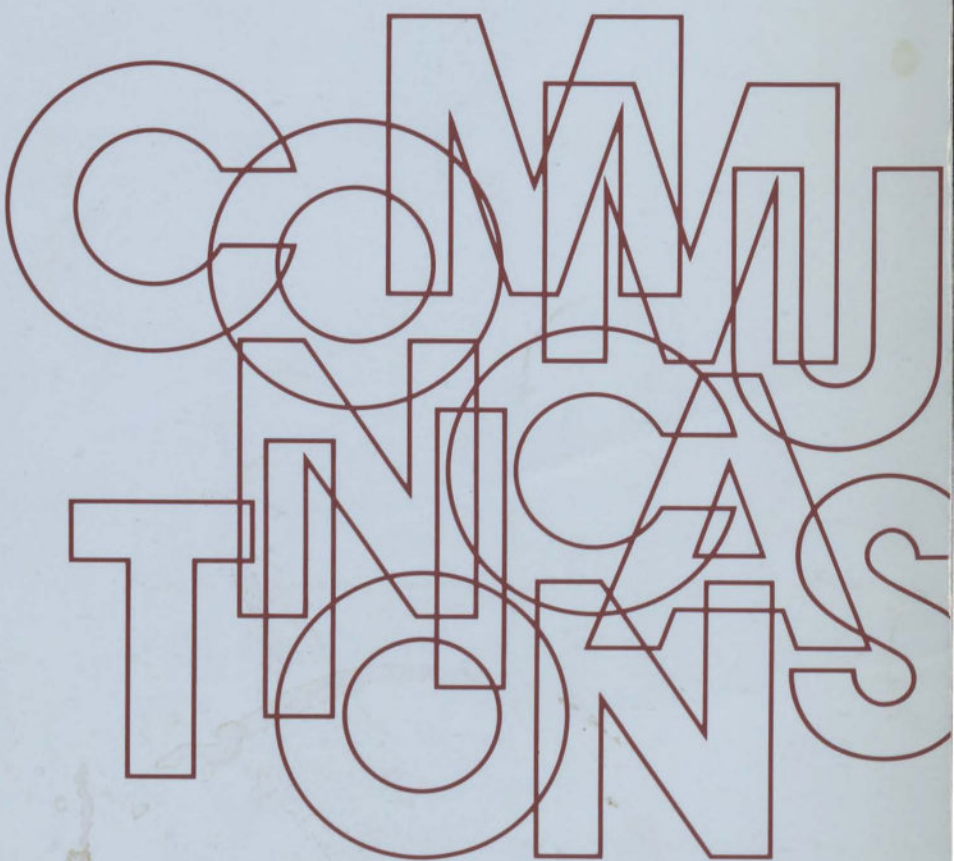
The supply of computer communications equipment in Canada



Canada

Government of Canada
Department of Communications

Gouvernement du Canada
Ministère des Communications

THE SUPPLY OF COMPUTER COMMUNICATIONS EQUIPMENT IN CANADA

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In this rapidly changing environment of technology, company structure and products, nothing is static, and therefore the information presented in this report is always subject to change

CONTENTS

LIST OF TABLES

CHAPTER 1

INTRODUCTION

During the past several years, many observers have emphasized that Canada, along with other industrialized countries, is on the verge of an information revolution. Noting the growing importance of information-related activities in our daily work, they have concluded that we shall soon have an economy characterized as much by the exchange of information as by transactions in goods and services. Within such an economy, the quick and efficient exchange of information will be vital to Canadian competitiveness; Canada's communications industry will play an increasingly important role. This report focuses on one sector of that industry — the suppliers of computer communications equipment.

In 1974, the Department of Communications (DOC) published a working paper entitled Canadian Telecommunications Carriers and Their Suppliers (the "Red Book"). Since then communications technology has evolved so rapidly, that much of the information in that report has been overtaken by events. For this reason, in December of 1979 the department published The Principal Canadian Telecommunications Carriers: Expenditures on Telecommunications Equipment, 1973-82. This was followed in 1981 by The Supply of Communications Equipment in Canada (the "Pink Book"), which continued the process of updating the 1974 report. The present report is a sequel to the 1981 volume.

How is 1982 different from 1974? Today the western world is in the deepest economic recession in more than 40 years. In the midst of these difficulties, however, the information handling industry, continues to show strong growth in employment and plant investment. Information handling represents the convergence of four technologies that were once considered to be quite separate. Two of these, data processing and word processing, have converged to become known as "information processing". The other two technologies, voice communications and computer communications, are converging to become "information communications".

There are two primary driving forces that account for the strong growth of information handling products and services during this period of economic difficulties. One is the need to improve office productivity. The other is

the need to reduce "information float". ("Information float" is the inability to use information because it is somewhere between the source and the person using it.)

Productivity improvement in the 1980s is particularly important for Canada because this country's performance in productivity is by far the worst among the major industrialized regions of the western world (Tables 1.1 and 1.2). As the cost of knowledge workers increases, companies are focusing increasingly on the need to enhance office processes and productivity while reducing information float. Consequently, Canadian companies whose products satisfy these needs will have an excellent chance of success in the 1980s.

This report is by no means exhaustive. It is intended to illustrate the impact of a variety of existing and emerging information handling technologies on markets and opportunities for future growth. It focuses, in particular, on the computer communications aspects of those technologies.

"Computer communications" refers to communications between terminals and a computer to obtain a computer-generated product or service; between a computer and other computers (including word processors and other computer-based workstations); between a magnetic tape drive and a computer; and so on. In each case the transmitted data is processed at a computer.

"Computer communications equipment" in this report refers to devices used for computer communications including communications switches, concentrators, multiplexors, terminal controllers, terminals, computer front-end equipment, modems, couplers, PACXs, facsimile devices, communicating word processors, local area networks, videotex, electronic messaging, and computer-based communicating workstations. These devices generally fall into three basic categories: switching, transmitting, and terminating equipment.

This report identifies 62 companies supplying computer communications equipment in Canada. It divides these companies into two groups -- those that are known primarily for their communications activities and those known primarily for data processing or word processing.

The report isolates for detailed analysis a few companies in each group with outstanding market success and provides a brief overview of each of the other companies identified.

Thus, Part I deals with the communications equipment suppliers. Within Part I, Chapter 2 provides an overview of the communications equipment industry in Canada. Chapters 3 and 4, respectively, provide detailed analyses of Northern Telecom and Gandalf. These companies are Canadian-owned multinationals with outstanding records of market penetration in the United States and other highly competitive markets. Part I concludes in Chapter 5 with a brief description of the other major communications industry suppliers that provide computer communications equipment.

Part II deals with the data processing and word processing suppliers who provide computer communications equipment. Within Part II, Chapter 6 provides an overview of the data processing and word processing equipmenv industry.

Chapter 7 and Chapter 8, respectively, provide detailed analyses of IBM and Digital Equipment Corporation. These companies are American-owned multinationals which dominate the sectors of the Canadian data processing markets in which each competes. IBM dominates the large-scale general purpose computer market (the main frame market) and is also a significant supplier of computer communications equipment. Digital Equipment is by far the largest minicomputer supplier and its computer-based equipment is frequently used in computer networks.

Chapter 9 provides a detailed analysis of AES Data Ltd., a Canadian-owned supplier of stand-alone and communicating word processors. AES has given Canada worldwide recognition as a major competitor in this field. Part II concludes in Chapter 10 with a brief description of each of the major suppliers that provide computer communications equipment.

Part III provides the conclusions in this report. Within Part III, Chapter 11 looks at Canada's penetration of international markets for computer communications equipment and the factors necessary for continuing success. Chapter 12 summarizes this report's observations and conclusions, and looks at the limits imposed by the small size of the Canadian market and the opportunities and problems related to foreign sales.

Table 1.1

ANNUAL PERCENTAGE GROWTH IN REAL GROSS DOMESTIC PRODUCT PER EMPLOYED PERSON, 1950-1974 AND 1974-1980

	Japan	EEC*	United States	Canada
1950-74	7.5	4.3	1.9	2.5
1974-80	4.0	2.5	0.9	0.1

*European Economic Community (EEC): Includes only the four largest countries: France, West Germany, Italy and the United Kingdom.
Source: U.S. Department of Labor, Comparative Real Gross Domestic Product, 1950-1980 (Washington: Bureau of Labor Statistics, Office Productivity and Technology, May 1981).

Table 1.2

ANNUAL PERCENTAGE GROWTH IN OUTPUT PER HOUR IN MANUFACTURING, 1950-1974 AND 1974-1980

	Japan	EEC*	United States	Canada
1950-74	9.6	4.9	2.6	4.2
1974-80	7.2	3.5	1.8	1.7

Source: U.S. Department of Labor NEWS (Washington Bureau of Labor Statistics, May 20, 1981).

PART I

THE COMMUNICATIONS EQUIPMENT SPECIALISTS

CHAPTER 2

THE COMPUTER COMMUNICATIONS EQUIPMENT INDUSTRY

In 1980, the computer communications equipment industry generated revenues estimated to be $566 million, up 26 percent from $451 million in 1979 (Table 2.1). Evans Research Corporation forecasts that average annual growth will be about 26 percent per year and revenues will reach about $2.8 billion in 1987.

Revenues are generated from the sale of two basic types of equipment, terminals and data communications devices.

Thirty-six firms have been identified as terminal suppliers in Canada (Table 2.2). Their terminal equipment revenues totalled $355 million in 1980, up 23 percent from $290 million in 1979. This growth rate for the terminals segment of the industry is expected to continue through 1987.

Terminals come in many types. There are printers that are strictly computer output devices and keyboard devices that are strictly for computer input. There are Cathode Ray Tube (CRT) devices that are used for both input and output purposes. Some terminals are programmable ("intelligent" terminals); others are non-programmable ("dumb terminals").

IBM dominates the terminal market in Canada, with an estimated market share of 47 percent in 1980. The remainder of the market is fragmented; no supplier holds more than an 8 percent share.

About 120,000 terminals averaging in the $3,000 range accounted for most of the $355 million in terminal revenues in 1980. At the current annual growth rate of 23 percent, about 511,000 terminals will be shipped in 1987, with a total value of about $1.5 billion.

Forty-five firms have been identified as data communications equipment suppliers in Canada (Table 2.3). Their revenues totalled $211 million in 1980, up 31 percent from $161 million in 1979.

Data communications equipment includes data communications switches, concentrators, multiplexors, terminal controllers, computer front-end equipment, modems, acoustical couplers, private automatic computer exchanges

(PACXS), facsimile equipment, communicating word processors and computers used in communications networks. It also includes local area networks and videotex equipment, electronic messaging equipment, end-user work stations (such as Displayphones) and certain distributed processing computing equipment.

The telephone companies tend to dominate this segment of the industry. Bell Canada is the largest single supplier, in 1980 accounting for $42 million or 19 percent of the total. When the data communications revenues of the other members of the TransCanada Telephone System are added to the total, the telephone companies account for about $73 million or 35 percent of the data communications equipment market in 1980.

At the current annual growth rate of about 30 percent, data communications equipment revenues will reach about $1.3 billion in 1987.

Suppliers of computer communications equipment in Canada can be divided into two groups. First, there are those whose traditional market base is the information processing business. These suppliers — including IBM, Digital Equipment Corporation and AES Data Ltd. -- are dealt with in Part II of this report. Second, there are those suppliers whose traditional market base is the communications business. These suppliers, including Northern Telecom and The Gandalf Group are dealt with in the remainder of Part I.

Table 2.1

COMPUTER COMMUNICATIONS EQUIPMENT INDUSTRY IN CANADA

(For details see Tables 2.2, 2.3)

	Estimated C$ Millions			Percentage of Annual Growth	
	1979	1980	1987	1979-1980	1980-1987
Terminal Equipment	290	355	1500	23	23
Data Communications Equipment	161	211	1300	31	30
	451	566	2800	26	26

Source: Evans Research Corporation

Table 2.2

SUPPLY OF TERMINAL EQUIPMENT IN CANADA

(Excludes foreign sales)

	Estimated Terminal Equipment Revenues (C$ Millions)		
	1979	1980	Ownership
IBM Canada Ltd.	136.8	165.5	U.S.
Sperry Inc.	24.7	27.9	U.S.
NCR Canada Ltd.	23.4	27.6	U.S.
CNCP Telecommunications	23.4	25.5	Can.
Digital Equipment of Can. Ltd.	10.8	14.8	U.S.
Ahearn & Soper Ltd.	7.9	10.4	Can.
Lanpar Ltd.	5.5	9.0	Can.
ITT Canada Ltd.	7.4	8.8	U.S.
Tektronix Canada, Inc.	6.7	6.8	U.S.
Data Terminal Mart	3.8	6.8	Can.
Cdn. General Electric Co. Ltd.	5.0	6.1	U.S.
Burroughs Inc.	3.3	4.1	U.S.
Honeywell Ltd.	3.0	3.6	U.S.
Philips Data Systems Ltd.	1.5	2.7	NETH
TRW Canada Ltd.	2.5	2.7	U.S.
Centronics Inc.	2.8	2.7	U.S.
Zentronics Ltd.	2.5	2.5	Can.
Xerox of Canada Ltd.	2.4	2.4	U.S.
Hewlett-Packard (Canada) Ltd.	1.7	2.3	U.S.
Norpak Ltd.	1.1	2.2	Can.
Westinghouse Canada Inc.	1.5	2.1	U.S.
Four Phase Systems Ltd.	1.9	2.0	U.S.
Memorex Canada Ltd.	1.4	1.9	U.S.
Electrohome Ltd.	NIL	1.8	Can.
Texas Instruments Canada Ltd.	1.4	1.6	U.S.
Volker-Craig Ltd.	.8	1.6	Can.
Anderson Jacobson Canada Ltd.	1.0	1.6	U.S.
Plantronics Canada	1.0	1.5	U.S.
Wang Canada Ltd.	.6	1.2	U.S.
Cybernex Ltd.	.9	1.2	Can.
Perkin-Elmer Data Systems Can. Ltd.	1.1	1.2	U.S.
Comtern Inc.	.8	1.1	Can.
Pertec Computer Corp. (Canada) Ltd.	.5	.6	U.S.
ICL Computers Canada Ltd.	.5	.6	U.K.
Paradyne Canada Ltd.	.1	.4	U.S.
Harris Systems Ltd.	.1	.2	U.S.
Total	289.8	355.0	
Growth		23%	

Source: Evans Research Corporation

Table 2.3

SUPPLY OF DATA COMMUNICATIONS EQUIPMENT IN CANADA

(Excludes foreign sales)

	Estimated Data Communications Equipment Revenues (C$ Millions)		
	1979	1980	Ownership
Bell Canada	36.9	42.2	Can.
Northern Telecom Ltd.	17.0	18.0	Can.
General Datacomm Ind. (Can.) Ltd.	9.1	12.9	U.S.
Xerox of Canada Ltd.	9.2	12.0	U.S.
Alberta Government Telephones	9.6	12.0	Can.
British Columbia Telephone	9.4	11.3	U.S.
IBM Canada Ltd.	8.7	10.5	U.S.
AES Data Ltd.	5.2	9.3	Can.
The Gandalf Group	4.2	8.1	Can.
NCR Canada Ltd.	5.3	6.2	U.S.
Wang Canada Ltd.	2.9	5.8	U.S.
Philips Data Systems Ltd. (Micom)	3.0	5.5	NETH
ESE Ltd.	2.4	4.7	U.S.
International Systcoms Ltd.	1.4	3.6	Can.
Siemens Electric Ltd.	1.5	3.0	FRG
AEL Microtel Ltd.	2.7	3.0	U.S.
Can. General Electric Co. Ltd.	1.8	2.8	U.S.
Cableshare Ltd.	2.0	2.7	Can.
Develcon Electronics Ltd.	1.3	2.7	U.S.
Honeywell Ltd.	2.2	2.6	U.S.
3M Canada Inc.	2.1	2.5	U.S.
Nixdorf Canada Ltd.	1.8	2.2	FRG
Manitoba Telephone System	1.7	2.0	Can.
Sperry Inc.	1.6	1.9	U.S.
Control Data Canada Ltd.	1.5	1.9	U.S.
Digital Equipment of Canada Ltd.	1.4	1.9	U.S.
Maritime Telegraph and Telephone	1.7	1.8	Can.
Texas Instruments Canada Ltd.	1.4	1.6	U.S.
New Brunswick Telephone Company	1.4	1.5	Can.

(Continued)

Table 2.3
(Continued)

	Estimated Data Communications Equipment Revenues (C$ Millions)		
	1979	1980	Ownership
Hewlett-Packard (Canada) Ltd.	1.1	1.5	U.S.
TRW Canada Ltd.	1.4	1.5	U.S.
Anderson Jacobson Canada Ltd.	.9	1.5	U.S.
Plantronics Canada	1.0	1.5	U.S.
Hemton Corporation	.7	1.3	Can.
Saskatchewan Telecommunications	1.1	1.3	Can.
MLPI Business Systems Inc.	.5	1.2	U.S.
Paradyne Canada Ltd.	.4	1.2	U.S.
Quebec Telephone Company	1.0	1.1	U.S.
ITT Canada Ltd.	.7	.9	U.S.
Burroughs Inc.	.7	.9	U.S.
Memorex Canada Ltd.	.4	.5	U.S.
Hitech Canada Ltd.	.2	.4	Can.
Westinghouse Canada Inc.	.1	.2	U.S.
Louis Albert & Associates Ltd.	.1	.2	Can.
Signatel Ltd.	.1	.1	Can.
Total	160.9	211.5	
Growth		31%	

Source: Evans Research Corporation

Data Communications revenues include: data communications switches, concentrators, multiplexors, terminal controllers, computer "front-end" communications equipment, modems and acoustical couplers, PACXs, facsimile equipment, communicating word processors, local area networks, videotex, electronic messaging equipment, end-user work stations (such as Displayphones) and certain distributed processing equipment. Also included in these figures are intelligent terminals; all other types of terminals are shown in Table 2.2.

CHAPTER 3

NORTHERN TELECOM LIMITED

Northern Telecom Limited is the principal manufacturer of telecommunications equipment in Canada and the second largest in North America. It is also a significant manufacturer of information processing equipment. Revenues in 1981 were $2.57 billion, up 25 percent from $2.05 billion in 1980.

Northern Telecom (along with IBM) is one of the two companies in the world that are best positioned to achieve success in the market for integrated computer, communications and office automation systems.

At the end of 1981, Northern Telecom employed 35,444 people around the world, including 20,776 in Canada. The corporation operates 49 manufacturing plants worldwide, including 31 in Canada, 16 in the United States, two in Malaysia, and one each in Brazil, England and the Republic of Ireland.

At the end of 1981 Bell-Northern Research Ltd. (BNR), which is 70 percent owned by Northern Telecom and 30 percent owned by Bell Canada, had 3,058 employees in Canada and the United States. By mid-1982, the number had grown to 3,200. BNR is by far Canada's largest industrial research and development organization.

As of mid-1982, about 2,300 BNR research and development personnel worked in the Ottawa, Ontario area in three laboratories. In addition, BNR had R&D laboratories in Montreal, Quebec; Toronto, Ontario; Edmonton, Alberta; Mountain View, California; Ann Arbor, Michigan; Richardson, Texas; and Raleigh, North Carolina.

About 60 percent of Northern Telecom's R&D effort is carried out by BNR. The remaining 40 percent is done through 22 R&D centres in Northern Telecom's manufacturing plants in North America and the United Kingdom. In total, Northern Telecom will spend about $230 million on R&D in 1982.

WORLD CLASS CANADIAN MULTINATIONAL

On May 6, 1981 Northern Telecom Limited received the International Industrial Award, the highest annual honour presented by the Institut

international de promotion et de prestige, of Geneva, Switzerland. Excerpts from the institute's citation show why Northern Telecom has achieved worldwide recognition as a leader in its field.

> Northern Telecom has pioneered in many significant stages of the development of computer technology in telecommunications, each time setting important technological precedents, such as: the use of stored program control; the development of switching systems controlled by computer software; the launching of a full line of digital transmission and switching systems transmitting with equal quality voice, video and data signals; making operational the first Centralized Automated Loop Reporting System (CALRS), and presently leading the field in the development of optical fiber and computer-aided design systems.
>
> Northern Telecom foresaw the convergence of computers and telecommunications, based on the common technology of integrated circuits and software control. Because of its exceptional awareness of the evolution towards decentralization through increased use of remote data processing methods and communications between computers, Northern Telecom has become a leader among those who design, manufacture and market integrated information networks which are the basis of what we now call the Intelligent Universe.

THE DECADE OF TRANSITION

As the Institute's citation shows, in terms of international stature, penetration into foreign markets and many other measures, Northern Telecom is Canada's most successful high technology multinational firm. The seeds of Northern Telecom's success through the eighties were sown early in the previous decade.

In 1970, Northern Telecom was a wholly owned subsidiary of Bell Canada operating with marginal effectiveness, without a significant research and development activity, selling products based almost entirely on technology imported from the United States and, with the exception of a growing presence in Turkey and almost insignificant exports to the United States, selling in the domestic Canadian market.

Entering the eighties, Northern Telecom had become a public company, of which Bell Canada owned 55 percent of the common shares, with a major investment following in the United States as well as in Canada.

Northern Telecom has become acknowledged, by its competitors and by the marketplace, as a technological leader in the global telecommunications industry, with proprietary products accounting for 77 percent of total sales.

By 1980, Northern Telecom's products were selling around the world. It had become a successful multinational manufacturer with half of its plants outside of Canada. These plants were providing a steady market for components made by, and exported from, Canadian factories. They represented an essential base from which the company was able to support some 2,500 Canadian Northern Telecom jobs maintained by exports, which in 1982, accounted for 5,000 jobs in Canada.

Consolidated sales quadrupled over the decade, to $2.0 billion in 1980. Net earnings increased tenfold. One simple measure of this remarkable financial turnaround was that in 1971, net earnings per-sales-dollar were only seven-tenths of one percent. In 1979 they were 6 percent and the average over the five-year period ending in 1979 was 6.6 percent.

This was a remarkable financial turnaround because it was accomplished during a period in which the corporation grew and expanded its operation and facilities at a rate rarely seen in Canada. From 12 plants on January 1, 1970 Northern Telecom grew by January 1, 1980 to 55 plants in operation, six new plants or expansions under construction and a further three facilities announced to begin construction in 1980. Every indication was that this growth in manufacturing capacity would continue (albeit at a slower pace) as the company moved towards its five-year growth target of $5 billion in sales, with a 7 percent return on sales, by 1985.

R&D - THE KEY TO SUCCESS IN HIGH TECHNOLOGY MARKETS

Northern Telecom considers its single most important financial decision during the seventies to have been to increase annual investment in research and development, (in 1982 running at more than 8 percent of sales). This is a level traditionally uncommon in the hardware-oriented telecommunications industry.

This commitment led to the establishment, in 1971, of Bell-Northern Research Ltd., today by far Canada's largest privately owned industrial research centre,

and one of the most effective in the world in terms of profitable new products conceived and developed. Northern Telecom considers BNR the true key to its past and future successes.

The work of the people in BNR made Canada technologically independent in telecommunications. It provided Northern Telecom with the most technologically advanced products to sell to all Canadian telephone companies. It enabled Northern Telecom to successfully penetrate the ultra-competitive U.S. market and even breach, on the strength of technological superiority, some of the otherwise closed markets of Europe.

PRODUCT EVOLUTION

Two products developed by BNR and introduced early in the decade were the base of Northern Telecom's initial success in the U.S. market: the Pulse electronic private branch exchange, and the SP-1 electronic cenvral office switching systems.

Pulse became the largest-selling PBX of its size in the U.S. market and SP-1 was, at its peak, the largest selling stored-program-controlled analog switching system in North America, outside of the AT&T system.

As Northern Telecom left the seventies, two other BNR products, the SL-1 digital business communications system -- a sophisticated PBX for the eighties -- and Digital Multiplex System (DMS) central office switch, were establishing even more impressive market records and achievements.

Northern Telecom attributes its financial turnaround, well underway by the mid-seventies, to two principal elements: the technological superiority and marketing success of such key products as SP-1 and Pulse, and the sustained annual productivity improvement in the company's Canadian manufacturing facilities, often running at twice the average annual rate of the Canadian manufacturing industry (Table 3.4).

Northern Telecom's productivity improvement record in Canada was, in part, due to the large number of new manufacturing facilities built during the decade. Outmoded plants were replaced in Northern Telecom's oldest

manufacturing centres with modern facilities while the company expanded out of traditional manufacturing centres into the Maritimes and Western Canada.

By 1980, Northern Telecom was far into its second phase of expansion in Western Canada, with a divisional headquarters, a new plant and research laboratories announced for Alberta, and an optics system division and manufacturing plant to be located in Saskatchewan. These new facilities brought to 10 the number of plants in Western Canada.

In total, 13 new plants were built, leased or purchased in Canada during the seventies; $314 million was invested in new plants and equipment.

Northern Telecom also points to its own R&D staff when giving credit for its spectacular productivity improvement. Its industrial engineers and business systems people were constantly developing new and better manufacturing and quality control methods. Its product and development engineers improved the quality and performance of their products while re-engineering and redesigning them to be manufacturable at lower cost.

The benefits of the resulting manufacturing and product competitiveness were passed along to Northern Telecom's customers. Throughout the seventies, Northern Telecom held its net product price increases (that is, price increases less price reductions), to well below the annual rate of increase of the Canadian Consumer and Wholesale Price Indices.

DMS -- GOING DIGITAL

Northern Telecom's operational, technological and financial success is bound up in the decision taken in the seventies to move from analog to digital technology. This may be judged, in future years, to be one of the most critical and far-reaching decisions ever taken by Northern Telecom management.

