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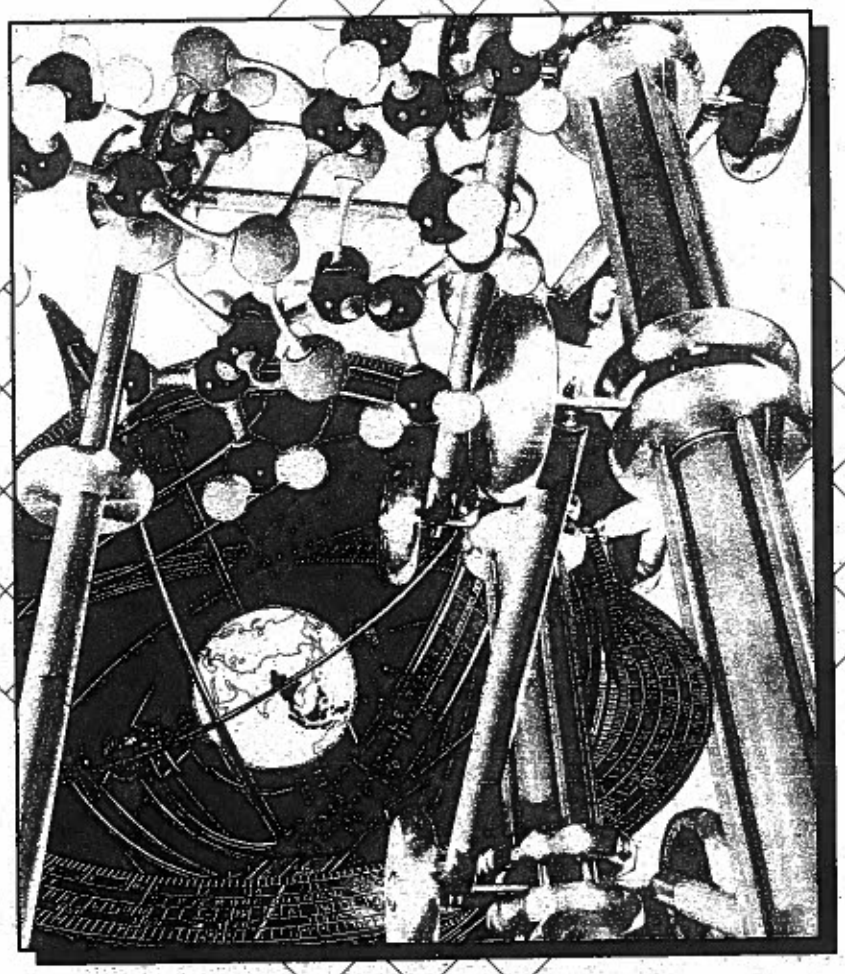
CANADA ASEAN Centre

Final Report



Canadian Mission on Science and Technology to ASEAN
January 1992

CANADA-ASEAN CENTRE

FINAL REPORT

CANADIAN MISSION ON SCIENCE AND TECHNOLOGY TO ASEAN

by

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Edmonton.

January, 1992

Jan Boon
Paul Kelly
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EXECUTIVE SUMMARY

INTRODUCTION

"Canada is sleeping", a quote from the Vice-President of Siam Cement, the largest company in Thailand. This comment capsulates the overall perception of Canada in the ASEAN region.

The Mission members met with some 200 senior decision makers in government, industry, university and research institutions and there were common perceptions regarding Canada in the region. Canadians are viewed as 'nice people' but lacking the aggression to pursue opportunities.

Other countries, particularly Japan, the USA, Australia, and the UK are very active in the region and even the NIC's (Newly Industrialized Countries) such as Korea and Taiwan have been very responsive to the extensive opportunities for science and technology linkages.

OVERVIEW OF SCIENCE AND TECHNOLOGY IN ASEAN REGION

The ASEAN economies have been growing at an average rate of 8% per annum for the last 10 years. Table E.1 shows some interesting statistics in this respect. It takes little calculation to determine that with this continued growth, the ASEAN countries will become a major economic force.

Manufacturing is an increasingly important sector and has overtaken agriculture in the ASEAN economies. Furthermore, there is a strong commitment to tie science and technology to industrial development.

Table E.1
ECONOMIC STATISTICS*

	Canada	Singapore	Indonesia	Philippines	Thailand	Malaysia
Population (million)	26.7	3.0	182	63.0	56.3	18.4
Population Growth (%)	0.8	1.1	1.8	2.3	1.4	2.3
GDP/Capita (C$, k)	23.2	13.6	0.64	0.83	1.63	2.64
GDP Growth (%)	1.0	8.3	7.0	3.0	10.0	10.0
Inflation (%)	4.8	3.4	9.1	14.9	6.0	3.1
Foreign Debt per Capita (C$, k)	6.41	0.0	0.41	0.53	0.56	0.97
Prime Rate (%)	8.5	8.0	27	25	16	8.5

*Source: Asia Week, Nov. 8, 1991

All ASEAN countries visited are focusing their science and technology development efforts on the same areas: microelectronics, biotechnology, automated manufacturing, information technology and environmental technologies. The degree of progress and the order of priority vary between countries and the level of achievement decreases from the high level of Singapore through to Malaysia, Thailand, Indonesia and the Philippines.

Each government supports, and has installed or is installing an infrastructure, and is committed to science and technology. For example, Singapore will spend C$1.4 billion to raise its research and development spending to 2% of GDP by 1995. Malaysia will spend $116 million to increase industrial technology capabilities.

Research and development are primarily government-led with some exceptions such as the multinationals in Singapore which are providing funding to the institutions. However, incentives are being put into place to increase industry involvement in research and development.

Also common to countries in the region is the need for improvement in both quality and quantity of education.

OPPORTUNITY

Thailand has strong potential for technological development, and Canada is viewed favourably. During the next three to five years there is a window of opportunity for establishing relationships that will result in a large number of substantial business opportunities. In addition, Thailand will be a good source for strategic alliances with which to do business in Laos, Cambodia and Vietnam.

In Malaysia, the opportunity is now. A focused marketing effort will likely produce quick results.

Singapore is unique and presents opportunities for strategic alliances in which both investment and technology can flow in both directions.

In Indonesia and the Philippines multinational aid agencies such as the Asian Development Bank and the World Bank are most likely project sponsors and initial marketing of technology should focus on these agencies.

Recommended priorities for action are: (i) Thailand and Malaysia; (ii) Singapore; (iii) Indonesia; and (iv) Philippines.

All countries need technology management and technology transfer training as well as access to post-graduate education both at home and abroad.

CANADA'S POSITION

Awareness of Canada and its technology capability is low. As noted in the Introduction, other countries which have been more proactive in the region are recognized as providers of technology. Canada, therefore, is not in a position of influence and this has been further compounded by the fact that most key decision makers have been trained abroad in countries other than Canada.

A common complaint is the lack of proactive marketing of Canadian university programs, particularly as ASEAN countries are willing and able to meet full rates, for post-graduate training. The longer term impact of this is a limit to Canadian influence and this is further exacerbated by the absence of Canadians on international advisory boards or as science and technology advisors in the region (again, with some individual exceptions).

Canada should not assume it has superiority in science and technology over the countries in the region. Our only obvious strength is in our industry-led research and development and our post-graduate education system. In other areas, Canada may soon be overtaken by Singapore.

The Canadian Government programs in the regions are seen to be poorly coordinated. Numerous different federal and provincial agencies with different mandates and programs which are unclear, often overlapping and therefore confusing, are operating in the region. Many interviewees did not understand the relationship between the Canadian High Commission or Embassy, CIDA and its agencies, IDRC, Canada Enterprise Malaysia, Canada-ASEAN Centre, Asia-Pacific Foundation, etc.

THE CANADIAN ADVANTAGE

Despite the current poor competitive positioning of Canada, the Mission has identified a number of factors that may potentially give Canada significant advantages in competing for business in the region:

1. *Canada is not a world power.*
   There is a significant level of anti-colonial sentiment in the region, partly due to the legacy of World War II and partly due to the concern over economic domination. To a lesser extent, there is a prevalent scepticism in doing business with world powers. Despite the general lack of awareness about Canada, it is looked upon very favourably and considered a very friendly and non-threatening dialogue country.

2. *Canada is English speaking.*
   The educated and the politically powerful in the region usually speak English, at least as a second language. As such, the people in the region do not see language

as a major barrier in doing business with Canada or sending students and staff to receive training in Canada.

3. *Canada is a member of the British Commonwealth and a member of the Asian Pacific Economic Community.*

4. *Canada is known for its multiculturalism.*
   Canada is one of the few developed countries where there is a significant number of citizens of ASEAN origin. This is certainly a valuable asset for developing trade relations with the region.

5. *Free Trade Agreement with the U.S.A.*
   The Free Trade Agreement is considered a factor favourable to Canada by some who may wish to build relationships with Canada or Canadian firms and set up a beachhead for the North American market.

Canadian success in the region depends largely on how Canadian business and government can cooperate in addressing the weaknesses and capitalizing on the advantages identified

CONCLUSION

The Mission finds that more emphasis and more focused organized effort is required on the ASEAN market and on science and technology as an effective means to build bilateral relationships. With a total population larger than that of North America and a 5-10% annual GDP growth rate over the last decade, low foreign debt and generally credit-worthy, ASEAN is the natural incubator for the next generation of NIC's.

A more aggressive Canada could easily increase science and technology business with ASEAN countries by an order of magnitude. Opportunities exist in training/exchange programs, joint ventures, consulting projects and joint bids, direct investments, procurement and government programs through memorandums of understanding. If Canada is to become a significant player in the region, it must act aggressively and act now.

A proposed strategy for beginning this process is outlined below.

STRATEGIES FOR PHASE II

The following strategies are proposed to achieve the goal of increased business within the region through science and technology:

1. Raise mutual awareness in the Canadian and ASEAN business, science and technology communities.

2. Place Canadians in key positions in science and technology advisory councils in the region.

3. Promote placement of ASEAN trainees in Canadian graduate schools, short courses and institutions and offer exchanges of staff.

4. Motivate Canadian business to develop linkages in the region.

5. Coordinate Canadian activities in the region, including: (a) effectively communicate the role of various government agencies active in the region and their programs to minimize confusion, (b) promote collaboration between Canadian industry and government, and (c) visibly pursue follow-up activities of this Mission.

ACTIONS

The Mission recommends the following action plan for Phase II.

1. Raise Awareness:

   i) Participate aggressively in ASEAN Science and Technology Week in Singapore (September 1992) and similar events in Malaysia and Thailand.

   ii) Invite selected key people to tour Canada as a follow-up to the current Mission. These must be a careful selection from industry and government and ASEAN Centre funding should be utilized.

   iii) Make better use of people in the region who have worked or been educated in Canada. For example, work with alumni associations, such as the existing Canada-Thai Association.

   iv) Invite ASEAN companies and institutions to Canada to promote their capabilities and exchanges (financed by CIDA or Enterprise Malaysia-Canada funds, etc.).

   v) Exchange management and scientific staff between institutions.

2. Placement of Canadians on science and technology councils and advisory boards:

   i) Identify upcoming vacancies and be prepared to offer qualified and eminent candidates.

   ii) Send retired Canadian executives and scientists on assignments (using Canadian Executive Services Organization).

iii) Assign Canadian science and technology advisors to ASEAN government ministries.

3. Placement of ASEAN Students:

i) Involve Canadian universities, federal, provincial and industry research organizations in developing a coordinated plan for placement of students, and if possible, have them stay with Canadian families.

ii) Awareness about Canada must be increased, especially its educational institutions.

4. Develop concrete business opportunities:

i) Follow-up on specific opportunities identified by this Mission.

ii) Promote Canada's competence in telecommunications, natural resource management, science and technology and transportation.

iii) Canadian companies involved in niche markets which match the technology ASEAN countries want (i.e. biotechnology) should be encouraged to visit on a more proactive basis.

iv) Alert Canadian companies as to the potential business in LDC's (less developed countries) such as Laos, Cambodia and Vietnam, which can be accessed through joint ventures with companies in ASEAN.

v) A more aggressive position on procurement opportunities through the Asian Development Bank, World Bank and other international development agencies.

vi) In procurement opportunities, emphasize associated training. Training is considered by the region as an integral part of equipment purchases.

In summation, industry must be involved by increasing awareness in the marketplace. Canada must focus on its best technologies (i.e. natural resource based) and not attempt to pursue everything. Particular areas recommended are: telecommunications, mining and petroleum exploration and extraction technology, education, transportation, fisheries, pulp and paper, remote sensing (i.e. RADARSAT), and information technology including GIS. The rest should be targets of opportunity only.

This concludes the executive summary. The Mission team is most concerned that action result from their efforts and findings and would be pleased to make themselves available to make presentations to interested groups across Canada to stimulate activity.

1.0 INTRODUCTION

1.0 INTRODUCTION

This report describes the findings of a Canadian Mission on science and technology to the ASEAN countries in October/November, 1991.

ASEAN refers to the Association of South East Asian Nations and currently includes: Brunei, Indonesia, Malaysia, the Philippines, Singapore and Thailand. Vietnam and Cambodia are negotiating to join.

1.1 Background: General

As Table E.1 shows, the economic growth of the ASEAN countries far exceeds that of Canada and therefore the region is an area of economic opportunity.

The Canada-ASEAN Centre was opened in Singapore in 1989 with a mandate to:

> "serve as a catalyst and the centre of a network linking Canadian and ASEAN interest groups in a wide range of activities designed to promote better understanding of our respective institutions, cultures and ultimately our peoples."

The Centre is empowered to develop a broad mandate in the following fields:

- Provide publicity by promotion, public relations and other marketing activities designed to raise the level of perception and understanding in ASEAN about Canada and in Canada about ASEAN.

- Support linkages between Canadian and ASEAN educational institutions and the activities of ASEAN related institutions pursuing activities of priority to Canada. The focus here is on people-to-people exchanges. The main media for the exchanges are regional institutions and the academic community.

- Support business cooperation, regional promotional programs and events, cooperative programs with regional business organizations and media, development of regional business strategies and other activities designed to supplement and support the trade and investment promotion activities of Canadian businesses, technology institutions and missions in the regions and of ASEAN businesses in Canada.

In addition to running its own projects and programs, the Centre provides office space for other organizations active in the region. The Canadian International Development Agency's (CIDA) ASEAN Development Cooperative Program is directed by a CIDA staff member located in the Centre. Also co-located in the Centre is the Director, South East Asia Program, Asia Pacific Foundation of Canada.

1.2 Background: The Mission

Discussions between a visiting delegation from the Alberta Research Council, embassy staff in Indonesia and Canada-ASEAN staff, in the fall of 1990, led to the conclusion that there are opportunities for economic linkages between Canada and ASEAN that can be realized through science and technology. An understanding of the science and technology infrastructure is necessary to design a strategy that takes maximum advantage of these opportunities.

The Canada-ASEAN Centre offered financial support for a mission on science and technology to the ASEAN countries. The Association of Provincial Research Organizations (APRO) formally endorsed the Mission and the four participating organizations: The Alberta Research Council, the Saskatchewan Research Council, The Government of Alberta, Ministry of Technology, Research and Telecommunications, and Telecommunications Research Labs offered to carry the salary costs of the participants.

The Canada-ASEAN Centre and the Alberta Research Council (representing APRO) agreed that this Mission would be Phase I of a program to increase the level of Canadian cooperation with ASEAN in the field of research and development. Phase II would involve detailed program planning and implementation.

1.3 Goal

The goal of the Mission was:

> To identify potential linkages between ASEAN Countries and Canada, and potential cooperation in science and technology. Specifically, to examine the organization of activities such as policy, research and development, technology transfer, training, and government/industry cooperation. In addition, to identify existing international science and technology linkages.

1.4 Objectives

The objectives were to:

a. Establish linkages and personal contacts with ASEAN science and technology:

- policy makers,
- agencies responsible for industrial development, and training,
- infrastructure agencies, and
- industry.

b. Identify opportunities for Canada, through sharing experiences and learning how the ASEAN countries:

- develop science and technology policy,
- implement science and technology policy with respect to industry, and
- implement science and technology infrastructure to support industry.

c. Lay the basis for Phase II, which will consist of developing and implementing, a strategy to improve Canada's competitive position in the region.

1.5 Scope

The report describes the science and technology infrastructure of each of the ASEAN countries except Brunei. The key agencies and personnel are identified and a summary of findings is provided. The relative participation of females and males in science and technology is discussed.

The report contains a listing of specific opportunities identified, and recommendations for Phase II: elements of a strategy to improve Canada's competitive position in the region.

1.6 Mission Members

The Mission consisted of Paul Kelly (Government of Alberta, Ministry of Technology, Research and Telecommunications), Dr. Michael Leung (Telecommunications Research Laboratories), Jeff Whiting (Saskatchewan Research Council) and Dr. Jan Boon (Alberta Research Council), Mission leader.

2.0 SCHEDULE

2.0 SCHEDULE AND APPOINTMENTS

The visits were scheduled and the appointments were made by the Canada-ASEAN Centre in Singapore; the Canadian Embassies in Jakarta, Manila and Bangkok; and the Canadian High Commission and Canada-ASEAN Centre representative in Kuala Lumpur. A description of the background of the Mission members and of the objectives was provided to all interviewees (See Appendix 6). A complete listing of names, affiliation, addresses, telephone and FAX number of all interviewees is provided after the individuals interviews for each country, Appendices 1 to 5.

A questionnaire was used to focus the discussions during the interviews, and to ensure a common base for comparison between countries and organizations. A copy of the questionnaire is shown in Appendix 6.

3.0 SINGAPORE

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3.1 Country Description

Singapore is a city state at the southern tip of the Malaysian peninsula. Its population of 3 million is mainly Chinese with small minorities of Malays, Indians and Eurasians.

Economic growth has been strong over the past number of years. Singapore is Canada's largest trading partner in ASEAN, with bilateral trade reaching C$933 million in 1990.

Over 90 Canadian companies are active in Singapore and there is a Canadian expatriate community of over 1000.

3.2 Summary of Interviews

The government has decided to work towards adding value to manufactured products, because labour and other base costs (land, buildings) are increasing and Singapore is losing its competitive advantage to other countries in the region.

In the government's opinion, a strong emphasis on science and technology in the manufacturing sector will maintain the attractiveness of Singapore as a base for operations, because of the improved technology atmosphere and the enhanced skills base. At the same time, it will allow local industry to develop new products and to become essential suppliers to large multi-nationals.

The country has set definite targets: a) to increase the investment in research and development from the present 1% of GDP to 2% by 1995, b) to increase the GDP/capita, currently at C$13,600, and c) to increase the proportion of the number of Research Scientists and Engineers (RSE's) from the present 28/10,000 to 40/10,000 labour force by 1995.

A national science and technology strategy has been unveiled, under which C$1.4 billion (1991-1995) will be spent on human resource development, infrastructure improvement, technology programs in key areas, and incentive schemes. Great attention will be given to close cooperation between research institutions, education institutions, and industry.

The areas of focus are: information technology, biotechnology, micro-electronics, materials technology, agro-technology, energy, and water and the environment.

Singapore has a well-developed science and technology infrastructure that has been consolidated through the establishment of the National Science and Technology Board, (NSTB), which plays a prominent role. The board is chaired by the Permanent

Secretary of the Ministry of Trade & Industry, who is also the Deputy Prime Minister. The Ministry of Trade & Industry is influential, and the Prime Minister fully supports the science and technology thrust. As a result, good progress is being made.

Beside the NSTB, the Economic Development Board and the National Computer Board play a role. Institutes have been set up in universities over the past 10 years, in addition to existing bodies. The resulting framework and organization are described in Figure 3.1.

The laboratories and Institutes visited by the mission are well equipped and have knowledgeable staff. A conscious effort is made throughout to link universities, research institutes and industry to ensure that research results find application and lead to added product value. The universities are expanding and extensive industry training plans are being implemented. A number of incentive schemes to encourage industrial research are in place. Questions have been raised in the Singapore press about the existence of markets for the technology that is being developed and about employment opportunities for the research scientists and engineers that are being trained. However, the local consensus view is that Singapore business acumen will ensure success. The mission was impressed by the vitality of the country and tends to agree with the consensus view.

Many institutes and companies visited are interested in strategic alliances with Canadian partners. Association of Canadian companies with Singapore research institutes would lead to the development of new products for local markets while at the same time, their association with the institute would provide them with credibility and contacts that can result in sales.

Notes from the individual interviews are given in Appendix 1.

In general, there is a lack of knowledge about Canadian science and technology except for a few Singaporeans educated in Canada.

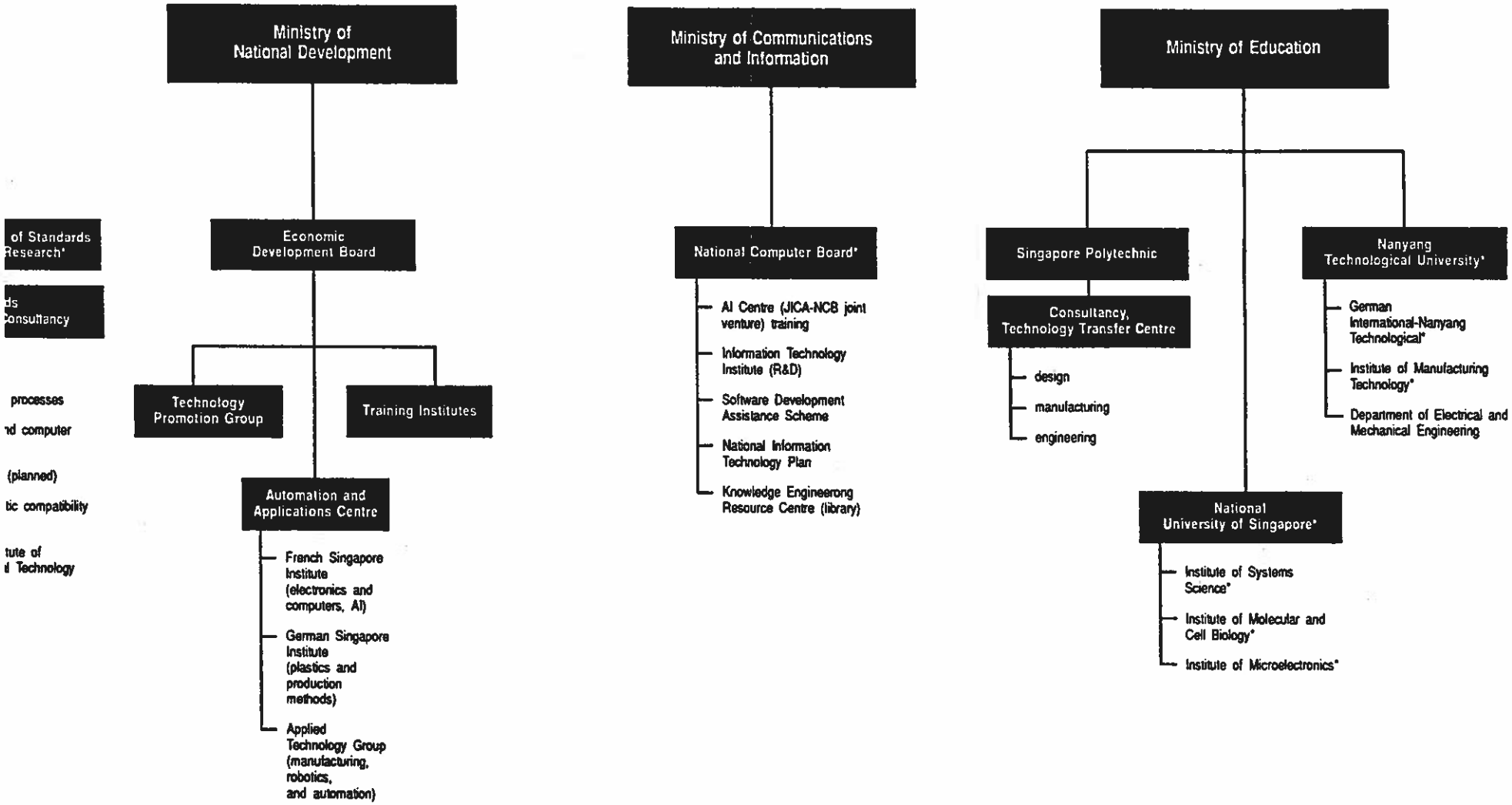


Figure 3.1. Singapore Science and Technology Organization Structure.

