Information Report
DPC-X-7

R&D in solid wood products

a review of non-federal government programs and activities

by
V.N.P.Mathur

Environment Canada
Forestry Service

Environnement Canada
Service des forêts

ISSN 705-324X

R & D IN SOLID WOOD PRODUCTS
– A REVIEW OF NON-FEDERAL GOVERNMENT PROGRAMS AND ACTIVITIES

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V.N.P. Mathur

Résumé en français

Department of the Environment
Canadian Forestry Service
Information Report DPC-X-7
Ottawa, 1978

Issued under the authority of the
Minister, Environment Canada

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Canada
1978

Printed in Canada

Additional copies of this publication can be
obtained from:
Environment Canada Distribution Centre
131 Greber Blvd.
Gatineau, Quebec
J8T 3R1

ABSTRACT

The wood products industry has limited capabilities to meet its R & D needs, but the federal Forest Products Laboratories (FPLs) can perform an essential function by solving the industry's medium and long range R & D requirements.

This study recommends that all sectors - industries, universities, federal and provincial government supported laboratories, machinery manufacturers and other suppliers should coordinate their activities and cooperate in increasing their commitments to meet the future R & D needs of the nation in forest resource utilization, energy from wood residues, structural composite wood products, improvements in codes and standards for increasing the legitimate markets for wood products at home and abroad and implementation of new technology from research laboratories into production facilities.

The programs and potentials of the non-federal government research and development (R & D) facilities in Canada were examined by visits to more than two hundred individual operations in solid wood products (excluding pulp, paper and converted paper products).

RÉSUMÉ

L'industrie des produits du bois possède des moyens limités pour satisfaire ses besoins en recherche et développement (R et D), mais les laboratoires fédéraux des produits forestiers (LPF) sont en mesure d'accomplir certaines fonctions essentielles pour solutionner les problèmes de l'industrie en matière de R et D, à moyen et à long termes.

La présente étude recommande que tous les secteurs - l'industrie, les universités, les laboratoires financés par les gouvernements provinciaux, les fabricants de machinerie et les autres fournisseurs - devraient coordonner leurs activités et collaborer en augmentant leurs engagements financiers en vue des futures exigences en matière de R et D au pays quant à l'utilisation des ressources forestières, à l'énergie provenant des résidus du bois, aux produits composites de bois de charpente, à l'amélioration des codes et normes pour augmenter l'essor des marchés légitimes des produits ligneux au pays et à l'étranger, et à la mise en oeuvre de nouvelles techniques provenant des laboratoires de recherche dans les installations de production.

Les programmes et possibilités des installations non fédérales de recherche et développement (R et D) furent examinés grâce à plus de 200 visites effectuées dans des établissements opérationnels du domaine des produits ligneux (exclusion faite des pâtes et papiers et des produits du papier transformé).

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FOREWORD

This study was undertaken to assemble and analyse information on the non-government wood products R & D programs in Canada so that federal government activities in the field could be developed or altered to achieve the best possible national program. During preparation of this report a government decision was announced to move its program of wood products research into the private sector during 1979.

The response of the private sector has been such that the formation of a new institute to conduct wood products research will undoubtedly be accomplished. The private sector activities will therefore be considerably expanded beyond those included in this report. Nonetheless the information and observations in this report are useful and timely.

R.J. Bourchier
Director General
Canadian Forestry Service

INTRODUCTION

This study was undertaken to enquire into the budgets and scope of research and development activities in solid wood products carried out in the non-federal government sector. A Canada wide survey was conducted by the author. The results of the survey are to be used for planning of federal forest products research and development (R & D) initiatives.

For the purpose of this study; definitions of R & D activity, the non-federal government organizations, product areas, etc. are provided in Appendix I.

Such diverse groups of the wood products industry as primary, secondary and tertiary producers of solid wood products, machinery and equipment manufactures and suppliers, universities and provincial government supported research laboratories were contacted personally in this survey. Appendix II presents an outline of a questionnaire used during interviews with the responsible executives in the surveyed organizations. As a secondary objective, response of the non-federal government sector on the effectiveness of research and development work being carried out in the federal government sector, specifically the two Forest Products Laboratories at Ottawa and Vancouver, has been sought in this survey. Future needs for technological developments have also been assessed, which could provide guidelines for planning and coordinating wood products R & D initiatives at the national level.

Statistics Canada report on "Research and Development in Canadian Industry (Aug. 1977)" indicates the research and development spending in wood products to be of the order of $2.8 million in 1977. This estimate is based on the data provided by the reporting companies having formal R & D departments, and is different from the figure reported in this survey which includes companies conducting R & D activity with or without formal R & D departments. The wood products industry in Canada comprises more than 8,000 operations, most of them small and distributed from coast to coast. An important criterion used for selecting companies for interviews in this survey was the size of the company as reflected in the Statistics Canada Catalogues on the wood products industry.

The solid wood products industry is classified for this survey as consisting of:

Primary - sawmills, shingle and shake mills.

Secondary - plywood and veneer mills, door, window and kitchen cabinet manufacturers.

Tertiary - particleboard, waferboard, hardboard and other composite wood products manufacturers; wood preservation, laminated wood products, wood boxes and miscellaneous wood products operations.

More than two hundred individual operations were contacted to cover all sectors

of the industry (except furniture and sporting goods). Furthermore, representatives of the Department of Industry, Trade and Commerce, provincial governments and universities were also consulted.

This report could not have been compiled without the frank and candid discussions with management personnel, and the author conveys his sincere thanks. The conclusions reached and recommendations made are therefore based on opinions expressed by the management personnel during these discussions.

In spite of the short time allotted to this study, the information generated is up to date, and has been integrated to cover all phases of wood products research and development at the national level. Moreover, it provides a comprehensive review which it is hoped will serve to focus and shape future R & D initiatives.

The author has chosen to divide this report in five sections dealing with each segment of the non-federal government sector active in wood products R & D (e.g. wood products industry, universities, provincial government supported laboratories, associations, machinery and equipment manufacturers and other suppliers). Response of this sector on the wood products research activity at the federal level (FPLs) and future needs of technological developments are reported in separate sections. General conclusions are recorded along with the acknowledgements at the end of this report.

WOOD PRODUCTS INDUSTRY

INTRODUCTION

The wood products industry consists of those manufacturers engaged in the processing of Canada's forest resources into a wide variety of wood and other derivative products but excluding pulp, paper and converted paper products. The industry is important to the country's economic growth in terms of its sales, creation of employment, export earnings, and its contribution towards reduction of regional disparity. In 1975, total shipments of wood products amounted to $3.8 billion of which 31 percent or $1.18 billion were exported. It directly employed over 98,000 workers who earned wages and salaries of $1.07 billion in 1975. In 1977, the total Canadian exports of wood products to all countries increased to $2.815 billion. While the manufacturing facilities are located virtually in all parts of Canada, the wood products industry is concentrated in British Columbia, Ontario and Quebec. The wood products industries in the Atlantic Provinces and Prairie Provinces are also major factors in their economic growth.

Statistics Canada reports that the intramural R & D expenditures in the wood products industry were approximately $2.4 million in 1975 and

$2.8 million in 1977. Thus the Canadian wood products R & D activity did not keep pace with the total value of exports. The need for R & D in the wood products industry could be compared more with a leak in the roof that seldom gets serious attention - when it is raining one cannot repair it, and when it is sunny, who needs to think of repairs. Very few companies have formal R & D departments. However, most of the industrial R & D work is carried out under the operating budget and does not show in the above statistics.

This low level of research effort in the wood products area could be attributed to many factors: (1) Canadian industry is less oriented to new technology than its American counterpart. (2) Government policies and plans for assistance for industrial research have been on a piecemeal basis rather than a constant long term sustained effort. (3) Industry itself can be blamed for lack of initiative and drive to increase its portion of the world market. (4) Technological improvements in existing wood products industries are generally left for industries in other countries to try out before being aggressively introduced in Canadian operations. (5) Lack of investment capital has prevented the modernization of the industry with the latest available technology. (6) International factors such as the oil costs, economic recession, and the branch office syndrome have also created their problems.

It has been shown that the development of new technology and the implementation of developed but hitherto unused technology is essential for the economic growth of Canadian industries. Economic incentives such as new tax provisions with 150 percent write-off for industrial R & D is a step in the right direction for launching new R & D initiatives.

A few large integrated companies like MacMillan Bloedel, Domtar, Abitibi and Price have their own R & D departments. Such small progressive companies as John Lewis Industries Ltd. and Lockwood Industries have also established R & D departments.