This decision determined not only the course of the corporation's future and its success in world markets, but also the course of the industry's technological development. In addition, because of Northern Telecom's influence in international markets, it probably accelerated the convergence of the

telecommunications and computer industries and opened up telecommunications markets to a host of new, technologically advanced competitors from the computer industry.

Northern Telecom announced its decision to the industry in May 1976, at which time the company committed itself to introduce, by year-end 1980, a full line of digital transmission and switching systems. The corporation beat its own formidable introduction schedule by one year. By the end of 1980, it was still the only manufacturer in North America producing a complete line of digital switching systems.

The costs of the DMS-100 family were felt keenly during 1980. The usual and expected problems involved with bringing a new product on stream resulted in delays so that by the end of 1980, only 30 DMS-100 systems were in service.

These problems, which reduced Northern Telecom's earnings in 1980, were only temporary. Entering 1981, demand continued to be strong for the large digital systems. DMS revenues grew from $36 million in 1978 and $127 million in 1979, to $269 million in 1980, more than offsetting a decline in the sale of the older analog switching products.

In the first quarter of 1981, Northern Telecom reported that their DMS products had turned the corner and the line was operating profitably. There was a very substantial increase in DMS revenues in the full 1981 year, with significant and growing profits.

Northern Telecom has paid the necessary dues to enter the digital market and with the DMS product line operating profitably, the company has a sizeable lead on its competitors in digital switches. The corporation positioned to compete effectively for market share in the "Intelligent Universe.

At the time of publication, Northern Telecom announced the OPEN (Open Protocol Enhanced Networks) World concept. This is their latest advance towards the Intelligent Universe, and comprises a universal planning framework for the design of information management systems, and the development and introduction of new and enhanced communication products and services.

PRODUCTS AND SERVICES FOR THE INTELLIGENT UNIVERSE

A communications network consists of two or more points joined together for the transmission of information. Many communications networks may be interconnected to form a universal information distribution system. Northern Telecom refers to this emerging international web of electronic communications networks as the "Intelligent Universe".

> Northern Telecom defines its Intelligent Universe as follows:
>
> Information in the form of words, images, voice or numbers enters the networks through integrated multifunction information systems. These systems are based on data terminals, computers, word processing machines, graphics-reproduction equipment, electronic telephones and other yet-to-be-invented electronic equipment. The information then travels through the networks where intelligent switching and tranmission systems electronically effect and control its flow among users.

Northern Telecom is positioned to compete in virtually every segment of the market encompassed by the Intelligent Universe. The paragraphs that follow describe the products and services the corporation offers.

The Public Telecommunications System

For most of the past 100 years, the public telecommunications system has been the only real global communications network. Thousands of telephone companies operate parts of this network.

The public telecommunications network consists of four basic elements:

TERMINALS -- telephones, Displayphones and many other instruments which enable individuals to send and receive information;

LOCAL LOOPS -- pathways that transmit a voice, data or image message from terminals to local switching centres, called CENTRAL OFFICES, or to other terminals. This connection may be made directly, or through another transmission medium, such as microwave radio. Loops are most frequently pairs of copper wire, but sometimes coaxial cable. In the growing number of new applications, they may be glass fibre cables (which offer greater information carrying capacity or bandwidth);

SWITCHES -- routing system (such as members of the DMS-100 family) which direct messages throughout a network to their destinations;

TRUNKS -- highways of telecommunications networks, usually consisting of copper, or increasingly glass fibre, cable or microwave radio, that connect switches -- sometimes across town, sometimes across continents.

Specialized Common Carrier Networks

As early as the 1950s, some organizations were leasing private telephone lines (tie lines) from the telephone companies to reduce communications costs. At the beginning of the 1960s, as computer technology advanced, businesses and other organizations increasingly developed new applications for computers.

Driven also by the need to curb their rising communications costs, these organizations created their own privately operated data networks within the public telecommunications networks in the United States and Canada. The trend began slowly with the first private data networks being created for special purposes, such as airline reservations systems.

The growth of distributed data processing (DDP) in the 1970s dispersed processing power and storage out of single, large computer centres into smaller decentralized systems generally close to where the data originated. This gave further impetus to the proliferation of private networks to link these distributed systems.

Today, voice and data networks are still generally distinct operations. One of the major developments in the 1980s will be the integration of these private networks into single telecommunications systems. Northern Telecom is committed to leadership in this market.

Recognizing the opportunity to create special networks within the public system to offer customized and economical long-distance communications systems, several companies in the United States (such as Tymshare Inc. and MCI Corporation) had by the mid-1970s established what are referred to as specialized common-carrier (SCC) networks.

These networks use the common carriers, (i.e. the telephone companies) local loops and switches to transmit information from their customers' terminals to the SCCs' long-distances switches. They then carry the information over their own or leased facilities, and thus generally avoid the public trunk facilities which are usually tariffed at higher rates.

As the principal supplier to Bell Canada and the other companies in the TransCanada Telephone System (TCTS), Northern Telecom grew up with the evolution of the public telephone network. TCTS is widely recognized as the finest national telecommunications system in the world. During the past decade, Northern Telecom, drawing on its years of experience with TCTS, has also become a major supplier of telecommunications systems in the United States and around the world.

The corporation designs, manufactures and sells virtually the full range of telecommunications equipment used in public and SCC networks. It is the second largest — next to Western Electric -- of a few corporations in North America capable of supplying such a broad range of telecommunications products and complete communications networks. It ranks about sixth among such companies in the world.

Taking advantage of the expertise it has gained during nearly a century of meeting the requirements of the public network, Northern Telecom is now successfully pursuing the vast and growing opportunities in the United States offered by the development of private voice and data networks and the SCCs.

SL-1 -- The Digital Business Communications System

Designing and installing communications networks requires the integration of many devices and systems. Individual private networks must work in harmony with the public telecommunications network. This integration is critical. It is a complex function which requires an understanding and mastery of such disciplines as traffic and transmission theory, signalling compatability, and network structures and operations.

A critical and essential difference between an ad hoc equipment supplier and what Northern Telecom, as a systems supplier, provides is that Northern Telecom can draw on the nearly 100 years' experience it has gained working with Bell

Canada, its parent company, designing, integrating, installing, operating and maintaining all types and elements of complex networks.

This experience gave birth to a major new digital communications system in June 1973 when Northern conceived, and BNR began to develop, the SL-1.

The SL-1, in its most basic role, is a private branch exchange (PBX), that controls internal networks. It serves as the switching system for calls within the building in which it is installed. Acting similarly to a telephone company's central office switching system, the SL-1 also connects calls to trunk lines.

Following a field trial begun in early 1975, the SL-1 was placed into commercial service in December 1975. By January 1982, six years after its introduction, there were more than 3,000 SL-1s in service in Canada, the United States and 33 other countries. By early 1982, SL-1 was serving about 1.5 million telephone lines.

From the outset, Northern Telecom planned to make the SL-1 far more than a PBX, and therefore has always referred to it as a digital business communications system. The SL-1 has evolved continuously since its 1975 introduction, and is still evolving. Northern Telecom initially invested about $11 million in research and development to bring the SL-1 to market. This amount is estimated to be only one-quarter or one-fifth of the total that has been, and will be, spent to add capabilities and take full advantage of technological developments.

In 1977, Northern Telecom extended the SL-1's role as an internal network switching system by adding remote peripheral equipment. This enabled a single SL-1 system to serve several remote locations linked to it by digital transmission through cable or microwave radio.

SL-1 Data Feature - Voice and Data in One System

In 1980, Northern Telecom supplied its first commercial SL-1 with a Data Feature providing integrated, simultaneous voice and data switching capability. Primary office applications in which the SL-1 Data Feature will facilitate voice and data communications are:

- Inquiry/Response -- The SL-1 Data Feature allows one terminal, such as the Displayphone, to dial into many other devices for instant information retrieval. With this capability, answers to phoned-in questions can be obtained without interruption to the voice call itself.

- Word Processing -- In both local (internal) and remote (external) situations, communications between word processors can be undertaken for such activities as document transmission, sharing storage, sharing printers, and duplicating information. With the SL-1 Data Feature, computers with word processing capabilities can be accessed by compatible terminals.

- Time Sharing -- Terminals can dial in to both local and remote computers for programming or applications processing.

SL-10 Data Packet Switching System

While the SL-1 was under development in 1974, Bell Canada, BNR and Northern Telecom were also working on a system to serve as the central node for public and private data networks. The result of BNR's work, derived from the computer processor and memory developed and proven for the SL-1, was the SL-10 packet switching system.

Data is often sent on a telephone line dedicated (held open) to the user for the duration of the transmission just as for a regular telephone voice call. This method, called line or circuit switching, is efficient for high-volume, continuous data transmission. However, in a growing number of applications, such as credit card verification, data is transmitted intermittently in small bursts. Dedicated lines for such use are inefficient and therefore costly.

In packet switching, data is tranmitted in blocks, called packets. Each packet is assigned an address; the process is much like the high-speed mailing of letters. The switching system stores, addresses, interprets the language or protocol of the data and then routes the data packets on their way in a standard format. This is the role of the SL-10, which uses the internationally recognized standard protocol called X.25.

At the destination, the system converts the standard data format to one that is recognized by the receiving terminal. This enables different computers or computer networks to "talk" with each other. If the computers already use X.25, as is increasingly the case, no protocol conversions are necessary.

In a packet switching network, many users share the same communications facilities. The SL-10s on the network interweave the packets of data, and efficiently fill in the empty spaces that would otherwise exist between data bursts. Users are charged only for each packet of data sent, rather than for the full cost of a dedicated line.

In June 1977, the Computer Communications Group of the TransCanada Telephone System became the first user of SL-10. It offered a public data packet switching network called Datapac, built on the SL-10 nodes in nine cities across Canada.

In July 1980, Northern Telecom announced the successful completion and start-up of its first major packet switching network outside Canada. The network, which initially consists of some 19 SL-1- switches, was sold to the Deutsche Bundespost, the telecommunications authority of West Germany. The system, called DATEX-P, will provide packet switching services throughout the country and will be able to connect with other international networks such as Datapac in Canada, and Transpac in France.

In January 1981, Northern Telecom signed its first contract for an SL-10 network in the United States. The SL-10s will provide the U.S. Federal Reserve System with its own packet switching network to link operations in 14 locations.

Two other major international customers have chosen Northern Telecom's SL-10 for their private data networks. They are la Société générale de banque, the largest bank in Belgium, and the Swiss telecommunications authority. La Société générale de banque initially purchased three SL-10s to provide data communications in the cities of Brussels, Ghent and Antwerp. In 1980, the bank purchased three more SL-10s, doubling its network. The Swiss telecommunications authority installed four SL-10s in 1981.

Local Area Networks

While advanced PBX-type systems like SL-1 will be the control centres for future private voice and data networks for many years, other systems are being

developed to work with the PBX. Northern Telecom is currently researching local area networks (LANs) for voice and data, which are expected to develop into a rapid growth area in the 1980s.

Many configurations are possible with LANs, which is still in its infancy. In one configuration, terminals are connected to a broadband transmission medium. No central controller such as a PBX is necessary within the LAN. Each terminal has built-in intelligence which enables it to enter information into the transmission medium in packet format addressed for a receiving terminal. Each terminal also monitors all the information packets as they pass by it on the LAN. Whenever a terminal (which may, for example, be a computer, a telephone, or a word processor) recognizes a packet of information addressed to it, it takes it from the network. In many applications, particularly for linking different LANs into broader networks, PBXs will continue to play a vital role.

The cable in LANs may be coaxial cable or an optoelectronic system using glass fibres. Optoelectronics, or fibre optics, which offers greater information transmission capacity at potentially lower cost than comparable copper cables, is expected to be an exciting market in the remainder of the 1980s.

Northern Telecom is gaining valuable experience in the applications of fibre optics. In 1980, it won a $22 million contract from Saskatchewan Telecommunications to provide a 3,200-km optical fibre system. The backbone of the longest digital, integrated telecommunications network in the world, it will provide voice, data and video (cable transmission) services.

On March 31, 1982, Canada's first manufacturing facility for the production of optical fibre communications systems was opened in Saskatoon, Saskatchewan. The $14 million facility is the global headquarters for Northern Telecom's fibre optics business. The new optical systems division is the only facility in Canada that designs and produces complete optical fibre systems, including manufacture of the basic fibre and the electronic components.

Fibre systems use hair-thin strands of glass fibre in place of more conventional copper cables to transmit communications. The electronic signals

are carried in the form of pulses of light. Electronic equipment converts the conventional electrical signals into light pulses at one end, and back to electrical signals at the other end. Fibre optic systems permit the simultaneous transmission of telephone calls, data and television or other video signals.

Electronic Office Systems

In 1978, Northern Telecom acquired Sycor, Inc. and Data 100 Corporation, two companies that were pioneers and were considered leaders in the design and marketing of terminal-based systems for distributed information systems. The amalgamation of these firms has resulted in the establishment of the company's Electronic Office Systems division.

One of the most important assets obtained when these companies were purchased was the technology associated with Sycor's Model 445 distributed data processing system.

The larger Model 585, announced in 1981, uses a multiple-processor architecture and can be configured with from 128K bytes to 512K bytes of main memory. Other processors are used in each peripheral controller, freeing the main processor to carry out its primary task of data processing.

A key feature of the new system is the availability of up to 44 million bytes of on-line disc storage for each processor. The Model 585 also permits on each processor a combination of 16 user work stations and printers. These can be located up to 5,000 feet from the processor.

The Model 585 is aimed at the medium-sized distributed data processing environment. Communications between Model 585s and the smaller Model 405, 435 and 445 systems is through Omnilink, the company's resource-sharing feature. Up to nine systems can share resources through this coaxial cable network arrangement.

Omnilink is being enhanced to include IBM 3270 access. In addition, communications on the Model 585 are being enhanced by the addition of dual

IBM 3270 emulators that allow interactive communications with two IBM or other main frame computers. The Model 585 also supports IBM 3270 pass-through applications.

In 1981, Northern Telecom's Electronic Office Systems division had 50 sales offices in Canada and 38 sales offices in 11 other countries around the world. The company is in a favourable position to capitalize on the expected strong demand for these systems in the eighties.

Private Communications Networks

In 1980, Northern Telecom announced the Electronic Switched Network (ESN). Designed to provide more efficient and cost-effective private communications for voice, and data, ESN is useful for organizations with anywhere from two to 100 locations, whether within a metropolitan area or across the North American continent. The heart of the ESN is the SL-1.

A potential ESN user must have in its network at least one SL-1 equipped with the special ESN software to serve as the network's central control switch. As a sophisticated private network system, ESN extends many of the capabilities of public telecommunications networks to private networks. Among other features, ESN provides a Communications Management Centre, which will collect and analyze detailed, current and accurate data on the use of the network. This will make it possible to match the design of the network to an organization's current needs, and to bill individual network users for calls.

Obviously, compared to a basic PBX, a private network requires greater planning and coordination. Northern Telecom will provide all the network design, engineering and management service to establish such a system. Through its affiliation with Bell Canada and BNR, and the technological expertise of its own people, Northern Telecom is in a unique position to provide the necessary nationwide support.

A major premise underlying Northern Telecom's strategy is that as the Intelligent Universe evolves, there will be rapidly expanding demand for public communications network services, for private voice and data networks, and for

specialized common carriers. To serve the rapidly developing markets for such networks in the United States, Northern Telecom formed a Network Systems Group. This concentrates network development, design, marketing and service responsibilities in one organization. The nucleus of the group consists of operations previously offered by a company called Danray, Inc., acquired by Northern Telecom in January 1978.

Network Systems is the principal supplier of switching systems to the specialized common carriers (SCC). SCCs have bought nearly 120 systems since Danray's first sale to MCI Telecommunications Corporation in 1975. The systems, called computerized tandem switching systems (CTSS), direct long-distance communications in the SCC networks.

The Network Systems Group can draw on the total resources of Northern Telecom, Bell Canada and Bell Northern Research to create and support large and efficient voice and data networks. In addition to supplying nevworks for SCCs, the group has prime responsibility within Northern Telecom for private networks such as the ESN and very large PBX systems.

The group offers a private network version of CTSS and a sophisticated private telecommunications network called the universal switched network (USN). The group's CMX 8000 computerized master exchange is a sophisticated PBX, with network voice and data capabilities. This PBX is larger than the switching systems operated by many of the American telephone companies.

Major corporations across North America are turning to private communications networks because of the rapidly rising cost of communications and travel. The private network market is a sophisticated one. Because new developments, such as personal computing, video conferencing and distributed processing are moving so quickly, buyers have growing needs and are demanding flexibility.

Large numbers of companies are interested in installing private networks and are very advanced in their planning. Its not untypical to find the large Fortune 500 companies with groups of a hundred or more people planning their networks.

A major thrust for Northern Telecom is to extend private networking in the office. Products such as the SL-100 digital business communications system -- a big brother to the SL-1 -- can accommodate up to 30,000 telephone lines and be wired into corporate networks linked across the continent.

Such products give to large corporations a greater communications flexibility than can be achieved with the public telephone network. Companies so equipped can run their own telephone network, and tie in with such integrated voice and data terminals as the Displayphone, or the DDP products being offered by the Electronic Office Systems division.

Such networks are now being installed by a number of major U.S. universities and the U.S. Military. As one example, Northern Telecom has announced the awarding of a contract valued at more than US$15 million by the University of California, Los Angeles, for Northern's SL-100. The large-capacity PBX will serve UCLA's campus and is scheduled to be placed into service in 1983.

Display -- A General Purpose End-User Workstation

On February 26, 1981, Northern Telecom announced its Displayphone, described as an "integrated voice and data telephone set". In one compact desk-top unit, the Displayphone incorporates a microprocessor-controlled CRT terminal, a voice telephone and a data modem.

Displayphone performs a number of office functions that would normally require the use of several different machines. It has an optional retractable typewriter-like keyboard that enables it to be used as a computer terminal by which a customer can input or retrieve information from data banks.

Displayphone also provides a number of enhanced telephone functions, including automatic dialing, hands-free talking and re-dialing of the last number called by touching one button.

Its ability to display messages and other information and graphics on its built-in display screen is a significant advancement over conventional business telecommunications hardware. The Displayphone can be used as an electronic

messaging terminal, creating and sending messages to others and receiving information through messaging systems such as the announced Envoy 100 service of the TransCanada Telephone System's computer communications group.

The Displayphone is a major step in the integration of voice and data. The marriage of telephone and local processor appears to be a natural one. Considering the number of telephones in existence, the market potential for upgrading these "dumb terminals" to intelligent, multi-capability end-user work stations may be immense.

Functionally, the Displayphone was designed to support concurrent operation of most voice and data communications features, and it represents a major step in the integration of many capabilities into one end-user work station. It involves integration of increasing levels of intelligence and functionality into the "dumb" telephone found on every office workers desk today. It includes integration of different forms of telecommunications, including images, voice and data. All of these will be required to produce in the office the same kind of productivity improvements that have occurred in factories.

STRATEGY FOR THE INTEGRATED ELECTRONIC OFFICE

As we move through the early 1980s, we find the cost of knowledge workers increasing as a percent of total expenses in the typical company. This, in turn, is driving the need to enhance office processes and knowledge worker productivity.

Information technology is being brought to bear on these opportunities. Northern Telecom recognizes that to participate effectively in the field of information technology, they must have a coherent set of strategies for data processing communications and office automation.

The Opportunities In Reducing "Information Float"

In the eighties, time is being recognized as an irrecoverable asset and users are requesting reductions in "information float."

The underlying premise of Northern Telecom's strategy for the integrated electronic office is that the 1980s will see information float reduced by the integration of currently parallel paths for voice, data, text and image communications through office controllers (that is, PBXs), and integrated networks, thus improving distribution. The efficiency of accessing, generating, editing, filing and retrieving information will be considerably enhanced by new generations of integrated work stations such as the Displayphone.

The Key Role Of The SL-1

The growing base of remote or distributed processors and office products that can communicate via the communications network suggests that the PBX, which already controls the office voice stream, will become the integrating element in this multi-node information system. Value-added office systems designed into or around the SL-1 controller will significantly increase the functional capabilities over competitive PBX products. This will represent a major additional market opportunity.

With more than 3,000 SL-1s already installed, Northern Telecom is well positioned to participate in these market opportunities. This PBX, with advanced integrated voice and data capabilities, has been widely acknowledged as a leader in the industry. Sales of the SL-1 totalled $318 million in 1981; they will continue to show strong growth.

About 70 percent of these systems are in the United States, 20 percent in Canada and 10 percent overseas. When companies with SL-1s come to look seriously at installing complete integrated electronic office systems, Northern Telecom will be in an ideal position to supply them with most components they require for complete systems.

In the United States, SL-1s are sold through 23 distributors which account for about 28 percent of business communications systems sales. Direct sales by Northern Telecom's own organization account for about 62 percent. Sales to telephone companies account for the remaining 10 percent.

A clear advantage Northern Telecom enjoys over some of its competitors is the effective sales and service organization that, with some pain and expense, has been built during the past five years. Again, Northern Telecom has paid dues that others must yet pay.

Software -- Reducing The Risk of Technological Obsolescence

The businessman who is selecting a new communications or information system often perceives this as an area of risk or confusion because of the rapid evolution in available technologies. The replacement of office manpower with technology requires that organizations look well into the future to examine each of today's decisions in light of expected change. In short, business users are seeking answers with greater longevity than current technology alone can provide.

Fortunately, new systems architectures, which use software rather than hardware solutions, make it possible to upgrade products or product elements at low cost. This enables users to gain the increased capabilities of new technologies while preserving much of the existing systems investment. Leading system designers, looking to extend product life cycles, will select architectures which keep software and hardware separate to permit easy retrofitting of successive generations of desices.

Evolution of Northern Telecom's SL-1 illustrates the corporation's strategy as it relates to many of the preceding points.

SL-1 was originally marketed in 1975. Northern Telecom selected digital technology for this product because they recognized that digital technology is the key to efficient integration of voice and non-voice services. For the SL-1, Northern Telecom selected a systems architecture that separated the software, the central processor, the memory network, and the peripheral equipment.

In memory technology, the company was able to introduce several succeeding generations of devices and, in the course of this, double the memory capacity. The choice of systems architecture has permitted all upgrades to be fully retrofitted to the installed base. A valuable extension to the process is that

the cost of both the network and peripheral equipment have been significantly reduced by taking advantage of succeeding generations of cheaper technology. The effectiveness of such an evolution strategy can be judged by the fact that Northern Telecom has had only one price increase on the product in six years. In real dollar terms, the product today costs about half what it cost in 1976.

In 1980, again due to the power of the digital technology, Northern Telecom introduced integrated voice and data switching on the SL-1, the first commercial realization of voice and data integration on a digital PBX. This permits a user to simultaneously place voice and data calls from his telephone set.

In 1981, Northern Telecom announced the Displayphone -- an advanced terminal that integrates the telephone and data terminal. Designed as a key element in Northern Telecom's strategy for expanding from digital PBX's into fully integrated electronic office systems, it permits voice and data communications to be handled simultaneously in one desk top work station, and offers a number of features to increase office productivity.

Strategy For The Eighties

A priority in Northern Telecom's evolution strategy is the creation of an office environment that enhances the capabilities of the office worker, the office process and the office administrator. Northern Telecom is meeting this opportunity in three areas:

- First, the corporation is constantly developing equipment to provide high-quality telecommunications networks. These include local area networks to meet the needs of expanded data and text communications in the office environment. Northern Telecom is conducting extensive tests with fibre optics which may provide the higher bandwidth required for some information transmission applications using local area networks.
- Northern Telecom believes local area networks may evolve considerably over the next few years. Many users will wish to take advantage of these for high-speed access to computer resources. The SL-1 will act as a gateway between local area networks and the outside world.

As advanced office automation systems become more pervasive, the transmission capabilities of packet switching become attractive. Northern Telecom is in a strong position to benefit from this market, having developed the SL-10, based on SL-1 technology, for the TransCanada Telephone System Datapac Network.

- Second, Northern Telecom is continuing to enhance the capabilities of its Business Communications Systems products by providing value-added office automation services for messaging, document creation, information storage and retrieval and other applications, through the use of distributed data processing systems from the company's Electronic Office Systems line.

  In 1978, Northern Telecom acquired Sycor, Inc. and Data 100 Corporation. The strategy behind the acquisitions of these companies was stated in the annual report for 1978:

  "Our interest in these companies is not solely the development of a significant position in the distributed data processing industry. They are an essential element in the creation of a corporation that will be a leader in the clearly identified trend of a coming together of the telecommunications and data processing technologies."

  Among the assets thus obtained was an installed base of more than 700 Model 445 distributed data processing installations. These systems, and the new, larger Model 585s add significant distributed processing, local area networking, switching and related capabilities to Northern Telecom's growing product line for the integrated electronic office.

  With its installed base of Model 445s and SL-1s Northern Telecom now has approximately 4,000 network-oriented, software-controlled processors and switchers installed around the world. This installed base, together with recent additional sales of these systems in the half-billion-dollar-per-year range, has established Northern Telecom as a leader in sales of systems for the integrated electronic office.

- Third, because the human interface is so critical and because distributed data processing will continue to be a driving force in office automation, the development of integrated terminals and office products form the third facet of Northern Telecom's strategy. The Displayphone is the first element of this product line.

  Northern Telecom described the Displayphone product concept as "the first stage in the evolution of the telephone into a general-purpose communication instrument that will ultimately appear in some form on every desk in the office of the future". Their intent is not only ambitious, but also encompasses much of what the computer industry intends as its share of the integrated electronic office.