3.3 Strategic Approach for Singapore

Singapore is the most technologically advanced of the ASEAN countries and it presents opportunities for strategic alliances, with investment and technology flowing both ways. Joint ventures with Singapore research and development institutes and with Singapore companies can lay the basis for expansion into other markets in the region.

In order to develop science and technology business in Singapore, the following strategies are proposed:

i) Raise Mutual Awareness

- ASEAN Science and Technology Week will be held in Singapore, in September, 1992. There will be technical sessions, a trade fair, meetings of senior officials from ASEAN countries and from dialogue countries, meetings of all the subcommittees of the ASEAN Committee on Science and Technology (COST). Ample opportunity will be provided for special group or one-on-one meetings. Strong representation from Australia and the European Community is expected. The Canadian International Development Agency has contributed C$100,000 towards the organization of the event — New Zealand has also made a contribution.

Canada should take advantage of this opportunity and participate aggressively:

- Promote the event to industry, research institutions and the universities in Canada to ensure strong participation from each of these sectors.

- In cooperation with the National Science and Technology Board, organize special sector workshops and company visits between Canadian and Singapore companies. The Canadian-ASEAN Centre should consider sponsoring a Canadian seminar on investment and joint venture opportunities in Canada.

- Ensure that Canadian papers are presented in each of the ASEAN areas of focus: micro-electronics, biotechnology, automated manufacturing, advanced materials, information technology, environmental technology and science and technology education.

- Be prepared to make side-trips to the other ASEAN countries to follow up on opportunities identified during Science and Technology Week, or to stay in Singapore a few more days to conclude deals.

- Financial support to participating Canadian companies and organizations should be considered by all levels of government.

- Invite key science and technology decision makers to Canada for a tour of research and development facilities and industry.

- Promote the activities of local alumni associations - many Singaporeans in important positions have studied at Canadian Universities.

- Request that the Singapore Economic Development Board establish an office in Canada (they have many in the U.S.). Failing that, establish links with their closest U.S. Office.

- Promote staff exchanges between Singapore and Canada (universities, research and development organizations).

ii) Place Canadians on key International Advisory Boards in Singapore.

The National Science and Technology Board and the research institutes have internationally staffed advisory boards. From the Singapore perspective, these boards serve a marketing function also, and the directors bring business to both Singapore and to their country of origin.

The Canada-ASEAN Centre should be aware of upcoming vacancies and propose Canadian candidates to fill these positions.

iii) Expand or establish plans for staff exchanges and placement of Singapore trainees in Canadian graduate schools, institutions and industry.

The Canadian-ASEAN Centre should gauge the interest of the NSTB in an integrated Canadian plan, as part of the National Technology Plan, and submit a proposal if warranted. The proposal can be prepared in consultation with the Association of Universities and Colleges of Canada, the Association of Provincial Research Organizations, and appropriate industry associations.

iv) Promote Canadian strengths in Singapore technology focus areas.

- Establish a library of appropriate directories in the Canadian-ASEAN Centre (e.g. of relevant companies, research institutions, Networks of Centres of Excellence, etc.).

- Ensure Canadian participation in relevant events (trade shows, workshops, conferences, etc.).

- Canadian trade missions.

v) **Opportunistic approach**

Distribute the immediate and specific opportunities identified through the appropriate channels for action. Establish a mechanism for keeping track of upcoming opportunities and channelling them to the appropriate organizations. The National Science and Technology Board and the Singapore Institute of Standard and Industrial Research should be involved.

vi) **Orchestrate**

Orchestrate all of the above to maximize the probability of successful realization of business opportunities through synergy. This should probably be contracted out and the effort should be jointly funded by the federal government, and industry. ASEAN Science and Technology Week should be the focus of effort during 1992, as it will provide a basis on which to build a continuing effort for ASEAN as a whole.

3.4 Specific Opportunities Identified.

i) Technology Opportunity Areas

Sector	Project	Contact
Information	"Neurological network" stock market forecasting (from Singapore)	Institute of Systems Science (ISS)
	Data bases as applied to telecom-munications systems (joint development)	ISS
Manufacturing	Communication between devices (joint development)	Institute of Manufacturing Technology (IMT)
	Foundry computerization (to Singapore)	IMT, Singapore Steel
Medical	Custom-made prothesis using tomography and CAD/CAM (from Singapore)	GINTIC Institute of CIM
	In vitro production of human islet cells (for diabetes treatment) (from Singapore)	Singapore Biotech Pte. Ltd.

Environment	Environmental technologies "Green Label" (to Singapore)	Singapore Institute of Standards and Industrial Research (SISIR)
Oil & Gas	Submersible for offshore drilling rig inspection and repairs (to Singapore)	National Science and Technology Board (NSTB)
Other	Sensors (to Singapore)	NSTB

ii) Business

Sector	Project	Contact
Manufacturing	Partnership with IMT to develop and market technology to ASEAN markets.	IMT
	Joint bidding on contracts to third parties	IMT
	Partner for Singapore Steel	IMT
Communications	Strategic alliance with companies offering good market access and good reputation in North America. Investment resources available. Interest in"mobile-satellite" market.	Agilis Communications Technologies Pte. Ltd.
Biotechnology	Joint bidding on contracts to third parties	Institute of Molecular and Cell Biology (IMCB) Singapore Biotech Pte. Ltd.
	Licensing of Canadian technology for ASEAN market	Singapore Biotech Pte. Ltd.
	Mutual marketing of products	Singapore Biotech Pte. Ltd.
Information Technology	Joint bidding on contracts to third parties	ISS

iii) Human Resources Opportunities

Sector	Project	Contact
Exchanges	Most research institutes are interested in staff exchanges.	
Education and Training	The National Technology plan envisages human resources development on a grand scale. Opportunities to have motivated, high calibre post graduate students and trainees who bring their own funding study in Canada.	NSTB

4.0 INDONESIA

4.0 INDONESIA

4.1 Country Description

With a population of over 180 million, Indonesia is the largest and most populous member of ASEAN. Its GDP per capita is C$632, growing at an annual rate of 7%. Inflation is at about 9%, and the prime lending rate is 27%. Its foreign debt per capita, at C$ 402, is the lowest (except Singapore) among the ASEAN members.

The following major similarities between Canada and Indonesia were stressed by the Mission members throughout the interview process:

(a) wide geographic span, running east to west
(b) rich natural resources, both non-renewable (oil and gas) and renewable (forestry)
(c) significant agriculture and fishery industries
(d) although they differ in stage of development, both adopt an economic diversification program with similar priority technologies and industries.

The timing of the Mission was such that it coincided with a complementary project undertaken by Dr. Alain Barbarie, a Canadian consultant operating in Jakarta on behalf of the Canadian Embassy. Accordingly, the Mission members benefited from the preliminary findings of Dr. Barbarie as depicted in his draft report and from his participation in most of the interviews. Also, the Province of Alberta and Indonesia signed a Memorandum of Understanding on technological cooperation a few weeks after the Mission's visit.

4.2 Summary of Interviews

The institutes showed a strong interest in training in Canada. This Government has a philosophy of importing technology using international development assistance, and assisting with deployment. (This contrasts with Singapore, which has a structured government plan aimed at increasing industrial research and development.)

The institutes do most of their work with government. Both the dominance of the Agency for the Assessment and Application of Technology (BPPT) and government ownership of industry contribute to this fact.

Most institutes visited by the Mission collaborate with other organizations at home, with Canada and other countries. There is moderate interest in strategic alliances with other organizations and other countries, and somewhat less in alliances with industry. Many institutes would like to second staff to Canada or have access to Canadian expertise.

Almost all research and development in Indonesia is performed by the public sector. There is a general expectation by industry, especially SMEs, that it is the proper role for the government to do so and that the role of industry itself is to commercialize the technology so developed.

The Agency for the Assessment and Application of Technology (BPPT) is the key government agency responsible for science and technology matters. It is headed by Professor Habibie, who is also Minister of State, Ministry for Research and Technology, and holds numerous other important offices. He is the central science and technology figure in Indonesia. His many titles and positions put him squarely in the driver's seat with respect to almost all and any matter related to science and technology. At the same time, this tends to gridlock the decision making process because of the many decisions that have to be made by one person.

There is a general recognition that the economic future of Indonesia depends largely on its ability to add value to its commodity exports through manufacturing and science and technology innovations. While Korea and Taiwan appear to be the role model for Singapore in science and technology development, Singapore in turn is viewed as the example for Indonesia to follow.

Although the Science and Technology Plan is linked very closely to the Industry Development Plan, both face serious difficulties in implementation due to a number of factors such as lack of personnel trained with the requisite technical or managerial expertise. In addition, despite the centralized control, communication and cooperation among various government agencies seem weak and local SMEs may not be able to benefit fully from the Government's programs due to lack of awareness or personal contacts.

Careers in science and technology, including manufacturing, do not rank as high as, say, entertainment, medical, legal, and trade in terms of preference among young Indonesians. This, and the fact that government wages are generally two or three times less than those offered by the private sector, has led to a high participation rate (in the 50% range) of women in science and technology.

The Minister's science and technology strategy advocates actions involving instant utilization of leading edge technology, instead of re-tracing the development path of industrialized nations. The Minister also recognizes the need to cooperate with industrialized nations to accelerate the acquisition and transfer of technology and know-how.

Canada, while considered as a "dialogue" country is not perceived to be among the top countries with technology capability. Perceived as higher ranking technology sources are: US, Japan, U.K. Germany, France, and Australia.

The major reasons for Canada's low ranking are: (i) most decision makers were trained in a dialogue country other than Canada, (ii) most major dialogue countries are exerting influence in Indonesian science and technology policy development and program formulation through providing experts in advisory and training roles and through striking general science and technology bi-lateral agreements with Indonesia. Some have special agreements on specific technologies. So far, Canada remains passive and "invisible".

There is little cooperation in science and technology between Indonesian and other members of ASEAN. Most decision makers interviewed considered bi-lateral agreements between Canada and Indonesia as a more effective vehicle for future cooperation, compared with possible umbrella agreements between Canada and ASEAN.

Referred to as industrial vehicles, the following sectors receive special attention and support: transportation, telecommunications, electronics, energy, engineering, agricultural machinery, defence and service industries.

Technology transfer from dialogue countries is a key part of Indonesian science and technology policy. This is accomplished through (i) training of technical personnel, which is a special challenge as careers in science and technology are not preferred among the more intelligent youth (ii) joint ventures and acquisitions, and (iii) government policies such as BOT (Build, Operate and Transfer). BOT is very common in ASEAN, whereby major international consortia build (e.g. a mass transit system) operate for a long enough period to return a profit and for the State to train enough technical personnel to operate and transfer back to the State thereafter.

Notes from individual interviews are given in Appendix 2.

4.3 Strategic Approach for Indonesia

The Canadian science and technology strategy should focus on building credibility and influence in Indonesia, and on increasing the level of coordination among Canadian government agencies and Canadian firms.

In building awareness and credibility of Canadian science and technology capability, Canada should stress its science and technology strengths developed as a result of its geographical diversity, richness of natural resources, and economic diversification programs, i.e. technological sectors such as telecommunication, resource exploration, environment, agriculture, fisheries, and forestry. Canada should also produce a video on its science and technology capability, to be used by Embassy personnel (it could also be used in other S.E. Asian countries).

Lack of size and coordination appear to be major factors why Canadian firms and consortia have not been able to gain a larger share of the activities and projects in

Indonesia, particularly in BOT projects. Increased communication and cooperation among Canadian federal and provincial governments, their different agencies and Canadian industry is a pre-requisite for commercial success. Collaboration should piggyback on the momentum generated by the signing of an MOU between Indonesia and Alberta in November, 1991, and to the extent possible, be formulated within that umbrella or as extensions of that MOU. The perception of lack of size of Canadian consortia can be countered by inviting appropriate partners from other countries to join such consortia. Such partners may help by bringing in complementary resources, as well as local or regional expertise and influence.

Immediate Action Items.

(a) Invite Professor Zen, Deputy Chairman for Natural Resources, BPPT, to visit Canadian institutions.
(b) Place a science and technology advisor in BPPT.
(c) Provide visible and action oriented follow up to the Mission by selecting one or two projects for collaboration which have high probability of success.
(d) Take advantage of the second World Bank Loan to Indonesia (Science and Technology for Industrial Development Program) to maximize the number of funded trainees and students to Canada.
(e) Produce a 15 minute video on Canadian science and technology

4.4 Specific Opportunities

i) Technology Opportunity Areas

Sector	Project	Contact
Forestry	embryo splitting technology	Agency for the Assessment and Application of Technology (BPPT)
Power	theft prevention and usage monitoring	BPPT
	small scale power plants using wood or solar energy, 400 MW coal-fired power plants, geothermal pilot plants	Indonesian Institute of Science (LIPI), BPPT

Sector	Project		Contact
Telecom	satellites	Q-band applications in rainy conditions low orbital equatorial satellites VSAT, GSO remote sensing satellites Radarsat	BPPT
	cables	optical submarine cables for Eastern Indonesia and Java	BPPT
	cellular	total roaming capability fully digital cellular PCN (Personal Comm. Network)	BPPT
	switching systems	low cost per line (<C$ 2300/line) technologies	BPPT
Resources	exploration technologies (e.g. sea bed mapping, airborne geophysics and marine mapping of mineral deposits.)		BPPT
	small scale mineral mines		BPPT
Water	method and techniques for ground water monitoring in semi-active and active volcanic areas		BPPT
Energy	geothermal, wave power, solar		BPPT
Environment	marine pollution monitoring, source tracing and identification		Dept. of Communications (DOC)
	air pollution weather forecasting technology		Meteorology and Geophysics Agency DOC

Sector	Project	Contact
Geomatics	remote sensing and GIS	Indonesian Air Force Survey and Mapping
	Global Positioning Systems	LIPI, BPPT
Aquaculture	trout, salmon and tuna farming	BPPT
Models	computer models for resource and environmental industries	BPPT
Transportation	wind tunnel technology	DOC
	ocean-going ship-building	DOC
Telemetry	SCADA (Supervisory Control and Data Acquisition)	LIPI
	low cost telemetry systems	LIPI

ii) Business

Sector	Project	Contact
Power	privatization of power production facilities	BPPT
Telecom	2 major projects in West Indonesia and one in East Indonesia	LIPI, BPPT
Transportation	rail transportation development	DOC, BPPT
Rural Development	using telecom and remote education	LIPI, BPPT
Used Equipment	demand for used equipment of various kinds	DOC, BPPT, LIPI

iii) Human Resources

Sector	Project	Contact
Advice	placement of a Canadian science and technology advisor in BPPT	BPPT

Sector	Project	Contact
Training	long term training as an important part of Canadian bids.	All Institutes
	training and education services from Canadian firms and institutions	All Institutes
	placement of Indonesian trainees in Canadian firms and laboratories for say, one year terms	All Institutes
	sending Canadian experts and/or graduate students and attaching them to Indonesian agencies and universities.	All Institutes

5.0 PHILIPPINES

5.0 PHILIPPINES

5.1 Country Description

The Philippines is an archipelago of about 7000 islands. The population numbers 61 million, with 63% living in rural areas. Filipinos are mainly Malay in origin. Filipino, which has numerous dialects, is the national language, but English is the official language of instruction in schools. Literacy rate is 90% and the workforce is reasonably well trained. GNP growth in 1990 was 3.5%. Interest rates are high (~30%) and inflation reached 19% in 1991.

Political instability and natural disasters greatly add to the country's problems.

Bilateral trade reached C$425 million in 1989. Opportunities for manufactured and high technology exports are expanding, particularly in telecommunications, mining, power and agri-food.

5.2 Summary of Interviews

Philippine institutes employ over 40,000 persons with more than half female employees.

There was significant interest in the 9 institutes that were visited in training in Canada. A majority engage in research and development and less undertake deployment to industry. This may be due to the fact that industry cannot absorb technology and also needs help deploying the technology once received.

Most institutes use or develop information technology whereas only one institute does work in biotechnology even though this is an area promoted by government.

The institutes do most of their work with government departments and SMEs. Philippine institutes do a small amount of work with other ASEAN countries. They want strategic alliances and are willing to collaborate at home, in other countries and in Canada. Cooperation with Canada in mutual recognition of standards is an area of interest.

The Philippine science and technology framework, shown in Figure 5.1 was put in place in 1988. The Department of Science and Technology plays a prominent role in planning, coordinating and funding government science and technology activities.

Neither multi-national corporations nor local companies carry out research and development in the Philippines, and most is done by government agencies. The government intends to change this situation but is working against considerable odds. The country is very poor and has many primary needs that have to be met at a very basic level. The instability of the political system and a series of natural disasters add

to this burden. Nevertheless, the mission found a great enthusiasm and confidence in the future among the people that were interviewed.

Many science and technology projects are funded through international assistance programs that play an essential role. The Technology and Livelihood Resource Centre provides incentives to micro, small and medium sized enterprises and in putting them in contact with technology resources. The needs of these companies are often very basic, an observation similar to that made by the Technology Applications and Promotions Institute in their survey of industry.

The Philippines have 70 universities and colleges, 20 of which are located in the greater Manila area. Care is being taken to involve the universities in national development. For example, the Science Education Institute has set up networks connecting groups of high schools to universities, who act as a "back up" for the science teachers. Also, a number of the institutes are located in the universities, or work closely together with them. For example, the Technology Applications and Promotions Institute worked with graduate students from the engineering faculties to survey SMEs and suggest improvements to procedures, processes, and management practices.

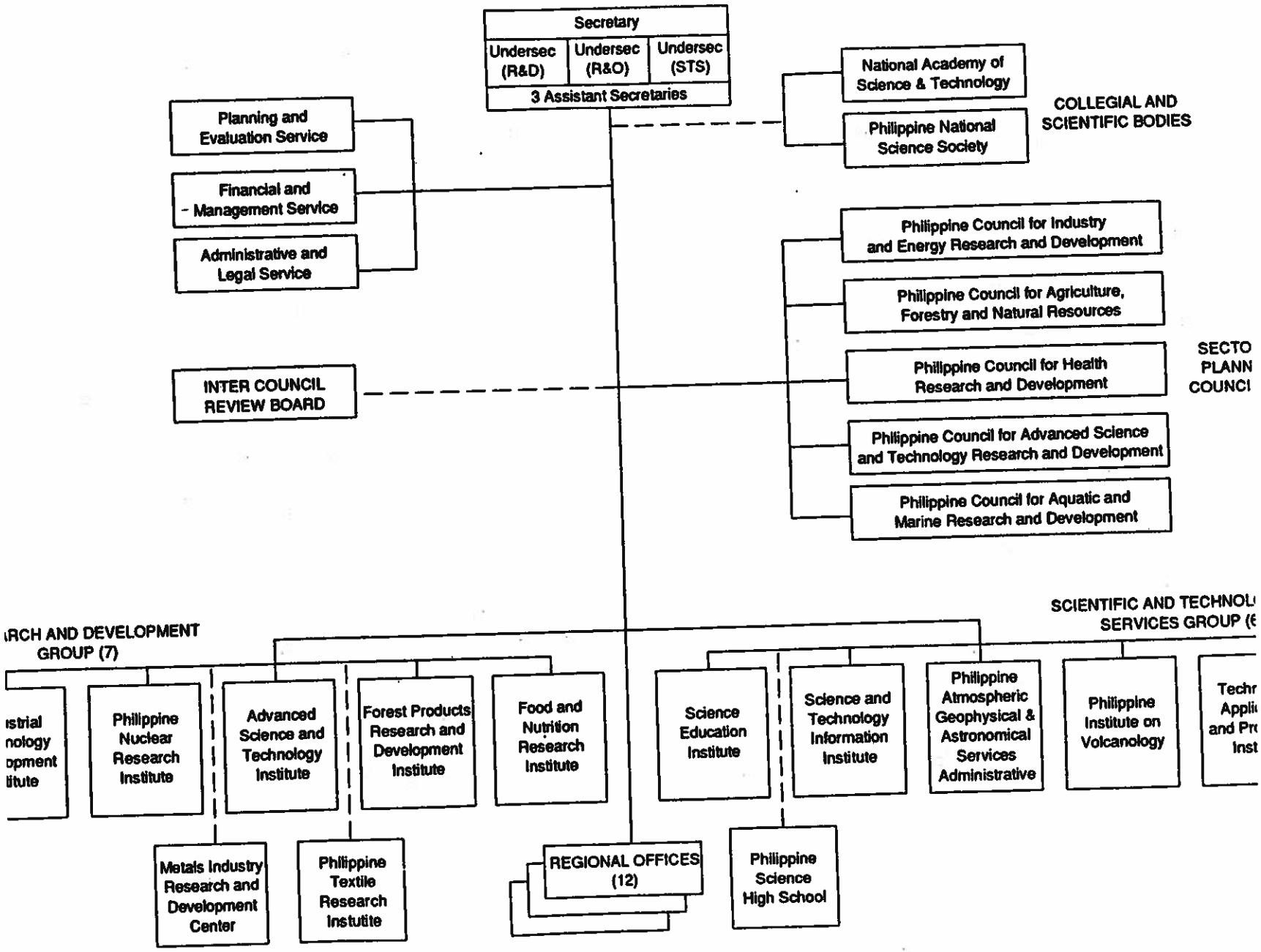
There is a great need for training in many areas, and DOST presented a manpower development plan for which foreign aid is being sought. ISO 9000 seems to be critical to industrialization, but they have a lack of personnel to do the training and certification.

A National Information Technology Plan has been developed. It covers information, technology and telecommunications, education, research and development, and application in government and industry. Only 4% of the total Philippine information technology workforce work in government. There are 300 software houses in the Philippines, half of which export their products valued at C$ 50 - 100 million per year. There may be possibilities for strategic alliances with Canadian firms in this area, especially since labour costs are very low in the Philippines.

Telecommunications are crucial, and the government wants to have a least one telephone installed in each municipality by 1992. There are plans to superimpose value-added networks and services on the existing telecommunications net. 83% of the telecommunications network is privately owned.

In natural resources management, the government is taking a total ecosystems approach and is looking to expand an IDRC-funded GIS pilot project into a C$ 46 million program.

Knowledge of Canadian technology capabilities is restricted to GIS.



e 5.1. Department of Science and Technology (DOST) Organization Chart.

The government institutions' ability to attract good scientists is limited by salary. Government salaries are only 50% of those in industry (in Canada it is 90%). Women work under these conditions because they are the second income earners of their family.

5.3 Strategic Approach for the Philippines

The Philippines is in desperate need of foreign assistance to build up the science and technology programs that will have a strong impact on economic development, therefore, the major strategy should be the provision of aid. It should be focused on strengthening the infrastructure, with high priority given to human resource development followed by natural resources management.

From a business perspective, the aid could be delivered by Canadian universities, colleges and institutions, and by industry. Otherwise, only targets of opportunity should be pursued. Projects funded by the World Bank and the Asian Development Bank (ADB), which is headquartered in Manila, should also be a target.