The current Canadian industrial research strategy in the wood products area is to make incremental process and product modification with a short term goal. Generally intermediate term (up to 5 yrs.) and long term strategies are rather obscure and not clearly defined. This role has generally been left to the Federal laboratories. Industry feels that it is paying high taxes which should be used by the Governments to ensure its economic viability. Consequently, it expects the federal government to provide major R & D initiatives for intermediate and long terms.

The wood products industry consists of small and fragmented companies and it does not see itself funding long term research like the pulp and paper industry. The latter consists of large companies, but few in number, who have successfully established such institutes as the Pulp and Paper Research Institute of Canada and the Forest Engineering Research Institute with government support. In contrast the wood products industry in general, does not seem to be organized to solve its long term R & D needs and expects the federal and provincial governments to provide R & D leadership.

FUNDING OF R & D ACTIVITY

Less than ten percent of all the industrial R & D budget comes from government grants. On the other hand about the same percentage of funds are provided by the industry through associations to various provincial laboratories and sometimes to federal laboratories or universities to conduct specific mission-oriented R & D with limited scope.

For the purpose of this survey the industry representatives have provided the information on their funding of research activities with the understanding that it would not be disclosed on an individual company basis. The author has therefore presented the following information on a collective basis for different groups of R & D activities.

In western Canada, (west of Manitoba/Ontario border) the R & D activity by private industry is of the order of $3,500,000 and in eastern Canada, it is of the order of $1,500,000 for a total of roughly $5 million. Large integrated companies in Canada spend approximately $3.8 million in R & D activities while the small companies account for the remaining $1.2 million.

The research and development activity of primary industry including lumber and shingle and shake mills is of the order of $300,000 each in western and eastern Canada. The secondary industry consisting of plywood, veneer, door/window, kitchen cabinet manufacturers, etc. spends an estimated $700,000 in western Canada and $350,000 in eastern Canada. The tertiary industry including wood preservation, particleboard, waferboard, and other composite wood products operations accounts for a major share of $3.35 million with $2.5 million in western Canada, and approximately $0.85 million in eastern Canada.

SCOPE OF R & D ACTIVITY

Primary Industry - Sawmills, Shingle and Shake Mills

Sawmill Technology: Application of computer technology in the sawmills in both eastern and western Canada is making gradual inroads. Use of scanners for measuring input of logs in the sawmills and monitoring the production has increased in the past several years. Thus the R & D activity in the mills has been in terms of developing computer systems to suit the needs of individual operations. Use of computers in conducting lumber recovery studies and in planning of modifications in sawmill machinery and equipment in western Canada is progressively increasing. The sawmill simulator computer program developed by the Western Forest Products Laboratory has been utilized by the industry. Similar studies of the Eastern Forest Products Laboratory are attracting interest of the industry in conducting its own development studies for improving recovery from sawmills.

Some of the sawmills in western Canada have conducted research and development work in the accuracy of sawing by the use of improved sawguide

systems and reduction in mismatch from double arbor saws.

Energy Generation: Use of hog fuel for generating energy and its applications in sawmill operations have also received considerable attention. Development and/or installation of hog fuel burners for predrying wood residues or to provide direct heat for seasoning lumber/veneer are on the up-swing. A large corporation has conducted fundamental research and has successfully developed a relationship between several variables such as moisture content, particle size, density of the furnish, furnace temperature and the time for complete combustion for generating energy efficiently.

Lumber Seasoning: Development of kiln drying schedules for different species, kiln designs and predetermined moisture contents of end products is an important R & D effort in the sawmill industry. For this type of R & D, the industry has depended upon the cooperation of the equipment suppliers and the two federal laboratories. The latter's contributions and active participation have been acknowledged by the industry in this survey. The economics and use of dehumidifiers in seasoning hardwood species have been investigated by some companies.

Control of Stain and Decay: Use of anti-sap stain chemicals in effectively preventing bio-degradation of lumber for export markets has been evaluated by the industry in cooperation with chemical suppliers and the two Federal Forest Products Laboratories. On the West Coast the problem has been tackled by joint evaluation program of industry (and its association) and the Western Forest Products Laboratory.

Secondary Industries

Plywood/Veneer Mills: The main activity in the plywood/veneer mill operations is veneer peeling, layups and veneer drying. Process development has been the prime target of R & D in this industry. On the west coast use of hemlock in plywood has been of major importance to all the larger producers of plywood.

Development of patching compounds and new finishes for speciality items are also being carried out in cooperation with suppliers. Hardwood plywood and its design criteria for strength characteristics are being investigated.

Development of Panel Products: Use of mixed hardwoods for production of hardboard in the East and development of new panelling products in the West are taking a large portion of R & D efforts in the hardboard industry. Pollution control problems in hardboard manufacturing are also attracting considerable attention in industrial R & D effort.

Several companies in Canada are contemplating starting the production of composites (such as solid core plywood), using plywood manufacturing operations. This is resulting in large R & D efforts for developing suitable particleboard cores (oriented/non-oriented) for such products. Raw material mix in different regions, testing for product performance and development of design criteria are other R & D activities for these products.

In many cases, this effort is being handled jointly with suppliers of equipment, machinery and adhesives.

Door, Window and Joinery: Door and window manufacturers are engaged in the following R & D activities: design of machines to handle new raw materials, jointing systems, R-Values and new designs for energy conservation, fire resistance rating and performance characteristics of wooden doors in fires compared with steel doors.

At present only a few of the door and window manufacturers are contemplating in-house R & D on the use of wood preservatives during the manufacturing operation. Development of criteria for codes and standards requiring use of preservatives, fire retardants and insulation are being developed by a few companies. However, this type of R & D would require a great input from the two Federal Laboratories since this industry lacks expertise in these areas.

Finger Jointing: Equipment design for finger jointing for green lumber and kiln-dried door stock is the R & D activity in some operations. However, more R & D is needed in developing criteria for standards for its uniform acceptance in the industry.

Tertiary Industry

Waferboard: Due to the efforts and innovations of private industry Canada has achieved distinction in waferboard technology. Its leadership in developing this technology is ascribed to the efforts of a large integrated company which contributed its resources in developing all aspects of waferboard technology, i.e., press schedules, mat formation, orienting wafers and adhesives. In the past few years several new waferboard manufacturing facilities have been installed. It has been predicted that by 1980-82, Canadian manufacturing capacity will be doubled. Such a large increase in production capacity is creating great demands for R & D effort in improving this product and expanding its markets. Many large and small companies are involved in this expansion plan. Many new concepts in waferboard technology are being investigated by full mill trials because very few companies have research laboratory facilities. Use of mixed hardwood, inorganic fibres, foliage and agricultural by-products are being evaluated for manufacture of waferboard.

Strandboard: Production of strands and development of technology for increasing yields in converting raw material (logs, sugar cane) to strands for oriented strandboard are the major subjects for R & D activity of a couple of companies in Canada. This type of product has great potential for efficient utilization of the raw material and export of technology to the developing countries.

Laminated Wood Products: Research on laminated wood products has been conducted by one company. Its major efforts have been in developing in-line testing of individual members, proof loading of laminated structures and improved laminating techniques.

Wood Preservation: The wood preservation industry has steadily grown in Canada. With the introduction of preserved foundation material in the market, there is an urgent need for R & D efforts in improving initial species segregation for treatment, preparation of material by incising, process and quality control techniques. Several of these and other such requirements as moisture content of the finished product and corrosion of fasteners are being evaluated at the Western Forest Products Laboratory, with financial assistance from the wood preserving companies.

The Canadian wood preservation industry lacks good service record data banks. Only when the data on efficacy/efficiency of preservatives in service conditions in different regions of Canada are available can codes and standards for Canadian conditions be developed. A large joint industry/government effort in this area has been sought by the industry.

Packaging: The wooden box and container industry is very small, but it is expanding rapidly. The total sales of the wooden pallet industry are approximately $80 million per year. This industry consists of relatively small individual units. Non-availability of hardwood species of suitable grades is encouraging R & D activity in the industry to develop softwoods for use in pallet manufacturing. Use of softwood pallets and their acceptance in codes (international and domestic) requires development of data banks, and the industry is trying to develop the necessary data with assistance from its trade association and the Federal Government.

Specialized machinery is required for manufacturing new types of containers. Only a few small companies (e.g. Oakville Wood Specialities) design and develop machinery for producing small containers.

Miscellaneous Products: A small company has specialized in producing wooden stirrers and tongue depressors. This company, because of its R & D initiatives in the design of new equipment, smooth surface veneering techniques and veneer drying, has improved its productivity significantly. It successfully markets its product in 35 countries around the world.

