the Canadian pulp and paper equipment market. This share has ranged from 30 percent to 60 percent over the last decade. In 1987 imports were $196 million or 47.7 percent of the domestic Canadian market. From a net trade perspective, imports outnumbered exports by two to one in 1987. More than 80 percent of these imports came from four countries, the United States, Finland, West Germany and Sweden.

Canadian companies, often too small to compete effectively against major international firms, have not been able to position themselves effectively and offer a wide range of technological services and equipment. Despite these odds, a number of Canadian

equipment suppliers have carved out a specific identifiable position for themselves in the domestic market and are beginning to show signs of export success.

These companies do their own R&D, and develop their own products. Their successful developments have been accepted as proven technology not only by Canada's pulp and paper manufacturers but internationally. A sampling of these Canadian successes includes S.W. Hooper and Co. Ltd., Hymac Ltd., Corrosion Services Co. Ltd., and SACDA.

S. W. Hooper and Co. Ltd. is one of the more successful Canadian equipment suppliers. Its success is based heavily on exports, with up to 90 percent of its products exported. The company has been especially successful in the United States and Europe. S. W. Hooper has R&D and manufacturing facilities in Sherbrooke, Quebec. Company products include pulp screening equipment, disc screens, waste fuel systems for power generation and material handling equipment. In the field of pulp screening, Hooper has been very innovative and has established a leadership position based on advanced technology.

Hymac Ltd., investing at least 5 percent of sales into R&D, has doubled its shipments from $25 million in 1986 to a projected $50 million for 1988. As a result of its R&D efforts, it is successfully marketing a high consistency jumbo refiner and captured several important CTMP and TMP contracts in Canada, successfully competing against the dominant foreign companies. In addition to system contracts, the company has been very successful in developing and marketing a wide range of pulp processing machines. Hymac is also active in the United States and is expanding its international marketing efforts.

Vancouver-based Devron-Hercules -- recently taken over by Hercules (U.S.) -- has sold more than 700 cross-machine control

actuator systems in 32 countries while maintaining growth in North America, which accounts for 75 percent of its business. Devron-Hercules relies heavily on sales agents in overseas countries, and does design and manufacturing at its North Vancouver home office. They recently formed a co-operative agreement with Voith Inc. of West Germany for Voith to incorporate Devron moisture profiling systems on all Voith paper machines.

Circul-Aire Inc. and Corrosion Service Co. Ltd., have used innovations developed by the Pulp and Paper Research Institute of Canada (PAPRICAN), and are among the world's leading suppliers of anti-corrosion equipment.

SACDA is a world leader in process simulation and Western Research a world leader in TRS analyzers. Fibron Machine Corp., of New Westminster, British Columbia, developed and patented a novel method of threading a tail for high-speed paper machines. Advanced Dynamics Corporation's roll and bale handling systems have been successful.

These and other Canadian firms are small by world standards. They find it increasingly tough to compete; when they are successful, there is always the possibility of a takeover by foreign firms.

3.5.4 Different Approaches

The narrow focus of Canada's pulp and paper machinery supply capability must be reviewed in the context of differing national pulp and paper industry philosophies and approaches, especially those of Sweden and Finland.

Canada is a trading nation that survives by its exports. Until recently the Canadian pulp and paper industry was

fibre-driven -- an industry based on maximum forest extraction, high production rates and cost minimization. The approach meant producing basic commodities, such as newsprint and bleached kraft pulp, that functioned best in a seller's market. The main requirement for pulp and paper equipment in that environment was that it increase output and reduce manufacturing costs as much as possible. By doing so, Canada's traditional role as a low-cost competitor in major commodity grades would be reinforced.

The European nations, particularly the Nordic nations, were forced many years ago to adopt radically different strategies because of chronic wood shortages, high energy costs, and the gradual removal of trade barriers between the EEC and Nordic countries. This included taking a longer-term view, concentrating on making very different products and convincing the consumer they were unique. Indeed, over 10 year Sweden and Finland made strategic plans to become leading forces in the European market once free trade with the EEC came into effect in 1984. The Swedes and the Finns did not have a market-driven culture from the outset, but as a result of their experiences they have become committed to new product and process development.

The research and development on products and processes of the Nordic pulp and paper companies were matched with the machinery technology and design capabilities of their equipment manufacturers to achieve world competitiveness in spite of some inherent low wood costs and low energy cost advantages enjoyed by other countries like Canada.

In the case of Finland, this came about as a result of their post-World War II industrialization. To meet war reparation payments to the Soviet Union, Finland's industries sought to develop products that were needed by the Soviets. Since the Soviet Union had abundant resources and raw materials, Finland's

industries moved into products of use to Soviet industrialization, e.g., logging, sawmilling, pulp and paper machinery. The state-owned conglomerate, Valmet Oy, is today one of the world's largest pulp and paper equipment suppliers.

Sweden's forest products and forest product machinery industries have also progressed in close co-operation although without the same degree of state intervention of the state as in Finland.

The philosophy behind this industrial development strategy is well explained by the wording of a recent advertisement from another large Finnish company, Tampella:

> "Tampella has an impressive record of helping its customers to find effective solutions to the problems they face. The key factor behind this success is **synergy** - the powerful force generated by the interaction of Tampella's two main areas of activity. Tampella produces paper, board and a wide range of converted products; its expertise in these fields forms the perfect complement to its other main business: the manufacture of machinery and equipment for the paper and board industry. This synergy leads to new equipment and methods which are then further developed and tested, both on the pilot machines at the Tampella Research Center and in the company's own mills." (Pulp and Paper, Miller Freeman Publications, March 1988).

A number of U.S. equipment firms have also pursued world-scale and world-competitiveness objectives but with a specific American advantage. The U.S.'s leading world position in computer software and hardware research, development and product innovation has been applied to pulp and paper equipment. Their generic research and development strength in computer-integrated manufacturing (CIM) is being applied to this

sector with resulting competitive advantages for U.S. equipment manufacturers.

3.5.5 Recent Technological Shifts

After the Canadian pulp and paper industry returned to pre-recession levels of capital expenditures in 1985, investments were made not only in the modernization and expansion of market pulp and newsprint mills, but also significant product diversification and upgrading has begun. This is in part due to tariff reductions on printing and fine papers from the GATT Tokyo Round and a recognition of continued reduction in tariffs from bilateral and multilateral negotiations. For example, between 1984 and 1990 six new fine paper machines will be installed in Canada with a resulting 60 percent increase in Canadian capacity. Newsprint machines are being replaced or upgraded to produce specialty grades such as super-calendered and other uncoated groundwood specialities.

Most of the leading paper finishing technology being installed has not been developed in Canada because the resultant products have not fit Canada's traditional product mix. It is possible that closer co-operation and R&D links between pulp and paper companies and equipment suppliers in the past could have given Canadian equipment suppliers more opportunities to benefit from these corporate decisions to diversify into other value-added products.

The demand for the largest, most efficient paper machines -- more than 7600 mm (300 inches) wide and operating at over 1070 m (3500 feet) per minute, -- are examples of the rationalization of equipment manu- facturing and the centralization of R&D. Suppliers have been narrowed to only three, Valmet, Beloit and Voith. This has directly affected both their Canadian

subsidiaries and their marketing of such paper machines in Canada.

Being at the leading edge of technology is a key factor in selling equipment to the pulp and paper sector. The Canadian pulp and paper equipment manufacturing industry consists primarily of subsidiaries that are highly dependent on their parent for technology and do very little, if any, R&D in Canada. Most large multinationals have their research centres and pilot plants located near their corporate head- quarters and their technological development, engineering and design work is done outside Canada. Although through transfer of technology, subsidiaries can benefit from the results emanating from these centres, this type of operation tends to reinforce the branch plant aspect of the Canadian entities. Failure to develop and manufacture innovative Canadian technology inhibits exports and resultant world product mandates and only encourages companies to view the Canadian firms as manufacturers of components.

With the acquisition of the pulp and paper division of Dominion Engineering in Lachine, Quebec, Valmet decided to strengthen the Canadian division in its capability to manufacture paper machine rolls. For this reason, some of the major investments by Valmet in the Canadian operation have been in radial drilling equipment, grooved roll manufacture (G-Roll) and roll grinding equipment. On the other hand, Valmet ceased the manufacture of paper machine headboxes, winders and rewinders in Canada. Shortly after the Valmet takeover Dominion Engineering closed its foundry, so that casting for dryer cylinders was no longer available from Canadian production. Valmet Dominion only machines and polishes these cylinders in Canada.

The end result of the Valmet/Dominion Engineering transaction is that of the total paper machine, most of the forming section, most of the press section, part of the dryer

section and the calender stack and the reel is still manufactured in Canada. The remainder is produced in other Valmet divisions in Finland.

Two years ago Beloit Corp. also decided to change to global sourcing and as a result decided that winders and rewinders would now be the responsibility of their Lennox division in the United States. At approximately the same time, because of the advent of CAD/CAM and the proximity of Beloit Canada to Beloit, Wisconsin, it was decided to downsize the engineering capability of the Canadian division. As a result, all design, production engineering and scheduling, formerly the responsibility of Beloit Canada are now done in Wisconsin and the Canadian engineering division in Pointe Claire, Quebec answers directly to Wisconsin.

The West German company, Voith, supplies the Canadian market from Brazil. The only Canadian presence at the time of writing is a sales office in Ottawa. Three of the most recent paper machines ordered in Canada and representing approximately $150 million of business, were supplied by Voith. The three machines -- one has been installed and is now running, the other two have been ordered -- were or may be built at the Voith's super-modern factory in Sao Paulo, Brazil with the sale of the machines partially financed by Brazilian government export credits. Financing available to Canadian firms for sales in Canada cannot compete with such concessionary rates.

Indeed, the patterns of acquisitions and mergers that have characterized the larger equipment manufacturers' corporate strategies have created corporate giants whose activities and investments are designed to maximize competitiveness and productivity, in the short term, by rationalizing production at the most efficient site in relation to the target market. In the long term, their strategies are to protect their competitive edge through R&D. Their Canadian subsidiaries could be strengthened

if R&D were attracted to Canada and if production facilities could be given mandates to service a North American market or even obtain a world product mandate for their developments.

The potential benefits of greater commitments to Canada of the resources of a company such as Valmet cannot be underestimated. Valmet Paper Machinery employs more than 7,000 worldwide (compared with total Canadian pulp and paper machinery employment of 4,000), and spends three to four percent of sales on R&D in six research centres world wide. Based upon an estimated total annual sales of $820 million, the estimated annual expenditure of Valmet on R & D in recent years represents about forty percent of the total Canadian industry expenditures on R&D.

Valmet is a very formidable competitor. As noted in their publication Valmet Paper News - R&D, February 1988:

> "The road to higher productivity is powered by about 100 projects and 300 highly skilled specialists; 80 percent of whom have college or higher degrees.
>
> Valmet has solved the problems of papermaking on a wide front by decentralizing and performing the product-related R&D in centres associated with the specific business.
>
> It leads to wide in-house expertise, a rare phenomenon in any industry. We can have our own experts in new materials, hydrodynamics, and automation working together on the same problem.
>
> Valmet's new modular pilot tissue machine allows several comparative runs in different configurations during one week. Critical parts of the machines are modules---we can roll one off and roll another one prebuilt outside the machine onto it.
>
> Each unit of Valmet is responsible for developing automation in its particular area of expertise.

