FINAL REPORT AND PROCEEDINGS
of the
ADVANCED FORESTRY TECHNOLOGY FORUM

An Executive Forum on
Science and Technology
Issues and Developments

May 14, 1987
Vancouver, B.C.

Canadian Advanced Technology Association
Science Council of British Columbia
Ministry of State for Science and Technology

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FINAL REPORT
THE ADVANCED FORESTRY TECHNOLOGY FORUM

by the Canadian Advanced Technology Association (CATA),
the Science Council of British Columbia (SCBC),
and the Ministry of State for Science and Technology (MOSST)

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BACKGROUND

In June of 1986, the Canadian Advanced Technology Association (CATA) began the development of the planning process to initiate and deliver a forum on advanced technology in the forestry sector. A primary purpose of the Forum was to determine how Canadian technology companies might work with the Canadian forest industry in the development and application of Canadian-made technologies.

Given the national dimension and sheer size of the forest industry in Canada, CATA decided that this first time forum focus on the largest concentration of the forest industry in Canada, which is the B.C. forest industry. To assist in the planning for the Forum, CATA approached the Science Council of British Columbia (SCBC), which had identified a similar need and thus agreed to co-host the Forum. The SCBC drew on its numerous links with organizations and agencies in British Columbia concerned with research and development in the forest sector in developing the plan for the symposium.

An Executive Advisory Committee began the planning process in September of 1986. The Executive Advisory Committee was co-chaired by Roy Woodbridge, President of CATA and Denis Connor, Chairman of the Science Council. Members of the committee included Tony French, President of Forintek; Richard Kerekes, Vice-President and Director of Pulp and Paper Research Institute of Canada (PAPRICAN); and Phillip Cottell, Director of Wood Harvesting for MacMillan Bloedel Ltd. Through the participation of the Science Council, its various committees and Board of Directors, the Universities of B.C., Simon Fraser and Victoria, departments of engineering and forestry were kept informed of the planning process. The Ministry of State for Science and Technology (MOSST), a major sponsor of the Forum, was represented by Jeff Pallister in the planning of the Advanced Forestry Technology Forum. The committee was assisted by Charles Kelly of Canadian Public Affairs Consulting Group in the planning and organization of the forum.

THE PLANNING PROCESS

Through the Executive Advisory Committee, the key early recommendation was the requirement for a discussion paper that would provide an overview of emerging technology needs in the forestry sector. The Committee also determined that the Forum should limit itself to the area of electronics in harvesting, wood products and the pulp and paper sectors of the industry. Areas such as biotechnology, although important, would more properly be the subject of a separate study and conference. As a result of the recommendation, the Ministry of State for Science and Technology (MOSST) agreed to an overview study which was prepared by Dr. John Madden and formed the basis of much of the later substantive discussions of the Committee. ("Emerging Technologies and the B.C. Forest Products Industry: A Summary Guide" Discussion Paper by John C. Madden, March 1987.)

Another key recommendation of the Committee was that the participation at the Forum should be from the senior executive levels of the forest companies and the technology companies. The Forum was to be an "executive" level of exchange and not a technical conference. This decision was based on the premise that there was currently very little contact between the B.C. and western Canadian high tech companies (primarily electrical and electronics manufacturers) and the forest industry. There are notable exceptions to this but by-and-large the western Canadian advanced technology sector is based upon markets outside of the forestry sector, primarily in the U.S. electronics and telecommunications industries.

This premise became a major feature of the Forum planning and led to the format of executive boardroom meetings, with the emphasis on discussions related to the relative strengths and weaknesses of both sectors and identification of opportunity areas where they might work together. The Forum was designed to achieve a mutual understanding of each other's environment and build a consensus on how they might work together in the future.

MARKETING

With the assistance of MOSST, a newsletter "Innovation and Ingenuity" was prepared and mailed in March 1986 across Canada to technology companies and organizations interested in science and technology issues. In addition, the newsletter was distributed through the mailings of Forintek and PAPRICAN. The purpose of the Newsletter was to raise awareness and provide information to encourage technology companies to focus on the opportunities of the forest sector.

Invitations to the Forum were extended by personal letter from the President of CATA and the Chairman of the Science Council of B.C. and followed-up by telephone. This proved most successful and all marketing targets were achieved.

THE FORUM

The Forum was held on May 14, 1987 at the Pulp and Paper Research Institute of Canada in Vancouver. About 110 persons attended the Forum. The participants included approximately 30 executives from the forest industry, 50 executives from advanced technology firms, 20 senior officials from government and universities in B.C. and 10 senior officers of the federal government.

A Progress Report on the Forum (dated May 25, 1987) has been produced by Jeff Pallister, Manager of Resource Technology, MOSST which summarizes the discussion at the Forum. In addition, MOSST has prepared transcripts of the key note addresses and workshop reports which are contained within this report. Cindy McCaffery edited the report for publication.

Near the closing of the Forum participants were asked to evaluate the Forum by filling in a questionnaire. The key findings are that the Forum was most useful, that 84% would attend a follow-up Forum, 95% made useful contacts, and 87% exchanged useful information.

RECOMMENDATIONS

As detailed in the Workshop Reports and in Pallister's Progress Report, a number of Recommended Actions were outlined by the Forum participants.

1. Better and stronger **linkages** should be **forged** between the forest industry and knowledge-based sectors (e.g. the electronics industry).

   Stronger links can be achieved through improved information access: holding workshops, seminars and trade shows; developing data bases on technology; providing a clearinghouse for information sources; etc.

   Funding should be directed at forging the links and development of a supplier community. Any government funding should be targetted and cost-shared with industry.

2. A national-provincial **strategy** focussed on bringing forestry and advanced technology together is **required.**

   Given the importance of the forest industry to the economy, this sector should become a priority for the province and nation. It is necessary to develop a long-term strategy to identify problems and goals, necessary targets for high technology, and areas for special funding.

   Industry and government together could define future technologies (e.g. Sawmill 2000) and proceed to implement a strategy for its implementation. This approach is similar to the Japanese Fifth Generation approach. A framework is needed to give guidelines for technology development efforts.

3. Industry, government and universities should more clearly **identify** the economic **returns** from R&D and technology to entice industry to act more vigorously in technology development and acquisition.

   Reference was made to returns in excess of 30% from R&D. This return raises the interest of industry in conducting more R&D.

4. **Investments** in R&D and technology development for the forest industry needs to be **increased.** More specific recommendations included:

   The forest industry should increase its investment in R&D and technology development and acquisition funding.

   Longer term, sustained funding is needed.

   IRAP funding should be increased. Funding for the IRAP-P program for larger projects should be restored.

   The 15% export tax could be used to increase funding levels.

   Government funding is not effective unless directed to projects conducted on a shared basis with industry.

5. A **mechanism** should be developed to **reduce** the **risk** encountered in R&D and by the first user.

6. Industry should vigorously use **procurement** to foster the growth of the Canadian supplier community. Government should support and encourage this practice.

7. Increased emphasis should be given to **technical education** and **shared** university-industry **programmes.**

8. More emphasis and activity is required on **technology transfer.**

   The research organizations (Forintek, FERIC, PAPRICAN) need to expand their scope of activities. It was recommended, for instance, that they include an associate membership for suppliers.

9. The Advanced Forestry Technology Forum is only a first step, and will be effective only if there is **continuity.**

   The Forum should be followed up with an action plan and by additional, more focussed Forums.

FOLLOW-UP

On June 2, the Executive Advisory Committee met to assess the Forum and make recommendations on follow-up activity. The Committee concluded, as did the Forum participants, that: this meeting was only a first step, it will only be effective if there is continuity and that the Forum should be followed-up with an action plan.

The recommendation of the Committee is that CATA and the Science Council of B.C. continue their organizational role with the support of MOSST to carry out the following progress elements:

1. A series of three one-day seminars be held in the fall of 1987 and winter of 1988, more focussed on specific opportunity areas in the respective areas of wood products, pulp and paper, and harvesting. Each seminar would work closely with the respective lead agency in these areas, Forintek, PAPRICAN and FERIC. CATA and the Science Council of B.C. would continue to play lead organizing, marketing and management roles in cooperation with MOSST.

   Each seminar would outline opportunity areas, key problems to be solved and the key agency in the area would assist before, during and after, to identify and "broker" strategic alliances or partnerships between forest and technology companies.

2. A second Executive Forum would be held within a year, after the more targetted and specific seminars to assess progress, and to identify executive investment and policy issues. This Forum would be planned for May or June 1988. This is a critical element to maintain the momentum. The planning for the Executive Forum should include the participation of the Council of Forest Industries and the Business Council of B.C.

3. The "Innovation and Ingenuity" newsletter should continue. A report on the Forum should be produced and information should be provided on the follow-up meetings for technology companies across Canada.

4. The research prepared on engineering technologies for the first Forum should be tested at the more specific seminars, revised and updated for the Executive Forum in the Spring of 1988.

PROCEEDINGS

The Forum commenced with opening remarks by the two co-chairman:
Roy Woodbridge, President, Canadian Advanced Technology Association, and
Denis Connor, Chairman, Science Council of British Columbia

Following the opening remarks, Bruce Howe, Secretary of the Ministry of State for Science and Technology introduced the first speaker, Tom Buell.

Keynote Address by Tom Buell, President & CEO, Weldwood of Canada Ltd.

Bruce Howe really did not ask me to come here to speak today. He, in a typical fashion, called and told me when to be here and at what time, and did not go quite as far as telling me what to say but came close it it. So, I am rather programmed.

I recognize that the purpose of this, for me at least, is not to discuss the specifics of high-tech because that would rather be disappointing to you I am sure, but rather, in the forest industry, to cover the current environment, the outlook, status of high-tech and the opportunity for further application of it in our business, which is really the purpose of this whole session.

I think I am going to address my comments more to do with what we do better rather than doing glamorous things that we are not doing yet. There is a lot of talk about added value, new products and all those things which are all very important but there is a tremendous amount to be done with what we are doing. Those are the things that I am more familiar with, and it is in that area that I think I will make my comments.

For a long time the industry in this province and in Canada in particular thrived on producing more by cutting more trees and producing more volume and the days of cutting more trees are behind us. The wood in British Columbia has been allocated. There is still more wood to be allocated but generally speaking, that is in what would currently be certainly non-economic areas and some day, it will be harvested. But as far as the industry as it sits today, gaining its profitability by just chopping out more wood in the same old way, those days are really behind us.

So, where we have to make our profits, where we have to improve, where we have to compete is through doing what we are doing better, and regardless of how many added value products and how many new products we get into, it is still an engine and the thrust is, for a long, long time, going to be the kinds of products that we produce today, in a better way and better quality but nevertheless, similar to what we are doing.

From my perspective, there is no qualification that we need more development towards higher technology in all aspects of the industry, from forestry to harvesting to solid wood manufacturing and the pulp and paper sector. I guess there may be a difference in what I would term high-tech and what some of you people that are more in the space age of high-tech might term high-tech. High-tech, 10 years ago, was dropping the saw kerf from 3/8ths of an inch to 1/4 of an inch, I guess. But things have moved very fast and I expect that what I call high-tech today is at least getting closer to what people in the high technology business would call high-tech.

I think to begin with, and contrary to a lot of comment in recent years, the forest industry in general and in B.C. in particular is not a sunset industry. By virtue of the size of the industry in British Columbia, its importance to world markets, the natural resource available to it, there is every reason and necessity that it survive and with the opportunities for technological change, to do so with prosperity.

If we are perceived in B.C. as a sunset industry, it seems that there are a lot of people in the world that are rather foolish, when you look at what has happened to the ownership in this industry in the last several months, from New Zealand, from China, from eastern Canada, all kinds of people that see something in these forests, that would certainly indicate that they do not consider it a sunset industry.

Just a little bit on the status of our industry in the world - it is old stuff to most of you but I think you should be reminded anyway, Canada is the world's leading exporter of manufactured forest products, accounting for 22% of all world exports, not world production, but world exports. Scandinavia is

a close second at 21%. And the total value of all world exports is about $60 billion.

In softwood lumber, Canada supplies 48% of all world exports, and British Columbia alone accounts for 37% of all world exports in lumber. Canada represents 33% of all international trade in wood pulp and 63% in newsprint.

The forest industry is THE major contributor to Canada's trade balance. In 1984, we showed a $14 billion surplus and total export sales of $15.6 billion. Therefore, the industry is crucial to Canada's trade balance. Forestry is almost triple the oil and gas industry and represents more than the combined trade value of mining, food, agriculture and fisheries together.

Within B.C., the industry accounts for 46% of all manufacturing shipments, and wood products constitute 61% of B.C. industry shipments, the balance being made up by pulp and paper.

There are lots of impressive statistics but surely, those are enough to at least stimulate the imagination in respect to the opportunities for technology.

The fact that we are heavily oriented to export certainly tells us that we must be world competitive, and high technology in our operations is essential to that. It might be simple if we were only competing with local competitors for local markets but this is not the case.

There seems to be a conception that technology in British Columbia is trailing the world, all kinds of comments about what the Scandinavians do; in certain instances, it is a fact, in certain segments. Difficult economic conditions in the last five years have prevented us from using much of the technology that is available today but there are exciting examples of much of it in many operations, and I think you will see a dramatic change in the expenditures and higher technology in our operations with the current economic situation in the industry.

In my company alone, since the middle of 1986 and through until the end of 1987, we are going to have spent about $70 million inside our existing wood product facilities, and some $8 or $10 million inside our pulpmill. Seventy-five per cent of that spending is what we would call high technology related installations involving scanning, process control, recovery optimization, conversion of gas into wood-waste energy, all of those kinds of things. Certainly, there is a lot of nonhigh-tech parts of the process but almost all of it involves high technology in our terms.

Those kinds of installations generally return to us -- because there are so many available, not that they cannot be improved but just what is available now -- generally return to us something in the order of 30% after tax. So, if we spend $60 million in those two years, we would look at a $24 million improvement on the bottom line of the company through an expenditure of $60 million. It whets our appetite and we are sure that there are all kinds more available, but those are the kinds of things that it does for us.

I have had opportunities to visit operations in Scandinavia and despite perceptions to the contrary, I have not seen a display of technology in any operation -- and I am talking wood products at this point -- equal to some of my own company's operations in the Interior. We have a new sawmill at 100 Mile House that we built two years ago. It has 14 or 15 integrated process control centres starting with optimized log bucking with the capability of

bucking logs to optimum lengths based on calculated product outturn -- that is through scanning -- and we can build into the process the price list of lumber; and by scanning the logs it can determine what the optimum sales value is by whatever length that log is bucked and what can come out of it.

That same process is carried on right through the mill, through scanning before it goes through the breakdown units, through scanning before it goes through the edger optimizers, through trimmer optimizers. If you stand just beyond the trimsaw on that mill, the numbers might not be precise but it takes every piece of lumber, like grocery stores, it says $1.29, $2.27, $9.10, and those numbers pretty well correlate with what the profitability of the mill is.