CONCLUSIONS AND DISCUSSIONS

The programs and capabilities of the Canadian wood products industry have been examined. Current annual expenditures on research by the wood products industries are approximately $5 million. The Federal government, realizing the importance of R & D in industrial sector, has provided such incentives as 150 percent tax write-off provisions in the 1978 budget proposals for new R & D initiatives. This should improve the climate for more R & D related expenditures in the wood products industry.

Such large integrated companies as MacMillan Bloedel, Abitibi and Price, and Domtar, together spend over 75 percent of the total annual industrial wood products R & D budget. The remaining companies (approximately 8,000) spend the balance. Over 70 percent of the industrial wood products R & D is carried on in western Canada.

Industrial research strategy is to make incremental process and product modifications with a short term goal. In general, the wood products industry lacks the capabilities, both financial and trained personnel, to carry out its own R & D. Consequently, it looks towards the non-industrial sector and especially the federal government sector to satisfy its R & D needs.

Programs of research and annual budgets in the wood products industry can be summarized as follows:

1.	Primary Industry	- Sawmills, Shingle & Shakes	$ 600,000
2.	Secondary Industry	- Plywood, Doors, Windows and Cabinets	$1,050,000
3.	Tertiary Industry	- Composite Wood Products - Waferboard, Wood Preservation and Energy from Wood.	$3,350,000

It is apparent that such mature products as lumber and plywood are getting less attention than such new products as composite wood products.

Most of the secondary and tertiary manufacturing industries (doors, windows, kitchen cabinets and packaging) are run by small companies. There is virtually no research input from the federal laboratories for the above-mentioned industries. It is the entrepreneurship of the small operators, with few research facilities, which is responsible for some specks of success in this sector. Most of the technology is imported from the United States or European sources, however, these industries stand to benefit tremendously if some R & D projects, relevant to their needs, are initiated at the federal laboratories.

Useful technology is being developed in Canada on structural composite wood products. Major breakthroughs in this area could increase the wood recovery factors from the forest resources of Canada. Canadian technology has gained international reputation in the fields of waferboard, composite products from wood, and agricultural residues. This demonstrates that with well-designed R & D initiatives, other areas of the wood products industry could also achieve a high level of advancement.

UNIVERSITIES

INTRODUCTION

Universities are in a unique position to conduct research in the wood products area. A community of researchers with keen interests and eagerness to expand as well as to undertake inter-disciplinary research activities exists in the Canadian universities.

Research in the universities is secondary to the primary objective of teaching. Hence research is considered a luxury which forestry departments can ill-afford due to shortage of staff in relation to the teaching load. It is only the personal drive of some of the university professors to stay up to date in their subjects, that is responsible for the limited research being conducted in the universities. The engineering and science faculties (civil, mechanical and chemical engineering and chemistry departments) are also engaged in pursuing research and development activities in the wood products area.

In all, nine universities were visited during this survey. Six of them have forestry faculties. In addition, the universities of British Columbia, Toronto, Laval and New Brunswick have graduate programs in Wood Science and Technology.

FUNDING OF R & D ACTIVITY

Most of the research activities at the Canadian universities are supported by research grants from the National Research Council and the Canadian Forestry Service. However, the activities in engineering faculties have been largely supported by grants from the industry. One such grant has been provided by the National Lumber Grading Authority to the Civil Engineering Department of the University of British Columbia.

In western Canada (Manitoba and west) approximately twenty man-years (8 professionals and 12 students/technicians) are allocated at the universities to carry out wood products research. This adds up to a yearly budget of approximately $530,000. About sixty percent of this comes from industry and the rest from various government grants.

In eastern Canada, approximately 15.5 man-years ($6\frac{1}{2}$ professional plus 9 students/technicians) are allocated to wood products research with an approximate yearly budget of $310,000. Most of these funds are from government grants.

Thus, the total R & D budget at all the Canadian universities in the field of wood products is approximately $840,000 annually - a very small amount when compared to the contribution of the wood products industry to the Gross National Product (GNP).

During interviews with university researchers, it was brought out clearly by them that the existing grant system to the universities is not satisfactory. University staff are not trained in overcoming the hurdles of the contract/grants systems of the Department of Supply and Services and the National Research Council. This results in a low level of research activity at the Canadian Universities. By comparison, the U.S. Government provides much better financing for research at the universities than the Government of Canada.

SCOPE OF R & D ACTIVITY

Forestry Faculties - Western Universities

In western Canada, the University of British Columbia (UBC) and the University of Alberta have faculties of forestry. However, research in wood products is being conducted only at the UBC.

The research programs at the UBC are related to the interests of individual professors. The main areas of interests have been on wood growth characteristics as related to its strength and dielectric properties, fluid jet cutting technology and chip production, radiation polymer composites and wood/cement boards technology. Several graduate theses have been completed in these areas.

Forestry Faculties - Eastern Universities

In Ontario, the University of Toronto and the Lakehead University have faculties of forestry. The Lakehead University has been conducting research in waferboard processing and is establishing good rapport with local waferboard industries. The University of Toronto has specialized in the structural aspects of wood, while some research is also being conducted on the anatomical behavior of wood and its effects on strength properties.

The University of Laval in Quebec city has been conducting research in wood products with special reference to wood seasoning, anatomical structure, wood impregnation with preservatives, and waferboard.

The University of New Brunswick is conducting some fundamental research in diffusion of gases in wood and inter-actions of synthetic coatings on surfaces and wood structures. Movement of moisture/gases in wood with the aid of Nuclear Magnetic Resonance (NMR) techniques is also under study.

Engineering Faculties

Nova Scotia Technical College is very active in two areas of research. These are in wooden structures, and the technology of producer gas from wood residue and its use in operating diesel motors. The producer gas R & D work is being conducted in cooperation with the industry. The

facilities for wooden structures R & D at the Nova Scotia Technical College are excellent.

The Civil Engineering Department of the University of Alberta is also very active in wooden structures research for which they too have excellent facilities.

The Mechanical Engineering Department of the University of Manitoba has studied the strength properties of wood at low temperatures. These studies are contributing to the design of laminated wooden pipes and poles.

The Chemistry and Chemical Engineering Department of the University of Saskatchewan has been conducting excellent work in lignin chemistry and the utilization of wood residues as a source of energy, cattle feed, and chemicals. Development of technology based on lignin chemistry offers new sources of adhesives, molding compounds and other polymeric materials. A process for generating a fuel oil type material from aspen chips with a calorific value of 15,000 BTU/lb (c.f. 18,000 BTU/lb from bunker C oil) has been developed. Application of this new technology from the bench scale to the industrial scale is still far away. However, this example is provided to point out the potential role of university research in enhancing the use of renewable resources as alternatives to our dwindling energy reserves.

The Chemical Engineering Department of the University of British Columbia, has evaluated the use of fluidized bed drying techniques for drying lumber. The other areas under investigation at the UBC are chemical extractives from wood/bark and foliage from western Canadian Species, and cattle feed from wood residues.

The Civil Engineering Department of the UBC has excellent facilities for evaluating In-Grade-Testing of lumber, structures and fundamental strength properties of wood, and has very good rapport with the North American wood products associations and industry.

Industry views the role of the universities in R & D to be oriented towards basic fundamental research in wood science and technology. Spinoffs of the basic research at the universities should be made available to the industrial community through joint or cooperative research programs. At present, very few universities are fulfilling this role.

CONCLUSIONS AND DISCUSSIONS

Our universities have great potential capabilities to conduct high caliber R & D activities, economically. Unfortunately, the present structure and financing of R & D activities at the Canadian universities are not conducive to developing new wood products technology. Part of the problem lies in a lack of adequate provincial support for R & D activities in wood products at universities. Even such provinces as British Columbia,

where close to 50 percent of the annual revenues come from the forest products industry, do not have a R & D policy which apportions the due share of support to the universities for forest products research.

The total R & D budget (salary) at all the Canadian universities in the field of wood products adds up to approximately $840,000 annually. Theoretical research projects undertaken by the graduate and post-graduate scholars at the forestry faculties are related to the effect of wood growth characteristics to strength properties, diffusion of fluids in wood and electron microscopic studies of anatomical characteristics of wood. The research programs of the civil engineering department at the University of British Columbia, have made significant impact on wood products R & D in North America.

ASSOCIATIONS

INTRODUCTION

Several associations representing various industry sectors either by province, region or at the national level exist in Canada. These associations represent their respective member entities on matters of common interest. Their activities in general encompass product promotion and quality control, briefs to government departments and the general public, lobbying for favorable legislation, tariffs, trade and other matters affecting their markets including research and development. Among these organizations only the Council of Forest Industries of British Columbia has its own research and product development laboratory.