GROWTH OUTSIDE CANADA

Northern Telecom's most rapid growth during the seventies occurred in the United States. In 1971 the corporation consisted of a simple distribution operation with sales of $40 million based upon exports from Canadian factories. By 1980, it had become a comprehensive integrated manufacturing, marketing, and R&D organization in telecommunications and electronic office systems, with three R&D laboratories and 22 manufacturing and repair facilities, employing about 13,000. Northern Telecom's 1980 sales in the United States were $807 million or about 39 percent of total corporate sales. In 1981, U.S. sales grew to $1,047.0 million, representing 41 percent of the total.

This surging growth in the United States was primarily responsible for the fact that in 1980 sales outside of Canada almost equalled sales within the country.

Much of this growth came from the steady expansion of established operations. The balance was achieved through a series of acquisitions by which Northern Telecom entered key, new American markets, extended or complemented their product lines, and strategically positioned themselves to take advantage of the new markets of the Intelligent Universe being created by the confluence of telecommunications and computer technologies. A perspective on this growth may be gained with the knowledge that over the four years between 1977 to 1981, sales in the United States increased by 441 percent.

Major Growth Opportunities In The United States

The corporation's strategy has been set firmly on a course that will continue that trend, since Northern Telecom's opportunities for expansion in the United States and in international markets continue to be far greater than in the Canadian market.

A perspective on how rapidly Northern Telecom's sales base is shifting to the United States can be gained by analyzing the corporation's proportion of DMS-10 and DMS-100 family systems now in service and on order. On March 31, 1981, 83 percent of DMS-10 systems in service and on order were for the U.S. market;

only 16 percent for the Canadian market and 1 percent for other markets. A similar pattern existed for the larger DMS-100 family.

The upper sizes in the DMS Family, in particular, are targeted at the U.S. market. The DMS-250, for example, is a 30,000-trunk capacity tandem switching system designed for the specialized common carriers such as MCI, Southern Pacific, ITT, Western Union and IBM's Satellite Business Systems (SBS). And in fact Northern Telecom's Network Systems Group, announced in 1981, a US$30 million contract from SBS for 20 DMS-250s.

Another large digital switch with significant U.S. sales is the DMS-100 PBX. In 1981, Northern Telecom received a contract estimated to be worth more than US$70 million to supply the U.S. Air Force with 29 DMS-100s for its bases around the world.

The U.S. component of sales also grows larger in the SL-1 PBX area. Of the more than 3,000 SL-1s that have been sold or ordered, representing more than one million telephone lines, about 60 percent are in the United States, 25 percent in Canada and 15 percent in other markets.

The geographical distribution of revenues is even more skewed in favour of the United States in the Electronic Office Systems (EOS) area, where growth rates of greater than 30 percent per year can be expected in the eighties. Estimates are that of $259 million in EOS sales in 1980, only $18 million, or 7 percent, came from Canada.

Northern Telecom's story, like that of the Gandalf Group of Companies, is one that Canadians turn to when asked to describe Canadian success stories in the high technology field.

An analysis of Northern Telecom's statistics shows, however, that despite its worldwide growth and success, employment at Northern Telecom in Canada has grown very little since 1976. In the five-year period between 1976 and 1981, worldwide sales increased by 137 percent -- from $1,083.5 million to $2,570.9 million. In the same period, however, employment in Canada increased by only 8 percent -- from 19,291 jobs to 20,776. Most of the new jobs associated with

increased sales have gone to the United States, where employment increased from 2,940 to 12,737 in the same period.

The same pattern holds when one examines the international distribution of the corporation's assets. In 1981, 58 percent of Northern Telecom's identifiable assets were located outside Canada, primarily in the United States. This was up dramatically from only 26 percent in 1977.

On balance, however, Northern Telecom has unquestionably been a good Canadian corporate citizen. In the five-year period ending in 1981, the corporation spent $621 million on research and development, most of it in Canada. In 1981, while 52 percent of the company's sales were made in Canada, 59 percent of the jobs were in this country (Tables 3.2, 3.3 and 3.4).

NORTHERN TELECOM LIMITED AND PRINCIPAL SUBSIDIARIES

Northern Telecom Limited, with its executive offices in Mississauga, Ontario, establishes the corporate policies and strategies for its principal subsidiaries.

Northern Telecom Canada's manufacturing plants produce a broad range of telecommunications products and systems for the Canadian market and for export. Many of these exports are sold by Northern Telecom International, which is also based in Canada. Northern Telecom has sold telecommunications equipment in more than 90 countries.

Following the year-end 1980, consolidation of the U.S. corporation's U.S. activities (excluding R&D, which is under the direction of Bell-Northern Research Ltd.), Northern Telecom Inc. (NTI) is responsible for all manufacturing, marketing and services activities in the telecommunications and electronic office systems operations in the United States. NTI also directs the electronic office systems business in international markets.

Bell-Northern Research Ltd., the largest private industrial research and development organization in Canada, employs 3,058 people in Canada and at BNR Inc. in the United States.

TABLE 3.1

WORLDWIDE EMPLOYEES AND SALES

(As of December 31, 1981)

	1981 Year-end Employees	1981 Sales (C$Mill)
Northern Telecom Limited Mississauga, Ontario,	35,444	$2,570.9
PRINCIPAL SUBSIDIARIES		
Canada		
Northern Telecom Canada Limited Islington (Toronto), Ontario		
Bell-Northern Research Ltd.		
Subtotal Canada	20,776	1,334.6
Percent of Total	59%	52%
United States		
Northern Telecom Inc. Nashville, Tennessee		
BNR Inc.		
Subtotal	12,737	1,047.0
Percent of total	36%	41%
International and Other (excluding U.S.)		
Northern Telecom International Limited Mississauga, Ontario (Operations outside North America)	1,931*	189.3
Percent of Total	5%	7%

*Excludes employees of NETAS-Northern Electric Telekomunikasyon, A.S., Republic of Turkey. Northern Telecom is a minority shareholder in NETAS.

Table 3.2

NORTHERN TELECOM LIMITED REVENUES BY GEOGRAPHIC REGION

	REVENUES (C$Mil.)				PERCENTAGE GROWTH				
Year	Canada	U.S.	Other	Total	Can.	U.S.	Other	Total	Percentage of Foreign Growth
1977	1,014.4	193.5	14.0	1,221.9	N/A	N/A	N/A	13	17
1978	1,007.9	447.1	49.6	1,504.6	-1	131	254	23	33
1979	1,000.8	739.6	160.1	1,900.5	-1	65	223	26	47
1980	1,084.0	807.0	163.6	2,054.6	8	9	2	8	47
1981	1,334.6	1,047.0	189.3	2,570.9	23	30	16	25	48

Source: Annual Reports
N/A - not available

Table 3.3

NORTHERN TELECOM LIMITED RESEARCH AND DEVELOPMENT EXPENDITURES

(C$mil.)

Year	Revenues	R&D Expenditures	Percentage of Revenues
1974	$ 957.7	$ 44.0	4.6
1975	996.8	49.0	4.9
1976	1,083.5	61.4	5.7
1977	1,221.9	68.2	5.6
1978	1,504.6	97.8	6.5
1979	1,900.5	132.6	7.0
1980	2,054.6	140.9	6.9
1981	2,570.9	181.6	7.1

Source: Annual Reports
Note: About 60 percent of Northern Telecom's R&D effort is carried out by 3,058 employees of Bell-Northern Research Ltd. and BNR Inc. in Canada and the United States. The remainder is done through 22 R&D centres in Northern Telecom's manufacturing plants in North America and the United Kingdom.

Table 3.4

NORTHERN TELECOM LIMITED EMPLOYMENT BY GEOGRAPHIC REGION

	NUMBER OF EMPLOYEES AT YEAR-END						
Year	Canada	U.S.	Other	Total*	Percentage of Foreign Employees	Revenues per Employee**	Percentage of Change
1971				22,030		24,993	
1972				19,487		25,594	2
1973				23,673		28,179	10
1974				24,647		39,640	41
1975				22,151		42,600	7
1976	19,291	2,940	1,346	23,577	18	47,389	11
1977	18,303	4,048	811	23,162	21	52,285	10
1978	17,487	12,607	1,662	31,756	45	54,794	5
1979	18,511	14,147	643	33,301	44	58,427	7
1980	18,634	11,479	1,802	31,915	42	63,009	8
1981	20,776	12,737	1,931	35,444	41	76,334	21

Source: Annual Reports

* Total excludes employees of NETAS in Turkey which Northern Telecom owns jointly with the Turkish Government.

**Based on average number of employees during year calculated using year-end figures. Estimates based on analysis of company records.

Table 3.5

NORTHERN TELECOM LIMITED IDENTIFIABLE ASSETS BY GEOGRAPHIC REGION

(As of December 31, 1981)

Year	Canada	U.S.	Other	Adjustments & Eliminations	Total	Percentage of Foreign Assets
1977	$462.0	$144.9	$ 17.5	($26.8)	$ 597.6	26
1978	532.2	598.6	149.5	(37.1)	1,243.2	58
1979	573.3	861.5	141.5	(66.5)	1,509.8	64
1980	663.1	846.8	98.2	(66.0)	1,542.1	59
1981	815.3	839.7	153.0	(91.2)	1,716.8	58

Source: Annual Reports

* Identifiable assets are those assets of the corporation that are identified with the operations in each geographic region.

Table 3.6

NORTHERN TELECOM LIMITED REVENUES BY BUSINESS SEGMENT

(C$mil.)

SALES TO CUSTOMERS*	1977	1978	1979	1980	1981
TELECOMMUNICATIONS EQUIPMENT					
Central Office Switching	412.6	338.9	386.0	505.1	776.0
Subscriber Apparatus and Business Communications Systems	275.3	374.3	524.6	618.6	739.9
Wire, Cable and Outside Plant Transmission	215.1	276.6	366.7	349.9	323.6
	114.5	141.3	227.3	277.6	409.0
	1017.6	1131.1	1504.7	1751.2	2248.5
ELECTRONIC OFFICE SYSTEMS	-	171.5	349.8	258.9	274.2
RESEARCH AND DEVELOPMENT	30.7	39.1	46.0	44.4	48.2
PRODUCTS DISTRIBUTION	173.7	162.8	-	-	-
TOTAL	1221.9	1504.6	1900.5	2054.6	2570.9

Source: Annual Reports

* Sales to Bell Canada, (which on December 31, 1981 owned 55.1 percent of the outstanding shares of Northern Telecom), and its associated companies in 1981 were $911.7 million, compared with $722.2 million in 1980 and $695.9 million in 1979.

While Bell Canada continues to be Northern Telecom's largest customer, its percentage of total revenues has been declining: 41.3 percent in 1978, 36.6 percent in 1979, 35.2 percent in 1980 and 35.5 percent in 1981.

CHAPTER 4

THE GANDALF GROUP OF COMPANIES

The Gandalf Group, with revenues for the fiscal year ended on July 31, 1981 of $40 million, is the largest Canada company specializing in the design, development and manufacture of data transmission equipment for the computer communications industry. Revenues in 1981 grew 54 percent above 1980 levels (Table 4.2); 68 percent of sales were generated outside of Canada.

Three affiliated operations comprise The Gandalf Group of Companies: Gandalf Data Communications Ltd., Ottawa, Ontario, Canada; Gandalf Data Inc., Wheeling, Illinois, U.S.A.; and Gandalf Digital Communications Ltd., Warrington, Cheshire, England. A subsidiary of Gandalf Data Communications Ltd., Gandalf Services SA, located in Geneva, Switzerland, provide marketing services for the company's European distributors (Table 4.1).

Shares of the three affiliated companies are held through Gandalf Technologies Inc. Until recently, Gandalf Technologies Inc. was a private Canadian company wholly owned by its founders, Desmond Cunningham and Colin Patterson.

In November 1981, however, about 2.3 million shares were sold, raising $26 million for the company. Approximately 35 percent of the shares are now held by the public. Demand was particularly strong from the United States and Europe, where the company has developed a reputation as a supplier of high-quality data communications products.

BEGINNINGS

In 1970, Gandalf began operations in a 400-square-foot office facility in Ottawa. It was there that the company designed and built the first Gandalf prototype modem for presentation to the federal government's Communications Research Centre (CRC) at Shirley Bay near Ottawa. The CRC needed an inexpensive asynchronous modem capable of operating at a speed of 2000 bits per second over a distance of up to five miles. In fact, Gandalf was able to

build a unit that reached 9600 bits per second. That unit, the LDS 100 data modem, became the first product in a series that was to put Gandalf in first place, after the common carriers, in the Canadian market for modems.

The data communications industry was caught off guard by the introduction of Gandalf's short-haul modem. The computer industry responded with praise and encouragement, however, because it would no longer be necessary to use expensive long distance modems when Gandalf's short-haul units would be able to do the job at about one third the cost.

By 1971, Bell Northern Research, the RCMP and Atomic Energy, to mention just a few, had joined Gandalf's expanding customer list. New product development was called for as the company strived to meet both current and future requirements. During the early years, Gandalf spent 12 percent and more of its revenues on research and development (Table 4.3).

The success of the LDS 100 led to requests to supply a synchronous version to operate at 4800 and 9600 bits per second. The LDS 200, developed to meet this need, was introduced in 1972.

BROADENING PRODUCT LINES: THE PACX

A third product, which played a significant role in the company's reputation for technological innovation, was introduced in 1973 at McGill University's Computer Centre in Montreal. McGill's need was for a system to use LDS modems in conjunction with a private switching arrangement to be installed on two large IBM computers. This led to the design and development by Gandalf of the Private Automatic Computer Exchange (PACX). The PACX, which was unique in the industry as a tool for connecting a large variety of different terminals to appropriate computer ports, was capable of handling 256 terminals and 128 ports.

Though Gandalf's PACX had no direct competitor, in some installations its use brought it into competition with programmable data concentrators and multiplexors. To be able to compete more strongly with these other devices, the company developed versions of PACX, called MiniPACX, which did not incorporate all the characteristics of the standard system.

Gandalf's PACX system was not restricted to handling only digital transmission; it could accommodate analog modems as well. It allowed users to take advantage of low-cost digital transmission within a ten-mile radius and to mix it with long-distance analog transmission coming in from across the country, with both types of line being served by the switching equipment.

By the end of July 1973, more than 2,000 local modems of varying typ s had been delivered along with seven PACX systems. Gandalf had just completed its second year of greater than 200 percent annual growth.

By November 1976, Gandalf's line of modems was selling well and the PACX product was making an increasing contribution to revenues. About 70 PACXs, each valued at about $30,000, had been shipped, most of them to Canadian customers.

"Since we have shipped so many PACXs to Canadian users, we instinctively know that the U.S. market is very large," said then company president Cunningham. "It's only been in the past year that we've been able to support PACX systems in the United States. The key is that we have to have enough technically knowledgeable staff to be able to provide customers with the reliable support they need."

"The system sits inside a computer room with all the communications lines coming into it. Therefore, it must be dependable. If a fault does occur we have to be able to send a service technician in quickly to repair it. We didn't even attempt to sell it in the United States until we had the appropriate base of technical people trained to maintain the PACX, and until we had a sufficient test equipment and spare parts organization so that we could service a customer quickly. The past 12 months has seen us achieve this and we are now selling fairly readily in the United States. One of our U.S. customers is forming a PACX users group which will encomp ss American, Canadian and European customers."

By this date, about five PACX systems had been installed in Europe, sold through a distributor. As in the U.S. market, Gandalf devoted considerable time to training distributors in Europe to ensure that an adequate level of backup support was available before marketing began.

The PACX is a much more complex and expensive device than the modem and Gandalf's decision to wait until it could provide full support before selling PACXs paid off. By November 1978, Gandalf had sold its 250th Private Automatic Computer Exchange and PACX shipments to date totalled $7.5 million. By January 1981, more than 600 PACXs had been shipped and these systems were accounting for about one-third of the company's annual revenues.

Over the years, Gandalf has made steady improvements in PACX technology, leading to the microprocessor-controlled PACX IV, introduced in January 1981. The key factor in deciding to purchase a PACX IV system is the potential dollar savings.

If the user has a large number of leased lines and modems, PACX experience shows that payback periods average between six months and a year, depending on the complexity of the system. These savings result from not having to pay each month for unneeded rented lines and equipment.

EXPANDING HORIZONS

Data communications is a worldwide market, and by 1974, Gandalf's innovations were receiving recognition in the United States. An early user was the State of Illinois Department of General Services (IDGS).

IDGS operates a Communications Technical Control Center at the State Office Building in Springfield. Providing teleprocessing installation and maintenance services for nearly all state agencies, this busy facility in 1974 was operating five IBM System/370 computers. One of the tasks of its Telecommunications Division was to provide data communications for the more than 1,200 terminals connected to the centre.

By early 1974, data communications costs had risen markedly with the increase in terminal utilization. The division was determined to find a less expensive way to connect local users to the system. It seemed intuitively wrong to use conventional long-haul modems to connect the many users within a few miles of the centre, but there seemed to be no other solution. They had seen "line drivers" but these required end-to-end DC continuity -- a characteristic that could not be reliably obtained over leased private facilities.

The division's search ended when they discovered a new technology being pioneered by the newly established Gandalf Data Inc. of Wheeling, Illinois, near Chicago. Gandalf's literature described a Limited Distance Date Set (LDS) -- exactly what the division wanted. The unit offered synchronous operation at 9600 bits per second, up to 5.5 facility miles (further at slower speeds), and did not require DC continuity. These short-haul units had standard EIA interfaces and "looked like" conventional modems to both the user and the computer. This equipment seemed to fill the division's needs exactly and, after consultation with Gandalf, they decided to proceed with its acquisition.

In May 1974, the first LDS 209s were received and put to work on point-to-point applications at 9600 bps at distances up to five miles. The evaluation was watched with great interest and much criticism was offered -- "It's too small, too light, it can't be reliable."

The units were small and light, which was a major selling point. They were held in one rack, where five racks were required before. Furthermore, with one modem per plug-in printed circuit card, the division was able to isolate and replace a faulty unit in only a few minutes, when it used to take hours using common carrier modem equipment.

By the end of 1974, studies, tests and tariff discussions with Illinois Bell and Western Union were completed and a minor modification was made to the transmitters to ensure compliance with AT&T requirements. The center quickly grew to the point where they were using over 140 of the Limited Distance Data Sets and showed complete satisfaction with both performance and reliability. They also began operating several circuits at 19.2 K bps using the 300 series equipment, and still others at 50.0 K bps with 250 series hardware. In each case, the division experienced the same high performance and reliability, along with considerable cost savings over conventional long-haul modems.

The division found the hardware to be well adapted to multi-point systems and several were develop d to operate at 7.2 and 9.6 K bps. The ability to bridge numerous drops using digital rather than analog techniques allowed terminal counts as high as 20 devices per modem. The switching capability inherent in the design let the division reconfigure networks quickly or disable defective drops without affecting other users and without common carrier intervention.

The division found the economics of using the Gandalf modems outstanding. As an alternative to conventional modems, Gandalf equipment has saved the State of Illinois more than $250,000 per year in communications modem costs alone.

Gandalf's data communications products won acceptance in the United States and then in other international markets because the company built a better mousetrap. They found a gap in the market the common carriers had tended to dominate. Their products were significantly lower in price, required less space and provided improved serviceability and ensured less downtime.

MOVING INTO THE MEDIUM DISTANCE MARKET

At the company's research and development facilities in Ottawa, Gandalf moved to strengthen its team of technical experts and maintain its leadership position in the data communications industry. By late 1976, Gandalf was preparing to unveil a new LDM 400 series of medium-distance modems.

In February 1977, the announcement was made. Gandalf now had a unit which could transmit data up to 50 miles at speeds of up to 4800 bps over standard telephone voice grade lines.

With the 400 series, Gandalf advanced data communications technology a notch further. Then vice-president (now President, Gandalf Data Communications Ltd.) Colin Paterson pointed out the "The 400 series, unlike it predecessors, uses the more easily obtainable 'loaded circuit facility' which increases by a factor of 5 the distance over which data can be transmitted, a feature which makes the 400 series particularly applicable to customers in large North American cities where earlier short-haul data devices do not transmit over sufficient distances and where 'unloaded' facilities are at a premium."

With this important breakthrough came an influx of orders for Gandalf's LDM 400 modems. In 1977, more than 1000 400 Series units were sold. Company sal s for the fiscal year ended July 31, 1977 were $4.1 million and exports accounted for 48 percent of revenues.

By the end of 1977, more emphasis was being given to markets outside of North America. A third affiliate, Gandalf Digital Communications Ltd., was established in England to market the Gandalf product line throughout the United Kingdom. Orders for Gandalf products were entered by such major organizations as British Steel, Unilever, Shell, and the U.K. Atomic Energy establishment.

In 1978 Gandalf sales outside of North America grew by 245 percent. Gandalf was clearly making its mark in the worldwide data communications industry.

COMPETING WITH THE GIANTS

By the late 1970s, the challenge to produce newer and better data devices incorporating the latest in state-of-the-art technologies proved to be one of the most important tasks in the comp ny's history. Gandalf's research and development team, which by 1979 had grown to 42, was given the responsibility of designing new Gandalf technology which would not only respond to current customer requirements, but would also provide the basis for Gandalf's strong market position throughout the 1980s.

By the spring of 1979, Gandalf launched a new 9600 bps long-distance modem dubbed SuperModem. This was Gandalf's entry into the tough, competitive world of the "giants" which all along have been capable of producing modems cap ble of transmitting data from St. John's Newfoundland to Vancouver Island. With its new product, Gandalf leap d to the leading edge of technology in this area. SuperModem was the first intelligent modem in the world.

Said Gandalf chairman, Desmond Cunningham (now Chairman, Gandalf Technologies Inc.), "SuperModem underscores a major milestone in our company's history... a datacom product which will establish Gandalf as one of the prime innovators in the telecommunications industry." Before the first SuperModem was shipped, Gandalf had more than $1.5 million worth of sales on the orderbook.

By mid-1979, industry observers were beginning to question what Gandalf would add next to its product lineup, already one of the broadest selections of data devices produced by any single company throughout North America. By

November 1979, Gandalf had made its response clear. Fast on the heels of SuperModem, Gandalf unveiled what the company today refersto as its "product line for the 1980s". The Private Intelligent Networker (PIN) series of data communications equipment was formally announced. The industry was told that PIN would initially be sold in two packages -- a 9102 X.25 Depacker for use with the datapac network, and a 9103 S-MUX intelligent data concentrator.

In brief, through the application of sophisticated computer hardware and software technology, the Gandalf PIN product line is designed to provide the datacom marketplace with network efficiencies and performance levels never before realized.

CONSIDERATIONS

All Canadians can be inspired by Gandalf's success story. The company's growth rate has been phenomenal. In the last ten years, Gandalf has spent more than $6 million on research and development, essentially all of it in Canada. In 1981, 68 percent of its sales were made outside of Canada, but 58 percent of the jobs were inside this country (Tables 4.2 and 4.3).

Indications are, however, that many of the jobs created in 1982 and beyond will not be in Canada. An analysis of Gandalf's statistics indicates that the percentages of Gandalf employees, and floor space outside Canada in 1980 (Tables 4.4 and 4.5) were both 44 percent. In the 1981-1982 period, the company will double its floor capacity by increasing its floor space around the world by 100,500 square feet. Only 30 percent of this expansion, however, will be on Canadian soil.

By the end of 1982, Gandalf plans to have 57 percent of its floor space outside of Canada. If the 1980 relationship between foreign employees and foreign floor space applies in the future (that is, the percentage of floor space and of employees outside of Canada are the same number), by the end of 1982 or shortly after, the number of Gandalf jobs on foreign soil could be 57 percent and growing. Over the next few years, if the current trend were to continue, Gandalf's exports from Canada could dry up. In fact, by the late 1980s, Canada could be a net importer of Gandalf products.

One can speculate that it will be only a question of time before a major part of the company's R&D expenditures will take place in the United States or in other marketplaces.

This raises an important question. Canadian companies like Gandalf, Northern Telecom and Mitel have been very successful in international markets. As international sales increase to 50 percent of total sales and beyond, it makes great sense for them to build plants and research facilities close to their markets.

Table 4.1

THE GANDALF GROUP: WORLDWIDE SALES, SERVICE AND MANUFACTURING LOCATIONS

CANADA

Head Office: Gandalf Data Communications Ltd.
Gandalf Plaza, 9 Slack Road
Ottawa, Ontario K2G 0B7

Manufacturing, sales and service are provided from the head office.

Regional Sales Offices: Longueuil, Quebec
Ste-Foy, Quebec
Don Mills, Ontario
Calgary, Alberta
Edmonton, Alberta
Burnaby, British Columbia

Service is provided at all regional sales offices.

UNITED STATES

Head Office: Gandalf Data Inc.
1019 South Noel Avenue
Wheeling, Illinois 60090

Manufacturing, sales and service are provided from the head office.

Regional Sales Offices: Warwick, Rhode Island
Silver Springs, Maryland
Richardson, Texas
Los Angeles, California

Service is provided at all regional sales offices.

Table 4.1 (Continued)

ENGLAND AND IRELAND

Head Office:

Gandalf Digital
Communications Ltd.
4 Cranford Court
Warrington, Cheshire
England

Manufacturing and service are provided from the head office.
Sales are handled through distributors.

Distributors:

ENGLAND	IRELAND
Mastersystems (Data Products) Ltd. Camberley, Surrey	The E.C.L. Group of Companies Dublin/Belfast

ASIA AND THE MIDDLE EAST

Distributors:

SAUDIA ARABIA	INDIA
M.E.S.C.O. Riyadh	Patni Computer Systems (PVT) Ltd. Bombay
JAPAN	AUSTRALIA
Nissho Electronics Corp. Tokyo	Datamatic Pty. Ltd. Sydnes/Melbourne

All distributors provide sales and service.

