Towards a National Computer and Communications Policy: Seven National Approaches

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TOWARDS A NATIONAL COMPUTER AND COMMUNICATIONS POLICY: SEVEN NATIONAL APPROACHES

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PREFACE

Canada does not have a national computer and communications strategy. It is possible that the country will pay dearly for this lack during the Eighties.

The objective of this project is to review the computer/communications strategies of seven selected foreign countries. The report is intended to serve as a stepping stone for a review of Canadian policy actions proposed so far in this area.

Given that the key importance of the computer/communications sector is recognized, and armed with the knowledge of what is taking place elsewhere, responsible decision makers in Canada could then be in a position to formulate solidly founded recommendations for the Canadian national strategies.

In preparing this report we have used literally thousands of pieces of information culled from reports, books, articles, newspaper clippings, annual company reports and personal interviews. We have also made extensive use of the computer searches of abstracts available from the New York Times Data Base. In order to keep the report readable we have chosen to waive the usual academic style of carefully footnoting each statement. Instead we have included selected references for each chapter, and list below the source periodicals from which it would be possible (admittedly with some difficulty) to provide specific citation for the statistics, tables and data we present.

The following key periodicals have been found useful: Business Week, Communications of the ACM, Computerworld, Datamation, Data Communications, Economist, Electronics, Electronics Times, Far Eastern Economic Review, Financial Times, Frankfurter Allgemeine, Fortune, IFOC, Le Monde, New

Scientist, New York Times, Nihon Keizai Shimbun, Science, Telecommunication Policy, Telecommunications Review, Time, and The Wall Street Journal.

The report contains very recent, sometimes current, information (May 1980) retrieved from various journalistic sources consequently some of the figures quoted are subject to change.

In many sections the report departs from a strict presentation of the facts. It is often interpretative, with a significant level of subjective judgements. In our view this is not undesirable in light of the objectives.

While the Department of Communications and IRPP made this report possible, they are not in any way responsible for any statements in it. The report should not be seen as a policy statement by either DOC or IRPP. It reflects our views, opinions and subjective judgements based on experience in the subject matter, and on analysis and interpretation of the facts we have gathered and opinions presented to us.

C.C. Gotlieb Z.P. Zeman
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The basic orientation of the study has emerged from discussions with D. Parkhill, Assistant Deputy Minister, Department of Communications whose broad guidelines led us in the project. C.D. Shepherd of the Department has supervised and closely watched the project.

We were helped enormously in our task by a review panel of experts who assumed the basic orientation of the study, helped to fill the gaps in the information field covered and discussed some of the moot points. The following panel members should be thanked: J. Campbell, Government of Alberta; M.J. Martyne, AES Ltd.; J.C. Paradi, Dataline Systems; G. Margita, Mitel Corp.; I.P. Sharp, I.P. Sharp and Associates; J. Nadon, Canadian Commercial Corporation; P. Styfield, Ministry of State for Economic Development; R. Walsh, ITC; and last but not least the three officers of the Department of Communications, P. Robinson, C.D. Shepherd and M. Estabrooks.

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CHAPTER 1

CHALLENGES OF THE EIGHTIES

1.1 TRENDS IN COMPUTERS AND COMMUNICATIONS

Perhaps the most significant trend in these two industries is the progressive overlap between them, to the point where it is already not unreasonable to regard them as having converged. Computers, even small ones, have more and more data communication facilities built into them; communication devices, especially for data, but even for voice and T.V. ranges of the spectrum, are more and more specialized computer processors, complete with logic, memory and interface. In all countries of concern to this study the computer industry started by being, for all practical purposes, unregulated although a regulatory system was soon established in Brazil and Japan. On the other hand the communications industry is strongly regulated, even in the USA, the only one of the countries where it is not a state monopoly. The merging of these two industries, one regulated, the other not, is producing complications in all countries. Before these are examined from different national viewpoints it is useful to review some of the salient facts.

1.1.1 COMPUTERS

The computer industry started in the early Fifties as a result of a series of technical accomplishments in the United States (and to a lesser extent in the United Kingdom) and that country continued to build on the lead, achieving a position which can only be called dominant. This position of the USA is illustrated by Table I-1 where shipments of computer hardware, and the installed base of equipment in that country, are compared with world totals.