5.4 Opportunities Identified

i) Technology

Sector	Project	Contact
Environment	Waste disposal technology	Technology and Livelihood Resource Centre (TLRC)
Manufacturing	Process for bending bamboo for furniture	Design centre of the Philippines (DCP)
	Furniture metal components and fittings	DCP
	Technology to make paper from grasses, bamboo and basket weaving waste material	DCP
GIS and Remote Sensing	Expanded GIS for land use planning - value up to C$46 million (depends on international assistance)	Department of the Environment and Natural Resources (DENR)
	Local updates of SPOT satellite data	DENR

Sector	Project	Contact
Other	Cellular phone technology	Advanced Science and Technology Institute (ASTI)
	Technical assessment of equipment by "arms length" agency.	DENR

ii) Business

Sector	Project	Contact
	Marketing Surveys on behalf of Canadian firms (as a learning exercise for TAPI)	Technology Applications and Promotion Institute (TAPI)
	Build-operate-transfer telecom networking infrastructure, with Philippine partners	National Computer Centre (NCC)
	Joint bidding on third party contracts	Industrial Technology Development Institute (ITDI)

iii) Human Resources

Sector	Project	Contact
Development	One-year, two-month fellowships and short-term individual training in biotechnology; laser technology; materials science (electronic, polymers; ceramics); information technologies; electronics, instrumentation and control. Foreign assistance of US$ 40 million over 5 years is being sought.	Department of Science and Technology (DOST)

Sector	Project	Contact
Education	Distance education	DOST
	Staff assignments for up to one year, with some salary top-up and travel cost borne by receiving organizations.	DOST

6.0 THAILAND

6.0 THAILAND

6.1 Country Description

Thailand is a constitutional monarchy. It has an ethnically homogeneous population with a small Chinese minority. Its population numbers 56 million and is mostly Bhuddist. Its economy grew by nearly 40% over the past three years. Long term prospects are good, with continued foreign investment growth. Over 30 joint ventures or technology transfer agreements have been signed between Thai and Canadian firms, representing over C$100 million in capital.

6.2 Summary of Interviews

The total number of employees in the Thai institutes visited is large (pver 56,000) with a high proportion of female staff. Just over half of the institutes visited are interested in having their staff trained in Canada, whereas almost all would accept staff from Canada.

The majority are involved in research and development and less than half in deployment. This may reflect the fact that industry is not yet doing much research and development. Micro-electronics, information technologies and advanced materials have found their way into many of the institutes. All institutes have clients in government, large companies and SMEs

Only one-fifth of the institutes visited work with other ASEAN countries, slightly less than half work with Canada, and three-quarters work with other countries.

Thailand's growth has resulted mainly from the importation of capital and technology. The country's objectives for the next five years are: an annual GDP growth rate of 8.5%, a 5-6% inflation rate and an increase in research and development spending from 0.25% to 0.5% of GDP. Presently, almost all research and development is carried out by government.

Thailand has always been strong in agriculture, and the research and development infrastructure in this sector is more advanced than that in others. There has been considerable growth in the electronics and computer industry, with at least 70 companies active in this area. The iron and steel industry is not well developed. There are no ore smelters and no sheet metal fabrication, while metal working and machinery sectors are weak. The foundry sector is stronger and exports machine bases to Japan. Plastic injection machines are another export item. There is some engine manufacturing, using Japanese technology. In plastics, the upstream factories use turnkey equipment imported from Japan and the USA and they supply hundreds of downstream factories. There are also hundreds of factories that add value to home-grown rubber. The ceramics industry produces mostly traditional items and is occupying a market left behind by others. The textile industry produces goods worth

C$4 billion per year, using imported technology and engineers. Thailand wants to start manufacturing textile machinery locally.

According to the local Canada-ASEAN Centre representative, there is significant opportunity for improving performance through the introduction of western methods in Thailand, thereby making companies more profitable.

There are a number of large companies in Thailand of which Siam Cement is the largest. Siam Cement is a diversified company. In the opinion of its Vice President, "Canada is sleeping" in comparison with other dialogue countries with which the firm has joint ventures. He is of the opinion that Canadian business should be more aggressive, particularly with respect to large projects (>C$20 million).

The science and technology infrastructure of Thailand is shown in Figure 6.1. The Ministry of Science, Technology and Energy is responsible for administering this structure and for coordinating science and technology activities in the Country. Biotechnology, advanced materials and microelectronics and computing have been identified as priority areas for development. This strategy is reflected in the establishment of the National Centre for Genetic Engineering and Biotechnology (NCGEB), the National Centre for Metal and Material Technology (NCMMT) and the National Electronics and Computer Technology Centre (NECTC).

In the near future, the name of the Ministry will be changed to Ministry of Science, Technology, Energy and the Environment and the three centres will be merged with the Science and Technology Development Board (STDB). A new 50,000 m^2 research centre will be built in the new research park to house STDB. The Thai Development Research Institute is a think tank funded by CIDA. It has produced many reports on Thai industries capabilities and directions.

The Petroleum Institute of Thailand was set up with the help of PetroCanada International Assistance Corporation, and is a good contact for the petroleum industry. The National Research Council of Thailand is a funding and coordinating agency. It has produced a 1991-1996 National Research plan (a copy was left at the Canadian Embassy in Bangkok for translation of major points).

Government is paying attention to the relevance of research. Industry would like government to do basic long-term research, and leave applied research and development to industry. Siam Cement, the largest enterprise in Thailand is only now starting a research program, with 3 laboratories planned in pulp and paper, and raw materials and building materials.

Thailand has a scholarship program under which 250 students have been sent abroad, with 130 more to follow. Under a special program, selected highly gifted high school students are sent abroad for university education. On their return they form the core for new research institutes. Many research engineers are leaving government

institutes for the private sector, where they earn three to four times more. There are 28 private universities and four major public universities. One of the most prominent is Chulalongkorn University. Its Faculty of Engineering is increasing its enrolment from 540 now to 1000 within two years. There is a need for education and training at all levels and Thailand is keen on cooperation with Canada in this area.

Thailand would like to form strategic alliances with Canadian companies in the areas of remote sensing (especially commercialization and marketing), science and technology management, marine science, non-conventional energy, microelectronics and telecommunications, especially SCADA. The Ministry of Science, Technology and Energy can assist Canadian companies interested in joint ventures find co-investors in Thailand. Their research institutes can act as entry points for Canadian companies by playing a broker's role.

Thailand will invest heavily in telecommunication in the near future, one million telephone lines in Bangkok and another million in rural areas. Thailand has plans to establish a data processing zone where an integrated telecommunications-dataprocessing-information complex will provide services to customers world-wide. The project members will include public and private enterprise. The government is considering the terms under which contracts will be awarded.

Thailand is now marketing its products and expertise into Cambodia, Laos and Vietnam and would welcome Canadian firms as joint venture partners. ASEAN links are not strong, and bilateral or trilateral agreements are preferred.

The mission was struck by the strong feeling of goodwill towards Canada found everywhere. However, if Canada does not take aggressive action now, indifference will replace goodwill, a sentiment also expressed by the Honourable Sanga Sabashri, Minister of Science and Technology.

Individual interview notes are given in Appendix 4.

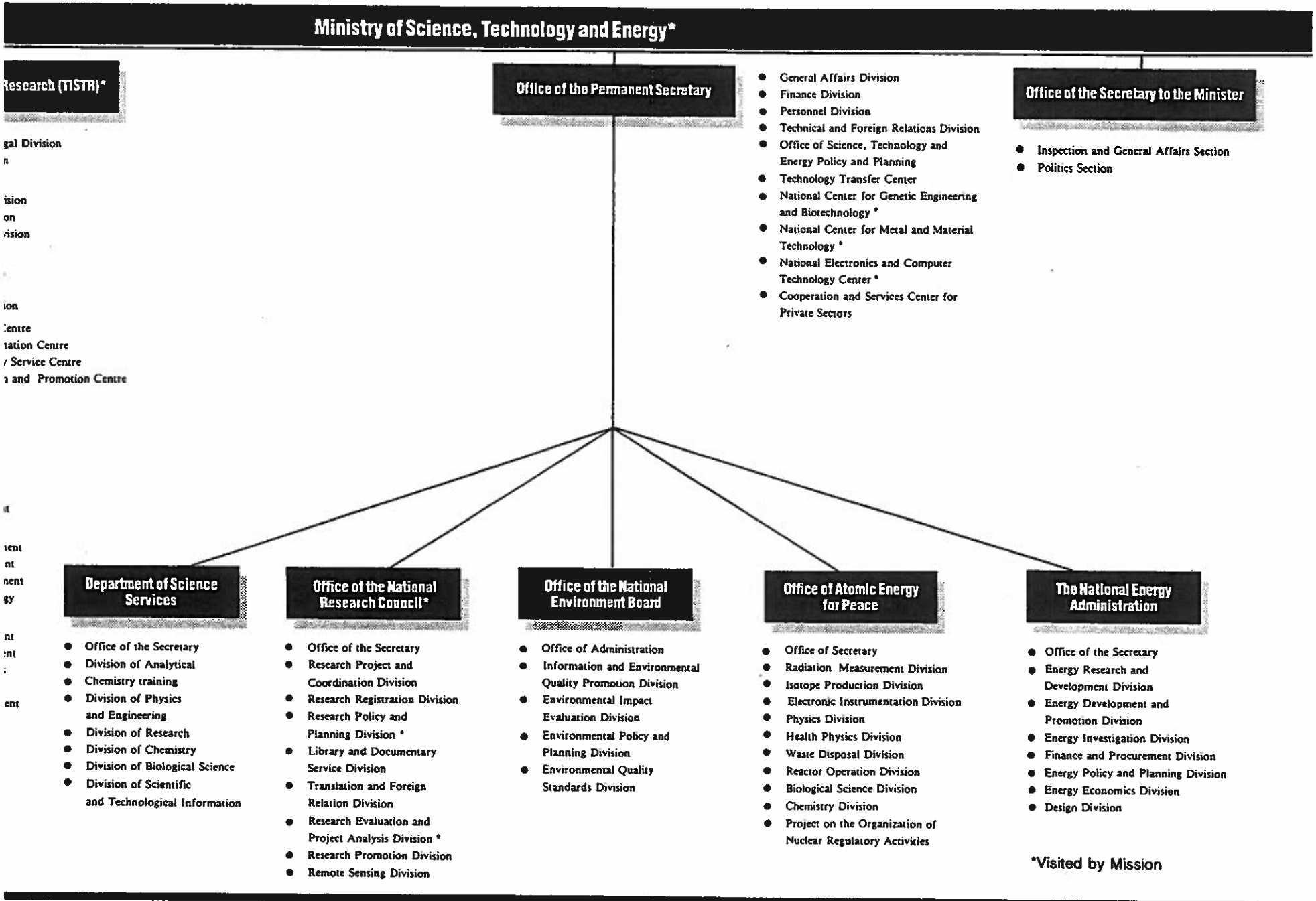


Figure 6.1. Thailand Science and Technology Organization Structure.

6.3 Strategic Approach for Thailand

The economy has grown at 7 to 10% annually over the past five years thanks to imported capital and technology. Thailand is preparing to add value to its products by increasing its technological sophistication. There is a three to five year window of opportunity during which Canada can take part in building up the Thai science and technology sector and position itself to take advantage of the rapid expansions that will follow. The existing goodwill towards Canada and the positive perception of its education system provide a competitive advantage. Thailand is positioning itself as the gateway to Laos, Vietnam, Cambodia and other neighbours for Canada and the West. They are interested in tripartite projects involving Thailand, Canada and one of these countries, with Canada being the supplier of science and technology expertise, and Thailand the "local" partner providing language, cultural, and managerial input.

Specific approaches are outlined below.

i) Mutual Awareness

- Aggressive participation in ASEAN science and technology Week, September, 1992, followed up by post-conference visits to Thailand.

- Invite key Thai science and technology decision makers from government and industry to visit Canadian facilities and plants.

- Place a Thai science and technology counsellor in one of the provincial research organizations, or work with the science and technology counsellor in the Thai embassy in Washington (invitation to science and technology events, inclusion in mailing lists, tours of facilities, industry association key note speaker, etc.)

- Canadian presence at Thai government industry round tables (through MOSTE)

- Promote Thai-Canada Association in Thailand and Canada-Thai Associations in Canada.

- Take part in science and technology conferences in Thailand.

- Promote "science and technology tourism" to Thailand by including visits to Thai universities, industry and institutions in the itinerary of travellers with a science and technology background.

- Take advantage of the Enterprise Thailand-Canada program (by firms both in Canada and Thailand).

Many of the above activities can be coordinated through the Canada-ASEAN Centre representative in Thailand.

ii) Place Eminent Canadians on Science and Technology Advisory Boards

The Canadian-ASEAN Centre representative in Thailand can identify upcoming vacancies, ISTC and APRO can identify potential candidates. The Ambassador can approach MOSTE with the list of candidates.

iii) Education, Training and Staff Exchanges

- Determine if technology assessment, technology forecasting, technology transfer components could or should be included in the Asian Institute of Technology management curriculum. If so, Canada could offer these courses. The concept should be discussed with Doug Webster at AIT.

- Coordinate the assignment of Canadian professors to teach at Chulalongkorn University for four to five week courses, starting with the Petroleum Engineering Program. If successful, expand the approach to other subjects and universities. Increase the number of Thai graduate students in Canadian Universities, involving ISTC, the Association of Universities and Colleges of Canada, and the Canada-ASEAN Centre in developing a plan of action.

- Set up a staff exchange program between research organizations. The program would be modelled after various existing programs. Details have to be worked out between the parties (ISTC, Canada-ASEAN Centre, sending and receiving organizations).

iv) Business Strategy

- Follow up on the immediate opportunities identified under 6.4.

- Use the network that results from the above to find and develop further opportunities. Coordination on both sides is important. In Canada, overall coordination could be contracted out as part of the overall ASEAN approach.

- Consider the possibility of using the "TR Labs" approach for a "prototyping - manufacturing" centre with Thai companies, Canadian companies, Canadian governments, Thai government, Canadian and Thai universities, APRO and NRC being potential sponsors.

- Coordinate all activities closely with CIDA's Enterprise Thai-Canada program (commercial transfer of Canadian technology).

In all of these, the science and technology international network is used as a vehicle for identification of business opportunities.

6.4 Opportunities Identified

i) Technology

Sector	Project	Contact
Information, Electronics and Computing	Five-way translation: Japanese-Chinese-Thai-Bahasa Malaysia-English	National Electronics and Computer Technology Centre (NECTC)
	Set up electronics test centre: electromagnetic interference and other standards.	NECTC
	TR labs concept	Thai Institute of Scientific and Technological Research (TISTR)
Biotechnology	Amino acids, antibiotics,proteins from plants, starch-based. agribiotech.	National Centre for Genetic Engineering and Biotechnology (NCGEB)
Materials	Advanced materials, metals	National Centre for Metal and Materials Technology (NCMMT)
General	Memorandum of Understanding	NECTC, TISTR

ii) Business

Sector	Project	Contact
Materials and Metals	Market access through joint ventures	NCMMT

Sector	Project	Contact
Electronics	Market access through participation in test centre.	NECTC
	SCADA industrial partnership	TISTR
Remote Sensing	Commercialization	National Research Council of Thailand (NRCT)
General	Research parks	Ministry of Science, Technology and Energy (MOSTE)
	Co-investment, joint ventures, brokerage	MOSTE
	Consultancy on lab set-up	MOSTE

iii) **Human Resources**

Sector	Project	Contact
Education	"Sandwich" Thai-Canada M.Sc. and Ph.D. programs	MOSTE
	Scholarship program - 800 students	MOSTE
Training	Use of new equipment - training at M.Sc. level	MOSTE
	Planning, natural resources and environment management	NRCT
	Science and technology transfer management	MOSTE
	Biotechnology pilot plant training	NCGEB
	Scientist exchanges, staff placement in overseas institutions.	MOSTE

7.0 MALAYSIA

7.0 MALAYSIA

7.1 Country Description

Malaysia has a population of about 17 million made up of three major ethnic groups: Malays, Chinese and East Indians.

Race relations play an important role in political and economic life: official policies to increase Malay ownership of the economy have been partly successful. These policies are being relaxed, but it is still important that projects have "Bumiputera" participation.

The country is ruled by a multiracial coalition which is dominated by the United Malays National Organization. The country is politically stable, with the present Prime Minister having been in office since 1981. The Prime Minister has the stated goal of Malaysia achieving Newly Industrialized Country status by the year 2020 ("Vision 2020").

Real GDP growth has been in the 7 to 10% range since the mid eighties. The Sixth Malaysia Plan seeks to diversify Malaysia's industrial base, enhance human resource development, promote technological upgrading, and reduce imbalances among sectors and regions of the country.

Malaysia maintains excellent relations with Canada. Bilateral trade in 1990 had a value of C$630 million, a 16% increase over 1989. Trade opportunities fall in the areas of agri-food, oil and gas, advanced technology, construction and transportation

The Enterprise Malaysia Canada program sponsored by CIDA is aimed at commercial transfer of Canadian technology through joint ventures and other commercial partnerships.

7.2 Summary of Interviews

The economy is booming and joint venture linkages are the order of the day with the U.K. and Australia being heavily involved. Significant investment funds are available for resource development. Canada is perceived positively, but lacking the aggression necessary to develop markets.

The Ministry of Science, Technology and the Environment is responsible for administering the government science and technology infrastructure shown in Figure 7.1 In 1986, it issued the National Science and Technology Policy and in 1990, it published "Industrial Technology Development, A National Plan of Action". The plan addresses the needs created by the change from an agricultural, primary products economy to a manufacturing economy over the past five to ten years. The Plan identifies the following weaknesses: *"Malaysia is technologically underdeveloped, with a*

poor science and technology infrastructure, a low level of technology application in industry, lack of awareness of critical technologies of the future, and societal indifference to science and technology". It sets out a number of strategic thrusts to address these weaknesses:

- strengthen institutional and support infrastructure
- diffusion and application of technology, and market-driven research and development to adapt and improve technologies in the nine key industry sectors: ceramics, chemicals, machinery and engineering, plastics, wood, textiles, food, rubber, electronics.
- build competence in key areas: automated manufacturing, advanced materials, electronics, biotechnology and information technology.
- human resources development.
- establish a science and technology culture in Malaysia.

Through these strategies, Malaysia hopes to achieve a high value-added component of its manufactured products and to maintain competitive advantage.

Earlier this year, the government obtained a C$61 million loan from the Asian Development Bank in support of the C$109 million Industrial Technology Development and Management Project which will kick start the strategies of the National Plan. Various Canadian organizations are pursuing bidding on components of this project.

The team visited the organizations marked with an asterisk in Figure 7.1 and also the Malaysian Technology University, the Petroleum Research Institute of the National Petroleum Corporation, and the Tenaga Electricity Board.

Malaysia is technologically less advanced than Singapore, but aggressive expansion and upgrading is being planned. There are opportunities for transfer of Canadian technology and for joint ventures in many areas.

There are great needs in human resources development and Australia is aggressively marketing its services in this area (e.g. during the Mission's visit there were 2 meter banners on every other lamp post in Kuala Lumpur's main shopping area promoting Australia).

There is a great demand for science and technology management training (technology transfer, planning and forecasting, contract and research management).

Individual interview notes are given in Appendix 5.

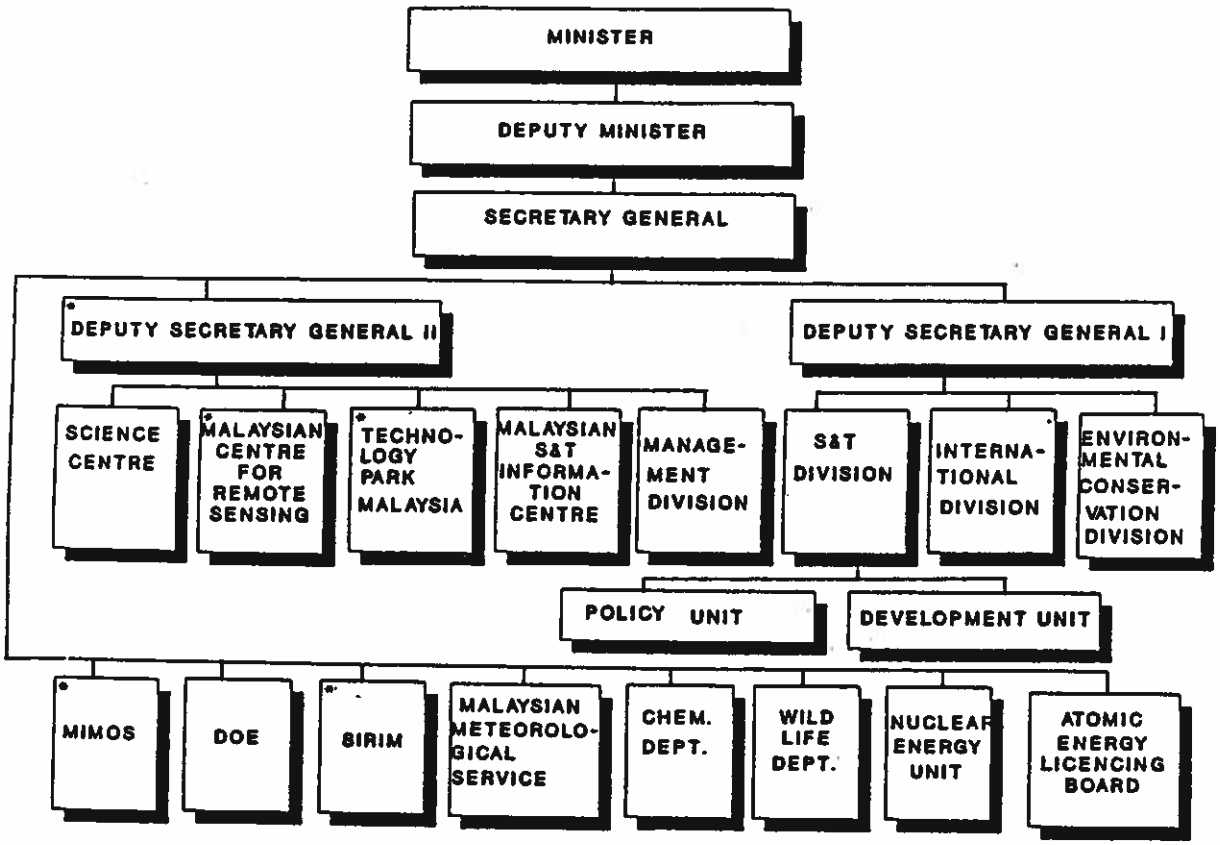


Figure 7.1. Science and Technology Infrastructure of Malaysia. Institutes marked with an asterisk (*) were visited by the Mission.

7.3 Strategic Approach for Malaysia

Malaysia is an excellent location in ASEAN for Canadian companies to initiate their involvement in the region. It has high potential in the short term. The influence of government is still strong, even though it is decreasing, and teaming up with government research and development organizations to approach local industry is an appropriate business strategy.

In Malaysia, the window of opportunity is now.

i) Raise Mutual Awareness

- Take advantage of 1992 ASEAN Science and Technology Week to show off Canadian capabilities, to contact Malaysian organizations and companies and to arrange for future visits in Malaysia.

- Be aware of local science and technology events, conferences, trade fairs, universities and stage a Canadian presence in Malaysia's areas of focus.

- Invite key decision makers to tour Canadian facilities.

- Support or help establish local alumni associations (there are an estimated 60,000 Malaysians that were trained in Canada).