Table 4.1 (Continued)

CONTINENTAL EUROPE

Subsidiary:

Gandalf Services SA
8, Chemin Du Fief-De-Chapitre
1213 Petit Lancy
Geneva, Switzerland

The subsidiary provides sales but not manufacturing or service.

Distributors:

GERMANY

Deutsche Eurotech GmbH
Hamburg/Dusseldorf/Frankfurt/Munich

NORWAY

Morgenstierne & Co. A/S
Oslo

DENMARK

Trend Electronics
Copenhagen

FRANCE

Eurotechnica S.A.
Paris

GREECE

Digico Ltd.
Athens

Business Electronics Systems Ltd.
Athens

FINLAND

Oy Emmett Ab
Helsinki

SWEDEN

Dextraferm ab
Stockholm

HOLLAND

Eurotech Nederland B.V.
Amsterdam

ITALY

Eurotech Italia SpA
Milan/Rome

BELGIUM

Eurotech Belgium S.A.
Brussels

All distributors provide sales and service.

Table 4.2

THE GANDALF GROUP
ELEVEN-YEAR GROWTH IN REVENUES BY GEOGRAPHIC REGIONS

	REVENUES (Can.$thous.)				PERCENTAGE GROWTH				
Year	Canada	U.S.	Other	Total	Can	U.S.	Other	Total	Percentage of Foreign Revenues
1971	50			50					0
1972	160			160	220			220	0
1973	500			500	212			212	0
1974	1,000	250		1.250	100			150	20
1975	1,200	330	330	1,860	20	32		49	35
1976	1,600	960	300	2,860	33	191	(9)	54	44
1977	2,130	1,640	330	4,100	33	71	10	43	48
1978	3,460	3,300	1,140	7,900	62	101	245	93	56
1979	4,176	6,545	2,338	13,059	21	98	105	65	68
1980	8,070	12,750	5,180	26,000	93	95	122	99	69
1981	12,800	19,600	7,600	40,000	59	54	47	54	68

Source: Gandalf Technologies Inc.
( ) Negative growth

Table 4.3

THE GANDALF GROUP
RESEARCH AND DEVELOPMENT EXPENDITURES (Can.$thous.)

Year	Group Revenues	R&D Expenditures	Percentage of Revenues
1971	50	6	12.0
1972	160	20	12.5
1973	500	44	8.8
1974	1,250	75	6.0
1975	1,860	95	5.1
1976	2,860	159	5.6
1977	4,100	279	6.8
1978	7,900	493	6.2
1979	13,059	905	6.9
1980	26,000	1,419	5.5
1981	40,000	2,813	7.0

Source: Gandalf Technologies Inc.

Table 4.4

THE GANDALF GROUP
ELEVEN-YEAR GROWTH IN EMPLOYMENT BY GEOGRAPHIC REGION

NUMBER OF EMPLOYEES AT YEAR-END

Year	Canada	U.S.	U.K.	Total	Percentage of Foreign Employees	Revenues Per Employee*	Percentage of Change
1971	2			2	0	25,000	
1972	3			3	0	53,333	113
1973	20			20	0	41,667	(22)
1974	45			45	0	39,062	(6)
1975	52	8		60	13	35,094	(10)
1976	55	10		65	15	6,129	31
1977	90	40		130	31	41,837	(9)
1978	120	60	2	182	34	50,641	21
1979	170	100	10	280	39	56,532	12
1980	332	242	20	594	44	59,497	5
1981e	420	262	46	728	42	60,514	2

* Based on average number of employees during year calculated using year-end figures.

Source: Gandalf Technologies Inc.

Table 4.5

THE GANDALF GROUP
TWELVE-YEAR GROWTH IN FLOOR SPACE BY GEOGRAPHIC REGION (SQUARE FEET)

FLOOR SPACE AT YEAR-END

Year	Canada	U.S.	U.K.	Total	Percentage of Foreign Floor Space
1971	400			400	0
1972	800			800	0
1973	3000			3000	0
1974	5000			5000	0
1975	7000	3000		10000	30
1976	7000	3000		10000	30
1977	14000	6000		20000	30
1978	25000	17000	1000	43000	42
1979	35000	17000	7500	59500	41
1980	57000	37000	7500	101500	44
1981/2	87000	95000	20000	202000	57

Source: Gandalf Technologies Inc.

Table 4.6

THE GANDALF GROUP
ADDITIONS TO FLOOR SPACE BY GEOGRAPHIC REGION PLANNED FOR 1980 THROUGH 1982
(square feet)

Year	Canada	U.S.	U.K.	Total	Percentage of Foreign Floor Space
1980	22000	20000	0	42000	48
1981/2	30000e	58000	12500	100500	70

Source: Gandalf Technologies Inc.
e: estimate

CHAPTER 5

THE OTHER SUPPLIERS

In addition to Northern Telecom and The Gandalf Group, there are 10 other companies whose traditional market base is communications and that generated computer communications equipment revenues of at least $5 million in 1980. These companies fall into three groups: the common carriers, the communications hardware specialists and the distributors.

THE COMMON CARRIERS

The common carriers, including the members of TransCanada Telephone System and CNCP Telecommunications, generated an estimated $99 million in computer communications equipment revenues in 1980. This represents 17 percent of the $566 million industry.

The common carriers, however, represent a declining factor in the sale of the computer communications equipment market. In 1980, the market grew by 26 percent, from $451 million to $566 million. However, the common carriers' computer communications equipment revenues grew by only 14 percent, from $86 million (Table 5.1).

The Computer Communications Group Of The TransCanada Telephone System

The Computer Communications Group of the TransCanada Telephone System (TCTS) is the organization responsible for the supply of data communications equipment and services for the ten companies who are members of TCTS. The member comp nies are:

- Alberta Government Telephones
- Bell Canada,
- British Columbia Telephone Company
- Island Telephone Company Limited
- Manitoba Telephone System
- Maritime Telegraph and Telephone Company Limited
- New Brunswick Telephone Company Limited
- Newfoundland Telephone Company Limited
- Saskatchewan Telecommunications
- Telesat Canada

In the early seventies the TransCanada Telephone System recognized that telephone service requirements differed significantly from data communication requirements. Consequently, the Computer Communications Group (CCG) was established in 1972 as an organization dedicated to data communications.

The Computer Communications Group represents the combined skills of the TCTS member companies in designing, implementing and maintaining a nationwide data communications system. Each member company offers expertise on local requirements and conditions and is backed up by the national organization providing knowledge at the national and international level.

The data communications services offered by TCTS through CCG can be categorized as either switched network services or dedicated private line facilities.

Users of switched network facilities have access to a group of common facilities that are shared among similar users. With private-line services, however, communications facilities are dedicated to individual users. Electronic equipment can be added to private-line services to condition the facilities and improve the transmission performance.

TCTS members are by far the largest suppliers of data communications services in Canada. Hence they have also tended, as a group, to be the largest suppliers of data sets (modems) and multiplexors in Canada. In the past few years, the market share of data sets installed by the TCTS member companies has been falling. As late as 1980, however, they still supplied about 90 percent of all data sets in Canada. These installations do not include acoustic couplers (data sets that use the telephone handset to transmit data) or short-haul data sets (data sets optimized for short distances), of which they supply a very small portion.

The TCTS members, through CCG, also supply data communications terminals and record terminals (TWX). In the mid-seventies, CCG was a major contender in the supply of data communications terminals with their VUcom and IBM-compatible 3270 VUcom terminals. The VUcom terminals have since been "destandardized" and are either no longer available or in low demand. CCG now supplies the Datacom line of video-displays and hard-copy terminals from Digital Equipment Corporation

(Bell Canada is one of Digital Equipment Corporation of Canada's largest customers) or Northern Telecom. The supply and market share of data terminals from CCG has been severely affected by terminal distributors in the past few years.

The TCTS member companies that are the three largest suppliers of data communications equipment in Canada are Bell Canada, the Altel Data division of Alberta Government Telephones and British Columbia Telephone. These three companies generated an estimated $66 million in data communications equipment revenues (excluding terminals) in 1980, up 18 percent from $56 million in 1979.

Bell Canada

Bell Canada is the TransCanada Telephone System's largest member and was the largest supplier from among TCTS members of data communications equipment in Canada in 1980. Its data communications equipment revenues increased by an estimated 14 percent, from $36.9 million in 1979 to $42.2 million in 1980.

Bell Canada is facing increasing competition in the data communications equipment market from the traditional suppliers of computer equipment, such as Digital Equipment and IBM, and data communications specialists, such as ESE Ltd. and Gandalf. It should be noted, however, that data communications equipment revenues generated less than 1 percent of the total consolidated revenues of Bell Canada.

Since Bell Canada is primarily in the business of supplying network services, the company's major data communications strategies are in this area. As the largest member of CCG, Bell stands to benefit the most from the new or enhanced network services that CCG will offer in the eighties. For instance, the iNet Gateway, CCG's intelligent network concept, is expected to provide companies with a gateway to computerized information and other computer-based services. It could contribute significantly to Bell Canada revenues in the last half of this decade.

New data communications equipment products such as the Displayphone and its complimentary service, the electronic mail system Envoy 100, could give the

company's data communications equipment revenues increased growth in the mid-1980s. Because of its ownership relationship with Northern Telecom, Bell Canada is in an excellent position to benefit from increased demand for the voice and data integration PBXs, such as the SL-1, which are expected to be a key element in the integrated electronic office.

From this perspective, the Displayphone and the SL-1 can be viewed as data communications equipment that could enhance the marketability of data communications services such as iNet and Envoy 100.

Altel Data

According to AGT, at the time of the formation of Altel Data in 1974, the Altel Data division of Alberta Government Telephones was created to "enhance AGT's position in the provision of data communication services to AGT's customers." AGT's strategy in establishing Altel Data was to provide a complete data communications capability, including data communications equipment, communication services and minicomputers. In 1980, Altel Data's data communications equipment revenues increased to an estimated $12 million, up 25 percent from $9.6 million in 1979.

When Altel Data was formed, AGT drew criticism from companies in the private sector that feared AGT would use Altel Data as a vehicle to enter the time-sharing or service bureau business. In 1974 the latter was seen as one of the more lucrative segments of the computer industry. The company did not enter the service bureau business, but it has begun selling computer hardware.

Altel Data stores sell video and hard-copy terminals, data sets, small business computers, supplies and application software packages. The stores also provide customers with access to engineers and software specialists.

British Columbia Telephone, Anglo-Canadian Telephone and Quebec Telephone

General Telephone & Electronics Corporation (GTE) of Stamford, Connecticut controls British Columbia Telephone Company, Anglo-Canadian Telephone Company

and Quebec Telephone Company. This group of common carriers accounted for an estimated $12.4 million in computer communications equipment revenues in 1980, up 19 percent from $10.4 million in 1979. In addition, GTE controls AEL Microtel Limited, which generated an estimated $3.0 million in computer communications revenues in 1980.

GTE, through its wholly-owned subsidiaries, Anglo-Canadian Telephone Company of Montreal and GTE International, Inc. is the owner of 55.05 percent of the shares of British Columbia Telephone Company and its subsidiaries. Voting control by GTE is restricted to 50.72 percent of the issued and outstanding ordinary shares of BC Telephone.

British Columbia Telephone Company, of which 44.97 percent is owned by Anglo and 10.08 percent by GTE International, had estimated data communications equipment revenues of $11.3 million in 1980, up 20 percent from $9.4 million in 1979. These revenues were derived primarily from data communications equipment such as modems, CCG-type terminals (Vutran, DataCom) and portable terminals supplied by Texas Instruments.

On September 29, 1979, BC Telephone acquired 100 percent of the outstanding common shares of GTE Automatic Electric (Canada) Ltd. and its subsidiary GTE Lenkurt Electric (Canada) Ltd. Subsequently, these subsidiary companies merged to form AEL Microtel Limited.

AEL Microtel is engaged in the manufacture and marketing of telephony equipment and systems. A subsidiary of AEL Microtel, Viscount Industries Ltd., is manufacturing Telidon Videotex business terminals, which are marketed by AEL Microtel.

Anglo-Canadian Telephone Comp ny owns 53.13 percent of Quebec-Telephone, in addition to its interest in BC Telephone. Anglo also has a wholly-owned subsidiary in the Dominican Republic, Comp nia Dominicana de Telefonos C. por A.

CNCP Telecommunications

CNCP is a consortium of the telecommunications departments of Canadian National Railway Company and Canadian Pacific Limited. CNCP operates as a nationwide telecommunications carrier, offering a wide range of data, voice and broadcast services. With increased competition from the other suppliers in the market, CNCP's share of the computer communications market has been decreasing.

Including the rentals of its telemode series of record terminals for the Telex network, CNCP data communications equipment revenues for 1980 were an estimated $25.5 million, up 11 percent from $23.4 million in 1979. CNCP data communication Infomode terminals range from printers to programmable display terminals to multiterminal systems. Generally the users of these terminals are users of CNCP's telecommunications network services.

A new record terminal service, Infotex, based on the teletex protocol, was introduced by CNCP in 1982. In its first ph se, Infotex will allow communicating word processors of different manufacturers to communicate via the Infotex network. Supported word processors will include those from Micom, AES, Wang and CNCP's own word processor which is manufactured by Ontel in the United States. CNCP has also applied to the CRTC for tariff changes that would enable Telex subscribers to provide their own terminals instead of leasing them from CNCP.

THE HARDWARE MANUFACTURERS

In addition to Northern Telecom and the Gandalf Group, three other companies whose traditional primary market base is the communications hardware field generated computer communications equipment revenue of more than $5 million in 1980. These companies -- General DataComm Industries (Canada) Ltd., ITT Canada Ltd. and Tektronix Canada Inc. -- generated estimated computer communications equipment revenues of $28 million in 1980, up 23 percent from $23 million in 1979.

General DataComm Industries (Canada) Ltd.

General DataComm Industries, Inc. of Danbury, Connecticut was founded in 1969. It designs and manufacturers data communications equipment, including multiplexers (a device that allows more data to be sent on a communications line), data sets, and network diagnostic and control products to monitor and maintain data communications equipment.

The company employs over 1000 persons worldwide. For the fiscal year ended September 30, 1980, the company reported worldwide revenues of US$ 53.6 million, up 30 percent from US$ 41.4 million the previous year.

General DataComm Industries (Canada) Ltd. is a wholly-owned subsidiary. The Canadian company has offices and service centres in Montreal, Toronto and Edmonton. For the fiscal year ended September 30, 1980, GDC Canada reported revenues of $12.9 million, up 42 percent from $9.1 million the previous year. Net income for fiscal 1980 was $402 thousand.

The principal product the comp ny is noted for is modems (data sets). As of the end of calendar year 1981, there were about 70,000 GDC modems in use in Canada.

The Canadian subsidiary sells its modems and multiplexers to both end-users and the common carriers. Bell Canada accounted for an estimated 10 percent of GDC's consolidated worldwide revenues and close to 50 percent of GDC's total Canadian revenues in 1980. Following the CRTC interconnect decision, the comp ny has broadened its customer base to include non-telephone company customers in Ontario and Quebec. TRW Canada Ltd. provides service to GDC customers in Canada.

The comp ny states that its new Megamux multiplexer can handle data from a variety of sources including communicating word processors. The company expects the Megamux to find an important niche in large integrated electronic offices. GDC also intends to enter the fibre optics field.

ITT Canada Ltd.

ITT Courier of Canada is a divison of ITT Canada Ltd. Its American-based parent division, ITT Courier, had revenues of about US$ 250 million worldwide in 1980.

The Canadian Courier division is the largest supplier of 3270 plug-compatible terminals in Canada. (A 3270 is a very popular IBM terminal. IBM plug-compatible terminals are terminals made by manufacturers other than IBM.) At the end of the first quarter 1982, ITT Courier of Canada held 7.5 percent of the installed base of such terminals in Canada.

ITT Courier of Canada generated an estimated $9.5 million, $7.2 million and $6.1 million in sales in Canada of terminals similar to the 3270 in 1981, 1980 and 1979 respectively. The rest of its sales were from point-of-sales (POS) terminals; McDonalds Restaurants of Canada is its biggest customer.

Courier Terminal Systems, Inc. of Phoenix, Arizona, established in the 1960s, was one of the first companies to introduce IBM-compatible display terminals. The attraction to users of IBM equipment was that the Courier terminals has more value-added capabilities and were cheaper than IBM-made terminals. In the mid-seventies, International Telephone and Telegraph Corporation bought Courier and began to market the terminals worldwide.

In 1977, ITT Courier of Canada entered into an agreement with Volker-Craig Ltd. to manufacture terminals in Canada. This agreement lasted for a short time only. ITT Courier of Canada now imports all terminals.

Tektronix Canada, Inc.

Incorporated in 1962, Tektronix Canada, Inc. is a wholly-owned subsidiary of Tektronix Inc. of Beaverton, Oregon. The parent company's sales for the year ending May 30, 1981 were US$ 1.06 billion, up 9 percent from those a year earlier. Sales for Test and Measurement Products accounted for 71.4 percent of

the 1981 total sales and Information Display Products accounted for 28.6 percent compared to 74.3 and 25.7 percent respectively in the previous year.

Tektronix Canada Inc. reported total sales for the year ending May 31, 1980 of C$ 24.1 million, comp red to C$ 23.9 million the previous year. It is estimated that Information Display Products accounted for $6.8 million in sales in 1980 and $6.7 million in 1979.

Tektronix Canada's head office is located in Barrie, Ontario and sales and service branches are located in Dartmouth, Montreal, Ottawa, Toronto, Winnipeg, Calgary, Edmonton and Vancouver.

The Information Display Division provides monochrome and colour displays such as CRTs, desktop computers, plotters, copiers (special devices used to make copies of CRT screens), software and peripherals for scientists and engineers. For end-user applications in the computer industry, the company is known primarily for its graphics terminals.

Tektronix is the world leader in the sale and development of oscilloscopes. This testing and measurement device is one of the mainstays of its product line. There are now many efficient and well-managed oscilloscope manufacturers, however, and the company is operating under intense competition.

In the computer industry, the name Tektronix has been synonymous with graphics terminals. In the last few years, however, most computer terminal manufacturers have built graphics capabilities into their terminals. While many of these capabilities may be quite rudimentary compared to those offered by Tektronix, Tektronix sales have been affected. In the graphics market the company's strategy is to focus on the expensive end of the market characterized by CAD/CAM systems and medical imaging systems.

THE DISTRIBUTORS

There are three companies among the computer communications equipment suppliers who are primarily end-distributors of computer communications equipment and who had sales in this field above $5 million in 1980. These companies -- Ahearn & Soper Ltd., Lanpar Ltd. and Data Terminal Mart -- had

revenues that totalled an estimated $35.4 million in 1980, up 44 percent from $24.6 million in 1979. The three companies' computer communications equipment revenues totalled an estimated $26 million in 1980, up 53 percent from $17 million in 1979. The computer communications equipment market is growing by about half that rate -- 25 percent a year -- which indicates that the independent distributors are significantly increasing their market share.

Lanpar Ltd.

Lanpar Ltd. is a Canadian-owned supplier of data terminal equipment, data communications equipment, microcomputers and CP/M software, a very popular operating system for microcomputers. The company op rated nine sales and eleven service offices across Canada at the end of 1981 and employed about 200 people.

Lanpar reported revenues of $15.1 million for the year ending January 31, 1981, compared to revenues of $10.5 million for the previous year. It is one of the largest and fastest growing distributors of terminals in Canada. The company reported a profit of $487,000.

The company is generally known as a supplier and service provider for Digital Equipment Corporation terminals and for its own terminals including the Lanparscope and the XT 100. These have the same general characteristics and capabilities as Digital Equipment terminals.

A subsidiary company, Northern Technologies Ltd., supplies Lanpar with its brand name terminals.

The company's aggressive advertising program, as well as its reputation for low-cost service at acceptable levels of quality, has played a major role in its success in the volatile and competitive digital equipment terminal marketplace. With the advent of the Japanese terminal manufacturers and more aggressive terminal distributors, however, the company has expanded its product offerings to include, among other things, microcomputer software and small business computers.

Ahearn & Soper Ltd.

Ahearn & Soper Ltd. is a Toronto-based distributor of data communications equipment and computer peripheral devices. Total sales for the company in 1980 were $12.8 million. Since 1978 the company has had an average annual growth rate of 37 percent. Data terminal sales accounted for an estimated 80 percent of 1980 total revenues. The company has sales and service branches in Montreal, Ottawa, Toronto, Calgary and Vancouver.

In addition to terminals, the company also distributes Xerox's Versatec printer/plotters (expensive devices that turn computer data in digial form into pictures and drawings), colour printers, Norpak video processors, add-on memories for minicomputers and magnetic storage devices.

Ahearn & Soper has identified its typical customer as a buyer interested in multi-vendor supplied systems rather than customers who prefer one-vendor systems.

Data Terminal Mart

Data Terminal Mart is a retail-franchised operation. In July 1977, the first two franchises opened in Montreal and Toronto, specializing in low-cost terminals and printers and various other supplies and equipment for the low-speed computer terminal market.

In late 1979, Data Terminal Mart began to market small business systems and the company now represents more than seventeen suppliers of data and word processing equipment and accessories. Suppliers include Applied Digital Data Systems, Digital Equipment, Cybernex, Texas Instruments and Wang. The company also supplies data communications equipment such as data sets from Racal-Vadic.

As of the end of 1981, Data Terminal Mart had stores in Vancouver, Calgary, Edmonton, Ottawa, Montreal and Dartmouth, and two locations in Toronto.

Data Terminal Mart's revenues for the year ending June 30, 1980 were $7.5 million. The company's average annual growth rate from 1978 to 1980 has been 117 percent. Terminals and other communications equipment generated about 90 percent of total sales in 1980.

Table 5.1

CHANGING COMPUTER COMMUNICATIONS EQUIPMENT MARKET SHARES BY SUPPLIER GROUPS

Supplier Group	Estimated Canadian Computer Communications Equipment Revenues (C$ mil.) 1979	1980	Percentage Growth 1979-80	Percentage of Total Annual Revenues 1979	1980
1. Data Processing Hardware Specialists[1]					
IBM	136.8	165.5	21		
Others	75.7	90.5	20		
Subtotal	212.5	256.0	20	47	45
2. Common Carriers[2]					
TCTS	62.8	73.2	17		
CNCP	23.4	25.5	11		
Subtotal	86.2	98.7	14	19	17
3. Communications Hardware Specialists[3]	44.4	54.6	23	10	10
4. Distributors[4]	17.2	26.2	52	4	5
5. Others[5]	90.4	131.0	45	20	23
TOTAL	450.7	566.5	26	100	100

Source: Evans Research Corporation

1. Includes these 14 companies: IBM, Sperry, NCR, Digital Equipment, Burroughs, Honeywell, Four Phase, Memorex, Wang, Perkin-Elmer, Pertec, ICL, Centronics, Hewlett-Packard.

2. Includes these 9 companies: Bell Canada, Alberta Government Telephones, British Columbia Telephone, Manitoba Telephone System, Maritime Telegraph and Telephone, New Brunswick Telephone, Saskatchewan Telecommunications, Quebec Telephone, CNCP.

3. Includes these 5 companies: Northern Telecom, The Gandalf Group, General Datacomm, ITT, Tektronix.

4. Includes these 3 companies: Aheran & Soper, Lanpar, Data Terminal Mart.

5. Includes companies shown in Tables 2.2 and 2.3 but not included in above 4 categories.

PART II

THE DATA PROCESSING AND OFFICE

TECHNOLOGY EQUIPMENT SPECIALISTS

CHAPTER 6

THE DATA PROCESSING AND OFFICE TECHNOLOGY EQUIPMENT INDUSTRY

Computer communications equipment is manufactured and distributed in Canada primarily by two industries. These are the communications equipment industry and the data processing and office technology equipment industry.

The Canadian data processing and office technology industries are often referred to together as the information processing industry. This has traditionally been made up of two segments, data processing and word processing, which have been converging so rapidly that it is now almost impossible to tell them apart. Their equipment suppliers, such as IBM, Digital Equipment and AES Data, are among the most important suppliers of computer communications equipment in Canada.

According to the annual survey conducted by Evans Research Corporation, the Canadian information processing industry had a strong year in 1981, especially considering that recessions hit both the American and Canadian economies. Overall growth of the industry was 27 percent and revenues reached $4.5 billion, up from 3.5 billion in 1980. Revenues in 1980 were up 25 percent from $2.8 billion in 1979. (Revenues include the computer communications equipment revenues shown in Chapter 2.)

Information processing is a diverse industry, comprised of many sectors related by the simple fact that the computer is at the heart of the technology and is used for the processing of information. Individual sectors are showing significantly different growth rates and future expectations.

The hardware sector has about 56 companies that generated revenues of $2 million or more in 1981. Together, these companies earned total revenues of $3.6 billion, up 28 percent from $2.8 billion in 1980.

Dominating the hardware sector is IBM Canada Ltd. (discussed in Chapter 7), which generated $1.5 billion in data processing revenues in 1981, up 25 percent

from $1.2 billion in 1980. It is the only company in the industry with the financial, engineering, marketing, management and other resources to compete in any and all sectors if it so chooses. IBM is also a considerable threat to the communications industry in Canada.

The survey indicated that the average growth rate for the other five traditional suppliers who provide main frames -- Burroughs, Univac, NCR, Control Data and Honeywell (sometimes called "The BUNCH") -- was about 9 percent in 1981. These companies had combined data processing revenues of $663 million in 1981, compared to $606 million in 1980.

