Communications Canada

USE OF INFORMATION TECHNOLOGY IN EDUCATION AND TRAINING

TECHNOLOGY, POLICY AND PLANNING BRANCH

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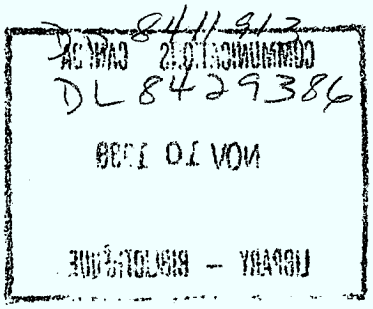

EXECUTIVE SUMMARY

1. INTRODUCTION

The rapid changes in the use of technologies in daily life are changing the skills needed to function satisfactorily in modern economy. In the industrialized world, it has been estimated that over the coming five years, four out of five people will be doing work differently from the way it has been performed in the previous fifty years. The requirement for an increasingly sophisticated workforce will present Canada with growing requirements for improved education and training opportunities. According to a recent report issued by the Canadian Manufacturer's Association:7

> "The pressure of international competition and the need for rising levels of productivity and innovation will only increase in the coming years. The established and newly industrialized countries will expand their output and the impact of new technologies will be felt in the production of an ever-wider range of goods and services. Canadian manufacturers must be able to keep pace with a global economy that is information-based and driven by the convergence of computers and communications. Knowledge has become the primary material in the merging world economy. Hence, Canada's universities and community colleges are as much primary producers as the nation's farms, mines, or fisheries."

At the same time that demands in education and training are increasing, there has been a parallel growth in the power and sophistication of information technologies. Canada has been in the forefront in the use of these technologies in education and training. **This report is meant as a background document giving some of the basic facts and figures on the current status of the use of information technologies in education and training.**

2. EDUCATION AND TRAINING ACTIVITY IN CANADA

Canada currently enjoys one of the best educational systems in the world. **At any given time, close to 30% of all Canadians are enrolled in formal education institutions.** This does not include a large number of adult Canadians who regularly undertake non-formal industrial training. In terms of Gross National Product, the Canadian Government spends a greater portion on formal education than any other Western Government. **Canadian public sector expenditures on education are about 8% of GNP compared to 6.7% for the U.S., 6.2% for the U.K. and 3.5% for France.**

Since 1971-72, spending on education in Canada has increased from $8 billion in 1971-72 to $35 billion in 1986. The elementary and secondary levels account for 64% of total spending and the post-secondary level 29%. Close to 91% of the education bill is paid for by the three levels of government, the rest comes from fees, donations and other sources. The share of the federal government in 1986-87 was about 8%. This federal share does not reflect the various transfer payments made for post-secondary education, minority language programs, Canadian studies program, and vocational training. If this amount had been reported, the federal governments' share would be approximately 21%, and the provincial share would be reduced accordingly.

In 1986, approximately 5 million students were enrolled in elementary and secondary schools, a 16% drop from all-time high of 5.8 million in 1970. Since that year, elementary and secondary enrolment has fallen steadily. However, the rate of decline is levelling off. While elementary and secondary enrolment was declining, full-time post-secondary enrolment was increasing steadily from .5 million students in 1970 to approximately .8 million students in 1986, for an increase of 60%. More than half of these are in university undergraduate programs (52%), about 41% were in community colleges and the remaining 7% were enrolled in university graduate studies.

One of the more dramatic trends in Canadian education has been the growth of part-time university enrolment. Overall, in the last two decades, part-time university enrolment increased by almost 300%, from 73,000 in 1965 to 285,000 in 1985. In the same period, total full-time enrolment increased by only 129%. As a result of these different growth rates, part-time students made up 38% of the total university population in 1985, up from 26% in 1965. The most common reason people choose to study part-time versus full-time is to enable them to continue working while they study. Personal or family responsibility is the second most important reason for choosing to study part-time, particularly for women.

Although the authority and responsibility for the organization and conduct of education falls within the jurisdiction of provincial and territorial governments, the federal government is continuously involved in educational policies. Its concerns include maintaining equity in the quality of education from region to region; improving accessibility to educational services for all Canadians; protecting the educational rights of official language minorities; supporting excellence in research and instruction through the provision of grants and fellowships; assisting new immigrants through education-related services, and maintaining and enhancing regional and national heritages.

In addition to $35 billion spent on formal education, an estimated $5 billion are spent annually in employee training programs by government and industry. While 80% of firms with more than 200 employees conduct formal training, only 20% of the firms with less than 20 employees do so. The majority of the firms undertake both formal and informal training in order to cope with continuing technological changes.

3. THE ROLE OF INFORMATION TECHNOLOGIES

Although traditional classroom and printed books remain the primary method of education and training, the evolution of information and communications technologies has increased the potential for providing education to those who would otherwise not have access to educational resources. For example, the concept of distance education has been discussed in Canada for nearly a century, but only with the recent integration of technologies into education have the possibilities for learning at a distance become so comprehensive, credible and popular.

Information technologies, which include both communications and computer technologies, will have two principal contributions:

- **extending the geographical reach of education and training; and**
- **providing opportunity for innovative training programs through personal instruction using an extremely powerful electronic medium.**

The following technologies are discussed in this report: radio and audio-cassettes, television and videotapes, satellites, computers, teleconferencing, videotex/telidon, videodisc and CD-ROM and artificial intelligence.

Teachers and instructors use these technologies to introduce, review, enrich, or summarize a lesson, and to direct students to pertinent materials, individually or in small groups. These activities stimulate student interest, expose them to situations outside their experience, present new information and concepts, encourage participation in related activities, and foster the exchange of ideas.

Technology has played an important role in the recent expansion of distance learning programs in Canada. Many colleges and universities use one or more of the technologies to support or partially replace print materials and to provide opportunities for personal contact and discussion.

The hardware developments over the past 50 years in communications and information technologies are impressive, but their applications in education have often produced less dramatic results

than anticipated. Identifying the most successful experiences and the reasons for their success is instructive. Both in distance education and in classroom instruction, the most exciting applications of technology occur when experiences are offered that attract adult learners with new types of learning opportunities, that foster students' development of concepts and understanding, or that tailor education to suit the needs and styles of individual learners. But using technology to create learning situations like these is a challenging, time consuming, costly process. The importance of developing quality software based on sound educational techniques cannot be over emphasized.

For people in communities far from post-secondary institutions or people who find traditional teaching methods ineffective or unappealing, technology holds great promise. The ability of technology both to enhance traditional teaching and to extend learning opportunities seems substantial. Developments in educational technology may eventually alter our basic approaches to education and the organization of educational activities.

Additional developments in hardware and educational software can be expected. Combining several technologies to develop new learning experiences is beginning - for example, in the integration of videodiscs and computers and in satellite transmission and telephone communication. Expected developments such as voice recognition and speech synthesis, expert systems, and artificial intelligence may provide new capabilities for educational use.

4. USERS OF INFORMATION TECHNOLOGIES IN EDUCATION AND TRAINING

A number of initiatives have been taken within the various Federal Government departments with regard to the use of computer in providing training. Those with commitment to CBT (computer Based Training) include: National Defence, Canada Post, Revenue Canada, Taxation, Supply and Services and Transport Canada. Many others are conducting pilot projects and studies to evaluate the potential for utilization. These include: CIDA, Environment Canada, External Affairs and the RCMP.

There are several provincial government involvements with the use of computers in training. The Ontario Ministry of Education is involved in developing computer based education material. They sponsored the development of the ICON, a specialized educational microcomputer. Over the past few years, they have funded courseware including the development of several videodisc based sample courses. Edmonton police officers are required to take 2 week refresher courses every five years. This was replaced by CBT in 1983. PLATO was used to develop the required software. City estimates an annual saving of $68,000 due to CBT.

In the field of commercial training, the leading users of CAL (computer aided learning) are the computer companies themselves. For example, most of IBM's training of customer engineers is now delivered in this way. CAL is extensively used in training people in data processing skills. The next largest users of CAL are those who make extensive use of microelectronics equipment, notably the telecommunications industry. For example, Bell Canada delivers all its digital switching systems training through the medium of CAL. Outside this group of firms CAL is found in large organizations which have well developed training departments and are aware of the cost of conventional training. For example, Air Canada uses computer based control panel simulators for training pilots. Ontario Hydro uses CBT to supplement traditional training for nuclear power plant operators. American Motors and General Motors both use CAL for training in industrial automation. Esso uses computer based simulator to train personnel in oil spill recovery.

There are some 70 institutions which offer distance learning education and training, aimed at people who cannot attend an institution either because they cannot find time due to family and work obligation or they live in rural or remote areas where access to an institution is not very convenient. In addition, most universities and community colleges have what are called extension divisions or continuing education divisions. Communications and computer technologies are natural for distant learning.

5. THE INSTRUCTIONAL TECHNOLOGIES MARKETPLACE

Compared to the annual expenditures of $35 billion on formal education and $5 billion on institutional training (industry and government), the expenditures involved with the use of these technologies in education are probably rather insignificant. However, with the convergence of communications and computers (CD-ROM, interactive videodisc, interactive television), communication technologies are expected to play an important role in education and training over the future years.

Of the total software sales of $1400 million in 1984, the educational software accounted for $7.3 million, or .4% of total software sales. Nevertheless, the Canadian courseware market for 1990 is forecasted at $55 million, which will represent 1.6% of the estimated total software market of $3400 million.

The courseware suppliers are constrained in exploiting the full market potential because of market fragmentation due to language of instruction, incompatible hardware configuration and different jurisdictional standards in various provinces.

In view of the above noted market forces, it is not surprising that the Canadian industry for instructional technologies is not large.

Nevertheless, there are a number of firms which have developed notable products and services in this area. In addition, the capabilities of Canadian telecommunications carriers and broadcasters also play an important role in the provision of quality educational and training opportunities for all Canadians.

6. SUPPLIERS OF INSTRUCTIONAL TECHNOLOGIES AND PRODUCTS

Computer hardware manufacturers are the dominant suppliers of Computer Aided Learning (CAL) products, both hardware and software. Most of the major companies have developed authoring systems, presumably at least initially for the purpose of promoting sales of their own hardware. IBM developed IIPS (Interactive Instructional Presentation System), CDC developed PLATO, DEC developed RENAISSANCE, Wicat developed WISE, Burrough developed THE AUTHOR and Hazeltine Corp. developed TICCIT. Originally these were mainframe systems tied to the equipment of the company marketing them. However, the large scale introduction of microcomputers has resulted in the development of microversions of some of these systems such as micro PLATO, micro TICCIT, and IBM's PCIS. For the most part, these authoring systems are intended to enable companies to develop their own in-house capability. Some of these companies develop special purpose courseware for their clients and some like CDC's PLATO have extensive "off-the-shelf" courseware.

The next group of CAL producers are the software developers (e.g. Logidisque, Force Ten, CAPA) who have added computer-based training to their product lines. Most of the work they do is custom courseware development. Firms which specialize in training consulting have also begun to be involved in CAL. Examples are the Training Group, Microtel Learning Services, General Cybernetics. While all of these provide consulting services in CAL, some also supply training systems. For example, Microtel Learning Services supplies TICCIT authoring systems.

Publishing houses are another group involved in CAL as an adjunct to publishing books. Softwords, a consulting company in CAL, is a division of Press Porcepic of Victoria. McGraw Hill has developed its interactive authoring system to assist in the process, which most publishing houses adopt, of subcontracting courseware development.

Finally, there are many small firms which are dedicated entirely to the production of courseware packages. Most of these have been nurtured through various government programmes.

7. EXISTING GOVERNMENT ASSISTANCE PROGRAMS AND POLICIES

Of the $35 billion spent on formal education, over 90% is funded by various levels of governments. Government departments and ministries are responsible for the organization and administration of educational institutions and have, therefore, been always involved with the introduction of new technologies in the educational system.

There are at least 70 institutions in Canada, which offer distance learning education and training. The majority of these institutions are funded by provincial grants of one kind or another. Up to approximately $155 million is spent by the provincial governments on the distant learning divisions of these organizations. These expenditures are distributed as follows:

Of the $155 million, approximately $109 million is spent by the provincial educational broadcasting organizations:

Knowledge Network of the West (KNOW), B.C.	:	$ 3 million
Access Alberta, Alberta	:	$16 million
TV Ontario, Ontario	:	$30 million
Radio Quebec, Quebec	:	$60 million
		$109 million

Approximately $34 million is granted to institutions which are devoted entirely to distance learning.

Open Learning Institute of B.C.	:	$ 7 million
Athabasca University, Alberta	:	$14 million
Teleuniversité, Quebec	:	$13 million
		$34 million

It is to be noted that only a small portion (5% or so) of this $30 million is spent on information technologies.

The remaining $12 million or so is spent by the Continuing Education Divisions of various Universities and Colleges. This $12 million is, of course, in addition to regular university funding of their Continuing Education Divisions. Again, only a small portion of this $12 million is spent on communications technologies.

In the areas of computer related technologies provincial education ministries have also established projects of one kind or another to help spread its use in education. The following discusses some of these programs.

The Ontario Ministry of Education issued functional requirements for microcomputers for use in Ontario schools in March, 1983. Products meeting these requirements are eligible for a grant of 75%, when purchased by a school board. The first system to be approved was developed by CEMCorp. (Canadian Educational Microcomputer Corp., a Consortium of 50 Canadian Companies) in February 1984. The Ministry provided CEMCorp. a contract guaranteeing purchase of $10 million worth of computers meeting its specifications. The computer known as ICON is now marketed and serviced by Burrough Canada and as of April 1, 1987, 12,000 of these systems were available at 1500 sites. There are currently 100,000 microcomputers of all kinds in Ontario schools with an average purchase price of $1500. Working closely with industry, the

Ministry has funded the development of 120 pieces of educational software so far under its $6 million /year program. Approximately 35-40 new programmes are funded each year. Over 65 Canadian companies in 4 provinces are involved in developing the software.

In order to help spread the use of computers in schools, the Educational Technology Program of the Department of Industry, the Trade and Technology of Manitoba brought together 8 major partners and an increasing number of other private companies to establish an industry-government Computer Resource Centre called Infotech Resource Centre. Apple, Burrough (ICON), Commodore, Cybershare, Epson, IBM, Sperry and Tandy as major industry participants have committed in excess of $4.3 million in support of a three year base program. The companies provide hardware, software, technical support, master purchasing agreements, and an array of projects to advance the use of these technologies in the schools. The centre is housed in a 33,000 sq ft facility which opened its doors in September, 1985.

The Ministry of Education of Alberta established in October, 1981, what is called "Computer Technology Project", with a full-time staff of 7 people. The Ministry standardized on Apple II+. It acts as a software clearinghouse and evaluates courseware (mainly Apple II+) for recommendation to schools. To date, it has evaluated some 2000 pieces of courseware and has recommended 200 for use in Alberta.

8. DOC'S ROLE AND INITIATIVES

The Department of Communications has been connected with the development and applications of educational technologies in a number of ways including the following initiatives:

1) Satellite Projects

2) Telidon Videotex/Teletext Applications to Education

3) Educational Systems Technology Branch

4) Membership in the Associate Committee on Instructional Technology of NRC

5) Association of Courseware Developers.

6) ANTEM

7 Distance Education Networks

Satellite Projects

The Hermes and Anik B Satellite programs of the Department of Communications provided opportunities for many educational institutions

for experimentation and field trials. Over 100 large and small projects were carried out over the last ten years. Knowledge Networks of the West, Access Alberta, TV Ontario, Quebec Department of Education and Memorial University in Newfoundland are some of the better known institutions which undertook these trials.

Telidon Videotex/Teletext Applications to Education

Telidon was publicly demonstrated on August 15, 1978, when the Department announced the second generation alphageometric Picture Description Instructions protocols, which came to be called "Telidon", an advance on the first-generation British "Viedata" and French "Antiope" alphamosaic systems. DOC supported a six year two-phase program of research and development, field and market trials, and content development.