TABLE I-1

SHIPMENTS ($ MILLIONS) AND *INSTALLED BASE* ($ MILLIONS, THOUSANDS OF UNITS) OF *UNITED STATES COMPUTER FIRMS;* UNITED STATES, *OVERSEAS, WORLD;* 1971, 1976, 1981

	1971 ESTIMATE i				1976 ESTIMATE ii				1981 FORECAST ii	
	Shipments		*Installed Base*		*Shipments*		*Installed Base*		*Shipments*	*Installed Base*
	($ Millions)		Units Thousands	($ Millions)	($ Millions)		Units Thousands	($ Millions)	($ Millions)	($ Millions)
	New Build	Net			New Build	Net			New Build	
U.S. *General-Purpose Computer Systems*	4,200	2,400	54.5	26,500	6,300	4,800	69	40,000	10,000	65,000
Mini & Dedicated Application Computer Systems	250		33.5	1,600	1,300	1,100	160	5,800	4,500	18,000
Data Entry & Terminal Equipment	630		553.5	2,800	1,500	1,300	1,800	9,000	4,000	20,000
OVERSEAS *General-Purpose Computer-Systems*	3,300	2,600	36.2	14,300	5,300	3,100	55	30,000	8,500	51,000
Mini & Dedicated Application Computer Systems	60		*	*	700	600	90	3,300	2,000	9,000
Data Entry & Terminal Equipment	*		*	*	800	700	800	4,500	1,500	9,000
WORLD TOTAL *General-Purpose Computer Systems*	7,500	5,000	90.7	40,800	11,600	7,900	124	70,000	18,500	116,000
Mini & Dedicated Application Computer Systems	310		*	*	2,000	1,700	250	9,100	6,500	27,000
Data Entry & Terminal Equipment	*		*	*	2,300	2,000	2,600	13,500	5,500	29,000

All prices are retail list purchase prices, and do not include customs or import taxes.
* No estimate is available.
[i] 1971 estimate in 1971 dollars.
[ii] 1976 and 1981 estimates in 1976 dollars.
[iii] "Net" is shipments less returned equipment.
Source: 1971 data from AFIPS Conference/Workshop, July, 1972; 1976, 1981 data from AFIPS Conference/Workshop, March, 1977.

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The phenomenon of the United States dominance in the international market with respect to integrated computer systems is paralleled by the fact that one company, International Business Machines (IBM), has played a dominant role in the USA and hence, also the international scene. IBM dominance, both domestically and internationally, is illustrated in Table I-2 - and in spite of the astonishing number of suppliers of smaller systems world-wide (semiconductor memories, disks, input/output peripherals, terminals, etc.) the central position of IBM has continued almost unchallenged by others. Brock, in an analysis of the USA computer industry estimates the economies of scale disadvantages in manufacturing, sales, maintenance and software processors by a firm having a minor share of the market to one having the major share. (Table I-3). The cost elevation of about 20% would not be decisive. But when other factors such as product differentiation and capital barriers to entry are considered, Brock concludes that, compared to IBM, potential entrants to the peripherals market are at a 20-30% cost disadvantage and to the minicomputer market a 10-15% disadvantage. Thus entry is effectively blocked by the amount of about $1 billion which would be required.*

Without doubt, the unwillingness to put up the massive amounts of capital required to stay in the integrated main frame computer industry has led to the temporary appearance of such companies as RCA, General Electric, and Xerox. In each case the companies decided that the capital commitment would bring greater rewards if invested in other products. The political difficulties providing such amounts through governments also explains the retreat from Le Plan Calcul in France and the continuing problems of ICL in the UK.

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*Entry has been achieved by Amdahl, but the financial backing provided by Nijxdorf and Fujitsu have in effect been of the order indicated by Brock.