> The extended pilot paper machine was inaugurated on 23 March 1988. This machine, one of the most versatile in the world, is the fourth complete pilot machine within the Valmet organization, its special function being the development of multi-ply technology for paper and board in particular applications of high-consistency technology."

In the face of such formidable international competition, the strategic importance of providing an effective domestic environment for the rapid growth and development of the Canadian equipment and machinery manufacturers becomes very evident.

One important key element to successfully achieve such rapid growth is the need for increased R&D by Canadian pulp and paper equipment manufacturers. Of 24 major equipment R&D centres worldwide (see Appendix 3), none is located in Canada, while the United States has 8, Finland has 6, West Germany 5, Sweden 3, and even the United Kingdom and New Zealand each has 1. The survey of Canadian equipment manufacturers identified the need for access to pilot plants and test facilities, as a significant factor in proving and commercializing new equipment. Other key factors included the need for financial risk sharing for machinery R&D and commercialization, as well as overcoming the reluctance of Canadian forest product companies to install anything not yet 'proven'.

Since Canada is the world's largest pulp and paper exporter, many Canadian equipment firms expressed concern that a world-class machinery and equipment research centre and pilot plant test facility did not exist in Canada. Many reported that they have to rent time in the United States and other foreign research facilities to test their prototypes.

3.5.6 Prospects for the Future

The Task Force survey of the Canadian industry and research experts have identified a number of areas where R&D and machinery development and design should be focused to advance the levels of technology and competitiveness of the Canadian industry.

1. The continued development and application of mill-wide control systems, such as computer-integrated manufacturing (CIM). This will allow for the linking of existing individual process control systems on refiners, digesters, bleach plants and paper machines. Such integrated control systems will result in a continual flow of information about quality, costs, the status of orders, etc. The result will be improved efficiency as well as higher quality products tailored to customers' specifications.

2. The use of advanced materials for various components of pulp and paper equipment will allow for the development and improvement of various processes. The pulp and paper producers are having significant problems due to increased corrosivity of process environment, which use new or recycled chemicals, operate at higher temperatures, pressures and/or speeds. The solution lies in the development and use of advanced materials such as super-austenitic stainless steel alloys, nickel-based alloys, duplex stainless steel, thermal or plasma spray coatings and composites. For example, new materials need to be developed to prevent chloride stress corrosion cracking in CTMP pressurized equipment.

3. It is difficult to foresee the degree to which the pulping, bleaching and waste treatment processes will be affected by developments in biotechnology. Research is currently underway for the biodegradation of lignin as well as enzymic modification of wood fibres to aid or replace chemical and

mechanical pulping. Bleaching may be enhanced or achieved using microorganisms. Waste effluent treatment will use microorganisms to recover wastewood or to convert it to obtain adhesives, animal feedstocks, rubber, fuel and fuel enhancers.

4. New chemical pulping processes are needed that are high-yield, involve significant chemical recovery, use non-traditional wood species and are environmentally benign. The experimental Alcell process, which uses alcohol at high temperatures and pressure to cook hardwood chips prior to mechanical refining, is an example of this type of new process. Other processes still being developed or modified include oxygen-alkali-delignification and alkaline or neutral sulphite-anthraquinone.

5. New developments in paper machine headbox design can be expected to produce new types of multi-layer papers at lower costs and competitive quality. For example, a single, multi-layer headbox has already been developed which produces a three-layered finepaper with the inner layer of lower valued CTMP for bulk and stiffness and a bleached chemical pulp of the two outside layers for strength and printability. The resulting paper requires about 20 percent less of the more expensive chemical pulp for an equivalent sheet of printing paper.

6. The expanding use of thermo- and chemi-mechanical pulps (TMP and CTMP) in printing and publication paper grades will be encouraged with the development of processes to increase brightness and to control the reversion or darkening of this brightness when exposed to light. Investments to modernize will increase as the installed cost for new processes like TMP and CTMP decrease. Focus on process and equipment

simplification in this area requires an ongoing major development thrust.

7. On-machine paper finishing including, on wider machines, will provide greater production efficiency. Integrating other finishing on-line would provide higher and more consistent printing quality at lower costs.

8. The greater use of mineral fillers, fibres, and coatings on paper will substantially reduce the pulp fibre costs. For example, paper grades are being developed using 50 percent CTMP for bulk, 35 percent filler to offset CTMP brightness reduction and 15 percent chemical pulp for strength. The quality of coated papers will be enhanced with improved synthetic binders, and thinner coatings. Improvements are also foreseen in coating heads and drying systems. High consistency pulp processing brings large economic benefits in the entire pulp handling area. Research and development in screening, cleaning, mixing, and pumping for pulp processing and forming for pulp and paper making will have to intensify.

CHAPTER 4 RESEARCH AND DEVELOPMENT IN THE INDUSTRY

4.1 Attitude Toward Science and Technology Must Change

The Canadian attitude to high technology is best shown by a study co-sponsored by the C.D. Howe Institute, "Meeting the Competitive Challenge: Canada and the U.S. in the Global Economy". This study found that in 1984 Canada had only 30 scientists and engineers for every 1,000 workers, the lowest ratio in six industrialized countries (see Table C). The United States was highest with 65 per 1,000 followed closely by Japan with 62 per 1,000. However, of significance for the future is the fact that the rate of growth in numbers of scientists and engineers in Japan was 5 percent. The U.S. growth rate was lowest at 0.1 percent followed by Canada at 2.4 percent. The availability of such experts will be a critical factor in future competitiveness. Change must start in the elementary schools, carry on through the high schools and into the universities. Canada must start being a creator of technology, not an importer.

TABLE D

R & D SCIENTISTS AND ENGINEERS

	1984 Number per Thousand in Labor Force	1965-84 Average Annual Rate of Growth
United States	65	0.1
Japan	62	5.0
Germany	49	5.1
France	41	3.6
United Kingdom	34	3.0
Canada	30	2.4

Source: C.D. Howe Institute

Technological leadership alone does not guarantee a permanent competitive edge. Technology is like paper money, it circulates widely and rapidly, is essential to everyday life, but offers no real security to the holder. A great deal of today's forest industry technology is widely available and can be either purchased or licensed. Future competitiveness is dependent on safeguarding future resources and on today's and tomorrow's investments in research and technology.

4.2 Industry Survey

According to the returns of the industry survey conducted by the Task Force, R&D undertaken by the logging and forestry equipment manufacturers amounted to 2.6 percent of sales. The equipment users, not counting their contributions to the co-operative research institutions, such as FERIC, conducted an insignificant 0.02 percent of sales, depending primarily on these institutions to conduct their research.

Similarly, in the sawmill and panel machinery sector, the equip- ment manufacturers' R&D amounted to 1.4 percent of sales. Users of this equipment in turn, reported research equaling only 0.17 percent of sales.

In the pulp and paper sector, R&D among the equipment suppliers who manufacture in Canada was reported at 2.0 percent of annual sales. For the equipment users in Canada, R&D is only 0.3 percent of sales.

These survey results compare well with the 1987 estimates recently published by Statistics Canada (Catalogue 88-202 Annual) on industrial R&D. Statistics Canada reports the 1987 estimated R&D for all of the wood industry to be $20 million in current dollars, and $85 million for the pulp and paper industry. The Statistics Canada figures include the expenditures of the

industry, research institutions as well as those of universities and governments.

Statistics Canada also reported that for the wood industry, R&D expenditures as a percent of sales were 1.4 percent, the same per- centage as the survey results for the sawmill and panelboard sector. For pulp and paper, R&D as a percent of sales was estimated at 0.3 percent, which compares well with the survey results for equipment users, but not as high as the 1.9 percent of sales for equipment manufacturers. Given the size difference between these two industry groups, it is not surprising that the Statistics Canada results reflect users rather than equipment manufacturers.

The R&D expenditures, however, are still substantially less than those of our competitors. In pulp and paper, expenditures of 0.3 percent of sales do not match the 0.8 percent of Japan and Finland and the one percent in the United States and Sweden. Canada's R&D spending of 1.4 percent of sales in wood products is closer to the 1.5 percent in the United States and 2 percent in Nordic countries.

According to the latest Statistics Canada reports, in 1985 the average spending by all Canadian industries on R&D was 1.3 percent of company sales, with primary metals (ferrous) at 0.3 percent, aircraft and parts 15.8 percent, machinery (in total) 2.0 percent, business machines 3.0 percent, and telecommunication equipment 14.3 percent. Wood as reported above was 1.4 percent, and pulp and paper 0.3 percent.

4.3 Continuity of R & D Efforts

Annual R&D expenditures in 1987 in the forest sector, including all private and public sources, amounts to about $240 million (see Figure 4.1). The Canadian Forestry Service

operating budget for its forestry research centres of about $65 million is about one-quarter of this total. Expenditures by industry on R&D in 1987 were estimated at $105 million.

It might be assumed that R&D spending would increase as profits rise. However, there was no significant increase in expenditures for either capital or intramural (on-going) research in the past three years. Since profits increased significantly in the same period of time, it is obvious that Canadian companies are spending proportionally less. In the forest industry research and development spending is less today in real terms than it was in 1968.

Figure 4.1

CANADIAN FOREST SECTOR R & D EXPENDITURES 1987

(Millions of dollars)

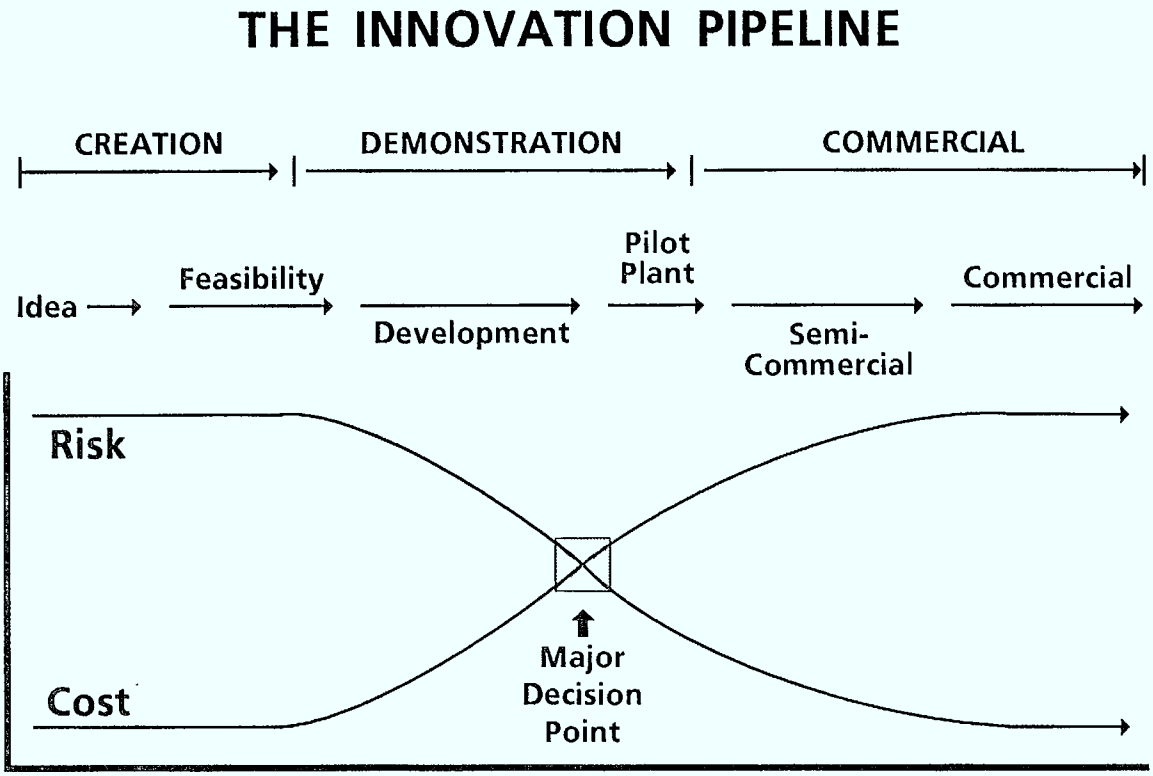
INSTITUTIONS	
FERIC	5.1
PAPRICAN	24.5
FORINTEK	13.7
Universities	9.0
GOVERNMENTS	
CFS	75.0
Other Feds.	8.0
Provinces	20.0
PRIVATE	
Companies	105.0
TOTAL	260.3