Following are some of the institutions which explored the potential of Telidon for educational applications. In many cases, these applications were sponsored by the Department.

Open Learning Institute, Vancouver
Access Alberta
Athabasca University
Manitoba Educational Telidon Association
Manitoba Telephone System
TV Ontario
Université du Québec à Montréal
Télé-Université, Université du Québec, Quebec
University of Moncton, Faculty of Arts
University of Prince Edward Island, Charlottetown

Educational Systems Technology Planning Branch

An Educational Technology Branch within the Department of Communications was created in 1973.

In 1975, the Branch produced a set of reports dealing with various educational technologies such as computer learning and videodisc and developed educational technology ("ed-tech") projects in Universities in several provinces. It appears that cooperation with the provinces was achieved. It also appears that lack of funds and/or federal-provincial politics intervened, as the Branch was dissolved shortly after the publication of this set of reports.

The Associate Committee on Instructional Technology

The Associate Committee on Instructional Technology was formed by the National Research Council of Canada in 1969. The Department of Communications has been one of its active members as well as a member of its subcommittee one the development of a Canadian Courseware Industry. The specific objectives of this committee are as follows:

1) To bring together specialists from the various disciplines involved in the field of instructional technology, in order to formulate requirements and establish guidelines for research and development.

2) To promote interchange of information on instructional technology as, for example, through the organization of symposia.

3) To promote and coordinate relevant research, development and application with the aim of establishing a strong, Canadian-based capability.

4) To encourage standardization of technology for instructional systems sufficient to foster the widest interchange and application of instructional material.

Association of Courseware Developers

The Department provided logistical and financial support for the organization of the national colloquium on courseware in Montreal held in 1987 and was instrumental in the creation of the association of the courseware developers.

ANTEM

The aim of this project is to encourage collaboration between teams in various countries (Canada, France, Italy, Great Britain, etc) that wish to apply technology more successfully to education,vocational training and culture through sharing of information, expertise, resources and recent innovations. The Department has been instrumental in setting up this project. The ANTEM working group sponsored a number of meetings, workshops and conferences in each of the member countries. As a result of these meetings, a number of collaborative projects are being pursued.

Distance Education Network

On October 17, 1987, the Honourable Flora MacDonald, Minister of Communications announced the creation of a distance education network for the Commonwealth countries, with the central coordinating unit to be located in Vancouver.

Canada and Bristish Comlumbia will provide as much as $12 million for up to one-half of the network's facilities and operating costs for the first five years.

The establishment in Canada of the International Francophone Center for Distance Education was announced at the Francophone Summit held in Quebec in September 1987.

9. ISSUES

Educators and employers have used information technologies to augment traditional methods to meet the growing requirements for training. Although there have been several successes, they are relatively few and far between. Reasons for the lack of adoption are complex and not well understood. This section summarizes some of the courseware related issues.

Market Fragmentation

Since the Canadian market is already small compared to, for example, the U.S. market and is further fragmented along many lines (language, provincial boundaries and hardware configuration), it is very hard for a courseware developer to recover his costs from the Canadian market alone. Thus, any strategy which could minimize market fragmentation would be beneficial.

Canadian Content

Almost 90% of the courseware used in our schools come from the U.S. This raises serious problems from the cultural point of view. Like other, more traditional educational materials, computer-assisted learning and related materials will not enhance Canadian social and cultural development and will not produce appropriate responses to Canadian problems unless they have been produced specifically for this country. In particular, Canadian databases must be available to Canadian classrooms so that people doing their own computer-aided research can do so on the basis of Canadian data; and computer courseware must reflect Canadian conditions, history and personalities in order to enhance the Canadian identity of learners. Government has an obvious concern in correcting this situation.

French Language Software

In addition to the problems mentioned above, the development of French language courseware is further constrained by lack of authoring tools available in the French language. In the case of English language, a number of authoring tools have been developed for the U.S. market and these can be imported easily for use in the development of English language courseware.

Research and Development

There is little doubt that R&D is essential to the development of Canadian CAL products. Research is needed in areas such as intelligent response, natural language interfaces, video and sound integration. Most Canadian companies are too small to undertake such research in any significant manner. Thus, there is an obvious need for some kind of government action.

Market Research

While the requirement can be demonstrated for CAL and other relevant technologies in industrial and government training, the full extent of the possible applications of these technologies is far from being well defined. A great deal of market research needs to be done to confirm that : a) a sufficient market really exists for commercial CAL and other technologies and b) exactly what is required by the market and how it can be provided.

Individual Canadian companies are too small to afford such a comprehensive market research. This could, therefore, be an area where federal government could have a useful contribution, not just in exploring the national market but exploring the international market as well for export opportunities.

Applications Demonstrations

CAL is a promising technology and it would appear that it could benefit from some initial nurturing from government in way of supporting the development and demonstration of some good applications in the private and/or government sectors.

Use of CAL Within Federal Government

As the largest employer in Canada, the federal government has major requirements for retraining. CAL will be an important component of the required training facilities. A coordinated approach to the application of CAL within federal government departments and agencies will be a vital factor in the successful development of a Canadian CAL capability that will respond to needs of both government and industry.

Information Clearing House

Although CAL and other instructional technologies have been around since the 1960s, the industry is still very young. There are many small companies involved in the development and distribution of courseware. Most provincial ministries are involved in one way or another. Various departments of federal governments are also involved with various aspects of this technology. For example, NRC has long been involved with research and development. Other departments such as DND, Employment and Immigration and Correctional Services have been the major users of these technologies. Since the industry is still young and there are many players involved, many feel the necessity of some kind of coordinating unit which would also act as a clearing house for information on various aspects of CAL.

Need for Leadership

Since education is essentially a provincial responsibility, most provincial governments have programs and policies of one kind or another aimed at encouraging the use of CAL and others related technologies. There are many companies involved in the development and distribution of CAL products. These are mostly small companies. Various departments of federal governments are involved in various capacities. It appears that the responsibility for the development and exploitation of this potentially powerful technology is too diffused and fragmented and there is no single focal point. Many feel the need for a leadership and think it should be provided by the federal government. What exactly should be the nature of such leadership if it indeed should be provided by the federal government?

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CHAPTER I: INTRODUCTION

1. INTRODUCTION

Canada was one of the first countries to recognize the potential of telecommunications technologies for education and training. In 1969, an order in Council was passed, opening the way to the establishment of educational broadcasting authorities in all regions of Canada. The success of such services as TV Ontario, the Knowledge Network in British Columbia, Access Alberta and Radio Quebec, attest to the effectiveness of applying broadcasting technologies to extend the training resources of large centres to smaller communities in an efficient and effective manner.

As a result of these efforts, Canada has achieved world recognition in the development and application of instructional technologies. In 1986, the Commonwealth Secretariat asked Canada to take the lead role in examining the feasibility of a Commonwealth distance learning project. In the same year, at the Summit of Francophone countries, Canada was requested to provide guidance and to set the example in the use of communications and information technologies to meet national educational and training needs.

Heightened international interest in instructional technologies has grown out of the rapid restructuring of world economies which are changing skill requirements in both developed and developing countries. In the industrialized world, it has been estimated that **over the coming five years, four out of five people will be doing work differently from the way it has been performed in the previous fifty.** The requirement for an increasingly sophisticated workforce will present Canada with many challenges. The importance of re-training and skill upgrading is demonstrated by the fact that the annual expenditures of Canadian industry and government for staff training is estimated at $5 billion, or 16% of our national expenditure for formal education. **According to a recent report issued by the Canadian Manufacturer's Association:**7

> "The pressure of international competition and the need for rising levels of productivity and innovation will only increase in the coming years. The established and newly industrialized countries will expand their output and the impact of new technologies will be felt in the production of an ever-wider range of goods and services. Canadian manufacturers must be able to keep pace with a global economy that is information-based and driven by the convergence of computers and communications. Knowledge has become the primary material in the merging world economy. Hence, Canada's universities and community colleges are as much primary producers as the nation's farms, mines, or fisheries.
>
> Our country's system of higher education can be the basis of a powerful competitive advantage. But to realize their full

potential, our post-secondary institutions require additional government support and stronger ties with business.

Canada's educational and training institutions do not yet measure up to the task set for them. In part, the problem is scarce funds. Facilities and equipment are inadequate. Well-trained faculty in key fields such as engineering are in short supply. And in certain critical areas, such as scientific research, Canada simply does not produce enough qualified individuals".

The importance of human resources is also emphasized in another recent report done by the Canadian Association for Adult Education:[8]

"At present, Western economies are undergoing rapid structural changes. The combined effects of recent technological breakthroughs in micro-electronics and telecommunications have created an information economy. As a result, human resource investments are increasingly viewed as critical to the whole process a economic development. In the future, a nation's competitiveness in the world market will depend on the quality of its human resources -- knowledge, learning, information and skilled intelligence.

A number of observers have noted the comparatively sluggish pace of change in the composition of the Canadian economy away from slow gowth, mature industries toward faster growing industries such as the high technology sector. As well, there are signs that technological innovations spread more slowly among our manufacturing industries than in countries with which we compete for world markets. This has been attributed by some to our tendency to import research and development applications from abroad, but others look to our human resources for an explanation of this lag.

Because Canada is an aging society, the contribution to the labour force of new entrants will decline by more than 25% over the next decade. This means that future labour market demand for skilled labour will depend less upon new entrants, and rely more heavily on the recurrent education of the adult work force -- this at a time when the useful duration of specific work skills is shortening owing to the accelerated pace of technological change.

In order to meet the challenges of an information economy, Canada is faced with the task of developing a dual approach to industrial policy: increasing investment in technology and research, while at the same time improving the training and

adaptability of the labour force. As a result, greater attention is now focussing upon education and training as an economic instrument to increase labour market flexibility.

But, as the OECD recently pointed out, providing more opportunities for education and training by public and private action is not enough. Policy-makers, educators and citizens alike will have to learn the importance of making education and training accessible in alternation with work throughout the whole cycle of an individual's working life. OECD has suggested to western governments that the focus of attention should shift to recurrent education as an organizing model for a learning society -- as a norm, rather than an exception in educational delivery. In the words of McLuhan: "The future of work will consist in learning a living".

At an international level, interest in the recurrent education and training of the working population is increasing among employers who are seeking to position themselves for effective responses to these structural changes. As they seek to enhance the futue adaptability of their employees, these employers' concern for the capacity of their workforces to learn and adjust rises accordingly. Changing modes of production have also blurred the distinction between intellectual and manual labour, thereby increasing the economic importance of training for working people."

The same message comes through in yet another recent report done by the Canadian Advanced Technology Association:[9]

"The Roundtable activity is premised on the assumption that Canadian society is faced with the challenge of continuous adjustment to rapid industrial evolution.

Increasingly, the pace and directions of industrial change are being driven by a worldwide explosion of innovative activity that is rooted in exploration of the frontiers of scientific and technological knowledge.

The ideas, technologies and product concept flowing out of this inquiry are creating new sources of economic opportunity and employment growth. The use of these new technologies and their rapid diffusion to industries around the world, are changing the nature of international competition. Together, the development and use of new technologies are redefining the attributes for national success in promoting social well-being.

They key to effective adjustment to these new forms of wealth creation and competitive pressure is to recognize that knowledge is becoming the crucial factor in opening avenues for economic and social advance.

> It follows that people have become Canada's most abundant and valuable natural resource: our potential for international market success is being shaped by the attitudes, motivation, skills, orientation and knowledge of individual Canadians.
>
> It is, therefore, of fundamental importance that both formal and informal education and training systems equip our citizens with the abilities to immerse Canada in the front edge of technology development and use".

At the same time that demands for education and training are increasing, there has been a parrallel growth in the power and sophistication of communication technology. Teleconferencing techniques using satellites and computers can allow students to participate in classroom dialogue while separated over great physical distances. Interactive software on optical discs, which permits students to tailor training to their particular needs, are making it possible to offer individual attention to each and every student. On-line access to powerful computer simulation models can provide students with valuable opportunities to practice and develop new skills. These and other applications of communications and information technologies are playing an important role in shaping Canada's educational and training infrastructure.

Operational trials carried out over the last decade using communications and information technologies to meet specific training needs have demonstrated their effectiveness in providing quality educational services. However, these experiences also showed that technological excellence alone is not sufficient to ensure its rapid adoption to meet Canadian needs. The development of educational software reflecting distinctive Canadian needs, for example, has been slow to develop because of our small market size. Faced with these constraints, it is essential that we develop a national approach to encourage swifter and more effective utilization of new technologies to meet Canada's education and training needs.

This report is meant as a background document giving some of the basic facts and figures on the current status of the use of information and communications technologies in education and training. Including the current introductory chapter, the report consists of 5 chapters.

Chapter 2 gives a brief account of the education and training activity in Canada. For example, the total expenditures on the formal education sector in Canada in 1986-87 were $35 billion or 7.3% of the Gross National Product and the institutional training expenditures have been estimated to be as high as $5 billion.

Chapter 3 gives a brief description and typical applications of various information and communications technologies used in education and training. The technologies included in this chapter are: radio, audio-cassettes, television, videotapes, computers, satellites, teleconferencing, videodiscs, CD-ROMs and artificial intelligence. The applications discussed include the following user groups: Federal Government Departments, Provincial Governments, Private Industry, Academic Institutions and other Distance Learning Institutions such as TV Ontario and Knowledge Network of the West.

Chapter 4 discusses the current and projected market size for various information technologies. For example, the market for Computer Aided Learning (CAL) software packages is expected to grow from $7 million in 1984 to $55 million in 1990. It also discusses various suppliers of information technologies. The suppliers are grouped into the following categories: computer hardware manufacturers, software developers, publishing houses, telephone companies, broadcasters, satellite operators and other independent suppliers.

Chapter 5 outlines various government programs and policies concerning the use of communications and information technologies in education and training. For example, the chapter includes a discussion of programs of various provincial ministries of education to help spread the use of computer technology in schools. It also outlines the Department of Communications' involvement with the use of communications and information technologies in education and training. For example, it includes a discussion of satellite educational field trials, Telidon educational applications trials and a discussion of the Educational Technology Branch which existed within the Department in mid-seventies.

Chapter 6 discusses some of the issues related to the development and use of CAL and other information technologies in education and training. These include market fragmentation, lack of Canadian content, lack of French-language authoring tools, need for R&D, market research, application programs, government purchase policies, need for an information coordinating and clearing house and finally the need for leadership.

CHAPTER II: EDUCATION AND TRAINING ACTIVITY IN CANADA

1. INTRODUCTION

At any given time, almost 30 percent of all Canadians are enrolled in formal educational institutions. This does not include a large number of adult Canadians who regularly undertake non-formal and industrial training. In terms of Gross National Product (GNP), Canadian government spends a greater proportion on formal education than any other Western government. Canadian public sector expenditures on education are about 8% of GNP compared to 6.7% for the U.S., 6.2% for the U.K. and 3.5% for France.

Implementation of compulsory school attendance laws early in the century has meant that virtually all Canadians now devote at least ten years of their lives to formal education. Furthermore, increasing social and technological complexity have made it necessary for many to remain in school well beyond compulsory age. In fact, to progress from Junior Kindergarten to PH.D. completion takes about two decades - and schooling does not stop then. The recent upsurge in continuing education, whether it entails refreshing old skills, learning new ones or taking courses out of interest, indicates that education is a life-long process. It is not surprising that many Canadians consider education and training as two of the most important activities in their lives.

This Chapter gives a brief overview of education and training activities in Canada.

2. EDUCATION

2.1 Spending

Since 1971-72, spending on education in Canada has risen steadily from $8 billion to $35 billion in 1986-87, representing 7.3 percent of Gross National Product, or 16 percent of the total government expenditures, or $1304 per capita, or $2616 for each person in the labour force, or $4100 per student.