- Exchange technical and management staff. (Retirees, are also most welcome in Malaysia.)

ii) Place Canadians in Key Advisory Positions in Malaysia

The Canadian High Commission should offer MOSTE its services in identifying eminent Canadians willing to serve in advisory positions. When advised of upcoming vacancies, The Association of Provincial Research Organizations or ISTC could assist in finding suitable candidates.

iii) Placement of Malaysian Students

Placement of Malaysian students and trainees in Canadian universities, colleges, research and development organizations, and industry. Canada should take a coordinated approach and propose an integrated placement service to MOSTE. This service could be offered on a cost recovery basis, or the Canada-ASEAN Centre may subsidise the service.

Consideration should also be given to establishing a Canadian training component in Malaysia, especially in areas that don't need sophisticated facilities or equipment (e.g. science and technology management).

iv) Identify Business Opportunities

Identify business opportunities through the activities listed above through follow-up on the potential specific opportunities seen by the mission (section 7.4) and through direct approaches. Local consulting firms, government research and development Institutes, the Canada-ASEAN Centre and the Enterprise Malaysia Canada program can all assist with the latter.

Coordination of the overall strategy should be contracted out with industry (through a consortium approach), ISTC and the Canada-ASEAN Centre jointly funding this effort. The Canada ASEAN Centre and APRO will work together to design an appropriate approach.

7.4 Opportunities Identified

i) Technology

Section	Project	Contact
Manufacturing	Automation Exhibition in Penang - 1992. Information available from MIMOS.	Malaysian Institute of Microelectronic Systems (MIMOS)
	Development of lead-free soldering material.	Universiti Technologi Malaysia (UTM)
	Automated Manufacturing, Advanced Materials Consultancy	Standards and Industrial Research Institute of Malaysia (SIRIM)
Electronics	Canadian partner that has silicon processing technology (0.5 - 1.0 micron level).	MIMOS
		MIMOS
	SCADA in palm oil mills	MIMOS
	45k Amps testing facility	UTM
Other	Set up a Laser Centre	SIRIM

ii) Business

Section	Project	Contact
Partnerships	Canadian Electronics Industry	MIMOS
	Memorandum of Understanding with APRO	SIRIM
Investment	Tabung Haji (Pilgrim's Investment Fund). Can only invest in ventures where no interest is charged.	High Commission (for info)

iii) Human Resources

Section	Project	Contact
Education	Distance education technology and methods	MIMOS
	Canadian retirees teaching advanced manufacturing, structure and materials analytical and graphical computation	UTM
	Joint Ph.D programs	UTM
	Twin Malaysian private universities with Canadian universities	SIRIM
	M.Sc., Ph.D. programs	SIRIM
Training	science and technology management, technology forecasting commercialization of R & D findings R & D management, contract research management	Ministry of Science, Technology and the and the Environment (MOSTE)
	Planning	MIMOS
	Technical training through staff assignments to Canadian research laboratories	SIRIM

8.0 ASIAN DEVELOPMENT BANK

8.0 ASIAN DEVELOPMENT BANK OPPORTUNITIES

8.1 Summary of Interviews

The Asian Development Bank's primary role is to raise the living standard in the lesser developed countries (LDCs) by supporting projects utilizing appropriate technology as opposed to advanced technology. The Bank does generally finance high tech projects, but when it does it sees them as the final loan to a country that is becoming an NIC (newly industrialized country).

Korea was a typical example of a country graduating from the utilization of bank loans. That country's final ADB sponsored projects were in advanced technology development. The country was changing its industrial structure from one based on low labour cost and light industries, to one based on higher value-added and high technology industries.

Four such projects were completed successfully in Korea. The country now entering this "graduation" phase is Malaysia with the Industrial Technology Development and Management Project. The Association of Provincial Research Organizations is promoting its capabilities in areas covered by this project, and is hoping to be placed on the bidding list for various components.

One of the primary objectives of the ADB loan is to upgrade the research and development infrastructure of Malaysia. It will provide scholarships and fellowships to Malaysian researchers in research and development institutes to upgrade their skills through training overseas, and establish an information system connecting all science and technology organizations in the country, and the Ministry of Science, Technology and the Environment. It also provides for procurement, consultancy in automated manufacturing and advanced materials, and expert assistance in many other areas.

The project also assists the Standards and Industrial Research Institute of Malaysia by providing a technical assistance grant for a study on industrial technology contract research management and corporatization of its research and development.

A project engineer in Telecommunications for ADB stated that telecommunications were considered a luxury item in the 20 years of the Bank's operations to 1988. However, the bank for the past 3 years has realized it is a major basic infrastructure component required for a country's effective development. They approved C$747 million in Telecom projects between 1972 and 1990 and in the first part of 1991, C$345 million will be added to the sector.

The next major Asian Development Bank financial telecommunications project will be in Indonesia and approval for the loan is expected to be received from the Board in December 1991. This is an integrated project and includes switching, junctions,

outside plant, satellite services, staff training, human resources development and post-graduate courses.

Two Canadian companies were invited to propose on the technical assistance project leading up to this program, and both declined. This would have provided an excellent opportunity for these companies to be involved throughout the initial stages of the project. The executing agency is Telecom INDO, a government limited company. Bi-lateral financing is expected on rural components of the program. The loan is C$379 million, C$184 million of which is coming from the ADB.

This RFP (Request to Proposal) was the second PPTA (project preparation technical assistance) in Telecoms for which a Canadian company was invited and declined to propose. The second project will be developed for the next year and includes all the project components noted in the first loan above. This loan will be in the C$230 million range and will cover Sulawesi. A strategic master plan will also be piggy-backed onto the first loan for the overall development concepts. Also piggy-backed on the technical assistance in 1992 will be a look at the sector institutions, policy and private sector involvement.

Outside of ASEAN, a further TA on Telecom master planning for Mongolia will be upcoming and it is understood some Canadian firms have expressed interest in this project that will develop in early 1993. Mongolia will receive funding from the ADF (Asian Development Fund), a very soft component of the bank's lending (40 years repayment and 1% interest with a ten year grace period at the start). This compares with the OCR (Ordinary Credit Resource) on lending 6.75% interest currently.

At this early date, Telecom may be coming up in China and Tonga. Further projects exist in Pakistan and we have requested the embassy in Manila to contact the project officer for this project, as well.

Bank staff confirmed that the agency has few loans in high technology and the Malaysia project is the only major current one. Malaysia's concentration is biotechnology, automated manufacturing, and new materials. Thailand is also going into high technology, and their loan approved last May will provide a significant number of grants for overseas studies for students and researchers. The Thai's have decided which sectors they are going to send students in, but not which universities. This would imply a good opportunity for Canada to encourage the use of its universities.

A technical assistance project done on SMEs in Malaysia by TGC (Toronto Group of Canada)is in place. This TA is presently underway and a draft report has been submitted. It is titled "Industrial Technology Development."

The Bank's main thrust in Indonesia is in the private sector. A study has been completed on an industry and minerals project, but is now outdated and new technical assistance study will have to be done. The main function will be looking at product testing.

8.2 Strategy for Pursuing ADB Projects

Canadian firms have historically lacked the tenacity to maximise ADB opportunities, mostly because it requires frequent and long term development of contacts at the Bank (for early identification of opportunities), followed by focused follow up in the country receiving the project loan. This is expensive to achieve from Canada.

The Canadian Embassy in Manila has long had a specific commercial person assigned to follow up on ADB opportunities, but it requires the Canadian firm, or its local representative, to prospect effectively.

Many firms attempt to follow up on projects only after they have appeared in the ADB's monthly project report. This is most often far too late. Advance information on projects is vital to provide the time for follow up.

The remedial strategy is for firms to contract a local representative in Manila who can keep up the contact with ADB officials in sectors of interest - Telecom firms should particularly be following up on opportunities.

9.0 FEMALE PARTICIPATION IN SCIENCE AND TECHNOLOGY

9.0 FEMALE PARTICIPATION IN SCIENCE AND TECHNOLOGY

The Mission observed that in most countries visited, female participation rate in science and technology management is significantly higher than in Canada.

The replies to the question on female participation rate can be summarized as follows:

- female participation rate in science has been increasing steadily over the past 10 to 20 years. Enrolment rate has reached 50% in a number of universities, and participation rates up to 80% were cited in a number of government organizations.

- female participation rate in engineering is generally low, with the exception of information technology, where it reaches or exceeds 50% in many cases. One technical university stated that no women are accepted in certain faculties.

- in a number of countries the private sector seems to give preference to hiring males and a corresponding higher proportion of women ends up in lower-paying government jobs.

- in the Philippines, one reason given for higher female participation rates was the fact that many males take overseas jobs.

- in many countries where female participation is high, the school system is streamed and only allows two choices: a science stream or an arts stream after grade 9. Mathematics is obligatory for all students in most countries.

- the comments that women are more clever, more tenacious, more patient and better organized than men were made by a number of individuals in different organizations in different countries.

- the existence of an extended family structure that provides child care for working womn was cited as a possible reason for higher female participation rates in Thailand.

- there is some concern about the relatively large proportions of women that leave their careers in science and technology (50 - 75%).

- in Singapore, where science enrolments are 50% female, the comment was made that women prefer to marry men with more education than they have, which causes problems for women that make a career in science and technology.

- government removal of financial barriers to higher education opens doors to females as it counteracts the tendancy of oriental families to invest scarce resources in the education of male children first.

In summary, the role of women in science and technology in ASEAN countries has grown in importance over the past 10 - 20 years, and compares favourably to that in Canada. Further progress can be made. A variety of economic and societal factors affect female participation rate.

10.0 CONCLUSIONS AND RECOMMENDATIONS

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10.1 The Canadian Advantage

Despite the current poor competitive positioning of Canada, the Mission has identified a number of factors that may potentially give Canada significant advantages in competing for business in the region:

1. *Canada is not a world power.*
   There is a significant level of anti-colonial sentiment in the region, partly due to the legacy of World War II and partly due to the concern over economic domination. To a lesser extent, there is a prevalent scepticism in doing business with world powers. Despite the general lack of awareness about Canada, it is looked upon very favourably and considered a very friendly and non-threatening dialogue country.

2. *Canada is English speaking.*
   The educated and the politically powerful in the region usually speak English, at least as a second language. As such, the people in the region do not see language as a major barrier in doing business with Canada or sending students and staff to get trained in Canada.

3. *Canada is a member of the British Commonwealth and a member of the Asian Pacific Economic Community.*

4. *Canada is know for its multiculturalism.*
   Canada is one of the few developed countries where there is a significant number of citizens of ASEN origin. This is certainly a valuable asset for developing trade relations with the region.

5. *Free Trade Agreement with the U.S.A.*
   The Free Trade Agreement is considered a factor favourable to Canada by some who may wish to build relationships with Canada or Canadian firms and set up a beachhead for the North American market.

Canadian success in the region depends largely on how Canadian business and government can cooperate in addressing the weaknesses and capitalizing on the advantages identified.

10.2 Conclusions

The Mission achieved its goals:

- a good understanding of the science and technology infrastructure of the ASEAN countries.

- contacts with key science and technology decision makers.

- identification of a number of specific opportunities.

The region is developing rapidly, and science and technology play an important role in this development. There is a great need for education and training and much interest in the acquisition of expertise and technology from abroad. Canada is generally viewed in a favourable light and a serious Canadian effort focused on the region's target technology areas will almost certainly result in increased business. Thailand offers the best chances for success in the longer term, while immediate opportunities seem to abound in Malaysia. Singapore should be viewed as an equal partner that can both receive and provide technology and investment. Indonesia and the Philippines will be targets of opportunity for the short to medium term.

Unfortunately, only a small number of companies was visited and this should be remedied during Phase II.

The following sections present a recommended strategy and action plan for Phase II.

10.3 Strategy for Phase II

Business with the ASEAN countries can be increased through science and technology. The Mission recommends a strategy that consists of five coordinated components:

1. Raise mutual awareness in the Canadian and ASEAN business and science and technology communities.

2. Place Canadians in key positions on science and technology advisory councils in the region.

3. Promote placement of ASEAN students and trainees in Canadian graduate schools, short courses and institutions and offer exchange of staff.

4. Motivate Canadian business to develop linkages in the region.

5. Coordinate Canadian activities in the region, including: (a) effectively communicate the role of various government agencies active the region and their programs, to minimize confusion, (b) promote collaboration between Canadian industry and government, and (c) visibly pursue follow up activities of this Mission.

10.4 Action Plan

The Mission recommends the following action plan for Phase II.

1. Raise Awareness:

   i) Participate aggressively in ASEAN Science and Technology Week in Singapore (September 1992) and similar events in Malaysia and Thailand.

   ii) Invite selected key people to tour Canada as a follow-up to the current Mission. These must be a careful selection from industry and government and ASEAN Centre funding should be utilized.

   iii) Make better use of people in the region who have worked or been educated in Canada. For example, work with alumni associations, such as the existing Canada-Thai Association.

   iv) Invite ASEAN companies and institutions to Canada to promote their capabilities and exchanges (financed by CIDA or Enterprise Malaysia-Canada funds, etc.).

   v) Exchange management and scientific staff between institutions.

2. Placement of Canadians on science and technology councils and advisory boards:

   i) Identify upcoming vacancies and be prepared to offer qualified and eminent candidates.

   ii) Send retired Canadian executives and scientists on assignments (using Canadian Executive Services Organisation).

   iii) Assign Canadian science and technology advisors to ASEAN government ministries.

3. Placement of ASEAN Students:

   i) Involve Canadian universities, federal, provincial and industry research organizations in developing a coordinated plan for placement of students, and if possible, have them stay with Canadian families.

   ii) Awareness about Canada must be increased, especially its educational institutions.

4. Develop concrete business opportunities:

   i) Follow up on specific opportunities identified by this Mission.

   ii) Promote Canada's competence in telecommunications, natural resource management, science and technology and transportation.

   iii) Canadian companies involved in niche markets which match the technology ASEAN countries want (i.e. biotechnology) should be encouraged to visit on a more proactive basis.

   iv) Alert Canadian companies as to the potential business in LDC's (less developed countries) such as Laos, Cambodia and Vietnam, which can be accessed through joint ventures with companies in ASEAN.

   v) A more aggressive position on procurement opportunities through the Asian Development Bank, World Bank and other international development agencies.

   vi) In procurement opportunities, emphasize associated training. Training is considered by the region as an integral part of equipment purchases.

In summation, industry must be involved by increasing awareness in the marketplace. Canada must focus on its best technologies (i.e. natural resource based) and not attempt to pursue everything. Particular areas recommended are: telecommunications, mining and petroleum exploration and extraction technology, education, transportation, fisheries, pulp and paper, remote sensing (i.e. RADARSAT), and information technology, including GIS. The rest should be targets of opportunity only.

The strategy can be coordinated under contract. The possibility of industry, the Canada-ASEAN Centre and ISTC jointly funding this effort should be investigated. APRO and the Canada-ASEAN Centre will work together to design an appropriate solution.

APPENDIX 1
INDIVIDUAL INTERVIEWS IN SINGAPORE

A 1.1 National Science & Technology Board (NSTB).

The mission was received by Lee Kian Phing, Manager, Engineering Systems Group, Technology Promotion Division and Verdayne Nunis, Senior Officer, Public Relations, Corporate Service Division.

The Board's Advisory Committee is composed of eminent scientists and managers from abroad. This strategy provides an invaluable networking effect to the benefit of the board.

The Board has 45 employees and was established one year ago replacing the National Research Council. The number of employees is expected to increase to 90 over the next six months under Phase 1. The Board, in Phase 2, will build its own building in the Science Park. Its main tasks are shown in Figure 3.1.

On its return to Singapore, the Mission met with Dr. Chou Siaw Kiang, Executive Director of the NSTB. Dr. Chou attaches great importance to ASEAN Science and Technology Week in 1992, and offered assistance to Canadian organizations that will participate in setting up meetings, providing meeting rooms, etc.

A.1.2 National University of Singapore.

i) Institute of Systems Science (ISS).

The following were interviewed by the team: Dr. A.Desai Narasimhalu, Program Manager; John Conlon, Technology Application, Dan Patterson, Dr. Francis Wong Fut Suan, Dr. Lui Ho Chung.

The institute was established in 1981 with the help of IBM. In the early 1980's the emphasis was on training. Five years later, the emphasis was shifted towards making Singapore into a regional leader in the use of computers, again with the help of IBM. The present research focuses on NEXT generation prototypes. Areas of research include multi-media, natural language processing and AI. Projects include computer aided translation of documents, video disk instruction for the Curriculum Development Institute of Singapore, and virtual reality machines.

ISS works with industry using a variety of fee-for-service mechanisms, from direct manpower charges to royalties. Typical project team size is 10-15 people. ISS offers post graduate diplomas and degrees. ISS has 120 people and will add 100 more by 1995.

ISS is eager to participate in strategic alliances and to bid on joint contracts.

ii) Institute of Microelectronics (IME).

Dr. Bill Chen received us at the IME temporary location in the Faculty of Engineering.

IME started operations in April 1991. Its purpose is to serve as a catalyst to move the work done by multi-national companies from testing and assembly into full product realization. This will be done through "developing expertise, bringing in expertise training local people, and entering into meaningful projects with multi-national corporations."

It is expected that this will induce multi-nationals to move their research and development operations to Singapore. 12 experienced experts have been hired from all over the world. These will be the managers who will hire local technicians. By the end of 1993, the staff will number 80-90, 50 will be professionals. In 1992 and 1993, the operating budget will be C$4.2 and C$6 million, respectively. C$14.4 million of capital funds have been identified (not approved). Four areas have been identified: silicon technology, quality awareness and failure analysis; VLSI; CAD circuit design and testing; and system applications (work in niche markets). Each of these groups will have 15-20 staff by 1993, with half to be hired from overseas. A new building will be ready by the end of 1993.

Students can get degrees based on the work done at the institute. Intellectual property and ways of cooperating with the universities have yet to be worked out.

They would be interested in having their staff trained in Canada but only in training Canadian staff if multi-nationals operating in Singapore make the request.

The financial projections call for 40% of total revenue to be generated from clients. Dr. Chen considered that a higher percentage than this would not be achievable by an institute with a strong training role.

IME are prepared to bid on projects with Canadian organizations, but only in Singapore and only where they need special expertise that they do not have.

Dr. Chen is on loan from AT & T for four years.

iii) Institute of Molecular and Cell Biology (IMCB).

Dr. Chris Y. H. Tan, Director of Institute of Molecular and Cell Biology at the National University of Singapore met with the study team and provided a very interesting tour of the facility.

The institute was started in 1987. The laboratory building was completed one year later. 160 scientists are employed by IMCB. These were attracted from 14 different

countries including Canada. They work in research teams comprising about 5 people each. IMCB would like to grow to 250 scientists.

The focus of IMCB is on academic excellence and high rating in the citations index. The emphasis is on medical research applications and plant biology.

The annual operating budget is C$ 10 million plus a 10% capital budget.

The institute has a close working relationship with world class institutions: Scripps (California), Cambridge (UK) and the University of British Columbia. Professors from the University of Calgary are invited to give 3-4 week courses. IMCB is in the process on setting up a clinical trial of a cancer drug with BC Health. Intellectual property will be shared.

The institute has had some interesting technology transfer successes: it has formed a technology transfer company called Singapore Bio Innovations Inc. (5% owned by IMCB) with the remainder owned by Dr. Chen, Dr. Brenner and AMYLIN Corp. (a USA company), and Economic Development Board venture capitalization (C$ 12 million). This company supplies chemically engineered rats for research into diabetes. It is already making money and has declared dividends. Glaxo (UK) has signed an agreement with IMCB which provides C$ 58 million over 15 years for research on the central nervous system.

Millipore Corp. has a joint development agreement with IMCB under which C$ 0.6 million worth of equipment is on loan to the institute. This is the only known case of Millipore providing equipment. This is part of the company's expansion of business in the region.

66% of intellectual property developed by scientists is owned by IMCB and the remainder by the National University of Singapore. The 66% is shared with the inventor, and negotiated on a case-by-case basis.

A 1.3 Nanyang Technological University.

The tour was arranged through Irene Ho, Assistant Director, Office of Public Affairs. The first meeting was with Dr. Cham Tao Soon, President. Meetings were also held with Assoc. Prof. Ho Nai Choon, GINTIC Institute of CIM, and Yap Kian Tiong, Director of the Institute of Manufacturing Technology.

Nanyang Technological University was established in 1981 on the campus of the former Nanyang College. It has grown to 10,000 students and is expected to reach 15,000 by 1994. Facilities are being expanded. The present student to staff ratio is 14:1 and the plan is to decrease it to 10:1. Faculty is being hired from all over the world including Canada. The university works closely with other universities abroad including Loughborough (UK), Sloan School of Management (MIT, USA). They take

an approach that matches students with industry throughout their degree program, (somewhat akin to the Canadian Co-op programs), including project management, communication and human resource management. They also have established a program with Peat Marwick aimed at the developing SMEs. They have established various institutes and centres including: Innovation Centre, Centre for Advanced Construction Studies, Microelectronic Centre, Centre for Transportation Studies, and GINTIC Institute of CIM (Computer Integrated Manufacturing).

Staff has 10 months industry leave every 5 years. This may be an interesting opportunity for Canadian industry organizations to establish linkages.

Faculty is allowed to spend up to 60% of "overtime" time consulting and up to 1 day per week of university time. Intellectual property belongs to the faculty member.

Currently, 18% of the students are from other ASEAN countries, mainly Malaysia. This is close to the 20% limit imposed by the government. Foreign students pay a 50% surcharge on tuition fees.

Of the institutes listed above, two were visited by the Mission: GINTIC Institute of CIM and Institute of Manufacturing Technologies.

i) GINTIC Institute of CIM.

GINTIC was originally set up as a CAD/CAM Centre with Grumann International Inc. At the end of this collaborative arrangement, GINTIC evolved into its present role. The institute employs 82 staff. An additional 70 industry employees are involved in GINTIC projects. The institute consists of 4 groups: Research, Applications, System & Technical Support, and Business Development (responsible for promotion and commercialization).

GINTIC has formed a consortium with IBM, DEC, PRIME, Grumman, and Dynamech. Research partners are: Arts Computer Centre, Bull Far East, Expert Edge, Mentor Graphics, National University Hospital, Singapore Computer Systems, and Singapore Network Services.

The total cost of the consortium project mentioned above is C$ 90K per year. Collaboration between an individual industrial partner and GINTIC, is handled through a general Memorandum of Understanding (MOU), with specific agreements for individual projects. The MOU details responsibilities, commitments, and ownership rights to products, reports and technology.

GINTIC enters into agreements with foreign institutions. They have good working arrangements with institutions in Germany and the USA.

Five major areas of study related to Computer Integrated Manufacturing have been identified: planning and management issues, systems analysis and design, modelling, simulation and control, factory automation, and product design and process definition.

GINTIC is offering M.Sc. courses and postgraduate research leading to M.Eng. and Ph.D degrees.

ii) Institute of Manufacturing Technologies (IMT).

We were received by Professor Yap Kian Tiong, Director. IMT was only established recently and is located in temporary space. The institute is modelled after the German Fraunhofer Institute for Production Automation (IPA) and there is close cooperation between IMT and IPA, with staff being trained in Germany.

The mission of IMT is to establish and promote advanced manufacturing technologies that are strategic to the economic growth of Singapore and applied research to develop and nurture industrial entrepreneurs in new and improved manufacturing technologies. The IMT program is focused on developing people that can negotiate, look after their businesses and are technically competent.