Source: DIST Estimates

In times of fiscal restraint or lower profits, R&D is one of the first areas to be constrained or even cancelled. There is a

conservative, short-term attitude in Canada toward research and development. However, the average forest product R&D project takes about six years to reach the prototype development stage, and another three years to commercialization. Thus, the funding for R&D must be maintained or increased over about 10 years, on average, to arrive at a commercialized result. Figure 4.2 shows that over the period of time from creation to demonstration to commercialization of an innovation, the costs get progressively higher as risks decline. The major division point occurs when the costs of a pilot plant or full-scale testing is considered.

Figure 4.2



Source: FORINTEK

Continuity of R&D has not occurred in the forest industry during the past recessions. Roger Hayter, in a background study published by the Science Council of Canada in January 1988, "Technology and the Canadian Forest-Product Industries", reported that in-house research and development employment in nine Canadian forest product firms dropped by 22 percent from 582 in 1980 to 451 in 1984 due to the recession throughout the industry. There is no way of estimating the long-term loss to the industry in knowledge and expertise from these cutbacks.

Current statistics on the level of R&D among Canadian-based equipment manufacturers compared with foreign countries are very difficult to obtain. However, P. Hanel, in a paper published by the Montreal L'Institute de recherche politiques 1985, reported that patents issued between 1978 and 1980 reveal Canadian inventors to be most competitive in forestry machinery, but progressively less so with respect to wood processing, pulp and paper, and paper converting.

Canada accounted for 28.9 percent of the 135 patents issued with respect to forestry equipment, but only 8.9 percent of the 395 pulp and paper patents issued over the same period. The same relative differences were noticed in a 10 percent sample of patents issued over the period of 1950-1975. Hanel goes on to point out that Canada's traditional strengths in forestry equipment are being reduced by stiff Swedish competition, and recent pulp and paper machinery patents are overwhelmingly concentrated in the hands of American, Swedish, and Finnish firms.

In the industry survey conducted by the Task Force, several equipment manufacturers indicated that they had to take their ideas abroad for commercial development since no Canadian company was willing to participate in development.

4.4 Forest Product Firms R&D

Most forest product industry in-house R&D is applied and developmental research. Technical services, or trouble-shooting, account for 10 to 50 percent of in-house research and development effort.

Hayter surveyed companies and asked them to outline the advantages of in-house R&D. Advantages included:

- in-house R&D can be related to specific investment opportunities;
- in-house R&D groups can respond quickly to a problem;
- in-house R&D provides for rapid transfer of technology; and
- R&D results are specific to the company's production and/or marketing requirements.

Three main cooperative research institutions are involved in forest industry research and development. Each serves a separate clientele, although some major corporations are active in all three institutions.

PAPRICAN

The Pulp and Paper Research Institute of Canada (PAPRICAN) does fundamental and applied research in pulp and paper operations and trains university students in fundamental pulp and paper research.

PAPRICAN is largely supported by yearly fees from forest-product manufacturing companies. It is the oldest of the three co-operative research and development laboratories, having started in 1913 as the Forest Products Laboratory, set up by the federal government at McGill University in Montreal. It focussed

on timber testing and physics, wood preservation and distillation, and pulp and paper manufacturing.

The pulp and paper industry felt that not enough was being done in pulp and paper research, and in 1925 an agreement was reached between the government, the Canadian Pulp and Paper Association, and McGill establishing PAPRICAN. Until the mid-1950s, the federal government provided an annual operating grant. The operating grants were replaced by occasional capital grants for the PAPRICAN Pointe Claire facility and, in 1986, the federal government also provided capital of $15 million for the PAPRICAN Vancouver facility.

With 377 employees, PAPRICAN's current annual budget is $24.5 million, with industry members providing about 85 percent of the revenues. PAPRICAN supplements members' fees by providing technical services on contract, and less than five percent of its revenue is from government sources.

Of the 20 members on the PAPRICAN board, 12 are designated from industry, 4 from affiliated universities, 2 from government, and the remaining 2 from PAPRICAN itself.

PAPRICAN has the largest research capability of the three co-operative organizations, focusing on pre-commercial basic and applied research and development, and developmental research that is too expensive for individual members or has industry-wide application. About 80 percent of the research is process-oriented.

PAPRICAN sponsors graduate student research at McGill and the University of British Columbia; does research into matters of public interest; maintains a pulp and paper library; provides computer information retrieval services, calibration services, and standards and research consultation; promotes the awareness

of technical needs through publications and seminars; and provides pulp and paper training courses for engineers.

FERIC

The Forest Engineering Research Institute of Canada (FERIC) conducts a research and development program primarily directed toward woodland harvesting and silviculture. It began operations in 1975 and was essentially a PAPRICAN spin-off, replacing PAPRICAN's woodlands section, made up of a silvicultural group and a logging group, which were disbanded in 1971.

FERIC has 70 employees, of which 32 are professionals and 11 technicians. Its research and development program includes reforestation and tree planting, although its mandate relates primarily to wood harvesting.

Member contributions to FERIC's budget of $5.1 million totalled 50 percent, with the remainder coming from federal and provincial governments, and development contracts with companies. The board of directors has 20 members, with 11 coming from industry, 3 from government, and 6 from FERIC itself.

FERIC's mandate is to conduct research and development to improve the efficiency of wood-harvesting operations and to minimize the cost of wood used in manufacturing. Before FERIC was formed research and development in wood harvesting engineering technology was meagre and fragmented because of diverse local conditions and the importance of small business in logging.

FERIC has attempted to provide a Canada-wide framework for research and development to improve components, machines, and systems in all phases of wood harvesting operations. FERIC seeks out relevant technology and concepts throughout the world, and publishes its findings.

Its research and development is strongly developmental and site-specific. It has been concerned mainly with technology transfer and with promoting the best use of technology, no matter where it originates. FERIC maintains some contact with equipment suppliers and manufacturers, but concentrates on research and development that supports wood harvesting businesses.

FORINTEK

Forintek Canada Corporation directs its research and development program principally toward sawmill and lumber, panel products and solid wood research. It was created in 1979 when the Department of Environment's Eastern Forest Products Laboratories, and Western Forest Products Laboratories were privatized.

FORINTEK obtains more funding from government than industry, with about 50 percent of its current budget of $13.7 million coming from the federal government and 25 percent from the governments of Alberta, British Columbia, Quebec, New Brunswick and Nova Scotia. The remaining 25 percent is provided by industry members. Some additional funds are obtained directly from companies for contract work. Its 23-member board has 14 industry members, 6 government members, and the remainder from within FORINTEK.

FORINTEK does research and development and provides services in codes and standards, technology transfer and training and education for the Canadian wood products industry. It estimates that about 60 percent of its work is research and development, and 30 percent codes and standards.

FORINTEK sees its role as providing technological leadership to the wood-processing industry:

- by acting as a technological bridge between forest manager and manufacturer;
- by stimulating higher levels of productivity and wood utilization in the mills;
- by providing the technical expertise to develop and influence codes and standards that are in the interest of Canadian wood products and wood designs; and
- by increasing the competitiveness of wood products through the development of new products and processes and by educating industry about technology through courses.

The Corporation promotes adopting the best technology that has been developed anywhere in the world and has, sometimes in co-operation with universities, established long-term research and development programs in such fields as biotechnology.

Some forest companies have tended to assume that their contributions to PAPRICAN, FORINTEK and FERIC were adequate contributions to research and development, and that additional internal research was not required.

4.5 Equipment Supplier Research and Development

In the industry survey conducted by the Task Force, although not all companies reported on their extent of R&D, the reported annual research was $8.3 million or 2.6 percent of sales for logging and forestry machinery manufacturers, $2.5 million or 1.4 percent for sawmill and panel machinery manufacturers, and $11.8 million or 2.0 percent for pulp and paper machinery manufacturers.

Hayter found that technology strategies vary considerably among equipment manufacturers. Leading suppliers invest in research and development as a source of competitive advantage and are normally strongly export-oriented. They recognize that competitiveness in Canada depends upon product innovation.

Most foreign-owned equipment manufacturers do little or no R&D, engineering or design work in Canada, with the majority of it being conducted at the parent facilities. This is common to U.S.-owned firms such as Beloit or Scandinavian-owned Valmet.

4.6 Government and University Research and Development

Traditionally, the federal government and universities have done research and development for forestry and silviculture activities. The research and development is mostly forest-related and only peripherally concerned with equipment or product manufacturing through government contributions to co-operative research institutions.

The Canadian Forestry Service operates the Petawawa National Forest Research Institute, the Forest Pest Management Institute and regional laboratories at St. John's, Newfoundland; Fredericton, New Brunswick; Ste.-Foy, Quebec; Sault Ste. Marie, Ontario; Edmonton, Alberta; and Victoria, British Columbia. In 1987 they spent $75 million on forestry research, and have spent approximately $8-9 million per year for the past five years on capital expenditures for research facilities. Research undertaken as part of the federal-provincial Forestry Development Agreements and funded jointly by both parties amounts to about $11 million annually.

The provincial governments of British Columbia, Ontario, and Quebec have set up industrial research organizations that do research and development related to forest products and forestry.

The universities of Laval, New Brunswick, Toronto, Alberta, British Columbia, and Lakehead University have forestry schools that do forest-related research. The applied sciences and biology schools also do forest-related research. Several other

universities, such as McGill, British Columbia, University of Quebec at Trois Rivieres, and the University of Toronto, contribute to forestry and forestry-related research and development, including pulp and paper.

CHAPTER 5 THE TASK FORCE FINDINGS AND RECOMMENDATIONS

5.1 Industry Collaboration

During the Task Force deliberations, and further supported by individual replies to the industry survey, it became evident that there is an opportunity for considerable improvement in co-operation and collaboration between the equipment manufacturers, their clients (users), and the co-operative research institutions.

In general, European producers are more willing to use innovative domestic technology than North American mills. Canadian companies, when shown a technological development, all too often say "show me where it is running successfully first", rather than taking the risk of being the first user. This attitude will have to change if Canadian equipment suppliers are to have any chance of competing with foreign equipment manufacturers who have the co-operative backing of their governments, research organizations, and domestic end-users; otherwise we will always be scrambling to catch up to other countries.