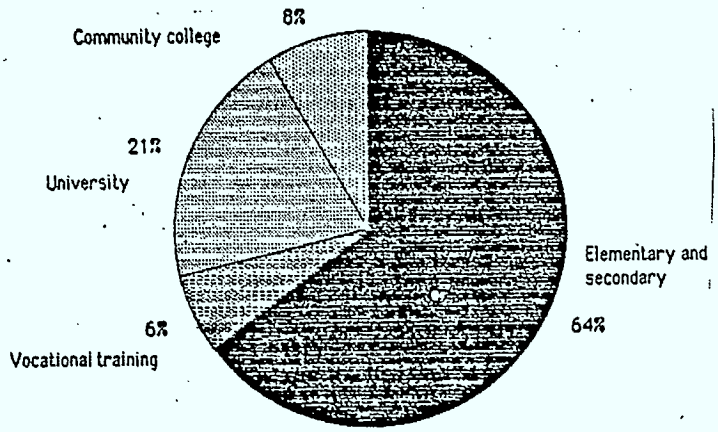
The elementary and secondary levels account for 64% of total education spending and the post secondary level 29%. The remaining 6% is spent on vocational training.

Close to 91% of the education bill is paid for by the three levels of government, the rest comes from fees, donations and other sources. The share of federal government in 1986-87 was about 8%. This federal share does not reflect the various transfer payments made for post-secondary education, minority language programs, Canadian

CHART 1

EXPENDITURES FOR EDUCATION

Canada 1986-87

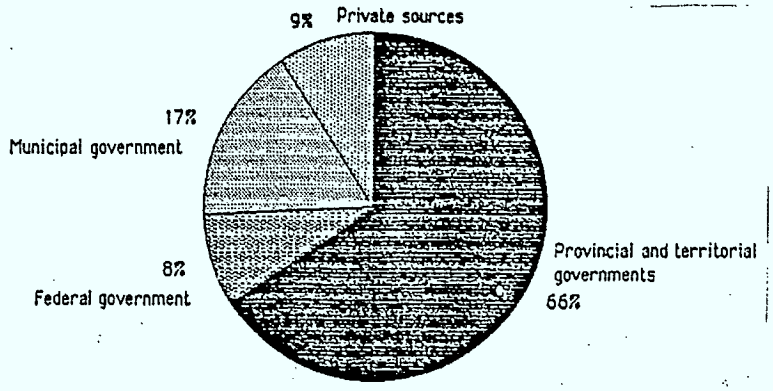


studies program, and vocational training. If this amount had been reported, the federal governments' share would be approximately 21%, and the provincial share would be reduced accordingly.

CHART 2

DIRECT SOURCES OF FUNDS FOR EDUCATION

Canada 1986-87



TOTAL $34,603 MILLION

2.2 Canadian Educational System

Perhaps one of the major obstacles to a clear understanding of Canada's education system is the division of jurisdiction among the

various levels of government. Education is a provincial responsibility, although the federal government operates and administers a limited number of institutions. As a result, ten (twelve if the Yukon and Northwest Territories are counted) separate systems have been created; and even within a single province, variations on the prevalent structure may exist.

In all areas, however, Canadian education is divided into three successive levels: elementary, secondary, and post-secondary.

Elementary education is general and basic. When students reach the secondary level (high school), they usually have a choice of at least two programs: academic and vocational. The academic program consists of courses preparatory to post-secondary education, while vocational programs prepare students either for an occupation or for more advanced specialized studies. At the elementary and secondary levels, at least four types of schools may be distinguished:

1) **Regular public** - established and operated by local authorities according to the public school act of the province;

2) **Federal** - administered directly by the federal government for Canadians overseas and for native people.

3) **Private** - non-sectarian or church-affiliated, operated and administered directly by private individuals or groups; and

4) **Handicapped** - administered directly by provincial governments.

After high school, students may undertake post-secondary training in either a non-university institution (non-degree-granting) or university (degree-granting).

The 192 non-university institutions (collèges d'enseignement général et professionnels, Colleges of Applied Arts and Technology, agricultual colleges, schools of art, etc.) offer career-oriented programs of one to four years duration. Some also provide one- to two-year academic programs after which students may enter university.

Admission to one of Canada's 67 universities is usually contingent upon high school graduation. Undergraduate degree programs (bachelor's) last from three to five years, depending on the entrant's qualifications and the nature of the degree sought (pass or honours). Professional schools begin at different stages, have various entrance requirements, and offer programs of different lengths, usually three to five years. A bachelor's degree at the honours level is normally necessary for acceptance into a master's program. Most entail one year of study, but some master's degrees take two years to complete.

Doctoral studies usually require entrants to have a master's degree in the same field.

Non-university institutions are either operated or supervised by the provincial government. Since most universities receive considerable financial support from the federal and provincial governments, it is difficult to make a distinction between public and private.

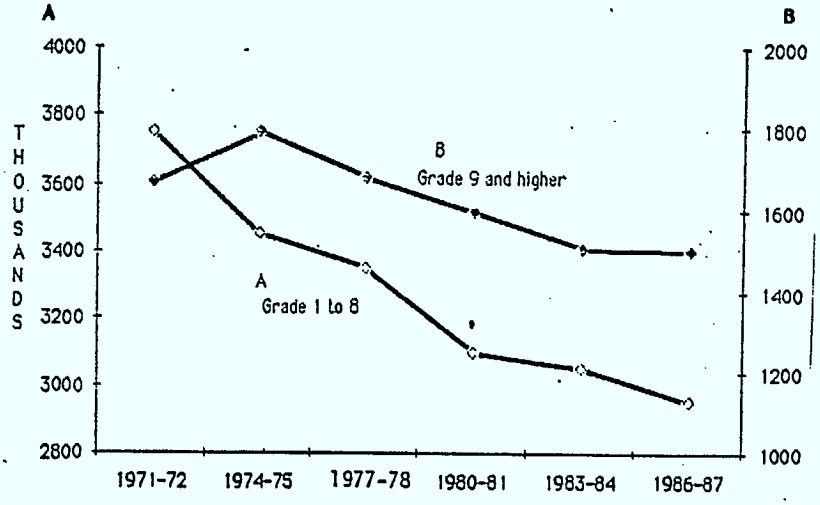
2.3 Enrolment

Elementary - Secondary

In 1986, approximately 5 million students were enrolled in elementary-secondary schools, a 16% drop from the all-time high of 5.8 million in 1970. Since that year, elementary-secondary enrolment has fallen steadily. However, the rate of decline is levelling off.

CHART 3

ELEMENTARY AND SECONDARY ENROLMENT - CANADA

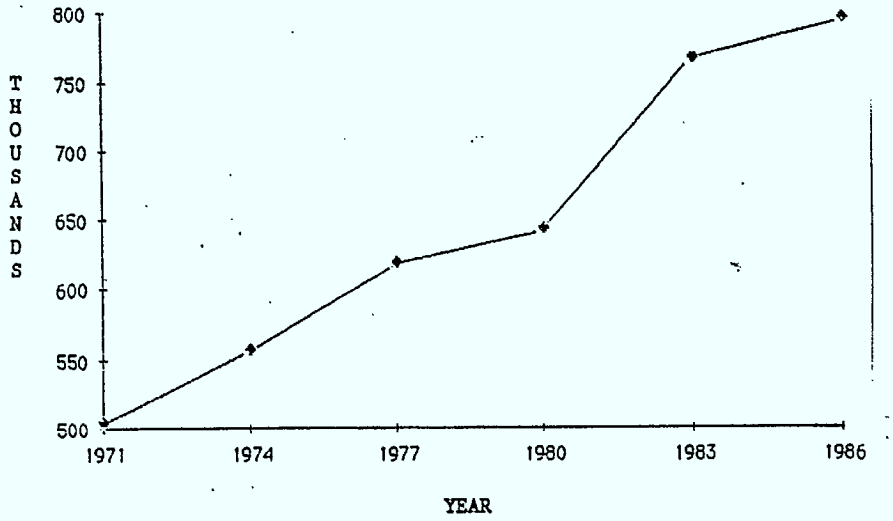


Post-Secondary

While elementary-secondary enrolment was declining, full-time post-secondary enrolment was increasing steadily from .5 million students in 1970 to approximately .8 million students in 1986, for an increase of 60%. More than half of these are in university undergraduate programs (52%), about 41% were in community colleges and the remaining 7% were enrolled in university graduate studies.

CHART 4

FULL-TIME POST-SECONDARY ENROLMENT - CANADA



One of the more dramatic tends in Canadian education has been the growth of part-time university enrolment. Overall, in the last two decades, part-time university enrolment increased by almost 300%, from 73,000 in 1965 to 285,000 in 1985. In the same period, total full-time enrolment increased by only 129%. As a result of these different growth rates, part-time students made up 38% of the total university population in 1985, up from 26% in 1965. The most common reason people choose to study part-time versus full-time is to enable them to continue working while they study. Personal or family responsibility is the second most important reason for choosing to study part-time, particularly for women.

2.4 Jurisdiction and Federal Responsibility in Education

According to our Constitution, the authority and responsibility for the organization and conduct of education falls within the jurisdiction of provincial and territorial governments. Thus, there are 10 provincial and two territorial departments/ministries of education, each of which is responsible for the organization and administration of education at the elementary, secondary and post-secondary levels within its boundaries.

Although there is no federal department of education, the Government of Canada supports education through financial programs. Because the federal government provides funds for certain education-related activities, it tends to have a strong indirect

influence on the conduct of education at the provincial level. Programs funded in recent years include:

- making loans, fellowships, and language grants available to post-secondary students in order to promote equity for less affluent students;
- transferring federal revenues to provinces through a complex funding formula that recognizes provincial priorities, responsibilities, and economic conditions, and that is intended to equalize inter-regional disparities;
- funding the development of social and cultural programs that include the encouragement of minority language students in French or English, and the promotion of Canadian Studies, emphasizing the use of Canadian texts, authors, publishers, and content;
- transferring block grants from federal revenues to provincial revenues of the conduct of post-secondary education;
- granting funds to institutions, businesses, and industries for the development and conduct of selected occupational skill training programs, and to students to assist them with living expenses while they attend such programs;
- funding the various research activities of institutions and individuals in areas related directly and indirectly to educational endeavours; and
- funding citizenship classes and programs in English or French as a second language for recent immigrants.

The federal government, through constitutional authority, is responsible for the education of Canada's native peoples, of the children or armed forces personnel both in Canada and overseas; and of the inmates of federal penitentiaries.

The federal government is continuously involved in educational policies. Its concerns include maintaining equity in the quality of education from region to region; improving accessibility to educational services for all Canadians; protecting the educational rights of official language minorities; supporting excellence in research and instruction through the provision of grants and fellowships; assisting new immigrants through education-related services, and maintaining and enhancing regional and national heritages.

3. TRAINING ACTIVITY IN CANADA

According to International Data Corporation (IDC), a Toronto based consulting firm, Canadian business and government together spend

about $4-5 billion on training each year including salaries and overhead. According to a recent report by CATA (Canadian Advanced Technology Association), we invest 25 hours on in-service training for every 35 hours in the U.S. and 65 hours in Japan.

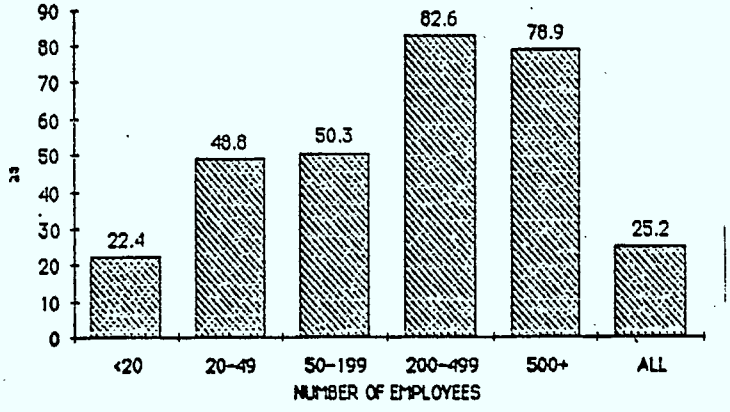
A recent survey carried out by Employment and Immigration Canada, ~~the Canada~~ found that private industry spends about $1 billion for training in addition to $1 billion in lost wages and overheads. The purpose of the survey was to provide information on the nature and extent of formal industry training programs in Canada. The survey was conducted in 1984-85 and involved the responses of 7,652 establishments to a series of questions regarding formal training activity. Approximately 70% of establishments were in the service sector, that is, Transportation, Communication and Other Utilities; Finance, Insurance and Real Estate; Community, Business and Personal Services and Trade. About 7% of firms were classified as belonging to the primary sector and 22.8% of firms to Construction and Manufacturing. The following observations are based on the results of this survey.

3.1 Incidence of Training

As expected, **larger firms, as measured by the number of employees had a much higher incidence of training programs than did smaller firms.** While approximately 80% of firms with 200+ employees conducted formal training programs, only about 20% of firms with fewer than 20 employees did so. Firm size and incidence of training would, therefore, appear to be closely correlated. While only 25% of establishments surveyed did conduct formal training programs, this reflects the large proportion of small firms (that is less than 20 employees) in this survey.

CHART 5

INCIDENCE OF TRAINING BY FIRM SIZE

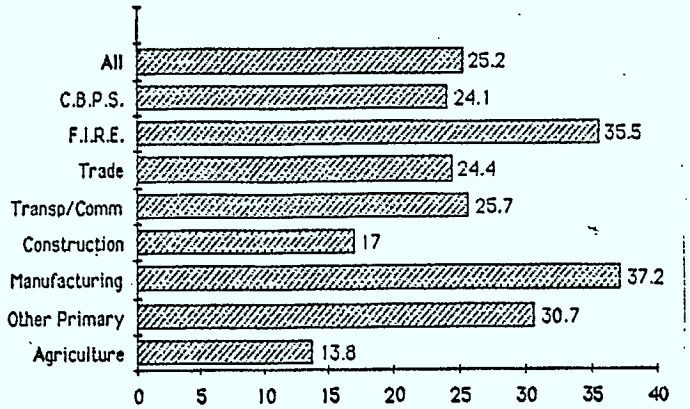


Establishments in the manufacturing sector held the highest incidence of training, with 37% of respondents operating training programs as compared with an overall rate of 25%. The Finance Insurance and Real Estate sector also reported a higher than average number of training programs, with an incidence rate 36%.

Employees in managerial and professional/technical occupations were more likely to receive formal training than were employees in

CHART 6

INCIDENCE OF TRAINING BY INDUSTRY



F.I.R.E. - Finance Insurancnce & Real Estate
C.B.P.S. - Community Business & Personal Services

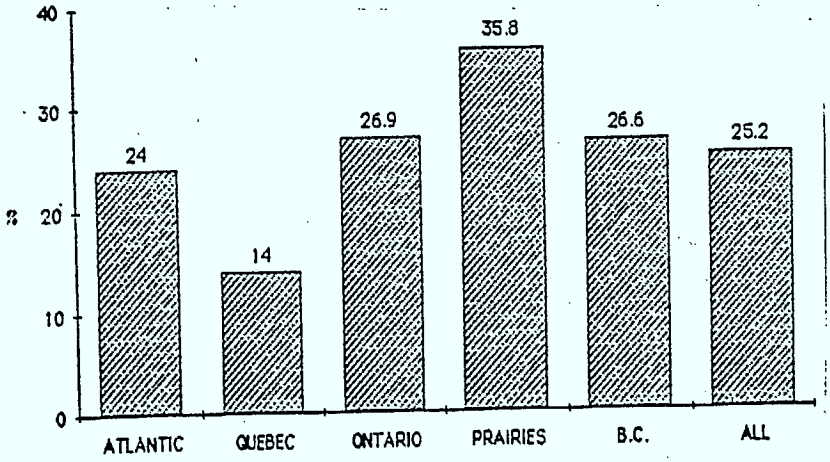
other occupations. Relatively few employees in construction and transportation trades received formal training by respondent establishments.