The fastest growing segment of the main frame segment (including related peripherals) was that represented by the IBM plug-compatible suppliers. Amdahl, STC Inc., Memorex and National Advanced Systems grew by an average of 61 percent in Canada in 1981. These companies had combined revenues of $185 million, compared to $115 million in 1980.

Indications are that, on a worldwide basis, the main frame business is gradually evolving towards a computer standard similar to IBM's, at the expense of the BUNCH who, as a group, are losing market share.

Close behind the plug-compatible segment of the hardware sector in terms of growth rate in 1981 was the minicomputer market. Most minicomputer suppliers, generally selling computers in the $10,000 to $150,000 price range, showed a 30 to 40 percent growth rate in 1981. This sector is benefitting from the trend to offloading processing from centralized main frame computers to distributed minicomputers.

Digital Equipment Corporation, the largest minicomputer supplier, is featured in Chapter 8. Digital is positioned in the industry as the leading satellite processor vendor. Satellite processing systems act as host computers for terminals and work stations while communicating through local networks to large, corporate data processing centres, which usually consist of IBM main frame computers. Among the top eight industry suppliers in North America (those with revenues above US$2 billion in 1981) Digital is second only to IBM is placing the most emphasis on communications.

Included in the lower range of this segment of the market, generally selling in the $10,000 to $30,000 range are the word processors. The leading word processing company, AES Data Ltd., is featured in Chapter 9.

AES Data Ltd. is the most successful Canadian-owned manufacturer and distributor of standalone and communicating word processors. It has shown spectacular growth over the past six years, with revenues increasing from only $4 million in 1975 to $173 million in 1981.

Most microcomputers are priced under $10,000 and are sold through computer stores. This was a $100 million market in 1981. It grew by 150 percent in 1981 and is forecast to grow by an annual average of 70 percent in the 1982-1987 period.

Microcomputers are expected to find a growing market in the computer communications networks of large companies and government departments. Virtually all microcomputers now sold have communications capabilities that allow them to communicate with public and private data bases.

CHAPTER 7

INTERNATIONAL BUSINESS MACHINES CORPORATION

International Business Machines Corporation, with headquarters in Armonk, New York, is the largest and most profitable information processing company in the United States, Canada and most other countries where the company competes. One way of obtaining a perspective on IBM's influence on the worldwide information handling industry is to appreciate IBM's commitment to research and development. In 1981, IBM spent $1.612 billion on R&D. Out of every R&D dollar spent by the American computer industry, IBM accounted for about 40 cents.

With 1981 worldwide revenues of $29.1 billion, (Table 7.1), IBM accounts for approximately 35 percent of the worldwide revenues generated by information processing companies based in the United States. In 1981, 48 percent of IBM's revenues were generated from foreign operations.

IBM's operations, with minor exceptions, are in the field of information handling systems, equipment and services that solve problems of business, government, science, space explorations, defence, education and medicine.

IBM's products include data processing machines and systems, information distributors, telecommunications systems and products, office systems, electric and electronic typewriters, copiers, dictation equipment, educational and testing materials and related supplies and services. Most products are both leased and sold through IBM's worldwide marketing organizations.

In 1981 revenues related to information processing represented 85.3 percent of the worldwide total, up steadily from 84.0 percent in 1980 and 82.9 percent in 1979. Office products represented 14.5 percent of the total, down steadily from 15.8 percent in 1980 and 16.8 percent in 1979. Electric typewriters, copiers and related products that are not software-controlled are a declining portion of IBM's business. The remaining 0.2 percent of the company's business

in 1980 was accounted for by educational, training and testing materials and services for school, home and industrial use.

Worldwide revenues grew by only 11 percent in 1981. This low growth, in an industry expanding in the neighbourhood of 20 percent per year, was due primarily to foreign currency translations. If foreign currency rates had been the same as 1980 levels, revenues would have been $2 billion and net income $600 million higher. Under those circumstances -- which are important to consider because they more accurately reflect IBM's real growth in 1981 - the company would have shown a worldwide growth rate of 18.5 percent and a net income of 13 percent of revenues.

Growth in the United States, however, was a full 21 percent. This was up from an average annual growth rate of only 13 percent in the three years ended in 1980.

The resurgence in IBM's growth is due to significant changes in corporate strategy. They have thrust the company into sectors of the computer hardware, processing services and communications industries where it has never been before. These changes are so important that they could affect every sector of the Canadian computer, communications and office automation industry.

Table 7.1

INTERNATIONAL BUSINESS MACHINES CORPORATION
FINANCIAL SUMMARY
FOR YEARS ENDED DECEMBER 31
(US$MILLIONS)

Year	Total Sales	Net Earnings	Earnings Percentage of Sales	Percentage of Sales Growth	Percentage of Earned Growth	IP related* Sales	IP related* Percentage of Total	IP related* Percentage of Growth
1981	29070	3308	11	11	(7)	24792	85.3	13
1980	26213	3562	14	15	18	22014	84.0	16
1979	22863	3011	13	8	(3)	18950	82.9	8
1978	21076	3111	15	16	14	17623	83.6	16
1977	18133	2719	15	11	13	15251	84.1	10
1976	16304	2398	15	13	20	13842	84.9	13
1975	14437	1990	14	14	8	12243	84.8	N/A

Source: 1981 Annual Report and company press releases

* Information Processing (IP) sales include Data Processing and Federal Systems business segments.

( ) Negative growth

Table 7.2

INTERNATIONAL BUSINESS MACHINES CORPORATION
GEOGRAPHICAL DISTRIBUTION OF BUSINESS
(US$MILLIONS)

Year	Total Sales	U.S. Sales	Percentage of Total	Percentage of Growth	Foreign Sales	Percentage of Total	Percentage of Growth
1981	29070	15088	52	21	13982	48	1
1980	26213	12426	47	17	13787	53	13
1979	22863	10619	46	6	12224	54	11
1978	21076	10036	48	11	11040	52	21
1977	18133	9008	50	N/A	9125	50	N/A

IS THE GIANT IN A STATE OF DECLINE?

In just three years, from 1977 through 1979, IBM ran through $4 billion in cash and then borrowed $1.5 billion in the first bond borrowing in its history. It announced products that it couldn't deliver (like the System /38), and delivered products (like the 8100) that it couldn't support with the necessary software. In 1979, IBM was in the midst of an apparently self-inflicted earnings decline from the over-aggressive pricing of its 4300 series, including 80 percent slash in memory prices.

With all this, in 1979 IBM's earnings slipped to a level 3 percent below the 1978 level. Revenues grew by only 8 percent, which was less than half the average of the industry. IBM's share of the information processing market dropped from 40 percent in 1978 to 36 percent in 1979. Many analysts began to ask, "Is IBM in a state of decline?"

Observers who had bet on IBM's demise in 1979 received a surprise when IBM's revenues rebounded with a 15 percent growth rate in 1980. Net income grew at an even faster 18 percent rate. A major part of IBM's apparent weakness in 1979 was simply the inevitable cost of an unpleasant but necessary shift in long-range strategy designed to keep the giant at the top of the industry.

IBM's apparent mistakes and miscalculations in 1979 need to be placed in the context of a conscious and deliberate drive to push the pace of current technological development to its limit. The company is hastening the transformation of the entire computer and communications industries. The change will be as significant as the switch from punched cards to stored programs in the 1950s. But to understand what IBM is doing, it is important to understand what is happening in the computer industry as a whole.

An Industry Undergoing Significant Change

The transformation started in a small way, without IBM, with the advent of the microprocessor - the computer on a chip.

In the old days, hardware was costly to own, and the main customers were big corporations who could afford the large main frame computers. IBM still dominates that industry today, with about 77 percent of the main frame processor market.

The minicomputer, introduced by Digital Equipment Corporation, at first seemed an oddity, useful mainly to scientists, but of little interest to the data processing leaders.

However, as the price of computing power dropped and machines became equipped with software that made them easier to use (more "user friendly"), it made more and more sense to move processing out of the large host computer and into small computers placed under the control of users. Such action saves communications costs.

If the small computers operate on a stand-alone basis, this process is known as decentralized processing. If the small computer is part of a network of other computers, it is considered distributed processing. As the Canadian growth rate of 40 percent in units of small computers shipped in 1981 indicates, the trend to decentralized and distributed processing is well advanced.

Large computers are IBM's main business. But it is a declining sector of the information processing industry. As a result, IBM's percentage of the American-based information processing industry was 40 percent in 1978, 36 percent in 1979 and 35 percent in 1980.

Therefore, if IBM were to stick solely to its traditional main frame business, its future would be clear: It would control a declining segment of the market.

Where Is The Growth?

A Radio Shack TRS-80 Model 11 computer, with all the options, has most of the power of the old workshore IBM 1401 computer which was the mainstay of the

big corporation computer rooms in the early 1960s. In the $5,000 to $10,000 purchase range, the TRS-80 has a purchase price equal to about one month's rent on the 1401. Stated another way, the purchase price of the TRS-80 is about 1/40th of the old 1401.

When one looks at an industry in which spending 6 to 9 percent on R&D is the norm, every indication is that the price of hardware will keep going down.

Where, then, is the potential for growth in revenues and earnings? The growth is in the system software and the service itself, which adds value to the hardware.

As the terminals that IBM and other computer hardware suppliers sell get more intelligent, it becomes possible and desireable to interconnect them with one another as well as with the host computer. Soon, an environment of inter-related electronic appliances with potentially infinite variety emerges.

It is comprised of word processors, electronic messaging and filing systems, electronic dictionaries, yellow pages and other directories, data processors, public and private electronic data bases and facsimile transmitters. The total "intelligent network" itself becomes the product or service, and the host computer only a processing power source in the system.

The automated management office is where the growth is in the 1980s. It is evolving into a world of small, separate, but interlinked, information appliances.

Through the word processing work station, the secretary of the 1980s office will use the network for storing and retrieving letters, reports, manuals and documents.

Through the professional work station, the research analyst will use the network to access information from public data bases anywhere in the world.

Through the managerial work station, the profit centre manager will use the network to find out how revenues, expenses and profits compare against those planned. Decisions-support systems for managers are making great advances as we proceed through this decade.

That, in brief, is how the computer world of the 1980s is emerging. In 1979, the sector of the North American market that involves distributed processing, networks, small decentralized computers and office automation grew by more than 40 percent. IBM's information processing revenues grew by only 8 percent.

As we left the 1970s, the modern office of the 1980s was beginning to send up shoots around IBM's old centralized business like a forest of young trees around an old one, eventually to obscure it.

IBM's Corporate Strategy for the 1980s

Had one taken a short view of the situation as the 1980s began, one could have made the case that IBM was in deep trouble. But revenue growth is only one factor in measuring performance and strength. Looking at IBM's financial position as the new decade began, the figures are awesome.

In 1980, IBM's income at $3,562 million was a full 62 pecent of the approximately $5,750 million earned by the information processing industry as a whole. The company's cash flow from operations in 1980 was $7,023 million. Add $422 million from sales of stock to employees and $604 million from long-term borrowings and IBM's total cash flow in 1980 was $8.049 million.

IBM entered 1981 with a working capital position of $3,399 million and a capital structure that included only 14 percent debt.

In 1980, IBM spent $1,250 million on research and development. This represents 40 percent of the approximately $3,800 million spent by the total U.S. based industry.

IBM's return on shareholders' equity in 1980 was 23 percent, (compared to a 14 1/2 percent median for the Fortune 500 companies) and IBM's return on total investment was 21 percent.

Taking a short-term view of the situation in 1979 was to ignore IBM's counterattack. A long-term business, with five- or six-year product cycles, cannot be run on the basis of single-year earnings comparisons.

As early as September 1971, IBM's current Chairman, Frank Cary, was reporting to former Chairman T. Vincent Learson his conclusions that the market was moving towards communications-based interactive computing and decentralized processing, and that centralized processing equipment would become a continually declining portion of the business.

Soon after, IBM quietly installed a prototype interactive system at its Armonk headquarters. It has grown over the years.

IBM now has a vast international network for its own internal use. The company has satellite space on its own Satellite Business Systems subsidiary, and all branch offices, headquarters, distribution centres, information data bases and other accumulations of knowledge are in, or ready to enter, the network.

As the decade began, the network included 96 major processing centres in the United States and seven in Canada. A "major" processing centre is described as one having at least one IBM 3033 or equivalent processing power main frame computer. The Canadian centres are located in Vancouver, Calgary, Toronto (four centres) and Montreal.

All IBM processing centres around the world are networked. Many are linked by 19.2 or 50K bps communications links. Information can easily be sent at high speeds over IBM communications facilities to an IBM processing centre from any city in the world where IBM does business. Furthermore, there is no technical reason why all computers on client premises could not become part of the worldwide IBM network.

In 1974, when main frames still represented 83 percent of the value of shipments in the business, IBM introduced Systems Network Architecture (SNA). SNA is IBM's masterplan for integrating the hardware appliances and the software intelligence that makes the networks of the 1980s work. It provides the blueprint for allowing an orderly transformation of all the separately developed, incompatible communications schemes worked out for various IBM product lines into one universal, standardized system.

What else would a company be working on if it was preparing for a networking future? Communications, for one thing. In March, 1981 Satellite Business Systems (SBS), jointly owned by IBM, Aetna Casualty and Surety Company and Comsat General Corporation, began offering commercial services on their own satellite system, launched in November 1980. SBS places IBM in direct competition with AT&T in the United States and possibly Bell Canada and the rest of the TransCanada Telephone System.

From the Canadian perspective, it is interesting to note that SBS has sought and obtained approval from the U.S. Federal Communications Commission to offer satellite services in Canada. SBS must now negotiate terms of agreement for provision of service with Telesat.

The company would also want a position in office equipment. IBM had revenues of $4,219 million in office products in 1981. IBM's new Displaywriter word processing system and the IBM Personal Computer are the electronic appliances needed for the intelligent network. The Displaywriter, with a starting price in the United States of about $7,500, and the IBM Personal Computer, at less than $2,000, are priced so aggresively that IBM seems intent on dominating the market for software-controlled office products as it now dominates the electric typewriter market.

The company would also want to gear up for new products. In 1980, IBM completed more than 4 million square feet of manufacturing and laboratory space companywide. More than twice that square footage was under construction in eight countries at the end of the year.

To provide more room for marketing operations, IBM added over one million square feet in office space in 1980. An additional three million square feet for marketing were being built at the end of 1980.

As the 1980s began, observers began to speculate on where all this was leading. Subtly, IBM appeared to be undergoing a metamorphic change from being a manufacturer to becoming a vast, immensely sophisticated processing and communications solution-oriented network.

The legal obstacle that kept IBM from offering computer services in the United States (the settlement with Control Data Corporation) expired in January 1979. Frank Cary, when asked if IBM would provide processing services, made it clear that IBM would be back in that business. Processing services are an essential element in the networking concept.

IBM was doing what it has done for decades -- letting the market segment develop until its direction is clear and its operations are profitable before committing its massive resources to that market segment. The information processing market was in transition in the middle of the 1970s but by the end of the decade, its directions of growth had become clear.

The speculation about IBM's direction was confirmed when, on February 2, 1982, IBM reentered the U.S. processing services business with the announcement of the IBM Information Network.

Putting it in this perspective, IBM's pricing of the 4300 becomes more rational. Over the useful life of the computer, the 4300's software and related service could cost more than the hardware. IBM is charging more for the intelligence, and not so much for the hardware.

Project this trend to the late 1980s, and it is reasonable to forecast that IBM will be earning more from software and network-related services than it does from hardware. The company will be in business of solving customer problems. The hardware will simply provide the processing power required to drive the intelligent network that delivers the solution.

A Return to the Strategy of the Past

This evolving strategy has links to the past. Like Xerox, IBM has traditionally made its money by owning the assets -- first the punched card machines and electric typewriters before the 1950s, then the computers -- and leasing them. The corporation made money from the leases, and from having software, servicing and hardware all "bundled" in one monthly price.

Laying the groundwork for the new business -- one in which IBM will make more money from software and services than it does from hardware -- is expensive and disruptive. There has been a drag in earnings, and the recession has made inroads on orders for large computers. Computers, after all, are capital goods items and customers are inclined to defer or cut back when times are tough.

The new 3081, announced in November 1980, and the rest of the new series of large-scale computers is expensive to bring out. They are an important part of the networking concept, however, because the storage, retrieval and processing of previously unheard of volumes of information will require massive, centralized processing power stations in the more than 100 major processing centres that may become the primary nodes in IBM's emerging network.

Unless IBM's strategy goes seriously awry, a huge earnings surge is building up. The big new machines are beginning to appear and, as is typical in the early stages of a new product cycle, a high percentage of them are purchases. Meanwhile, the incremental income from new machines leased each month adds to the size of the company's revenues.

The big 3033s now on lease, in fact, actually create the potential for highly profitable sales revenues in the near future.

IBM's cost of manufacturing is the lowest, by far, in the industry. The 3033s will soon be fully depreciated on IBM's books and the proceeds from the sale of these computers at a discount will go straight to the bottom line.

Perhaps in 1983, everything will come together: end of recession, major deliveries of the 3081, growing dominance in the personal computer and word

processing markets, a vast international intelligent network, increasing production from the huge amount of plant IBM is building, and an irrestible fire sale on the lease base of 3033 computers.

Will Everything Go According to Plan?

Still, there will be tough competition for IBM in the networking business.

The telephone companies and their affiliates -- TransCanada Telephone System and Northern Telecom, General Telephone & Electronics, and AT&T -- see intelligent networks as a natural extension of their business and will fight jealously to win that market.

Xerox Corporation, with 1980 revenues of $8 billion, is determined to be a major factor in the automated office of the 1980s.

The major processing services firms, such as Tymshare, Inc. in the United States and Canada Systems Group Limited in Canada, will also be competing for the value-added network services business. They must focus on value-added services because IBM will be difficult to complete against in providing raw computer power.

In the face of strong competition, however, IBM is the one supplier that appears to have the resources to compete effectively in all information processing market sectors it chooses to enter.

In the middle of the 1970s, IBM set its sights on recovering the share of the market taken by the plug-compatible manufacturers (PCMs). When the 4300 was announced and the smoke had cleared, IBM had driven the weaker players -- including Itel and Calcomp -- from the market and seriously affected at least over the short term, the revenue growth and profitability of most of the remaining competitors.

The net effect of IBM's aggressive moves into the communications, personal computer, word processing and processing market segments will be a significant shakeout of the weaker players.

Product Innovations

The U.S. information processing market is growing at about 20 percent per year. It reached approximately $75 billion in revenues in 1980. There are about 2,600 players in the market, from giant IBM to small professional services companies generating a few hundred thousand dollars in revenues per year.

Within this diverse industry, IBM, with revenue growth which averaged only 13 percent in the 1976 to 1980 period, had been steadily losing market share.

IBM has the financial muscle, however, to move into, and be a significant factor in, any market sector it chooses. Consequently, to slow the erosion of market share, IBM invested heavily in several dozen key technologies that drive the information processing industry ahead. These investments have placed IBM incresingly into the higher growth segments of the industry and in future its main frame business, which is a mature business, will be less of a factor.

The results registered in 1981, (which include a 21 percent growth rate in the United States and 22 percent in Canada), may therefore be more typical of IBM's growth throughout the 1980s than the 13 percent average in the 1976 to 1980 period.

Since 1979, IBM had introduced a stream of new products designed to keep the company well placed in the market. It now provides the broadest range of products in the information handling industry. (Information handling in this context includes data processing, word processing and computer communications.) Its products lines are described briefly in the remainder of this chapter.

IBM AND THE COMPUTER COMMUNICATIONS MARKET

Data processing, office systems and communications are rapidly merging. The thread tying these three elements together is electronic information. IBM's strategy for competing in the communications field can be defined in terms of six areas of growing importance to users:

- Product interconnection -- satisfying the need for communications capability among all IBM equipment;

- Network architecture -- a framework to ensure that IBM equipment and software will function in the network of any organization;

- Gateway functions -- the focal point for interconnection of end-user work stations to the distributed processing network;

- Long distance transmission links -- facilities to ensure that efficient communications can occur between computers at significant distances;

- Local distribution networks -- facilities that transmit data and voice from the termination of satellite transmission directly to and from the user's site;

- Local area networks -- communications facilities that provide for efficient data and voice transmission between offices within the user's organization.

Product Interconnection

IBM recognizes that communications support must be available so that text documents that require filing or transmission can be sent to or retrieved by authorized individuals throughout the organization, using mutiple devices, coming from multiple marketing divisions within IBM. Consequently, in 1980 IBM made it clear that devices from all IBM divisions would be developed with compatible communications interfaces.

Systems Network Architecture

From its announcement in September 1974, IBM has been at work on its Systems Network Architecture (SNA). The objective has been to provide an architectural direction, a road map for individual developers in individual IBM

laboratories. SNA is used as a framework to ensure that the company's products -- both hardware and software -- will function in the network of any organization.

SNA is a host-controlled network and is designed to provide distributed data processing to users while maintaining centralized network control. In its initial form, SNA allowed for one host processor in the user's network. This has since been expanded to allow interconnection of multiple hosts.

Each host, however, retains control over all its terminals, other processors and all other devices within its "domain." This implies that communications between a user on system A and one on system B must go through both hosts, regardless of the advantages of direct communications between the two user work stations. In SNA, communications can bypass the host but only after the two users have been "set up" by the two hosts.

A basic concern until recently was that SNA's Synchropnous Data Link Control (SDLC), which deals with device protocols, was incompatible with the X.25 standard adopted by the International Standards Organization. In July 1981, however, IBM announced the availability of a Network Interface Adapter that converts SDLC to and from X.25 communications protocols and provides users with gateways to the public packet switched networks.

Why did IBM announce X.25 support after ignoring the international standard for so long? Probably because X.25 is gaining momentum and the clamour from users to support hybrid SNA/X.25 networks has been increasing.

The Gateway Function

The gateway function represents the capability to integrate information -- voice, data, fax, image -- to maximize the effectiveness of the chosen transmission service. Conceptually, the gateway function will embrace such hardware devices as PBXs, communications multiplexers, and communications adaptors on individual distributed processors.

Communications functions included will be switching information within organizations, modulation/demodulation, concentration, protocol conversion, and encryption.

The gateway function is clearly evolving towards integration of hardware and software products into increasingly powerful, flexible and efficient gateway nodes.

The interconnect decisions in the United States and Canada mean that this business is likely to be a battleground between the computer companies and the telephone companies. In this regard, IBM has recently announced a development accord with Mitel Corporation, the successful Canadian PBX supplier, which could lead to interesting developments.

Long Distance Transmission Links -- Satellite Business Systems

IBM is in the information transmission business in a big way since it launched its first transmission satellite in November 1980. IBM's satellite services have been available since March 1981 via Satellite Business Systems (SBS), the partnership formed by subsidiaries of the Aetna Casualty and Surety Company, COMSAT General Corporation and IBM.

Some of the capabilities of the service originally announced, or announced since the service was launched, include:

- A facsimile service capable of transmitting more than 60 pages per minute.

- A teleconferencing system which Aetna and other companies are now using for conferences held between their geographically dispersed offices.

- A system comprising a combination of coaxial cable and microwave systems, instead of telephone company-provided circuits, to connect data communications users in San Francisco and New York with SBS earth stations on user premises. These users can also be linked through Tymnet, Tymshare Inc.'s domestic and international packet-switched

network. Users will be able to transmit data and voice at up to 56,000 bits per second, end-to-end.

This latter service is an important program for resolving some of the transmission bottlenecks created by traditional local-loop facilities in metropolitan areas. To date, the development of high-speed business communications has been retarded by inadequate, costly methods of local distribution.

Several other innovations are included in SBS' service. Voice messages are digitized and digital speech interpolation (DSI) is used to reduce bandwidth requirements, reducing costs to the user. Basically, DSI allows multiple voice conversations to be carried simultaneously on the same channel by filling in the normal pauses in each with a portion of the others.

The SBS network also features dynamic bandwidth reallocation, providing each customer with transmission capacity when and where he needs it on a minute-by-minute basis. This has significant benefits because the customer can avoid the expense of buying full-time capacity to meet peak loads.

SBS backbone circuits transmit data at speeds up to 6.3 million bits per second, making on-line bulk transfers of large data files practical for large organizations. At 56,000 bits per second, it would take almost two days to transmit a one-billion-byte file, which might be the daily sales transactions for a large retailer. SBS can transmit such files in an hour and a half at 1.5 million bits per second, or in 23 minutes at 6.3 million bits per second.

Total satellite transmission capacity is 480 million bits per second. This allows for 8,600 channels, each operating at 56,000 bits per second.

Rates for SBS subscribers have been planned so that users with heavy voice loads would save 10 percent to 20 percent over AT&T rates. Where an SBS network is cost-justified for voice applications, other applications are available at low incremental costs.

A target has been to keep the incremental cost to an SBS user for 56,000 bits-per-second data circuits far below the cost of AT&T's Digital Data Service at distances over 200 miles.

In June 1981, IBM announced that it was holding discussions with British Aerospace about starting a joint satellite communications service for business users in Western Europe. IMB stressed that the American partner would be IBM, not SBS.

Local Distribution Networks

In August 1981, Satellite Business Systems and Tymnet, Inc. each asked the Federal Communications Commission (FCC) for authority to build wideband, digital local-distribution networks in major U.S. metropolitan areas. If approved by the FCC, these digital termination systems (DTS) will transmit data directly to and from a user's site at speeds of 2,400 to 1.5 million bits per second.