It is interesting to see a foreman come over and push a button, and he can tell exactly how many logs have gone through each line to that point, what the recovery is out of the logs, how many two by fours, six, eights, tens, what the lengths are, and marry that to whatever you want to marry it to. I could have it on my other computer screen on my desk and if we wanted to, I could also tell what was going down that line in the morning by just going another circuit.

So, it is pretty interesting stuff, and that is high-tech to us. It may not be space age but it is high-tech.

We just installed a highly automated lathe line in our plywood operation in Williams Lake, Al Coomb's operation, who is here today. This fall, we will be installing another one in our Quesnel operation. These installations are about $5 million each, and Al is here to verify that he is going to get a 40% return on that investment.

They do not do anything much different than they have done, they still peel veneer. They do it better, they do more of it and they do it with a tremendous increase in recovery because of the scanning equipment that develops the precise centre of that log before it goes into the lathe. They are completely automated. Al tells me, and I think it is true, that the other day, the operator leaned over to get his coffee or something and while he was not watching, three logs went through the system and went through correctly. So, we call that high-tech too.

The pulp and paper industry has obviously advanced technology in its own rate, and the need for process control to higher and higher degrees of precision is a necessity.

Product increases through improved technology and control deliver dramatic economic returns. The incremental value of quantity and quality improvements through facilities that cost hundreds of millions of dollars required little explanation. If pulpmills cost $500 million, and everybody agrees that there are percentage points available in increased production, there is one, two, or three, obviously every one percent equates with $5 million in basic capital requirements to produce that volume and the incremental value of course is dramatically better than original volume with original capital -- just the control of the process in order to reduce downtime, to improve quality, to improve volume, there is absolutely no question of the necessity.

So, it is not a question of an insignificant or dying industry, and it is not a question of an apathetic industry in my opinion that has no appetite for the use of high-tech. It is a question of the integration of the tremendous capabilities of a high-tech organization with the needs of the forest industry and the mechanism to deliver these.

There are outstanding examples of local businesses that have been on the forefront of technological development, plywood and sawmill equipment, and they service customers worldwide. We have the Science Council, as mentioned this morning. We have excellent vehicles within the industry really through PAPRICAN, Forintek and FERIC to help deliver these goods.

British Columbia is a world centre for engineering consulting firms in forestry, wood products, pulp and paper engineering. Now that we have a taste of what we would classify as high-tech in the industry, it is not difficult to develop a wish list with more examples. For instance, higher resolution remote sensing for a variety of silvicultural factors; improved resolution in aerial photographs, automatic log scaling through estimation of log volume, transmission, billing, et cetera; improved forest inventories through satellite imagery; infra-red scanning to eliminate use of patrol planes; improved scanning to detect internal defects; improved scanning to identify true log shape; scanners that would allow automatic lumber grading.

That is one of the things that as yet, we have not seen and that is the ability to scan solid surfaces; in other words, we can scan for wane, we can scan for splits and open knots and those kinds of things but it has not been perfected to be able to scan and grade or scan and test strength perhaps. Plywood, where we have to do a lot of surface repair, if we could scan the surface of those panels and determine roughness or certain kinds of solid defects so that we could then use robotics in order to patch these defects as we do, it would be a tremendous saving in manpower and labour rather than having to use people with their arms and their eyes.

Certainly, the optimization of drying is an important factor, both from the point of view of quality and quantity. We ruin a lot of lumber by overdrying in order to make sure that the wettest piece is down to the proper dryness.

There is unlimited potential in the pulp and paper industry through the process, as I have mentioned earlier. I believe really though that the greatest potential will come in the ideas from the high-tech organizations as they become more familiar with our business.

For all those reasons, the environment is certainly in place to facilitate the evolution of high technology in our industry at a more accelerated rate and to the benefit of all those attending here today. Creating a relationship is not an easy task. I am not suggesting there is not a relationship but cementing it and, as Bruce said, making it more productive is not an easy task.

Today, in wild wood, we may have as well developed this information system as exists in the industry, covering all aspects of our business from logging to sales, with over 400 terminals across Canada connected to our mainframe by the end of this year. I have one on my desk, as I mentioned earlier; that is not high-tech but it is a great thing to come in in the morning before the guy that runs the mill and know exactly what happened in his mill yesterday and what the sales outlook is like. And, as I say, it can be carried to any extent; if it were of any value for me to know what went through Al's lathe yesterday, I will know.

It is on there actually, is it not, Al? It was not on yesterday; what happened?

For years, we did all the typical things with computers. We did payroll, normal accounting functions and some rather serious sales and marketing information but we really did not do anything that allowed us to manage and generate more profit because the information that was available to us but we could not get at it.

When times got really tough in the early 1980s and we were demanding forecasts and cost analyses from all our operations on a weekly if not a daily basis, we recognized the need for better information systems. We had the luxury of having really excellent people in our data processing group and excellent people in our operations, but they did not speak the same language and they could not relate to the others' problems; people on the operation side did not realize just what could be available and people on the data processing side did not know what people needed.

With a lot of effort, mostly from the side really of the computer-oriented staff, in learning the needs of the operation people, we got it all together. It has helped dramatically with the development of third generation languages that made training and usage by the user more simple.

Today, I would say that it is probably the most important factor in our ability to manage the information flow that we have. It has done dramatic things for us across the country in inventory control, it has done all kinds of dramatic things for the people in the operations that are able to do what ifs? in five minutes, we can do a consolidated balance sheet in the company in about three hours with all of the operations consolidated if we wanted to, it is all there. That is by building different recoveries in the mills and price lists and labour rates and change, whatever. It certainly has put a new era in our hands as far as management is concerned.

But even within our own company, with two disciplines, it was difficult to accomplish. In a way, it was similar to the gap that we are gathered here to address today.

There is no doubt, however, that the interface between the enterprises with very different historical differences, as has been the case between the high-tech business and the forest industry, is not going to be easy to accomplish. The proper ingredients in our educational system and more emphasis on cooperative research will help integrate our businesses.

Research in the real high-tech field may not become the thrust of the forest industry directly but the industry is supportive, financially and otherwise of work carried out by the research organization; they currently support, and I believe would be anxious to increase research support in other environments, particularly the improved interface between the disciplines.

Certainly, this event is timely and I am sure it is an excellent forum to create a permanent relationship between us, who really do not understand how much you could do for us, and you who perhaps do not understand what we need.

Bruce Howe, Secretary of the Ministry of State for Science and Technology introduced the second speaker, John MacDonald.

Keynote Address by John MacDonald, Chairman of the Board, MacDonald Dettwiler

Bruce has told me what I have to say in the front part of this speech anyway. I also noted something that Tom Buell has said. He mentioned with great pride that the trade surplus in the forest industry is $14 billion. I believe, if my memory serves me right, the trade deficit in the high-tech industry is $12 billion, maybe $14 billion. So, we are quite balanced in this room today.

Just a very brief introduction, before I get on with my prepared remarks, as to what MacDonald Dettwiler does. Basically, what we are is a company that specializes in developing systems for remote sensing and for other markets based on advanced digital technology. For example, we are the leading supplier in the world of ground segment processing systems for remote sensing satellites. We have built over half the ground stations around the world that process data from those satellites.

We have recently introduced a system we call "Meridian", which is a system which is used for analyzing that type of data. It is becoming recognized as one of the world's leading approaches to that particular problem.

We are, I think, the largest company in the world that derives most of its revenue from the remote sensing business, and we are world leaders in that area.

From that core activity has sprung several other things. For example, we have now a manufacturing plant that makes image recording technology. We now sell products based on that technology in the electronics industry for making printed circuits board masters and in the graphic arts industry.

In addition to all of that, we have another product which is quite new, it is a synthetic aperture airborne radar. It is the only radar of its kind available in the civilian world. It is a fully digital, real-time synthetic aperture radar system. The arithmetic rate in the processor that is on that aircraft is about 400 million arithmetic operations a second. So, it gives you some idea of the level of the technology involved.

In addition to all of that, we also have what is becoming recognized as a very significant capability in what we call high-reliability software, which is the ability to put together large software systems on time and on budget with a minimum of bugs the first time round, and to document that process and do it well. We are just in the process now of getting ready to deliver a very large software system done for the U.S. Air Force. It has been a very successful project.

So that, in a nutshell, is what we do.

The problem that we are assembled here to discuss today is not new. For many years, the high-tech industry and government planners had had a vision that somehow, through fulfilling the needs of our primary industries in this country and indeed in this province, a high-tech industry could flourish and expand into world markets.

This vision is driven by a perceived need to build in our economy a strong knowledge-based component. I am not saying that Canada should not always be a resource-based economy. I think what I am saying is there is

plenty of evidence around that it is in our interest. If we wish to maintain our standard of living that those of us in this room have all grown up with, we would be wise to build a strong knowledge-based component to our economy.

The idea that one can use the forest industry, the mining industry, other resource industries as the place where you help develop markets for Canadian high-tech industry is not a new one. It is something that many of us have discussed for many years.

However, the vision that we have had has not happened to any substantial degree. There are exceptions to this, but if you look at the sort of overall average, one does not see a burgeoning advanced technology industry that could be suppliers of the kinds of equipment that Tom was talking about to Canadian resource industries. If it had happened we would not be gathered in this room today. We would all be out doing things, not sitting around here talking about it.

It has, to some degree at least, happened in other parts of the world. We all know of the success in the forest industry of some of the Scandinavian technology- oriented companies that have supplied equipment not only in Scandinavia but here in British Columbia and in many other places in the world.

We are motivated really to ask why this has happened, for if we understand why, perhaps a solution will emerge. Or, at the very least, we can agree that we cannot do it and quit having meetings like this. Is it the well-known characteristic of the average Canadian which says that if something is sophisticated it has to come from somewhere else? Is it a failure of the high-tech industry, of the forest industry? Or, is it a failure of the government? Now, we all know it really is the failure of the government, but let us ask the question.

It is perhaps to some degree related to all these things but I would submit that the real reasons lie in the following -- Tom alluded to some of these things during his remarks -- lies in a lack of shared objectives between what we commonly call the high-tech industry and what we call the resource industries. Moreover, a lack of understanding of each other's objectives, of each other's methodologies, and in fact, when I think -- I hope you will understand when I am finished my remarks today -- a totally different philosophy that pervades the two solitudes. This boils down, really, to a lack of communication or perhaps more than that, a lack of a motivation to communicate.

In the next few minutes I will try to explain what I mean by these statements. They sound a little bit general, they sound perhaps a bit like motherhood. But I think if you think about it for a while, we may find the clue, or some clues at least, to the solution to the problem we are addressing here today.

I am going to divide my remarks into three parts. First of all, I will describe the advanced technology industry as I see it, how it operates, what are its key characteristics, what really makes it go and what is its philosophical base. I will follow that by a short description of what I, as a high-tech person, perceive as the key characteristics of the forest industry. This may not be a correct perception in the eyes of someone in the forest industry, but that in itself is informative. Thirdly, I will offer some perceptions which may, in some as yet unknown way, stimulate us to move towards mutually beneficial solutions to the problem that we have come here to consider today.

Let me begin with a short discussion of the high-tech industry. A synonym for the high-tech industry is knowledge-based industry. In fact, I prefer to use that term. Knowledge is the primary resource of the advanced technology industry.

What I mean by that is that the primary resource of the advanced technology industry is know-how. It is know-how, contained within the heads of the highly-skilled individuals which compose that industry. It is therefore a people industry. It functions by tapping a knowledge base to produce products and services to satisfy the needs of a market.

Basically what a high-tech enterprise does is it takes a knowledge base and it creates a set of products and services which tap that knowledge base and produce those services for the use of customers. As Denis so eloquently pointed out, this little engine, as he calls it, is driven by two things, by two knowledge bases: its scientific knowledge base and its market knowledge base. But if you look at what a high-tech company is, it is primarily a knowledge base of technology, uses that knowledge base as a resource to attempt to devise products and services to satisfy needs in some customer base. That is what it does.

The product life in such an industry is something like three years and shortening. Product differentiation is on performance. Products in the advanced technology industry are value-added products. The smarts that you put into something is what differentiates you from your competitor. Being first with a product is important. Being first with a new process is important to your competitive edge. Therefore, nurturing that knowledge base over there is absolutely vital to the success of the enterprise.

Research and development is the key activity of a high-tech enterprise. In fact, it is the lifeblood of a high-tech enterprise. Without a vibrant R&D activity, survival is at best difficult, more likely impossible, in the long run. As a rule of thumb in such an industry, the R&D activity should be something of the order of 10% of sales or more. There are many companies in our industry that peak up in good times to 20% of sales devoted to R&D. The knowledge base that I speak of must be indigenous to the company. The company must be a performer of R&D to be able to respond to the changes in technology and the changes in the marketplace with sufficient speed to be able to out-manoeuver its competitors.

Technology transfer, that well-worn phrase, requires the technical capacity of the recipient to be on a par with that of the donor. New ideas which are imported into such an enterprise must fall on fertile soil. To be successful in such an enterprise, you do not have to invent everything you do but you must have the capability to do so. Ideas can come from anywhere. To understand and exploit those ideas, you must have the equivalence of the capacity to, in fact, create them.

In British Columbia the high-tech industry is substantially the electronics industry. There is some very high capability in what you might call the underwater advanced technology industry. There is also some developing capability in biotechnology. But the electronics and computer industry is really what is, in terms of size, the high-tech industry here in British Columbia. It may not be well known to you but it is now fourth in terms of sales in the province with sales somewhere in the neighbourhood of $300 million a year. While it is fourth, it is a distant fourth and it is still really an embryonic industry.

There are five or six large-to-medium scale companies in the industry and most of you know who they are. But there are in excess of 150 smaller enterprises in the electronics industry in British Columbia. To operate out of Canada, from an early stage, such an enterprise must have the following characteristics. It must have an international outlet. In general -- at least in my experience, during the time that I have been in the business -- you cannot build a significant company on the strength of the local market alone. You must export.

The easiest competitive advantage to obtain, and this was the strategy we used, is technical superiority. Because, you know, if you are starting out as a small enterprise -- and let me remind you that as I have stated in terms of numbers, most of our industry is comprised of small enterprises and that is where the growth is going to be -- if you are such an enterprise, it is going to be a long time before you are bigger than your international competitors, many of whom, in our case, are multinationals. It is going to be a long time before you have a track record and so on. But from day one, you can be smarter. Because it is a knowledge-based industry, it is fairly easy, if you put together the right group of people, to attain that.

There is another way, and that is to somehow come up with a totally unique and economically effective solution to an existing problem, to address a niche market. It does not do you any good to compete with IBM. That, too, requires a world class knowledge base. This leads us to several conclusions.