Individual equipment-user companies in Canada must find ways to work more closely with domestic equipment suppliers to identify technological opportunities and share the risks and benefits of testing new machinery and equipment. For example, representatives of equipment manufacturers could sit on the Board of Directors of producing companies and vice versa. Industry associations and senior management of the forest industry companies need to be more aware and to communicate, both internally and externally, the benefits to Canada of buying Canadian equipment, components and technology. Similar commitments must be made by the Canadian government.

In the Science Council of Canada's "A Sectoral Approach to Innovation: The Case of the Forest-Products Industries," the Council states: "The lack of a thriving and technologically aggressive domestic equipment supply industry is a major failure of Canadian development policy. The demand for forest-product machinery and equipment within Canada is massive. There would be considerable benefits to the Canadian economy if there were a few large, internationally oriented highly innovative equipment manufacturers serving the forest-product industries. Foreign experience indicates the benefits would be reflected in employment, visible and invisible exports, and in contributions to innovation in the forest product industries."

The Task Force felt that the key to the successful development of internationally competitive equipment suppliers is the adoption of this objective by the forest products industry, and concerted efforts by these equipment users to foster domestic equipment supply and R&D capability. Without this positive environment provided by the Canadian equipment manufacturers and users, government and institutional efforts to promote the equipment suppliers will have significantly lower prospects for success.

The forest products industry can assist the development of Canadian equipment through a variety of corporate activities, such as:

- purchasing policies which require consideration (but not necessarily preference) of Canadian-made equipment;
- in-house R&D activities which include consideration of new process or product equipment sourced by Canadian manufacturers;
- joint R&D projects with Canadian equipment manufacturers;
- encouragement of collaborative research with cooperative research institutions and equipment manufacturers;

- a better awareness of how Canadian equipment manufacturers contribute to improved competitiveness and a more technically sophisticated forest products industry.

The Task Force recommends:

Recommendation No. 1

> **That the Canadian forest products industry (individual companies, research institutes, associations), as an element in their corporate strategies, give high priority to the development and utilization of Canadian equipment.**

5.2 Industry Educational Support

Several respondents to the industry survey said they could not recruit Canadian engineers and technologists skilled in equipment design and development.

As in the forest industry research institutions, research at universities is normally process-oriented. At the same time, the industry is doing little to encourage teaching of equipment design in universities and colleges.

FERIC, in a study for the Task Force, reported that:

> "Very few engineers trained in Canadian universities today have any knowledge of the forest industry or take any courses in forestry or forest products. This is true of both mechanical and chemical engineers entering the forest industry and also of those working for machinery manufacturers. It is a particularly serious problem among advanced students seeking Masters and Doctorate degrees. This automatically ensures that the

> engineering professors are unfamiliar with the industry.
>
> The reasons for this trend are obvious: movement of people from the country to the city; more emphasis on advanced technology; fewer summer jobs for students in forestry (and in the mills) because of automation; more scholarships available from other industries."

As noted in the previous chapter, Canada has only 30 scientists and engineers for every 1,000 workers compared to 65 in the United States. While Canada shows significantly more increase in the average annual rate of growth than the United States, it is still less than the other countries, and will not enable us to catch up with the United States for a considerable period of time, let alone be competitive with the other foreign countries.

Dr. David Goring, who recently retired as PAPRICAN's Vice-President, Scientific, said in a speech to the Canadian Society of Chemical Engineering in Vancouver that despite having the brainpower, resources and money, Canada has not been developing the good, new technology required in the resource-based industry, certainly not in the pulp and paper industry. He said the lack is not so much in basic science, but in the transfer from basic research to applied research and subsequent implementation. In this respect, he said, Canadians are weak, tending to buy technology from outside the country.

The Task Force concluded that Canada must not only train more scientists, technologists and engineers, but persuade more of them to take general forest industry courses, including equipment design and development. The low profile of the forest industry in engineering schools means that many of the best and most innovative students go to work in other industries.

Very few undergraduate courses are taught at Canadian universities in forest-related technologies, let alone in the design of equipment required for these technologies. At the Graduate level, some universities such as McGill, Toronto, and UBC have Masters and Doctoral degrees in which one can specialize in these technologies but these are all related to process or basic research. None of the universities offers Masters' programs in solid and composite wood technology. As a result, Canadian companies are unable to recruit new graduates from Canadian colleges with training in these areas.

Unless universities can train graduate students in forest industry equipment development technology, and then hire them as professors to teach undergraduate courses, it will be very difficult to extract ourselves from the present self-perpetuating impasse. Canada cannot continue to depend on recruiting scientists and technicians overseas.

Throughout Canada there is a lack of adequately trained instructors in many forest industry technologies. This is not only in the universities, but also in our technical colleges. For example, the school at Burnaby, British Columbia has provided good training in the techniques of saw blade refinishing and filing. However, with the major changes in saw technology in the last ten years, standards and techniques require updating. This will require the purchase of state-of-the-art equipment and up-to-date, trained instructors in the school. Similarly, other skilled trades are not being taught. While not specifically forest related, there is a tremendous shortage of skilled tool and die makers, which are a necessity for any innovative machine development, and none of the schools is meeting this demand.

In one specific area an opportunity exists for Canada to take the forefront in developing innovative technology. Current

trends indicate that as our original-growth forests become depleted or more remote from economical access, Canadian producers will be forced to move from solid, one-piece lumber to composite or laminated pieces composed of wafers, slivers, and particles of wood moulded and glued into the desired shape. This is only an extension of the existing movement of technology from plywood to waferboard and oriented-strand board.

At present, research into these composite products is still in its infancy. This presents a significant opportunity for Canada to become a world leader in this technology. However, more research needs to be done at the university level as well as in the co-operative research institutions. This research should be in both the end-products as well as in the equipment to produce these products to meet world demand.

The Task Force recommends:

Recommendation No. 2

> **That forest industry companies and the Associations adopt a strategy to encourage universities and technical colleges to enlarge their formal teaching and R&D programs in forest industry machinery design and development, and product and process development, through funding "Chairs", grants, scholarships, bursaries, summer work programs, and other collaboration.**

5.3 Equipment Links with Cooperative Research Institutions

The co-operative research institutions were established to meet the needs of the respective forest industry users, and not in response to any defined need of the equipment manufacturers.

As a result, forest equipment manufacturers are currently ineligible for membership in these institutions.

Because of the nature of their membership, sponsoring corporations and mandates, the research and development programs of the co-operative research institutions are directed at solving member problems. Research and development only indirectly assists equipment manufacturers in designing and developing innovative equipment.

Task Force members noted that even when equipment manufacturers are asked to contribute specific equipment to assist research, the research is oriented to product and process development, not new equipment development. The equipment manufacturers complain that research institutions are not aware of their needs, and do not consider them in developing short- and long-range research programs. In turn, the research institutions say they have major problems interesting Canadian equipment manufacturers in developing and commercially exploiting research and development innovations.

There are various examples where close co-operation between research institutions and equipment firms has helped commercialize a product and where closer links would have been beneficial.

As reported by Roger Hayter in the background study for the Science Council of Canada "Technology and the Canadian Forest-Product Industries", PAPRICAN developed their Papriformer, a twin-wire former for paper machines, from research conducted in the 1950's. By 1959 PAPRICAN had built a crude prototype with the assistance of Dominion Engineering Works of Montreal. The first commercial unit was installed (with federal government support for first-user risk guarantees) at Bromptonville by Kruger Pulp and Paper. Subsequently, at least 13 other units

were installed, including 6 in Canada. Unfortunately new, improved models were not developed, and with the purchase of Dominion by Valmet of Finland, subsequent sales were of Valmet's own twin-wire former.

Another success story was the commercialization of Papritection, a system to provide corrosion protection especially in chlorination and chlorine dioxide stage washers. However, other PAPRICAN inventions such as a) the Papridryer, b) chip debarking, c) a method of producing lime in a rotary kiln, have not been commercially developed. Numerous other inventions have not been commercially developed for a variety of reasons, but frequently it could be that PAPRICAN cannot interest an equipment manufacturer to participate in the prototype development leading to commercialization, or perhaps the lack of equipment manufacturer participation in planning of PAPRICAN's R&D overall program results in inventions which may not have sufficiently perceived advantage to interest the equipment manufacturer to participate in prototype development.

Since the programs of the co-operative research institutions meet the needs of their current membership, their programs do not take into account the needs of the forest industry equipment manufacturers. Collaborative research is very infrequent, and is usually process- oriented. In a few isolated instances there is a duplication of research as the research institutions are trying to develop similar control systems as the equipment industry. Some equipment manufac- turers are forced to either contract out research and development work to research organizations outside the country, or develop their own R&D facilities and expertise, duplicating that available within the institutions.

Membership in these institutions and on their boards of directors will help eliminate many of these problems, and assist in establishing priorities for R&D activities and programs that

will meet the joint needs of the institutions, equipment manufacturers, and the users. Collaborative research can be planned and scheduled, and private in-house R&D objectives will be influenced as researchers become more knowledgeable about Canadian equipment manufacturers and their technological capabilities. A greater exchange of information on the interests and needs of the forest industry and the potential of Canadian equipment manufacturers to meet these needs will be possible.

The Task Force recommends:

Recommendation No. 3

> **That the cooperative research institutions (FERIC, FORINTEK, PAPRICAN) create a stronger link with the machinery and equipment manufacturers through full memberships and representation on boards of directors and research program committees.**

5.4 Information Dissemination

Although several of the research organizations hold regular seminars to inform the industry of their research programs and the results of on-going research, it was the Task Force's general opinion that many senior officials as well as engineers and technicians are not aware of the state-of-the-art throughout the industry.

Equipment manufacturers report that Canadian consultants and the producing companies frequently specify and purchase foreign equipment even though Canadian equivalents are available and competitively priced. Technology is advancing rapidly throughout the industry. However, in many cases, mill personnel are not aware of the latest technology and are dependent on sales people and trade magazines to keep them up-to-date.

General information on the latest patented technology is readily available from provincial research organizations and major Canadian universities, which are part of an information network established by the Canadian Patent Office. Unfortunately these services are not well known.

The Task Force recommends:

Recommendation No. 4

> **That research institutions, universities, and other qualified organizations provide and widely publicize seminars and training programs for the forest industry equipment manufacturers and users.**

5.5 In-House Research and Development

The Science Council of Canada's, A Sectoral Approach to Innovation: The Case of the Forest Product Industries pointed out - in-house research by PAPRICAN member companies is meager and inadequate. One large U.S. firm (Weyerhaeuser) has more R&D professionals on staff than the entire Canadian pulp and paper industry combined.

As previously reported in Section 3.5.5 estimated R&D expenditures by Valmet alone are about 40 percent of the total Canadian pulp and paper industry R&D spending in both public and private sectors.

This inadequacy is not restricted to only the pulp and paper sector. The Task Force industry survey indicated that the R&D conducted by producers in the logging and forestry sector amounted to only 0.1 percent of annual sales, the sawmill and panelboard sector only 0.17 percent of annual sales, and the pulp and paper producers 0.3 percent of annual sales. Several

companies did not report any research expenditures. The equipment manufacturers themselves spent 1.4 to 2.6 percent of annual sales.