Hiring started earlier this year. Sixteen research engineers are now on staff, ten others are working on Ph.D degrees based on their consulting work. Their goal is to achieve 10% overall cost recovery and this percentage will increase with time.

There is potential for collaboration in device communication, inspection technologies, and standards for communication. They are looking for a partner for Singapore Steel to work on the computerization of foundries.

A 1.4 Singapore Biotech Pte Ltd.

The Mission was received by Dr. Khong Peek Wah, President and Chief Executive Officer.

Singapore Biotech Pte. Ltd. was established seven years ago, one of the early biotechnology ventures in Singapore. It employees 37 staff and has subsidiaries in Malaysia and Hong Kong. The company focuses on development and sales of medical diagnostics for diseases common to the region.

Their research is entirely market-driven, and they have an ongoing marketing and sales effort throughout Asia. They work together with the National University of Singapore for part of their research, and use SISIR's fermenters when the need arises. They may be interested in using ARC's pilot plant for large batches.

Eight per cent of revenue is being invested in research and development. The return on this investment is slow, and it is difficult to make a profit. Singapore Biotech forecasts a growth in the demand for diagnostics, with the increasing affluence of countries in the region. Government screening programs for immigrant workers also increase demand in this area. The company is engaged in a long-term research project on in vitro production of human insulin islet cells from foetal cells, with Australian and Swiss(?) partners.

In addition to Singapore Biotech, there are nine other biotechnology companies in Singapore (PlanTech, Pacific Biomedical, Everbloom Mushroom, Aroma Biotech and a few smaller ones).

Singapore Biotech is 10% US owned. 60% of its products are exported to the Asian region (ASEAN, Taiwan, Hong Kong) and Europe. The Research Park provides space at S$2.20/sq.ft., whereas downtown rates would be S$8 - 10/sq.ft. The company is planning to have some components produced in Thailand, Vietnam and Laos to lower costs. Product certification is very important for exports.

There is a great interest in strategic alliances, especially those that provide mutual access to markets, and in becoming licences for Canadian or US companies. They like the idea of joint bidding on contracts to third parties.

A 1.5 Singapore Institute of Standards and Industrial Research

The Mission met with Mr. Liew Mun Leong, Chief Executive, Ms. Leong Wai Leng, Assistance Chief Executive, Mr. Quek Seow-Boon, Marketing Manager, Mr. Leon Mong Pheou, Senior Consultant (Metals and Materials), Dr. Lai Meng Fook, (Steve), Director of Materials Technology, and Ltc (res) Kee Teck Koon, Director of Corporate Planning and Services.

SISIR is an independent, self-financed, not-for-profit organization. It has 501 staff, 40% of whom have graduate degrees. Revenues are distributed by industry as follows: electronic and electrical products: 30%; metal products, machinery and equipment: 19%; petroleum and chemical products: 11%; other manufacturing industries: 18%; transport, communication and services: 10%; commerce: 8% and construction and utilities: 4%. The annual budget is C$25 million.

SISIR focuses on applied research and functional prototype development. It is involved in electronics and computer applications, materials technology, product and process technology, food technology, standards and quality, and technology transfer. It belongs to an international certification network covering 20 countries including Canada, and has collaboration agreements with technical organizations in nine countries on all continents, with up to five agreements in any one country. SISIR has over 3000 clients, 60% of whom are local companies, 25% are multinationals and 15% are government and the public.

Standardization and certification services are provided through a government contract.

They put great emphasis on technology transfer (20 staff) and marketing (20 staff). Technology transfer vehicles include information and advice, joint ventures, equity investments, spin-off companies. Nova Technology Pte Ltd. is a wholly-owned subsidiary that commercializes SISIR technology and brings in technology from abroad.

SISIR undertakes work in Thailand, Malaysia, Indonesia, the Philippines, Saudi-Arabia and other countries, often under contract to international assistance organizations, the Asian Development Bank or the World Bank.

SISIR would like to cooperate with Canada in environmental work. they seem particularly interested in the "Green Label" program (?). They are doing a business survey in the environmental area.

SISIR has profiles on 3000 companies in Singapore and is selling its market research services in the region.

SISIR seems to be a suitable partner for research organizations or companies wishing to establish a foothold. SISIR staff will travel to Canada early in 1992 to explore opportunities for strategic alliances.

A 1.6 Information Technology Institute.

The Mission met with Dr. Aug Hoon Kee, Senior Manager, Research Engineering Centre, Dr. Roland Hor Yew Keong, Program Manager, Computer and Communications), Andrew Gill, Manager, Knowledge Systems Laboratory). Mr. K. Sugumaran, of the Industry Development Department, National Computer Board, was also present.

The Information Technology Institute (ITI) is part of the National Computer Board (NCB). Other groups in the NCB include the Government Systems Division, IT Industry Division, and IT Applications Division. The NCB's mission is to assure that Singapore stays at the forefront in the information age.

The ITI is the research arm of the NCB. It has applied research and development capabilities in software engineering, expert systems, office communications and image processing, multimedia applications, and scientific visualisation.

ITI collaborates with industry, helps information technology users exploit leading edge technology and shares knowledge with research and development laboratories and universities. ITI has 126 professional staff and an annual budget of C$7.2 million. It tries to recover 20% of its costs through contributions from industry. ITI has developed a number of software products in cooperation with industry that have been

very successful. For example, the Computerized Integrated Terminal Operating System developed for the port of Singapore Authority had a major impact on most operations, and has reduced the time required for loading and unloading vessels by a factor seven.

ITI is interested in strategic alliances, and willing to work with overseas companies. They did a project with Idacom (Canada) on software testing, through Hewlett Packard Singapore.

The National Computer Board welcomes joint ventures with foreign companies that establish research and development facilities in Singapore and tax incentives are available.

A 1.7 Singapore Telecom.

The Mission members met with Dr. Chia Choon Wei, Vice President (Ventures).

Selected Statistics - Singapore Telecom

	FY 90/91	FY 89/90	% Change
Operating Income (C$ billion)	1.5	1.4	8
Surplus	1.1	0.9	24
Employees	10,157	10,964	-7
Telephones/100 population	35	37	-5

Of the 10,000 employees, about 500 have a degree, a majority of whom are engineers. They send people to the Netherlands, Japan and other European countries for training.

There is no research and development in Singapore Telecom, because "procurement policy is open international tender" and "market is too small". However, they are actively involved in field trials, e.g. telemetering trial in collaboration with a Norwegian company, OA system with Data General, Videotex with Marconi and UK Prestel, ISDN with Fujitsu.

There is no central coordination on these trials. Decisions to go ahead are made by individual managers. On the question of why Fujitsu is chooses as partner in the ISDN trial, the answer was "because of a decision made in favour of procurement of Fujitsu switches some years ago".

There are some joint research and development projects with both the National University of Singapore and the Nanyang Technological University. A fund of C$0.7 million (50% from Telecom and 50% from the University) is put aside and researchers

make project proposals to a joint committee. When the funding is used up, the committee is expected to approach the two partners for additional funds. There is also some collaboration with ITI of NCB towards the development of ISDN terminal equipment. There is no formal committee.

Chia's position is new. Part of his mandate is to help the company to "internationalize" and invest (e.g. through joint ventures) in "only services" in SE Asia, e.g. cellular services, data communication, paging. Also interested in acquiring new technology from Europe and the States, e.g. in a Mississippi company (M Tel?) for national paging technology, American Mobile Satellite.

Their international arm (SR International) is interested in joint bidding with, say RBOC's for one block of the upcoming Indonesian BOT projects for 5 million new lines. He mentioned that all RBOC's are "stretched" and not interested in pure equality investments.

A 1.8 Agilis Communication Technologies, A Subsidiary of Singapore Technologies.

The Mission members met with Mr. Leon Koh, Deputy General Manager, and later with Mr. Chen Wee Piak, Vice President and General Manager. Chan is the CEO of Agilis.

Previously known as Chartered Microwave, Agilis is a subsidiary of a major holding company in Singapore: Singapore Technologies. Agilis has 45 people, mostly technical. There are 12 to 15 engineers, with three home grown RF engineers. Agilis sent them overseas for training by bond.

"The two local universities are very good in training RF engineers academically. However, graduates still need seasoning as RF engineering is an art".

Agilis has facilities in (1) thin film etching, (2) metallization (3) MIC/PCB assembly, (4) automatic test station, and (5) temperature control HPMDS

Agilis product application areas: (1) Microwave digital radio, (2) C Band and KU Band VSAT, (3) Satellite Communication Systems, (4) Defence Communication and (5) Electronic Counter Measure.

Quality control is very important. ISO 9001 registration hoped for by April 92.

Agilis is looking for a Canadian partner which can offer marketing (especially entry to US market), volume production (e.g. for VSAT). It is also interested in small companies with specific technology or a service company with good market access and reputation.

A 1.9 Digital Equipment Corporation (DEC).

Mission members met Mr. G.G. Koh, Manager, Solution Centre. Mr. Koh is moving into a new position: Co-Director of the soon-to-be-announced Network Technology Research Centre (NTRC), a collaboration between DEC and Nayang Technological University.

Mr. Koh informed the Mission that Eric Lawrence, Managing Director of DEC in Singapore, is from Canada.

Mr. Koh is well aware of the Government's emphasis on science and technology and of its plans to spend about C$1.4 billion, as stated in the National Plan.

With respect to MNC's active in R&D in the region, he mentioned IBM's support of ISS, AT&T's support of ICIS. GINTIC is also supported partially by DEC. HP is also active.

In Singapore, IBM has the largest market share. DEC is second.

The Government's vision of Singapore is to make it an intelligent island. Accordingly, the mission of NTRC is to turn this vision into a reality, by (1) doing research and development in communications and network technology, (2) developing true industry projects, and (3) supporting and expanding the capabilities of Telenet (a videotex system currently in the market, using VAX as a front end), Tradenet (an EDI VAN) and OS-Net. A possible project is to provide network integration for all these networks.

NTRC is the first project of its kind in SE Asia. DEC will contribute C$1.4 million upfront (expected to last 2 years) all in the form of services in kind (e.g. S/W, H/W, one co-director, and one full time network consultant). NTU will provide the facilities and 12 people (engineers, research assistants, lab technicians, and up to C$350K per year in operating costs. Mr. Koh does not believe NTRC can stand on its own. It will need additional collaborators.

NTRC is ready to move in by the end of 1991. It will be located close to the Electrical Engineering Department, occupying 250 sq. m. temporarily. It will move into a new building in two years' time.

DEC has major manufacturing plants in Singapore, Hong Kong, Korea and Japan. DEC has hardware manufacturing (memory boards) in Singapore. In Taiwan, they have manufacturing facilities for terminals and PC's as well as design work. Hong Kong is their Asia headquarters.

DEC has a staff of 120 in sales, marketing and customer service and 800 in the manufacturing plant.

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APPENDIX 2
INDIVIDUAL INTERVIEWS IN INDONESIA

A 2. Individual Interviews

In Indonesia, Mission members benefited from the assistance and previous work of Dr. Alain Barbarie, who is a Canadian consultant working on an assignment for the Canadian Embassy. He helped in the scheduling and arrangements for the interviews and accompanied the Mission members to attend these interviews. As a result, the following interviews were conducted.

A 2.1 Centre for Survey and Mapping.

The Mission was received by the Head of the Centre and Air First Marshall, Mr. Benny Suparno, and several of his staff.

The Centre controls and coordinates land, ocean and aerial surveys in Indonesia. It serves military and civilian groups.

He is quite interested and concerned about the process of Canada-Indonesia government collaboration, especially whether such collaboration will be under an ASEAN umbrella. He believes a simple bi-lateral relationship will be more effective.

His forces are trained in Australia, the Netherlands, U.S., U.K. and other countries through inter-armed forces cooperation agreements.

He is interested in oceanography, remote sensing, GIS digital terrain models. He is open to Canadian instructors coming to Indonesia to train or instruct.

A 2.2 Agency for the Assessment and Application of Technology (BPPT).

The Mission was received by three of BPPT's five Deputy Chairmen and their staff: Prof. M.T. Zen (Natual Resources), Dr. H. Haryanto Dhanutirto (Basic and Applied Sciences), and Dr. Rahardi Ramelan (Industry).

Chaired by Prof. Habibie, BPPT has a staff of 2000. It is the single most important and powerful agency in Indonesia in science and technology. It formulates and coordinates national science and technology policies and their implementation, takes a major role in government procurements and projects related to science and technology, provides advice and consultation services to other departments, assesses and conducts research and development, and coordinates technology transfer.

Mr. Haryanto's department has four directorates: Basic Sciences, Life Sciences, Engineering Sciences, and Marine Sciences.

Mr. Ramelan's department deals with commercial and implementation aspects of science and technology. His current focus is on Energy, Telecommunication and Transportation. Topics of interest to him are: protection of intellectual property,

standardization, productivity and monopoly/antitrust regulations. His department is involved in all government procurements and he is a member of the Procurement Committee.

Mr. Ramelan is currently assessing a number of technologies and has listed a number of areas for potential cooperation with Canada (Section 4.4).

Prof. Zen is interested in new techniques and methods to deploy satellites, aircrafts and sea vessels for resource exploration and in bringing certain technologies to market, e.g. remote sensing. He has also identified a number of opportunity areas (Section 4.4).

Indonesia has science and technology agreements with the US, Japan, Germany, France and the U.K. and has developed strong links with these countries, including annual meetings and sub-agreements on specific technology areas, e.g. marine biology. These countries second science and technology advisors to BPPT. Indonesia looks after housing and transportation, while salaries are paid by the dialogue country. Indonesia also has working relationships with Australia.

An MOU has been signed with the Government of Alberta in November, 1991. The Mission members were also informed that a joint venture exists between Canada and Indonesia in aquaculture in the Thousand Islands. Indonesia is interested in trout or salmon farming. They plan to organize a seminar on Fishing Technology in July '92 and would like to invite Canadian experts to participate.

On the subject of women in science and technology, the participation rate is about 40 60% in science and engineering. "They are usually the brighter ones!" However, only 50% of those are "career women".

As a result of the Mission, they would like to see one or two projects getting started and build on them.

i) LAGG (Aerodynamics, Gas Dynamics, and Vibration Lab) - a BPPT facility

LAGG studies the problems of aerodynamics, aeroaccoustics and vibration which are important for aviation, navigation, transportation, off-shore platforms, etc. It has a staff of over 150.

LAGG consists of the following sub-laboratories:

(a) Low speed wind tunnel
(b) High speed wind tunnel
(c) Flight dynamics lab
(d) Acoustics and vibration lab

ii) LSDE (Energy and Energy Resources Lab) - a BPPT facility

It has a staff of 120. Its mandate is to conduct research in energy technologies such as alternative energy sources (to oil), special software research to energy conservation and energy economics.

A 2.3 Agency for Industrial Research and Development

The Mission was received by Mr. Garjito Pringgo Sudirjo, Head, Center for Industrial Research. He was educated in Fredericton, NB.

The Agency has a total staff of 3800, distributed over five Centres (380), nine institutes (2500) and 13 Regional Institutes (960). The five Centres are: (1) Industrial Research, (2) Industrial Engineering (3) Development of Industrial Climate (Policies, Taxes...), (4) Industrial Standardization and (5) Industrial Exhibition. The nine Institutes are: (1) Chemical, (2) Agriculture, (3) Metal and Machineries, (4) Material and Technical Products, (5) Textile, (6) Ceramics, (7) Cellulose, (8) Leather, and (9) Handicraft. The Regional Institutes deal with practitioners in the regions and serve as coordinating points.

It seems that the Agency deals with existing technology and existing industry, while BPPT deals with anything that involves new technology or new industry.

Mr. Garjito seemed very pragmatic and knew how to work the bureaucracy and got things done. He was quite free to share his experiences with the Mission members.

Challenges:

"Hard to keep engineers in remote areas."
"Indonesians are traders, not inventors. We build our wealth traditionally, not through inventions."

Communication with ASEAN counterparts is based on personal contacts, but they are not formal or regular, or in any organized manner. Working with universities is again based on personal contacts. Universities usually like projects that are academic, and may not be necessarily relevant to industry.

On standards, Indonesia is beginning to focus on quality control, e.g. ISO 9000 registration (a possible area of collaboration), an important area because of globalization. The Ministry is trying to obtain accreditation for institutes.

The Agency charges industrial and government clients for its services, including outside (ASEAN) clients. Typically, clients are medium to large institutes. SMEs may not be aware of the services offered and are typically sceptical of how their ideas are

received. Further, the Agency does not have enough resources to promote its service to SMEs.

Participation of women in science and technology is about 20% in chemical, not so much in mechanical.

"Hope to see something coming out as a result of this Mission."

A 2.4 Department of Communications

i) Research and Development Agency

The Mission was received by Ir. Hariadi Soedjono, Chairman.

The Department of Communication has seven Director Generals, each responsible for a department or an agency. The three departments are: Land Transport, Sea Transport, and Air Transport, and the four agencies are: Search and Rescue, Meteorology and Geophysics, Research and Development, and Training and Aviation. Within the Agency of Research and Development, there are three centres: Data and Information, Air Communication, and Sea Communication. The Agency has a staff of 300. 200 are support staff and 100 are researchers with graduate and post-graduate degrees.

There are 500 seaports in Indonesia. 120 are under state corporations. 100 are under private port corporations. There is a need for EDI for port management, especially among four main ports, to support container identification, scheduling, cargo, billing and accounting systems. The feasibility study was done by SNS of Singapore.

Inter-modal transportation involving Indonesian ocean going ships (capacity 3 to 5 kilotonnes) has decreased over the years because of competition and now accounts for only 4% of traffic for goods from Indonesia. However, they have a 25% share of inter-island traffic (sail and engine combined).

His agency is concerned with policy and regulations (e.g. safety), not technical advice. A larger Department existed before 1985, when it was split into the current Ministry of Communications (actually Transport is more appropriate) and the PTT.

The Agency has a close relationship with BPPT, and LIPI, but does not have too much to do with LAPAN. It does cooperate with universities (U. of Indonesia, U. of Bandung, etc.) on studies on development of transportation in Indonesia. They work with experts, not graduate students, and pay direct costs.

They also work with foreign countries, e.g. France, Japan, Belgium. In 1972-74, Lockheed International of Canada did a preliminary study for them on the Airport Planning Service.

Some of their staff are funded by the Agency (3 or 4 per year) to take postgraduate courses or degrees. Less than 10% of their staff are women.

He would like more access for Indonesia to Canadian universities for technical training and needs a recommendation from the Mission on how training can be implemented. (This remark is consistent with the Canadian Ambassador's observation that there are only 160 Indonesian students in Canada). Connection to Canada's environment labs to address noise and transportation pollution is also of interest.

ii) Meteorological and Geophysical Centre

The Mission members met Drs. Karjoto, Chairman of the Centre, and about 10 of his staff.

The Centre works closely with BPPT (e.g. rain making program and cloud seeding), LIPI, the Agency for Survey and Mapping, Indonesian National Aerospace Agency (.e.g. remote sensing), and the universities. Its clients include various government departments, including Agriculture, Environment, Social (disaster mitigation). It also interacts with its counterparts in Europe, and ASEAN in a number of committees and subcommittees, including COST Subcommittee in Geophysics.

The National Centre is in Jakarta and there are five regional centers (Sumatra, Java, Bali, Celebes and Irian Jaya) and there are 156 stations operated by these centres: 112 meteorological stations including 90 in airports, 16 climatology stations, and 28 geological stations. In addition, there are 6 seismological stations, 19 air pollution monitoring stations and 28 telemetry stations.

The Centre has a staff of 2900. Most are technical (100 administration). In 1991, 205 held B.Sc. degrees nine with M.Sc.and two Ph.D. degrees. In addition, there are 400 academy graduates. Research and development is not the Centre's main activity. 25-35% of the staff is female (some say 50%). The role of women has increased in prominence in the recent years.

The Agency recommends policy changes to the Minister and serves other client departments without chargeback: Aviation, Sea Communication, Agriculture, etc. It has two categories of service: general purpose services and specialized services. The latter have a potential for chargeback.

The Centre is supported by WMO (World Meteorological Organization) to extend background air pollution monitoring stations. WMO sends an Australian expert to help.

There are three outstanding proposals for seismic cooperation with European countries.,

The TOGA (Tropical Ocean and Global Atmosphere) office of WMO is working with them for intensive data gathering in East Indonesia to study atmospheric and oceanic coupling to explain El Nino in 1992/93, partly to assess the correlation of the long draught in Indonesia in 1982, 87 with El Nino. The facilities are connected to radio sonic stations in Melbourne and Singapore through high speed telecommunications.

The Centre also operates an academy, offering a regular three-year course on meteorology and geophysics. Brighter graduates of this program may move on the undergraduate training in one of the three most famous universities. Some of them also could be sent to the Philippines, US, Australia or Japan.

Possible collaborative areas with Canada:

Computer models, e.g for air pollution, long range climate forecast
Trainee programs
Cloud seeding (in Canada to prevent hail formation)
Satellite technology for meteorological applications
Loan of used equipment
Calibration

They have some bad experience in cooperation projects with Canada in the past, e.g. a project on solar energy and wind resources assessment with UBC and CIDA was submitted to Canada first in 1987. This project was recently submitted to ASEAN through LIPI instead.

A 2.5 The Indonesian Institute of Sciences (LIPI)

The Mission met with Prof. Dr. Samaun Samadikun, Chairman of LIPI, Dr. Herudi Kartowisastro, Deputy Chairman for the Development of Scientific Infrastructure, and Moertini Atmowidjojo, Head, Bureau of Scientific and Technological Cooperation, very late in the afternoon as Prof. Dr. Samadikun had just returned from a trip to China.

LIPI has a staff of 4700, and reports directly to the President of the Republic. Funding approval comes from the Minister of State/Secretary, and its program comes from Prof. Habibie.

In addition to the "hard sciences", LIPI also has a social sciences group and a biology group, and runs four national botanical gardens.

LIPI (and Indonesia) adopts a philosophy of social concepts first, and the main purpose of science and technology is to improve the quality of life. LIPI is strong in social sciences and has recruited a number of strong individual researchers.

LIPI does not have a teaching role. Its outputs are (1) scientific research and papers, (2) government policy and recommendations, (3) product/service prototypes, and (4) scientific services such as calibration and consulting. LIPI is both a research and manufacturing organization and can manufacture prototypes for Canadian research organizations.

Generally, 30% of its budget is allocated to items (1) and (2), and 70% to (3) and (4). Government provides C$23 M (20B rupiahs) other sources C$2.9 Million (5B rupiahs). Its research budget is C$8.6M (15B rupiahs) (exclude salaries). Salaries and fixed costs (building, light, maintenance, etc.) are C$10.3 M (18B rupiahs).

It has a C$425 Million loan from the World Bank to support training of technical personnel abroad (Overseas Fellowship Program). They send people to US, Japan, Europe, Australia and Canada. They work with WUS of Canada and IIE (Institute of International Education) of the US. This Program is over by now and has trained a total of 125 people. A second loan (science and technology for Industrial Development Program) is just starting.

It takes C$ 15k to train a Ph.D. graduate. Candidates are required to sign a service contract for 2N + 1 years, N being the number of years abroad supported by LIPI. Three are instances where industry bought out the graduates from the LIPI for two times this cost. Fresh graduates typically earn C$46 a month!

Female participation is mostly in medical, biological and social sciences. There is a relatively low percentage of females in the hard sciences. However, over 60% of cum laude students are female.

They confirm that career priorities in Indonesia are (1) show business, (2) professional services, e.g. doctors, lawyers, (3) trade, and (4) manufacturing.

Canada is not popular among local students for studying abroad (after US, UK, Australia, and others), primarily because of lack of awareness and effort from Canada. LIPI has not explored Canada as a training source.