First of all, almost without exception, companies in this industry in their early stages are technology driven. They are usually founded by technically-oriented entrepreneurs who think they have a better idea or a better way of doing things. They run the grave risk of creating solutions looking for problems. R&D is crucial from day one. However, as Denis has already pointed out, if these little enterprises are to become big enterprises, indeed to survive in the long term, they must be able to make the transition from a technology-driven company to a market-driven company. In doing this, and in the advanced technology business, having a demonstrated installation of whatever you are doing is an important ingredient in being able to get other customers onside. Remember, in most cases what you are trying to do is to introduce a new idea or a new process or a new thing into an already existing milieu. To be able to point to an existing place where in fact your idea is working and making somebody else some money is almost vital.

In the aerospace industry, which our company is part of, the saying is if you can't sell at home, you can't sell abroad. Given that the future of what we are discussing here today lies in large measure with the small high-tech enterprises, these points, I think, are pertinent to our discussion.

How is a high-tech company able to perform the necessary R&D, particularly in its early stages? There are several methodologies for doing this. The first that comes to mind is the use of internal cash, cash provided by shareholders, cash provided by profits if there are any. That, in a small enterprise, in today's technology, is in most cases not adequate. Also, you really only get one shot at the use of that money so you had better be sure of the practicability of your market before spending all of the money. New technology-driven entrepreneurs often forget that.

The second thing one can do is you can go to our friendly government and get R&D grants. Those are 50 cent dollars, and so they should be. They are

sometimes 30 cent dollars. Sometimes, I guess, 10 cent dollars. They are certainly not 100 cent dollars, nor should they be. What this tells you is that you can only stand a certain amount of that stuff because it constitutes in parallel an obligation to spend your own funds.

The third method, and the thing I want to spend a bit of time on today, is the performance of R&D contracts. This is how we built MacDonald Dettwiler. In an R&D contract, the customer pays for the development as well as the deliverable product. It is the principal method by which the aerospace industry creates its new technology worldwide. It is the method that I think is most often envisioned as the model for solving the problem we are discussing today. This sort of idea is that, well, somehow there are all these wonderful little high-tech companies around that can solve all these problems and the forest industry can just contract with these people and they will do all these wonderful things and out will stream products. This process works well with a government customer. At least it has worked well for us.

Back in the early '70s (the company was founded in early 1969) we obtained three key contracts in the area of remote sensing. Remote sensing in those days was a very new thing. These key contracts totalled $251,000. Based on that start, based on the technology developed and the market knowledge gained by that, as of January of '85, we had done a total of $127.6 million worth of business around the world. That number is probably close to $200 million today.

Basically what happens here is the creation of technology followed by the exploitation of technology. The creation of technology followed by the exploitation. That is the dynamics of how this process can work.

Now, as I mentioned, it works well with a government customer and all of what I showed was with a government customer. There is a benefit to both parties in that case. In the case of the advanced technology company, one ends up with addition to its knowledge base, it ends up with some product and some demonstrable systems that it can demonstrate to potential customers and go out and get business. To the government or to the taxpayer, there is the benefit of jobs created and a positive economic activity in that company, which leads to job creation. So, there are benefits on both sides.

The process has the advantage that it is focused around a practical objective with real deliverables as opposed to a research project with fuzzy objectives.

The process works less well with a commercial customer because one has to stop and ask the question "Where is the benefit for the commercial customer?" Is it in higher efficiency? Remember, he is paying for the development. Is it in higher quality of his product or is it something else? Maybe it just makes him feel good. Maybe there is a joint venture; so perhaps he benefits financially. Maybe he vertically integrates, gets into the high-tech business himself.

But I think one of the key things we have to turn our minds to today, if we want to use this mechanism to help create high-tech industry, we have to seriously ask ourselves "Where is the benefit for the customer of this enterprise, of this activity?"

Let us now turn to the forest industry as viewed from a rather naive person in the high-tech industry. The way I see the forest industry is it has the following objective: to turn wood fibre into products in as efficient a

manner as possible. That may be an oversimplified view of the forest industry; I am sure it is.

It is historically a commodity industry. Product differentiation has not historically -- and I emphasize the work "historically" -- been a significant factor in that industry. Efficiency is critical in a competitive market, and unscheduled downtime is synonymous with a disaster.

Technical innovation, the lifeblood of high-tech, has been viewed as risky. When it comes to new technology in the process, traditionally -- maybe Tom's company is an exception, but my experience has been that all of the resource industries are very conservative, and for good reason.

Being the first to install a new process is not necessarily viewed as being an advantage. You are just the guy that has to get all the bugs out of the process. It is the second guy who benefits from it.

So here we have a bit of a dichotomy. We have one industry which, on the one hand, being first, being there with something new and wonderful, is really part of the whole philosophy of the industry. We have the resource industry where this is viewed with a certain amount of skepticism, as a way of doing things.

I must tell you a story from my own experience. When our company was very young, back in 1970, we would take on anything to make some money. I got a call from a fellow in Portland Oregon who was a consultant and there was this small log mill up in the interior of Oregon that had a problem. They had decided to build an automated mill. This was in 1970, this is some time ago. The mean time between failure of this process was measured in hours. So, I was asked to come out and try to figure out why this was and what to do about it.

When I got there, I found something very interesting. The logic design behind the process control for the mill was very good. In fact, one could even say it was elegant. The construction of the system, the techniques which had been used to build the system were just awful. It was not professionally done and the techniques which were used were more appropriate to the communications industry than to the lumber industry.

This had been done by a small company in Portland, not unlike some of the small companies we have here in British Columbia, who knew theoretically what to do but in practice did not.

In recommending a solution, what I saw was, my God, this thing was set up -- this had been a hard-wired logic control system. It was perfect for minicomputer control. I thought this was a wonderful idea.

Unfortunately, I cannot repeat in a public audience the response to my suggestion. There was just no way that that mill was going to go to anything more sophisticated that it already had, troublewise.

The solution was to implement the same logic design in reliable hardware. But it was an interesting process to notice and go through and experience, the differences in attitude between the industry I came from and the forest industry.

For what we are trying to deal with today, to work, the perceived risk/reward equation must be balanced, as perceived by the forest industry customer and as perceived by the high-tech supplier. To enter into a development project with a high-tech group, there must be a perceived pay-off for both parties.

For

the high-tech party, the pay-off is fairly obvious. It is a product or a technology to exploit. For the forest company, what is the pay-off? Is it a market advantage achieved through improved quality or improved efficiency? Is it glory and prestige? Is it money? Or is it product differentiation?

In addition, we must also remember that we are introducing new technologies and ideas into an existing system, into an existing environment. That motivates me to read to you a quote, something that I often think about:

> "It must be remembered that nothing is more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system, for the innovator has the enmity of all who would profit by the preservation of the old system and merely lukewarm defenders in those who would gain from the new one."

Those words were written in 1530. The author's name was Niccolo Machiavelli.

Our challenge then is to create an environment where all parties are motivated to work together because all parties see a downstream pay-off, and having accomplished this, to execute our projects in such a way as to maximize the chances of success; by that, I mean not only the project itself be successful but there be a worldwide market for the result.

I believe a window is opening which may enable this to happen. I was very encouraged by Tom Buell's remarks earlier. I was very encouraged to see that somebody who is an expert in the forest industry seems to think there may be a window opening too.

I would submit that the forest industry in B.C. is undergoing a fundamental change. And change, to me at least, is synonymous with opportunity.

There are three aspects to this change which are pertinent to our discussion. Our forest industry is undergoing a transition from a wild harvest business to one based on cultivation. This happened somewhere around 50 years ago in Europe. In the agriculture industry, it happened in the midst of antiquity somewhere, and it is currently also happening in the fishing industry.

The competitive environment in the wood industry is changing around the world. Wood from Third World countries in a tropical environment is replacing our products in some areas, not in all areas, but in some.

This is leading to my third point, that the industry is moving more toward a value-added stance and away from its historical route as a commodity business. Philosophically, therefore, it is moving more in the philosophical direction of the advanced technology industry.

How do we take advantage of these opportunities? It is easiest to begin by describing what we should not do. We in the high-tech industry should not, in isolation, attempt to develop solutions which we perceive as filling needs in the forest industry. This will inevitably lead to solutions having no problems.

A lack of knowledge of the needs and problems and methods of the forest industry will doom such a strategy to failure. Conversely, we should not wait for our colleagues in the rest of industry to come and tell us what they need. They do not have sufficient knowledge of the capabilities of our

technology. It is difficult for them to imagine what could be done with what we have today.

We must dialogue. We must be prepared to innovate and to brainstorm for a long time. This process will not be fast or simple, but there must be mutual respect. In such an exercise, there is no such thing as a crazy idea or a ridiculous requirement.

We must be prepared to let our imaginations open up to create ideas but we must assess and evaluate and sift through those ideas in the cold light of practicality and cost effectiveness.

Thank you for your attention.

WORKSHOPS

Four workshops of approximately 30 participants were held. Each workshop had a chairman, two animators and a reporter. All workshops worked through the same agenda having the following topics relevant to advanced forestry technology of:

Strengths
Weaknesses
Opportunities
Threats
Actions Required

REPORTS FROM WORKSHOPS

Denis Connor, Science Council of British Columbia

What we propose to do is have reports from each of the chairmen of the working groups. Then we will close with some concluding remarks from myself and my co-chairman Roy Woodbridge.

Conrad Pinette, President Finlay Forest Industries Ltd.

Thanks Denis. Basically, dealing with the strengths, our group felt that we do have the resource base; we are a world-class or a world-scale forest industry so we have economies of scale, the critical mass there to work with and basically it is a low cost, high quality abundant resource. So, we've got everything there to do it. We've also been convinced by the high-tech people that the technological capability and infrastructure is there. We've got facilities in place and very good people and feel that the climate is right to deal with our problems.

On the weakness side, we sensed or were told that there is a tremendous lack of communication - there is a missing link there in terms of communication from the forest industry to the high-tech and from the field to the laboratory. Our attitudes: we have a serious aversion to risk, we are very conservative, we are very impatient when it comes to have something tried or tested, a lot of that being on the wood side in terms of wood delivery from the woods and one that really struck me as being really bad is that we are almost lazy. We have not really defined the technological requirements that we have. We have talked about requiring some new technologies or improvements but we really at many times do not know exactly what we want. We really have

to work at defining that more completely. We seem to have an affinity for foreign rather than domestic suppliers. Often we have old technology coming to us from foreign suppliers because they have tried and tested technology and we're ripe for it and they are moving on the next stage. We are not participating sufficiently with the domestic producers. We are basically, currently, in many cases, a commodity supplier as opposed to value-added, so the indication there is that there should be more thrust into the value-addded facet. We are terribly wasteful with the resource. We were told that within our businesses we do not have the technically trained or competent people to really interface with some of the high-tech people.

In opportunities, we see a high variable input resource that we can turn into a uniform quality product with the right effort. In that context we can increase our position, reduce our errors in terms of the production of our products, and all that can be achieved with the technology that they claim they can develop for us.

From a technological standpoint the things that we thought that have to be addressed, and there is a significant room for an early move to, are: sensors, information processing or the integration of these systems; remote sensing; and robotics. A very specific one is the control of plastics in pulp which is a serious problem and can and should be addressed very shortly. There is a lot more high-tech that can be used in terms of the forest renewal programs. The opportunity is for the technology industry to work with the manufacturing industry to produce for some of these requirements. There is room too for considerable diversification on the part of industry from instead of being a volume producer to some of the engineered products which we hear about.

If we don't proceed with this advanced technology the threats we envisage are: loss of markets and we will lose the access to technology. A serious problem is this on again/off again with the finances with the ups and downs of the markets. When we have the money its there we have some - when its not we don't provide it; so we're losing the continuity. The R&D funding levels are inadequate. A further threat that is linked into all of that is that there is structural change in industry, that we are now very seriously competing on an international basis so we do have to worry about the international considerations and the regions that are developing their technology more quickly and applying it more successfully than we are now.

In closing, the initiatives that our group envisaged - - first, we have got to somehow get an information access from the industry to the technology people. There was some suggestion of a newsletter and really we are going to throw it to the likes of Tony and the other people that are running these various organizations on how we can best communicate to the universities and to the people who are interested in solving our problems. The funding area: we've concluded that it is inadequate and it's inadequate from every conceivable source. We have got to get more money from industry, from government and the suggestion is to provide money for both short and long term and the IRAP program should be pushed forward again so we can source the funding. There was some suggestion that we could look at some consortia to evolve some of these ideas and push them towards application and that was really left as an idea to pursue, but there was nothing absolutely firm on that. In conclusion, there was a suggestion that there should be a much

closer linkage between the Science Council, Forintek, FERIC and PAPRICAN in terms of communication. I think they are doing it currently, but it was one of the comments that came out of the group.

I would like to thank the people that worked with me. It was a very interesting afternoon.

Terry Howard, President, B.C. Research

Our group had an interesting session and I will now try to report it. We followed the agenda fairly closely in terms of what we talked about but we didn't always follow it in terms of how the discussion took place. But we focussed specifically on the first two topics on strengths and weaknesses. In looking at the strengths of the forest industry to take advantage of technology we were very impressed by the size of the industry. We felt that was the predominant and rather obvious but nonetheless real advantage. We also concluded that the timing to take advantage of technological change is very good for the industry, having gone through the difficult times it has and being ripe for another cycle of capital investment and expenditure. It presently is enjoying a somewhat improved cash flow, that it had real strength in terms of moving on technological development right now. Industry we considered to be well-positioned at least for some of its major commodities and thus likely to be making investments. There was a feeling within the group that this is an industry within transition. We felt there were other strengths the industry had. The first one was that it operates in a stable economy which we felt gave us a competitive advantage against some of our world competitors and there was a feeling among the group that within the province of British Columbia we had the asset of labour willingness to participate in change due to technology. We were somewhat encouraged by that. We also felt that the fact that industry had leaned itself down from a personnel point of view meant that it could make rational decisions to build up and incorporate technology.

When it came to weaknesses, we didn't have too much problem coming up with specifics. But I will broach there what was perhaps one of the more interesting parts of our group's meeting. We got repeatedly into a discussion comparing the situation of technology adaptation in British Columbia with that in specifically Scandinavia where at least, allegedly, technology is king and everyone works to incorporate it. The whole concept of a socially democratic system whereby the vertically integrated mill supplier inter-relationship works to helps the manufacturing and supplier companies to sell their product world-wide is obviously effective. Concluding that this is not Scandinavia, we tried throughout our discussion to work out how we could achieve the same net end under the Canadian social and institutional system. I'm not sure we will be very successful but we felt it was important that the question be addressed: how do we provide in our societal constraints the kind of incentive to Canadian manufacturing companies so obviously needed? At the same time we pointed out that there are no manufacturing companies in British Columbia and that is probably a major problem because it stops very small companies being either symbiotic or parasitic with these large companies that have the access to industry.