The Canadian Wood Council is a federation of associations acting for the Canadian forest products industry in building codes, fire regulations and product standards to ensure favorable markets for wood products in North America. It assists in coordinating research rather than conducting its own, in engineering and fire behavior so that structural and fire performance data are available to support its objectives. The Canadian Wood Council submitted a brief to the Federal Minister of Environment, based on a study by A.N. Huddleston, entitled "A report on the need for research in Canada's Forest Products Industry", Jan. 10, 1975. Major recommendations of this report required CFS to increase research and development activity in the federal laboratories. The industry recognized its own failure in providing adequate input to Research Program Committees of the two federal laboratories and in conducting its own share of research and development. This brief has been helpful in reorganizing the two laboratories.

FUNDING OF R & D ACTIVITY

The Council of Forest Industries of British Columbia (COFI) raises its R & D funds by a levy on member companies on their annual production, (0.03 percent of value added). Apart from conducting its own research program, COFI also assists in providing funds for specific projects at the Western Forest Products Laboratory.

Similarly, the Canadian Institute of Timber Construction (CITC) has provided research funds to the federal laboratories to carry out certain specific high priority mission-oriented projects.

All of the provincial/regional associations are participating in an In-Grade-Testing study, financed by a levy of $.02 per 1,000 foot board measure of lumber production through the National Lumber Grading Authority. These funds have assisted programs at the Civil Engineering Department of the University of British Columbia in conducting in-grade-testing studies. The major benefit of these studies will be in providing better scientific basis for the development of new codes and standards for structural strength of lumber.

In 1977, the COFI research laboratory had a staff of twelve (3 professionals plus 9 support staff) with an annual budget of $325,000.

SCOPE OF R & D ACTIVITY

COFI has very good facilities for conducting product research on plywood and those factors affecting its use such as strength, durability, design and codes and standards requirements.

In the past, COFI has coordinated its own research activity in the wood protection area with both federal laboratories and structural properties with the Western Forest Products Laboratory (WFPL).

Anti-sap stain chemical treatment of wood, treatment of lumber and plywood for Preserved Wood Foundations have been joint projects of COFI, other associations and the WFPL.

COFI has been actively evaluating fire retardant treatments developed by the EFPL for western red cedar roof covering materials.

Associations play a limited role in conducting research and development on their own. From time to time, by their active participation in the Research Program Committees of the FPLs, they have brought in suggestions for new studies which could assist their respective member entities.

CONCLUSION AND DISCUSSIONS

The associations representing the wood products industry are mainly organized for the purpose of promotional, marketing and codes and standards activities. With one or two exceptions, these associations rarely undertake R & D to improve the technological base of their member entities. COFI, on the west coast, is the only association in Canada with a R & D facility and an annual R & D budget of $325,000. It has made significant contributions in improving Douglas-fir plywood applications at international levels. Its financial support, along with the support of some other associations, has contributed to the development work in improving anti-sap stain preservative treatments of green lumber, preservative treatments of Canadian plywood for preserved wood foundation systems and in-grade-testing of lumber.

PROVINCIAL GOVERNMENT SUPPORTED LABORATORIES

INTRODUCTION

Provincial government grants have assisted in the formation of a chain of research laboratories across the country. These research foundations/councils operate under contracts to the industrial and government sponsors of research. Each laboratory has a regional interest and as such are strong in certain disciplines, e.g., Alberta in earth sciences, B.C. and Nova Scotia in oceanography.

Provincial hydro departments, which are large users of such preservative treated wood products as poles, also have limited research facilities in the wood products area. Ontario Hydro and B.C. Hydro have established R & D facilities in wood protection.

Provincial departments of regional development, forestry resources and industry, trade and commerce, etc. are not active in wood products R & D. However, they play an important role in marketing research and initiation of research projects at the provincial and federal laboratories.

FUNDING OF R & D ACTIVITY

Each of the Provincial Government laboratories is organized to suit regional requirements. None of the laboratories visited had a separate department for wood products research. However, research on wood products is conducted in several departments (e.g. Chemistry, Applied Physics, Marine Biology, etc.), depending on the nature of studies.

The industrial contracts and government grants/contracts contribute

entirely to the total budget (approximately $1.62 million for these laboratories). Lately, there has been an increase in the funding of projects related to research and development activity in the generation of energy from wood residues.

SCOPE OF R & D ACTIVITY

Except for Quebec, all the provincial government supported laboratories are engaged in research on energy from wood residue. In Quebec, this research is undertaken by the Quebec Hydro. Wood residues for cattle feed or production of proteins seems to be another area of research activity which has been undertaken in Western Canada, Ontario and Nova Scotia.

Quebec's (CRIQ) laboratory specializes in assistance to small-scale and secondary industries in developing machinery and equipment to increase the productivity of the local industries.

Ontario Hydro has been engaged in development work on remedial treatment of wooden poles for prolonging their service life and evaluating and developing methods for assessing service life of poles.

CONCLUSIONS AND DISCUSSIONS

Provincial laboratories have great potential in conducting R & D for wood products to suit regional requirements. They have the capability of adjusting their staff and their disciplinary requirements based on the contracts from industry. Small companies depend on them for solving problems in manufacturing operations, pollution control and generation of energy from wood residues. Quebec laboratory (CRIQ) is a unique institution engaged in development of machinery and equipment to increase the productivity of the local industries.

MACHINERY AND EQUIPMENT MANUFACTURERS AND OTHER SUPPLIERS

INTRODUCTION

Machinery and equipment manufacturers and other suppliers are the main sources of innovations in the production of wood products. New innovative designs in machinery have been mainly responsible for the increase in productivity of the Canadian wood products industry in the past decade.

Both small and large machinery and equipment manufacturers spend a portion of their budgets on engineering design, improvements to existing machinery and equipment, and development of new machinery and equipment.

Certain large-scale machinery, because of the high cost of fabricating a prototype, is built from concept to the operating unit for sawmills. Thus, the risk involved is shared by the machinery manufacturers and the lumber producers. The risk presents a major obstacle to the machinery manufacturer in conducting more innovative R & D in heavy machinery and the assessment of new concepts in wood processing.

Resin manufacturers for the plywood, particleboard and waferboard industries undertake considerable research and development activities to keep ahead of their competitors. Similarly, the instruments, paints and coating suppliers also play a role in R & D for the wood industry.

Most of the chemical wood preservative suppliers are companies with headquarters in the U.S.A., and most of the R & D on new preservatives which are environmentally safe is being conducted outside the country. Compared with chemicals for agricultural use, the chemicals for wood preservation are not getting their share of research efforts from Canadian chemical suppliers.

FUNDING OF R & D ACTIVITY

Only major machinery manufacturers and other suppliers were contacted in this survey. Only a few of these have established R & D departments. Most of the machinery and equipment manufacturers and other suppliers of resins, coatings and finishes, conduct design, engineering and formulation development activity out of their operating budgets.

In western Canada, the annual research and development budget is worth approximately $3,000,000, and ten percent of this comes as grants from the Department of Industry, Trade and Commerce. In eastern Canada, there are few large companies dealing with machinery and other suppliers, and the R & D expenditure of the companies surveyed is limited to only $775,000.

SCOPE OF R & D ACTIVITY

A wide range of development work in designing sawmills, plywood and particleboard machinery and equipment is being carried out in Canada. In machinery design it is more of imitation than innovation. Much of the innovation in sawmill automation is taking place in Sweden, Finland and U.S.A.

Resin and coating suppliers are generally subsidiaries of American companies. However, due to increased regional demands for special adhesives for particleboard and waferboard, some original research work in formulation development is being carried out in Canada.

Western Canadian machinery manufacturers, such as CanCar (Pacific),

Brunette Machine Works Ltd. and Durand Machine Co. Ltd., have benefited greatly from their R & D activities. They have established themselves as reputable suppliers of machinery for wood products manufacture. The markets for machinery for the composite wood products industry have hitherto been dominated by West German companies.

Machinery, equipment and chemical suppliers are well suited for conducting R & D activity for the wood products industry. They are very close to the operating personnel, recognize the problems and can react fast to develop and/or design new systems. However, as a result of limited markets, especially for the secondary wood products industry, the benefits of R & D activities are limited. This has led provincially supported laboratories (such as CRIQ) or individual companies (such as John Lewis & Co.) to play an active role in designing and manufacturing of the required systems.