The Prairies had the highest incidence of formal training programs, with 35.8% of respondents operating such programs. Ontario and British Columbia firms also reported a higher than average percentage of training programs, with an incidence rate of 26.9% and 26.6% respectively. In contrast, establishments in Quebec had the lowest number of training programs, reporting an incidence rate of only 14.0%, compared to 25.2% for all of Canada.

CHART 7

INCIDENCE OF TRAINING BY REGION

PER CENT DISTRIBUTION



3.2 Training Budgets

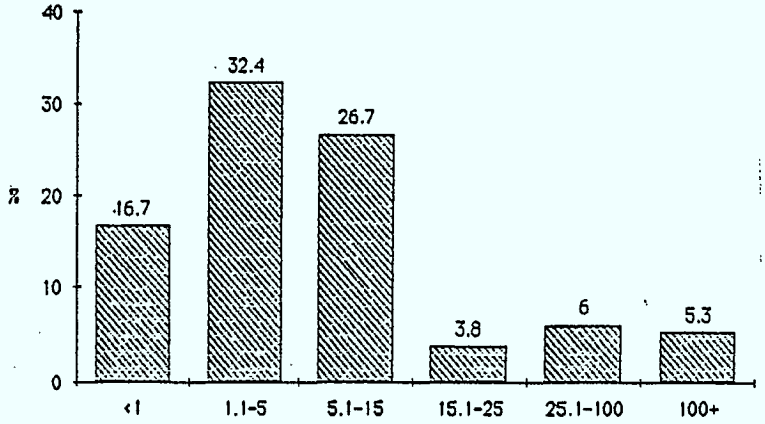
Of the firms having training programs, the majority (76%) spent less than $15,000 on training programs in 1984. Only 15% spent over $15,000, the remaining 9% did not specify any training expenditure.

As might be expected, firms with fewer than 50 employees spent significantly less on training programs than did firms with over 200 employees. Therefore, while 94% of firms with fewer than 50 employees had training budgets of less than $15,000, 80% of firms with more than 200 employees had training budgets of more than $25,000. However, in terms of per employee, larger firms (over 500 employees) spent less per trainee than did small firms, probably due to economies of scale.

CHART 8

TRAINING BUDGET

PER CENT DISTRIBUTION BY THOUSANDS OF CURRENT DOLLARS (1984)



* INCLUDES FUNDING BY ALL LEVELS OF GOVERNMENT

3.3 Training for Technological Change

The majority of the firms responded to technological change through the use of formal and informal training of employees. This was true of both office and production employees. However, production employees were more likely to be transferred or laid-off in response to technological change than were office employees.

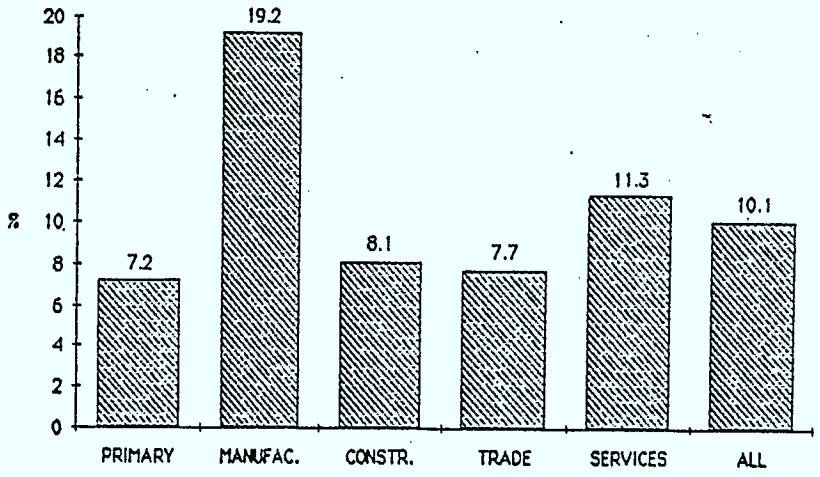
Of all firms responding to the survey, approximately 10% had made staffing changes (training, laying off, attrition loss). Larger firms made more staffing changes than smaller firms. While 53% of firms with 500+ employees instituted staffing changes in response to technological change, only 7% of firms with fewer than 20 employees did so.

The manufacturing industry was particularly affected by new technology, with 19% of firms in the sector instituting staffing changes.

CHART 9

CHANGE IN STAFFING DUE TO TECHNOLOGICAL CHANGE

PER CENT DISTRIBUTION BY INDUSTRY

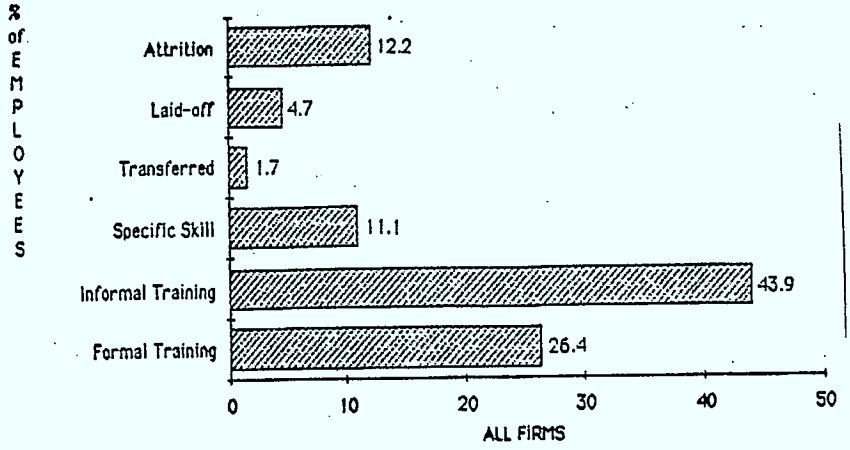


In terms of staffing changes, majority of firms relied on training, both formal and informal. Relatively few employees were transferred to another branch, laid off or lost to attrition. **Of employees affected by technological change, 44% received informal training, 26% formal training. Five percent were laid of and 2% transferred to another branch.**

CHART 10

TECHNOLOGICAL CHANGE EFFECT BY FIRM

PER CENT DISTRIBUTION



4. CONCLUSION

Canada enjoys one of the best educational system in the world. At any given time, close to 30% of all Canadians are enrolled in formal educational institutions. Spending on education has risen steadily from $8 billion in 1971-72 to $35 billion in 1986-87, representing 7.3% of our Gross National Product.

One of the more dramatic trends in Canadian education has been the growth of part-time university enrolment. Overall, in the last two decades, part-time university enrolment increased by almost 300%, from 73,000 in 1965 to 285,000 in 1985. The most common reason people choose to study part-time versus full-time is to enable them to continue working while they study. Personal or family responsibility is the second most important reason for choosing to study part-time, particularly for women.

A rapid technological change over the last two decades has resulted in increased requirements for industrial training to cope with this change. According to International Data Corporation (IDC), a Toronto based consulting firm, Canadian business and government together spend about $4-5 billion on training each year including salaries and overhead.

It is becoming increasingly evident that education and training is going to become (if not already) a life long activity. No longer will we be able to learn a trade and be guaranteed long term employment. Wide availability of affordable training geared towards individual needs will become very important. The capabilities of communications and information technologies (described in the next chapter) have demonstrated effectiveness in meeting this need. However, much remains to be done to ensure wider availability and to capture the full potential of these technologies.

CHAPTER III: THE ROLE OF INFORMATION TECHNOLOGIES

1. INTRODUCTION

Although traditional classroom and printed books remain the primary method of education and training, the evolution of information and communications technologies has increased the potential for providing education to those who would otherwise not have access to educational resources. For example, the concept of distance education has been discussed in Canada for nearly a century, but only with the recent integration of technologies into education have the possibilities for learning at a distance become so comprehensive, credible and popular.

Information technologies, which include both communications and computer technologies, will have two principal contributions:

- **extending the geographical reach of education and training; and**
- **providing opportunity for innovating training programs through the use of an extremely powerful electronic medium.**

This chapter describes the pertinent technologies in terms of their applications to education and training and also their major users.

2. INSTRUCTIONAL TECHNOLOGIES

The following gives a brief description of various instructional technologies.

2.1 Radio and Broadcasting

Educational radio broadcasts, aimed primarily at senior elementary school students, were begun in 1936 by the Canadian Broadcasting Corporation in cooperation with provincial departments and ministries of education. With the growth of television during the 1960s, the appeal of radio lessened. National educational radio broadcasts were terminated by the CBC French network in the mid-1970s and by the English network in 1981. At present, educational radio broadcasting is found in three provinces. A radio network, CKUA, operated by ACCESS Alberta, offers 15½ hours weekly of educational broadcasts for students at all levels, as well as educational programming of a more general nature. In Ontario, Open College/Ryerson uses broadcast radio in offering credit and noncredit university level courses to students in its distance education program. In Manitoba, audiotapes of university lectures are broadcast for general audiences on rural radio stations throughout the province.

Although educational radio broadcasting today is limited, the production and use of educational audiocassettes are increasing. In some provinces, large numbers of audiocassettes are available for elementary and secondary school use; these are distributed by the CBC in Newfoundland, and by provincial educational communications authorities in Quebec and British Columbia. In other provinces, some audiocassettes are available from local or regional media centres. Audiocassettes are also used in combination with 35mm filmstrips or slides in many schools, especially in elementary schools.

Audiocassettes are used by some postsecondary institutions, most often in language instruction. They are usually produced in the individual institutions, often in conjunction with slides. On occasion, audiocassettes are obtained from the CBC or from other educational institutions. In Quebec, the Ministry of Education is involved in the production of audiocassettes for colleges. In some universities, lectures are taped for students who miss them or who would like to review the material.

Postsecondary distance education programs use audiocassettes in many of their courses. For example, the University of Waterloo, which offers degree programs by correspondence, uses audiocassettes as the central learning resource in most distance courses. Audiocassettes are used by other postsecondary institutions as a supplement to print material in both credit and noncredit courses.

Audio recordings alone are used less often than audiovisual materials, film, or videotape. The lower costs of production and equipment have made the use of audiocassettes appealing in specific circumstances, particularly distance education and language instruction, and some feel that their potential as educational resources has not been fully tapped.

2.2 Television and Videotape

Without a doubt, television has more impact today on the daily living habits of individuals in industrialized countries than any other medium. With the production of such educational television programs as "Sesame Street", "Civilization", and "The Ascent of Man", educators were encouraged to attempt to use television to provide new types of quality instruction to a wider audience than had heretofore been possible.

The production of television programs for use in education in Canada began in the 1960s. In the larger provinces - British Columbia, Alberta, Ontario, and Quebec - provincial educational communications authorities produce and/or broadcast educational programs for elementary and secondary schools. In most parts of the country, some educational programs are televised by the Canadian Broadcasting Corporation (CBC). At the postsecondary level, programs are broadcast

by provincial networks or private stations as a component of college or university courses (telecourses) designed for students registered in distance education programs. A wide selection of educational programs aimed at general interest audiences are widely offered by provincial educational authorities.

Telecourses are generally characterized by the primary use of television programs supplemented with printed materials (student guides, textbooks) and the presence of some mechanism for student/instructor or student/tutor interaction (such as telephone tutoring, written correspondence, or teleconferencing). The video portion of a telecourse might be produced by using a camera in the classroom to record a series of lectures for broadcast, or it may be acquired from a producer such as the British Broadcasting Corporation, TV Ontario, or, quite often, one of several American producers of educational material. Telecourses may be broadcast or distributed by cable, usually in cooperation with one of the provincial educational communications authorities.

Mount Saint Vincent University's Distance University Education via Television (DUET) program uses a studio-equipped classroom to transmit live, interactive credit and noncredit courses to distance learners throughout the four Atlantic Provinces (Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland). Regular classroom lectures are delivered live on weekdays via microwave to the local cable company in Halifax/Dartmouth, and on the Atlantic Satellite Network channel of the Anik C3 satellite to cable distributors in the other Maritime Provinces. Return telephone links have been provided by means of either dedicated telephone lines, collect call lines, or an audio-teleconferencing bridge which allows up to 10 callers to participate in classroom discussions at the same time. Taped reruns of the programs are shown on Saturdays.

In Ontario, the **University of Ottawa** and **Carleton University** offer telecourses for distance education. The University of Ottawa uses television, print supplemented by audiocassettes, and teleconferencing. The courses are developed by regular faculty members, usually in addition to their normal teaching responsibilities. Carleton University has been involved with distance education since 1978, using camera in the classroom techniques. Distance students may reach the instructor by telephone during the lecture and during designated office hours. The telecourses are delivered via cable, on the **TV Ontario** broadcast network, or videotapes of the class are sent out to the students. All courses carry credit toward a Bachelor of Arts degree. The School of Continuing Education is responsible for the organization and coordination of distance education (providing registration and other administrative services), and the academic departments are responsible for the preparation of supporting materials and for provision of instructors and tutorial resources.

The University of Regina Extension broadcast live, on-campus classes to four remote classrooms in Swift Current, Moose Jaw, Melville, and Yorkton, since 1984. Classes in personnel administration, industrial relations, business information systems, and the art of motion pictures are sent via Saskatchewan Telephone's fibre optic network and distributed by community cable networks to designated sites equipped with decoders. Distance students participate in the classroom interaction via audio-teleconference.

Videotapes and video equipment are available in most educational institutions. The educational communications authorities in the larger provinces distribute or make available videotapes of their broadcast programs for distribution to schools in their own province. These videotapes are also sold to institutions or ministries of education in other provinces for use in colleges, universities, schools, and organizations outside the formal education system. Several of the smaller provinces also produce some programs to meet specific regional or local needs. Videotapes are now available in most subject areas and grade levels, and demand continues for new programs that are closely linked to the curriculum.

In colleges and universities, videotape viewing is increasing. In some courses, video equipment is also used to record individual efforts or events, and the videotapes are used to give feedback to students about their performances in public speaking or counselling, to study behavioural analysis in family or child studies, and to analyze movement in kinetics.

The major problems with the use of television and videotapes and their delivery technologies (such as cable and satellites) are the cost and access to production and distribution resources. And, as with other technologies, there is a recognition that television and videotapes are suitable only for some types of teaching and learning styles.

2.3 Satellites

The advent of communications satellites has expanded the geogaphic reach of broadcast distribution and has increased the potential for access to distance education. In 1977, **Memorial University in Newfoundland** participated in a telemedicine project using the Hermes satellite. The University's television centre in St. John's transmitted video and audio signals to hospitals in four locations in the province. Interaction with St. John's was provided

through a return audio signal for teleconferencing. The experiment made available continuing medical education, nursing education, community health education, and consulting services to the different locations.

Project Outreach was a satellite experiment conducted from January to June 1982 by **ACCESS Alberta** in cooperation with various educational and governmental agencies and the Educational Cable Consortia. Sixteen televised series for adults were transmitted to Anik B from ACCESS facilities in Edmonton and then broadcast from the satellite to seven locations throughout the province. A total of six ours of programs were broadcast on Monday and Wednesday evenings. During the broadcasts, viewers were encourages to use a toll-free telephone number to comment or ask questions about on the programs they were watching.

TVOntario distributes its signal via satellite to 12 main regional transmitters and 75 low-power rebroadcast transmitters throughout Ontario. Its usual broadcast schedule of 16 hours a day includes educational programs and series for preschool children, elementary and secondary schools, colleges, universities, and an array of programs and learning opportunities for the at-home viewer. The **Knowledge Network in British Columbia** offers a similar broadcast service, but with greater emphasis on accredited telecourses and noncredit teleseries sponsored by colleges and universities in the province. some courses or series are pretaped, others are broadcast live. Distance education programs in British Columbia are often enhanced by telephone communication between students and course instructors.