The second most obvious weakness is that nobody will pay for the R&D to develop new processes and be the guinea pig because of the high cost of down-time. We heard some horrible stories about the problem about commitment

to performance specs to completion that suppliers are forced to make and can't deliver on. Again, the contrast was made with international competitors who tested out their equipment back home and can meet deadlines and performance specs more easily than Canadian companies. There are few equipment manufacturers here and most high-tech innovations are tied to equipment development. There is nothing in it for forest companies to be the first to implement process innovations. We could not make a case that there would be much advantage in being the first. The forest industry has a world view which says they can buy the best technology as and when they need it. The advice from the industrial members of our group is that is the status quo and will continue to be the status quo. That again prompted another re-surfacing of structural and institutional arrangements issue. We got on to a discussion of supplier packages and consulting engineers. Relatively new and certainly attractive to our industrial members was the concept of supplier packages whereby a company will undertake to put together a system with one, two or maybe three brand names and the supporting configuration systems of hardware and what have you and offer performance guarantees on a full-service package. We were advised that B.C. consultants can't compete with this depth of capability and specifically because we don't have manufacturers, we can't compete at all. Again, because no one will fund prototype and pre-production testing, we have to make units which are demonstrably effective right off.

Moving from weaknesses, we went to opportunities. We felt that there was a very obvious niche for B.C. companies and that related to modernization. There was a lot of discussion about this but there certainly is a niche. There is a concern that having met this niche we then don't have a role in the total rebuilding of mills. The second thing was that high-tech companies must realize two things: one, that it's not necessarily the forest companies who are the ones to approach concerning the sales of the development of equipment but quite often the suppliers who may well be foreign nationals. Secondly, that it is satisfactory, indeed desirable, for industries to be number two in using new equipment; and this truism should in fact be observed, but it is very good for them to be number one in developing new products. The example given was Parallam. Clearly, we felt that in the Parallam case where we are competing with steel and other products, that the B.C. industry was capable and visionary as anybody else to see market opportunities. In that regard, we came up with a recommendation that smaller companies in particular had a need for real information on what might sell to the industry and then they would worry about the marketing. We recommend that there be a study of the needs of the forest industry and that this initially access chief executive officers. It should be carried out and be made available to technology companies. In our discussion on who should do this this came out it was not well resolved but I think there was a slight preponderance of opinion that it be best done by one or more consultants. MOSST was recommended, so was Forintek, as people who could do it.

When it came to the question of threats to forest industry in not using technology, we were a bit of a damp squid on this. We really felt that industry is adapting to technological change and has an inherent capability to continue to do so. It has market pressures to do so and it is quite well aware that it competes in world markets. Thus, there is no special threat from a incorporation of technology nor is there special pressures to use B.C. high technology preferentially.

In that case we recommend forums for industry problems to be put to the high technology companies and we suggest that a database be established on the technological needs of the forestry industry. There was a lot of laudatory comments on John Madden's briefing document. In the area of institutions and government we generalized that they are solitudes in government, forest industries and high technology companies. We recommend that there is a desperate need for a clearinghouse for information sources and a desperate need to enhance communications. In view of the fact that one of the cornerstones of the National Science and Technology Policy is to create a science culture in Canada, we recommend that consideration be given to prying out some funds to service B.C.'s number one industry. Finally, it was suggested that by some mechanism we stimulate joint ventures between universities and the forest industry and the need for trade shows both of technology availability and technology needs for high technology companies, university and industry bodies, Forintek, B.C. Research, and others. Overall, we concluded that there is an appalling lack of liaison and information transfer between high technology companies and companies to license to. We recommended that there be an IRAP officer appointed to service the needs of suppliers, particularly small and medium sized suppliers to the forest products industry of British Columbia and that this be administered out of Forintek. Then we were delighted to hear that this is exactly what is going to happen in 30 days. So, it obviously was a smart decision to do it. I'd like to thank the group and we had a good time and I found it an enjoyable day.

Denis Connor

Thank you very much Terry. It's nice to see that some of your initiatives are being responded to so quickly. The man who is responsible for this is next, Tony French from Forintek.

Tony French, President, Forintek

I think we had a lot of fun today too. I really appreciate the help of my group. It was rather light on the forest industry side; one company was represented - and a extremely large number of people from government, university and the advanced technology sectors.

Some of my comments will repeat the previous speakers. We may have somewhat of a different angle.

Strength

- We had many comments on the sheer size of the forest industry and the volume of money it commands;
- We also touched on the thought that the forest industry has a very effective international trade structure which exists at the moment and could provide a good opportunity or good infrastructure for secondary spin-offs over time;
- When we were talking about strengths, the work "adversity" kept coming up - adversity as a motivator. Examples were given of how the Interior industry in the lumber sector has been very successful in improving its productivity because it was scared to death several years ago by high labour rates. A few other examples were given where wood costs went very high in the Pacific Northwest and there was some moves to deal with those kinds of issues too. This point kept coming up over and over

during the day - and maybe it is something we should not take too casually;

- Canada has an established identity as a world leader as a commodity producer - that was clearly understood;
- We talked quite a bit about our current knowledge base or our current education base. Knowledge was generally perceived to be adequate in the forest industry to apply technology but not adequate to effectively innovate and make its own technical decisions;
- Good political strength exists in the industry, but lots of cries of agony - why can't the industry get its act together in a more effective way with a more common voice and focus on some common technology goals?
- There are clearly a number of world class examples in innovations in our industry. We should be proud of them and should build upon them;
- From the electronics side, the electronics industry is becoming large enough to address international market niches. Their education base is good but there was a lot of agony about the sheer volume of people in this sector - not enough. The knowledge base that is there is excellent but there is nowhere near enough of it. The fact is that the electronics industry or the advanced technology industry does today co-exist with the forest industry albeit imperfectly at this time. They are good at adapting technologies from other countries and we have a number of world-class examples of electronic industries that have been successful. Once again, the numbers may be small but the success is clear and we must build on success;
- And finally, the advanced technology people seem to have numerous solutions ready for use or adaptation. I hesitate to suggest looking for problems but that was the area of discussion.

<u>In the area of weaknesses</u>

- From the forest industry point of view, there seems to be a perception that there was a lack of a good attitude by its industry leaders, its CEOs, towards technology needs and opportunities. There are some exceptions, but generally speaking there seems to be a lack of positive attitude;
- There are considerably poor communications between the advanced technology sector, the supplier sector - the machinery and equipment suppliers - and the industry. More importantly, as John MacDonald indicated this morning, a lack of clear understanding of philosophies and a lack of acceptance of different philosophies between the sectors. That is a serious weakness;
- The forest industries are generally perceived to be technologically unsophisticated;
- Lack of national or provincial goals regarding technology was a subject that we talked quite a bit about. Many of you know there is a lot of discussion in the province on science and technology goals and priorities. Even at the national level there is a strong requirement;
- The comment about barriers to international trade resulting from government standards and regulations, these are Canadian government standards and regulations, particularly regarding production of new products;

- The attitude "If I can buy it, why invent it?" Of course, that does not do anything to develop a domestic supplier community;
- The electronics side is generally viewed as being rather fragmented, without a clear marketing focus towards the forest industry;
- The perception of volume not being adequate in the forest industry was discussed quite a bit. The electronics and advanced technology people seemed to have a very high need for large volume markets. The forest industry does not see that sort of thing in its business.
- Fairly heavy dependence on government subsidy makes it a little difficult for the forest industry to get the best mileage out of the sector. High-tech firms tend to be problem solvers rather than market oriented suppliers. There are some exceptions but that tends to be a characteristic of the sector.

Moving Onto the Threat Area

- The world around us is changing, we must accept this; our forest industry is changing domestically; but internationally forests are looking different - there will be different sources of timber supply in the next few decades and we have to be aware of this kind of globalization;
- Protectionism is growing;
- International competitiveness is a serious issue;
- We do not have a good advanced technology base in our country, how can we expect to be able to trade intelligently with other countries? We have in the forest industry traditionally a very wide open industry - we tend to share information back and forth between mills quite freely. But as one rises in the knowledge base, the more tendency one has to learn from other sectors, and become proprietary-oriented. Electronics industry people understand that business very well of course. Again, John MacDonald remarked this morning, being first into the market is extremely important to them. Market lead times are also extremely important. So if we don't have our own infrastructure, how in heaven's name can we expect to trade effectively in the future. Even if we are good at buying and applying? We may not have that opportunity.

In the Opportunity Area

We produced lists and lists of opportunities. I think most people present had a good appreciation of where some of the opportunities lay. I will summarize them in five broad areas:

- The existing knowledge of people in existing advanced technologies; let's get the technology transfer process running. Let's not be too ambitious about creating new and magnificent things. We've got an infrastructure - let's build on it and get it moving;
- We talked about the comments Tom Buell made this morning on improving management information and communications generally throughout the industry. Which lead to thoughts such as avoiding duplication of effort; a number of examples were stated and given about huge

duplication of effort because we don't communicate well - all the way from the forest to the finished product - no exceptions at all in that area. I think the Weldwood example is something that everybody should think about very seriously. I know some other companies are doing the same kind of thing but there are not very many;

- The third area focussed on improving the production processes, striving towards modifying existing ones and eventually to create new ones. We listed new opportunities from the forestry sector right through the lumber, plywood and pulp and paper.
- The fourth area was to start to focus on product differentiation. Product differentiation is the next logical step from our high volume commodity based industry to go after specific niches. We talked about the lumber area, where better engineering knowledge will get some of our lumber products into different and new markets and new uses for wood.
- And finally, in the opportunity area, it was very clear from our discussion that for the advanced technology people, those technologies that are good for the forest industry are frequently good for other industries as well. The point was made on logging harvesting equipment and how a lot of it had been modified to be specific to the forest industry but the base machine is frequently used in other industry sectors as well. The advanced technology industry people shouldn't lose heart if the forest industry market isn't big enough, be aware that there is ample opportunity to produce control systems that could be applicable in other sectors.

Action List

- The last question, which we called our Action List, is where we spent most of our time. First point, there must be a much stronger emphasis on strategic procurement by large industry. We were really building on the discussion this morning by John MacDonald on how much front-end R&D is funded through government contract. Generally the feeling was that this should be supported by government but it should not be government procurement. All of this is designed to focus on opportunities for technological advances. We need to do more to encourage joint ventures between forest industry and advanced technology sectors; there is nowhere near enough. It leads to much better communications between us and much better definition of opportunities. A strong pitch - why don't we use some of the 15% lumber export duty money to facilitate linkages between our two sectors? Our group questioned why should money of that nature go into general revenue, when we have such a tremendous need in both of our industries;
- In terms of a provincial or national strategy, it's important to focus an industrial strategy on the forest industry and the advanced technology industry - two industries that basically need help. Help in the sense that the primary sector of the forest industry, with the exception of the last couple of quarters, has for some time been a marginal industry albeit a very successful one over long periods of time. The advanced technology industry also has its more than fair share of problems at the present moment. Here is a golden opportunity

for two industries that are co-existing to be given a strong government focus as an industrial strategy to bring them together for their mutual benefit. That's the kind of thing which has been successful in the past through government initiative and government leadership. It must happen in the future;

- A strong plea was made to encourage better "working together" if you like, between universities, within universities, but certainly between universities and the knowledge sectors. There tends to be a certain degree of competitiveness which is not necessarily healthy. We should be working on more clearly focussed goals for the benefit of our mutual interest in the two sectors. Once again, as an industry we must convince both government and the universities to focus more sharply on the forest industry as a priority. This leads to the criticism perhaps of our industry that we do not do a good enough job of focussing on our own needs. Views were expressed that can be best summarized as helping our forest industry leaders, our forest industry CEOs, to be more understanding of the economic returns that can accrue from advanced technology opportunities. There is no point in beating them over the head and telling them bigger is better or that advanced technology is better, we've got to show them where there are some clear economic returns and entice them to take some strong leadership in this area. In the area of education, there are strong feelings that we should be doing more in cooperative education, particularly in the area of applied sciences and engineering to enhance the forest industry focus. There was discussion on the technical university concept - MIT and a number of the European universities - but a real need to focus more sharply in the education area on the technical university concept;
- A recommendation was made that a review be done of the advantages to be gained from a stronger secondary manufacturing industry linked to the primary sector as a means of moving our primary focus - the wood products sector;
- And finally, a very strong need for much better linkages between the advanced technology community and the machinery community sectors with the forest industry. Organizations like Forintek, FERIC and PAPRICAN and perhaps universities, build better and stronger linkages in this area to create the opportunity for dialogue, create the opportunity for workshops and seminars. The bottom line is to develop a shared vision, to develop a set of common goals which we can all strive towards.

I would like to thank my group for their patience and I hope I have reasonably represented what they have said and look forward to hearing the next speaker.

Denis Connor

Thank you very much Tony. Now I would like to introduce our final speaker, Per Delshammar.

Per Delshammar, President & CEO, CETEC Engineering Company Ltd.

In the value-added area there is a substantial potential opportunity for development of new technology and machines to actually produce value-added product. In the areas of threats, if the forest industry does not have access to advanced technologies, one is the threat in "always" following the lead of someone else. If we don't develop the capacity to be leaders in technology in this industry we will by definition be followers. And being followers always means being less competitive. That of course poses a significant threat. Another one is that changes in the environmental side which pose a threat to the present Canadian practices. One specific area is how we treat lumber. This is now being outlawed in many areas.

On a more interesting aspect, that is definition of initiatives and actions, we believe that it's essential, as stated by the three speakers before me, to create a vehicle for the transfer of technology. One way of doing this as we discussed is to broaden the scope of the three institutions - Forintek, PAPRICAN and FERIC - to include some kind of associate membership of suppliers and high-tech companies; thereby providing a forum for this transfer of technology and maybe more importantly the transfer of needs from the industry to the industry which can provide a solution to these needs. We also discussed the use of the export tax as a way of funding some of these activities.

It is essential to develop a long term strategy for identifying the real problems and goals for the industry and by doing that we can provide necessary targets for the high-tech industry. We believe that this area of defining goals and problems could be an area for special funding for instance through the lumber export tax. One particular area which we saw a lack or deficiency today is the funding by the governments for definition of problems in industry. There are ample situations or grants provided for development and research, but nothing to try and identify the real problems that have to be addressed.

A particular suggestion related to creating something which is similar to what we see in Japan for instance, in the Fifth Generation Computer project; the government has gone together to define very ambitiously this fifth generation computer and we think that on a very more modest scale with a similar effort the industry could go together with the institutions the universities and the supplier industry to define what we call a "Sawmill 2000" a future sawmill which could act as a model for the future, not only defining specific technology but possibly more importantly to define the new methods and procedures for breaking down logs than we do now. By defining this framework we would provide a vehicle to set specifications for future products. This should then be disseminated to all advanced technology companies in the province or in the country, thereby they would have some guidelines on what really to direct their development efforts in the future.

We believe that this seminar has been a first in setting some kind of forum for bringing high-tech or advanced technology companies with the forest

products industry. We believe that it will be effective only if there is some form of continuation. We don't believe that this kind of meeting will be effective unless people meet on a regular basis. We discussed the possibilities of continuing the dialogue between the advanced technology industries with the forest industry but by having the former contact the various forest industry companies in particular those which have shown an interest in high technology. We felt that having a large number of high technology companies individually approach a limited number of forest industry companies would very quickly wear them down and the doors would be shut. So, it is essential to form or establish a means of meeting which is not based on one to one contacts. We believe that regular sessions sponsored or initiated by a combination of Forintek, PAPRICAN and FERIC could be such a vehicle.