Besides being less error prone and supporting far higher bit rates than analog local loops provided by telephone companies, DTS channels are likely to cost the user far less for nominally equivalent service. DTS rates may also be considerably lower than those now charged for digital wideband offerings, such as AT&T's Dataphone Digital Service.

Electronic messaging, high-speed facsimile and teletext are among the services likely to be supported by DTS networks. Generically, DTS networks are usually referred to as digital electronic message services (DEMS), although SBS plans to call its version the Data Exchange Service (DXS).

Tymnet, a national and international value-added carrier that now offers intercity packet-switched communications services, wants to establish DTS networks in 50 cities in the next six years. The first two networks, in New York and San Francisco, would be operational six months after the company gets the green light from the FCC.

SBS is planning to build DTS facilities in 32 cities, starting in the first half of 1983.

An official at Tymnet stated that "Today in a typical city, it costs $200 per month to lease a 9,600 bps local loop from the phone company, plus $600 per month for each of the two modems required. By comparison, our microwave system

will deliver 256K bps -- 25 times more bandwidth - to the same user's site for about half of AT&T's price."

SBS stressed in its FCC application the importance of DTS networks in solving the "last mile" bottlenecks -- an allusion to the quality and speed limitations imposed by the telephone companies' analog local loops.

The SBS concept, of delivering large communications capacity directly to a user's premises became a reality for large users through the use of easily placed earth stations at user sites. This was a major step in solving the last barrier for very large businesses.

SBS stresses that what is still needed is the addition of digital termination systems which will extend the solution to the needs of smaller businesses.

The technology to be used by SBS and Tymnet is essentially the same. The key element is one or more radio transmitters located within each metropolitan area where DTS service is to be provided. Each has a range of up to six miles.

Alternatively, or in addition, a local TV network can be used, or coaxial cable can be leased from the telephone company.

Local Area Networks

To fully exploit the productivity advantages of data processing, office systems and communications, the design of communications links within the organization must be coordinated with the network architecture.

The first consideration is the internal bus structure used to interconnect the devices that make up the end-user work stations, and the flexibility it provides for function and performance enhancements.

The next consideration is the attachment of work stations to the communications link within the establishment -- the local area network. This must then be connected to the external network -- the local-distribution

network -- via cable, or other means. Finally, the long distance transmission links must be taken into account.

As text, data, voice, image and graphics are integrated on one device, the joint consideration of these devices becomes more important.

Telephone lines linking offices in the typical organization are inadequate to handle the high-speed transmission requirements of these devices. A number of computer companies, including Xerox, Datapoint, Digital Equipment and Intel, are now providing, or have announced, local area networks to handle processor-to-processor transmission between offices.

High capacity local area networks are essential elements in IBM's strategy for the integrated electronic office. Consequently, IBM is planning to test local area network facilities at a number of customer sites as a second phase in its Local Distribution Network offerings. IBM will probably announce the availability of services in this area in the near future.

IBM AND THE PROCESSING SERVICES MARKET

In February 1982, IBM announced that it was reentering the processing services business with the launching of the IBM Information Network. Three major factors seem to have prompted IBM's reentry into this market segment.

First, the processing services business has shown steady growth and become soundly profitable. In both the United States and Canada, the processing services industry has been showing average annual growth rates of about 22 percent. Return on equity in the United States, which is a more mature and profitable market for processing services than Canada, has averaged about 20 percent annually for those firms with yearly processing services of revenues above $100 million.

Second, IBM wants to be a part of the processing services segment of the market, that same segment that has posed a threat to IBM influence over many of its key major accounts.

Third, IBM recognizes that it is faced with a possible additional treat by AT&T for account control at IBM's major accounts. While this battle is not yet being waged, battle plans are being established by corporate planners in both organizations. Networking, rather than hardware or software will likely comprise the main issue. Simply put, IBM cannot afford to ignore AT&T and its plans for providing value-added services.

IBM's Impact on the Processing Services Industry

The processing services industry would continue to grow even without the entry of IBM and AT&T. Their entry into the processing services marketplace, however, will cause substantial changes to occur.

It appears that by 1987, the remote processing services, remote information services and value-added network segments of the industry will have evolved into overlapping but still distinct sectors of what IBM is calling Information Network Services. Surviving suppliers, in both Canada and the United States, will have to become more specialized in providing value-added customer solutions in vertical markets. IBM will likely be the lowest cost competitor in providing raw computing power.

It is possible to expect that by 1987, IBM and AT&T in the United States and IBM and TCTS in Canada will be among the overall market leaders in the information network business.

Initial Offerings from the IBM Information Network

The initial four service areas are in the east -- New York, Washington, DC, Atlanta and Tampa -- with only three test sites elsewhere -- Chicago, Dallas and San Francisco. While this indicates a rather conservative approach to a national network, plans appear to be underway to expand to a second round of metropolitan areas which will include 25 or 30 of the nation's largest concentrations of IBM customers.

It appears that IBM planners have based their initial network node selections using three key selection parameters: the share of local computer market held by IBM and IBM-compatible medium- and large-scale systems; the tendency of these areas to be relatively strong sources of processing services revenues, especially for the revenue bases of IBM-compatible processing services; and the suitability of these cities as adequate test markets.

Initially, dual IBM 3033 main frame computers have been installed in an IBM facility in Tampa, Florida to provide the backbone for the IBM Information Network.

The fact that the initial network is limited keeps one fixed cost element of the processing services business lower than normal - networking and communications equipment. This will be an important point in reaching an early break-even point. When coupled with the fact that the processors are relatively inexpensive 3033 computers, it appears that IBM wishes to reach a point of profitability relatively early in the life of the new business.

Initially, over 100 "library" type products are being made available. These range from program/system development facilities for the professional data processing staff to modeling programs for end-users.

The IBM Information Network is being positioned as a generally applicable, value-added remote computing service serving a wide variety of industries and government agencies.

Expected Evolution of the IBM Information Network

IBM has not made its future plans public. However, their planned evolution may involve "piggybacking" the Network on IBM's existing internal network, which connects all branches in the United States to the approximately 100 large processing centres throughout the IBM organization. Under this arrangement, the current private network would "go public" and IBM would become a super value-added network, like Tymshare, Inc.

The advantage is that users who could not afford leased lines would be able to use IBM's high-speed data links, wideband and the company's SNA products. IBM can also buy or lease space from its Satellite Business Systems subsidiary to handle high-speed, high-volume applications.

IBM's intention appears to be to have clients dial their local branch and be routed by the high-speed network into IBM's processing services complex. If their needs were small, they could use their terminal and IBM's timesharing facility to develop their own programs or access their data files. If their in-house computers were too small, they could have IBM handle their monthly batch load. Or they could lease space on the processing services' sophisticated high-speed peripherals for colour printing and colour graphics.

As their needs increase, users would start fitting more and more of their information processing operation into their IBM processing network.

In this way, IBM Information Network customers could start with a simple time sharing terminal at $100 per month and soar to a full facilities management treatment at perhaps $100,000 per month or more for the whole package.

Because communications costs are expensive when large volumes of data are being moved about, IBM's strategy may involve Network-controlled 4300 or equivalent remote computers on the customer's premises. These could run virtually unattended at the user's sites, with the system software being managed and maintained from IBM's processing centres. This innovation is known by the code name "Hydra".

THE INFORMATION PROCESSING PRODUCTS MARKET

IBM generates about 62 percent of the net income, 40 percent of the R&D and 35 percent of the revenues in the North American information processing industry. (Information processing in this context includes both data processing and word processing.) It is the only company with the financial, marketing, management, engineering and other resources necessary to compete effectively in any sector of the market that it chooses. The major information processing products sold by IBM are discussed in the following paragraphs.

The IBM Personal Computer

A major growth area targeted by IBM is the sale of small computers to individual users for applications in small businesses, or for use as stand-alone work stations in larger organizations. IBM's studies indicated that only a small percentage of those who can economically justify a computer in these environments are doing so today.

In 1981, IBM announced its smallest computer to date, the IBM Personal Computer. IBM recognizes the need for altogether new marketing channels for distributing the new system. Consequently, the company announced an untraditional marketing agreement with ComputerLand and Sears, Roebuck retail outlets as distributors of the system. Furthermore, IBM proclaimed it is looking to buy programs from outside software companies.

Priced to compete with Tandy Corporation (Radio Shack) and Apple Computer, Inc. products, IBM's market entry is priced to start at under $2,000 in Canada. It offers 16K to 256K bytes of internal storage, up to 320K bytes of diskette storage and printing speeds of up to 80 characters per second.

The IBM Personal Computer is based on an Intel 8088 microprocessor and displays graphics in any of four different colours.

IBM announced a disc operating system for the system developed for the company by Microsoft, Inc., the developers of the primary programming language for the system, Microsoft Basic. It also announced a contractual agreement with Digital Research Corporation to provide the commonly used CP/M-86 operating system.

IBM has also contracted with Personal Software, Inc. and Information Unlimited Software, Inc. to provide the "VisiCalc" financial planning software package and the "Easywriter" word processing package.

There are three accounting packages: accounts receivable, accounts payable, and general ledger. All were developed by Management Science America Inc.'s Peachtree Software, Inc. Also available is a computer game similar to Dungeons and Dragons called "Microsoft Adventure."

Apparently, in a move to catch up to Tandy and Apple in the area of applications software available, IBM has gone into the third-party software business with the Personal Computer Software Publishing Department.

The publishing department will review programs created by just anyone. The programs will be evaluated by IBM and, if approved, offered to IBM Personal Computer users with a royalty going to the developer.

The processor can communicate over asynchronous lines with a standard RS-232C adapter to access other personal computer processors, private data bases on in-house main frame computers, or public data bases.

The processor is being manufactured in IBM's Boca Raton, Florida assembly plant. The CRT, however, is being manufactured in Taiwan.

The IBM Personal Computer represents IBM's lowest-priced entry in the small business computer market. The other systems in IBM's current small business line, from least to most expensive, are the System/23 Datamaster, the System/34 and the Models 3 and 4 of the System/38.

The IBM System/23 Datamaster

IBM's strategy for selling small business computers (at least for those systems above the personal computer size) appears to involve two key elements:

- providing fundamental-application software, especially accounting-oriented programs, and high-level programming languages, including Basic and Report Program Generator, so the small business does not have to hire trained programmers; and

charging a significant price for that software, so that the user may pay as much over the useful life of the system for the software and maintenance as he does for the hardware.

In July 1981, IBM announced what was then its smallest computer yet -- the System/23 Datamaster. (The IBM Personal Computer was not announced until mid-August.) The Datamaster, a data processing and word processing machine, is aimed at the $12,000 to $18,000 market in Canada, and is being sold through IBM retail outlets.

The Datamaster comes with a minimum of 32K bytes of main memory, which is upgradeable in 32K byte increments to a maximum configuration of 128K bytes. Up to two work stations can operate concurrently, but IBM is likely to expand that number to four.

The processor can make use of industry-standard Basic programs and the Datamaster Basic programs will run on the larger System/34. With the announcement of the Datamaster, IBM made no mention of the RPG programming language, popular on the System/34 and larger System/38. IBM is expected, however, to offer RPG-II support as well as Basic.

The processor is based on an Intel microprocessor. (The IBM Personal Computer and the Displaywriter are also based on Intel microprocessors.) It features diskette storage capabilities that provide for a maximum of 6.6 million bytes of on-line storage.

Software announced with the system is collectively called the "Business Management Accounting System". Programs include billing, inventory accounting, accounts receivable, accounts payable, payroll and general ledger. The programs, which are menu-driven, each cost about $1,200 in Canada.

A word processing option that uses what is understood to be the same software as the Displaywriter is also available on Datamaster. Features include the ability to draw upon data processing files to print business letters for mass mailings. The word processing circuit card costs about $700 and the software costs about $600 for a combined cost in Canada of about $1,300.

The IBM System/34

The natural upgrade for the System/23 Datamaster is the System/34, first announced by IBM in April 1977. The System/34 was down-priced in June 1981 and IBM states that users of the System/23 can easily upgrade to the System/34 when they outgrow the smaller system.

The lowest priced System/34 is a unit configured with 32K bytes of main memory and 8.6 million bytes of disc storage. It was cut about 25 percent in price in June 1981, from about $24,000 to about $18,000.

Also announced by IBM in June 1981 were a new group of application programs and several new system programs. The system software includes new versions of the system utilities programs as well as Basic and RPG-II programming languages. They sell for between $600 and $2,000 each.

The new application programs include order entry, billing, inventory control, accounts receivable, accounts payable, sales analysis and general ledger. They have licence fees that require the user to pay between $150 and $550 monthly for one year (i.e. the full cost is between about $2,000 and $7,000).

The System/34 is designed to grow with the customer's information processing needs. Larger systems have capabilities that overlap with the System/38. The full-blown System/34 configuration can concurrently handle up to 16 independently functioning multiprogramming local work stations, 64 remote terminals and a SPOOL operation. ("SPOOL" means Simultaneous Peripheral Operation On Line and refers to an operation such as disc-to-printer output.)

The IBM System/38

The natural upgrade from the System/34 is the IBM System/38. System/38 models 3 and 5 were introduced in November 1978; Model 4 was announced in June 1981.

A basic System/38 Model 3 was 512K bytes of main storage and 64.5 million bytes of disc storage sells for about $70,000 in Canada after a cut from about $85,000 announced in June 1981.

The System/38 is a virtual storage machine in which disc storage is treated as a continuation of main storage. This allows programs and files of any size to run on the system without the usual fixed-storage design constraints.

The System/38 has a number of application programs and programmer productivity improvement tools designed to ease the software development bottleneck being experienced by so many users.

In January 1981, IBM announced data communications enhancements designed to enable users to communicate with the full spectrum of IBM processors and terminals. Binary Synchronous Communications (BSC) support permits a System/38 to communicate with other System/38's, as well as with the System/34, Series/1, 4300, System/370, 3033 and 3081 lines of computers.

BSC is a means of transmitting data whereby the data being sent is synchronized by signals from the sending and receiving equipment. Data can be transmitted to and received from terminals and processors using either System/38 Cobol or RPG programming languages.

In addition, SNA/SDLC (System Network Architecture/Synchronous Data Link Control) communications support for the System/38 as a terminal to another processor is available.

The IBM Displaywriter

In mid-1980, IBM announced a product with design features and a competitive price geared to give the company a significant share of the market for word processing systems.

After years of losing ground to a number of smaller competitors, led by Canada's AES Data Ltd. (which had been the leader in stand-alone word processing systems), and Wang Laboratories, Inc. (still the leader in shared logic word

processing systems), IBM is moving strongly to restore its formerly dominant position in the word processing market. Indications are that IBM wants to establish the same dominant position there that it has in the electric typewriter market.

Its hopes ride on the Displaywriter line of machines priced in Canada from about $9,000 to $22,000. The Displaywriter was unveiled in June 1980 and shipments began in November of that year. The Displaywriter's effect on the market has been explosive.

Many of IBM's more than two dozen competitors have been forced to bring out new models -- better, but cheaper than the old ones. The pressure may be so great as to shrink the profit margins of many word processing companies to the vanishing point. Some forced mergers or casualties are likely.

All competitors are being forced to introduce a product which sells in Canada for somewhere in the $8,500 range. Wang's Wangwriter was introduced with a base price of about $9,000. Digital Equipment Corporation was forced to slash the price of its WS-78 word processor by about 35 percent from about $14,500 to $9,500.

AES Data Ltd., of Montreal, has come out with the Alphaplus at about $7,000.

The Displaywriter is an easy to use, low-cost desk top text processing system. The most unusual new feature is the system's ability to check the spelling of about 150,000 words using an electronic dictionary.

The system's modularity (up to 20 separate components and options were originally announced, and more have been added) allows the user to tailor the system to his own needs. Optional communications features allow information to be distributed over telephone lines. The system comes with dual-density, double-sided diskettes that provide a maximum of 1.9 million bytes of on-line storage.

In May 1981, IBM enhanced its Displaywriter to include a records-processing capability and IBM computer programming support, making the work station into what the company terms a "text processing terminal".

At the same time, IBM introduced computer programming support for communications between the Displaywriter and a variety of operating systems and programs resident in host IBM computers. This support gives users access to data that can be merged with text at the Displaywriter to prepare documents.

The IBM 5280 Distributed Data System

Announced in January 1980, the IBM 5280 Distributed Data System features intelligent terminals that can process information locally as well as communicate with a central computer. Circuitry in the terminals enables them to enter, process and print information at loading docks, branch offices and similar locations.

In June 1981, Toyota Motor Sales, U.S.A., Inc. began installation of the first of more than $15 million worth of IBM small systems for its 700 direct dealers. The system -- 5280s and System/34s --will be linked to the corporate data centre's 3033/158 complex as part of a large SNA network to handle parts availability as well as other applications.

The dealers will use the system locally during the day, storing data for polled transmission during the night. Headquarters will "refresh" the dealers' files in the morning, as well as send administrative and other messages in a form of electronic messaging.

The IBM 6670 Information Distributor

Announced in 1979, the 6670 provides high-speed laser printing for both word processing and data processing applications, as well as text processing and copying.

It combines an office copier, memory, data communications capabilities and laser printing. The unit can store, manipulate, send and receive text that is

generated either internally or in cooperation with a remote location linked by communications lines. The ability to perform these tasks is provided by two microprocessors with 128K bytes of random access memory (RAM). The unit's price is about $90,000 in Canada.

The 5520 Administrative System

Introduced in 1979, the 5520 combines advanced text processing with electronic document distribution. It enables office personnel to create, store, retrieve, edit and electronically distribute documents that range from single-page memos to multi-page manuals.

A typical system with 130 million bytes of disc storage, an ink-jet printer, two display systems and a desk top impact printer is priced at about $110,000 in Canada.

The IBM 8100 Information System

At the end of 1979, IBM began shipping the 8100, specifically designed for small distributed processing applications. Typical Canadian prices for a full-blown 8100 system are in the $120,000 to $240,000 range. A stripped-down 8100 processor without a printer or display unit acting as a node in a distributed processing network, however, may run as low as $35,000.

The 8100 can function as a stand-alone system or be integrated into a network of host and peer systems. The host can be an IBM System/370, a 3033, a 3081 or a 4300 system, and the peer systems can be other 8100s.

In June 1980, IBM announced the Distributed Office Support Facility (DOSF), which enables word processing and data processing applications to operate concurrently on the 8100. DOSF is a $580 licensed program enabling users to create and edit documents from a CRT terminal and output on a correspondence-quality printer.

In July 1981, IBM announced a number of features designed to make the 8100 easier to use. The announcement appears to underline IBM's intent to make the 8100 IBM's showcase distributed processing system.

The 8100 is designed to support three kinds of relationships: stand-alone; interconnected processors; and host-connected processors.

STAND-ALONE SYSTEMS. The stand-alone system performs an application or group of applications without depending on another processor. Data or program information may be transferred to other systems by store-and-forward transmission or by exchange of physical media.

If several locations require the same application, each location probably has its own independent processor performing that application. Stand-alone systems can grow to interconnected processor or host-connected processor configurations by subsequent connection to hosts or peers.

INTERCONNECTED PROCESSORS. Interconnected processors are two or more 8100 processors directly linked in a distributed system. They operate jointly on one application, or a group of closely related applications, in which a program on one processor either activates application tasks resident on an interconnected processor, or reads from or writes to an on-line data base on an interconnected processor with the aid of user programming.

Other characteristics of an interconnected processor include interactive use of interprocessor applications; no subordination of one system to another with regard to communication or applications; and optional communication links to a host processor or batch data transmission.

HOST-CONNECTED PROCESSORS. The host is the top system element in a host-connected system. Depending on application requirements, a System/370, 3033, 3081 or 4300 computer can act as host to 8100s which act as satellite systems.

A host-connected system consists of a host processor and one or more 8100s operating jointly on an application or a group of closely related applications, in which a program on one processor: activates application tasks on another

system; reads from or writes to an on-line data file or data base on another system with the aid of user programming; or transmits programs to another system for execution.

The Series/1 Minicomputer

Introduced in the mid-1970s, IBM's Series/1 minicomputer is the company's major entry in the original equipment manufacturer (OEM) market. An entry-level Series/1 with 128K bytes of main memory, a 1.2 million byte diskette drive and a 40 cps dot matrix printer is priced at about $20,000 in Canada.

In January 1981, IBM announced a new communications feature called the "Local Communications Controller" which permits the interconnection of up to 16 Series/1 processors in a ring configuration with data transmission speeds of up to two million bits per second. With this feature, each Series/1 can direct messages to any other unit in the ring without a master controlling station.

The 4300 Line

The 4300 was introduced in January 1979 in two models -- the 4331 and the 4341 -- signalling the replacement of the earlier low-end System/370 systems, the 370/138 and 370/148. Both 4300 series models have since been expanded so that each has two divisions, Model Groups 1 and 2. The series now replaces the full System/370 line and the larger IBM 3031.

The most important thing about the 4300 system when it was announced was its price: an approximately 4:1 price/performance improvement over the 370 line.

For example, in January 1979, the purchase price for the IBM 4331 Group 1 processor with a 1 million byte main memory was announced at about US$76,000. By comparison, an IBM System/370 Model 138 with the same internal storage and about the same performance was $271,000 -- an improvement of 3.6:1.

Main memory prices provided even better price and performance. A million bytes of internal storage for the 4300 was priced at US$15,000, compared to $75,000 on the 370/138 -- an improvement of 5:1.

These prices did not include software. With the introduction of the 4300 series, IBM announced that users would have to begin paying for some software that was previously free, as well as have their operating systems maintained by IBM.

Users who looked into the cost of IBM's software for the 4300 series generally found that the software charges were more than they had been expecting. In fact, in some cases, the software would cost more than the hardware over the useful life of the system. After taking software into account, the price and performance improvements reduced to about 3:1.

The 3033 Line

IBM's large-scale main frame 30 series has been repositioned over the past few months. When IBM announced the 4341-2 in September 1980, it eliminated the 3031 as a competitive system. The 4341-2 has 1.2 times the relative power of the 3031 but its purchase price is only approximately 3/4 of the purchase price of the 3031. Likewise, when IBM announced the 3033s in November 1980, the 3032 was bumped out of the IBM big processor lineup.

The 3081

IBM's latest and most powerful addition to the main frame lineup is the 3081, announced in November 1980. Like the 3033 and 4300 series, the 3081 uses 370-era software. This means the user can take advantage of hardware price and performance improvements without the necessity of program conversions.

The price for the new 3081 did not send shock waves through the industry the way the 4300 series did. It was not as aggressively priced as expected. When IBM announced the 4300 series, the price per million instructions per second was set at US$300,00. With the 3081, the price was set at about $375,000, which

gives the rest of the industry a chance to compete on the basis of harware price and performance.

When the 3081 was announced, IBM also announced a reduction in price of the basic 3033 by 15 percent, dropping from US$2.620 million to $2.225 million for the processor. This reduced the purchase-to-monthly-rental ratio from about 32 to about 27.

This pricing arrangement significantly increases the benefits of purchase over rental, suggesting IBM is having a clearance sale. It is selling off the 3033 line before announcing other models above and below the current 3081.

IBM'S CANADIAN OPERATIONS

IBM Canada Ltd. has by far the largest market share in the Canadian information processing industry. Reported revenues of $1,845 million in 1981 (Table 7.3) included an estimated $1,530 million for data processing products and services and $135 million for office products. Exports accounted for $522 million of total revenues.

IBM's $1,530 million comprised about 34 percent of the estimated $4,500 million in domestic and export products and services revenues generated by all companies involved in the Canadian computer industry.

Total reported revenues of $1,845 million were up 22 percent above the 1980 level of $1.5 billion. Included in revenues for 1981 were exports totalling $522 million, up 16 percent from $451 million in 1980. IBM employs 11,657 people in Canada. Of this total, 3,726 are employed in manufacturing and in research and development at facilities in Don Mills, Ontario and Bromont, Quebec.

The Don Mills plant manufactures video display terminals and other peripheral computer devices for IBM's North and South America and Far East markets. The Bromont plant manufactures high-density circuit components used in most IBM products and Selectric typewriters for IBM's markets in Canada, the United States and Europe. The total production of circuit components at Bromont is exported to IBM plants for inclusion in products being manufactured there.

Employment Considerations

Over the past two years, IBM's Canadian revenues have increased by 48 percent, from $1.2 billion in 1979 to $1.8 billion in 1981. During this period, however, IBM employment in Canada has actually decreased -- from 11,830 persons at the end of 1979 to 11,657 at the end of 1981 (Table 7.3).

Between 1978 and 1981, the number of persons employed per million in revenues on a worldwide basis dropped from 15.4 to 12.2, a reduction of 21 percent over three years. In Canada, however, the number of persons employed by IBM per million in revenues dropped from 10.3 to 6.3, a reduction of 39 percent in three years.

The reduction in persons employed per million in sales appears to be a worldwide phenomenon at IBM (Table 7.4) and, perhaps to some extent, can be attributed to improvements in productivity. The reduction in number of IBM sales jobs per million in Canada, however, appears to be significantly greater than the worldwide average.

Plant Considerations

Between 1977 and 1981, sales for IBM Canada Ltd. increased by 87 percent, from $989 million to $1.8 billion. During the same period, however, the number of employees working in IBM plants and in R&D in Canada increased by only 25 percent from 2,979 in 1977 to 3,726 in 1981.

By the end of 1980, on a worldwide basis, IBM had invested $420,000 in fixed assets for every million in sales generated in that year. In Canada, however, the company had invested only $155,000 for every million in 1980 sales.

The total investment in plants, equipment, and other fixed assets in IBM Canada Ltd. to the end of 1980 was $233 million. This represented $155,000 for every million in sales in 1980, in contrast to the worldwide figure of $420,000 for every million in sales.