This means a much stronger and pro-active in-house research and development effort by Canadian forest industry companies is required to make them competitive on an international level. At present only a handful do research and development; too many rely on others for innovative product research and development, and process ideas. At the very least, Canadian firms should increase their aggregate research and development spending to match the level of their foreign competitors.

A Department of Industry, Science, and Technology working group study on the extent and effectiveness of research and development in the forest industry recommended that the industry members collectively double their R&D commitment over the next 5 years. In order that Canada achieve an international level of competitiveness, this Task Force supports that recommendation, and proposes that all sectors double their annual expenditures on R&D.

Since many companies are conducting little to no research at the present time, primarily depending on the cooperative research institutions, it would not be cost-effective for them to start construction of facilities and hire additional staff to conduct this research. However, they should dedicate at least the equivalent of the current industry average, based upon annual sales volume, to supporting the research, education, and training conducted by these institutions and universities in the area of co-operative research for the forest industry equipment sectors.

The end result of buying existing conventional technology means that Canada will never be ahead of the United States, the Scandinavian nations, and Japan in new, competitive processes and

products. If we do not develop innovative Canadian technology, we will never be able to have a competitive advantage over other countries. We need to develop Canadian innovative technology specific to the needs of Canadian industry. While our varied climate and types of forests are similar to those in other countries, the combinations produce conditions unique to Canada, requiring unique equipment designed to function under those conditions.

Canadian companies have tended to slash their R&D budgets when the economy turns downward. We must have a greater commitment to research by ensuring the long-term continuity in spite of financial adversity.

The Task Force recommends:

Recommendation No. 5

> **That senior management of forest industry equipment manufacturers and users give high priority to R&D and innovation within their companies by doubling their current levels of R&D expenditures. Those currently conducting little to no research should dedicate at least the equivalent of the current industry average. Emphasis should also be placed on long-term continuity of R&D.**

5.6 Access to R&D Facilities

Last year's Science Council of Canada statement on innovation in the forest products industries "A Sectorial Approach to Innovation: The Case of the Forest Products Industries" was very blunt in its assessment of the current R&D system in the Canadian industry.

- The tendency is for basic research to be performed by university researchers, applied research by the cooperative

laboratories, process development by the equipment suppliers, product development by the industries themselves, and technology transfer by equipment suppliers, consultants, and forest product firms.

- The different organizations should complement each other. In-house R&D and internal technology capability, especially in large firms, is a key ingredient in the R&D system. This key component should be complemented by cooperative and university laboratories, whose long-term basic and applied research should provide a basis for their own developmental activities. These laboratories should also supply scientists and engineers to private firms. In practice the current R&D system leaves much to be desired.

Equipment manufacturers do not have easy access to the facilities or staff of either co-operative research institutions or universities. In many cases it would be more economical for private companies to contract to use the facilities and staff of these organizations rather than spending the funds to construct in-house research capabilities. Private researchers, working in collaboration with knowledgeable specialists in universities or research institutions, could result in reinforcing synergistic relationships.

In Montreal the National Research Council has created one of the world's largest dedicated biotechnical research institutes, the Biotechnology Research Institute (BRI), which concentrates on biochemical and genetic engineering, molecular immunology, cell fusion, and sectorial research such as food and waste treatment. Private companies interested in conducting research in related areas can enter into a shared-cost agreement with BRI to use BRI's offices, supporting staff, and access to the facilities. The company can either supply its own research staff, or use BRI staff as necessary to conduct private research using the resources of the public research institution.

The facilities and labs at BRI are designed for this kind of co-operative effort. NRC hopes that expertise from these outside laboratories (and companies) will complement and strengthen its own internal programs and that, in turn, technology developed at the Institute can be transferred outside to industry.

PAPRICAN has three co-operative programs with industry

1. The Allied Industry Research Sponsorship (AIRS) program provides for collaboration between the Institute and allied industry companies to develop innovations for the Canadian pulp and paper industry. The program of work is developed and carried out jointly by the Institute and the sponsor, with the Institute retaining full control of its management. Any patent rights arising from the work will vest in the Institute and be subject to the rights of its maintaining members. The sponsor will be given preferential consideration in any commercial exploitation and recognition in the Institute's publications.
2. Their Grant-in-Aid (GIA) program allows a non-member company to support an Institute project of special interest to the grantor. A GIA must support a project in the current research program. The Institute will retain all rights to any patentable developments, made by Institute personnel, that result from the project undertaking.
3. The Allied Industry Sponsored Institute Fellowships are to develop closer and continuing collaboration in innovation between the Institute and companies supplying the Canadian pulp and paper industry. It is intended that such fellowships be continuing, subject to three years notice of termination by either party. The program of work would tend to be fundamental in nature in a field of interest to the sponsor, and be developed by the Institute in close consultation with the sponsor. Upon completion of the project, or a phase of a project, a report is available both

to the sponsor and to maintaining members. The results of the work would be used by the sponsor and by members of the Institute, both in their own way as appropriate. If patentable developments arise from the work, all rights would vest in the Institute, with the sponsor involved in commercialization on a mutually acceptable but preferential basis. Funding must be sufficient to finance a senior scientist together with supporting staff and would be $100,000 per year, subject to two years notice of change by the Institute to reflect the effect of inflation.

Given all of these restrictions, these PAPRICAN programs have not been greatly utilized by equipment manufacturers, especially small ones.

FERIC conducts considerable research into equipment development in conjunction with its wood harvesting and silviculture program. Current programs involve reduction of whole body vibration for forest machines, review of wide tire experience for logging operations, high speed delimbing, ideal prime mover for powered disc trenchers, processing equipment for woodlots. In some of these projects industry participation is encouraged, but as previously noted, for the majority of projects, such participation is lacking. However, as with PAPRICAN, industry support is solicited for projects originating within FERIC's overall program, not necessarily in support of a request from a specific company, and occasionally in competition with development work being conducted by an equipment manufacturer.

The Task Force recommends:

Recommendation No. 6

> **That research institutions, universities, and industry develop collaborative programs on a shared-cost basis to allow companies to assign their research staff to work on company projects in other institutions.**

Task Force members reported that in some instances research projects within an institution had been hampered because expensive equipment or expertise was not available in that institution. Even though it was available in another on a nominal, cost-shared basis, arrangements could not be made because no budget mechanism existed to permit funds to be transferred so that the research could be conducted on a shared-cost or contract-out basis with another institution.

In some cases innovative technology in an unrelated industry may be applied to the forestry industry. For instance, medical ultrasound technology might be used in determining saw log, or even pulp log, internal rot. The inability to detect internal defects for log optimization purposes has prevented the application of geometrical scanners, where biological defects such as rot and knots are important considerations. Using the resources of a medical research laboratory would permit experiments to be done more economically than requiring the purchase of equipment and technical operating expertise by a forest industry research facility.

However, several research institutions, such as NRC, do not provide programs or resources to assist inter-industry technology transfer that already exists in another industry. This presents barriers to companies willing to adapt innovative technology to meet an apparent need in the forest industry.

The Task Force recommends:

Recommendation No. 7

> **That universities and co-operative research institutions adopt collaborative programs with the forest industry to permit inter-industry technology transfer of innovative technology developed by research in another unrelated industry.**

5.7 Composite Wood Technology

Some of the most dramatic innovation and technological changes in the forest industry are taking place in the composite wood field in which Canada's capability to supply equipment is limited. Plywood must now compete with waferboard and more recently with oriented-strand board. It is predicted that as our ready access to original-growth forests decreases, Canada will have to develop processes that use second-growth trees, and also less desirable but more rapidly growing species such as aspen.

The innovation and technological change in composite woods focuses on expanding the uses for certain species, improving product yield from existing wood supplies, and creating or engineering wood-based beams and planks that are larger than most existing timbers.

Additional experiments are being conducted with extruding mixtures of wood fibres and glue in complex shapes suitable for using as structural members e.g. T-beams, columns, arches. These, purportedly, will have equal or better strength characteristics than traditional steel or laminated structures as well as being resistant to corrosion and other moisture effects.

To plan and coordinate a national strategy for R&D and implementation of composite wood technology from both an equipment manufacture and end-product viewpoint, it would be more effective to establish a task force or coordinating committee so that duplication of effort will be minimized.

The Task Force recommends:

Recommendation No. 8

> **That a task force of research and industry experts on composite wood products be established to identify the challenges and potential posed by the development of an increasing range of composite wood products, and to develop a strategy to place Canada at the leading edge of these developments.**

5.8 Pilot Plant Facilities

Several respondents to the industry survey conducted by the Task Force commented on the lack of R&D facilities to assist in the development of innovative technology. The facilities and programs of the existing co-operative research institutions do not lend themselves to trials of experimental equipment, nor even of commercial size prototypes. In some cases the equipment manufacturers had to contract for time and facilities with foreign research pilot plants.

One reason for the dramatic inroads made by the Scandinavian countries into equipment manufacture has been government encouragement of industrial research by public research organizations, which has benefited equipment manufacturers and equipment users. In the case of government-owned Valmet, all of this is done in-house with direct government support.

As a result, within the one conglomerate organization, innovative equipment can be conceived, designed, constructed, and tested under commercial working conditions. This is a very effective marketing tool, especially in Canada where most companies want to know where the machine is currently working successfully, and are unwilling to be the first user.

Constructing commercial scale research pilot plant facilities is very expensive. Unless the plant is adjacent to a mill, raw materials and disposal of effluents are very expensive and complicated e.g. how do you feed a commercial-size refiner for a long test run, and dispose of the considerable quantity of pulp produced? Instrumentation and testing facilities can be significant costs, especially if they are not required on an on-going basis.

From the list of pulp and paper R&D facilities available internationally (Appendix 3), it is obvious that if Canadian equipment manufacturers are going to compete equitably not only within Canada, but also on the international market, pilot plant facilities will have to be made available.

Canadian industry and the research institutions have the expertise to develop competitive innovative technology, but not the necessary tools to bring this technology to commercialization. They need the intermediate step between bench models and full-size mill trials. This can only be done economically using jointly funded pilot plant facilities.

The Task Force recommends:

Recommendation No. 9

That pilot plant facilities be constructed within three years on a capital cost-shared basis by the federal government, provincial government(s), and the forest industry to provide state-of-the-art R&D facilities for pulping, bleaching, and paper making - guided by the following principles:

a) The facility be designed to allow the flexible interchange of equipment to be developed and tested, and for trial production of new equipment and products.

b) In association with a network of universities and technical colleges, the pilot plant operate as a world-class training centre for researchers, engineers, and technicians in the area of equipment design and manufacture, and product and process development.

c) The facility be strategically located to be accessible to existing pulp and paper mills, resources, personnel, and universities in order to operate at optimal costs, and to attract students, faculty, researchers, etc., from all areas of Canada and internationally.

d) Administration of the facility would be on a non-profit basis with space and equipment available to the forest industry equipment manufacturers and producers at cost, and with the objective of its operational costs being self-supporting.

e) The facilities and programs not compete with, but rather complement those of other research facilities.

5.9 Logging and Forestry Testing Facilities

The recent announcement of an agreement by the federal and B.C. governments and the industry to fund the building of a new forest research centre for FERIC and FORINTEK at the University of British Columbia near the new PAPRICAN laboratory is an example of the active, co-operative relationship needed to generate new research and development and technological solutions for the industry's challenges.