And finally, we discussed that we increase grants and government funding. The consensus of our group was that is not effective unless it is done on a matching basis. Just to have grants for a research project entirely paid by government is not effective - it has to be done on a shared basis. That is a summary of our discussion - lots was said - it was an interesting discussion and I thank my group for a very interesting day.

Denis Connor

Thank you very much Per. Tony informs me that we have had another hit - apparently the Forintek Board will get a recommendation in June that they establish an associate membership for supplier companies. So, two initiatives already responded to.

I would like to thank everybody who has participated here today. I feel it has been a very positive and extremely forward-looking session. I think it has hit at a very appropriate time where the forest industry can start some forward looking, now that the bottomless pit seems to be behind them. And I think that the advanced technology industry similarly is in a position to be credible in the eyes of the forest industry as potential suppliers, maybe not for this generation of equipment or this wave of buying although there is some of that from the existing technology companies, but most assuredly could start now on the development of equipment that will form the basis for the next wave of buying, let's say in the early '90s. I think the session today can only be viewed as a first step.

What really comes to me as the fundamental message from this session is that we have got to increase the level of communication between the forest industry and the advanced technology community. It is quite evident that a fundamental vehicle for this is the three research institutions that the forest industry has established and exist here today. As Chairman of Science Council I would certainly undertake that Science Council will do everything it can to improve those communications. We will work strongly, as we have in the past, with those three institutions to improve communications. I think the next event should be some further session that focusses more specifically on opportunities on the one hand for forest industry products and processes and on the other hand provides some greater information on the capabilities of the advanced technology community. A final point is that one of the key elements that comes out of our discussions is that we need to identify mechanisms for reducing the risk threshold. In other words, reducing the risk threshold which the forest companies are prepared to take to be first out of the gates

with a new product or process. That mechanism needs to be defined in discussions with government, the forest industry and the technology industry. I will now turn it over to my co-chairman for a few remarks as well.

Roy Woodbridge, President, Canadian Advanced Technology Association

I just want you to know that I am absolutely delighted with what we've accomplished today. When I think back to when we began to plot this initiative, the original ambitions were very limited. All we really wanted to do was to try to improve the dialogue between the forest sector and the advanced technology sector. It is quite clear that we've accomplished that at the beginning. I'd like to compliment the excellent and very competent reports of the chairmen. It provided a lot of grounds for confidence in our ability when our sponsoring organizations get together in a couple of weeks to knock heads to see what we've really accomplished today, that what's emerged is a very sound and practical basis for building on today's initiatives. So, I'd just like thank you all for coming, for contributing your ideas, and look forward to your continued participation in this ongoing dialogue if in fact we are able to target and structure activities that emerge from today's event.

GUEST SPEAKER

The Honourable Frank Oberle, Minister of State for Science and Technology

I have at least three reasons I am happy to join with you in this Forum on Forestry and High Tech.

First of all, forestry is and has been one of my most ardent interests. Indeed, forestry goes to the very heart of our country's culture, of our nation's identity.

Through my ministry, I have been able to sponsor this special encounter of you who are involved in advanced technology with you who are involved in forestry. I appreciate very much the B.C. Science Council and the Canadian Advanced Technology Association for their work in organizing the Forum.

And finally, it is always great to be home in British Columbia.

The Importance of our Forests

Perhaps we out here in the West are biased. But is there any doubt that across Canada, our forests support our country's most important economic sector? That our forests are our most precious national asset? Forestry contributes so much to our foreign exchange earnings, our tax revenues, our employment opportunities, our gross domestic product.

* The value of our forestry shipments runs well over $20 billion. If we add logging, the figure is $30 billion.
* Nearly a million Canadian workers are dependent, either directly or indirectly, on the forest sector for their jobs - - one job in every seven.
* 300 Canadian communities derive their sole livelihood, their very existence from forestry.
* Canada is first in the world in forest exports, in newsprint production.

* We are second in pulp production, third in softwood lumber output.
* Forestry is the largest contributor to a positive trade balance, and is vital as a source of foreign exchange, outstripping the combined net contributions of mining, agriculture, fisheries and petroleum.
* The forestry sector is the largest purchaser of manufactured goods in most Canadian provinces.
* The forestry industry generates $1 billion in federal taxes, and another $1 billion in provincial taxes.
* The forest biomass in Canada is the energy equivalent of 87 billion barrels of oil.

These are just some of the direct benefits.

Now try to imagine a Canadian tourism sector in a Canada without forests.

What would happen to our soils, our water supply, our environmental quality in a Canada without forests?

Despite all these benefits, we as a nation have taken our forests for granted.

Despite the deep emotional feelings we Canadians have for our forests, we have neglected and abused our forests.

Despite the realities which confront us, we are learning that our forests may not be forever. In fact, forestry is probably the most threatened sector of our economy.

The threats come both from within and without.

Important Shifts Have Taken Place

In the domestic and international marketplace, important shifts have taken place: demand is decreasing; costs of production are increasing; prices do not cover the gap. Optimistic projections of growth have been stunted by unforeseen realities.

Those who have regarded these problems as just a brief glitch in a short-term cycle now recognize that they are facing something more serious, something quite permanent.

We have new competitors who enjoy favourable climates for production; our customers have become producers; our wood products are being challenged by new materials, new processes.

We are finding we sell too few commodities in too few markets at too low a price.

Inside Canada, we are finding that the image of inexhaustible forests is pure myth and we face regional shortages of commercial wood in every province.

The reasons are not difficult to find.

Some of us have never gotten over an unfortunate cultural attitude which has caused us to view forests as obstacles to development which must be cleared away as rapidly as possible. Our lack of foresight in management and renewing forests has put premium softwood logs in the same category as such non-renewable resources as petroleum - - and the end of the wealth is in sight. We have already seen it happen with our high quality hardwoods.

Sir John A. Saw the Danger

It can come as no surprise - - John A. MacDonald saw it coming 116 years ago when he said: "The sight of immense masses of timber passing my window

every morning constantly suggests to my mind the necessity of looking into the future of this great trade. We are recklessly destroying the timber of Canada, and there is scarcely a chance of replacing it."

The day of reckoning which Sir John A. prophesized has arrived. There are no more hills left over which we can climb to view a new stand of timber. The last frontier of forest has been crossed, and the only new frontiers available to us are those which lie within our minds.

It is our minds which can cause us to adopt new healthy attitudes. It is our minds which can cause us to be innovative, to explore new technologies, to take bold measures to carry us into the future.

A Mental Shift is Required

There is no doubt such a mental shift is needed, backed by a commitment of resources.

The University of British Columbia's Forest Economics and Policy Analysis Project is warning that significant portions of B.C.'s forest sector will be economically obsolete unless there is intensified investment in new technologies. The seriousness of that gloomy forecast can be seen when we note that here in B.C., forestry still accounts for 50% of all manufactured goods.

Unless new forests replace natural forests, unless we look ahead to our needs twenty and forty and a hundred years ahead into the lives of our children and grandchildren, history will know us more for our greed and lack of vision than for our having been number one in 1987.

Unless we end our carefree attitude and take decisive action both at provincial and national levels, our most precious resource will be nothing more than a precious memory.

The Neglect of Science and Technology in Forestry

But we have another serious attitude problem which must also be changed. The neglect of science and technology in our forestry sector is as serious a problem as our neglect of renewing our forests.

Can it be true that despite the importance of our forests to our economy, Canada spends less than seven-tenths of one percent on R&D, less that half that spent in the U.S.? less that Scandinavia? less than New Zealand and Japan?

Would you believe that a single U.S. company spends more on R&D alone than the entire budget of the Canadian Forest Service?

Can it be true that a nation with the forests which Canada has has so few professional foresters? so few forestry researchers? Our chief competitors have one forester for about every 15,000 hectares forest; Canada has one forester for every 450,000 hectares.

And why is it, we must all ask, that the private sector supports only 39% of the small amount - - much less than $200-million - - that we spend nationally on forest R&D?

Yet there is so much which could be done, which must be done.

What Technology Can Do For Forestry

Technology can help us develop new products and upgrade manufacturing operations and discover new forestry-based materials to meet the needs of new markets.

Technology - - especially biotechnology - - can help us renew our forestry resource, to ensure supply for our mills and plants, to develop new or improved products.

Technology can help us become more efficient producers and more efficient managers.

Technology can help reduce the need for toxic pesticides and herbicides.

Information technologies can give us analysis on climate, weather, growth and other data useful in management.

New jobs can be produced in silviculture.

We already have seen the value of new technologies in the few areas where we have applied it. Canadian companies are among the most efficient in the world when it comes to getting wood from forest to mill. We have seen the results obtained by those firms which have installed and perfected state-of-the-art electronic and laser technologies. Especially in the interior of this province, the sawmilling industry has stayed on the leading edge of technology.

Opportunity Awaits the Entrepreneurial Spirit

I see a real opportunity from the marriage of high technology and forestry to develop and produce the next generation of machinery and equipment. Surely we cannot forever rely on foreign suppliers for most of our machinery needs in a major Canadian industry. When we consider that here in Canada we have yet to produce a chainsaw, we can see that we have nowhere to go but up.

I see opportunity if we view our forests in a holistic manner: which welcome rather than discourage other users: wildlife habitat; tourism; reserves of fresh water and air.

I see opportunity in reorganizing the industry and I predict that the successful company of the future will have as many people working in silviculture as they have working in the mill.

The company of the future:

* will have its own research department;
* it will be a partner in strategic alliances with other companies, other countries, with universities;
* it will be proactive in developing a manufacturing sector to produce equipment needed in the industry custom designed to our specific requirements;
* it will spawn off small companies making high value-added products with its raw materials;
* it will adopt a world market approach with a variety of diverse products which incorporate wood fibre in new compound materials.

Perhaps I am preaching to the converted. After all, you are here at this Forum. But perhaps we need to join forces to convince our colleagues - - those of you in high tech to see the opportunities and obligation to address

the needs of the forestry sector; those of you in forestry to demonstrate that R&D is an imperative, not a luxury or a frill; in other words, that forest managers must become technologically-oriented innovators and that scientists and engineers must become oriented to the forestry sector.

The task is not altogether an easy one. We must find new mechanisms to work together. Stronger links between your two sectors must be developed.

We need new national goals and priorities for new applications of existing technology and for developing future technologies.

Programs to encourage R&D by industry are already available from the Canadian Forestry Service and the National Research Council.

New policies recently adopted by the government relating to science and technology have as much potential for developing forestry as they do for developing the aerospace industry.

S&T: A Central Focus of This Government

Since this government took office less than three years ago, S&T have been a central focus of attention. We realized that our ability to meet our objectives of economic renewal, of national reconciliation, of social justice, and of constructive internationalism depended in large degree on whether science and technology could be utilized to build on Canadian strengths and overcome our weaknesses.

We faced serious constraints and striking deficiencies.

You know, in retrospect, I think that one of our most serious constraints may have been a blessing. Often people in government - - both politicians and bureaucrats - - try to solve problems by throwing money at them. They traditionally have been attracted to the quick fix, the classy flashy package.

But our Party received a massive mandate because of our expressed determination not to mortgage the future of our children beyond redemption, not to continue spending beyond our means. We were determined to arrest the cancerous growth of our national debt.

While this meant that we could not make dramatic press releases of new programs, nor please interest groups with handouts. Fiscal restraint forced us to face fundamental issues which had been avoided for decades.

First of all, we had to face up to the fact that Canada had no national policy on S&T, no consensus on our priorities amongst governments and sectors, no agreement to facilitate cooperation, no agenda for action, no collective will to address serious challenges.

Many of you will recall participating in the exhaustive and complex consultations which were necessary as we sought to bridge that gap. The result was an historic agreement reached in Vancouver on March 12 by federal, provincial, and territorial governments on Canada's first National Policy on Science and Technology.

The policy is designed to use science and technology in a constructive enlightened manner to strengthen all Canada's regions, to develop a science culture in Canada, to increase research and development, to help small firms involved in technology, to develop new technologies which are strategic to our economy.

Putting the Private Sector Back in the Driver's Seat

A second reality we had to address is that even in good times, the Canadian economy produces only a finite amount of money which can be set aside for research and development. If an excessive portion of that money is appropriated by government to itself that reduces the amount of money available to the private sector for research and development activities which must be done close to the workbench and the marketplace.

We discovered that for years with regard to R&D, generally the federal government had taken over the field while the private sector had taken the back seat. Not only were federal laboratories doing R&D which is appropriately done by the federal government, but Ottawa had been borrowing money and using tax dollars to finance R&D activities which is regarded by most nations as being efficient only if done by the private sector.

That is why a second step which we have taken is the development of a federal strategy which supports the private sector in using science and technology as a key force in Canada's economic renewal. This strategy, which has been named "InnovAction", is designed to use federal powers and resources to enhance government-industry cooperation, to stimulate industrial innovation, to facilitate diffusion of technology.

The strategy is designed also to develop and use leading-edge technologies to broaden our industrial base, to identify and secure appropriate niches in the international marketplaces.

We intend the strategy to work toward simultaneously achieving a greater degree of diversification of our economy to make us less dependent on our resource industries, while at the same time revitalizing our resource industries and the communities they sustain.

The strategy also focuses on developing sufficient numbers of highly qualified personnel, on ensuring positive adjustment to technological change in the workplace, on encouraging cultural attitudes which place a high premium on scientific and technological achievement.

Over the next few weeks and months, you will be hearing about concrete programs emerging from the National Policy and from the InnovAction strategy. These programs will complement the other initiatives we have taken:

* there are the ERDA agreements on forestry which we have made with the provinces;
* there are the new mechanisms we have put in place for funding researchers which encourages private sector/university linkages;
* we have put into place a framework to assist us in the wise and effective management of the $4 billion which is spent annually on S&T by the federal government.

All in all, the signals we have sent are as clear as they are powerful - - there is a determining role for the private sector which will receive very strong support from the federal government.

Partnerships in Exercising Our Responsibilities

You have a unique opportunity to exercise your responsibility to help our society realize its historic opportunities as we move toward the 21st century.

You have the opportunity to build the awareness of all Canadians of the shifts taking place which will so dramatically affect their lives.

Together, we have the opportunity - - indeed, the responsibility - - to help educators prepare our youth for a world very different than that in which you and I were born.

You can join with the federal and provincial governments and other sectors in shifting the cultural outlook of Canadian so we take more pride in scientific and technological achievements, so we can take part in decision-making and debate on vital scientific and technological issues.

Governments and the private sector have a shared responsibility to help in retraining of workers who attained skills for a lifetime of employment but which now are in diminished demand.

We have a responsibility to ensure that the workplace of the people who make your industry tick is a healthy and comfortable environment.

I assure you that the Prime Minister and my colleagues realize the potential which you are nourishing, and we support and encourage you in your efforts.