As stated earlier, the R & D activities in this sector of industry are of a short nature with an immediate goal of a short payback period (two to three years). Thus fundamental R & D activities in sawmilling - reduction of saw kerf, accuracy of sawing, design parameters related to species, noise, automatic filing, etc. are being neglected. In spite of the so-called incentives for fundamental R & D, the machinery manufacturer is neither capable nor interested in conducting fundamental R & D work.

CONCLUSIONS AND DISCUSSIONS

Machinery and equipment manufacturers and other suppliers have contributed to R & D activities of the wood products industry. As pointed out earlier, these companies recognize the needs of the users of their products and thus by close cooperation between them, this team has contributed significantly to new developments. In the past, this sector has been responsible for bringing such innovations as shearing for harvesting, foliage grinding machines for glue extenders, the steam injected press for thick particleboard, non-leachable fire retardants for wood products as developed at the FPLs to the wood products industry. With few exceptions, the R & D strategy of this sector has been more of imitation of technology from around the world, especially the United States of America, Sweden, Germany and Japan. These imitations or modifications of technology used in other countries to suit Canadian conditions could be considered a major activity. However, one should not get the impression that no new technology has been developed by this group in Canada. Waferboard technology and some sawmill (Chip-N-Saw*) and plywood plant equipment design have been developed, which have widespread use in Canada. Recently, a significant market for export of this equipment has also been developed.

Among suppliers - the resin, finishes, paint, coatings and preservative chemical suppliers have contributed towards R & D activities of the wood products industry.

* Registered trade mark

RESPONSE OF NON-FEDERAL GOVERNMENT SECTOR ON THE EFFECTIVENESS OF THE FEDERAL GOVERNMENT SECTOR IN WOOD PRODUCTS RESEARCH

INTRODUCTION

Examination of research and development in the non-federal government sector in isolation of the reactions to the federal R & D activities is meaningless. Hence, during this survey, response of the private sector to the role of WFPL and EFPL, their usefulness and technology transfer activities were evaluated.

The comments of the private sector on R & D activities in the federal sector range from very negative to very useful in advancing wood products technology in Canada. This is inevitable with such a diverse range of wood products industries from large integrated companies to small family-type operations. The small Canadian companies and foreign subsidiaries who have technical staff, commented favorably on the activities of the laboratories and their achievements. Following were the typical opinions expressed in this survey:

USEFULNESS OF FEDERAL FPL'S

1. Provide a forum for technical discussion with competent people in the wood products area.
2. Provide skills in specialized technical areas (e.g. microbiological testing, fire research, high speed photography, wood preservation and seasoning).
3. Reputable, independent, unbiased laboratories to settle code problems between different government departments, industries and consumers.
4. Assist in writing better specifications and codes and standards based on valuable technical and test data.
5. Assist in developing improved kiln drying schedules for indigenous and imported lumber species.
6. Important source of R & D for the industry on specific areas, e.g., sawing methods, mechanical problems in saws, drying, treating schedules and fire research.
7. Development of testing methods for strength, fire, efficacy of preservatives, etc.
8. Long term effects of the research and developments on industrial growth.
9. Concern about consumers and environment.
10. Assistance in gaining acceptance for Canadian products in the world markets.

Some of the negative opinions offered in the survey are:

1. Their existence precludes industry from having its own R & D.
2. FPL activities are not in step with the needs of the lumber producers.
3. FPLs are not keeping up with the developments in Canadian mills.
4. "No useful purpose" - small operators are not given proper attention. Requirements of secondary industry like doors, windows and kitchen cabinets are lumped with large industries, and as such, the former get no priority for their work.
5. "No useful purpose" - large operators react fast to solve their own development problems rather than take the projects to FPLs.

COMMENTS ON TECHNOLOGY TRANSFER

Questions on effectiveness of technology transfer from FPLs also got mixed reactions. Once again such diverse reactions are inevitable because of the nature of the wood products industry.

Favorable comments:

1. The dissemination of information generated at the FPLs is very good.
2. Lumber drying technology transfer has been excellent.
3. Basic technical data on structural aspects of wood products has been used in the codes and standards.
4. Monitoring of decay in houses and truss plate and particleboard performances have been good.
5. The waferboard study committee has assisted in developing working stresses for codes and testing of lignosulfonates as adhesives. The work of this committee has been well recognized and has also improved marketing potentials of Canadian waferboard.
6. Veneer cutting studies have helped hardwood veneer industries.
7. Good technology developed has found easy access in Canadian industry (e.g. lathe setting controls, nose bar for veneering, finger-jointing green lumber, fire retardants, drying schedules, anti-sap stain applications, etc.).
8. The capabilities of industries to utilize technical innovations are the key to successful technological transfer.

Some of the negative comments received and sometimes contradictory to previous statements, on technology transfer from government laboratories.

1. Negligible technology transfer to the industry.

2. No process and product technology developed worth acceptance by the industry.
3. It takes too long to get results of studies initiated by the industry at the FPLs.
4. Technology transfer in the area of fiberboard/hardboard is negligible.
5. Technology developed is not commercially successful.
6. Information is too technical for floor supervisors to understand.
7. Knowledge is there in the FPLs but industry does not have know-how to use it.
8. Small companies do not have technical people to take advantage of the findings of the FPLs.
9. Small operators in secondary and tertiary manufacturing do not even know the existence of the federal laboratories and how these laboratories could assist them.
10. No investment capital to take advantage of new technology or modifications introduced by the FPLs.

CONCLUSIONS AND DISCUSSIONS

It should be pointed out that both WFPL and EFPL together answer more than 10,000 enquiries per year, spend 12.5 percent of their budget annually on liaison activity, make hundreds of field trips a year to large and small industries, mail thousands of publications, have displays at many industry conventions.

The Federal Government laboratories (EFPL & WFPL) have diversified R & D activities covering many sectors of the wood products industry. Some of the R & D programs have been discussed earlier. The CFS has established the National Advisory Committee and Research Program Committees to advise its management of the R & D needs of the wood products industry and for advice on the priorities for the programs at the two laboratories. In many areas of wood products research this approach is working, but in others it has been observed that modifications are needed. Research Program Committees are in some cases covering large sectors of the industry, thereby requirements of small industries do not get the necessary attention. Generally the industry provides a greater number of high priority requests than the limited staff at the laboratories can undertake.

The two FPLs are also responsible for developing technology and information for the consumers and general public, the Provincial Governments and other Federal Government Departments. The evaluation of the effectiveness of technology transfer from the FPLs is incomplete until one examines the response from all the sectors for whom the technology is being developed. From the information collected in interviews with the industries, provincial laboratories, associations, machinery, equipment

manufacturers and suppliers, it appears that though liaison activity has improved in the past few years, there is still room for improving the technology transfer function of the federal sector.

FUTURE NEEDS FOR TECHNOLOGICAL DEVELOPMENTS

Technological developments are necessitated by market conditions and changes in national priorities. As stated earlier, Canada is one of the largest exporters of wood products. International competition, comparative labor costs, profit-taking, etc., dictate the need to keep the Canadian industry technologically up-to-date. On the other hand, national priorities concerning energy, housing and employment also impose conditions demanding technological innovations. We could either develop for our own technological needs or buy new technology from other countries. This choice depends upon many factors. Consequently, during this survey, the needs for technological development in Canada were assessed by enquiring what additional R & D would be needed if manpower and financial limitations could be removed.

The following three areas would benefit most from innovations:

1. Improved wood utilization and increased economic recovery from forest to final market products.
2. Wood residue utilization for energy, chemicals and feed.
3. Development of reconstituted structural composite wood products.

The specific aspects for R & D in these areas were suggested as follows:

Improved wood utilization and increased economic recovery from forest to final marketable products:

- Computerization and automation of sawmill and other manufacturing operations.
- Better utilization of forest resources.
- Increased recovery or improved wood utilization.
- Better utilization of aspen and other hardwoods in Canada.
- Assignment of logs based on their quality and demands of individual industry.
- Cooperation with forestry institutions in developing specific species (for high yields) for specific regions in Canada.
- Improved whole tree harvesting techniques related to improved lumber recovery factors.
- Use of small logs in existing sawmills and new techniques to breakdown logs for high yield of desired products.

- Improved recovery through finger jointing.

Wood residue utilization for energy, chemicals and feed:

- Wet bark burning systems.
- Utilization of wood residue from manufacturing plants and the forest floor.
- Non-conventional uses of wood for cattlefeed, protein and energy.
- Refining of wood residues like crude oil for energy or other by-products.
- Designing of wood residue burning systems for domestic use.
- Sawmill and energy production as community projects, especially for remote areas with small populations with allotted cutting rights of a given forest area. This could provide jobs, energy requirements, and commodity items for export, thus making these small communities self-sufficient.
- Development of chemicals from renewable resources - forest residues can provide a cheap source of organic chemicals for a variety of uses.