These investment figures raise questions as to whether IBM Canada Ltd. is getting a proportionate share of IBM's worldwide plant and manufacturing facilities.

R&D

Similarly, best available estimates of IBM's R&D expenses in Canada, suggest that IBM Canada Ltd. has not been getting a proportionate share of the company's worldwide research and development expenditures. In 1980, on a worldwide basis, IBM spent $1,612 million on R&D, equal to about 5.5 percent of sales.

IBM Canada Ltd., as a foreign-owned company, is required to publish far less financial information than it would have to publish if it were a Canadian publicly-owned company. Best estimates are, however, that IBM Canada Ltd. spent about $22 million on R&D in 1981, equal to only 1.2 percent of sales of $1,845 million.

In the late 1970s, the Bryce Commission reported that in 1975 IBM Canada Ltd. employed 311 persons and spent $11 million on R&D in its Toronto laboratory. Six years later, in 1981, the number of persons employed in the laboratory had not significantly increased.

The estimated R&D budget had increased by 100 percent but -- at an average annual increase of 12 1/4 percent over the six year period -- this was mostly accounted for by inflation. During the same period that IBM Canada Ltd.'s R&D expenditures increased by 100 percent, sales increased by 157 percent -- from $179 million in 1975 to $1,845 million in 1981. In other words, in the six-period from 1975 through 1981, IBM's R&D expenditures in Canada as a percentage of revenues appear to have been going down.

It should be noted, however, that the parent company has taken some actions that may increase the proportion of IBM investment in Canada. IBM Canada Ltd. has recently obtained an advanced software development mission for its laboratory. This has increased the number of R&D personnel to approximately 400 in 1982. Furthermore, in 1981 the Bromont plant earned a new high technology mission which will mean an estimated investment of $90 million.

Table 7.3

IBM CANADA LTD. FINANCIAL SUMMARY FOR YEARS ENDED DECEMBER 31

(C$mil.)

Year	Total Sales	Net Earnings	Earnings as Percentage of Sales	Sales Growth Percentage	Earn Growth Percentage	Employees	Persons Employed Per $1 Million in Sales
1981	1845	148	8	22	31	11657	6.3
1980	1506	113	8	21	24	11830	7.9
1979	1244	91	7	10	(12)	11830	9.5
1978	1126	104	9	14	6	11621	10.3
1977	989	98	10			11135	11.3

Source: Company news releases.

Table 7.4

IBM CANADA LTD. VERSUS PARENT COMPANY WORLDWIDE
YEAR-END NUMBER OF EMPLOYEES PER MILLION IN SALES

	In Canada (C$mil.)			Worldwide (US$mil.)		
Year	Total Sales	Persons Employed	Persons Employed Per $1 Million in Sales	Total Sales	Persons Employed	Persons Employed Per $1 Million in Sales
1981	1845	11657	6.3	29070	354936	12.2
1980	1506	11830	7.9	26213	341279	13.0
1979	1244	11830	9.5	22863	337119	14.8
1978	1126	11621	10.3	21076	325517	15.4

Source: Company annual reports and news releases.

Table 7.5

IBM CANADA LTD. VERSUS PARENT COMPANY WORLDWIDE YEAR-END FIXED ASSETS IN USE

	Canada (C$mil.)			Worldwide (US$mil.)		
Year	Total Sales	Fixed* Assets	$FA/$thou Sales	Total Sales	Fixed Assets	$FA/$thous Sales
1980	1506	233	155	26213	11018	420
1979	1244	191	154	22863	9002	394

Source: Company annual reports and news releases.

* Fixed assets represents land, buildings, plant, laboratory and office equipment at original cost.

Table 7.6

IBM CANADA LTD. VERSUS PARENT COMPANY WORLDWIDE INCOME TAXES PAID OR DEFERRED

	Canada (C$mil.)			Worldwide (US$mil.)		
Year	Total Sales	Provision* for Taxes	$Tax/$thous. Sales	Total Sales	Provision for Taxes	$Tax/$thous. Sales
1980	1506	110	73	26213	2335	89
1979	1244	88	71	22863	2542	111

Source: Company annual reports and news releases.

* Provision for taxes includes taxes both paid and deferred. In 1980 and 1979, IBM Canada Ltd. had deferred income taxes of $17,925,000 and $13,375,000 respectively.

CHAPTER 8

DIGITAL EQUIPMENT CORPORATION

Digital Equipment Corporation, with headquarters in Maynard, Massachusetts, sells and services computers and associated peripheral devices and related software and supplies. Digital is the fifth largest information processing company in the American-based computer industry.

The company's products are used in a wide variety of applications, including scientific research, computation, communications, education, data analysis, industrial control, time sharing, commercial data processing, graphic arts, word processing, health care, instrumentation, engineering and simulation.

Most of Digital's equipment is of its own design and sold under its own name. Overall, the company markets one of the broadest ranges of products in the computer industry. It sells small microcomputers (LSI-11 series), minicomputers (8-bit PDP-8s, 16-bit PDP-11s and 32-bit VAX-11s) and larger main frame computers (DECSYSTEM 10s and 20s). The company's products range in price from under $1,000 to over $1 million.

Digital uses five different channels of distribution in the marketing of its products. They include direct sales to end-users, sales to original equipment manufacturers (OEMs), sales through authorized distributors, catalog-telephone sales and retail store operations.

Digital's PDP-8, introduced in 1965, is generally recognized as marking the beginning of the minicomputer age. It contributed as well to the early development of distributed processing.

The PDP-11, the base of the company's success and rapid growth in the 1970s, has been the most popular minicomputer series, with some 200,000 units installed around the world.

Revenues for fiscal 1981, ended on June 30 1981, were $3,198 million, up 35 percent over 1980. Between 1977 and 1981, revenues increased by an annual average of 32 percent.

Of total 1981 sales, $1,252 or 39 percent were foreign sales, which grew by 40 percent.

Digital has one of the better profit margins in the industry. In 1980 and 1981, net income was 11 percent of sales, up from a consistent 10 percent in the 1976 through 1979 period.

During fiscal 1981, Digital spent $251 million, or 7.8 percent of revenues, on research and development. Digital's R&D expenditures have consistently ranged between 7.6 and 7.9 percent of revenues in the last several years.

SIGNIFICANT R&D TO BE INVESTED IN COMMUNICATIONS

Digital Equipment Corporation is positioned in the industry as the leading satellite processor vendor. Satellite processing systems act as host computers for terminals and work stations while communicating through local networks to large, corporate data processing centres, which typically consist of IBM main frames.

Next to IBM, among the top eight American-based information processing suppliers (those with 1981 sales above $2 billion), Digital is placing the most emphasis on communications, especially in satellite processing and local area networking (discussed later under "office communications systems").

Digital is expected to gain substantial market share as the current information processing workload on IBM and other main frame computers is offloaded onto minicomputers through distributed processing. Consequently, throughout the 1980s the company is expected to continue investing significant R&D effort in networking.

Particular emphasis is expected to be placed on integrating IBM and Digital computers into the company's DECnet networking system. The objective is to make

it easier for users to migrate their IBM processing workload to Digital systems at distributed locations.

At the end of fiscal 1980, DECnet was placed in more that 2,500 installations, making it one of the most widely used sets of networking software tools available. Together with the firm's Digital Network Architecture (DNA) protocol sets, DECnet allows communications to occur among any type of Digital computer system or between Digital computers and IBM or other foreign computers.

Digital offers a broad range of communications and processor options which make it easier to size and configure a network to an organization's particular needs. The following options are available:

- Digital supports batch bisync, interactive bisync, and other standard main frame protocols.
- An IBM Network Architecture (SNA) emulator allows Digital computers to participate in IBM SNA networks.
- Digital offers what they call "X.25 Packetnet System Interfaces" so Digital systems can communicate in public packet switched networks. In its fiscal 1981 period, Digital developed X.25 protocol products which handle the special variants of X.25 used in the Canadian and French markets.
- DECnet provides features not available with many main frame protocols, including a full range of point-to-point, multipoint and parallel communications.
- DECnet provides the facility to automatically reroute information around problem areas so network operations can continue even when communications links or nodes fail.
- With DECnet it is possible to add new nodes without shutting down operations.

To mid-1981, Digital had implemented more than 5,000 network nodes around the world.

Office Communications Systems

Digital is determined to become a dominant force in the burgeoning market for office communications systems. Consequently, in 1980, Digital entered into

a cooperative effort with Intel and Xerox to work on protocol standards for local area networks (LANs).

The cable has been the limiting factor in this local networking scheme, since it is only practical to use within a building or a close area of buildings. Therefore, Digital, with its strong background in networking, is responsible for the actual computer networking development portion of Ethernet, while Xerox is working on the host programming efforts to make Ethernet work, and Intel is working on semiconductor chip technology as its part of the effort.

Digital's commercial products group sees office communications systems as an extension of data processing, not as a new market. Over the 1982-1983 period, Digital is launching a series of office products called "Office Plus" that are compatible with its existing systems. Customers will be able to buy individual components of the automated office, such as word processing, electronic messaging, or computer graphics, then add other building blocks to a completely integrated electronic office.

Digital sees as the key to its success a flexible, stale network architecture built on DECnet that allows managers and professionals in the office to expand their systems without obsoleting equipment already in place.

Digital's Model Customer

The majority of the company's installed base is found in the scientific and technical sectors. Its model customer is a technical department with the need for interactive rather than batch processing.

Indications are, however, that in future Digital will focus on consolidating its market position as the leading satellite processing vendor. Consequently, Digital's major model customers over the next five years are likely to be companies that can be persuaded to offloading their IBM main frame batch and interactive processing workloads onto distributed Digital satellite processors.

Table 8.1

DIGITAL EQUIPMENT CORPORATION
FINANCIAL SUMMARY
FOR THE YEARS ENDED JUNE 30

(US$mil.)

Year	Total Sales	Net Income	Net Income Percentage of Sales	Sales Growth	Net Income Growth
1981	3198	343	11	35	37
1980	2368	250	11	31	40
1979	1804	178	10	26	25
1978	1437	142	10	36	31
1977	1059	108	10	44	48

Source: 1981 Annual Report.

Table 8.2

DIGITAL EQUIPMENT CORPORATION
GEOGRAPHICAL DISTRIBUTION OF REVENUES

(US$mil.)

Year	Total Sales	U.S. Sales	Percentage of Total	U.S. Sales Growth	Foreign Sales	Percentage of Total	Foreign Sales Growth
1981	3198	1946	61	32	1252	39	40
1980	2368	1475	62	28	893	38	36
1979	1804	1149	64	N/A	655	36	N/A

Source: 1981 Annual Report.

DIGITAL'S CANADIAN OPERATIONS

Digital Equipment of Canada Limited is Canada's largest supplier of minicomputers and a leader in time sharing systems. In addition, the company is a major supplier of small, medium and large-scale computers, peripheral equipment, interfacing devices, software packages and support services.

With 1981 Canadian revenues of $252 million (Table 8.3), Digital Equipment of Canada Limited accounted for about 9 percent of the estimated $2,875 million in domestic and export hardware and maintenance revenues generated by companies involved in the Canadian computer industry. Revenues were up 54 percent above the 1980 level of $164 million.

Digital employed 1,709 people in Canada at the end of fiscal 1981. Of this total, between 500 and 600 are employed in manufacturing and in research and development.

Employment Considerations

Digital's Canadian sales increased from $164 million in 1980 to $252 million, or by 54 percent, in 1981. During this period, Digital's employment in Canada increased by 16 percent, from 1,475 to 1,709 (Table 8.3).

Between 1977 and 1981 the number of persons employed per million dollars in revenues on a worldwide basis at Digital dropped from 34.7 to 19.7, an average annual reduction of 13 percent over four years. The reduction in number of Digital jobs per million dollars in sales in Canada, however, appears to be significantly greater than the worldwide average. In 1981, the Digital worldwide employment drop was 16 percent, in Canada the corresponding drop was 24 percent.

Plant Considerations

By the end of 1980, on a worldwide basis, Digital had invested $326,000 in fixed assets for every million dollars in sales generated in that year. In Canada, however, the company had over the same period invested only $118,000 for every million in sales generated that year (Table 8.5).

These investment figures raise questions as to whether Digital Equipment of Canada is getting a proportionate share of Digital's worldwide plant and manufacturing activities.

R&D

In 1980, on a worldwide basis, Digital spent $186 million on R&D, equal to about 7.9 percent of sales. An analysis of the company's financial statements for the American parent and the Canadian subsidiary (Table 8.1), however, suggests that Digital Equipment of Canada Limited has not been getting a proportionate share of the company's worldwide research and development expenditures.

In Canada the company spent $2.6 million on R&D in 1980, equal to only 1.6 percent of sales. It is interesting to see how much more spending on R&D there would have been if the percentage of sales spent on R&D were the same in Canada as it was for Digital on a worldwide basis. If Digital had spent 7.9 percent of Canadian revenues on Canadian R&D in 1980, then the total spent in Canada would have been $13.0 million.

Table 8.3

DIGITAL EQUIPMENT OF CANADA LTD.
FINANCIAL SUMMARY FOR YEARS ENDED JUNE 30

(C$mil.)

Year	Total Sales	Net Earnings	Earnings of Sales Percentage	Sales Growth Percentage	Number Employees	E/S*
1981	252	N/A	N/A	54	1709	6.8
1980	164	9.4	6	38	1475	9.0
1979	119	3.8	3	10	N/A	N/A
1978	108	3.6	3	27	N/A	N/A
1977	85	1.2	1	56	N/A	N/A

Source: Company financial statements and news releases and Consumer and Corporate Affairs Canada.

* E/S represents persons employed per $million in sales.

Table 8.4

DIGITAL EQUIPMENT OF CANADA LTD. VERSUS PARENT COMPANY WORLDWIDE YEAR-END NUMBER OF EMPLOYEES PER $MILLION IN SALES

	Canada (C$mil.)			Worldwide (US$mil.)		
Year	Total Sales	Persons Employed	E/S*	Total Sales	Persons Employed	E/S*
1981	252	1709	6.8	3198	63000	19.7
1980	164	1745	9.0	2368	55500	23.4
1979	119	N/A	N/A	1804	44200	24.5
1978	108	N/A	N/A	1437	39000	27.1
1977	85	N/A	N/A	1059	36700	34.7

Source: Company annual reports and news releases and Consumer and Corporate Affairs Canada.

* E/S represents persons employed per $million in sales.

Table 8.5

DIGITAL EQUIPMENT OF CANADA LTD. VERSUS PARENT COMPANY WORLDWIDE YEAR-END FIXED ASSETS IN USE

	Canada (C$mil.)			Worldwide (US$mil.)		
Year	Total Sales	Fixed* Assets	$FA/$thous. Sales	Total Sales	Fixed Assets	$FA/$thous. Sales
1981	252	N/A	N/A	3198	1128	353
1980	164	19.4	118	2368	772	326
1979	119	16.4	138	1804	582	323

Source: Company annual reports and news releases and Consumer and Corporate Affairs Canada.

* Fixed assets include land, buildings, plant, laboratory and office equipment and small amounts for leasehold improvements and computers on lease.

Table 8.6

DIGITAL EQUIPMENT OF CANADA LTD. VERSUS PARENT COMPANY WORLDWIDE RESEARCH AND DEVELOPMENT EXPENSES

	Canada (C$mil.)			Worldwide (US$mil.)		
Year	Total Sales	R&D Expenses	R&D as Percentage of Sales	Total Sales	R&D Expenses	R&D as Percentage of Sales
1981	252	N/A	N/A	3198	251	7.8
1980	164	2.6	1.6	2368	186	7.9
1979	119	1.4	1.2	1804	138	7.6

Source: Company annual reports and news releases and Consumer and Corporate Affairs Canada.

Table 8.7

DIGITAL EQUIPMENT OF CANADA LTD. VERSUS PARENT COMPANY WORLDWIDE INCOME TAXES PAID OR DEFERRED

	Canada (C$mil.)			Worldwide (US$mil.)		
Year	Total Sales	Provision* for Taxes	$Tax/$thous. Sales	Total Sales	Provision for Taxes	$Tax/$thous. Sales
1981	252	N/A	N/A	3198	224	70
1980	164	8.8	54	2368	160	68
1979	119	2.6	22	1804	117	65

Source: Company annual reports and news releases and Consumer and Corporate Affairs Canada.

* Provision for taxes includes taxes both paid and deferred. In 1980 and 1979, Digital Canada Ltd. had deferred income taxes of $17,925,000 and $13,375,000 respectively.

CHAPTER 9

AES DATA LTD.

AES is a Canadian-owned manufacturer and distributor of word processing equipment. The company produces a full range of products from stand-alone screen-based typewriters to shared and distributed logic systems. These products are marketed in different countries under the names AES, Lanier and Scribona.

Today, AES is one of the few high technology producers worldwide that can supply a comprehensive line of stand-alone and communicating word processors and word processing equipment. From it's inception in 1974, AES has grown to become a leader in one of the world's fastest-growing high technology industries. Revenues of $173 million in 1981 were up 12 percent from $155 million in 1980.

CONTRIBUTING TO CANADA'S BALANCE OF TRADE

AES has developed into a successful worldwide operation with foreign sales now accounting for about two-thirds of worldwide sales. All foreign sales represent exports from Canadian plants.

Until 1978, the company's majority shareholder was Innocan Investments Ltd., a venture capital organization of well established investor groups. In July 1978, the Canada Development Corporation, equity investors with more than $3.0 billion in assets, purchased a 64 percent share of the company. The remaining shares are held by Lanier Business Products, Inc., the U.S. distributor of AES equipment.

The company's three major business functions are research and development, design and manufacturing, and marketing. The AES workforce numbered 2,311 in September 1981 (including its wholly-owned subsidiaries) worldwide. Of that total, 79 percent were employed in Canada.

AES has four production facilities, two in Toronto and two in Montreal. Product development facilities are located in Montreal, Toronto and Boeblingen, West Germany. The company maintains 21 direct sales offices in Canada, the United Kingdom, Beligum, Luxembourg, Holland, Switzerland, Italy and Spain.

AES also operates through a network of distributor companies for the sale and support of its products. In early 1976 it signed a major agreement with Lanier Business Products of Atlanta, making Lanier the exclusive American distributor of AES products. In 1979, Lanier also acquired rights to sell under the AES name in West Germany, Spain, Portugal, Italy, Austria, Australia and South Africa. (In early 1982, AES began marketing directly in Spain, Portugal and Italy.)

Lanier has an extensive network of offices throughout the United States that are devoted to the sale, service and support of AES text editors. Additional major distribution agreements have been signed in Scandinavia, France, Greece, Venezuela, Mexico, Argentina, Bermuda, Hong Kong, Singapore, the Philippines, Japan, Colombia, Panama, Malaysia, Kuwait, Saudi Arabia, and other Middle Eastern and African countries.

Full educational and service facilities are available either directly or through its distributors, wherever the company sells its products.

AT LEAST ONE MAJOR NEW PRODUCT EVERY TWO YEARS

AES's success is based on the development of display word processors, beginning with the AES 90 in 1974. Subsequent AES products included the 100 series introduced in 1976, Plus (No Problem) in 1977, the Multiplus (System C20) shared system in 1979 and the Alphaplus and Superplus IV introduced in 1981.

The company has introduced a major new product at least once every two years. Existing products continue to be upgraded, however, through software modifications sent to customers on diskettes.

All units employ a video screen on which the characters are displayed as they are typed on the key board. Operators see the material as it is being typed and correct errors through command keys. The system also enables users

to restructure the documents in seconds; to append clauses; to adjust page length and characteristics throughout a text; to columnize, put data into alphabetic or numeric order and change from single to double spacing; to insert, delete, reformat, store or file; and to retrieve and reproduce endless copies with total accuracy. All units have data communications capabilities for sending and receiving electronic mail and for communicating with larger computers.

The AES 90, AES 100, AES Plus, AES Alphaplus and AES Superplus IV are stand-alone units. The AES Multiplus (System C20) is a multi-terminal shared logic and distributed logic system.

"Shared logic" means that the terminals do not have their own independent intelligence, but are under complete control of the central processing unit. "Distributed logic" means that the terminals have their own intelligence and are capable of independent action.

The Multiplus (System C20) is a powerful, flexible and fully expandable text editing system. Its modular concept is designed to make it highly adaptable, whether the business operation requires a single stand-alone work station or a fully integrated network of satellite connected work stations. In addition to its standard stand-alone components, video display screen, keyboard microprocessor and printer, the system offers a control console. This permits it to act as a central processing unit and connect to shared logic work stations as well as to distributed-logic (AES Plus) work stations.

Research and development have been key factors in the company's success since its inception. AES devoted $20.6 million dollars in 1981, or 12 percent of revenues to its research effort for new product development to meet a self-imposed mandate to anticipate change and new demand in the integrated electronic office environment.

CORPORATE AND PRODUCT EVOLUTION

In 1974, investors grouped under Innocan Investments Ltd. formed AES Data Ltd. and became its majority shareholder. Manufacturing operations for the AES

90, the company's first product, were set up in Montreal and sales and service offices opened in Montreal, Ottawa, and Toronto. In the same year, a European distribution network was started through association with Esselte in Scandinavia and smaller distributors in Holland and Belgium. The first full year of operations in 1975 produced sales of $4 million.

The AES 90 was a relatively primitive system by today's standards, though it was considered innovative at the time. Its printer used a slow (15 cps) IBM selectric typing element, its software was in ROMs (Read Only Memory chips) and therefore not modifiable by the user, and it had one 8" diskette drive. Since it's keyboard did not have foreign language capabilities, the system was targeted primarily at the North American market.

AES 100 -- Important Technological Advances

The AES 100-B was introduced in 1976. Lanier Business Products, Inc. was named exclusive American distributor of AES products. Distribution began in France, West Germany and the United Kingdom. The year's sales were over $10 million, representing a growth rate of 150 percent.

Advances for the AES 100-B included foreign language keyboards which permitted it to be more aggressively sold in Germany, Sweden and other European countries. The company also switched to the faster 45 cps Qume printer.

The AES 100 series received a major enhancement when it was upgraded to the 100-P. This model had its software on diskettes rather than in ROMs, making the system user-programmable. The installed base of 100-B was upgraded in the field by changing printed circuit boards.

In 1977, the company was named exclusive Canadian distributor of Lanier dictation products. Branch offices were opened across Canada as well as headquarters in Zurich, Switzerland, and London, England. The AES Plus was introduced -- a first in compact, mid-priced, programmable stand-alone display systems. Over $24 million in sales were generated, an increase of 140 percent.

AES Plus -- Price/Performance Breakthrough

The AES Plus was the product that established AES, at least temporarily, as the leader in stand-alone word processing systems. It was very innovative. The 64K Random Access Memory (RAM) AES Plus was the first word processing system that could sit on a desk and the first with 5 1/4" diskettes. It represented a price breakthrough, and now sells at about $12,000. Its predecessor, the AES 100, had sold for about $18,000.

Two new plants opened in 1978, increasing total manufacturing space to 250,000 square feet. Engineering support centres were created at Stuttgart, West Germany and in Toronto. New distributor agreements were signed for Switzerland, South Africa, Australia, Venezuela and Ireland. CDC acquired a 64 percent share of AES. In 1978, sales increased by 166 percent to over $64 million.

AES C20 -- A Shared Logic System

In 1979, AES was the market leader in Canada and the United Kingdom and a hot contender for first position in the American market for stand-alone word processing systems. New distributor agreements took AES into Austria, Mexico, Argentina and Kuwait. The year's sales were over $126 million, up 97 percent, and European headquarters moved to Brussels.

The C20 was introduced in September 1979, missing its target introduction date of 1978 because of technical and other problems. It was innovative, but did not represent a breakthrough because it was preceded in the market by a shared logic word processing system introduced by Wang Laboratories, Inc. in June of 1979. AES estimates that today Wang has about 50 percent market share of the shared logic or clustered type of word processing systems, compared to 5 percent for AES.

The C20 has what AES refers to as an "8 plus 8" capability. It can have up to eight slave C20 work stations online plus up to eight AES Plus intelligent work stations. In this configuration, the AES Plus work stations can operate on

a stand-alone basis under their own intelligence or as terminals on-line to the C20. Therefore, the C20 can act as either a shared logic or distributed logic system. When introduced, this capability was unique to AES.

The C20 has both hard disc and diskette storage facilities. It can handle up to 96 megabytes of on-line hard disc storage and two eight-inch diskettes with about 600,000 characters of storage on each.

Internal storage inludes up to 192K bytes of instruction memory, 128K bytes of data memory and 64K bytes of video memory. (Each terminal requires video memory storage to refresh the display on its CRT screen.)

The C20 can control up to 10 printers, including 9 Qume daisy-type correspondence-quality printers operating at 45 characters per second and one Printronics 300 lines per minute (lpm) line printer.

In 1980, additional distribution arrangements were completed for Hong Kong, Singapore, Philippines, Saudi Arabia, Italy and Bermuda. Additional manufacturing facilities were opened to increase the total to over 350,000 square feet.

Revenues were $155 million in 1980, up 23 percent from 1979. Net income was $4.7 million, representing 3 percent of revenues.

Alphaplus -- Another Price and Performance Breakthrough

In September 1981, the Alphaplus was introduced. This stand-alone word processor with 64K bytes of internal storage and one diskette drive, represents a significant price breakthrough. It sells for only $7,000, advancing the price and performance of word processors closer to the point where electric typewriters will become almost obsolete and the word processor will become a mass market commodity.