In the eastern provinces, the **Atlantic Satellite Network** (ASN) allots 20 per cent of its broadcast schedule, approximately 20 hours per week, to educational uses. The Distance University Education via Television program (DUET) at **Mount Saint Vincent University** in Nova Scotia is a major user of ASN satellite time, transmitting to 16 centres across the four Atlantic provinces. The signal is distributed from these centres by cable companies and is available only to cable subscribers. In some courses, registrants use the telephone network to participate in teleconference sessions. The satellite network is also used by the Nova Scotia Department of Education to distribute videotape programming to the public schools. Other educational institutions are developing proposals to use the network.

In 1983, a federally funded experimental project enabled the **University of Saskatchewan** to offer interactive educational programming to the four western provinces. Programs were distributed by the Knowledge Network in British Columbia and by cable companies in Alberta, Saskatchewan, and Manitoba. The major series transmitted, VETNET, was designed for practicing veterinarians in their homes. Viewers could respond by telephone. The system was also used to

provide material for educators, farmers, and animal owners. Programs for the general public dealt with topics such as robotics, high technology, the arts, legal concerns, and health. At present, funding is being sought to continue this satellite-based service.

Satellite transmission has contributed to the expansion of distance education opportunities in several provinces by providing a television link to wider audiences. Considerable attention is now being paid to designing different types of distance learning opportunities, using satellite transmission of video materials in combination with other technologies in cost-effective as well as educationally effective ways.

2.4 Computers

a) Computers in formal education

During the 1960s and 1970s, computers were acquired by large educational institutions for use in administrative and research activities. Today, relatively inexpensive microcomputers have been introduced into most educational institutions to perform a variety of functions. In elementary schools, they are used to give students an opportunity to learn about computers. In many elementary schools, computers are also used for instruction in mathematics and, less frequently, for instruction in language skills, science, social studies, music, and other subjects. In some schools, computers are used to encourage creative writing or to develop skills in problem-solving and reasoning. Computers are also used to provide remedial exercises for students having difficulty with basic concepts or to offer enrichment activities for gifted students.

In secondary schools, computers are used in computer awareness and programming courses, and in teaching business principles and practices, including data processing and accounting methods. Computer-assisted instruction (CAI) is most often used in mathematics courses and less frequently in science, geography, music, and language classes.

In both elementary and secondary schools, the use of computers for school, library, and classroom record-keeping is growing. **An increase in the use of CAI is seen as desirable, but is hampered by the scarcity of high-quality software and by the small number of computers available in most institutions.** Major efforts to develop satisfactory software, and to increase the number of computers are underway in several provinces.

Universities are using computer technologies in instruction, research, library services, and communications. Computers are used to support classroom instruction in a number of ways, including computation in math and sciences, compiling and analyzing data in the

sciences, social sciences, and humanities, word processing, creation of graphics for various engineering and other design courses, and simulations in math and physics. As in the colleges, CAI is seen as desirable, but implementation is limited by the scarcity of appropriate software.

Computers were first used to record and analyze research data in the 1960s by universities able to afford mainframe computers. As smaller computers and new database management systems appear, computer use in research is increasing. Researchers also use library data retrieval systems to locate pertinent information.

The organization and services of university libraries can be substantially improved by the introduction of computers, resulting in enhanced access to library materials by users and more efficient use of resources. Most university libraries have introduced or are considering the use of computers in purchasing, cataloguing, and circulating library materials. On-line searching and information retrieval from various databases outside the library and on-line public access to a catalogue of university holdings are also being introduced in many university libraries.

Computer networks are part of the communications systems at some universities. On-campus computer networks and, in some regions, local area networks linking several nearby institutions are being established. Electronic communications among faculty and departments, including libraries, is a useful result of this networking capability. Networks can be used to administer and manage course materials and activities, and can allow computer conferencing among groups of instructors and students. **The use of computer conferencing capabilities for enhancing distance education programs is being studied.** As funding permits, universities are eager to use communications and information technologies to facilitate interaction among faculty, local universities, students, and databases.

Overall, computer use in storing, handling, and retrieving information for administrative, research, and instructional purposes is growing. Using computers to provide educational and instructional experiences for students is seen as desirable, but more difficult to achieve. Software development efforts are now underway on a small scale in many locations, and on a larger scale where resources permit. In this new field, opinions are varied about the most desirable and potentially successful routes to take in the development of computer applications in education. The potential benefits of CML, CAI, and computer networking are assessed differently in different institutions.

b) Computers in institutional training

In recent years, organizations involved in training have been paying increasing attention to delivery training by means of computers.

This activity is referred to variously as Computer Assisted Learning (CAL), Computer Based Training (CBT) and Computer Assisted Instruction (CAI).

Computers have been used as training delivery vehicles with varying degrees of success since the late sixties. Recently, however, the technologies to produce much more instructionally and economically effective computer based training systems have become much more accessible.

CBT can be more effective because of the following two factors:

- Classroom instruction can only be as good as the individual instructor and cannot economically provide individual attention. CBT, on the other hand, can incorporate the instructional methods of an outstanding teacher and it can be provided to a trainee on a one-to-one basis.

- Text based individual study, on the other hand, suffers from another problem. Individual study can only be as good as the individual trainee's motivation. Even the best text books provide a completely passive training medium. In contrast to the passivity of text, CBT can provide an enjoyable and effective opportunity for interactive training.

In addition, CBT offers two more advantages:

- Distant Education: CBT can extend regular educational services to locations that are remote and underpopulated.

- Complex Process Simulation: Processes that are too costly or dangerous to be included in student labs can be simulated using computer for learning and training purposes.

It should be stressed, however, that advantages of CAL are contingent upon good instructional design which by no means is always present. In addition, it may lack the emotional and motivational reinforcement required by some trainees. **Another limiting factor to the use of CAL is the cost of producing good courseware. Authoring times can vary from 30 to as much as 600 hours per hour of instruction. At say, $40 per hour, this translates into $1000 - $24,000 per hour of delivered instruction.**

2.5 Videodisc and CD-ROM Technologies

These technologies can enhance the capabilities of traditional CAL through a realistic representation of actual objects and events with colour, sound, video and enhanced graphics, as well as an access to a much larger database.

A videodisc player transmits picture and sound to a television set or monitor. Laser videodiscs can store still and motion pictures on a numbered series of 54,000 frames so that, on command, any point or sequence on the disc can be displayed accurately and quickly. Videodiscs have two audio channels. **A microcomputer linked to a videodisc player can offer sophisticated computer-assisted instruction and training. In this interactive mode, the monitor will display portions of the recorder material according to learners' responses or choices. This interactive capability creates interesting possibilities for individualized learning experiences.**

Several videodiscs designed for educational or training purposes have been developed in Alberta, British Columbia, and Ontario by private companies such as Interactive Image and by educational institutions, often with the assistance of grants from interested government departments. Many of the discs produced offer instruction in work-related skills for nurses, teachers, correctional officers, foresters, automobile sales staff, mechanics, and machinists. Some videodiscs provide students with information or instruction on such subjects as the circulatory system and Indian culture. Others are designed for a wide range of viewers: for example, in one educational game viewers' decisions about ways of living can lengthen or shorten the life of the person shown on the television screen; other videodiscs show novices how to use an IBM personal computer and explain some key programs.

The first producer of videodiscs in Canada was Michael J. Petro Ltd. of Windsor, Ontario. This firm is involved in the continuing production of the training discs for General Motors (GM) and American Motors. The General Motors discs were initially prepared for both sales and mechanic training for GM's 10,000 dealerships in the United States. Petro Ltd. has produced completely new discs for the 600 GM dealerships in Canada. Some of these discs have been offered to trade and technical schools to enhance the instruction in such topics as repair of automobile sound systems, reconditioning, acrylic finish repair, and basic electrical troubleshooting. The discs are all interactive, using the capacity of the microprocessor in the videodisc player.

It is expected that the brightest future for the educational videodisc will be in industrial and skill training. There its effectiveness has been proven by many American industries, and particularly by the military. A successful application has been in the fast-food industry, where the problems of high turnover of unskilled personnel needing standardized skills were solved by using videodisc. Lengthy and complex repair manuals have also been put on videodisc for military use. GM and Ford, both in the U.S. and Canada, have made extensive use of videodisc training.

Training discs are not yet widely used in Canada, but the potential is recognized. The bulk of Canada's large "baby boom" population are now in the work force. Technological and social changes demand retraining for employment, and the videodisc could be the delivery system. The high price of training could be reduced, particularly in professional education, industrial training, and motor skills development.

One of the most promising development in the distribution of educational material is the emergence of CD-ROMs (Compact Disc Read Only Memories). Because the mastering costs are spread over copies manufactured, CD-ROMs provide for potentially dramatic economies for scale in high-volume publishing applications. The most staggering fact about CD-ROMs is how much information they can each pack: 550 megabytes of digital data, the equivalent of 150,000 printed pages or 250 large books.

CD-ROM already competes effectively with print in a number of areas: catalogs, reference works, medical or actuarial databases, business archives, genealogies and histories, cartography, census data, instructional material, and much more. CD-ROM gets around the problems of excess inventory, short product life, high distribution costs and insufficient shelf space. **By 1990 it is expected that many publishers will have their own CD-ROM publishing arms.**

Perhaps the most dramatic inroads will be made in libraries. After examining several technologies, the U.S. Library of Congress selected CD-ROM to contain more than one-hundred different bibliographic products and services, all part of its Disc Distribution Project. CD-ROM could challenge existing mainframe-based shared library networking systems.

The medical profession is also embracing CD-ROM, with products such as Poisindex -- a catalog of poisons -- already on the market. This brings into the operating room an unprecedented speed and precision of information and is bound eventually to save lives.

The legal profession is also ideally suited to CD-ROM, accustomed as it is to online computer searches. Tax information, statutes, case histories, legal forms and patent or trademark information are all natural candidates for distribution by CD-ROM.

Navigation and cartography are also naturals for CD-ROM. A nationwide digital map of the United States can fit onto a single disc. Grolier Inc. of Danbury, Connecticut offers the Grolier Electronic Encyclopedia. Grolier's twenty volume (nine million words) encyclopedia is available on a single CD-ROM disc. In addition to the disc player (a Philips CM100 player) full-text retrieval software from

KnowledgeSet and the Knowledge Retrieval System floppydisc is required. Together, the system costs $1,495 in the U.S. Of course, an IBM PC or compatible with 256K minimum main memory is also required to retrieve data from the CD-ROM disk.

Prices of CD-ROM players in Canada range from $1,200 to $1,500. Annual updated editions of the encyclopedia will cost only $24.95. Unlike their printed counterparts, one need never have an out of date encyclopedia. According to a spokesman for Grolier Limited, the Canadian subsidiary of Grolier Inc., the encyclopedia costs $299 in Canada and is available now. Grolier is currently setting up a distribution network. The company hopes to place a unit in every elementary school, high school, and college in Canada: twelve-thousand institutions in all. Grolier's next step is a thesaurus and dictionary. In addition to the Grolier Encyclopedia, more than ten other major reference titles from various companies have been transferred to CD-ROM.

Because of its low-cost characteristics, portability, potential office-home compatibility and a stable and rapidly expanding disk manufacturing infrastructure (based on the success of the compact audio disc), CD-ROM is expected to have the greatest impact on electronic publishing of education material over the next decade.

2.6 Teleconferencing

At present, approximately 20 of Canada's 71 universities and 30 of the 196 Canadian colleges use teleconferencing in their credit and noncredit programs. The use of educational teleconferencing networks is most highly developed in Newfoundland, Quebec, Alberta, and British Columbia.

Audio-teleconferencing enables three or more people in different locations to participate simultaneously in a telephone conversation. When used as part of a distance learning program, audio-teleconferencing is especially valuable in extending learning opportunities to people who live in communities far from a college or university. Experiences with educational teleconferencing indicate that live discussion and interaction among the participants and instructor can create a classroom-like learning situation. In more heavily populated areas, audio-teleconferencing can eliminate the need for instructors or students to travel and lessen the need for instructors to repeat material in several locations.

Teleconferencing can be used to offer continuing professional education programs to small communities, or to enable people in several locations to participate in the same program. Some regional teleconference sessions for professionals in law and medicine have been

established on a regular basis. Occasional teleconferences have also been organized for educators, veterinarians, science writers, and other groups.

The format and content of teleconference courses vary greatly among institutions. Typically, however, textbooks and print materials are a major component of course materials. In some instances, slides or videotapes are provided for use during teleconference sessions or for later reference.

Some experimentation has been done (most often using satellite transmission) with the use of two-way, full-motion video communications. Although pilot projects using visual as well as audio interaction have been very successful, costs prohibit extensive use. A more affordable intermediate step, using a combination of one-way, full motion video and two-way audio, has been introduced in British Columbia. The use of computer conferencing as an educational communications system is also being developed on an experimental basis.

The addition of visual communication and the development of teaching techniques appropriate to the teleconferencing experience present challenges in designing effective programs. **The costs of teleconferencing equipment and learning materials can be prohibitive, especially for small institutions.** To keep costs at a minimum, equipment and resources can be shared among several institutions. For example, the Atlantic Provinces Association of Continuing University Education, a new association in eastern Canada, facilitates the sharing of resources among institutions and minimizes overlap among their programs. Such activities will encourage the development and success of teleconferencing in education.

2.7 Videotex/Telidon

Over the past couple of years, private industry and the federal Department of Communications have sponsored several research projects and field trials to encourage the development of commercially viable or self-supporting applications for Canada's videotex system, Telidon. Although the commercial market for many of the Telidon services did not materialize, the field trials did demonstrate the capability of this technology to deliver many educational services through the utilization of its improved graphic capabilities.

2.8 Artificial Intelligence (AI)

What is AI?

The term artificial intelligence (AI) was coined nearly thirty years ago to describe the attempt to understand intelligence by

designing "intelligent" computer systems -- intelligent in that they could carry out tasks that we normally consider require intelligence when performed by a human being. Although AI has been brewing in the corners of advanced research laboratories for about 30 years, it is only in the last decade that the fruits of early research have begun to pay off commercially. A number of factors have come together to make this possible. These include:

- the development of a number of basic techniques in computer science;

- the development of relevant supporting techniques in areas such as mathematics, optics, linguistics, and psychology;

- the discovery that, despite their comparative inadequacy as general models of intelligence, certain techniques that had been developed in the laboratory were capable of providing commercially useful results in appropriately limited domains;

- the development and proliferation of general computational tools, as well as tools for specific artificial intelligence applications; and

- the general availability of powerful computers at prices which made them affordable by a larger number of research laboratories and industries.

AI in education and training

The development of intelligent computer-aided instruction (ICAI) systems -- also known as intelligent tutoring systems (ITS) -- coupled with AI programming environments and databases, provides the possibility of an improved learning process. The development of AI techniques for applications in education must be based on an understanding of the objectives of education. Even if the objectives are commonly agreed upon, however, the process by which, and the speed with which an individual progresses to satisfy the objectives can be markedly different from one student to another. The economics of western education are such as to preclude teacher/student ratios that would more effectively address attaining goals of education as accomplished by individuals. It is in the areas of neglected goals of education, intelligent computers could play a major role in significantly altering the education system and its ability to meet the educational goals of a society. This point of view stresses the contribution of AI theories, programming environments and systems to the improvement of the system's effectiveness -- as opposed to the system's efficiency, where traditional teacher functions and/or

textbooks are replaced. It is to be noted that many of the traditional CAL packages can also accomplish these goals, using AI concepts but without using specifically the AI programming languages.

The use of ICAI in the office has enormous potential. The marriage of AI and CAI technologies has only recently begun to be exploited. Experience with experimental systems (e.g., the Sophie system for interactive tutoring in electronics, and the Steamer system for training navy personnel in the operation and maintenance of a steam propulsion system -- both of which use natural language input and simulation models of the training domains) indicates that ICAI systems can be extremely beneficial. Because organizations spend such a large proportion of their time on training personnel (especially when new technologies are introduced), the use of ICAI techniques shows promise of being extremely cost-effective. According to some researchers, one solution to the problem of accelerated organizational learning lies in electronic networks, electronic conferences, on-line tutorials, and on-line user support -- rather than in the traditional forms of classroom education, book learning, or improvised implementation assistance.