Development of reconstituted structural composite wood products:

- More efficient structural uses of wood with appropriate preservative and fire retardant treatments.
- Solid core plywood.
- Production of pallets for Canadian food industries.
- Developing a substitute for 2 x 4 wood members for residential and industrial construction.
- Developing a low density high strength board product.
- Wood products for utilities, e.g., railway ties, cross arms.

Other items generally mentioned in the survey were:

1. Water-based systems for coatings, finishes, preservative and fire retardant treatments for wood products to decrease risk of pollution and costs of oil-based systems, and to reduce the fire hazard.
2. Preservation treatment of spruce to increase its utilization.
3. Insulation material, board and systems from wood residues.
4. Effective transfer to the wood-based industry of hitherto unused improved technology.
5. Improving the competitive position of wood over plastics and metals.
6. Improving productivity and profitability of small wood processing companies.

7. Developing economic utilization of low grade poplars in the northern belt.
8. Developing technical data on secondary and less used hardwood.
9. Uses of wood in pipelines and utility poles in Northern Canadian conditions.
10. Adhesives based on polymeric compounds from forest resources or as by-products of forest products industries.
11. Expanding uses of softwood for pallets with supporting technical data on strength, preservative and fire tests.
12. Innovative technology which could be used in the forest for production of specific end products.
13. Perfect substitute for solid wood or constructional material with rot- and fire-proofing qualities.
14. Tools, such as a thin kerf saws, for hardwood flooring.
15. Protection of the use of wood from competition from steel and plastic in cabinets, door and window markets.
16. Hardwood drying technology.
17. Development of new end products and applications of thin hardwood flooring in order to compete with synthetic floor covering materials.
18. Wood preservation and fire retardant processes for waferboards.
19. Development of processes and products suitable for secondary industries - utilization of birch for newer products.
20. Development of thicker particleboards.
21. Process industry should develop along with equipment manufacturers.
22. Edge gluing of lumber to produce wider boards from small logs.
23. Development of new environmentally safe wood preservatives.
24. Improvement of processes for increasing digestibility of wood residues by cattle.
25. Health and safety of mill workers.
26. Expanding the market base for Canadian wood products.

In this survey general discussions on who should and who could do R & D to bring in the technological innovations in the above desired areas also took place.

The majority of people surveyed agreed that it is the industry who should do the R & D as it is closest to the problem, has profit motive and is well suited to utilize the results of innovations. However, it was also apparent that though industry should do the R & D, it could not do it without full financial and manpower support from the federal and provincial governments. Though provincial governments have jurisdiction on forests, research and development for improving forest resources fall under the

federal jurisdiction. Thus close cooperation at all levels is needed for developing a technologically sophisticated forest products industry in Canada.

GENERAL CONCLUSIONS

The R & D expenditures in the solid wood products industry in Canada were identified as only $5 million in 1977 compared to wood products export of $2.8 billion. This was less than 0.02% of the wood products export and as a result were ranked last in R & D expenditures among the 20 leading industrial sectors in Canada.

The wood products industry has recognized that it should seriously consider providing greater input in R & D activities. Furthermore, all sectors - federal and non-federal - should cooperate in pooling their meagre R & D resources to organize an effective result- and market-oriented research initiative. The following activities are suggested to meet the needs for technological developments in the wood products sector:

1. CFS should continue through contributions, contracts or other involvements in the formulation and coordination of a national policy and program for R & D in solid wood products.
2. Greater recognition should be given to technology transfer and codes and standards activities in commercializing or otherwise applying the results of R & D.
3. All sectors, industries, universities, provincial/federal supported laboratories, machinery manufacturers and suppliers should find means to cooperate or coordinate activities in the following areas:

   Complete forest resource utilization.

   Energy from wood residues.

   Structural composite wood.

   Development of profitable new processes and products which do not pollute the environment and ensure the safety and health of workers.

ACKNOWLEDGEMENTS

Many individuals and organizations have cooperated in helping me meet my objectives. They have given their valuable time and advice generously, and I am indeed grateful.

My special thanks are to the Canadian Forestry Service, especially Dr. T.S. McKnight and Dr. R.J. Bourchier and other members of the CFS, Dr. R.W. Kennedy and his staff at WFPL and Dr. J.E. Stone and his staff (including regional liaison officers) of the EFPL who were helpful in providing services which have made this study possible.

Mr. R.F. DeGrace, in his capacity as chairman of the National Advisory Committee (NAC) and as Executive Director of the CWC and Dr. R.H.J. Creighton as outgoing chairman of the NAC have made some valuable suggestions in developing the scope of this study.

Appendix III provides a list of industries, associations, provincial government supported research laboratories, foundations and universities, whose senior executives and professors contributed very valuable comments which led to the compilation of this report, and I am greatly indebted to each one of them individually and to their organizations.

Mr. J.F. McCracken, Executive Director of the Canadian Lumberman's Association and Mr. Brian Deacon of Machinery Branch of the Department of Industry, Trade and Commerce, have provided names of valuable contacts in the industry. Dr. D. Read of the Ministry of State, Science and Technology, has provided helpful suggestions in bringing out this report.

APPENDIX I

DEFINITION OF TERMS USED IN THIS REPORT

Research and Development (R & D)*

The following definition of research and development was used in this survey:

R & D is investigative work carried out:

(1) to acquire new scientific and technological knowledge;

(2) to devise and develop new products or processes, or

(3) to apply newly acquired knowledge in making technically significant improvements to existing products or processes.

Intramural Expenditures*

Expenditures for work performed within the reporting company, including work financed by others.

Wood Products

These are defined as material/articles made entirely of wood. Product grouping of wood products could be simplified by calling lumber, plywood, waferboard as primary products and the remaining products as secondary products. However, for this study the following system is used in conjunction with Standard Industrial Classifications Manual Cal. 12-501 Dominion Bureau of Statistics:

Primary Wood Products: As described in item 251 of the Standard Industrial Classifications. This includes sawmills, planning mills, shingle and shake mills manufacturing products as dimension stock, dressed lumber, kiln dried lumber, shingles and shakes.

Secondary Wood Products: As described in item 252, 254 of the Standard Industrial Classifications. This includes plywood, veneer, sash, door, window and other millwork.

Tertiary Wood Products: As described in items 256 and 259 of the Standard Industrial Classifications. This includes pallets, wooden boxes, wood preservation, particleboard, waferboard, hardboard and composite wood products.

Non-Federal Government Organizations

This includes industries, universities, associations and institutions supported by provincial governments.

*Source: Statistics Canada.

APPENDIX II

QUESTIONNAIRE USED AS A GUIDE IN THE SURVEY

1. Name of Company/Association and Address:

2. Person Contacted:

3. Does your company have a scientific research and development department?

4. (a) Approximately how many staff members in R & D?

   R & D: Supporting Staff

   (b) What is the budget for R & D and how much of it is supported by Government grants?

5. Wood products covered by R & D — Primary / Secondary / Tertiary

   Machinery / Equipment / Supplies

6. What is the R & D strategy of the company? (Definition of R & D, responsibility, etc.)

7. What is the industry doing for its R & D?

8. What are the potentials for the industry to do its own R & D?

9. What role do the industry trade associations play in R & D?

10. What is the scope of research work covered by your company? (Fundamental/Applied/Project/Product/Process-oriented)

11. What is the scope of development work covered by your company?

12. Who is responsible for implementation of R & D and how successfully is this function carried out?

13. What is the scope of Marketing Research?
    (In initiation of projects and implementations of the results)

14. What areas does the industry depend on the Government laboratories WFPL/EFPL/NRC, etc.?

15. What is the usefulness of R & D activity from the Government labs?

16. What role do Suppliers play in conducting R & D for the Wood Products Industry?

17. What role do the universities play in doing R & D for the Wood Products Industry?

18. Who should and who could do R & D for the Wood Products Industry? (Industry/industry associations/government laboratories)

19. Should the R & D for the Wood Products Industry be conducted by organizations like FERIC/Trade Association/Government laboratories under direction of industry?