LIPI recently has spun off one state company, taking with it C$23 million in sales and 600 staff, or previously 4 departments.

Possible collaborative areas with Canada:

LIPI has a contract with the Electric Company to look into ways to curb electricity theft. C$69 million of electricity is being stolen every year. The Electric company is willing to spend C$ 23 million per year to solve this problem. (Possible lead for Canadian power utilities for consulting work).

They are also interested in ways to reduce the cost per telephone line from the current level of C$2300 - $3450 per line. They are not interested in CATV systems.

They are interested in making contact with a medium sized Canadian company in instrumentation. Also interested in weather forecasting technology, GPS (Global Positioning System) and low cost telemetry systems and SCADA.

i) LUK (Strength of Materials, Components and Structures Lab) - A LIPI Facility

LUK conducts testing and research on various types of structures and components, made of metal, plastics or other materials used in vehicles, trains, ships, aircraft, buildings, roads, bridges, etc. LUK has a non-destructive test lab and a destructive test lab. It has a staff of about 200.

ii) LMT (Applied Metallurgy Lab) - a LIPI facility

LMT specializes in research and development in metallurgy, including: extractive metallurgy, metal, metal conservation, non-metal materials. It has a staff of about 250.

iii) LKMI (Calibration, Instrumentation and Metrology Lab) - a LIPI facility

This lab is the main part of the activities of KIM (Indonesian Institute of Sciences). It is a collaboration in Germany. They generally deal with science and technology counsellors and commercial counsellors of other embassies.

A 2.6 National Institute for Aeronautics and Space (LAPAN)

Dr. Leung and Dr. Barbarie were greeted by Prof. Dr. Ir. H. Wiryosumarto, Chairman of LAPAN and a number of his staff, one of whom, Mr. Toto Marnanto Kadri of the Remote Sensing Data Bank Division, visited Vancouver in May 1991 for two weeks and participated in a Canada/ASEAN function.

LAPAN is engaged in three primary activities: (1) remote sensing and telemetry, (2) space vehicle guidance systems, and (3) studies on "space media" (e.g. atmosphere, ozone).

It has a staff level of 1340, less than 20% are female, and about 30% hold university degrees.

They operate two satellite ground stations in Jakarta, developed by MacDonald Detwiler Associates. They are paying C$1.1 M per year for Radarsat for a total of C$5.7 M if they become customers. China is launching a geostationary satellite in 1993 for meteorological and environmental research (e.g. studies on sea temperature).

They are a participant of the UN RRSP (Regional - i.e. Pacific Region - Remote Sensing Program) in training and pilot projects, e.g. SEAMEO, which is an ASEAN program.

They are interested in Canadian computer models for seabed mapping, pollution and forestry. They are willing to send us similar listings in return. They want to develop their own weather model of Indonesia for longer term forecasting.

They have one space vehicle launching pad in South Java and are planning to build a larger pad on an island close to the equator (0.5 degrees S) just north of New Guinea. They recognize that this is an area difficult to get foreign support for, especially after the Gulf War. A U.S. counsellor visited Prof. Wiryosumarto and warned that they should not develop any rockets beyond certain capability.

They are also interested in studying the warming of sea water due to global changes.

A 2.7 The National Center for Research Science and Technology Project (PUSPIPTEK)

Dr. Leung and Dr. Barbarie visited PUSPIPTEK, which is located at Serpong, about 90 minutes away or 27 km SW of Jakarta. They met Mr. Gunawan Sakri Soemargono, Director of Planning, Office of the Minister of State for Research and Technology, PUSPIPTEK as well as official representing the major tenants of PUSPIPTEK.

PUSPIPTEK is a research park established in 1976. It provides facilities for non departmental research and development institutions such as LIPI, BATAN (the National Atomic Energy Agency) and BPPT. The park occupies an area of over 350 hectares, to be expanded to over 1000 hectares. In addition to laboratories and offices of the major tenants, supporting facilities include conference and information centres, office centre, botanical garden, scientists' residency and community complete with kindergartens, elementary and junior highs, community centres and shopping centre, worship centres, and sport centres. PUSPIPTEK also has its own infrastructure: electric power, drinking water supply, cooling water of machines, telephone system, waste processing system, roads, parking and street lighting systems.

PUSPIPTEK has the objective of providing an ideal environment for research and development institutions, high tech industry (as incubators for non-polluting industries) and education institutes. It aims at facilitating cross fertilization among

its tenants, joint use of equipment and facilities, and simple access for industry. The following are laboratories and/or facilities of BPPT and LIPI in PUSPIPTEK. Information on BATAN facilities is missing as no BATAN representative attended the meeting.

Instrumentation development and Physical Standards are key foci of LKMI. They are interested in SCADA information from Canada.

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APPENDIX 3
INDIVIDUAL INTERVIEWS IN THE PHILIPPINES

A 3.1 Department of Science & Technology (DOST)

Secretary Ceferino Follosco chaired the meeting of the mission team with a number of his staff. Dr. Amelia AncOG, Assistant Secretary (a lawyer) was very helpful in setting up meetings with institutions, and providing the organization chart shown in Figure 5.1.

DOST is the premier scientific body in this country. The Department prepares the Science and Technology Master Plan for the country that charts the new industrial strategy for the year 2000 (plan on file). The strategy is: modernization of production through technology transfer, upgrading research and development capability, and developing a science and technology infra-structure.

DOST employs 5,000 staff, of which 45% are technical.

DOST provided the most detailed response to our questionnaire of any of the institutions visited.

DOST is seeking foreign aid for the following projects:

1. Tailored fats from coconut oil (C$ 605K over 4 years),
2. Utilization of indigenous lignocellulose materials for the preparation of industrial polymers,
3. Manpower development program (one-year, two month fellowships, and short-term individual training)
   (C$ 51 million over 5 years): bio-technology, laser technology, materials science (electronic material, polymers and ceramics), information technologies, and electronics, instrumentation, and control.

DOST likes a "sandwich" program in which the M.Sc. and Ph.D degree is done in the Philippines with the experimental work done overseas. SRC currently uses this approach with the University of Edinburgh, Scotland.

i) Advanced Science & Technology Institute (ASTI)

Orlando Dayco, Director, received the team.

The ASTI mandate is to develop advanced research in micro-electronics and bio-technology. They are concentrating on system development software and communication hardware. ASTI is shying away from the bio-tech side which is being well looked after by the University of the Philippines. ASTI also draws up its own research plans with limited input from the Philippine Council of Advanced Science and Technology, Research and Development.

ASTI's medium term thrusts are data/voice communications, image processing, pattern recognition, industrial automation, environmental quality and medical instrumentation.

ASTI is working at a fairly basic level.

ii) Science Education Institute (SEI)

The team was received by Dr. Ester B. Ogena, Director and Dr. Anna P.E. Amerilla, Chief, Science and Technology Education Division.

The Institute was established in 1987. Its mandate is to develop a critical mass of highly trained science and technology manpower, needed by the country for economic development. The program thrusts are aimed at science educators to ensure a steady supply of qualified people to priority science and technology areas; to improve the education of science and mathematics teachers at all levels, both pre-service and post-service; and to develop a science culture in the nation.

Programs to achieve these goals are: development and utilization of scientific and technological manpower, building institutional capabilities and support activities and alternative delivery programs. The Institute has a staff of 52.

They are doing a survey of science and technology manpower requirements (updating that done in 1987). The institute now supports 4 high schools where science or agriculture are the main curriculum (there are no course curriculum options). These science high schools are for the brightest students. 60 to 70% of students graduate from these high schools enrol in science university degree courses. Three new networks link high schools to universities that provide back-up and training to teachers and that act as regional centres.

Only 4% of teachers major in physics and 30% have science related degrees. Therefore, the regional training centres are very important. They would be interested in receiving literature from Edna Einsiedel, University of Calgary on measurement of science literacy.

Teachers are being sent to Australia and this could be expanded to Canadian university courses, schools, and science institutions.

iii) Metals Industry Research & Development Centre (MIRDC)

The mission met with Dr. Leopoldo Abis, Executive Director, Rolando Vilonia, Deputy Executive Director and Leonardo Aleantara, Corporate Management Staff.

The centre was established in the early 1960's and became a "crown" corporation some seven years afterward. The centre provides analysis, testing and inspection,

consultancy and production services to the metals industry sector, transfers and provides skills, upgrading and operates a business incubator and an information centre.

About 25% of their budget comes from government grants, with the remainder from contracts. Most of their clients are "walk-in", but they recognize a need for marketing for new clients. Their budget is operational C$890K and capital C$44K per year.

If a funding source could be found for airfare and to top up the salary (C$400 to C$1500), they would be willing to send people to Canada on exchange for up to 6 months.

MIRDC has linkages with Singapore, Germany, Austria, France and Japan. Germany is providing 45 person months and C$ 1.4 million worth of equipment over 15 months (ending in 1992).

iv) Industrial Technology Development Institute (ITDI)

The mission was received by Dr. Rufino Lirag Jr., Director. The Institute was established in 1901 and currently has 600 staff and a budget of C$6.5 million (operations C$3.3 million, C$222K for assistance projects from Australia, Japan, US/Israel, IRDC and local sponsors). ITD1 is located in six buildings.

ITDI is the largest of the Institutions under DOST and the only multi-disciplinary unit in the country. The Mission was shown some interesting industrial chemical processing of local material especially waste. Of most interest to Canada was the addition of coconut waste to potash and limestone to produce a time-delay in nutrient release from fertilizers.

ITDI needs experts in food, environmental research, energy and ceramics (especially for high temperature, lightning arrestors and industrial applications).

They have much new equipment, but it may not be used very often.

v) Technology Applications & Promotion Institute (TAPI)

Professor Fortunato de la Pena, Director, met with the mission. TAPI was established in 1987 with 80 staff. They provide Project Development, Investment and Business Operations, Marketing and Consultancy Services. TAPI has done a feasibility study on incubation malls and science parks. They have identified 6 possible sites. The World Bank has been approached for financing: 1) productivity consulting (apprenticeships); 2) Philippine Technology Development Corporation (venture capital); 3) upgrading research and development Institutes. Items 1 and 3 could be opportunities for Canadian consultants and equipment suppliers.

Initially, TAPI's main focus was on metal, food and furniture research and development. They have now shifted to a broader base much like the Canadian research councils. TAPI has formed a venture capital corporation with the Korean Development Corporation using UNDP funding at 7 locations. TAPI only transfers technology from DOST institutes.

Sixty four SMEs have been assessed for procedures and process improvement by engineering students, as part of their course work. TAPI could be used for marketing studies by Canadian companies and provide training to students. Charging for the work is a problem. They would like to broker technology for foreign companies but this may be more appropriate for the new venture capital company.

A 3.2 Department of Environment and Natural Resources (DENR)

The mission met with Ricardo Umali, Undersecretary, Policy, Planning and Project Management.

The department is the result of the amalgamation of Environment and Natural Resources. Its mission is related to total ecosystem management, sustainable development of uplands, protection and rehabilitation, exploration and development, land and resource management and generation of data and technology needed.

DENR research and development activities are carried out by the Ecosystem Research and Development Bureau, the Environment Management Bureau (pollution), Mines & Geoscience Bureau, and Protection Areas and Wildlife Bureau (breeding, biology, population dynamics). Research at the national level is controlled by DOST. DENR also works with universities, research institutions and international organizations such as UNDP, FOD, IDRC, UNESCO, WINROCK, IUFRO, JICA, and IUFN. DENR is linked to other ASEAN countries through the Committee on Science and Technology (COST), including studies in remote sensing and GIS.

The Ecosystem Research and Development Bureau is the most active. Training, seminars and workshops are important tools for technology transfer.

In 1988, completed SPOT data were collected for the entire country. IDRC has funded MacDonald Detwiler Associates for a GIS pilot project. Plans call for C$ 34-46 million to be spent, on expansion of the project.

Relations with the Canadian government are good. Mr. Umali was Chairman of the APEC working group on marine environment in which Canada is a leading country. A C$ 4.6 million environment research management program is being undertaken with CIDA. The contract deals mainly with technology training carried out by Dalhousie University with Canadian staff and the University of the Philippines at Los Barrios.

DENR needs help with upgrading technical skills and with acquisition of equipment. A large proposal has been made to JICA. In the past such equipment has not been used effectively. APRO could help by providing an unbiased assessment. Appropriate information will be forwarded by the mission team.

A 3.3 Design Center of the Philippines (DCP)

Ms. Minerva Franco, Executive Director, met with the mission team. DCP reports to the Ministry of Trade and Industry. The center's mandate is to improve quality and competitiveness through design. Programs operated by the Center include: product research and development; design education; and design promotions.

The Center offers product and packaging design, and technical information. The designers at the center want to start using computers in design and to increase the use of higher tech in their designs.

They use DOST labs for any high-tech work. The ceramics industry consists of two sectors: "studio potteries" and "industrial ceramics." There is little technology transfer between the two.

The Center would benefit from cooperation with Canadian firms in design and production of metal fittings and components and in developing paper pulp from bamboo, basket weaving from waste and grasses. Information on what is available in Canada is difficult to obtain.

A 3.4 Technology and Livelihood Resource Center (TLRC)

Luis Guanio, Manager Technology Utilization Financing Department, Dr. Vedasto Jose, Consultant, and Mrs. Amelia Mendoza Torrente, Information Centre, met with the team.

The center employs 600 staff and has an annual operating budget of C$4.5 million (P99 million). TLRC's main function is to promote the utilization and commercialization of appropriate technology and to create livelihood opportunities. A variety of funding vehicles to a full spectrum of companies from micro (1 to 2 persons) to large companies is available. The Center provides training and information services, information technologies and distance education.

Its operating budget is covered from services, management and consultancy fees and income from loans. Many of the funds that flow through TLRC consist of foreign assistance, foreign loans or Philippine government loans. Employment generation is blended with a technology vision of making the Philippines into a newly industrialized country by the year 2000. TLRC is seen as an investment agency that is willing to take risks to make its clients successful.

The Information Technology Division builds software for the government from systems planning to implementation. They would like to obtain more tools and are quite interested in expert systems. The National Information Technology Plan covers information technology, telecommunications, education, industry, government and research and development. The entire government employs only 4% of the total IT manpower. The private IT sector is active in office automation. There are 300 software houses and software is finding foreign markets. They would like to market software capabilities internationally. TRLC would like to computerize its TI and referral system holdings and the library of feasibilities studies. They also would like to add information from Canada to their information data base.

A 3.5 Philippine Council of Agriculture & Natural Resources Research and Development

The team met with Cynthia Romero Mamon (PCARRD)

The possibility of an advisory role for SRC and ARC in their work was discussed.

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APPENDIX 4
INDIVIDUAL INTERVIEWS IN THAILAND

A 4.1 Chulalongkorn University

The University is named after King Chulalongkorn and is one of the three most respected universities in Thailand. Among foreign countries, Canada, surprisingly, is considered very favourably and is well known among at least the university's senior managers:

- The President, Dr. Charas Suwanwela serves as President of the Thai/Canada Association;
- Dr. Wiwat Mungkandi, Vice President for International Affairs organized the first Canada Studies Program in Thailand for university students;
- more recently, a senior university delegation including the President, VP - International Affairs and Dean of Business School went on a tour of Canadian universities (including Alberta, McMaster, Queens, Toronto) to explore opportunities in staff and student exchanges and joint research projects.
- Northern Telecom has contributed equipment to set up one of the labs in Electrical Engineering.

The university offers a four-week training course on Thai culture. They have an annual Science & Technology in Thailand (17th) meeting.

There are four main universities and 28 private universities.

i) Unisearch

Unisearch is an arm of the University set up to transfer technology to industry through consulting and contract research in industrial research and development. It has reached break-even on operating costs. It also works for MOSTE on science and technology policy. It has current contacts with a Canadian firm regarding a biotech project on plant extraction, and with LVM (?), another Canadian company on a QA joint venture.

ii) SASIN

With assistance from Kelloggs, the University has set up SASIN as a graduate institute. Scientists and professors of international fame are invited to come to give intensive five week courses throughout the year. Instructions are given in English and students from all over the region pay international scale fees. Lunch was hosted in the SASIN facilities and members of the mission were most impressed.

iii) Faculty of Engineering

Thailand has committed in a major way towards significantly increasing its scientific and engineering competency. As an example, the Faculty is charged with a mandate to produce 500 graduate engineers per year now, and it is expected to

increase this to 2000 within two years. Another example: the country is committed to double its telephone lines in Bangkok to 2 million within three years, and add another one million throughout the rest of the country. The Faculty has research labs in telecommunications and robotics and considers its strength to be in high voltage, semiconductors, chemical engineering, catalysis, petroleum research, mining, and civil engineering, especially on concrete.

iv) **Business School**

The University has worked with the Asia Pacific Foundation in Vancouver and IDRC in Singapore. ADGSM (graduate school of management) is the ASEAN organization and it has set up two centres for management, one in Bangkok and the other in Manila. The three largest universities offer a joint DBA program, focusing on Accounting, Finance and Marketing.

v) **Faculty of Science**

The faculty was organized in 1918. At present, it has 14 departments and 13 cells for research. Staff to student ratio is 1:7.

The opportunities for science and technology are judged by the team to be: material science (ceramics), natural products (medical - ARC), organic synthesis (Universities of Toronto and McMaster), genetic engineering (NRC/POS), tissue culture and mushrooms (SRC/NRC).

The new dean of the faculty starting in 1992 will be the previous of Head of Geology, Assoc. Prof. Chaiyuth Khantaprab.

The faculty has had CIDA contracts with the University of Ottawa in the past but this ended three years ago. They would like to re-establish contacts with Canada but they have to be on a personal basis to work (not government to government).

A 4.2 Ministry of Science, Technology and Energy

Mr. Sanga Sabhasri, Minister of Science, Technology and Energy (MOSTE) received the Mission members. In attendance were also 5 or 6 of his senior staff. He and his staff were well versed in Canadian affairs and were very familiar with key people in Canada. The meeting with him extended to an hour (pleasantly longer than expected). Two messages were delivered by the Minister: (a) to see REAL action, having seen several Canadian missions; and (b) concerned about the Lavalin situation - which might undermine Canada's credibility in this region. He mentioned there has always been a good level of cooperation with Canada in the past, e.g., in the Food Radiation Centre, and he asked for more cooperation in the future, e.g., in telecommunications and information technology. Telecom is identified as a major area for Thai investment in the future (e.g., doubling of

number of lines in Bangkok from 1 to 2 million, and another million for the rest of the country)

The Minister was past chairman of the ASEAN Science & Technology Committee.

Thailand has identified three strategic technology areas for development: (1) genetic and biotechnology, (2) material science and (3) electronics and computing. This strategy is reflected in establishing the National Center for Genetic Engineering and Biotechnology (NCGEB), the National Center for Metal and Material Technology (NCMM), and the National Electronics and Computer Technology Center (NECTC).

The Ministry will change its name to the Ministry of Science, Technology, Energy and the Environment, and combine the three centres into one state enterprise in the near future (before end of 1991) - the Science & Technology Development Board (STDB). This is one of the initiatives that will contribute to the attainment of the stated objectives for the next five years: (a) 8.5% annual growth of GNP, 0.5% of GNP will be spent on research and development, (b) 5 to 6% inflation rate, (c) regional political stability.

The Government will also create incentives to encourage private sector research and development spending to grow to 0.25% of sales.

Technology assessment expertise and postgraduate training in target technologies are two specific areas in which Canada can make a contribution. Canada is perceived to be passive compared to other countries (e.g., US and Australia) in attracting Thai students. The mission learned that an IRAP representative will be visiting Thailand in January and that he should stay longer and give a seminar or two on Technology Assessment.

The new STDB will be the main vehicle to fund Thai universities and research institutes (currently at C$8.5 million a year). A new 10,000 m^2 building will be erected next to the MOSTE building and a new 50000 m^2 research centre will be built in the new research park next to the Asian Institute of Technology in North Bangkok, alongside other industry and facilities.

i) Advisor to the Minister of Science and Technology

Meeting with Dr. Malee Suwanaadth, Advisor to the Minister of Science and Technology.

Dr. Malee is a private consultant and works for a couple of NGO's as well as an advisor to the Minister.

She mentioned that there is no close liaison with ASEAN and thinks that regionally the cooperation will take place initially in climatology and environmental

technologies, i.e. areas in which member countries do not compete with each other. It will be some 15 years before a free trade agreement is in place and, therefore, not a priority.

She is involved in discussion with CIDA now for support of an office of technology assessment. Thailand considers it needs a neutral assessment of major policies, for example what to do in case of importing genetic engineering and how to handle nuclear technology. They consider an independent institute would be best. A formal request for funding will go to CIDA within a few months. She has been in discussions with Mr. Eric Yendal at the Embassy. She feels they could combine potential technology and trade between Canada and Thailand. Training Thai staff on nuclear technology is an example project, then leading to developing an office of technology assessment.

On other issues, she has visited technology institutes in Canada several years ago on food related activities and biotechnology. She considers Canada's capability in refrigeration and transportation to be solid. They would have pursued some potential business, however, at that point, U.S. Aid stepped in with major funding which precluded other bilateral contacts.

She noted that the staff of the STDB is on loan.

On food issues, she feels Thailand has the basic grinding technologies, (etc.,) but needs more sophistication that Canada could provide. This also would serve CIDA's socio-economic plans.

Dr. Malee also talked about the Women's Scientist Forum that is part of an international network of women in technology. She feels that this can be used as a qualified technology focus group. In March of next year, they will be having a worldwide meeting in Bangkok.

A 4.3 National Research Council of Thailand (NRCT)

The meeting with National Research Council of Thailand was held with Dr. Aphirat Arunin, Secretary General, Miss Wanasri, Director, Foreign Relations, Mrs. Prabha, Project Analysis Division, Dr. Paibul, Remote Sensing Division, Mr. Pracha, Director, Research, Policy and Planning

This department, consisting of 380 personnel in 9 divisions, works in concert with the 5 year National Research Plan. A new division will be developed starting in 1992.

Their mandate is promoting and stimulating research work by providing funds. They are also responsible for coordination with foreign agencies and give permission to foreign researchers to do research in Thailand. NRCT is a clearing house for research. They focus on remote sensing and biology.

MOUs have been signed with Japan and Germany and the Royal Society of London and also with the Korean Science and Engineering Institute. New MOUs with Israel and China are being discussed.

They have a close relationship with Canada on remote sensing: the Remote Sensing Centre was set up in 1982 and upgraded with CIDA funds. MacDonald Detwiler Associates of Vancouver have been working for this agency for the past 3 years and are well placed to continue work. They are now upgrading to receive LANDSAT 6 and a European satellite that can look through the cloud cover. They hope to get RADARSAT from Canada in 1994.

They say they need help in marketing the database they are developing. They also need help in management of natural resources and the environment.

Eventually, the remote sensing activity will be split off from the NRCT to a more entrepreneurial operation. They will separate the research and commercial activities of this new enterprise and will operate the marketing as a crown corporation that is not covered by the rigid rules of central government.
They had one potential customer in the Government of Malaysia who wanted their travel costs covered to come and tour the facility, but the government does not have the means to provide that. (The Malaysian Remote Sensing Centre says they have regular meetings and buy data from Thailand).

They understand research is important for economic development and they are trying to give grants to the private sector for research and development. The private sector wants the government to do research in new technologies and then let the private sector do the final development and commercialization.

In university, science and technology, 50% are women, whereas 80% of the employees of NRCT are women. This is primarily because males can get paid three to five times more in the private sector than in government.

Other areas where they would like to see Canadian input would be in the management of science and technology; marine science; nonconventional energy, i.e. solar, wind, hydro, agriwaste as a replacement for wood products.