However, in addition to such laboratories, the capability to test prototypes of new equipment, or even modifications and attachments to existing logging and forestry equipment on-site is needed. Due to the wide variety of terrain and environment encountered within North America, facilities are required to test equipment under actual operating conditions on-site. Sophisticated instrumentation and computer analyses are required as well as scientists and technicians to operate them. Being mobile would enable the equipment to be used on-site across Canada.

As can be readily understood, no private company could afford to establish and staff such a mobile testing facility, let alone keep it employed continually. For that reason it should be affiliated with an existing research establishment, like the National Research Council, having knowledge and experience in the latest instrumentation and accompanying computer analysis. Private companies would be able to contract or lease the mobile laboratory and its accompanying personnel.

Although various locations in Canada experience significant winters for varying durations, no facility exists in which full-scale equipment can be tested under working load under severe winter conditions for prolonged periods year-round. Such a cold weather testing facility would provide the necessary

environment for testing not only forest industry equipment, but could be used for testing a variety of other equipment, from vehicles to remote-controlled communications devices. National Research Council has a fairly large cold room, but it does not have a dynamometer nor sufficient refrigeration capacity enabling the equipment to be run under working loads. Likewise, Transport Canada's testing facilities are not totally satisfactory. Either facility could be modified to overcome these limitations.

The Task Force recommends;

Recommendation No. 10

> **That a mobile technical centre, and a large cold-room suitable for testing commercial-size equipment be constructed on a cost-shared basis by the federal government, provincial government(s), and the forest industry to provide state-of-the-art R&D facilities for the design and development of logging and forestry equipment.**

5.10 First User Risk-Sharing Financial Assistance

In other nations forest industry companies are far more willing or financially able to take a risk on new equipment, or find ways to offset the risks. Often suppliers structure payments so none are made until the technology or machinery performs to certain, guaranteed specifications and in many cases a bonus is paid if equipment exceeds specifications.

A recent example of the ad-hoc funding situation in Canada points to the need for a new risk-sharing program. A Canadian company, Hymac Ltd. has boosted its domestic profile and is also attempting to become more of an international player in high-yield pulping equipment. One of Hymac's keys to success has

been a commitment to industrial research and development. An example of this commitment is a high- consistency jumbo refiner that can handle motors of up to 32,000 horsepower. The HXD-64 refiner is said to be the largest pulp refiner in the world, and one of the biggest research projects in the Canadian pulp and paper industry.

The HXD-64 will be installed at Cascade's Port Cartier mill in an unusual trial. Cascade will pay roughly half the cost and the federal government will pay the rest. If the technology is successful, Cascade will repay the full costs. This financing package was put together in order to share the risks and capital costs of installing and testing this equipment, which could not otherwise be solely supported by any one of the three interested parties.

In the Province of Quebec the provincial government has several financial assistance programs administered by the Société de developpement industriel du Québec. One of these programs provides businesses with financial assistance to promote research and development activities and innovation activities in Quebec. A more detailed description is in Appendix 4. Basically this program shares in the front-end costs of R&D on the condition that this investment is repaid if successful.

Under existing federal and provincial programs there are no provisions to assist in the costs of the construction of new facilities to test innovative developments. If a new development requires facilities that do not exist elsewhere, and which cannot be created through existing facilities, companies often have to undertake major capital costs on the construction of new in-house operations to develop the new concept. The brick and mortar costs of such a construction should be shared for the resulting benefits to industry to be ensured.

With the industry doubling its spending on R&D by contributing an additional $105 million per year to research and development, it is proposed that the federal government contribute 25 percent of this amount to establish a first-user, risk-sharing program amounting to $130 million over a five year period. To get the program established, the program will have to be significantly front-end loaded. Subsequent annual contributions would be much less as reimbursement from commercially successful projects would start being received, maintaining the fund at a healthy operating level.

The Task Force recommends:

Recommendation No. 11

That a government-funded program be established to share the risks (other than normal business risks) of development, commercialization, and first installation of innovative technology and equipment - under the following principles:

a) **Government assistance would normally be 50 percent of the cost for R&D, capital, commercialization, and commissioning. Repayment would be based upon successful commercial development.**

b) **Non-repayable financial assistance may be granted to support capital expenditures including major expansions or construction of R&D facilities and infrastructures when other institutional or industrial test facilities do not exist.**

c) **Companies benefitting from this program should be require to make the first installation in Canada, and to guarantee a world product mandate in Canada for successful developments.**

d) **Joint proposals by equipment manufacturers and users would be preferred and encouraged.**

e) Regional or tier considerations should not be a factor, since they impede R&D of national benefit.

5.11 Other Recommendations

Several members of the Task Force report have encountered difficulties with Revenue Canada-Taxation in claiming tax deductions for research and development. On several occasions companies have received government financial R&D assistance to develop innovative equipment, but Taxation has deemed such development as ineligible for R&D tax credits. Similarly, if more than one company is involved in a joint-venture, both may not be eligible for tax credits for their individual involvement. This also can be a problem if they are involved in collaboration with a university or research laboratory.

The costs of obtaining a patent, not only within Canada but internationally in the major industrialized countries, are increasing dramatically. It is conservatively estimated that obtaining patent protection in the major industrialized countries, assuming that no complications arise in the prosecution of the patent application, could cost in excess of $75,000 for each invention. An innovative piece of equipment could require several patents for protection of each aspect that is innovative and patentable.

The Task Force recommends:

Recommendation No. 12

That a) government tax credits or grants be made available to both companies (equipment manufacturers and users) and R&D organizations for cooperative ventures.

b) increased tax credits be available for research undertaken jointly with universities or research institutions.

c) the definition of "research" for tax purposes should be reviewed to ensure that all the R&D activities of equipment manufacturers are eligible.

d) the cost of obtaining international patent protection including the maintenance fees be eligible for tax credit.

Most foreign machinery manufacturers, especially those in Sweden and Finland, operate under a different set of rules than Canadian exporters. Companies that compete domestically often form consortia to sell abroad. Canadian companies attempting to form similar consortia have had limited success.

Members of the Task Force have the perception that other countries are offering highly concessional rates of financing while Canada, through the Export Development Corporation (EDC), continues to follow the levels and gentleman's agreement of the major world economies. EDC says that they are competitive with foreign commercial funding. However, currently other countries are providing direct and indirect concessional financing which Canada is so far unwilling to match.

The Brazilian government is currently underwriting production of Brazilian equipment for export. As an example, a Voith Duoformer produced in Brazil for a Canadian mill was partially financed through Brazilian government export credits. It has been reported that by purchasing the machine offshore, the mill was able to finance 50 percent of the $44 million project cost at 8 percent interest rates, repayable in 16 semi-annual payments starting one year after delivery. This financing reduced the cost of borrowing by $7.5 million. Another Voith machine is being similarly financed at 6.5 percent interest rates, also repayable over eight years.

The Task Force recommends:

Recommendation No. 13

> **That the Canadian government strongly urge all concessional financing world-wide be eliminated. In the interim, Canadian export financing be competitive with those of other foreign countries.**

It is often difficult for the Canadian equipment industry to obtain import statistics in sufficient detail to be able to identify what products and parts, especially new innovations or improvements, are being imported. Industry production, and import/export data reported by Statistics Canada are confusing, if not misleading. As an example, they report data for wood working machinery together with data on sawmilling.

The Task Force Recommends:

Recommendation No. 14

> **That Statistics Canada be requested to report separate statistics for wood working machinery and sawmill machinery.**

5.12 Forest Sector Advisory Council

Increased research and development effort, elimination of duplication, collaboration and communications will not happen spontaneously, and will need guidance and direction. The direction does not necessarily have to come only from the federal government, but should come from within industry. When various industries are involved, it becomes obvious that a co-ordinating committee should be established, with representatives of all forest industry sectors.

The Forest Sector Advisory Council (FSAC) is an advisory body to the Minister of Industry, Science and Technology, and the Minister of State for Forestry and Mines. Members of the council are senior forest industry management, labour officials, and senior forestry science academics. Since FSAC has direct access to the decision-making levels of government, it would be the logical body to make effective recommendations having a direct effect on the forest equipment sectors.

However, at present, the membership of FSAC does not include any representatives of the equipment manufacturers, and so there is no one to directly bring their concerns to the Council or to the government. As noted previously, there is little collaboration between equipment manufacturers, users of this equipment, and the cooperative research institutes and universities conducting forest industry research.

It is proposed that a subcommittee of FSAC, including representatives of the equipment manufacturers, be formed to consult regularly with officials of the research institutes and universities. This subcommittee will assist the parties in establishing their annual and long-range priorities for forest industry-related research on a national basis to be conducted by the institutes, universities, and also by individual companies' research departments. The subcommittee would also establish similar priorities to guide ISTC in their review of applications for funding innovative technology development.

In order that the Ministers can verify whether these recommendations are being effectively implemented and maintained, this subcommittee should regularly appraise the status and report annually to the Ministers, recommending areas for further action.

The Task Force recommends:

Recommendation No. 15

That the Forest Sector Advisory Council (FSAC) be enlarged to include membership of representatives of the forest industry equipment manufacturers, and that a special subcommittee of FSAC, including these manufacturers, be established to:

a) make recommendations to the Government on priorities for areas for technology enhancement in the forest industry, on the policies and programs to expand R&D activities, and on the issues and opportunities for the expansion of forest industry equipment manufacturing in Canada.

b) review and report annually to the Ministers on the progress of the various participants e.g. equipment manufacturers, equipment users, co-operative

research institutes, universities and technical colleges, in implementing these Recommendations.

c) promote formal and informal networking between manufacturers, users, and cooperative research organizations.

d) encourage the development of educational and promotional campaigns in support of technology in the forest industry.

Appendix 1

ORGANIZATIONS AND COMPANIES MAKING REPRESENTATIONS

Machine Directorate, Surface Transportation and Machinery Branch
Department of Industry, Science, and Technology
- Status Report on Forest Industry Equipment Sectors
- Duty Remission Program

Forintek Canada Corp. (FORINTEK) - outline of current policies, programs, funding for this cooperative research institute.

Forest Engineering Research Institute of Canada (FERIC) - outline of current policies, programs, funding for cooperative research institute.

Pulp and Paper Research Institute of Canada (PAPRICAN) - outline of current policies, programs, funding for co-operative research institute.

Black Clawson-Kennedy Ltd. - review of experience of BCK in international marketing, sales, engineering, and production; recommendations of areas for consideration by Task Force.

Reports Commissioned by the FIM Task Force

John Madden, STC Enterprises:

a) Conduct a study to determine the state of the forest equipment manufacturing industry in Canada, with the emphasis on the industry within British Columbia.
b) Interview senior representatives of the industry to determine their short-term and long-term objectives which will affect the industry.
c) Recommend actions to encourage a healthier, long-term domestic equipment and software supply industry in

British Columbia in particular, and in Canada generally.

Forest Engineering Research Institute of Canada:

a) Review of the state-of-the-art technology currently used on Canadian forestry operations by major forest regions (western Canada, central and eastern provinces, Atlantic provinces) compared with major forest regions of the world.
b) In light of changes and trends (within and outside Canada), review and discuss future needs for forestry machines, equipment, and components.
c) Recommend future work, if deemed necessary.