20. How do you rate technology transfer from the government laboratories/ university to the industry?
(Liaison activity role of RPC/NAC)

21. If manpower and other limitations could be removed, what additional R & D would be needed?

APPENDIX III

LIST OF INSTITUTIONS

Universities

1. University of British Columbia, Vancouver.
   - Faculty of Forestry
   - Department of Civil Engineering
   - Department of Chemical Engineering
   - Department of Chemistry

2. University of Alberta, Edmonton.
   - Department of Civil Engineering
   - Department of Forestry

3. University of Saskatchewan, Saskatoon.
   - Department of Chemistry and Chemical Engineering

4. University of Manitoba, Winnipeg.
   - Department of Mechanical Engineering

5. University of Toronto, Toronto.
   - Faculty of Forestry

6. Lakehead University, Thunder Bay.
   - Faculty of Forestry

7. Laval University, Quebec City.
   - Faculty of Forestry

8. University of New Brunswick, Fredericton.
   - Faculty of Forestry

9. Nova Scotia Technical College, Halifax.
   - Faculty of Engineering

Associations

1. Council of Forest Industries of British Columbia, Vancouver, B.C.

2. Alberta Forest Products Association, Edmonton, Alberta.

3. Central Forest Products Association, Winnipeg, Manitoba.

4. Housing and Urban Development Association of Canada, Toronto, Ontario.

5. Canadian Hardwood Plywood Association, Ottawa, Ontario.

6. Canadian Institute of Timber Construction, Ottawa, Ontario.

7. Canadian Kitchen Cabinet Association, Ottawa, Ontario.

8. Canadian Lumberman's Association, Ottawa and North Bay, Ontario.

9. Canadian Waferboard Association, Ottawa, Ontario.

10. Canadian Window & Door Manufacturers Association, Ottawa, Ontario.

11. Canadian Wood Council, Ottawa, Ontario.

12. New Brunswick Forest Products Association, Fredericton, N.B.

13. Nova Scotia Forest Products Association, Truro, N.S.

Provincial Government and Industry Supported Institutes

1. B.C. Research Council, Vancouver, B.C.

2. Research Council of Alberta, Edmonton, Alberta.

3. Saskatchewan Research Council, Saskatoon, Sask.

4. Manitoba Research Council, Winnipeg, Manitoba.

5. Ontario Hydro, Toronto, Ontario.

6. Ontario Research Foundation, Mississauga, Ontario.

7. Pulp and Paper Research Institute of Canada, Pointe Claire, Quebec.

8. Centre de Recherche - Industries du Québec, Sainte-Foy, Quebec.

9. Nova Scotia Research Foundation Corporation, Dartmouth, N.S.

Machinery and Equipment Manufacturers and Other Suppliers

1. Brunette Machine Works, Ltd., New Westminster, B.C.

2. CAE Machinery Ltd., Vancouver, B.C.

3. Canadian Car (Pacific) a division of Hawker Siddeley Canada Ltd., Vancouver, B.C.

4. Durand Machine Co. Ltd., New Westminster, B.C.

5. Elsworthy & Co. Ltd., Burnaby, B.C.

6. Kockums Industries Ltd., Surrey, B.C.

7. Lamb-Cargate Industries Ltd., New Westminster, B.C.

8. Mainland Forestry and Engineering Ltd., New Westminster, B.C.

9. Moore Canada Ltd., Richmond, B.C.

10. Q.M. Industries Ltd., Prince George, B.C.

11. Reichhold Chemicals Co., Surrey, B.C.

12. Reliance Universal Co., Surrey, B.C.

13. Walker Brothers Ltd., Burnaby, B.C.

14. Canadian Morbark Ltd., North Bay, Ontario.

15. Forano Ltd., Montreal, Quebec.

16. Swecan International Ltd., Lanoraie, Quebec

17. Volcano Ltd., St-Hyacinthe, Quebec.

18. Oxford Foundry and Machine Co. Ltd., Truro, N.S.

Primary Industries - Sawmills, Shingles and Shakes

British Columbia

Ainsworth Lumber Co.	100 Mile House
British Columbia Forest Products Ltd.	Vancouver
Canadian Forest Products Ltd.	New Westminster
Crown Zellerbach Canada Ltd.	Vancouver
MacMillan Bloedel Ltd.	Vancouver
Northwood Pulp & Timber Ltd.	Prince George
Prince George Pulp & Paper Ltd.	Prince George
Rayonier Canada (B.C.) Ltd.	Vancouver
Takla Forest Products Ltd.	Prince George
Weldwood of Canada Ltd.	Vancouver
Weyerhaeuser Canada Ltd.	Vancouver

Alberta

North Canadian Forest Industries Ltd.	Grand Prairie

Saskatchewan

Meadow Lake Sawmill Co. Ltd.	Meadowlake
Saskatchewan Forest Products Corp.	Prince Albert
Simpson Timber Co. (Sask.) Ltd.	Hudson Bay

Ontario

Abitibi Lumber Ltd.	Toronto
G.W. Martin Lumber Ltd.	Harcourt
William Milne & Sons Ltd.	North Bay

Quebec

E.B. Eddy Co.	Davidson
Industries Maibec Inc.	Ste-Foy
Gillies Bros. & Co. Ltd.	Montreal
Consolidated Bathurst Ltd.	Montreal
Normick Perron Inc.	LaSarre

New Brunswick

Ashley Colter Ltd.	Fredericton
Fraser Companies Ltd.	Edmundston
J.D. Irving Ltd.	Saint John
Maritime Lumber	Woodstock
Juniper Lumber	Bristol

Secondary Industries - Plywood, Veneer, Door and Window, etc.

Plywood and Veneer

British Columbia

B.C. Forest Products Ltd.	Vancouver
Canadian Forest Products Ltd.	Vancouver
Crown Zellerbach Canada Ltd.	Vancouver
MacMillan Bloedel Ltd.	Vancouver
North Central Plywood Ltd.	Prince George
Weldwood of Canada Ltd.	Vancouver

Alberta

Zeidler Forest Ind. Ltd.	Edmonton

Saskatchewan

Saskatchewan Forest Products Corporation	Prince Albert

Ontario

Canada Veneer Ltd.	Pembroke
Levesque Plywood Ltd.	Hearst
Multiply Plywood Ltd.	Nipigon

Quebec

Masonite Canada Ltd.	Gatineau
J.H. Normick Inc.	LaSarre
Commonwealth Plywood Co. Ltd.	Ste-Therese
Megantic Manufacturing Co.	Lac Megantic

Door and Window

Alberta

W.R. Zeidler	Edmonton
Dashwood Industries	Edmonton

Saskatchewan

Pre-Built Ltd.	Regina

Manitoba

Dashwood Industries	Winnipeg
C.P. Lowen Enterprise Ltd.	Steinbach

Ontario

Alexander Sash & Door Co. Ltd.	Alexandria
Conduits - Amherst	Mississauga
Dashwood Industries	Centralia
Mason Windows Ltd.	Pickering

Quebec

Jos Gingras & Fils Ltd.	St. Hyacinthe

New Brunswick

Lock-Wood Ltd.	Scoudouc

Nova Scotia

Amherst Woodworking (Man) Ltd.	Amherst

Hardwood Flooring

Barwood Flooring (Canada) Ltd.	Montreal, Que.
Floor Co. Ltd.	Toronto, Ont.
Satin Finish Harwood Flooring	Weston, Ont.

Kitchen Cabinets

Eastland Industries Ltd.	Minto, N.B.
Lamtech	St. Hyacinthe, Que.
Prebuilt Kitchen	Regina, Sask.

Tertiary Industries

Hardboard

Canadian Forest Products Ltd.	New Westminster, B.C.
Abitibi Building Materials	Mississauga, Ont.
Masonite Canada Ltd.	Hubbard, N.S.

Wooden Box Factories

West Coast Specialities Ltd.	New Westminster, B.C.
Dycks Containers & Forest Products Ltd.	Winnipeg, Manitoba
Oakville Wood Specialities Ltd.	Oakville, Ont.
Livingston Industries Ltd.	Tillsonburg, Ont.

Miscellanous Industries

John Lewis Industries Ltd.	Montreal, P.Q.

Particleboard and Waferboard

Weldwood of Canada	Vancouver, B.C.
MacMillan Bloedel (B.C.)	Vancouver, B.C.
MacMillan Bloedel (Saskatchewan)	Hudson Bay, Sask.
Pluswood Ltd.	Atikokan, Ont.
MacMillan Bloedel (Thunder Bay)	Thunder Bay, Ont.
The Great Lake Paper Co. Ltd.	Thunder Bay, Ont.
Waferboard Corporation Ltd.	Timmins, Ont.
Malette Wood Products Ltd.	New Liskeard, Ont.
Rexwood Products Ltd.	New Liskeard, Ont.
Sogefor Ltee	Labelle, P.Q.
Flake Board Company Ltd.	St. Stephen, N.B.