My colleague, Gerald Merrithew, Minister of State for Forestry and Mines, has demonstrated his commitment.

My own support is sincere and wholehearted.

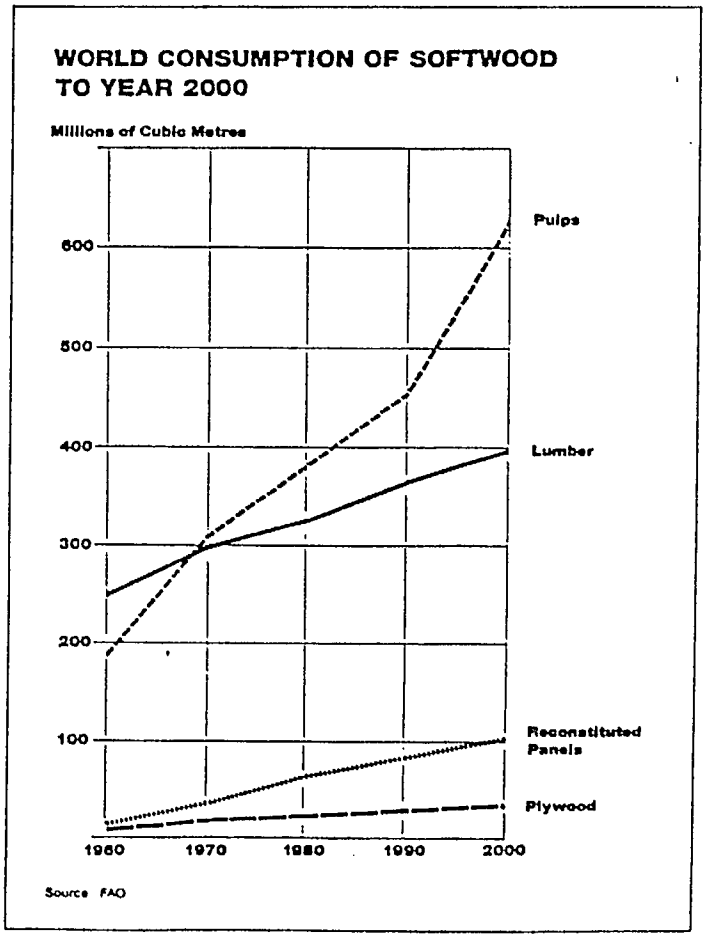
In the context of the government's strong commitment to science and technology, we fully understand the importance of your industry in the Canada of today and in the Canada we are building for tomorrow.

Please accept my best wishes for a most successful Forum.

Thank you for listening to my words.

DISCUSSION PAPER

EMERGING TECHNOLOGIES and THE B.C. FOREST PRODUCTS INDUSTRY: A SUMMARY GUIDE



EMERGING TECHNOLOGIES AND THE B.C. FOREST PRODUCTS INDUSTRY: A SUMMARY GUIDE

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THE FOREST PRODUCTS INDUSTRY IN OUTLINE

The attached pages are intended to provide a thumbnail sketch of the activities associated with the forest products industry in British Columbia, along with a similarly abbreviated indication of areas where new technology needs to be applied.

It is designed to serve as a background "orienting" paper for executives in a restricted range of "high tech" industries who will be meeting with executives in the B.C. forest products industry on May 14, 1987 under the sponsorship of the Canadian Advanced Technology Association and the B.C. Science Council to explore ways that high technology might be usefully exploited to mutual benefit. No attempt has been made to "cover the field" of high technology. Rather it was thought to be more productive to limit the family of high technology areas which would be considered to the following:

1. Monitoring and Control Instrumentation (M&CI)
2. Control Systems
3. Robotics
4. Software
5. Telecommunications and Remote Sensing (T&R)
6. Other

Biotechnology, for example, has not been included, despite its obvious importance, on the grounds that it could more properly be the subject of its own separate study and conference.

As with any thumbnail sketch of a complex area, a lot has been left unsaid. The reader should be aware that where statistics and percentages have been given, they are approximate in almost all instances. They have been included with the objective of providing an order of magnitude sizing of the activity involved, not

with being a source book for statistics. Nonetheless, the writer has endeavoured to be as accurate as possible, and would be grateful if any substantial errors were reported to him.

The data included in these pages is a compilation of information supplied in the first instance by Forintek, Paprican, and MacMillan Bloedel Research, and enriched by a variety of personal interviews. The graphs and charts which appear on the cover and elsewhere in the report are copied from the British Columbia Forest Industry Fact Book for 1986, produced by the Council for Forest Industries of British Columbia, with the exception of the chart on the following page which is reproduced from a report by Allen Hopwood Enterprises Ltd. entitled "The Potential for New Technologies in Canada's Forest Sector", (March, 1986).

Financial assistance for the preparation of this discussion paper was provided by the Federal Ministry of State for Science and Technology.

The writer has had valuable technical assistance from a number of quarters in the preparation of this document, but he wishes to acknowledge particularly three members of the conference steering committee who were especially helpful in providing guidance, knowledge and advice. Without the assistance of these three - Tony French, Jim Rogers and Phil Cottell, production of this paper would not have been possible. Any responsibility for errors or omissions however rests with the writer.

John C. Madden

March, 1987

THE OPERATING ENVIRONMENT

There is no agreed upon standard set of environmental specifications for equipment designed to work in the forest products industry, in part at least, because there are a variety of different environments encountered. In general however, operational equipment is expected to function under the following conditions:

Temperature Range: -40 to +50 deg. C.

Humidity: 0 - 95%

Vibration: May be severe.

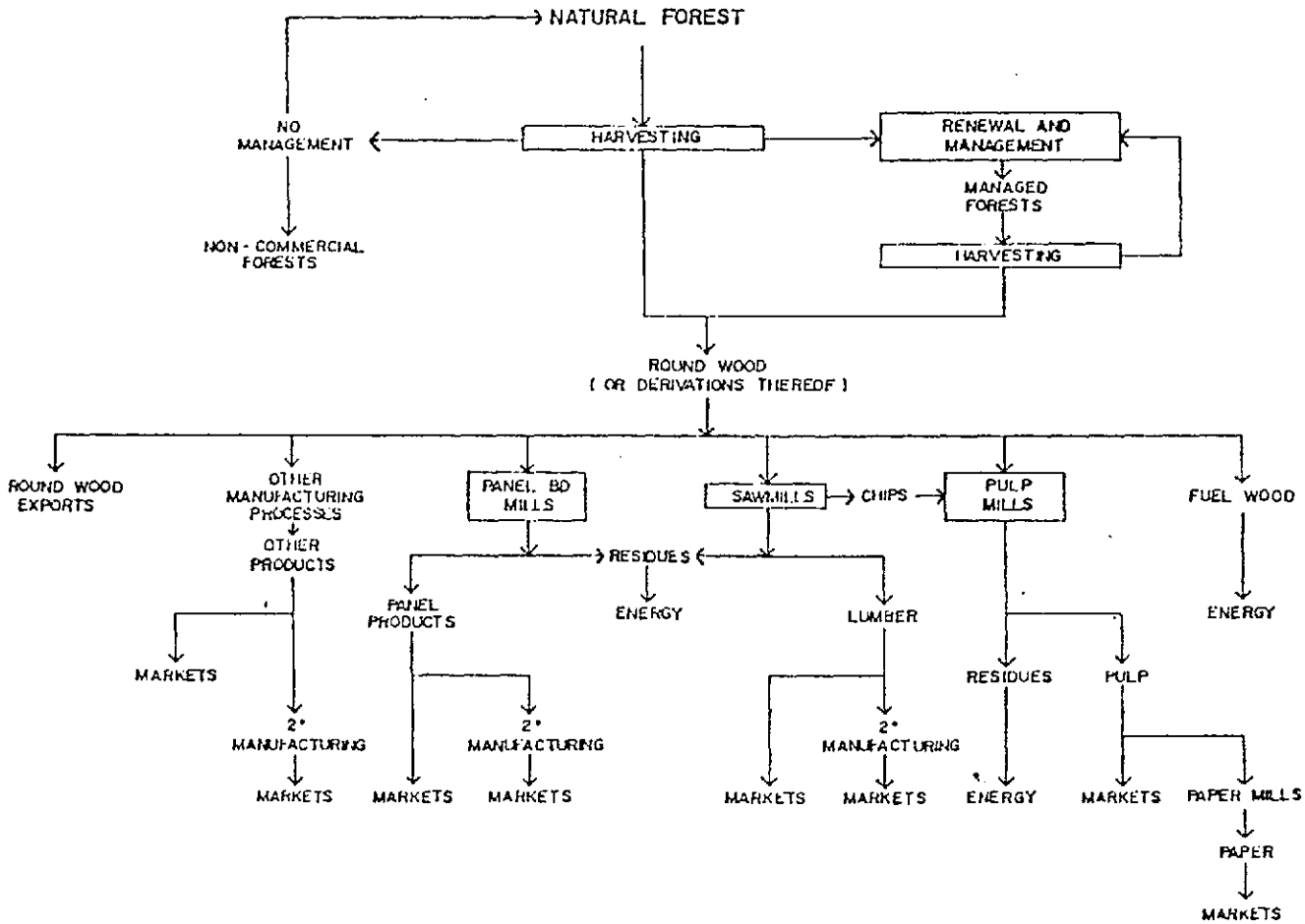
Moisture: Water proofing or water resistance required for many applications.

Dust: Dustproofing and provision for immunity to dust accumulation required for many applications.

Instrumentation which is designed for lumber kilns, and which cannot be remotely located, needs to be able to operate at 115 deg. C. and 100% relative humidity. Similar conditions prevail in other areas of pulp and paper mills. Equipment designers need to be aware of potentially unusual specifications such as a requirement that equipment can be operated with heavy gloves, or in a high noise environment, or that it be able to sustain a mechanical impact or shock.

FIGURE 1

SIMPLIFIED SCHEMATIC
OF
CANADA'S FOREST SECTOR PRODUCT FLOWS



PRIMARY SUB - SECTOR

FIGURE 1

From: Allen Hopwood Enterprises Ltd., "The Potential for New Technologies in Canada's Forest Sector", March, 1986, p. 45

I. FOREST MANAGEMENT

A. Silviculture and Inventory Planning

(8% of Forest Management and Harvesting Costs)

Description

Innovations Required

INVENTORY & TIMBER SUPPLY PLANNING

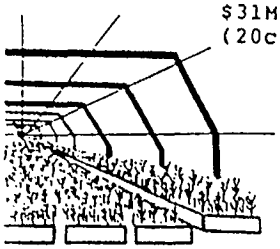
1/2%
$5M

Most timber harvested today is still first growth, but a rapidly increasing effort is being expended in reforestation as well as in better planning and management of the remaining first growth forests. The most important decisions are those related to the rate at which cutting of the stock of timber is permitted in order to achieve a "sustainable yield". About 94% of commercial timber is on crown land in B.C. Dollar figures in the left hand column are based on provincial gov't expenditures in 1984/85.

1. Critical sustainable yield decisions currently made on the basis of simple for regeneration models. Furthermore, wh funding for reforestation and better invent management is growing rapidly, there is a stro possibility that the funds could be better spe if better models of the forest environment we available. Careful planning before criti reforestation decisions are made can yie enormous dividends when the forest is ready f its next harvest. At stake are billions of dolla of revenue in 40 to 100 years, as well potential changes in allowable harvests on yearly basis. (Software)

NURSERY OPERATIONS

3%
$31M
(20c/seedling)



Includes seed collection, genetic improvement, growing and packing seedlings for planting. Approximately half the seedlings used in B.C. are grown in government owned and operated facilities. The rest are produced by contractors or by the larger forest products companies.

1. Seedling greenhouses are already qui highly automated. The principal suppliers a greenhouse companies already supplying ti traditional vegetable and horticultural markets

2. Seedlings are sometimes overstressed pri to planting, often, but not always, durin transportation to the planting site. A method detecting seedling stress either by direc measurement (e.g. chlorophyl fluorescence), by monitoring the temperature and humidity whole truckloads of seedlings during transit ar storage would be helpful. 136 M seedlings we planted in B.C. in 1985. (M&CI)

BASIC SILVICULTURE
4%
$47M &

INTENSIVE SILVICULTURE
1%
$12M

Consists of site surveys, site preparation for natural regeneration or planting, brushing and weeding of young stands.

Intensive silviculture is the term used to describe activities where special additional reforestation work is required, such as pre-commercial and commercial thinning, site rehabilitation and fertilization.

1. Higher resolution remote sensing to perm checking for planting survival, plant healtl timber typing and brush control. Currer resolution of about 50 m. (from satellites) coul usefully be improved to 1 m or even 3 cm.(About $5M p.a. is currently spent o helicopter and "on-the-ground" surveys.) (T&R)

2. Inexpensive radio telephone system fo field use equivalent in quality to cellular radi There is also a rapidly growing need for mor reliable data communications. (T&R)

B. Stand Protection

(7% of Forest Management and Harvesting Costs)

FIRE & PEST MANAGEMENT

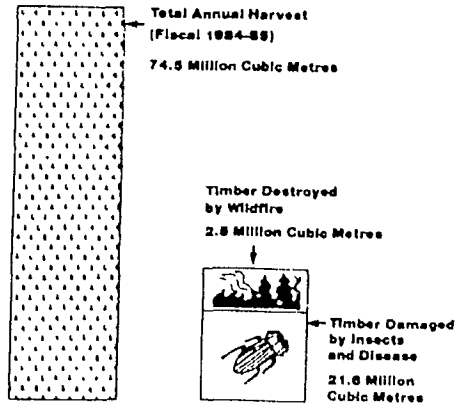
7%
$70M

Protection of stands from fire and pests. Timber area lost to pests and fire is roughly equivalent to one third of the timber area harvested. About 80% of the damage is from insects and disease, with the remainder of the damage being from fire. This latter is of course highly variable from year to year. Early detection of problems is crucial to reducing losses.