They also have a keen interest in micro electronics.

With respect to ASEAN, they meet twice a year on a science and technology committee and the next meeting will be in Brunei in January. This will be an information exchange as opposed to a practical effort.

This ministry, as are others, is now looking at bilateral cooperation with Laos, Cambodia and Vietnam and they are interested in tripartite arrangements with Canadian firms to do business in one of these countries.

i) **NRCT Research Policy and Planning Division**

One mission member met with Mr. Pracha Chantravchin, Director, and Mrs. Sammaluck Phumiwasana.

The Division has a print-out of research institutes in Thailand both in government departments and universities. Not all government departments have research facilities. Those that do usually work on in-house projects on their own.

For the past 3 years, NRCT has been working with the budget bureau in recommending research priorities and in avoiding duplication.

Research policy is drawn up by the two advisory committees to NRCT. The NRCT plan is based on the framework laid out in the National Economic and Social Development Policy. The purpose of the research policy and planning is to decide where to allocate NRCT resources, and what the national research directions should be.

The total government research budget for Thailand, including social sciences and scientific and technological research is of the order of C$100 million per year. Approximately C$1.3 million of this is spent through NRCT.

The fourth five-year plan had just been completed and a copy was left at the Canadian Embassy for partial translation.

NRCT has the power to stop projects that do not fit in with the national plan by recommending that they not be funded. Coordination with the Budget Bureau is not yet perfect, though.

ii) **NRCT Research Evaluation and Projects Division**

Mrs. Prabha Sattayanon explained how the Division operates. They analyze research proposals that have been submitted to NRCT on behalf of the Budget Bureau. Proposals are rated in terms of feasibility, cost and quality. The table below summarizes statistics on the projects that were reviewed.

Area	Number of Projects	Total Value (C$ million)
Agriculture	4000	14.8
Science & Technology	700	13.6
Social Services	714	4.0

The table below shows statistics on the number of projects reviewed and approved in 1991.

Number of Projects	Action	Total Value (C$ million)
5605	Submitted	41.6
6514	Approved by NRCT	25.6
5185	Approved by Budget Bureau	20.1

There are only 10 staff members, which does not allow for follow-up on projects once they are started.

Only a fraction of all projects reviewed are funded by NRCT. Most of these are submitted by individuals, whereas the Budget Bureau funds proposals submitted by or through organizations. The 1991 breakdown of NRCT funded projects is: agriculture: 66, Science: 50, and Social Science: 52, with a total value of C$ 1.4 million.

NRCT has to approve foreign researcher visits to Thailand. Presently there are 820 visiting scientists and 1201 visiting social scientists from all over the world. They stay for up to three years.

Both the Research Policy and Planning Division and the Research Evaluation and Projects Division requested assistance with training of staff.

A 4.4 Thailand Institute of Scientific and Technological Research (TISTR)

Dr. Santhad Rojanasoonthorn, Governor, and a number of his staff met with the Mission.

This department has state enterprise status and its responsibility is to match between research and development in government and industry. Their concentration is on commercialization and, therefore, they are heavy on development as opposed to research. They are busy trying to make themselves known to the private sector and have had some success. Their job is to identify and adapt technology for final adoption by the private sector. Towards this end, they are setting up a technology manufacturing engineering centre.

The private sector itself is not doing much research and development, whereas the government spends 0.25 % of GDP on it. They are also looking at developing technology parks, incubators, etc.

Some areas of concentration are:

a. Agriproduction (cash crops, new industrial processes, post harvest technology, processing of fruit and vegetables, natural health food, drugs from plants, rubber products, and packaging technology.)

b. Building industry.

c. Wood substitutes (soil cement), prefab bathrooms.

d. Electronics and computers, anti-corrosion materials, micro-COB telephone exchanges.

e. Ecology research, waste water treatment, environmental impact assessment, air cleaners, production of ethanol from cassava, rice waste as a source of fuel, and energy conservation. In addition, they are concerned with industrial product testing, inspection and manufacture of products to export qualification.

The government is concerned that they are in too many fields and will concentrate on agri industry, environmental protection and energy saving. They feel they can carry out these three with the equipment they have. The Japanese have provided C$21 million for testing and standards equipment and they are working on ISO 9000.

The difficulty they have found is in making products out of government research and development and they feel the need to do some marketing before doing research and development. Michael Leung was to write to the directors to explain the formation and operation of TR labs as a model. Paul Kelly to ask Glen Mitchell for research park and incubator information to forward to the Governor.

Importing science and technology with/from foreign partners is the way Thai firms should be operating. They need SCADA telecom technology and they are presently using Mitel parts. They would like to join with Mitel in some form.

They have been working with a company called World Computer Graphics of Canada on computer work and they do much of in-house training.

They would be keenly interested in a MOU with Alberta Technology, Research and Telecommunications to strengthen the ties with Canada.

In summary, the Governor and personnel of this agency are very dynamic and worthy of extensive further contact.

A 4.5 Asian Institute of Technology (AIT)

Dr. Leung was the only member of the Mission who visited AIT. He met with Dr. Douglas Webster, a faculty member of AIT who is also the Field Manager for the Canadian Universities consortium at AIT. Dr. Webster was a faculty member of the University of Calgary. Thereafter, Dr. Leung, accompanied by Dr. Webster, met with the following individuals separately:

Dr. John E. Lukens, Associate Professor, Natural Resources Program, Prof. A. B. Sharma, Chairman and Project Director, Division of Telecommunications, Dr. Ricardo Pama, Vice President for Development, Mr. Cary Nourie, Technology Park, Ms. Uni Rost, Research Scientist, Women in Development Project.

AIT has 10 divisions, 1 school of management, and 2 interdisciplinary schools The 10 divisions are: Agricultural Engineering; Computer Science; Engineering Technology (e.g. Intelligent Buildings); Environmental Engineering, Geotechnology and Transportation Engineering; Human Settlements Development (rural and regional development and planning - in collaboration with Germany); Industrial Engineering Development and Management; Manufacturing Systems Engineering; Structural Engineering and Construction, Water Resources Engineering; Telecommunications (in collaboration with Finland).

The two indisciplinary schools are: Agricultural Land and Water Development, Natural Resources Development and Management (Canada was a major donor, Japan is taking over as major donor).

The School of Management has an Asian focus. It also focuses on the management of technology. There is a strong realization that in addition to acquiring technology, one needs to acquire the expertise to manage technology.

There is also a "Korea House" (of unknown nature).

AIT has 800 graduate students from 30 different countries. 80% are working towards their Masters (M.Sc. or M. Eng.). It takes about C$23K to complete an M.Sc. degree.

AIT claims that its graduates will become key decision makers within their countries in five to ten years. A number of foreign countries realize this and have been actively building a strong relation with AIT to build up their image.

The Telecom Division is headed by Prof. Sharma, on a secondment from Helsinki University, who is also a prior employee of Ericsson. The Division has its own building, which is very well equipped. The majority of the equipment in the laboratories was donated by Ericsson. Nokia donated some as well. Dr. Leung met some of the students and observed that they came from different countries in the region. The Division offers a 20 month comprehensive telecom course. There are

currently 12 students. Despite Sharma's origin, he was quite open to Canadian participation, indicated that Ericsson's original sponsorship is almost over and he is interested in new additional sponsors. The original budget was C$8M over three years, donated by Finland.

About one third of the students is female, highest among technical schools in the ASEAN region.

A 4.6 Telephone Organization of Thailand (TOT)

Dr. Leung visited TOT and met with Dr. Thongchai Yongchareon, Director, Department of Engineering. He reports to the Deputy Managing Director, Bureau of Engineering and Projects. (The Managing Director is equivalent to the President).

TOT just moved into a brand new building (Dr. Leung noticed that the Ericsson building is conveniently located "just across the street"). It is a "state enterprise" with over 20,000 employees. Dr. Thongchai has about 800 people in his department. Like most telecoms in the region, TOT has enjoyed phenomenal growth and is highly profitable, as represented by the following statistics:

Selected TOT Statistics

	FY 88	FY 89	% Change
Revenues (C$ million)*	479	667	20
Net Profit (C$ million)	113	241	112
Total Assets (C$ million)	1.68	2.1	25
Cellular Phones (thousand lines)	10.6	20.9	159
Phones/100 population	1.8	2.1	16
Metro	8.8	10.4	18
Provincial	0.7	0.8	14

There are existing formal collaborative agreements between TOT and NTT, the French and Swedish PTTs, and Singapore Telecom, involving exchange of people, transfer of technology, etc. TOT does not work directly with AIT and universities.

Only 70% of their switches are digital. In 1992, they are committed to an ISDN trial covering the entire country. The interexchange facilities in the Bangkok region are predominantly fibre. Their long distance network is 50% fibre and 50% digital microwave. Starting 1992, projects will be commissioned to lay fibre along railroads and these projects will be completed within two years. By then, over 90% of their facilities will be fibre.

AGT's subsidiary, ATI, is involved to some extent in the fibre along railways project. TOT has sent staff to Edmonton for traffic training and is planning to send more.

The vendor portfolio for TOT for switching is: 75% NEC, 24% Ericsson, and 1% Siemens; for cables, they rely on 4 local manufacturers. The question was posed on why not Northern Telecom? Answer: "Market in Thailand is very competitive, Northern did not participate in the switching tenders, but have some presence in PABXs and CPE, which are deregulated markets".

BOT (Build, Operate and Transfer) projects are very popular in Thailand and they cover major telecom, transit and other areas. Out of four operating cellular systems, two are under BOT agreements. The Communications Authority of Thailand (CAT) is the competing operator. TOT and CAT each have one BOT system. There are three paging services, all BOT, 2 under TOT and 1 under CAT. Both are growing markers. Four years ago, there were only 1000 users. Now, the number is 140,000.

There are three mega telecom projects underway, (1) the interexchange fibre along railroad project, awarded to ComLink. Dr. Leung later found out that DATAP of Calgary is a subcontractor, (2) 1 million line BOT project for the City of Bangkok, valued at C$2.3 billion was recently awarded to a consortium based in Bangkok, Dr. Leung is not aware of any Canadian participants. (3) another 1 million line BOT project for the rest of the country. (3) is still in the early tender stage. TOT does not expect any Canadian bidders.

A 4.7 Siam Cement

The Mission met with Mr. Tawee Butsuntorm, Senior Vice President, Siam Cement.

Siam Cement is one of Thailand's largest companies with 20,000 employees. Cement is one third of the firm's business. It was established in 1913 and has now diversified into many other sectors of the economy.

Historically, the firm did little research and development but has just set up an organization in 1988 called the Technology Developed Institute (TDI).

There will be three research and development centres under TDI:

1. in Bangkok on cement and construction materials.
2. in Banpong (Western Thailand) on pulp, paper and packaging.
3. in Talung on metals.

Siam Cement have numerous joint ventures with firms in Europe, the USA and Japan and when asked about Canada, the response was "Canada is sleeping".

At the moment, only Centre # 1 has been established and new buildings are expected to be completed in April 1992. Their approved budget for equipment is C$250K. They expect 150 staff will be employed in the next four years at this centre. Further exchanges will take place with their joint venture partners, such as Redland Cement, Dow Chemicals and Lafarge. Pulp and paper research and development will follow after the first centre is completed. There may be a potential linkage here for expertise in the pulp and paper sector and this should be discussed with appropriate Canadian organisations. It is interesting to note that Siam Cement will recruit overseas for specialists if necessary.

A 4.8 Science and Technology Development Board (STDB)

The Mission met with Dr. Thalung Thamrong-Nawasawat, Director, Professor Montri Chulavatuatol, Deputy Director, Dr. Rong Rujkorakarn, Dr. Aroon Auansakul, and Dr. Sumol Pavittranon.

STDB was created in 1986 under a Thai-US agreement and is jointly funded by US Aid and the Thai government (75/25). In the near future, STDB will be merged with NECTC, NCGEB and NCMMT, and reorganized. The corresponding legislation will be passed soon.

STDB is a funding agency. Areas of focus are biotechnology, materials, and applied electronics and computer technology. These are to support agriculture and industry. The 1991 budget is C$56.8.4 million (US loan C$22.5 million, US grant C$18.2 million, Thai government C$11.9 million, private contributions C$5.2 million).

Funding is provided for the following activities:

1. Designated research and development and engineering
2. Competitive research and development and engineering (both 1 and 2 are done in universities and institutions.
3. Company-directed grants and loans.
4. Graduate fellowships for local training.
5. Conference support in Thailand.
6. Project initiation (pre-competitive)
7. Industry-directed strengthening of institutions.

Industrial development support is given to the following areas:

1. Standards, testing, quality control.
2. Technical information access centre (electronic access to US information)
3. Diagnostic/Research Design Service - using local consultants.
4. Technology assessment and mastery
5. Commercialization of science and technology.

Their seven-year agreement with US Aid ends in August 1992 and may be replaced by an endowment fund. Thailand is approaching a number of countries to ask for contributions to the fund.

STDB has 20 support staff and 20 professional staff. The STDB program was started because industry was not doing research. This is slowly changing now, with more companies accessing and adapting technology from elsewhere. STDB has no special linkages with ASEAN.

STDB is developing a data base on Thai companies. They can help Canadian companies get access to Thai science and technology companies.

Petroleum company subsidiaries are developing new programs. Multinationals are now producing plastics in Thailand, whereas these used to be imported previously.

STDB sees possibilities for interactions with Canada in the areas of science and technology commercialization. They would like linkages with Centres where technology is available.

It was pointed out that the science counsellor in the Washington Thai embassy has little activity in Canada.

Eight hundred Thai students will be sent abroad, and Canada should train many of them. The Canadian education system is considered to be good. Canadian universities should advertise in Thailand. Many Thai students have had difficulty finding placement in appropriate graduate school even though they bring their own funding.

Canada has strengths in areas that Thailand has to address over the next ten years: natural resources management, telecommunications, energy, food supply.

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APPENDIX 5
INDIVIDUAL INTERVIEWS IN MALAYSIA

A 5.1 Ministry of Science, Technology and the Environment

The Mission met with Mr. Kong How Kooi, Deputy Secretary General and a number of representatives of the various institutes and agencies, for a total of about 16 participants. Dr. M. Mohinder Singh, Director of Science and Technology, presented an overview of MOSTE. Most of his presentation is captured in Section 7.2 of this report, under ii). Additional comments are:

The Ontario Science Centre has lent interactive displays to the Malaysian Science Centre.

The Industrial Technology Development Plan sees the role of government as catalytic. Its philosophy is practical and action-oriented, and aims for demand-led, market-driven research and development.

The Ministry needs training for its offices in the area of science and technology management, technology forecasting, commercialization, research and development management, and asked the Mission to assist with the identification of Canadian institutions and organizations where this training can take place. Hands on training is needed, not degrees. The ADB loan provides for a flexible time frame. MOSTE hopes to start sending staff for training early in 1992.

MOSTE would like to learn from Canada in terms of building up an appropriate infrastructure. What should be done to reach Vision 2020? Can we send experts to help this?

Also, experts to provide local training in contract research management are required.

APRO members have been asked to find solutions to these training needs.

i) Malaysian Institute of Microelectronic Systems (MIMOS)

The meeting was with Dr. Arif Nun, Deputy Director-General, Dr. Mohammed B. Awang-Lah, Director of Computer Systems (in the information technology area), Plan Noor Asmar, Director of Administration, Mr. Rafee Yusoff, Senior Researcher (information technology design) and Mr. Zatisah Bin Hanafi (Semiconductor Technology).

This organization already has a relationship with IDRC, who are doing a study on free trade zones in Malaysia to identify the capability of multi-nationals to operate beyond assembly operations in Malaysia. It is a government agency with about 100 staff and expects to grow to 288 by next year. Their main mission is to use microelectronics for economic development. They want to enhance the effectiveness of manufacturing using information technology, which is a C$2.5 billion industry.

There are 30 to 50 foreign firms, multi-national subsidiaries manufacturing semi-conductor components. Intel is now almost 100% run by Malaysians. Motorola Malaysia won the first prize for customer satisfaction in the region. It has good research facilities. Malaysia has a good infrastructure and an educated workforce with a stable government. The Japanese made Malaysia their first choice in Asia. In May of 1992, Penang will celebrate the 20th anniversary of automation for world class manufacturing and there will be an exhibition on automation.

They have developed SCADA technology which is now being used by the National Electricity Board. Telecommunication technology is now a bigger issue for introduction into schools. They are going beyond hardware and software provisions into the philosophy of using information technology in schools. Michael Leung is to send information on remote education. MIMOS does software development and also chip design facilities for ASIC, but the main focus is on software.

They have an agreement with the Interuniversity Micro Electronic Centre in Leuven Flanders for training and exchange.

They are looking for technology partners to acquire silicon processing technology at 0.5-1.0 micron level. They have had some liaison with Mitel Microsystems in Canada. This would appear to be an opportunity for LSI Logic. They are concerned that ASIC are only being used by big firms. They also have a relationship with the University of California at Berkeley, who supplied some equipment. They would like to receive our directories on software, telecom and the electronics.

ii) Malaysian Centre For Remote Sensing (MACRES)

Jeff Whiting visited the Director, Nik Nasruddin Mahmood.

MACRES receives too many requests for the current staff to handle. The centre has a problem in dealing with SMEs because these companies do not have: 1) training, 2) proper equipment, 3) experience and 4) the centre cannot charge for the work (only the data). Item 4 will be solved when the centre is privatized in 1996.

The Centre has no mandate to setup operational systems - this is the mandate of line departments. However, no department has done so yet. We feel this is an opportunity for Canadian companies.

The Centre is interested in working with Canadian Institutes such as SRC and ARC in making research pay. MACRES would also like to work with Canadian companies when they undertake contracts in Malaysia. The company will use MACRES equipment and pay for its use by up-grading MACRES equipment and training staff.

MACRES does much public promotion especially to the news media.

iii) Science Park

Dr. Salleh, Technology Park, was visited by Paul Kelly.

They have 600 acres and are looking to get a further 400 for their initial development of a research park including an incubator and room for major research projects. There will be three components:

1. Innovation House (inventors and innovators).
2. Enterprise House (medium sized companies).
3. Large companies.

The Saskatchewan Research Council has supplied information previously. The land will be available by the end of this year and buildings will be complete by the end of 1993. Australian consultants under an UNDP loan are doing preliminary studies. Dr. Salleh has visited Discovery Park in Vancouver. They are interested in information technology and biotech but most tenants, at present, are in information technology.

With respect to manpower training the park will take on 20 more staff, especially personnel in microelectronics and precision engineering. Three laboratories equipped with high precision equipment in biotechnology, microelectronics, and machine tools will be located in the park. Training of graduates is needed..

Ms. Dolite Hashim is the marketing person. Much effort is dedicated to ISO 9000. The park will be open to foreign firms who are in joint ventures with locals. A hormone was developed in Canada to stimulate spawning of fish, and a U.S. firm has implemented the actual process in Malaysia.

The park would like to access the Enterprise Malaysia Canada fund. We can suggest joint ventures with their firms.

C$417 million was spent on imported information technology (mainly software) in the first five months of this year. Malaysia is a good place for software developers to market their product. They expect CIDA funds to help with research. Malaysians accept Canadians better than U.S. companies, but Canada has been slow to take advantage of the potential.

They would like a proposal on training in a Canadian technology park.

A 5.2 Petroleum Research Institute, PETRONAS (PRI)

Dr. Ahmad Zahrudin Idrus, Director and Dr. Khalid Ngah, Deputy Director (Upstream) met with Dr. Jan Boon.

PRI was formed in 1988 as a research arm of PETRONAS, the National Petroleum Corporation. Of the 250 people, 150 are scientists (8% PhD, 60% B.Sc.) PRI was setup and equipped with IFP (Institut Francais du Petrole) assistance.

Alberta is well known: Dr. George Miller of Nova Husky is a member of the Advisory Council. Dr. Don Flock (University of Alberta), Dr. Nick Mungan (Calgary consultant) and Dr. Phil Sigmund (University of Calgary) are regular paid advisors. PRI is a member of the Computer Modelling Group in Calgary.

A new lab will be completed in 1992 with a staff level of 350. PRI is contemplating signing an MOU with the Alberta Research Council

The labs are all relatively well equipped.

PRI will be converted to a contract lab next year. Petronas negotiated exploration and production agreements in Vietnam. Similar agreements are in place for the offshore Malaysian Sedimentary Basin.

A 5.3 Tenaga Electricity Board (TEB)

The Tenaga Electricity Board visit was with Mr. Hoesny Nasauddin. TEB wants to build an 'electrum' to make people aware of the uses of electricity: it should be an interactive centre. Paul Kelly to contact potential Canadian entities who could help with the design and put them in touch if they are interested in assisting. The company employs 23,000 staff with a C$1.15 billion dollar annual expenditure and profit of C$460 million. They produce, transit and distribute power from coal, gas and oil stations plus new developments in hydro.

A 5.4 Standards and Industrial Research Institute of Malaysia (SIRIM)

The mission met with Dr. Hamzah Kassim, Head, Corporate Affairs Division.

The organization chart of SIRIM is show in Figure A.5. The 1991 expenditure budget is C$21 million, C$3.8 million of which is covered by external revenue, with the remainder provided by government. The total number of staff is 947.

SIRIM developed a 1991-1995 corporate plan with six major thrusts:

- an effective and viable research and development system,
- a national measurement, standards and quality system,
- a responsive customer support program,
- transfer technology to local industry for growth and innovation,
- enhance human resources and administrative systems,
- move towards corporatization.

As part of the ADB-funded Industrial Technology Development Management Project in Malaysia, SIRIM will upgrade its capabilities in various areas, including automated manufacturing, advanced materials and contract research management. APRO is bidding on the technical assistance and consulting projects. SIRIM also needs assistance with staff training and education in the following areas, with over 700 staff candidates taking part:

Short courses in standardization, technology management, advanced manufacturing technologies, instrumentation, advanced materials, CAD/CAM, testing in a variety of areas, pollution technology, biotechnology. In Addition, M.Sc. and Ph.D. degree courses in SIRIM's focus areas.

SIRIM needs to obtain 40% of its revenue from contract research by 1995. A 10% to 25% annual growth rate is projected for the next five years.

SIRIM's clients are mainly in the manufacturing sector, covering a wide range of products. SIRIM is interested in strategic alliances, both through industry and through research organizations. They would like to sign a Memorandum of Understanding with APRO.

A 5.5 Telecom Malaysia

Dr. Leung met with Mr. Gordon King, Assistant General Manager (Technical Training). Mr. King advised that the more appropriate people to talk to were: Mr. Khoo Seng Keat, General Manager of Research and Development and Mr. Sharmugam Manickam, General Manager of Corporate Planning. However, because of scheduling difficulties, the Mission was not able to contact these gentlemen.