Wood Preservation

Koppers International	Richmond, B.C.
Saskatchewan Forest Products Corporation	Prince Albert, Sask.
Northern Wood Preservers Ltd.	Thunder Bay, Ont.
Koppers Hickson Ltd.	Mississauga, Ont.
Domtar Chemical Ltd., Wood Preserving Division	Montreal, P.Q.

EXECUTIVE SUMMARY

(R & D in Solid Wood Products - a review of non-federal government programs and activities; Canadian Forestry Service Information Report DPC-X-7)

A Canada wide survey has been conducted to examine the programs and capabilities of non-federal government organizations such as Canadian industry, institutes and universities on solid wood products research and development (R & D) (excluding pulp, paper and converted paper products). Responses of this sector on the effectiveness of R & D work from the two Federal Forest Products Laboratories (FPLs) at Ottawa and Vancouver and future needs for technological developments have also been assessed. This study will be useful for planning and coordinating forest products R & D initiatives at the national level.

Industrial research strategy is generally to make incremental process and product modification with a short term goal. The wood products industry consists of a few large integrated companies and a large number of small companies. The former group spends annually over 75 percent of the total industrial R & D expenditure which is of the order of about $5 million. Another $6.5 million a year is spent on wood products R & D by non-federal government organizations (institutes, universities, machinery manufacturers and other suppliers). Over 70 percent of the industrial R & D is carried on in western Canada.

The sectorwise breakdown of this wood products R & D expenditure during 1977 was as follows:

Sector	Western Canada	Eastern Canada	Total
	$ 000	$ 000	$ 000
Industries	3,500	1,500	5,000
Universities	530	310	840
Associations	325	000	325
Provincial Labs.	570	1,050	1,620
Suppliers	3,000	775	3,775
Non-Federal Sector	7,925	3,635	11,560
Federal Sector	3,000	3,300	6,300

Significant technology is being developed in Canada on structural composite wood products. Increased recovery in sawmills by the use of computer and electronic technology is rising slowly in Canada. Other activities, e.g., drying, treatment against bio-deterioration and fire, and structural strength criteria are an integral part of continued efforts to improve the wood products industry.

Machinery and equipment manufacturers and other suppliers have contributed significantly to R & D activities of the wood products industry. The strategy of this sector has been largely to modify existing new technology in the United States of America, Sweden, Germany and Japan.

Universities, associations and provincial government supported laboratories have a very limited role in conducting R & D for the wood products industry. Universities have great potential and capability to conduct fundamental R & D economically.

An examination of the programs and potential of the non-federal government R & D facilities indicates that some effort is being made to increase the technological base of the wood products industry, but not enough is being done due to several reasons beyond the control of this industry.

The Federal Government Laboratories (EFPL & WFPL) have diversified R & D activities covering many sectors of the wood products industry. Technology transfer from two laboratories to the wood products industry has had many important successes in recent years.

The wood products industry has recognized that it should seriously consider providing greater input in R & D activities. Furthermore, all sectors - federal and non-federal - should cooperate in pooling their meagre R & D resources to organize an effective result- and market-oriented research initiative. The following activities are suggested to meet the needs for technological developments in the wood products sector:

1. CFS should continue through contributions, contracts or other involvements in the formulation and coordination of a national policy and program for R & D in solid wood products.

2. Greater recognition should be given to technology transfer and codes and standards activities in commercializing or otherwise applying the results of R & D.

3. All sectors, industries, universities, provincial/federal supported laboratories, machinery manufacturers and suppliers should find means to cooperate or coordinate activities in the following areas:

   Complete forest resource utilization.

   Energy from wood residues.

   Structural composite wood.

   Development of profitable new processes and products which do not pollute the environment and ensure the safety and health of workers.

RÉCAPITULATION

(R & D in Solid Wood Products - a review of non-federal government programs and activities. Service canadien des forêts, Rapport d'information DPC-X-7)

Une étude à l'échelle nationale a été mise sur pied afin d'examiner les programmes et capacités d'organismes étrangers aux agences gouvernementales fédérales comme l'industrie, les instituts et universités du pays, touchant la recherche et le développement (R et D) sur les produits ligneux (à l'exception des pâtes et papiers et des produits connexes transformés). Les réponses provenant de ce secteur sur l'efficacité des travaux de R et D, particulièrement des deux laboratoires des produits forestiers (LPF) à Ottawa et Vancouver, ainsi que les besoins futurs quant aux techniques de développement furent évalués. Une telle étude a servi à planifier et coordonner les initiatives en R et D relatives aux produits forestiers, au niveau national.

Dans l'industrie, la stratégie habituelle consiste à accroître les méthodes et modifications de production en une période relativement courte. L'industrie des produits du bois comprend quelques grandes sociétés intégrées ainsi que de nombreuses sociétés de moindre envergure. Le premier groupe dépense annuellement plus de 75 p. cent de tous les déboursés en R et D, ce qui représente une somme d'environ $5 millions. Les autres organismes non fédéraux (instituts, universités, fabricants de machinerie et autres fournisseurs réunis) dépensent un autre $6.5 millions par année en R et D des produits du bois. Plus de 70 p. cent de la recherche et du développement dans le secteur industriel provient de l'ouest du pays.

La répartition sectorielle de la dépense en R et D pour les produits du bois en 1977 fut la suivante:

Secteur	Ouest du Canada	Est du Canada	Total
	$ 000	$ 000	$ 000
Industries	3,500	1,500	5,000
Universités	530	310	840
Associations	325	000	325
Laboratoires provinciaux	570	1,050	1,620
Fournisseurs	3,000	775	3,775
Secteur non fédéral	7,925	3,635	11,560
Secteur fédéral	3,000	3,300	6,300

Il se développe une technologie importante sur les produits composites de bois de charpente au pays. L'accroissement de la récupération du bois dans les scieries via la technologie électronique et les ordinatrices augmente lentement au Canada. D'autres activités comme par exemple le séchage,

les traitements contre la biodégradation et le feu, de même que les critères structurels et de résistance, sont toutes partie intégrante des efforts déployés continuellement en vue d'améliorer l'industrie des produits du bois.

Les fabricants de machinerie et d'équipement ont contribué de façon significative, avec les autres fournisseurs, à la recherche et au développement touchant l'industrie des produits du bois. Dans ce secteur, la stratégie a surtout porté sur la modification des nouvelles techniques existantes aux États-Unis, en Suède, en Allemagne et au Japon.

Les universités, les associations et les laboratoires financés par le gouvernement provincial ont un rôle très limité dans leurs travaux de R et D pour l'industrie des produits du bois. Les universités possèdent beaucoup de possibilités et de capacités pour mener à bien économiquement la recherche et le développement.

Une étude des programmes et du potentiel des installations de R et D étrangères au gouvernement fédéral porte à croire qu'il se fait un certain travail pour augmenter les connaissances technologiques de l'industrie des produits du bois, mais pas encore assez, à cause de raisons multiples au-delà du contrôle de cette industrie.

Les laboratoires du gouvernement (LPFE et LPFO) ont des programmes diversifiés en R et D couvrant plusieurs secteurs de l'industrie des produits du bois. Le transfert de la technologie à partir des deux laboratoires vers l'industrie des produits du bois a connu d'importants succès au cours des dernières années.

L'industrie des produits du bois a reconnu qu'elle devrait considérer sérieusement le fait de contribuer aux activités en matière de R et D. De plus, tous les secteurs - fédéraux ou non - devraient collaborer et amalgamer leurs maigres ressources en matière de R et D afin d'organiser leurs travaux en vue d'un résultat efficace, orienté vers la commercialisation. Les activités suivantes conduiront aux développements technologiques dans le secteur des produits du bois:

1. Le SCF devrait poursuivre sa participation au moyen de contrats ou autres engagements, à la formulation et la coordination d'une politique nationale touchant le programme de R et D dans les produits du bois.

2. On devrait donner plus d'importance au transfert de la technologie et aux activités de normalisation puis aux codes de commercialisation ou autres concernant la R et D.

3. Tous les secteurs, l'industrie, les universités, les laboratoires émanant des provinces et du fédéral, les fabricants et fournisseurs de machinerie devraient trouver des moyens de collaborer et de coordonner les activités dans les secteurs suivants:

   Utilisation complète des ressources forestières
   Énergie provenant des déchets de bois
   Bois de charpente composé
   Développement de nouveaux procédés et produits rentables antipolluants qui assureront la sécurité et la santé des travailleurs.