1. Better topographical maps and photograph Much higher resolution maps are becomin available from military sources, but new an complex software is needed to derive maximu advantage from them. (T&R, Software)

2. Remote sensing of pest infestation. (T&R)

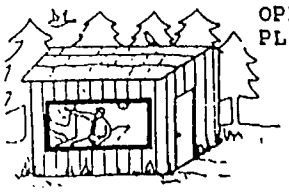
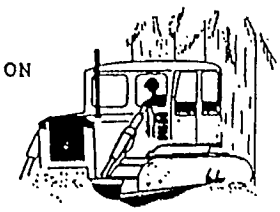
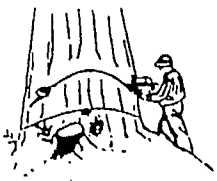
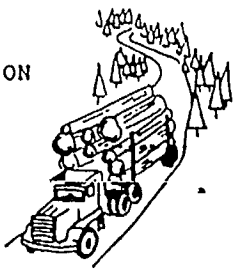
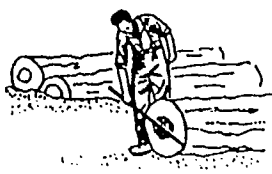
3. More sensitive IR scanners, similar to thos now available to the military, to perm detection of nascent fires immediately after lightening storm has passed overhead. (M&CI)



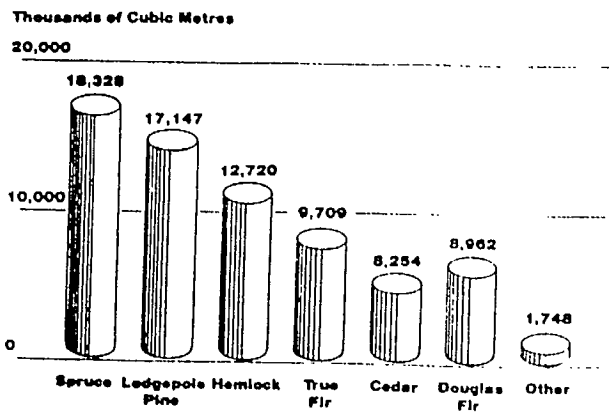
ANNUAL TIMBER LOSSES IN B.C. (FIRE, INSECTS, DISEASE) Source: B.C. Ministry of Forests

C. Harvesting

(8GX of Forest Management and Harvesting Costs)

	Description	Innovations Required
 OPERATIONS PLANNING 5% $150M	Operations planning uses data describing terrain slope, ground conditions, timber types and other natural and administrative boundary features to design roads and logging areas. In-field activity comprises surveying and ground checks of photo or map features and harvest scheduling. Logging on the coast and in the interior are two quite different industries. Coastal logs are typically valued at $100/cu.m, while those in the interior are closer to $25/cu.m. In part this reflects differing timber species and demand patterns, but costs of recovery are a factor as well.	1. Harvest managers and those leasing th forests are searching for better ways to correlat the allowable annual cut (which is based on forest inventory), with the actual cut, which measured by scaling the harvested timber. Larg variances have major economic consequence (sometimes positive!) for lessor and lessee. Bette remote sensing equipment (70 mm aeric photography is used now) combined with patter recognition software and forest models coul play an important role here. (T&R, Software) 2. A vehicle and equipment monitorin system would help improve scheduling, util zation and maintenance. Small improvements i scheduling could yield large savings. Fo example, a 1% reduction in the cost of operatin road construction, logging, and log trans portation equipment, or a corresponding increas in its utilization is worth $24M p.a. in B.C ((M&CI) and (T&R))
ROAD CONSTRUCTION  13% $370M	Road construction in forestry aims at building main haul roads, secondary roads and temporary "spurs" to optimize the overall cost of log hauling and longer term access. Design standards vary with intended road use.	
 LOGGING 37% $1.1B	Logging includes felling and bucking the trees; yarding or skidding logs to roadside; and processing trees (limb, top, buck, sort) at roadside where required. Care taken to delimb the logs cleanly, and to avoid stressing the log while cutting and bucking can substantially improve yields at the mill.	
LOG TRANSPORTATION  20-25% $850M	Transportation of the logs to the mill.	
SCALING, GRADING AND SORTING  5-10% $150-$300M	The measurement of log volume either manually (using a scaling rule), or by weight with manually scaled samples to correlate weight with log volume. Log grading is done visually. This process and the resultant sorting can take place at booming grounds (on the coast), at the mill, or even in the forest.	1. A recording log scaler with data tran mission to the data centre for billing an inventory control. Cost savings are primarily i manpower, although speed and accuracy o reporting are a factor. There are approximatel 500 scalers in B.C. Some equipment is already o the market. (M&CI) 2. An automatic log scaler which woul estimate log volume electronically, and recor and transmit the information as required. A (ba code?) log identification system would be useful if not essential adjunct for high valu (coastal) logs. In this way the more detailed lo valuation which takes place at the sawmill coul be correlated with the initial valuation an sorting. (M&CI)

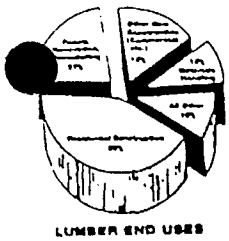
B.C. LOG HARVEST– 1985



Total: 76.9 Million Cubic Metres

Source Statistics Canada and B.C. Ministry of Forests

II. WOOD PRODUCTS



LOG MERCHANDISING & DEBARKING

3-5%

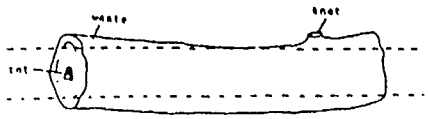
Description

Logs are typically delivered in lengths of 40 feet or more. They must be sorted as between their utilization for lumber, plywood or pulp. They are then debarked before sawing so that bark free waste wood can be sold to pulp mills and coincidentally, in order to rid the wood of imbedded stones before sawing.

Innovations Required

1. Current debarkers (both mechanical and hydraulic) do significant damage to the logs. A sensor which accurately controlled bark removal could save millions of dollars p.a. in B.C. Several hundred would be required, but would probably be useful only in redesigned barkers. Current barkers work at high speeds with a lot of accompanying noise, moisture and vibration. This is a real challenge! (M&CI)

BUCKING & SCANNING 5%



Plywood logs are normally bucked to 8' lengths, as are most logs used for stud lumber. Other lumber logs are bucked to 10'-24' lengths. The logs must be carefully cut to the best length/diameter combinations.

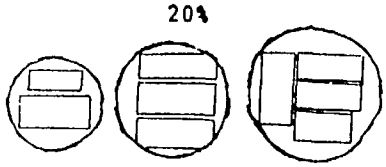
Cameras or position sensors scan the outside of the log in order to determine log diameter, length, sweep, crook, knots, rot, etc.

1. Instrumentation to provide total log characterization including cross section outline, sweep, crook, length, bark thickness and the location of knots and decay. Sales potential includes 124 out of 183 B.C. mills. (M&CI)

2. Internal log scanner (using X-rays, gamma rays, NMR?) to search for knots, rot and other internal defects. Could achieve 10-15% increase in value of lumber from B.C. coast logs, 20-30 sawmills, value increase about $5M per mill. (M&CI)

3. Better software to compute maximum value break-up. (Software)

LOG BREAKDOWN AND SPECIES IDENTIFICATION 20%



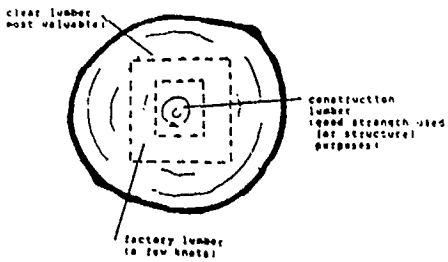
Given the results of the log scan, a determination of the profit maximizing products to be cut from the log is made.

Many sawmills process and market mixtures of species (e.g. hemlock/balsam; spruce/pine/fir) due to their similar strength properties and appearance. There is sometimes a need to sort part of the mill's production, either to facilitate processing (e.g. drying of alpine fir, preservative treatment), or to take advantage of value added markets (e.g. joinery stock).

1. Automatic detection of imbedded rocks before damage occurs to the saws. Most mills would buy in price range $20K-$50K. (M&CI)

3. Automatic differentiation of hemlock/fir and/or spruce/pine/fir. Some error prone visual and chemical sorting is done now. Potential mkt. size unknown, but is not thought to be large, perhaps 20-30 mills in B.C.(M&CI)

SAWING AND OPTIMIZING 10%

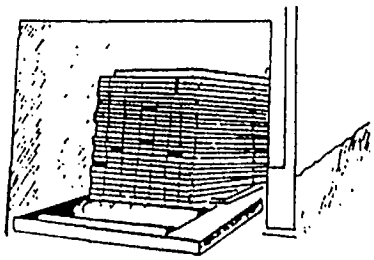


Rough sawn lumber varies greatly in quality. Obtaining maximum value requires accurate edging, trimming and defect recognition.

1. Automatic defect recognition could improve yields. A 1% increase in sales value is worth $30M p.a. Such a device is eagerly sought, and would be used in several places in the mill (e.g. edger/trimmer, grading) (Software and M&CI)

2. Saw kerf reduction to reduce wastage. Some techniques for kerf reduction involve monitoring of saw blade location and heat distribution. Paybacks of several hundred thousand dollars a year per saw are claimed for kerf reductions of 40%-50%. Another estimate is that every .020" of kerf reduction is worth $180K p.a. to a 200 thousand board foot (mbf) mill. See under planing below for another aspect of this opportunity. (M&CI)

KILN DRYING 6-10% S-P-F 15-25% Hemlock



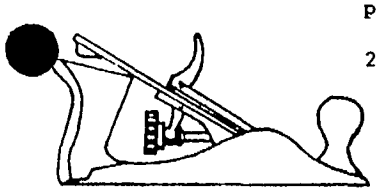
About 15% of sawn lumber produced on the coast, and 75% or more of that produced in the interior is kiln dried primarily to reduce shipping costs (by rail), but also to enhance value. Because moisture content varies in the range 30%-150% of dry wood weight, it is important to be able to sort the wood by moisture content prior to kiln drying to a targeted 16-18% moisture content. Overdrying causes losses due to checking and twisting. It is estimated that control of moisture content to within 3% is worth $500K p.a. to a 200 mbf mill.

1. There is a need for mathematical models which will describe the drying process. (Software)

2. Optimized drying won't be achieved until moisture content distributions within the lumber are detectable and measurable. (M&CI)

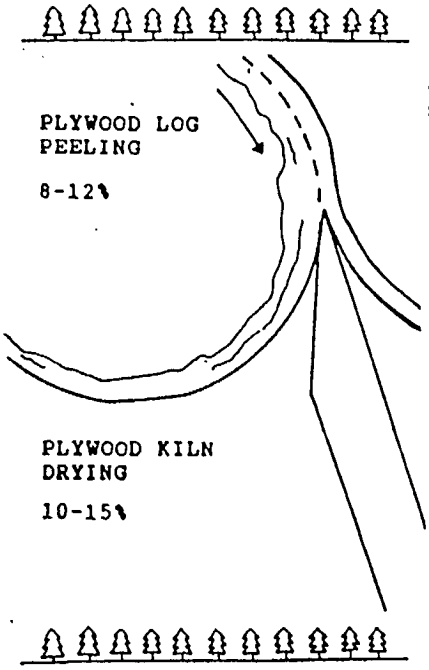
3. Replacement of batch drying process with a continuous piece-by-piece drying system would permit better controlled drying leading to enhanced product quality. (Other)

PLANING 2%

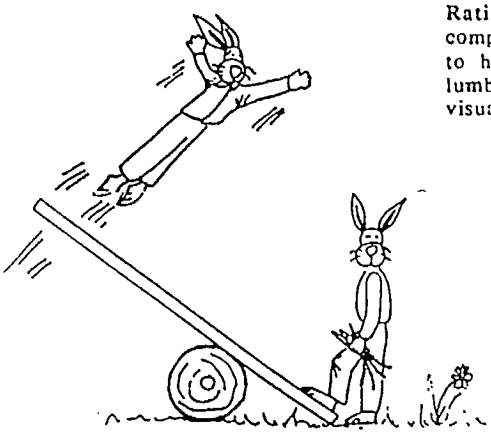


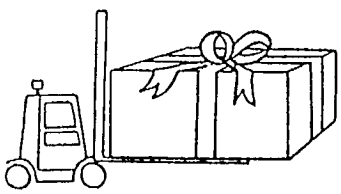
Most, but not all, lumber is planed to help ensure conformity to size specifications and to make it easier to handle. Improvements in cutting uniformity and the use of smoother cutting saws could eliminate this step in the future to provide approximately 7% improvement in yield, or $350M p.a. of added revenue in B.C. alone.

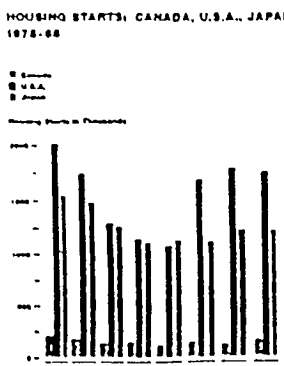
1. Tensioning of saw blades to reduce saw vibration (and hence kerf size and lumber dimension variation) is still a black art which badly needs research. The interaction of the saw blade with the wood is only partially understood. As a result there is a wide variation among mills in the tolerances of their lumber. This is a field which is begging for more study, particularly if the ultimate goal of eliminating the planer altogether is to be realized. (M&CI)



	Description	Innovations Required
PLYWOOD LOG PEELING 8-12%	Softwood veneer is produced by rotating logs on a rotary lathe, and cutting off wood with a sharp knife in a continuous ribbon. Thickness of the veneer is usually 1/10 to 1/6 of an inch, with a targeted thickness tolerance of 0.005-0.008". In practice this target is often not achieved due primarily to the variability of wood density and knife wear. An exciting new spindleless lathe which can peel logs to a diameter of 1 15/16" may revolutionize the plywood and the lumber industry by permitting cheap small logs to be made into either plywood or laminated veneer lumber (LVL), a composite lumber which is stronger than standard lumber, and, most imnportantly, whose strength variability is reduced to 10-15% from 200-300%!	1. Control instrumentation to permit reduction in the thickness variability as betwee sapwood, heartwood and core. If the variabilit were reduced by 0.001", there would be annua increased production in B.C. mills amounting t a total value of about $100K/lathe/p.a. Ther are approximately 40 lathes working in B.C. an about five times that number in the U.S.? (M&CI)
PLYWOOD KILN DRYING 10-15%	Veneer is clipped and sorted by moisture content, and then dried to an average moisture content of 4% by passing it through different drying zones on a conveyor belt. New resins with a higher tolerance for moisture content (20%) are expected to change this situation substantially.	1. A fast, efficient moisture reader required. Current RF measurement systems ar inaccurate above the fibre saturation point, an are overly sensitive to dielectric constar variations and mineral content in the wood. good system would save about $10M p.a. in B.C (There are about 60 dryers in B.C.) (M&CI)
GRADING AND MACHINE STRESS RATING 10%	Lumber can be classified as either structural or non-structural. The latter is visually graded on the basis of appearance. Structural grade lumber and plywood veneer may be machine stress rated as well. Repeatable grading processes enhance value and reduce liability. Ratings are for strength and stiffness in tension, compression and bending, as well as the ability to hold fasteners. Machine stress rated (MSR) lumber commands a premium of about 12% over visually graded lumber.	1. MSR typically takes place after the lumbe has been through the planer. It may have bee stored in the interim at temperatures in th range -40 - +40 deg. C. Normal operating spee of MSR equipm't is 70 pcs./min. The majo problems are the unreliability of using stiffness measurement as a proxy for strengt (as there is considerable variability in th relationship both within and between species and the extrapolation of measurements a differing temperatures and moisture contents t a std. temp. and moisture content. Currentl checks on MSR accuracy are made by testin samples every few hours..(M&CI, Software) 2. Automatic defect recognition to supplement or replace visual inspection. Defects requiring recognition include wane (rounded edges from original log surface), splits, rot (both unsightly specks and larger volumes), bark pockets and knots. Lumber grading rules should not be hard to program, the challenge will be in defect recognition. (Software)
PACKAGING AND SHIPPING 2-5%	Packages of finished products are assembled, banded and often wrapped with protective covers. Package ends may be spray painted.	1. Potential application of robotics to reduce safety hazard and labour costs. An 'average' B.C. mill with a capacity of 100 million board feet p.a. could save about $100K p.a. Equipment should not cost more than $250K-$300K to be economic. (Robotics) 2. Robotics could also be used paint the ends of the lumber to company requirements as well as to label lumber length, a feature which many customers would like to see. (Robotics)
ENGINEERED COMPONENTS $250 Million?	There is a high rate of growth forecasted for prefabricated trusses, I-beams, walls, floors and entire houses. About 50% of the cost of a wood truss lies in its manufacture. The table below may be an indicator of future trends in Canada: COUNTRY — % Housing Starts using Prefab Houses Canada — 7% Japan — 15% U.S.A. — 50% Sweden — 70%	1. Improvements in the speed of manufacturing and quality control of engineered components. (Robotics) 2. Computer aided design and drafting software tailored to use of manufactured components. (Software) 3. Expert systems to assist in design and cost management. (Software)