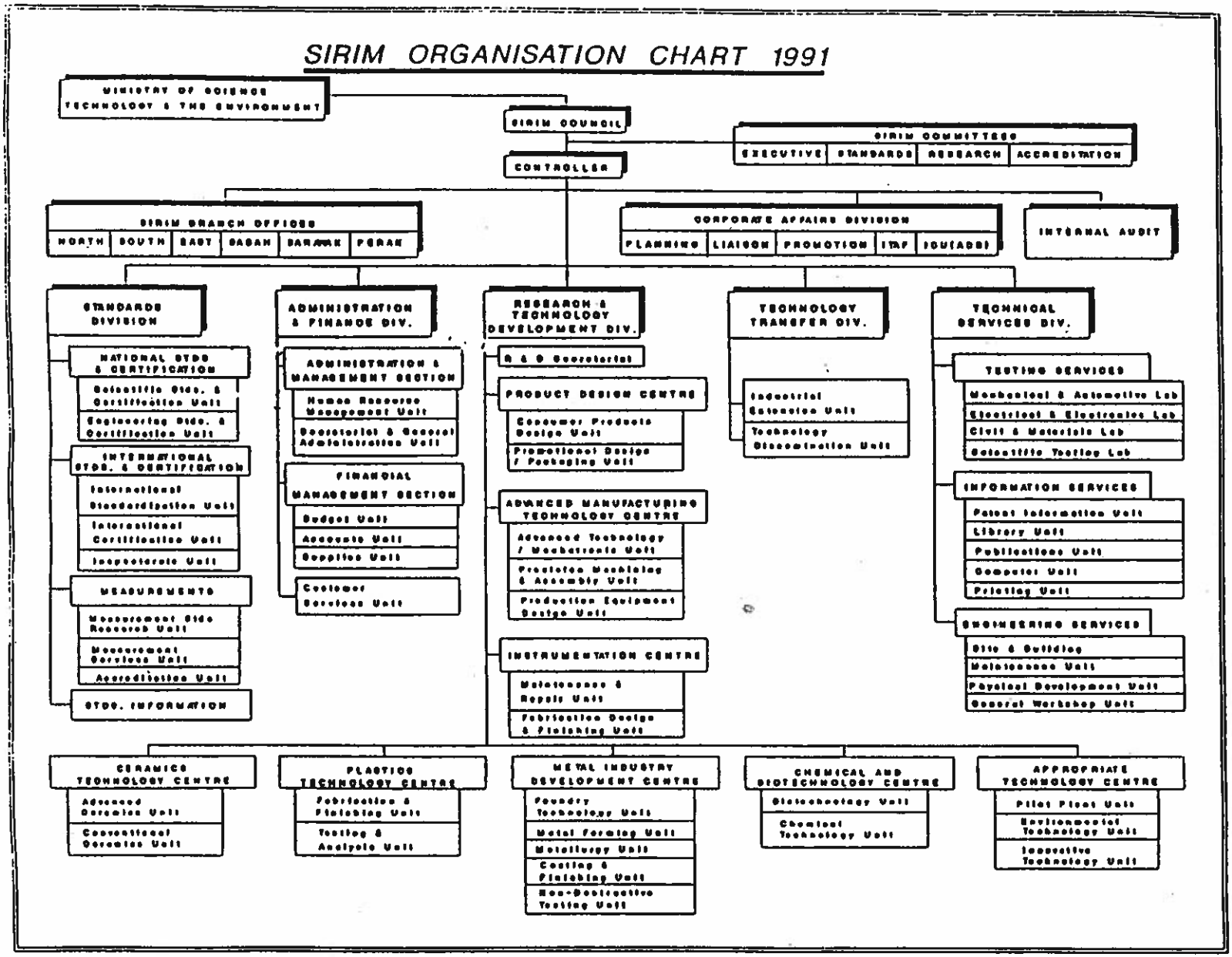

Figure A5.1. SIRIM Organization Chart 1991.

Telekom Malaysia has a staff of 29,000, 400 of whom are with the Technical Training Centre (TTC). TTC has six training locations in Malaysia, and typically trains 17,000 student-courses per year. While primarily an in-house operation, it does train "outside" students historically from 24 other countries, most under the Commonwealth Telecom Office. There are also bi-lateral training agreements with other ASEAN members. They have also built linkages with Hongkong Tel, NTT and Australia Tel.

He said that the US Telecom Training Institute (USTTI) provides 40 training programs per year and it sends information to all countries (Africa, SE Asia) and are very aggressive and pervasive.

CIDA has sponsored some programs in telecom in the past. For example, two of their marketing managers were sponsored to be attached to BCTel for a four to five month period. TEMIP (Telecom Executive Management Improvement Program) has two programs per year. Their people have been invited to attend. participants of TEMIP are the nine operating telcos in Canada and SPAR Aerospace. Mr. King is quite familiar with Canada, having visited cities from Vancouver to Montreal.

About 30% of their technical staff are women.

While recognizing he was not the spokesman for Malaysia Telekom, he can seen the benefits of possibly joint venturing with Canadian telecom players to undertake some Indonesian projects (currently the fourth project is being tendered) or other projects in Vietnam, Saudi and Cambodia.

A 5.6 Universiti Technologi Malaysia (UTM) Kuala Lumpur Campus

The Mission members met Dr. Sainal Abidin Ahmad, Campus Director of UTM and three senior officials, including Prof. Dr. Hashim Bin Saibun, Dean, Faculty of Electrical Engineering.

UTM has two campuses. The Kuala Lumpur Campus has the faculties of Electrical Engineering, Computer Science and Petrochemical Engineering. The Johor Campus has the faculties Management of Technology, Mechanical Engineering, Civil Engineering, Surveying, Environment and Architecture.

UTM has 10,000 students about one third are in the Kuala Lumpur Campus. About half of these students are in the diploma program, the other half are in a degree programs. There are some 5% working towards their postgraduate degrees. Output is about 200 graduates per year. Most graduates are employed by the manufacturing sector.

UTM also has three research institutes: Coastal/Off-Shore Engineering, Vibration & Noise, and Urban Habitat, with a tenth of the funding from industry. There are three priority areas: advanced manufacturing and processes, structure and material,

analytical and graphical computing. Enhanced oil recovery of medium or light crude is also of interest. They are aware of PRI (Petroleum Recovery Institute) of Calgary.

UTM is a member of the Association of SE Asia Institutes, and has exchange professor programs with the National University of Singapore and the U.K.

UTM is interested in having Canadian input in the hi-tech sector, specifically interested in having senior professors (possibly retired) joining their team and guide junior local researchers, e.g. in the area of power engineering.

A 5.7 List of Organizations and Personnel

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Country Coordinator

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Counsellor (Commercial) & Second Trade Commissioner

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Cherise M. Valles
Second Secretary (Commercial) & Trade Commissioner

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Zafisah Bin Hanafi
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APPENDIX 6
MISSION BROCHURE

Canada-ASEAN Mission on Science and Technology

Advance Material for Meetings in October/November 1991

Canada-ASEAN Mission on Science and Technology

Goal

The goal of the mission is to identify potential linkages between ASEAN countries and Canada, and potential cooperation in Science and Technology. Specifically, to examine the organization of Science and Technology activities such as policy, research and development, technology transfer, training, and government-industry cooperation. In addition, existing international science and technology linkages are of interest. This Phase 1 study will lead to a Phase 2 action plan. The mission is sponsored by the Canada-ASEAN Centre, and supported by the participating organizations.

Mission Members

- *Dr. Jan Boon*
  Director, Development and Planning
  Alberta Research Council (ARC)
  Mission Leader
- *Jeff Whiting*
  Manager, Business Development
  Saskatchewan Research Council (SRC)
- *Paul Kelly*
  Executive Director, Business Development
  Ministry of Technology, Research, and Telecommunications
  Government of Alberta
- *Dr. Michael Leung*
  Vice-President, Business Development
  Telecommunications Research Laboratories

The Alberta Research Council and the Saskatchewan Research Council are members of the Association of Provincial Research Organizations (APRO).

A questionnaire, a brief curriculum vitae of the members, and a description of the organizations involved in the mission are presented on the following pages.

Questionnaire for Canadian Mission on Science and Technology to ASEAN Countries

We hope that you will have an opportunity to read the tentative questions listed below to help focus the discussions during our meeting.

1. How many employees does your organization have?
2. Would your organization be interested in training staff from Canada, or have your staff trained in Canada, through secondments?
3. In Canada, only 27% of those enrolling in university level science and engineering are women, which exacerbates the projected future shortages in these areas. Has your country been successful in attracting more women into science and technology and, if so, how was this achieved?
4. In what types of activities is your organization engaged?
5. What research and development activities is your organization focusing on?
6. To whom are your products or services provided?
7. Do you have science and technology linkages with:
   – Other ASEAN countries?
   – Canada?
   – Other countries?
8. Does your organization have a need for collaboration with other organizations at home or abroad in the area of science and technology?
9. Would industry in your country or other ASEAN countries benefit from strategic alliances with Canadian industry?
10. If the answer to the previous questions is yes, what actions could be undertaken to make this happen?
11. In this context, would you be able to identify staff with special expertise that could undertake short or medium term assignments in Canada?
12. Would it benefit your organization or country to have access to Canadian experts for short or medium term assignments in your country?
13. Would your organization be interested in bidding on science and technology projects jointly with Canadian organizations, either in your country or overseas?
14. Is your organization interested in establishing mutual recognition of tests based on standardization of test procedures?

CANADA ASEAN Centre

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Executive Description

The Centre was opened in Singapore in 1989 with a mandate:

"... to serve as a catalyst and the centre of a network linking Canadian and ASEAN interest groups in a wide range of activities designed to promote better understanding of our respective institutions, cultures and ultimately our peoples."

With the appointment of an Executive Director in September 1990, and an Advisory Council in October 1990, the Centre was empowered to develop a broad mandate in the following fields:

Public Affairs – promotion, publicity, public relations and other marketing activities designed to raise the level of perception and understanding in ASEAN about Canada, and in Canada about ASEAN.

Institutional Cooperation and Academic Relations – support for linkages between Canadian and ASEAN educational institutions, and for the activities of ASEAN regional institutions pursuing activities of priority to Canada. The focus here is on people-to-people exchanges. The main media for the exchanges are regional institutions and the academic community.

Business Cooperation – regional promotional programs and events, cooperative programs with regional business organizations and media, development of regional business strategies, and other activities designed to supplement and support the trade and investment promotion activities of Canadian businesses, technology institutes, and missions in the region, and of ASEAN businesses in Canada.

In addition to running its own projects and programs, the Centre provides space for the staff of other organizations active in the region. CIDA's ASEAN Development Cooperation Program is administered by a CIDA staff located in the Centre. Also "co-located" in the Centre is the Director, Southeast Asia Programs, of the Asic Pacific Foundation of Canada. Other "co-locators" will be welcomed over time.

Profile

The Association of Provincial Research Organizations (APRO) is a national network of eight Provincial Research Organizations (PROs) and two territorial organizations dedicated to using science and technology for the economic and social development of Canada and the regions. Through its member organizations, APRO operates applied research and testing laboratories throughout the country and specializes in services to small and medium sized industries. APRO provides a strong interface with industry and provincial governments, and a broad base of knowledge on science and technology issues and policy matters. The member organizations of APRO are: British Columbia Research Corporation (BCR), Alberta Research Council (ARC), Saskatchewan Research Council (SRC), Manitoba Research Council (MRC), ORTECH International, Centre de Recherche Industrielle du Quebec (CRIQ), New Brunswick Research and Productivity Council (RPC), Nova Scotia Research Foundation Corporation (NSRF), Science Institute of the Northwest Territories, and Yukon College (YK).

The mandate of APRO members is to:

- provide essential technical support and services to provincially based industries;
- maintain an awareness of science and technology issues and problems facing provincial industries;
- maintain currency in leading edge technologies which may benefit industry;
- provide information, advisory and technology transfer services to assist provincial industries in acquiring technology, solving problems, and becoming more innovative and competitive;
- establish alliances with research, educational, consulting, government and other organizations to facilitate the development and delivery of required technical services and programs;
- provide consulting, testing and other contract services required by industry and government;
- maintain an awareness of national and provincial science and technology policies and issues and their impact on industry, and provide advice and recommendations on science and technology issues and policies which may affect provincial economies.

To this end, APRO members also provide advice on science and technology issues to their respective provincial governments, participate in a wide range of seminars, courses, trade shows and other technology transfer initiatives, and respond to many thousands of client enquiries from industry for assistance and advice in resolving technical problems. APRO member organizations, in the fiscal year 1990/91, conducted some $170 million worth of projects and employ more than 2,000 research professionals, technologists, and support personnel..

In summary, APRO, through its linkages with provincial industries and government, is a primary national science and technology resource.

Association of Provincial Research Organizations
APRO
L'Association des organisations provinciales de recherche

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Professional Profile

Jan A. Boon

Dr. Boon's experience includes working as a chemical analyst, university teaching, research, and management. He has held a variety of positions in a large research organization and he has developed strengths in human resources management, bridging between disciplines and between different groups and organizations, and the development of strategic alliances. He is keenly aware of the role of science and technology in society, and has undertaken various initiatives in the area of science education and public awareness.

Before entering university, Dr. Boon worked as a chemical analyst in a rayon and cellophane factory. After completing his Ph.D., he taught physical chemistry at a Venezuelan university for a number of years. He then moved to Canada where, after one year as research associate in the Geology Department of the University of Windsor, he joined the Alberta Research Council. There, he did research on oil sands recovery technology and managed project teams including chemists, engineers and geologists. He was also in charge of the day-to-day operations of a $5 million per year government-industry joint research program. Subsequently, he became head of the Alberta Geological Survey, where he obtained experience in working with government departments, and with other jurisdictions. He was a member and later chairman and co-chairman of the Provincial Geologists Committee and the National Geological Surveys Committee, respectively. He established strong links between the Alberta Geological Survey and industry. About one year ago, Dr. Boon was appointed to the newly created position of Director, Development and Planning, at the Alberta Research Council, and he was intimately involved in the development of *A Vision to the Year 2000*, the corporate plan.

Dr. Boon obtained a B.Sc. in chemistry and an M.Sc. in geochemistry from the University of Utrecht (Netherlands), both with distinction. His Ph.D. in geochemistry was the result of a cooperative project between the universities of Utrecht and Manchester (U.K.). He is the author of over 20 publications. He has been program chairman and chairman of international symposia.

Dr. Boon has lived in the Netherlands, England, Venezuela and Canada, and has travelled extensively in Europe, North America, South America, and Asia. He is fluent in Dutch, English, Spanish and French and has a reading knowledge of German. He is curious about people and cultures.

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Corporate Profile

Alberta Research Council

The Alberta Research Council, established in 1921, is the oldest and largest provincial research organization in Canada. It is supported through government appropriation and through contracts with government and private industry.

Responding to the needs of the private sector and supporting activities of the public sector, the Alberta Research Council has a stated mission to advance the economy of the Province of Alberta by promoting technology development and application; performing applied research; andproviding expert advice, technical information, and scientific infrastructure. With 600 employees, it offers a diversified range of scientific, engineering and technological capabilities in: geological and soil surveying, environmental research and engineering, oil sands and hydrocarbon recovery, coal and hydrocarbon processing, advanced computing and engineering, electronics testing, forestry, biotechnology and manufacturing technology. Joint research venture programs are carried out with industry partners. The ability to assemble multi-disciplinary teams that provide comprehensive integrated solutions to difficult technical problems is one of the major strengths of the corporation.

The corporation is preparing for operations in global context and agreements have been signed with organizations in Europe, North America and Asia. It has done contract research with or for organizations in the U.S.A., Great Britain, Indonesia, China, Russia, Thailand, Australia, South Korea, Japan, Venezuela, U.K., India, France, Germany, Belgium, Czechoslovakia, Hungary, and Italy.

The Research Council is a member of the Association of Provincial Research Organizations (APRO).

Alberta
TECHNOLOGY, RESEARCH
AND TELECOMMUNICATIONS

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Professional Profile

Paul F. Kelly

Paul Kelly, Executive Director, Business Development and Marketing, of the Ministry of Technology Research and Telecommunications, has over 20 years experience in engineering and marketing in Asia, Canada, the Caribbean, Africa, U.K., and Europe.

As former Manager, International Business Development for one of Canada's most prestigious consulting firms, his experience includes extensive marketing efforts in Malaysia, Indonesia, the Phillipines, Burma, Thailand, South Korea, and Singapore. He has a particularly detailed comprehension of the activities of the Asian Development Bank, World Bank, World Health Organization, United Nations Development Programme, and the Canadian International Development Agency.

Mr. Kelly joined the Government of Alberta in 1990 and is responsible for diversification into High Technology by the promotion of Strategic Alliances/Joint Ventures between Alberta firms and their counterparts around the globe. He is also responsible for High Tech. Investment Development from international sources.

Department Goals

The goals of the Department are to:

- expand and diversify the Alberta economy through the development and application of advanced technology in both traditional and new non-resource based industries;
- provide opportunities for future Albertans in skilled technology industries which are competitive on a world-wide basis;
- encourage a technology culture within the province which prompts broad participation by Albertans in the research, development, commercialization and utilization of advanced technologies;
- establishment of an environment and infrastructure that will enable rapid development and deployment of technology, whether developed in Alberta or elsewhere;
- maximize the commercialization of research and development in Alberta;
- make Alberta an important centre for industry-led research and development in priority areas;
- emphasize priority advanced technology areas in conjunction with other provincial agencies, government jurisdictions, research institutes and industry to create co-operative initiatives aimed at exploiting the commercial benefits of technology development; and
- establish linkages that enable meaningful co-operation on advanced technology development between industry, universities, and government.

Saskatchewan
Research Council

15 Innovation Blvd. Saskatoon, Sask. Canada S7N 2X8 Phone: (306)933-5400 Telex: SARECO 074-2484

Professional Profile

Jeff Whiting

Mr. Whiting has over twenty years of experience in contract research, both as a researcher and as a project manager. Through his work, he has gained an intimate knowledge of the key aspects of environmental technologies and related areas. His skills cover a broad range and include research, teaching, business development and technology transfer. He encourages lateral thinking and is good at teambuilding.

His professional career path took him from junior scientist to middle management in an applied research and development organization. Mr. Whiting is presently Director of the Spatial Information Division and Manager of Business Development at the Saskatchewan Research Council. He developed and managed programs in hydrology, remote sensing, and environmental impact assessment and abatement. He also has consulted for overseas companies, for testing and marketing of equipment.

Mr. Whiting holds a M.Sc. degree in Geography from the University of Saskatchewan, a B.Sc. in Meteorology from McGill University and a Certificate of Stochastic Hydrology from Colorado State University. He is a registered Professional Hydrologist. Mr. Whiting has presented over 110 seminars and papers at conferences, workshops, and television and radio appearances. He has served on many national and international committees.

Mr. Whiting has travelled in North America, Europe, and Africa on numerous occasions.

Corporate Profile

Saskatchewan Research Council

The Saskatchewan Research Council (SRC) was established in 1947 and is Saskatchewan's principal R&D organization. SRC is located ast Saskatoon's Innovation Place, Canada's largest science park.

Over 200 researchers, scientists, engineers, technologists and support staff provide contract scientific and technological research, technology development and technology transfer services for the development of Saskatchewan. Expert capabilities and state-of-the-art facilities are uniquely suited to the province's industrial, manufacturing and resource sector needs. Multi-disciplinary teams work with private sector clients, government departments and universities. Three branches – Operations, Research, and Technology Transfer – deliver programs and services in the areas of:

- product design, development and testing for equipment, machinery, electronics, plastics, construction materials, instrumentation
- process design and improvement
- analytical chemistry
- environmental research and analysis
- spatial information
- bovine blood typing
- petroleum research
- pipeline research
- geoscience services
- building science research
- productivity and quality assessment, including computer and integration services.

For further information:

Mr. Jeff Whiting (306) 933-5423, fax (306) 933-7817.

Mr. Ravi Maithel, Vice-President, Technology Transfer and Corporate Business Development (306) 933-5499, fax (306) 933-7896.

TRLabs
Telecommunications Research Laboratories

Professional Profile

Michael L. Leung

With over fifteen years in the telecommunications industry, Dr. Leung has a wide range of experience in managerial and technical capacities, primarily within the context of major Canadian telecommunications firms (Bell Canada, SaskTel) and research institutions (TR*Labs*, Bell Northern Research, Centre for Chemical Physics). He has developed a good understanding of the industry, its internal dynamics and its participants, having worked with a variety of service providers, manufacturers, regulators, policy makers, customers, labour unions and lobby groups. He also has a good appreciation of the role of research institutions as part of an infrastructure for economic development and growth, and their importance and contribution to industry, government and academia.

His professional career path covers mid and senior management positions in a diverse mix of corporate disciplines (Manager and Head of Strategic Planning, Director of Marketing, Product Development & Product Management, Director of Finance & Administration, Director of Business Development), progressively leading to his current position in TR*Labs* as Vice President, Business Development.

He has successfully completed a number of major corporate projects under tight time frames, leading multi-departmental task teams to address key corporate issues or to undertake major corporate assignments. On multiple occasions, he was instrumental in setting up and staffing new organization units, and in designing and implementing new internal processes and policies in response to new corporate priorities.

His technical experience includes working as a member of the scientific staff in research institutions, primarily in the areas of systems planning, scientific programming and technology research in solid state physics and biophysics. He has also taught undergraduate courses in marketing and physics.

Academically, he holds post-graduate degrees both in the physical sciences (Ph.D. in statistical physics and M.Sc. in solid state physics), and in business administration (MBA, with a focus on international business and finance), all from the University of Western Ontario. He has a B.Sc. degree from the University of Hong Kong. He is the author of a number of papers published in referenced journals.

Dr. Leung is well travelled, having lived in the Far East, the U.S., and Canada, and he is fluent in English and Chinese (Mandarin and Cantonese).

ncorporated company

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Corporate Profile

TR*Labs* was founded in 1986 by the University of Alberta. It operates as an arm's length, not-for-profit research consortium, based on industry, university, and government collaboration, and undertakes applied research in telecommunications, specifically on networks and systems, network access, photonics and wireless technologies.

- **Networks and Systems Research**
  High speed ISDN access, real time network restoration, SONET, timing noise generation and accumulation, avanced functional blocks (eg. protocol engines, multiplexers, high speed interfaces, phase lock loops) for integrated implementation.
- **Photonics Research**
  Wideband local area networks, integrated voice/data multipoint trunking, semiconductor laser stabilization, coherent FSK transmission, multimode fibres high speed transmission, optoelectronic switching, optical backplane, optical signal tapping.
- **Wireless Research**
  Diversity and amplifier studies, modelling, and simulation of digital radio systems, in-building wireless systems.
- **Network Access Research**
  Established as a new research thrust in the fall of 1991, its research program is yet to be developed.

As an accredited affiliate of a number of universities in western Canada, TR*Labs* provides student training at the graduate level. Its output in people and technology contributes to the growth of its industry, university, and government sponsors in business, research and education, and economic development. TR*Labs* currently operates research laboratories in Edmonton and Calgary, and has immediate plans for a third one in Saskatoon. It has a staff of over 60, consisting of staff researchers, industry professionals on secondment, professors, graduate and undergraduate students, and technical and administrative support staff. Over the past five years, sponsorship has grown from 3 to 14, and some highlights of sponsor benefits delivered by TR*Labs* are:

Industry	University	Government
10:1 leverage	3 additional professors	2:1 leverage
6 patents awarded	1 NSERC Chair	1 spin off company
6 patents pending	2 sabbaticals	11 professionals relocated
10 professionals trained	over 100 research papers	economic development
10 TRLabs grads hired	20 Masters/Doctoral grads	visibility
many technical ideas	50 undergrads	role model

Networking and collaboration with industry and institutions is a key corporate priority. The list of sponsors now includes AGT Ltd., Bell-Northern Research, Digital Equipment, ED TEL, LSI Logic, NovAtel, SaskTel, TR Technologies Inc., the universities of Alberta, Calgary, and Saskatchewan, the governments of Alberta, Saskatchewan, and Canada. Strategic alliances have been formed with Telecom Canada, Alberta Microelectronics Centre, The Laser Institute, Electronics Test Centre, Alberta Research Council, Solid State Optoelectronics Consortium, Canadian Institute for Teleommunications Research, Communications Research Centre, Telecommunications Research Institute of Ontario and Vision 2000.