3. CONCLUSION

Technologies have been used in education and training both to supplement classroom teaching and to provide learning materials for distance education programs. In the classroom or lecture hall, teachers and instructors in most educational institutions have available a variety of videotapes, audiocassettes, and, on a smaller scale, computer software to draw upon in planning their lessons and directing students' activities.

Teachers and instructors use these technologies to introduce, review, enrich, or summarize a lesson, and to direct students to pertinent materials, individually or in small groups. These activities stimulate student interest, expose them to situations outside their experience, present new information and concepts, encourage participation in related activities, and foster an exchange of ideas.

Technology has played an important role in the recent expansion of distance learning programs in Canada. Many colleges and universities use one or more of the technologies to support or partially replace print materials and to provide opportunities for personal contact and discussion.

The hardware developments over the past 50 years in communications and information technologies are impressive, but their

applications in education have often produced less dramatic results than anticipated. Identifying the most successful experiences and the reasons for their success is instructive. Both in distance education and in classroom instruction, the most exciting applications of technology occur when experiences are offered that attract adult learners with new types of learning opportunities, that foster students' development of concepts and understanding, or that tailor education to suit the needs and styles of individual learners. But using technology to create learning situations like these is a challenging, time consuming, costly process. **The importance of developing quality software based on sound educational techniques cannot be over emphasized.**

For people in communities far from postsecondary institutions or people who find traditional teaching methods ineffective or unappealing, technology holds great promise. The ability of technology both to enhance traditional teaching and to extend learning opportunities seems substantial. Developments in educational technology may eventually alter our basic approaches to education and the organization of educational activities.

Additional developments in hardware and educational software can be expected. Combining several technologies to develop new learning experiences is beginning - for example, in the integration of videodiscs and computers and in satellite transmission and telephone communication. Expected developments such as voice recognition and speech synthesis, expert systems, and artificial intelligence may provide new capabilities for educational use.

CHAPTER IV: THE INSTRUCTIONAL TECHNOLOGIES MARKETPLACE

1. INTRODUCTION

Chapter 2 of this report provided a brief outline of the educational and training structure in Canada. In Chapter 3, we described a number of communications and information technologies applications and discussed their current role and future potential in furthering Canadian objectives in education and training. This fourth Chapter gives an overview of Canadian industrial capability in supplying such technologies and products. It also outlines the potential market opportunities and constraints for supplies of instructional technology products and services.

2. USERS OF INFORMATION TECHNOLOGIES IN EDUCATION AND TRAINING

2.1 Federal Government

A number of initiatives have been taken within the various Federal Government departments with regard to the use of computer in providing training. Those with commitment to CBT (Computer Based Training) include: **National Defence, Canada Post, Revenue Canada, Taxation, Supply and Services and Transport Canada.** Many others are conducting pilot projects and studies to evaluate the potential for utilization. These include: **CIDA, Environment Canada, External Affairs** and the **RCMP.**

Canada Post trains its postal clerks for encoding letters. They claim that CAL requires only 30 hours of training as compared to 60 hours before the use of CAL. Since the early 80s they have trained 6000 encoders using CAL.

Studies carried out by **National Defence** indicate a saving of 25-30% in training time with no loss of performance. They are also planning to develop several videodisc based systems to determine the applicability of this technology for their needs.

The **National Research Council** has been in the forefront of developing the application of computers in training environments. They were involved in the development of NATAL, a Canadian authoring language.

In addition, every department is using off-the-shelf tutorial courses for training in microcomputer application programs such as Lotus and Wordstar.

2.2 Provincial and Municipal Governments

There are several provincial government involvements with the use of computers in training.

The **Ontario Ministry of Education** is involved in developing computer based education material. They sponsored the development of the ICON, a specialized educational microcomputer. Over the past few years, they have funded courseware including the development of several videodisc based sample courses.

Edmonton police officers are required to take 2 week refresher courses every five years. This was replaced by CBT in 1983. PLATO was used to develop the required software. City estimates an annual saving of $68,000 due to CBT.

2.3 Industry

In the field of commercial training, the leading users of CAL are computer companies themselves. For example, most of **IBM's** training of customer engineers is now delivered in this way. CAL is extensively used in training people in data processing skills. The next largest users of CAL are those who make extensive use of microelectronics equipment, notably the telecommunications industry. For example, **Bell Canada** delivers all its digital switching systems training through the medium of CAL. Outside this group of firms CAL is found in large organizations which have well developed training departments and are aware of the cost of conventional training. For example, **Air Canada** uses computer based control panel simultors for training pilots. **Ontario Hydro** uses CBT to supplement traditional training for nuclear power plant operators. **American Motors** and **General Motors** both use CBT for training in industrial automation. Esso uses computer based simulator to train personnel in oil spill recovery.

The capability of CBT to provide less technical training is also documented. The **Great-West Life Assurance Company** uses CBT to train staff on the processing of claims. **The Royal Bank** has completed a pilot project which has resulted in the recommendation for further CBT implementation within the bank. **The Toronto Stock Exchange** uses CBT for training employees in brokerage houses.

There has also been some involvement with the use of videodisc based training within the private sector. **Bell Canada** has completed a large videodisc training course for equipment training. **Canadian Pacific** uses videodiscs for training in the use of their office automation systems. **The Continental Bank** has completed the design for a videodisc based program for teaching interview techniques. **General Motors** has recently incorporated videodisc based training for a wider range of training courses including electronics, robotics and hydraulics.

2.4 Distance Learning Institutions

There are a number of institutions which offer distance learning education and training, aimed at people who cannot attend an

institution either because they cannot find time due to family and work obligation or they live in rural or remote areas where access to an institution is not very convenient. In addition, most universities and community colleges have what are called extension divisions or continuing education divisions. Communications and computer technologies are natural for distant learning. **A brief literature review conducted during the preparations of this report identified close to 70 organizations which use information technologies to deliver distance education courses.** A description of some of these are contained in Appendix A.

3. MARKET SIZE

Compared to the annual expenditures of $35 billion on formal education and $5 billion on institutional training (industry and government), the expenditures involved with the use of these technologies in education are probably rather insignificant. However, with the convergence of communications and computers (CD-ROM, interactive videodisc, interactive television), communication technologies are expected to play an important role in education and training over the future years.

According to Evans Research Corporation, the total market for computer hardware in Canada in 1984 was worth $4.6 billion. Most of the computers are general purpose machines on which any type of applications can be run, not just educational ones alone. Thus, it is hard to assign a specific dollar figure for computer hardware sales specifically meant for the education and training purposes.

The total software sales in Canada in 1984 were worth $1900 million. Based on discussions with both suppliers and users of courseware, Professor Beckman of the University of Manitoba estimated that of this amount, $7.3 million, or 0.4% of total software expenditures was spent on the purchase of courseware. **Nevertheless, the Canadian courseware market for 1990 is forecasted at $55 million, which will represent 1.6% of the estimated total software market of $3400 million.**

If we apply the ratio of courseware sales to total software sales to estimate the hardware sales meant for educational purposes, a figure of $18 million would be obtained fo 1984. For 1990, using a ratio of 1.6%, and total hardware sales of $7300 million as forecasted by Evans, Educational hardware sales will be worth $117 million. Thus, the total educational computing market (hardware plus software) will increase from $25.3 million in 1984 to $172 million in 1990.

It is to be noted that the above figures do not include substantial amounts of funds which are spent for in-house courseware development.

It should be noted that the courseware suppliers are constrained in exploiting the full market potential and to market fragmentation. Canadian marketplace is fragmented along many lines as discussed below:

1) **Language of Instruction:** A courseware package written in English would not be suitable in an environment in which the language of instruction is French.

2) **Hardware Configuration:** Apple, Commodore and Radio Shack remain the dominant computers in the Canadian educational system but they are facing challenges from the emerging provincial standards such as ICON in Ontario. Each of the machines uses a different operating system with the result that to transfer a program from one brand of computer to another requires that the program be essentially rewritten.

3) **Jurisdiction over Education:** Education is largely a provincial concern with each educational authority adapting independent approaches for the use of technology in education.

4) **Competition:** For any application (given grade level, language and hardware configuration), there are many Canadian and foreign titles competing against each other.

These factors make it very difficult for a courseware developer to survive on the Canadian market alone. For example, assuming Canadian market at $14 million in 1986; if a developer was to capture 2% of that market (a figure considered highly optimistic), assuming a net of 15% after marketing and other costs, the developer would receive $43,000. Any program of sufficient sophistication to garner 2% market share would cost considerably more to develop.

4. THE CANADIAN INSTRUCTIONAL TECHNOLOGIES INDUSTRY

In view of the above noted market forces, it is not surprising that the Canadian industry for instructional technologies is not large. Nevertheless, there are a number of firms which have developed notable products and services in this area. In addition, the capabilities of Canadian telecommunications carriers and broadcasters also play an important role in the provision of quality educational and training opportunities for all Canadians. **The following descriptions, together with the profiles of 15 Canadian firms presented in Appendix B, provides a brief overview of Canadian industrial capabilities in instructional technologies.**

Computer hardware manufacturers are the dominant suppliers of Computer Aided Learning (CAL) products, both hardware and software. Most of the major companies have developed authoring systems, presumably at least initially for the purpose of promoting sales of their own hardware. **IBM** developed IIPS (Interactive Instructional Presentation System), **CDC** developed PLATO, **DEC** developed RENAISSANCE, Wicat developed WISE, **Burrough** developed THE AUTHOR and **Hazeltine Corp.** developed **TICCIT.** Originally these were mainframe systems tied to the equipment of the company marketing them. However, the large scale introduction of microcomputers has resulted in the development of microversion of some of these systems such as micro PLATO, micro TICCIT, and IBM's PCIS. For the most part, these authoring systems are intended to enable companies to develop their own in-house capability. Some of these companies, however, do develop special purpose courseware for their clients and some like CDC's PLATO have extensive "off-the-shelf" courseware.

The next group of CAL producers are the software developers (e.g. **Logidisque, Force ten, CAPA**) who have added computer-based training to their product lines. Most of the work they do is custom courseware development. Firms which specialize in training consulting have also begun to be involved in CAL. Examples are the **Training Group, Microtel Learning Services, General Cybernatics.** While all of these provide consulting services in CAL, some also supply training systems. For example, Microtel Learning Services supplies TICCIT authoring system.

Publishing houses are another group involved in CAL as an adjunct to publishing books. **Softwords**, a consulting company in CAL, is a division of **Press Porcepic of Victoria. Mcgraw Hill** has developed its interactive authoring system to assist in the process, which most publishing houses adopt, of subcontracting courseware development.

Some users have developed their own CAL capability essentially independently. For example, Bell Canada has developed its own authoring system.

Telecommunications Carriers

Most distance learning institutions rent telephone facilities from appropriate telephone companies. **Telecom Canada**, which is an umbrella organization of ten of Canada's major telecommunications carriers, owns and operates audioconference facilities for internal purposes and sells the service to customers. It also offers videoconferencing facilities in a fully interactive mode between any two permanent studio facilities.

Telesat is Canada's domestic satellite operator and owns 51% of its facilities, the other 49% is owned by the government. It rents its transmission channel capacity to as many as 25 distance learning institutions around the country. Among the users of its facilities are - Knowledge Network, Access Alberta, TV Ontario, Memorial University of Newfoundland, Radio Quebec, Manitoba Department of Education, Athabasca University and University of British Columbia.

At least 30 institutions use CATV, 33 use TV broadcasting and 5 use radio broadcasting to deliver their educational material. TV Ontario, for example, distributes its signal using 20 medium and high power transmitters, 185 low power rebroadcast transmitters mainly in remote and rural areas, and 160 cable networks. Carleton University of Ottawa offers its credit courses exclusively through Cable Television.

Canadian Teleconference Network (CTN) Inc provides a complete range of services for videoconferencing from a single site to multiple sites in Canada, the U.S., or around the world. Its principal format is one-way radio and two-way audio. There were an estimated 50,000 attendees at Canadian site in 1985.

The Darome group of Toronto was incorporated in Canada in 1984. It seels audioconferencing and audioterminal as well as full range of services needed by an organization to implement audioconferencing. It conducts over 1200 teleconferences per month on its combined Canadian, American and British offices: over 200 of these are exclusively Canadian.

CHAPTER V: EXISTING GOVERNMENT ASSISTANCE, PROGRAMS AND POLICIES

1. INTRODUCTION

As described in Chapter 2, approximately $35 billion was spent on education in Canada in 1986, of which, over 90% was funded by various levels of governments. Government departments and ministries are responsible for the organization and administration of educational institutions and have, therefore, been always involved with the introduction of new technologies in the educational system. This chapter describes various government assistance programs and policies aimed at facilitating the use of communication and information technologies. It also describes the Department of Communications' role and initiatives in the use of these technologies in education and training.

2. GOVERNMENT PROGRAMS AND POLICIES

Communications technologies are extensively used by various educational and training institutions to deliver their course material. Although the technologies are used for both distance and non-distance learning purposes, they are obviously more important to distance learning applications. There are at least 70 institutions in Canada, which offer distance learning education and training. This does not include the in-house training departments of large private organizations. Majority of these institutions are funded by provincial grants of one kind or another. **Up to approximately $155 million is spent by the provincial governments on the distant learning divisions of these organizations.** These expenditures are distributed as follows:

Of the $155 million, approximately $109 million is spent by the provincial educational broadcasting organizations:

Knowledge Network of the West (KNOW), B.C.	:	$ 3 million
Access Alberta, Alberta	:	$16 million
TV Ontario, Ontario	:	$30 million
Radio Quebec, Quebec	:	$60 million
		$109 million

Approximately $34 million is granted to institutions which are devoted entirely to distance learning.

Open Learning Institute of B.C.	:	$ 7 million
Athabasca University, Alberta	:	$14 million
Teleuniversité, Quebec	:	$13 million
		$34 million

It is to be noted that only a small portion (5% or so) of this $30 million is spent on information technologies.

The remaining $12 million or so is spent by the Continuing Education Divisions of various Universities and Colleges. This $12 million is, of course, in addition to regular university funding of their Continuing Education Divisions. Again, only a small portion of this $12 million is spent on communications technologies.

In the area of computer related technologies, provincial education ministries have also established projects of one kind or another to help spread its use in education. The following gives a brief outline of some of these programs and projects.

ONTARIO

The following initiatives have been undertaken by the Ontario Ministry of Education:

1) A central focus within the Ministry of Education, for the introduction of technology, was created in 1981. This was subsequently enlarged in 1984 with the creation of the **"Computers in Education Centre" with a staff of 24 people.**

2) The Ministry issued functional requirements for microcomputers for use in Ontario schools in March, 1983. Products meeting these requirements are eligible for a grant of 75%, when purchased by a school board. The school broad would pay the remaining 25% of the cost.

3) The first system to be approved was developed by CEMCorp. (Canadian Educational Microcomputer Corp., a Consortium of 50 Canadian Companies) in February 1984. The Ministry provided CEMCorp. a contract guaranteeing purchase of $10 million worth of computers meeting its specifications. **The computer known as ICON is now marketed and serviced by Burrough Canada** and, as of April 1, 1987, 12,000 of these systems were available at 1500 sites; there are currently 100,000 microcomputers of all kinds in Ontario schools with an average purchase price of $1500.

4) In February, 1986, an IBM AT/PC was approved by the Ministry as meeting its specifications. This system uses PORT operating system developed by Waterloo Microcomputer System Inc.

5) Working closely with industry, the **Ministry has funded the development of 120 pieces of educational software** so far

under its $6 million/year program. Approximately 35-40 new programmes are funded each year. Over 65 Canadian companies in 4 provinces are involved in developing the software.

MANITOBA

1) **In 1984,** the Department of Industry, Trade and Technology, in consultation with the Department of Education established the **Information Technology Program (InfoTech).**

2) A Subset of the Information technology program is the **Educational Technology Program (ETP).** Its mission is to support the implementation of educational technologies in the K-12 school system through a joint industry-government initiative, while promoting the development of courseware industry.