Forintek Canada Corp.:

a) Review the state-of-the-art technology currently used in the Canadian sawmilling industry according to major areas of softwood lumber production, covering the technology used from log preparation to green lumber production in sawmills.
b) Compare the Canadian state of technology used in major softwood lumber producing countries of the world, concentrating on the Scandinavian countries.
c) State expected or forecast trends and changes in the sawmilling production technology in Canada and abroad, identify the future needs for technology and comment on the potential market effect for machinery needs.
d) Recommend future actions that could reinforce the machinery sector and better integrate the new technology development through machinery to improve the competitiveness of the sawmilling sector.

Edmund R. Mooney:

a) Extract pertinent data from the FIM industry survey of forest operation equipment manufacturers and their

clients, compile and analyse this data to identify items of commonality, industry sector trends.

b) Personally contact recipients of the survey to request completion of unreturned questionnaires, clarify responses.

Woodbridge, Reed and Associates:

a) Analyse trends in equipment-supply and associated services provided globally to the pulp and paper industry.

b) Quantitatively assess:

i. 1988 world total capital expenditure estimates, showing major regions;

ii. North American capital expenditures, by regions;

iii. U.S. capital expenditures, by major regions and major expenditure type;

iv. Canadian capital expenditures, by major regions and major expenditure type; and

v. Past capital expenditure patterns and trend projections for the next 12 years to the year 2000.

c) Discuss the opportunities and threats facing the Canadian sector.

d) Discuss policy considerations.

Appendix 2

FOREST INDUSTRY MACHINERY TASK FORCE

INDUSTRY SURVEY ANALYSIS

In order to solicit current statistics and opinions on the state of the forest industry equipment production and use within Canada and exported, a survey was sent out to a representative cross-section of both equipment manufacturers and users of this equipment in the various sectors of the industry e.g. logging and forestry (including silvi- culture), sawmills and panelboard, and pulp and paper. Ancilliary operations such as windows, doors, or cabinets were not surveyed specifically.

Sector	No. Mailed	No. Returned	Percent Returned
Manufacturers:			
Forest Operations	47	21	78
Sawmill and Panels	47	16	34
Pulp and Paper	103	29	28
Users:			
Forest Operations	47	24	51
Sawmill and Panels	136	47	35
Pulp and Paper	56	24	43

Summary of Findings and Comments

Although each sector has its own concerns, comments, and suggestions, the following comments were common to all sectors.

1. There is no correlation between the size of the company (sales volume) and the replies to the questionnaires.

2. All companies agree with a first-user risk reduction program. While the majority of equipment manufacturers do not think such a program should be extended beyond the cost of equipment replace- ment, the majority of users think the program should be extended to include loss of production etc.
3. Apart from the forest operation machinery users, a large majority feel a special program should be initiated to assist manufacturers and users to develop new equipment. Several thought that such a program could be combined with increased financial assistance to existing co-operative R&D institutes such as FERIC, FORINTEK.
4. Everyone agreed that there should be greater co-operation between R&D institutes, manufacturers, and users, with government providing the catalyst through assistance programs.
5. Canadian manufacturers in all sectors would like to be full and equal members of the R&D institutes so that the research programs can include their interests, instead of being currently process-oriented.
6. Foreign equipment manufacturers and suppliers were frequently preferred to Canadian manufacturers since respondents were of the opinion that foreigners used state-of-the-art technology, while Canadian manufacturers were only followers using existing, proven technology.
7. Foreign-owned companies did very little research within Canada, depending on the research conducted by the parent corporation.
8. The overall level of research ranged from low to nil for the majority of forestry operation equipment users, except for a unique 40 percent of sales for one company that was involved in artificial intelligence systems.

LOGGING AND FORESTRY MACHINERY MANUFACTURERS

Number Surveyed: 27
Number Responding: 21 (78 percent)
Total Annual Sales of Respondents: $365 million

R&D expenditures: While only 19 companies reported on the extent of R&D conducted, the overall amount reported was 2.6 percent of annual sales, ranging from nil to 17 percent.

Percentage of Total Machinery Production Costs Consisting of Imported Parts or Components: This varies from a minimum of 3 percent to a maximum of 60 percent. However, companies manufacturing mobile equip- ment, such as skidders and forwarders, import most of the carrier equipment e.g. power plant, drive trains, and tires, and then add on the Canadian-made components. Other companies manufacturing attachments have a much lower percentage of imported parts.

Foreign Machinery Preferred: Pricing (price, terms, package deals) and the use of high-tech technology by foreign companies were the reasons why most customers were buying foreign equipment instead of domestic.

Conditions to Induce Customers to be First-User of New Technology:
Everyone wanted a first-user risk reduction program. However, only half of them indicated that this should extend beyond the cost of equipment replacement to loss of production etc.

Factors Leading to Development of Most Successful Products: There were a variety of responses indicating identification of customer needs, timing, competitive pricing, availability of experienced and innovative personnel, good delivery time.

Increase the Probability of Successful Innovation: Ninety percent wanted the creation of a special program to help users or manufacturers to develop new equipment.

LOGGING AND FORESTRY MACHINERY USERS

Number Surveyed: 47
Number Responding: 24 (51 percent)

Total Annual Production of Respondents: This was 39.9 million cubic metres. While there was no indication of a dollar value, a rough approximation can be made by valuing a cubic metre at $52, which is derived from reported statistics of the quantity and value of Canada's exports of logs. The total annual value would be $2.07 billion.

R&D expenditures: While only 16 companies reported on the extent of R&D conducted, only 5 reported conducting any R&D at all, with 3 reporting $100,000 each, and the other two $30,000 and $40,000 for their annual R&D expenditure. For these 5 companies, this produced a minimal 0.024 percent of annual sales. In many cases, companies reported that their research was conducted by FERIC, and that they did not carry out any additional research.

Percentage of Total Machinery Production Costs Consisting of Imported Parts or Components: This varies from a minimum of 3 percent to a maximum of 60 percent. However, companies manufacturing mobile equip- ment such as skidders and forwarders import most of the carrier equip- ment e.g. power plant, drive trains, and tires, and then add on the Canadian-made components. Other companies manufacturing primarily attachments have a much lower percentage of imported parts.

Foreign Machinery Preferred: Pricing (price, terms, package deals) and the use of high-tech technology by foreign companies were the reasons why most customers were buying foreign equipment instead of domestic.

Conditions to Induce Customers to be First-User of New Technology:
Everyone wanted a first-user risk reduction program. The large majority (83 percent) felt that risk sharing would have to extend beyond only the cost of equipment replacement.

Consideration of Integration with Equipment Manufacturer: Nearly three-quarters of the respondents felt that they had no in-house technical expertise that would enable them to integrate with a manufacturer. Most of the others thought that it would be too expensive, or that they were not in the equipment manufacturing business.

Opportunities for Equipment Development: The following are examples of areas proposed by the users in which innovative equipment was needed:

a) multiple function processors (feller/delimber/bucker);
b) small tree harvesting equipment;
c) multiple stem delimber;
d) harvesting equipment for mixed wood stands;
e) universal carrier for off-road with soft gravel capabilities for fellers, delimbers, and forwarders;
f) wheeled carriers for feller bunchers/delimbers;
g) mechanical equipment for tree planting and thinning;
h) b-train hauling equipment for chip transportation;
i) steep slope harvesting equipment; and
j) portable barker/chipper to use on tree tops, defects, etc. in the woodlands.

Factors to Increase Probability of Successful Innovation: About half the respondents felt that there should be increased financial assistance to existing cooperative R&D institutes. One-quarter wanted the creation of a new program to assist either users or equipment manufacturers to develop new equipment. Another quarter specified increased R&D by manufacturers, and

about 5 percent thought there should be specialized testing facilities.

SAWMILL AND PANEL MILLS MACHINERY MANUFACTURERS

Number Surveyed: 47
Number Responding: 16 (34 percent)
Total Annual Sales of Respondents: $188 million

R&D expenditures: While 14 companies reported on the extent of R&D conducted, the overall amount reported was 1.4 percent of annual sales, ranging from nil to 3 percent.

Percentage of Total Machinery Production Costs Consisting of Imported Parts or Components: This varies from a minimum of 3 percent to a maximum of 35 percent.

Foreign Machinery Preferred: Overestimated reputation of foreign competitors by Canadian users; high cost for developing new technology; and lack of collaboration with users in developing new technology. Foreign manufacturers have strong R&D support from their governments. Major foreign manufacturers supply complete package deals. Foreign ownership of Canadian mills leads to R&D and equipment purchases being made in parent countries' home base.

Conditions to Induce Customers to be First-User of New Technology: Everyone wanted a first-user risk reduction program. However, only one-third indicated that this should extend beyond the cost of equipment replacement to loss of production etc.

Factors Leading to Development of Most Successful Products: There were a variety of responses ranging from creation of custom designs to meet customer needs, customers willing to share risks, collaboration with customer to develop innovative equipment on-site, and demonstrating similar manufacturing and product capability.

Increase the Probability of Successful Innovation: Sixty-eight percent wanted the creation of a special program to help users or manufacturers to develop new equipment; twenty-five percent wanted increased R&D by manufacturers. Consortium development of innovative technology should be encouraged to enable design and testing in working environment. Equipment manufacturers should be members of co-operative research institutions.

SAWMILL AND PANEL MILL MACHINERY USERS

Number Surveyed: 136
Number Responding: 47 (35 percent)

Total Annual Sales of Respondents: Some respondents reported annual sales in cubic metres. Although some of this might be panels, and there was no indication of species, as a rough approximation of total annual dollar value of export sales, each cubic metre was valued at $132.40, which is derived from the annual value of lumber produced ($4.9 billion for 37 million cubic metres). This would produce a total reported value of annual production at $8.89 billion.

R&D expenditures: While only 27 companies reported on the extent of R&D conducted, the amounts varied from nil to $2 million per year. The average reported was 0.17 percent of sales.

Foreign Machinery Preferred: Foreign manufacturers use state-of-the- art technology, whereas Canadian manufacturers use existing technology as reported by two-thirds of the respondents. Pricing and reputation were next, but at only 10 to 12 percent.

Conditions to Induce Customers to be First-Users of New Technology: Everyone wanted a first-user risk reduction program. Sixty percent felt that risk sharing would have to extend beyond only the cost of equipment replacement, as start-up and implementation costs were frequently more expensive than the cost of equipment.

Consideration for Equipment Development: Half the respondents felt that they had no in-house technical expertise that would enable them to integrate with a manufacturer. Most others thought that it would be too expensive, or that customers would not want to buy from a company owned by a competitor.

Opportunities for Equipment Development: The following are examples of areas proposed by the users in which innovative equipment was needed:

a) log scanning and optimizing equipment;
b) automated grading equipment;
c) saw technology - preparation of saw tips and kerf reduction;
d) computer process controls;
e) improved kiln drying technology;
f) automated value-driven log merchandizing systems;
g) laser sawing;
h) panel processing equipment e.g. forming lines, presses, edge benders, splicing, laminating, wood treatment; and
i) debarking equipment.

To Increase Probability of Successful Innovation: Half the respondents wanted the creation of a special program to help users or manufacturers develop new equipment. Twenty-four percent thought increased financial assistance to existing R&D institutes is required, and another twenty percent thought manufacturers should increase their R&D. Manufacturers and users should work together in equipment development outside the standard research institutions.