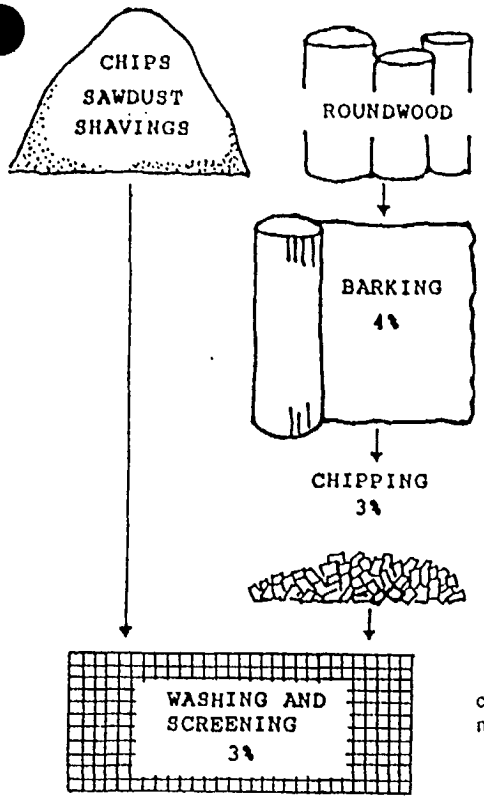




III. PULP AND PAPER

A. Wood and Wood Preparation

(30-45% of Total Cost of Manufacturing Pulp or newsprint)

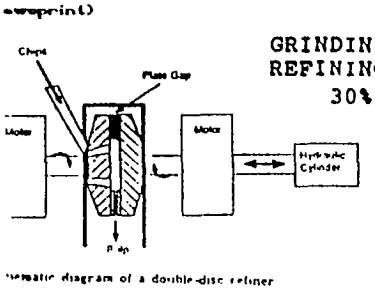


CHARACTERIZATION
1%?

Description	Innovations Required
In B.C. about 80% of the basic input material comes from sawmills (the corresponding figure nationally is just over 50%). Up to 10% of the input is sawdust and shavings. The moisture content and species mix of this material is highly variable. About 7 M tons of pulp are produced annually in B.C., of which about 5 M tons are chemical pulp. 1.8 M tons of pulp are consumed annually in B.C. in the manufacture of newsprint.	
Bark is removed from the solid wood (usually mechanically).	1. There may be a need for an intellige barker which recognizes where bark remai and removes it. This would lead to improv product cleanliness and reduced wood loss. Some see this as a low priority for developmer (M&CI and Robotics)
Solid wood is reduced to small, thin pieces.	1. Increased automation and improved inspection systems would ensure proper contro of wood preparation and improve the uniformity of chips, yielding improvements in pulp quality and better wood yields. The presence of frozen chips in winter makes the task particularly challenging, while the fact that the environment is very noisy makes a move towards automation additionally rewarding. Instrumentation to measure chip density, brightness, moisture content (to 1%), decayed wood content, the chemical composition and species of the chips are needed. Sensors priced at $25K - $100K would sell in quantity 100 in Canada. Moisture sensors could be priced in the $250K-$400K range. (M&CI, control systems)
Chips and stray bark are separated, and the chips are sorted by size. This is done mechanically.	2. Improved management of chip inventories, adjustment of operating rates, and variations in material supply require judgement and expertise with potential for application of artificial intelligence. (Software)
It is increasingly important to know about the presence of decayed material and the % content of moisture and extractives. These factors can have a major effect not only on the quality of the end product, but on the amount of heat and chemicals which should be used during processing.	

B. Mechanical and Thermo-Mechanical Pulps

(30-40% of Total Cost of Manufacturing Pulp or newsprint)

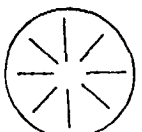


Schematic diagram of a double-disc refiner

GRINDING AND
REFINING
30%

REJECT
TREATMENT
5%

MECHANICAL
SEPARATION
5%



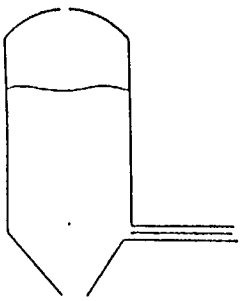
Mechanical pulp is produced by grinding short lengths of small logs against a rotating stone "grinder", while thermo- mechanical (TMP) and chemithermomechanical (CTMP) pulp are produced by "refining" wood chips between high speed rotating plates in the presence of low pressure steam, and, in the case of CTMP, some chemicals to aid in the breakdown of the wood into reactive fibres. While mechanical pulping is now an "old" process, and is being replaced by TMP and CTMP in many applications, it is still a preferred component of many papers. Mechanical pulp has a much higher yield than chemical pulp (about 95% vs <50%) but requires much more energy to produce and is usually of lower quality. Some newer pulps such as CTMP have yields of about 90% and some of the strength properties of chemical pulp. Further refining of rejected fibre bundles and long single fibres for return to the process.	1. Automation of the refiner, including start-up, shutdown, control of the motor load, the gap between the grinding plates, and wood feed rates. (Control systems) 2. Instruments to measure the grinding plate gap and to determine the wood feed rates. (M&CI) 3. An on-line sensor to detect the degree of sulphonation of CTMP and CMP pulp is needed. $25K-50K/instrument x 50 in Canada. (M&CI) 4. An on-line device which measures the fibre length distribution in the pulp would sell well. There is an off-line device (using a polarized light source) which sells for about $50K+. Could video pattern recognition techniques be used here? Several hundred instruments in the $25K range could be sold in Canada alone, as fibre length is a critical parameter, and should be measured several times during the manufacture of pulp and paper. Fibre surface area measurements are also required. Both length and surface measurement are fundamental to control of mechanical pulping and pulp screening. (M&CI)
Fibre bundles and other contaminants are removed using screens. Heavy solid contaminants are removed using centrifugal "cleaners".	

C. Chemical Pulp

(60-68% of Total Costs of Manufacturing Pulp or Paper)

CHIP IMPREGNATION AND PULPING

10%



Description

A typical pulp mill produces 800 tons/day. A new mill costs $600M-$800M.

Chips or sawdust are cooked in alkaline (Kraft process) or acidic (sulphite or bisulphite process) solution to remove lignin and preserve the cellulose. In Canada, Kraft mills account for about 75% of chemical pulp production. Mills operate in either a batch or a continuous processing mode.

Innovations Required

1. A sensor to detect the moisture content of the incoming chips after they have been steamed but before they are cooked. (M&CI)
2. Better instruments to measure the progress of pulping is required for control purposes, since cooking time varies according to moisture content and other factors. (M&CI)
3. A sensor to measure the lignin content of pulp after cooking is needed., It is estimated that any of the above instruments would sell in quantity 100 in Canada at a price of about $100K.(M&CI)

CHEMICAL RECOVERY AND REGENERATION

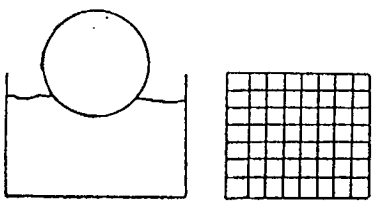
15%

Chemicals from pulp washing are concentrated in evaporators and burnt in recovery furnaces to produce steam and chemical smelt. Smelt is processed with lime to produce pulping liquor. Since the recovery furnace is the largest single investment in the mill, it often is the ultimate limiter of production. A 1% production increase would add $1M p.a. to the bottom line of a typical mill.

1. There are about 40 recovery furnaces in Canada. Often this stage determines productivity, so that returns for effective instrumentation can be large. More accurate and cheaper sensors are needed for temperature measurement as well as instruments to measure concentrations of CO, H_2S and particulate loading. The sensors must work at 400 deg. C. Measurement of H_2S and other reduced sulfur compounds is particularly important. (M&CI)
2. Expert systems are believed to have the potential to yield major returns by providing better control of recovery furnace boilers. (Software)

WASHING AND SCREENING

5%

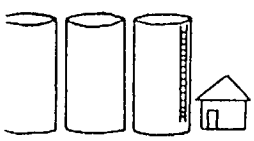


Pulp slurries containing large quantities of dissolved contaminants are washed on vacuum drums or in diffusion towers. Uncooked fibre bundles, knots etc. are removed by screening. Plastic contaminants are a major problem, as plastic sticks to the blades in the (paper) coating process. One small piece of plastic can ruin a ton of paper.

1. Contamination of pulp with plastic can be critical in some applications. About 30 plastic sensors (either for slurries or for dry webs) are urgently needed in B.C. The mills would pay $50K-$100K (perhaps more) per device. (M&CI)
2. Sensors to detect and control the concentration of dissolved organics such as lignin and xylose sugar could be very cost effective. A 5% saving in Cl_2 and NaOH consumption is worth $10M p.a. in Canada. (M&CI)
3. On line control of screening requires the development of inexpensive methods for measuring contaminants. A 1% reduction in off-grade pulp would save $50M+ p.a. in Canada. (M&CI)

BLEACHING

15-20%

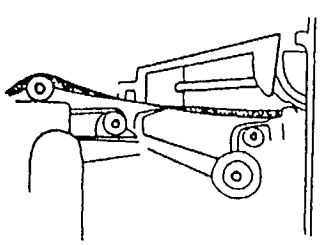


The pulp is treated with various chemicals to remove lignin and whiten fibres. Better control of bleaching would improve pulp quality, and could lead to significant savings of chemicals.

1. Instruments to measure chemical residuals on line (Cl2, ClO2, NaOH). The Finns have made some progress in this area. One instrument for each chemical req'd for each mill @ $25K-$100K. (M&CI)
2. A Kappa number (i.e. lignin) monitor to conserve use of chemicals. Two required per mill at $50K-$100K. (M&CI)

DRYING BALING CHARACTERIZATION

5%



The wet mat of pulp is heated to reduce moisture content to about 10%. The dried pulp is cut into 9 sq. ft. sheets, piled, pressed and tied into 450 lb. bales

It is important to monitor the key characteristics of the pulp produced, especially as customers are using the pulp in increasingly sophisticated ways which place greater demands on the consistency of the product.

1. An improved range of instrumentation is needed to help monitor pulp quality. Included are instruments to measure fibre length distribution, degree of poly-merization of the cellulose, strength, contaminating particle count, and optical properties. (M&CI)
2. Because of the large capital cost of the mill, it is very important to optimize production. A production control system which helped in the management of all factors of production could have an important impact on productivity. (Software)

D. Papermaking

(25-35% of Cost of Newsprint)

	Description	Innovations Required
CHEMICAL PULP / MECHANICAL PULP / ADDITIVES	There are two paper mills and eight combined pulp/newsprint mills in B.C. The corresponding figures for Canada are 75 and 33 respectively. In 1984, Cdn. newsprint sales were $4.5B, and other paper sales were $2.1B.	
STOCK PREPARATION 5%	Pulp slurries are diluted, refined and blended. Additives such as clay (to improve opacity) or cationic starch (to improve wet strength, drainage and finish) may be blended in. The paper industry in B.C. annually consumes 400,000 tons of mechanical pulp, 1,100,000 tons of refiner pulps (TMP & CTMP) and 350,000 tons of chemical (Kraft) pulp.	1. It is important to measure and control the composition of the mixed slurry, and to measure and control its retention by the forming screen in order to ensure uniform paper quality. One important parameter for which a sensor is needed is the ratio of filler to fibre. May need different sensors for clay and cellulose filler. The Canadian market is small, but there is a large U.S. and overseas market.(M&CI) 2. Expert systems are required for the analysis of upsets and production curtailment. A 1% reduction in downtime or off-specification production is worth $1M p.a. to a 1000 ton/day mill.
FORMING 10%	The dilute pulp suspension is delivered by precise jet onto a moving wire screen(s) at high speed. Excess water is removed.	1. Improved means of interpersonal communications in a high noise, hot and humid environment are needed to help in the expeditious handling of paper breaks. An average ten minute saving of time/paper break with 100 breaks p.a. (there is a wide variation here), would recover about $140K p.a. (T&R) 2. Mechanized sheet restoration (after a break). This is considered to be a priority. Paper produced at 50 km/hr piles up quickly! Some work has been started here. (Robotics)
PRESSING 5%	Water is further removed by pressing between precision rollers using vacuum assist.	1. An accurate water content monitor is needed (to save on energy). A 1% reduction in moisture content at the press is worth a 5% reduction in dryer energy consumption. (M&CI)
DRYING 10%	Heat is applied by 30-40 steam filled cylinders over which the paper travels.	1. It is very important to maintain uniformity across the width of the paper as it is formed, pressed, dried and calendered, otherwise it will not accumulate cleanly and evenly on the winders. Moisture content, thickness and drainage are critical parameters needing more accurate measurement. (M&CI)
CALENDERING 2%	Surface smoothness and uniform paper thickness are achieved by compression between 2-6 precision rollers.	
WINDING 2%	Large rolls of paper from calendering are rewound to diameters and widths required by customers. The winder must work at about twice the speed of the paper machine.	1. Automated transfer of paper to the winder. Typically a crew of four is used to feed the winder. (Robotics)
CHARACTERIZATION 1%	Paper quality is monitored on and off line. Mass, moisture, strength and optical qualities are the properties usually measured.	1. On-line (non-destructive) paper strength tester. A U.S. company has a device using ultrasonics. This is a priority requirement. (M&CI) 2. On-line paper formation or uniformity tester. (M&CI) Both these instruments could sell for about $100K. About 4-5/mill req'd.
COATING	Slurries of opaque pigments are applied to the paper and dried in order to improve opacity and smoothness.	1. On line detection of coating thickness. Only Island Paper would need such an instrument in B.C., however there would be a large external market for such a device. (M&CI)