3) In order to help spread the use of computers in schools, Educational Technology Program brought together 8 major partners and an increasing number of other private companies to **establish an industry-government Computer Resource Centre called Infotech Resource Centre.** Apple, Burrough (ICON), Commodore, Cybershare, Epson, IBM, Sperry and Tandy as major industry participants have committed in excess of $4.3 million in support of a three year base program. The companies provide hardware, software, technical support, master purchasing agreements, and an array of projects to advance the use of these technologies in the schools. The centre is housed in a 33,000 sq ft facility which opened its doors in September, 1985. The centre provides:

   - an industry display area opened in evenings and Saturdays to provide teachers with a friendly environment to drop in and examine hardware and software;

   - a local area network and integrated office system supported by a SL-1 switch;

   - in excess of 200 microcomputers.

4) Infotech operates with a budget of approximately $3 million a year (not counting industry participation).

ALBERTA

1) **The Ministry of Education established in October, 1981, what is called "Computer Technology Project",** with a full-time staff of 7 people.

2) The Ministry standardized on Apple II+. It acts as a software clearinghouse and evaluates courseware (mainly Apple II+) for recommendation to schools. To date, it has evaluated some 2000 pieces of courseware and has recommended 200 for use in Alberta.

3) It also demonstrates the use of microcomputers and courseware across the province.

3. DOC'S ROLE AND INITIATIVES

The Department of Communications has been connected with the development and applications of educational technologies in a number of ways including the following initiatives:

1) Satellite Projects

2) Telidon Videotex/Teletext Applications to Education

3) Educational Systems Technology Branch

4) Membership in the Associate Committee on Instructional Technology of NRC

5) Association of courseware developers.

6) ANTEM

7) Distance Education Networks

3.1 Satellite Projects

The Hermes and Anik B Satellite programs of the Department of Communications provided opportunities for many educational institutions for experimentation and field trials. Over 100 large and small projects were carried out over the last ten years. The following provides a brief description of some of the early projects which used satellite technology for the delivery of their educational material.

Knowledge Network of the West (KNOW)

Using Hermes and Anik B satellites, several universities, institutes and colleges in British Columbia provided live lectures, sessions and programmes in areas such as health care, career and professional education. The project utilized one way video and interactive audio. The programs were uplinked from a site near Vancouver and received by community colleges throughout the province as well as cabled households. The trial generated continued interests in interactive and satellite technology for distance education in the province and encouraged the establishment of a permanent service.

Access Alberta

Anik B satellite was used to distribute television signal to a number of colleges and seven cable system in Alberta. Terrestrial telephone lines were used for audio interaction to facilitate discussion between students and teachers. The trials encouraged the establishment of an operational satellite service.

TV Ontario

TV Ontario used first Hermes and then Anik B satellites to distribute educational television programming, uplinked from Toronto and received by four school sites in northern Ontario. The satellite trials subsequently developed into operational service.

Quebec Department of Education, Kativik School Board

Anik B satellite was used for the field trials which used one way video and interactive audio services to link five communities in northern Quebec to distribute educational material to Native schools.

Memorial University

The Hermes project used one-way TV from the University Health Centre in St. John's and interactive audio, while the Anik B satellite used slow-scan TV and interactive audio to distribute continuing medical and nursing education for practitioners in distant areas of the province. The project developed into an operational service.

3.2 Telidon Videotex/Teletext Applications to Education

Telidon was publicly demonstrated on August 15, 1978, when the Department announced the second generation alphageometric Picture Description Instructions protocols, which came to be called "Telidon", an advance on the first-generation British "Viedata" and French "Antiope" alphamosaic systems. DOC supported a six year two-phase program of research and development, field and market trials, and content development.

Following are some of the institutions which explored the potential of Telidon for educational applications. In many cases, these applications were sponsored by the Department.

British Columbia Motor Vehicle Department for Driver Training Test
Open Learning Institute, Vancouver
University of Victoria, Department of Creative Writing

Access Alberta
Athabasca University
University of Calgary
Alberta Education Correspondence School

Manitoba Educational Telidon Association
Non-formal Home Learners in Manitoba
Manitoba Telephone System

University of Guelph, Department of Rural Extension
TV Ontario
University of Western Ontario

Edimedia Limited, Mediatex, Montreal
Université du Québec à Montréal
Télé-Université, Université du Québec, Quebec

University of Moncton, Faculty of Arts
University of Prince Edward Island, Charlottetown

3.3 Educational Systems Technology Planning Branch

The mandate to create an Educational Technology Branch within the Department of Communications was approved by the Cabinet in September, 1972, provided the Council of Ministers of Education gave their approval. On February, 1973, the Council of Ministers gave their approval and thus the Branch was created in 1973. The following were seen as the responsibilities of the Branch:

- to ensure that national communications networks and associated practices employed in the support of educational applications in all provinces and territories of Canada are cost beneficial and in the national interest;

- to develop plans and programs that will ensure the orderly and optimum development of communication systems, networks and techniques to meet multibillion dollar educational requirements;

- to ensure uniform standards and practices for educational communications systems and technologies, in order to create a well defined Canadian market for Canadian suppliers;

- to develop working relationships and federal-provincial government interfaces that will permit continued and mutual collaboration in the use of communications systems in support of educational processes.

In 1975, the Branch produced a set of reports dealing with various educational technologies such as computer learning and videodisc and developed educational technology ("ed-tech") projects in

Universities in several provinces. It appears that cooperation with the provinces was achieved. It also appears that lack of funds and/or federal-provincial politics intervened, as the Branch was dissolved shortly after the publication of this set of reports.

3.4 The Associate Committee on Instructional Technology

The Associate Committee on Instructional Technology was formed by the National Council of Research of Canada in 1969. The Department of Communications has been on of its active members as well as member of its subcommittee on the development of a Canadian Courseware Industry. The specific objectives of this committee are as follows:

1) To bring together specialists from the various disciplines involved in the field of instructional technology, in order to formulate requirements and establish guidelines for research and development.

2) To promote interchange of information on instructional technology as, for example, through the organization of symposia.

3) To promote and coordinate relevant research, development and application with the aim of establishing a strong, Canadian-based capability.

4) To encourage standardization of technology for instructional systems sufficient to foster the widest interchange and application of instructional material.

3.5 Association of Courseware Developers

The Department provided logistical and financial support for the organization of the national colloquium on courseware in Montreal held in 1987 and was instrumental in the creation of the association of the courseware developers.

3.6 ANTEM (New technologies applied to education, vocational training and culture).

The aim of that project is to encourage collaboration between teams in various countries that wish to:

apply technology more successfully to education, vocational training and culture through sharing of information, expertise, resources and recent innovations;

extend and test the transferability and portability of technology in those domains; and

increase fruitful contacts with individuals and groups with similar interests in other countries.

Canada and France are the co-leadrers for this project. Italy and Great-Britain are the other two members while Germany and other European countries have the observer status.

A number of meetings, workshops and conferences have been held by the ANTEM working group in each of the member countries. As a result of these meetings projects were initiated by the International ANTEM working group.

International Collaboration Projects:

i) International Network of Instructional Technology Referral Centres

The aim of this project is to establish a network of data banks providing information on the instructional technology resources of member countries.

ii) International Computer Conferencing Exchange Network (ANTEMNET)

The aim of this project is to test various computer conferencing systems for the purpose of defining the operational specifications for a computer conferencing system through which research teams from participating countries communicate economically and effectively.

iii) International Pilot Instructional Technology Workshop Network

The aim of this project is to establish effective communication links between teachers and between students concerned with the application of new technologies of education at the elementary and secondary level.

iv) Interactive Film and Video Products

The aim of this project is for member countries to share their respective experience in the application of new interactive film and video products to education and training.

3.7 Distance Education Networks

On October 17, 1987, the Honourable Flora MacDonald, Minister of Communications announced the creation of a distance education networks for the Commonwealth countries, with the central coordinating unit to be located in Vancouver.

Australia, Barbados, Bostwana, Britain, Brunei, Darussalam, India, Malta, Nigeria, New Zealand and Zimbabwe, have agreed to contribute to the costs of the distance education network, with other Commonwealth countries expressing an active interest. As well, the government of British Columbia will be providing substantial support, including accommodation for the coordinating unit. A working group composed of representatives from donor countries and others with substantial experience and interest in this area will be established immediately to complete the detailed financial and organizational planning.

Apart from the coordinating unit in Canada, the Commonwealth network is envisaged as a decentralized operation to promote exchange of information, training, technical assistance and research.

Canada and British Columbia will provide as much as $12 million for up to one-half of the network's facilities and operating costs for the first five years.

The establishment in Canada of the International Francophone Centre for Distance Education was announced at the Francophone Summit held in Quebec in September 1987.

CHAPTER VI: CONCLUSION

The foregoing chapters discussed the importance and therefore, increased requirements, for education and training as we move from an industrial economy to an information based economy. The technologies, especially the information technologies, are changing so fast that it is estimated that over the coming five years, four out of five people will be doing work differently from the way it has been performed in the previous fifty years. This puts a tremendous demand on our educational and training system for the continuous requirements for education and training.

Educators and employers have used information technologies to augment traditional training methods. For example, computer aided learning (CAL) is extensively used by organizations such as IBM, Bell Canada, Air Canada, Ontario Hydro, Royal Bank and Toronto Exchange. Although there have been several successes with the use of instructional technologies, they are relatively few and far between.

In order to exploit the full potential of information technologies in education and training, we will have to resolve a number of issues. On the basis of a literature search and discussion with a number of knowledgeable people in this field, the following summarises some of the courseware related issues.

1. Market Fragmentation

Canadian market is fragmented along many lines as discussed below:

Language of Instruction: A courseware package written in English would not be suitable in an environment in which the language of instruction is French.

Hardware Configuration: Apple, Commodore and Radio Shack remain the dominant computers in the Canadian educational system but they are facing challenges from the emerging provincial standards such as ICON in Ontario. Each of the machines uses a different operating system with the result that to transfer a program from one brand of computer to another requires that the program be essentially rewritten.

Jurisdiction over Education: Education is largely a provincial concern with each educational authority adapting independent approaches for the use of technology in education. Procurrent decisions are made by individual school boards in each municipality.

Many courseware developers find it very hard to sell their products into provinces other than the one for which they were developed.

Competition: For any application (given grade level, language and hardware configuration), there are many Canadian and foreign titles competing against each other.

Since the Canadian market is already small compared to the U.S. market and is further fragmented along many lines, it is very hard for a courseware developer to recover his costs from the Canadian market alone. Thus, any strategy which could minimize market fragmentation would be beneficial.

2. Canadian Content

Due to our smaller market size and market fragmentation, it is very hard for a Canadian courseware developer to compete with his American counterpart. It is much cheaper to buy an American software program than to develop our own. It is not then surprising that over 90% of the courseware used in our educational institutions comes from the U.S. This raises serious problems from the cultural point of view. Like other, more traditional educational materials, computer-assisted learning and related materials will not enhance Canadian social and cultural development and will not produce appropriate responses to Canadian problems unless they have been produced specifically for this country. In particular, Canadian databases must be available to Canadian classrooms so that people doing their own computer-aided research can do so on the basis of Canadian data; and computer courseware must reflect Canadian conditions, history and personalities in order to enhance the Canadian identity of learners. Government has an obvious concern in correcting this situation.

3. French Language Software

In addition to the problems mentioned above, the development of French language courseware is further constrained by lack of authoring tools available in the French language. In the case of English language, a number of authoring tools have been developed for the U.S. market and these can be imported easily to use in the development of English language courseware.

Thus, there is a need to make the French language computer environment more conducive to the development of French language courseware.

4. R&D

There is little doubt that R&D is essential to the development of Canadian CAL products; for example, a research into areas such as

intelligent response, natural language interfaces, video and sound integration etc. In short term, research is required to meet market needs (e.g. portability of software, interactive graphics). Long term research is required to place Canada in the forefront of courseware development. In addition, R&D is needed to develop special applications of CAL such as specialized work stations for the handicapped. Most Canadian companies are too small to undertake such research in any significant manner. Thus, there is an obvious need to correct this situation.

5. Market Research

While the requirement can be demonstrated for CAL and other relavent technologies in industrial, government and academic training, the full extent of the possible applications of these technologies is far from being well defined. A great deal of market research needs to be done to confirm that: a) a sufficient market really exists for commercial CAL and other technologies and b) exactly what is required by the market and how it can be serviced.

Individual Canadian companies are too small to afford such a comprehensive market research. This could, therefore, be an area where federal government could have a useful contribution, not just in exploring the national market but exploring the international market as well for export opportunities.

6. Market Stimulation/Application Demonstrations

Inspite of many success stories, there remains a fair amount of resistance to the acceptance of CAL in most institutions. This is due to a number of reasons:

Data Processing Departments: Although CAL is a computer based technology, it is much more than simply a data processing technique. The data processing or MIS people (as they are commonly called) do not feel comfortable with the technology and as a result are often not helpful in acquiring and spreading its use through user departments. With the spread of microcomputers, the situation has improved somewhat.

Poor Quality Courseware: Market for CAL is not yet developed to the extent where people feel comfortable in committing large sums of money to courseware development. As a result, there are many pieces of bad courseware around. This has tarnished the image of CAL somewhat.

CAL is a promising technology and it would appear that it could benefit from some initial nurturing from government in way of supporting the development and demonstration of some good applications in the private and/or government sectors.

7. Use of CAL Within Federal Government

As the economy absorbs the new information technology, there will be need for retraining of workers displaced from jobs and for training of workers to fill new positions. As the largest employer in Canada, the federal government has major requirements for retraining if improved efficiencies of operation possible through application of new technologies and procedures are to be realized. CAL will be an important component of the required training facilities. A coordinated approach to the application of CAL within federal government departments and agencies will be a vital factor in the successful development of a Canadian CAL capability that will respond to needs of both government and industry.

8. Information Clearing House

Although CAL and other instructional technologies have been around since the 1960s, the industry is still very young. There are many small companies involved in the development and distribution of courseware. Most provincial ministries are involved in one way or another. Various departments of federal governments are also involved with various aspects of this technology. For example, NRC has long been involved with research and development. Other departments such as DND, Employment and Immigration and Correctional Services have been the major users of these technologies. Since the industry is still young and there are many players involved, many feel the necessity of some kind of coordinating unit which would also act as a clearing house for information on various aspects of CAL. Should this function be carried out by federal government or some other organization such as the recently formed association of courseware developers.

9. Need for Leadership

Since education is essentially a provincial responsibility, most provincial governments have programs and policies of one kind or another aimed at encouraging the use of CAL and others related technologies. There are many companies involved in the development and distribution of CAL products. These are mostly small companies. Various departments of federal governments are involved in various capacities. It appears that the responsibility for the development and exploitation of this potentially powerful technology is too diffused and fragmented and there is no single focal point. Many feel the need for a leadership and think it should be provided by the federal government.

If Canada is to make use of instructional technologies more effectively to meet its growing educational needs, steps must be taken on a wide front to address this set of interrelated issues. Individual efforts aimed at only one element of the problem would not be effective. Policy and programs to encourage applications of information technologies in education and training must have the support and participation of the users, hardware and software suppliers, and the various government agencies charged with the responsibility of Canada's educational system.

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APPENDIX A

EXAMPLES OF INSTITUTIONS WHICH US INFORMATION TECHNOLOGY TO DELIVER EDUCATION AND TRAINING

APPENDIX A

Examples of institutions which use information technology to deliver education and training.

British Columbia

Knowledge Network of the West Communications Authority:

- was established in 1980 as a non profit entity to "establish, maintain and operate a telecommunications network" and to "assist and collaborate with the universities, colleges, provincial institutes, school districts, ministries and agencies of the province in the development and delivery of educational programs and material".