At the moment, the Alphaplus has less software than the more expensive but threateningly competitive IBM Displaywriter. Additional software is being developed, however, and AES strategy is to enhance Alphaplus software to the

point where the system is fully competitive with the Displaywriter and the Wangwriter of Wang Laboratories, Inc.

Superplus IV -- More Storage and Better Software

The Superplus IV is another recent AES announcement. With 96K bytes of RAM, the Superplus IV doubles the internal storage capability of the AES Plus. It has better software and is priced in the $14,000 to $15,000 range.

In early 1981 a new systems development group was established in Florida (since disbanded) and distribution was expanded into Colombia, Japan, Greece and several African countries. Revenues reached $173 million in 1981, up 12 percent over 1980. Net income of $7.5 million in 1981 represented 4 percent of revenues, up from 3 percent in 1980.

THE FUTURE -- CONTINUED HIGH DEGREE OF R&D NEEDED FOR SURVIVAL?

A basic objective in the AES corporate mission is to ensure that Canada will have a strong national and international presence in the rapidly growing office product sector of the electronic industry. In addition, in keeping with the Canada Development Corporation goal, AES wishes to develop and maintain a strong Canadian-controlled and Canadian-managed corporation in the private sector.

A driving force in AES is the stated desire to be known as the supplier of the highest-quality products and services in the markets it serves.

More Manufacturing In Canada

All assembling and manufacturing of AES products in now done in Canada. The AES Plus and C20 and all printed circuit boards are manufactured in Montreal; the Alphaplus is manufactured in Toronto.

Many of the components used in the assemblies, however, are imported. The printers are purchased from Qume in the United States and the diskette drives from Shuggart and others, also in the United States.

The Cathode Ray Tubes (CRTs) are purchased from Motorala in the United States and also from Electrohome in Canada. The keyboards are purchased from Honeywell, which manufactures them in Canada.

The company's intention is to manufacture more of what it assembles. A step in that direction was the purchase of Daisy/Holland in the Netherlands, which manufactures printers.

A Communications Future

All current AES word processors have communications capabilities, though some systems are more advanced than others. The AES C20, the AES Plus and the Superplus IV all have communications capabilities, between themselves and with larger computers. The C20, which is the company's most sophisticated word processing system, has 2780, 3780 and 2770 protocol support as well as asynchronous or teletype support. It does not as yet support the popular 3270-type protocol.

In future, AES intends to place increasing emphasis on communications capabilities. Their stated intention is to be able to interface with X.25, SNA, Ethernet, Wangnet and other data communications protocols.

Increased Competition May Force Continuation of High R&D Expenditures

Prices of word processing systems are continuing to drop. AES is targeting to eventually compete in the electric typewriter upgrade market. When prices for sophisticated word processors drop to the $3,000 to $4,000 range -- which appears to be the price at which word processors will become a mass market commodity -- volume sales are expected to increase dramatically. This has not escaped the attention of IBM and Wang who are, respectively, AES's major competitors in the stand-alone and shared logic word processor markets.

AES estimates that in 1981 it had about 30 percent market share in Canada for word processing work stations. According to AES estimates, Micom had about 20 percent and Wang, IBM, and the other competitors shared the remaining 50 percent. AES estimates that in 1981 it had about 10 percent of the market

for stand-alone work stations in the United States and 5 percent of the market for shared- logic or clustered systems.

In 1981, the company sold about 20,000 work stations around the world, representing terminals on AES Plus, AES Alphaplus and AES C20 systems. About 4,500 of these work stations were C20 terminals. A C20 can have up to 16 work stations. The remaining were stand-alone Plus or Alphaplus systems.

Until 1981, AES was the world leader in sales of stand-alone word processing systems. In 1981, however, IBM sold what AES estimates to have been 20,000 Displaywriter word processing systems to displace AES from the number one position in the United States.

Competition will be fierce in the word processing market over the remainder of the 1980s. With the aggressive marketing of its Personal Computer and the Displaywriter, IBM appears to be intent on dominating the market for stand-alone word processing systems, just as it now dominates the market for electric typewriters. With US$1.6 billion in R&D expenditures last year, compared to C$21 million for AES, the smaller company must be very careful taking on IBM.

Wang Laboratories, Inc. has its sights set on remaining number one in the market for shared logic word processing systems. In June 1979, Wang introduced two Integrated Information Systems. The first was a data processing-based system which incorporates word processing capabilities on its VS (virtual storage) computer. The VS computer had been introduced in 1977. The second was a word processing-based system which incorporates data processing capabilities in the Wang OIS (office information systems) word processing system.

Wang is setting the standard for integrated shared logic word processing/ data processing systems. In fiscal 1981 (ended on June 30 1981), Wang had worldwide revenues of US$856 million, up 58 percent from 1980. R&D expenditures were US$67 million, more than three times the AES level. AES may find it risky to compete head-on against Wang in this market, given their relative R&D efforts. To compete effectively, AES may find it necessary to invest considerable R&D in enhancing the data processing capabilities of its systems in order to provide fully integrated systems.

Table 9.1

AES DATA LTD.
WORLDWIDE EMPLOYMENT IN JUNE 1982

Country	Activity	Employees	Percentage of Total
CANADA	Manufacturing	691	
	Engineering	245	
	Administration	313	
	Sales & Service	702	79
	Sub-total	1951	
EUROPE	Sales & Service	299	
	Manufacturing	94	
	Marketing	34	
	Engineering	21	
	Administration	81	21
	Sub-total	529	
UNITED STATES	Marketing	6	--
	Sub-total	6	
WORLD WIDE TOTAL		2486	100

Source: Company officials.

Table 9.2

AES DATA LTD.
SEVEN-YEAR GROWTH IN REVENUES
FOR THE YEARS ENDED DECEMBER 31

(C$mil.)

	1975	1976	1977	1978	1979	1980	1981
Revenues	4	10	24	64	126	155	173
Percentage Growth		150	140	167	97	23	12
Net Income	N/A	N/A	N/A	N/A	N/A	4.7	7.5
Percent of Revenues	N/A	N/A	N/A	N/A	N/A	3	4

Source: Company officials for 1975 to 1979, published financial statements for 1980 to 1981.

Table 9.3

AES DATA LTD.
REVENUES AND EMPLOYEES BY GEOGRAPHIC REGION

	Employees		Revenues	
Country	June 82	Percentage of Total	1981	Percentage of Total
Canada	1951	79	62	36
Europe	529	21	47	27
United States	6	-	51	30
Other	-	-	13	7
TOTAL	2486	100	173	100

Source: Company officials.

Table 9.4

AES DATA LTD.
R&D EXPENDITURES

(C$mil.)

Year	Revenues	R&D	Percentage
1981	173	20.6	12
1980	155	12.5	8

Source: Company officials.

CHAPTER 10

THE OTHER SUPPLIERS

In addition to IBM, Digital Equipment and AES, there are six other companies whose traditional market base is information processing and that generated computer communications equipment revenues of at least $5 million in 1980.

XEROX OF CANADA LTD.

Famous for the plain-paper copier, Xerox Corporation of Stamford Connecticut intends "to end the decade as a leading force in automating the offices of the world".

Worldwide Xerox revenues grew by 6 percent to US$ 8.7 billion and profits increased by 6 percent to US$ 598 million in 1981. The reprographics business (copiers/duplicators) segment of Xerox produces the bulk of its revenues and profits and will likely continue to do so.

Xerox's Information Products Group is composed of eight digital-technology and computer-oriented companies. Four of these companies are stand-alone units -- Office Products, Xerox Computer Services, Versatec and Kurzweil Products. The other four are grouped together as Xerox Peripheral Systems.

The Office Products Division offers the Xerox 8000 Network System which, according to Xerox, allows users to assemble a completely integrated office information network. A key product of the 8000 system is Ethernet, Xerox's local-area network which allows various elements of an office system within a building or a group of buildings to exchange information. Xerox, Digital Equipment and Intel are actively promoting Ethernet's architecture in the computer and communications industry.

The Xerox 8010 Information System (STAR), is a work station for professional users and can be connected to Ethernet. Other Ethernet-connectable work stations from Office Products include the secretarial work station, the

860 Information Processing System, the 820 Personal Computer and the Xerox Memorywriter electronic typewriters. Office Products also market Xerox's line of facsimile transmission devices.

Xerox Computer Services is a remote computer services company. In addition to on-line services this company sells the Xerox 1350 intelligent terminal.

Versatec manufactures electrostatic printers and plotters, and plotting systems -- devices that receive computer-generated data and make it visible on paper or film.

Kurzweil Computer Products manufactures and markets automated data entry and reading machines.

Xerox Computer Peripherals is an organizational grouping of four Xerox subsidiaries: Diablo Systems, Century Data Systems, Shugart Associates and Xerox Magnetics.

Diablo Systems markets a selection of printers and hard-copy terminals. Century Data Systems manufacture hard-disc drive assemblies for Original Equipment Manufacturers (OEMs) of end-user disc drives. Shugart Associates is a leading manufacturer of low-cost diskette drives and hard-disc drives for personal computers, word processors and small business systems. Xerox Magnetics manufacture rigid magnetic discs that are marketed to OEM companies that manufacture disc drives.

Xerox's Electro-Optical Systems markets the Xerox 1100 scientific information processor as well as laser and other optical assemblies.

Xerox of Canada, a wholly-owned subsidiary of Xerox Corporation, reported revenues of $484.2 million and net income of $36 million in 1980 compared to revenues of $408.4 million and net income of $37 million in 1979. Estimates are that about 92 percent of Xerox of Canada revenues are derived from reprographics.

In the data terminal field, Xerox of Canada sells only correspondence-quality terminals (Diablo). Xerox terminal revenues were an estimated

$2.1 million in 1979 and $2.4 million in 1980. The rest of its data communications equipment revenues came from facsimile machines and communicating word processors. Xerox is the leader in Canada in facsimile sales with its Telecopier series.

Xerox of Canada employs over 4000 persons in 50 locations in Canada. The company's manufacturing plants in Oakville and Mississauga produce reprographic products. There is a research and development plant in Oakville.

NCR CANADA LTD.

NCR Canada Ltd. is a wholly-owned subsidiary of NCR Corporation of Dayton, Ohio. The Canadian subsidiary employs over 2,700 people. In 1980 it generated revenues of $176.6 million and a net income of $16.3 million.

NCR's products and services include point-of-sale terminals and retail software, banking and financial terminals and systems, electronic data processing systems, business forms and supplies.

NCR Canada also provides remote and batch processing services and offers Computer Output Microfilm (COM) hardware and processing services in most major Canadian cities.

NCR Comten, Inc. is responsible for development, marketing and support for NCR's communications equipment and software. Its products include communications processing systems and performance measurement equipment. It is estimated that the Canadian division of Comten generated about $6.2 million in 1980, up only 9 percent from $5.3 million in 1979.

Founded in 1968, Comten, Inc. entered the data communications market with IBM-compatible communications and front-end processors. In 1979, NCR Corporation purchased Comten.

NCR Comten's user base of communication processors connect to NCR and IBM main frames and data terminals. Comten's Communications Network Architecture provides networking capabilities for a mix of different equipment using IBM's System Network Architecture and other network protocols and systems.

Comten's products include the 3650 11 communications processor, the 3400 Link Processor System, the 3690 communication processors and the T-8100 communication system.

The Canadian Comten division was also responsible for the NCR 721-11 communication processor that is used in Canada by the telephone companies on the packet-switching network.

In addition to retail, financial and industrial terminals, NCR Canada supplies the 7900 series of display terminals, IBM 3270 emulator terminals and terminal cluster controllers.

Applied Digital Data Systems Inc. (ADDS), leading manufacturer of display terminals, was acquired by NCR near the end of 1980. ADDS supplies low-cost display terminals, intelligent terminals and small business computers.

In the field of office automation, NCR's initial product offering is the WorkSaver. The WorkSaver is a repackaged version of the popular Convergent Technologies desktop computer. Since Convergent Technologies is an Ethernet licensee, it is probable that NCR will use Ethernet in its office automation products.

NCR's research and development, manufacturing and distribution facility in Waterloo, Ontario employs about 400 technicians and engineers. This facility produces equipment and develops software for item processing products used by financial institutions worldwide. More than 90 percent of the plant's production is exported. The Waterloo facility opened in 1972 with the help of an $8 million grant from the federal government. Since 1972, NCR has invested nearly $75 million in R&D in Canada, including about $13 million in 1980.

WANG CANADA LTD.

Wang Canada Ltd. is a wholly-owned subsidiary of Wang Laboratories, Inc. of Lowell Massachusetts. Wang Canada is the third largest and has been the fastest growing Wang subsidiary.

For the year ended June 30, 1981, worldwide revenues for Wang Laboratories, Inc. were US$ 856 million, an increase of 58 percent over 1980 revenues of US$ 543 million. Since 1972 the company's average annual growth rate has been 41 percent. It employs over 16,000 persons worldwide in over 60 countries.

Wang Laboratories was founded in 1951. Since its inception the company has undergone a number of growth phases. The first was marked by the development of specialized digital systems such as block-type readers for the machine tool industry and the Lin-a-Sec, one of the first justifying typesetters. The second phase began in the early sixties with the introduction of the first electronic programmable calculators. The third phase of the company's development began in 1972 with the introduction of the first Wang small business computer.

Paralleling the Wang move into the computer market was the development of word processing products in 1972 and the introduction of one of the first video display-based word processors in 1976. Over the last few years the product line has expanded to include word processing systems which range from stand-alone to shared-resource systems, and the Office Information Systems, which offer larger word processing system configurations and data processing capabilities.

A new phase of the company began in 1981 with the introduction of products which reflect the company's commitment to office automation. These products include WangNet and Digital Voice Exchange (DVX). The local area network system, WangNet, can connect simultaneously a variety of Wang and non-Wang products in the office. DVX is an automated voice communications system integrated with the telephone system.

The company's major product announcement of 1981 was Alliance, an office system which integrates data base storage and retrieval capabilities, voice processing, word processing, telecommunications and data processing.

Wang began Canadian operations in 1966 with the opening of a district office in Toronto. The Canadian subsidiary now has twenty-one offices across Canada. Wang Canada grew 119 percent from $9.6 million in the fiscal year ended on June 30, 1979 to $21 million in 1980. For the fiscal year ended in June 30, 1981 Wang Canada's revenues were $44.5 million, representing growth of 109 percent. A significant portion of that growth was due to the market penetration of

Wang's word processors, many of which are installed with communications capabilities. The 1981 calendar year revenues were $56.1 million. Anticipated fiscal year revenues for Wang Canada in 1982 are $68 million. Taking into consideration the company's new products such as WangNet, DVX and Alliance, an increasing share of its revenues will be related to data communications.

In September 1981 Wang Canada opened an administrative and engineering complex in Don Mills. To date, however, Wang does not have manufacturing facilities in Canada.

SPERRY INC.

Sperry Incorporated is the wholly-owned Canadian subsidiary of Sperry Corporation of New York. In 1979 the Canadian subsidiary changed its name from Sperry Rand Canada Ltd. to Sperry, Inc.

The corporation consists of five divisions: Sperry New Holland, farm machinery; Sperry, defence systems; Sperry Vickers, fluid power systems; Sperry Flight Systems, guidance and control systems; and Sperry Univac.

Sperry Univac, the largest division of Sperry Corporation, manufactures computer systems and equipment. For the year ended March 31, 1981 this division reported US$ 2.707 billion in revenues or about 50 percent of Sperry Corporation's total revenues of US$ 5.4 billion. The division's sales were up 17 percent from 1980 revenues of US$ 2.3 billion.

Sperry Incorporated reported Canadian revenues of $279.6 million for the fiscal year ended March 31, 1980, up 13 percent from the previous year's revenue of $247.3 million. The Sperry Univac division of the company generated revenues of $124 million in 1980, up 14 percent from $109.2 million in 1979. In 1981 the Univac division's revenues were $149 million, up 20 percent.

Sperry Univac is also one of the world's largest suppliers of data communications equipment. During fiscal 1981 nearly 30,000 communications terminals an related equipment were ordered worldwide.

Sperry terminals include the popular Uniscope 100 and 200 display terminals, the Universal Terminal Systems line of intelligent terminals, the Data Communications Terminals line, and the Computer-Assisted Data Entry System (CADE). The UTS 4000, a micro-based intelligent terminal introduced in 1980, has an intalled base of over 14,000 worldwide. Sperry Corporation expects that over the life of the product, revenue from the UTS 4000 family will exceed $1 billion worldwide.

The company's data communications products also include a line of front-end processors (communications processors), including the recently introduced Distributed Communications Processor (DCP/40).

Sperry Univac has two manufacturing plants in Canada. In Dorval, Quebec, power supplies are manufactured for Sperry Computers. A Winnipeg plant manufactures storage assemblies and computer sub-assemblies for military applications.

In July 1981, Sperry acquired the installed base of some 1,300 data entry systems from Pertec Computer Corporation, located in the United States and Canada.

PHILIPS DATA SYSTEMS LTD.

Philips Data Systems Ltd. owes its success to the Micom Co. of Montreal. Micom was founded in 1975 as a word processing manufacturer. In its first years of operation it reported high growth with a technologically-advanced video-display-based word processor.

Despite the company's technological head start, it recognized the need for backing from a major international firm. Micom wanted access to international markets and service facilities as well as R&D capital to allow it to grow and remain competitive in the rapidly expanding word processing marketplace. The backing came from N.V. Philips of the Netherlands, which gained control of Micom. Micom in Montreal is Philips' worldwide corporate centre for word processing.

Micom sales are incorporated into the revenues of Philips Data Systems Ltd. of Montreal which, because of the Micom affiliation, is one of the largest computer manufacturers in Canada.

Micom's Montreal manufacturing facility employs 340 people. There are more than 45 branches and dealer outlets marketing Micom products in the United States through Philips Information Systems, Incorporated. In Canada, Micom products are sold through 25 branch offices. A total of 1,400 people are employed by Philips Data Systems Ltd. and Philips Information Systems, Inc. in North America.

Philips Data Systems Ltd., expecting to build on the Micom base, is hoping to become a major contender in the integrated electronic office market. New products include a capability which allows Micom stand-alone word processors to connect to Philips minicomputers, a local area network and IBM 3270-type emulation for its word processors. The company will also begin shipments of its new Teletex Terminals to Europe in 1982. Teletex is the new, enhanced Telex system.

CANADIAN GENERAL ELECTRIC COMPANY LIMITED

Canadian General Electric (CGE) is an affiliate of the General Electric Company of Connecticut. The Information Services and the Data Communication Products divisions are the components of CGE's computer and communications business.

The Data Communication Products divison of CGE has sales and service offices across Canada. It is one of the leading suppliers of hard-copy terminals and modems for 1200-baud sevice in Canada.

CGE's Data Communication Products division is the supplier of the popular TermiNet hard-copy printer manufactured by General Electric, video display terminals, printers, Panafax facsimile equipment, as well as the Racal-Vadic line of data communication equipment.

CGE Information Services is the service bureau representing the worldwide General Electric Mark III time sharing and data communication system.

In partnership with Dartmouth University, CGE developed the first on-line interactive language, BASIC, and offered the first commercial time sharing service in 1965.

PART III

SUMMARY

CHAPTER 11

CANADA AND WORLD MARKETS

Trends in the computer communications equipment industry strongly support the argument that if a Canadian firm is to compete effectively in international markets, it should either be large, or collaborate with other firms which together form a large entity.

IBM tends to set the international standard. It is the largest and most profitable information processing company in the United States, Canada and in most other countries where it competes. In 1981 IBM generated revenues of US$29 billion. Information handling related technologies require high levels of R&D spending and in this area IBM's efforts are awesome. IBM spent $1.6 billion on R&D in 1981. This represents 40 percent of the R&D spending of the entire U.S.-based information processing industry. IBM is firmly committed to successful penetration of computer communications equipment markets and already generates 47 percent of the revenues from terminals sold in Canada.

Another major competitor that is set on winning a significant share of information handling markets in the United States is the American Telephone and Telegraph Company. In 1981, AT&T generated revenues of US$59 billion. In January 1982, AT&T agreed to divest itself of ownership of local companies in the United States. AT&T will continue, however, to own Western Electric, its manufacturer of communications equipment. Western generated revenues of US$13 billion in 1981. Also untouched is Bell Laboratories, which provides R&D services for Western Electric and AT&T. AT&T will continue to be a large company and, without its low-profit local telephone companies, might be an even more aggressive and formidable competitor in computer communications equipment markets.

Another major competitor that Canadian firms will meet with increasing frequency in international markets for computer communications equipment is Xerox Corporation. Xerox generated revenues of US$8.7 billion in 1981. Xerox is developing a computer communications Local Area Network known as Ethernet. Efforts such as the development of Ethernet require large investments in R&D. It

is important to note that Xerox has entered a cooperative venture with Digital Equipment Corporation and Intel Corporation for the purpose of developing the product. Digital's 1981 revenues were US$3.2 billion and Intel's were US$0.8 billion. In other words, the companies developing Ethernet are an alliance that generated revenues of US$12.7 billion in 1981.

In comparison with IBM, AT&T, and the Xerox-Digital-Intel alliance, Canada's Northern Telecom (with 1981 revenues of $2.6 billion), AES Data ($173 million) and The Gandalf Group ($40 million) are small companies.

Northern Telecom and its parent company, Bell Canada, which taken together generate annual revenues in the $10 billion range, may be considered large corporate entities in Canada. On the world scene, however, they are small.

One of the reasons for Northern Telecom's success on the international information handling scene is its relationships with Bell Canada and the other members of the TransCanada Telephone System. TCTS is recognized as one of the best telephone networks in the world and Northern Telecom, through its association with Bell Canada, has access to extremely valuable resources.

The argument can be made, therefore, that if Canada is to compete effectively in international information handling markets, it must encourage the preservation and further formation of larger corporate entities.

CHAPTER 12

COMMENTARY

As we move through the early 1980s, the western world is in the midst of the deepest economic recession in more than 40 years. Despite these economic difficulties, a few industries continue to show strong growth in employment and plant investment.

One of these industries is the information handling industry. As presented in Chapter 1, there are two driving forces that account for the strong growth of information handling products and services during this period of economic stagnation. One is the need to improve office productivity. The other is the need to reduce information float.

Computer communications equipment and related information handling technologies are being brought to bear on the opportunities presented by these needs. The companies that have the best chance of participating effectively will be those that have a coherent set of strategies for information processing and information communications.

THE CANADIAN MULTINATIONALS

There are a number of Canadian companies that have outstanding success records in the information handling industry. In an attempt to identify the factors that contributed to this success; this study has focused on three companies: The Gandalf Group, Northern Telecom and AES Data.

Companies such as these have not only captured sizeable market shares in the domestic market, but have also contributed substantially to Canada's balance of trade through the export of high technology products. This is extremely important because Canada's trade deficit in data processing and office machines reached $1.8 billion in 1981 and has been deterioriating at a rapid rate (Table 12.1).

When one analyzes the evolution of some of these firms, however, there emerges a trend of disturbing consistency. For reasons that need further study,

a high proportion of the future jobs and investment in plants and equipment in these companies appear to be destined for the United States rather than Canada.

Northern Telecom provides one example of the seriousness of the problem. Between 1976 and 1981, total worldwide employment at Northern Telecom increased by 50 percent, from 23,577 to 35,444. During the same period, however, employment in the United States increased by 333 percent, from 2,940 to 12,737.

THE FOREIGN MULTINATIONALS IN CANADA

Canadian-owned companies currently dominate the communications services segment of the information handling industry in Canada. When it comes to the information processing segment, however, particularly the hardware sector, one must recognize the overwhelming dominance of the foreign multinationals. Two of these firms, IBM and Digital Equipment, are analyzed in detail in this report.

IBM, with its formidable resources, is perhaps the only company in the information processing or communications industries with the management, marketing, financial, engineering, manufacturing and other resources to compete in all sectors of the information handling field.

IBM, however, does not distribute jobs, plants and R&D investment in the United States and around the world in proportion to its sales in the markets where it competes. Consequently, Canada does not receive benefits in these areas that are proportional to the amount of business that IBM does in this country.

For example, as is shown in Chapter 7, in the past two years IBM's Canadian revenues increased by 48 percent, from $1.2 billion in 1979 to $1.8 billion in 1981. During this same period, however, IBM employment in Canada actually decreased. There were 11,830 persons employed at the end of 1979 but only 11,667 at the end of 1981.

Some of this disparity might be attributable to improvements in productivity. When one looks at IBM's employment on a worldwide basis, however, the figures show that there has been substantial growth in employment during this period.

The challenge that remains is to provide an atmosphere which encourages the establishment of research and development, manufacturing and distribution facilities in this country. This atmosphere should be attractive to both foreign multinationals and to aspiring Canadian multinationals.

Table 12.1

CANADA'S GROWING BALANCE OF TRADE DEFICIT
IN DATA PROCESSING AND OFFICE MACHINES

(C$mil.)

Year	Apparent Domestic Market*	Net Imports	Exports	Trade Balance	Percentage Increase In Deficit
1974	788	659	217	-442	
1975	816	715	272	-443	0
1976	846	765	331	-434	-2
1977	924	854	347	-507	17
1978	1216	1144	475	-669	32
1979	1458	1360	642	-718	7
1980	2033	1951	739	-1212	69
1981	N/A	N/A	N/A	-1770	46

Sources: Department of Industry Trade and Commerce (ITC) and Statistics Canada catalogs 31-001, 65-007, 65-004, 42-216, 13-212. Statistics are for Statistics Canada's SIC 318 classification.

* Apparent Domestic Market (ADM) -- defined by ITC as shipments out of plants in Canada plus net imports less exports. ADM does not include marketing expenses, maintenance, profits or related items.