PULP AND PAPER MILL MACHINERY MANUFACTURERS

Number Surveyed: 103
Number Responding: 29 (28 percent)
Total Annual Sales of Respondents: $616 Million

R&D expenditures: While only 25 companies reported on the extent of R&D conducted, the overall amount reported was two percent of annual sales, ranging from nil to 40 percent (although the latter is involved in artificial intelligence systems).

Percentage of Total Machinery Production Costs Consisting of Imported Parts or Components: This varies from a minimum of 1 percent to a maximum of 50 percent.

Foreign Machinery Preferred: Respondents ranked their reasons in order: pricing; overestimated reputation of foreign competitors by Canadian users; and high cost for developing new technology. Additional comments were made about the significant financial subsidies by Brazil, failure of Canadian companies to incorporate the latest technology, similar equipment from Finland being sold below Canadian costs, foreign exchange rates leading to low offshore prices, and foreign companies marketing complete turnkey packages.

Conditions to Induce Customers to be First-User of New Technology:
Everyone wanted a first-user risk reduction program. However, only 35 percent indicated that this should extend beyond the cost of equip- ment replacement to loss of production etc. Additional comments pertained to the conservative nature of Canadian pulp and paper companies in that they are extremely reluctant to buy anything that is not already proven elsewhere.

Factors Leading to Development of Most Successful Products: There were a variety of responses including customers willing to share development and trial costs, close proximity to customers, government assistance, project management over all phases, and a customer willing to try something new.

Increase the Probability of Successful Innovation: Fifty-six percent wanted the creation of a special program to help users or manufacturers to develop new equipment; 28 percent wanted increased R&D by manufacturers. Additional comments stated that consortium development of innovative technology should be encouraged to enable design and testing in working environment. Canadian companies do not spend enough time and effort to develop new technology, preferring to gain it by osmosis from foreign companies; hence our branch plant economy.

One respondent detailed some of his on-going problems:

> "All of the companies manufacturing paper machines in Canada are now foreign-owned. Their prices to Canadian companies are based upon their parent company's prices abroad plus freight, duty, and sales markup. This makes it impossible to compete overseas against the competition of the parent companies. Often such companies as Beloit, Dominion-Valmet, and Black Clawson will tell you to inquire directly from their parent company for overseas deliveries."
>
> "PAPRICAN is dedicated to the projects of major sustaining members only. Their pilot plant and their services are not available at any price to small companies like ourselves. For a number of special development projects, we have had to use foreign research institutes like the Herty Foundation Laboratories in Savannah, or the limited facilities of the universities and the Ontario Research Foundation."

Conditions to Induce Customers to be First-User of New Technology:

Everyone wanted a first-user risk reduction program. However only one-third thought that the program should be extended beyond the cost of equipment replacement to loss of production etc.

Factors Leading to Development of Most Successful Products: Sixty-eight percent indicated the creation of a special program to help users or manufacturers to develop new equipment. Others thought that increased R&D by manufacturers and cooperative research institutions would be required.

Additional comments made indicated the need for collaborative programs between manufacturers, users, and research institutions. Government financial assistance is required when Brazil provides six percent project financing. Many foreign companies are closely affiliated with producing companies enabling them to design and test equipment in a real working environment. The greater size of foreign companies enables them to sell and supply a complete package including system responsibility.

PULP AND PAPER MILL MACHINERY USERS

Number Surveyed: 56
Number Responding: 24 (43 percent)

Total Annual Sales of Respondents: $9.9 billion

R&D expenditures: While not all companies reported on the extent of R&D conducted, the amounts varied from $20,000 a year to over $4.5 million a year. The average reported was 0.3 percent of sales. Only one company reported that more than one percent of sales was spent on research and development.

Equipment Suppliers Successful: Reasons quoted ranged from using state-of-the-art technology (58 percent), and service (23 percent) to reputation (12 percent), and pricing (6 percent).

Foreign Machinery Preferred: Foreign manufacturers use state-of-the-art technology, whereas Canadian manufacturers use existing technology as reported by two-thirds of the respondents. Pricing and reputation were next, but at only 18 percent and 12 percent respectively.

Conditions to Induce Customers to be First-User of New Technology:
Everyone wanted a first user risk reduction program. Sixty percent felt that risk sharing would have to extend beyond only the cost of equipment replacement, as start-up and implementation costs were frequently more expensive than the cost of equipment.

Consideration of Integration with Equipment Manufacturer: Half of the respondents felt that they had no in-house technical expertise that would enable them to integrate with a manufacturer. Most of the others thought that it would be too expensive, and that they should specialize in only one field.

Opportunities for Equipment Development: The following are examples of areas proposed by the users in which innovative equipment was needed:

a) on-line process and/or quality serving equipment;
b) environmental control equipment;
c) paper machine - reliability of press section;
e) large sheeter for finishing department;
f) recycling equipment;
g) top wires;
h) cleaning of secondary fibres;
i) non-commodity paper machines;
j) pollution abatement within process; and
k) energy efficient pulp treatments.

To Increase Probability of Successful Innovation: Forty-one percent of the respondents wanted the creation of a special program to help users or manufacturers to develop new equipment. Thirty-one percent thought increased financial assistance to existing R&D institutes is required, and another eighteen percent thought manufacturers should increase their R&D. Manufacturers and users should work together in equipment development outside the standard research institutions. Canadian manufacturers must improve quality of their product to regain lost reputations.

Appendix 3

MAJOR PULP AND PAPER, AND PANELBOARD EQUIPMENT RESEARCH CENTRES

All major R&D centres for the pulp and paper and panelboard process equipment are located outside Canada. Following is a list of the most commonly known establishments.

1) Pulp and Paper Industry

Owners	Location	Specialty
Valmet	Jyvaskyla, Finland	Paper-making machinery
	Karkula, Finland	Paper-making machinery
	Karlstad, Sweden	Tissue paper machinery
	Turku, Finland	Paper-drying machinery
	Jarvenpaa, Finland	Paper-finishing machinery
	Appleton, Wisconsin, U.S.A.	Paper-finishing machinery
Voith	Heidenheim, W. Germany	Stock prep.& paper mach.
Sulzer Escher Wyss	Ravensburg, W. Germany	Stock prep.& paper mach.
Beloit	Bolton, Lancashire, U.K.	Paper-making machinery
	Rockton, Illinois, U.S.A.	Board-making machinery & fibre-recycling mach.
	Dalton, Mass., U.S.A.	Stock prep. machinery
Black Clawson	Watertown, N.Y., U.S.A.	Paper-making machinery
	Middletown, Ohio, U.S.A.	Stock preparation
	Fulton, N.Y., U.S.A.	Paper-finishing machinery
Sandy Hill	Hudson Falls, N.Y., U.S.A.	Paper-making machinery

Kleineweffers	Krefeld, W. Germany	Supercalendering

Kuster	Krefeld, W. Germany	Supercalendering
Jagenberg	Dusseldorf, W. Germany	Paper finishing
Sunds Defibrator	Sundsvall, Sweden	High-yield pulp
Jylhavaara	Jamsamkoski, Finland	High-yield pulp
Sprout Bauer	Springfield, Ohio, U.S.A.	High-yield pulp
Ahlstrom	Karhula, Finland	Chemical pulping
Papro	Rotorua, N.Z.	Mechanical pulping
STFI	Stockholm, Sweden	Paper processing

2) Panelboard Industry

Raute	Lahti, Finland	Panelboard machinery
Siemplekampf	Krefeld, W. Germany	Panelboard machinery
Dieffenbacher	Eppingen, W. Germany	Panelboard machinery
Pallman	Zweibrucken, W. Germany	Fibrillating machinery

In Canada, outside of PAPRICAN in Montreal and Vancouver, the only significant R&D facilities known to us are at Université du Québec in Trois Rivières, and University of Toronto. However, the programs at both of these facilities are aimed at process research and not equipment.

Appendix 4

Société de développement industriel du Québec
Financial Assistance Programs

Note: Similar SDI programs are available for investment, export, and design.

PROGRAM SUMMARY - RESEARCH AND INNOVATION ACTIVITIES

OBJECTIVES

The Société de développement industriel du Québec may grant financial assistance to a business in order to promote in Québec:

- research and development activities, and
- innovation activities.

FORMS AND TERMS OF FINANCIAL ASSISTANCE

a) a loan, usually unsecured, for a period **not exceeding** eight years;

b) at the market interest rate (variable or fixed);

c) a premium is required as compensation for risk involved, normally in the form of an option to purchase shares of the business at their book value at the time of approval of the loan;

d) payment of interest and repayment of the principal may be deferred for a period **not exceeding** three years from the date of the first disbursement (interest is then added to the capital);

e. interest costs may be absorbed for part of the term of the loan, depending on the economic priorities of the Government of Quebec;

f. the loan will be disbursed during the implementation of the research project.

GENERAL ELIGIBILITY REQUIREMENTS

ELIGIBLE BUSINESSES

The business must belong to one of the following categories:

1. a business in the manufacturing sector (including recycling);
2. a data processing services business, or a software or software package design and publishing business;
3. a profit-making business operating a research laboratory;
4. an industrial design business;
5. a fashion design business;
6. a business involved in sales or distribution.

MINIMUM AMOUNT OF PROJECT

The eligible expenditures must be:

a) at least $50,000 for technical projects or at least $35,000 for design projects;

b) less than 50 percent of the amount of the sales made during the applicant's last fiscal year, or less than four times its net assets.

ELIGIBLE EXPENDITURES

- Cost of studies and of consulting services.
- Salaries of professional and technical staff assigned to the project.
- Cost of subcontractors, raw materials, parts and fittings used directly in the development and perfecting of the goods, service or process targeted by the project.
- Cost of purchasing or leasing essential specialized equipment directly related to the project, provided that

the business demonstrates that the equipment it possess cannot be used for that purpose.

- Cost of research and application for patents.
- Cost of acquiring a patent, a know-how or a licence to manufacture, excluding royalties payable on sales or production volume.
- Expenditures required for the manufacture and testing of prototypes.
- Cost of preparing technical documents and of promoting the goods, service or process targeted by the project.

ELIGIBILTY REQUIREMENTS

a) The business must demonstrate that it has the appropriate financial structure, professional and technical staff, management, production and marketing ability to see the project through.

b) The business must also demonstrate to the satisfaction of the S.D.I. that the project is potentially profitable.

c) The business is not bound by any contract respecting eligible expenditures before it applies for financial assistance.

TECHNICAL ASPECT

OBJECTIVE

To provide financial assistance for the implementation of a research and development project of a technical nature.

ELIGIBILITY REQUIREMENTS

- The project is designed to develop or improve innovative products or processes.
- The period for research **must not exceed** three years.
- The ultimate product or process must offer significant competitive advantages.

- There is a target market that is large enough to make the project profitable.

TERMS OF FINANCIAL ASSISTANCE

AMOUNT

- The **maximum** amount of financial assistance is 50 percent of the eligible expenditures. (However, if more than 35 percent has been funded through other government financial assistance programs, the amount in excess of 35 percent will be deducted from the maximum limit.)

- The amount of financial assistance may not exceed $1,000,000 a business, unless the project represents an exceptional technical and economic spin-off for the Quebec industry.

TERMS OF REPAYMENT

The loan will be repaid as follows:

a) by payment of royalties calculated on the basis of sales generated by the project where they can be identified, or of the firm's total sales; and

b) over a period **not exceeding** five years immediately following the period of research and development.

For additional copies or more information, please write or call:

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