- uplinks to the Anik C satellite from the Network's distribution centre on the campus of the University of British Columbia. The signal is picked up in 190 communities and is available through cable to approximately 85% of the population of B.C.

- is 1983-84 almost 13,000 people enrolled in courses offered through KNOW, while over 300,000 people were regular viewers.

- is staffed with 38 personnel with an annual budget of about $3 million of which $1 million goes towards satellite costs, $800,000 towards network operations and $400,000 towards learning systems and the rest towards administration. Income is derived entirely from the provincial Ministry of Universities, Science and Communications, as well as from the Ministry of Education.

Open Learning Institute of British Columbia:

- was created in 1978 to exclusively serve the home study needs of British Columbians and provide through distance education methods educational opportunities for those who cannot attend traditional institutions.

- annual budget of $8 million of which 90 percent is provided by the province, the remainder comes from student fees; access to KNOW network is free of charge. It has a staff of 150.

- has enrolled since inception more than 50,000 people. The majority of learners are part time and female. Enrolment in career/vocational education represents 40 percent, degree programs represent 35 percent and the remainder is in adult based education.

- in terms of information technologies, it uses television programs as a mandatory component of many of its credit

courses, a computer network to link its three regional offices to its Vancouver office for administration purposes and an extensive use of telephone for student advisory services.

Other institutions which offer distant learning and make use of information technologies are:

- **Simon Fraser University,** Centre for Distance Education
- **University of British Columbia,** UBC Access
- **University of Victoria,** University Extension and Community Relations
- **North Island College**

ALBERTA

Access Network, Edmonton:

- Access Network is the trade name for the Alberta Educational communications corporation which was established in 1973 through the consolidation of a number of existing agencies that provided educational radio and television production and broadcast services. Its mission is to support formal and informal educational services for all age groups through the acquisition, development, production and distribution of educational material, including support for distant education and part-time learning opportunities.
- Access Network's educational TV and radio services are distributed through Anik C satellite to cable systems, rebroadcast systems, Community learning centres and individual homes. Toll free telephone service supports interactive instructional programming while audioteleconferencing systems owned and operated by educational institutions (over 200 audioteleconferencing centres in the province) are used in conjunction with several radio and television supported courses.
- Access Network has a staff of 210 with a budget of approximately $16 million, most of which comes from provincial grants and a smaller amount from program sales.

Athabasca University:

- was established as an undergraduate degree-granting institution in 1970 to remove barriers that traditionally restrict access to university level studies and to increase equality of educational opportunities for all adult Canadians, regardless of their geographical location. It has no on-campus students.

- course packages are primarily print-based, supplemented by radio, TV, audiotapes, seminars, workshops, teleconferencing and computer networking. An audioconferencing bridge with ports at the university links the teleconferencing sites.

- radio and television programs are broadcast by Access Alberta free of charge.

- has a total staff of 271 with a budget of $16 million, 88 percent of which comes from the provincial grants and the remaining coming from student fees.

The following are some of the other distant learning institutions in Alberta which make use of various information technologies:

- **Alberta Hospital Association,** Educational Services Department

- **Lakeland College,** Literacy Education and Reading Network (LEARN)

- **Lethbridge Community College,** Continuing Education Division

- **Mount Royal College,** Credit Extension and Part-Time Studies

- **Northern Alberta Institute of Technology,** Continuing Education Division

- **Southern Alberta Institute of Technology,** Division of Continuing Education

- **University of Alberta,** Continuing Medical Education

- **University of Calgary,** Faculty of Continuing Education

SASKATCHEWAN

University of Regina, University Extension:

- provides opportunities for University education through an extended classroom concept of teaching and learning, to students throughout Saskatchewan who cannot attend campus courses.

- regular classroom instruction is transmitted via the provincial fibre optic network an cooperating cable networks to five community-based classrooms. In addition, videotapes of the sessions are sent to other communities.

- the one way television transmission is supported by an audioconferencing network for questions and feedback.

The following are some of the distance learning institutions in Saskatchewan which make use of information technologies:

- **Saskatchewan Education,** Correspondence School
- **Saskatchewan Indian Fedrated** College
- **Saskatchewan Telehealth Consortium**
- **University of Saskatchewan,** Division of Extension and Community Relations

MANITOBA

Manitoba Department of Education, Educational Television:

Manitoba Educational Television (METV) was established in 1984 within the Education Department's Correspondence Branch as a pilot project to enhance in-school and at-home learning opportunities for Manitobians.

- in the first year of operation tapes are physically delivered to the broadcasters and cable operators. One hour of daily programming is aired.
- adult general programming includes literacy, job skills, German and various health programs.
- the cost is absorbed by the Department. Access to TV is provided free of charge by the local TV operators.
- a program review at the end of pilot project will set directions for METV.

The following are other distance learning institutions in Manitoba which use information technologies:

- **University of Manitoba,** Continuing Education Division
- **Inter-University North**
- **Brandon University,** Office of Continuing Education

ONTARIO

Ontario Educational Communications Authority (TV ONTARIO):

- was established in 1970 to acquire, produce and broadcast educational programs.

- makes its network available to universities and colleges for them to offer both credit and noncredit courses. In the fall of 1985, 16 credit courses were offered through TV Ontario. Approximately 1400 students enrolled in these credit courses. Enrolment for noncredit and part-time learning programs reaches about 12,000 per year.

- more than 35,000 teachers use TVO programming in their classrooms.

- has a full time staff of 470 with a budget of $30 million per year coming mostly from provincial ministries.

Telemedicine for Ontario (TFO):

- the project was funded by the Ministry of Health in 1984 and is jointly supported by the five faculties of Health Sciences from the Universities of Toronto, Western Ontario, Ottawa, Queen's and McMaster to provide continuing health education for physicians, nurses, and other health care professionals through distance education.

- audioconferencing is the primary delivery mode. As many as 46 sites participate in a single teleconference. Any of the participating hospitals can originate sessions from their own studios.

- approximately 140 sites registered for different programs during the 1985-86 academic year, representing about 95,000 participants contact hours.

Humber College, Technology and Open Learning Divisions:

- is a province-wide, cooperative distance education program among community colleges in the areas of occupational safety and occupational hygiene.

- print-based materials, an interactive microcomputer and video system are main components of the learning system. Occasional use is made of teleconferencing and electronic mail.

- study centres which may be person's home, an industrial setting, or an educational institution will link the student via a modem with a centralized computer system.

- project is financed through a provincial grant.

APPENDIX A

The following are the other distance learning institutions in Ontario which use information technologies:

- **Carleton University,** School of Continuing Education
- **Confederation College,** Outreach Project
- **CJRT-FM Radio,** Open College
- **Georgian College,** School of Continuous Learning
- **Guelph University,** Department of Rural Extension and Office of Educational Practice
- **Laurentian University,** Centre for Continuous Education
- **Ministry of Education,** Independent Learning Centre
- **Northeastern Ontario** Telehealth Network
- **Ontario Institute for Studies in Education Computing Services Group**
- **Sheridan College,** Distance Education and Teleconferencing Project
- **Television Language Training** Inc.
- **Toronto Institute of Medical Technology,** Outreach Department
- **University of Ottawa,** Distance Education
- **University of Western Ontario,** Faculty of Part-Time Studies and Interactive Health Services
- **Wilfrid Laurier University,** Telecollege and Part-Time Studies and Continuing Education, Waterloo

QUEBEC

Radio-Quebec:

- established in 1968 as the provincial Educational Communications Authority to acquire, produce and distribute educational TV programs for Quebec.
- operates 17 TV transmitters and repeaters reaching about 6 million viewers or 91% of the population of Quebec.

- over one-third of the programming aired supports the formal education sector. Programming content depends on the Ministry of education.

- has a full time staff of 600, plus 200 short term contract employees. The annual operating budget is in the order of $60 million and is primarily derived from provincial appropriations and some from program sales.

Tele-University, Quebec:

- created in 1972 as part of the Université du Québec System to provide throughout the province the Quebec, university level education through distance teaching methods to people who cannot attend traditional institutions.

- course packages are primarily print-based, but they also include audio-cassettes, TV programs, interactive television, electronic mail and computer services. Two central computers are accessed by about 500 microcomputers provided to students across the province; access to PLATO-based computer assisted instruction is available as well.

- an equivalent of 2400 full-time students are handled annually by the system. Two-third enroll to obtain a degree, the remainder are general-interest students.

- has a staff of 209 with an annual budget of $15 million, of which 85% is provided by the province and 15% through student fees.

The following are some of the other distance learning institutions in Quebec which use information technologies:

- **Université de Montréal,** Centre Audiovisuel, Québec

- **Université du Québec,** Vice Presidency for Communications

ATLANTIC CANADA

Mount Saint Vincent University, Distance Education Via Television (DUET), Halifax:

- was established to enable university-level courses to be more readily accessible to people who may not otherwise have access to them through the use of communications technologies that are most widely available at home or at work.

- live, open broadcast television with simultaneous audioconferencing is the main vehicle to enable students to see and hear from the classroom and provide their verbal input to the session.

- in 1984-85, 367 students enrolled. All are over 25 years old and 90% are female.

Memorial University, Telemedicine Centre, Newfoundland

- the Telemedicine centre operates an audioconferencing system, augmented at some sites with equipment for medical data transmission, such as slow scan TV and ECG.

- the network is primarily used by health groups and agencies, the Faculty of Medicine and the School of Continuing Studies offering both credit and noncredit courses and various government departments.

The following are some of the other distance learning institutions which use information technologies:

- **New Brunswick Hospital** Association Education Services

- **University of Moncton,** Continuing Education Division

- **University of New Brunswick,** Department of Extension and Summer Sessions

- **Atlantic School of Theology,** Continuing Education Department, N.S.

- **Dalhousie University,** Distance Education and Learning Technologies, N.S.

- **Technical University of Nova Scotia,** Continuing Education Division

- **Telecom Canada,** Training Centre

- **Developing Countries Farm Radio Network.**

APPENDIX B

PROFILE OF THE CANADIAN SUPPLIERS OF COMPUTER-BASED TRAINING TECHNOLOGIES

PROFILE OF THE CANADIAN SUPPLIERS OF COMPUTER-BASED TRAINING TECHNOLOGIES

The following gives a brief profile of various suppliers of computer-based training technologies.

BURROUGHS CANADA

Burrough Canada is a subsidiary of a large United States company. Burrough is involved in the manufacturing of computer hardware and the provision of associated services.

Its major products are two authoring systems: THE AUTHOR and PLANT.

CAPA LTD., SASKATOON

CAPA has been established since 1980 and currently employs 12 people. CAPA offers CBT capability base on their CADET desk top system and also CAL courseware for technical training.

CEGIR INC., OTTAWA

CEGIR is a management consulting firm with approximately 225 employees. About a year ago, CEGIR representatives toured the United States and Europe to study CAL suppliers. As a result, they entered into a cross-licensing arrangement with Wicat to distribute their hardware and software in francophone areas. Wicat produces the WISE authoring system and CEGIR have been adapting this for French language use.

COMPRIS INC., OTTAWA

Compris became in incorporated company in 1977. It has 12 employees, both full-time and part-time, and specializes in the CAL and CBT areas. Its activities in the CAL area have included courseware development, consulting, CAL workshops and training in courseware authoring and languages.

COMPUTER-BASED TRAINING SYSTEMS, CALGARY

Computer-Based Training Systems (CBTS) does consulting in the area of general training development from needs analysis through to the implementation of computer-managed learning and CAI systems. The company has 6 permanent employees and was founded in 1981.

The company has developed a computer-managed learning (CML) system which is designed to run on any of the VAX systems. The CML performs the following functions: course organization, maintaining student records, and student testing. It also markets DEC's RENAISSANCE system of which its CML is a major component.

CONTROL DATA CANADA LTD.

Control Data Canada Ltd. (CDC) is the Canadian subsidiary of the U.S. based firm Control Data Corporation. Control Data Corporation sells high technology products and services in 47 countries, employ 60,000 people and has annual revenues in excess of $4 billion.

CDC's major CAI activity is centered on its PLATO system for the authoring and delivery of CAL material. This system has been developed over a 19 year period and was introduced to Canada about 8 years ago. The PLATO division in Canada has 60 employees, of whom 10 are in marketing and 50 are in areas such as needs analysis, consulting and instructional design. The company's U.S. PLATO operations employ 300 people.

Users of PLATO in Canada include the following:

- Ontario Hydro - for training nuclear power station operators
- General Motors of Canada - courses in areas such as robotics and pneumatics
- Ontario Ministry of Correctional Services
- Air Canada
- Esso Resources Canada - for training in oil spill recovery
- Edmonton Police
- University of Quebec
- University of Alberta.

FORCETEN ENTERPRISES INC., HALIFAX

Forceten Enterprises which was founded in 1984, develops and markets computer software products. It is 73% owned by Maritime Telegraph and Telephone. It has 140 employees and claims to be the largest computer service organization in the Atlantic Provinces.

The company's major CAL activity to date has been the development of its Computer-Based Training System (CBTS). Future plans include the development of a natural language interface for the CBTS to assist SMEs (Subject Matter Experts) in its use.

GENERAL CYBERNETICS CORP., WHITE ROCK, B.C.

General Cybernetics Corp. was founded in 1982 and now has 43 permanent employees. They have three major product areas at present,

namely, CAL in preventive medicine, videotex systems and training systems. They are involved in the creation, marketing and delivery of these products.

To date their only area of commercial application of CAL has been in the field of preventive medicine. They are currently designing a new videotex host computer to support the use of CAL in homes.

HOMECOM, TORONTO

Homecom has been in existence for about 7 years. It is the successor of Edcom which started in 1970. Homecom is a supplier of CAL systems using CAN-8 author language. It has six permanent employees.

Homecom's main activity centres on the development, marketing and delivery of CAN-8 systems. They convert computers into CAL machines to run CAN-8 and claim that they can achieve a dramatic deliverability of courseware for a given power of CPU.

HONEYWELL LTD.

Honeywell Ltd is a part of a large U.S. based multinational computer company, Honeywell Inc. The parent company has 96,000 employees and the Canadian subsidiary has 3500 employees, mostly in Toronto, Montreal and Ottawa.

Honeywell's involvement with CAL dates from a 1979/80 PILP contract with NRC under which the NATAL author language was transferred to them for development and marketing.

IBM CANADA LTD.

Although marketed in Canada, IBM's CAL authoring systems are developed in the U.S. IBM's principal CAL activity is the marketing of authoring and delivery systems for their mainframe and personal computers. For their mainframe computers, they have developed the Interactive Instructional Presentation System (IIPS) to deal with the delivery function and the Interactive Instructional Authoring System (IIAS) to assist in courseware development. These systems were introduced in 1980. For the IBM PC family, the company contracted with Computer Systems Research Inc. to develop their Personal Computer Instructional System (PCIS).

LOGIDISQUE INC., MONTREAL

Ligisdisque was the first producer of microcomputer software in 1982. Logidisque's CAL activity has been quite limited thus far. They have produced basic programs in learning French, Algebra and Geography which are available off-the-shelf. They do their programming in BASIC and in machine code rather than using authoring languages or systems.

METAVISION, MONTREAL

Metavision is the French-language arm of Softwords. They have been in business for about 2 years and have 4 full-time employees. In addition to marketing Softword's products, Metavision has been working in the areas of courseware development and the development of a NATAL-based authoring system.

MICROTEL LEARNING SERVICES, BURNABY, B.C.

Microtel Learning Services in an independent service of Microtel Ltd., a manufacturer of telecommunications equipment. Microtel is a wholly owned subsidiary of the British Columbia Telephone Company and is a member of the worldwide GTE family.

Microtel Learning Services have between 20 and 25 people in the instructional design and project development area. Many of these are employed on CBT projects. Currently, they use Hazeltine Corp's TICCIT system for courseware development.

SOFTWORDS, VICTORIA, B.C.

Softwords specializes in the areas of CAL and CBT. it also specializes in the use and development of the NATAL language and provides associated training and consultation services. The company has 16 employees.

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