TABLE 1-2

WORLDWIDE INSTALLED BASE
U.S.-BASED MANUFACTURERS - GENERAL-PURPOSE COMPUTERS
(December 1975)

	United States				International				Worldwide				
	# CPU	Avg. $K	$M Value	% Total	# CPU	Avg. $K	$M Value	% Total	# CPU	Avg. $K	$M Value	% Total	$ % 1974-1975
IBM	48,796	467	22,770	68.0	30,473	502	15,308	67.9	79,269	480	38,078	68.0	12.4
MIS	5,591	525	2,938	8.8	8,236	291	2,396	10.6	13,827	386	5,334	9.5	9.7
Sperry Univac	4,845	509	2,468	7.4	3,884	462	1,795	8.0	8,729	488	4,263	7.6	10.2
Burroughs	3,971	540	2,143	6.4	1,977	558	1,103	4.9	5,948	546	3,246	5.8	17.5
CDC	522	2,287	1,194	3.6	467	1,989	929	4.1	989	2,147	2,123	3.8	11.6
NCR	5,026	192	966	2.9	3,715	158	587	2.6	8,741	178	1,558	2.8	11.5
Xerox	826	585	483	1.4	200	630	126	0.6	1,026	594	609	1.1	12.4
DEC	339	791	268	0.8	160	775	124	0.5	499	786	392	0.7	57.7
Other	1,955	119	233	0.7	1,643	111	183	0.8	3,598	116	416	0.7	28.2
TOTAL	71,871	466	33,463	100.0	50,755	444	22,551	100.0	122,626	457	56,024	100.0	
Non-IBM	23,075	463	10,693	32.0	20,282	357	7,243	32.1	43,357	413	17,926	32.0	

Source: EDP Industry Seminar, 1976.

TABLE I-3

SUMMARY OF ECONOMY OF SCALE

Activity	Percent of Computer Revenue	Elevation of the Average Costs of Firm with 10% of the Market Compared with 100% of the Market
Manufacturing	15-20	5-15
Sales	10-15	2-5
Maintenance	7-10	15-20
Software	10-15	50
Total	50	Weighted-ave. = 19.4

Source: "the U.S. Computer Industry", G.W. Brock

Aside from the barriers created by capital requirements, in trying to understand the continuing IBM dominance, recognition has to be given to the fact that it has been a superbly managed company, reorganizing itself periodically to meet new conditions, ready to devote a large fraction of its income to research and development,* and above all it has concentrated on marketing with an intensity and success which other companies have found almost impossible to match. This near-monopoly in the computer industry has had both favourable and unfavourable aspects. Thus,

* Although a review of the seminal, innovative idea in computers shows that the contributions of companies other than IBM have been major.

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- IBM standards for input devices, tape densities, communications equipment, and programming languages were originally industry and, hence, international standards. At first this benefited the development of computers; now it is regarded as an undue influence.

- For a long time, until the US government intervened, IBM had a policy of only renting (and not selling) its machines. When a company can rent its products there is little incentive to replace them, and a tendency to keep obsolete equipment in service. Rapid changes in computer technology and competition eventually introduced strong counteracting forces, but even now the fact that much computer equipment is rented means that companies have to be prepared to invest in large, expensive inventories.

- IBM hardware has been consistently reliable and this has set performance standards which other manufacturers have had to meet. IBM prices have been an umbrella under which other companies could often operate for a time, but they become highly vulnerable to sudden changes in IBM pricing policies.

- Because IBM has a large multipurpose market it has tended to develop unified programming and operating systems to serve a very broad spectrum of computers and applications. This has often led to very large software systems, unnecessarily complex and inefficient. On the other hand it has left openings for an independent software industry.

Aside from the key positions of the USA and IBM in the computer industry, the other fact of central importance has been a dramatic increase, for three decades, in hardware performance as measured by processing speed, memory capacity or operations per dollar. For each of these factors there has been an exponential improvement with time. Whereas a computer commercially available in the late 50s might typically have an addition time of 2 milliseconds, a high speed memory of 1,000 words and a cost of $300,000; a small business computer today will have an addition time of 1 microsecond, a high speed memory of 64K bytes (as well as a disk memory of 500 megabytes) at a cost of $60,000. A state-of-the-art computer will carry out several hundred million instructions per second (MIPS), have a hierarchical array of memories with the largest containing perhaps 10^{12} bytes, and a price of $10,000,000 dollars.

This enormous improvement in hardware performance accompanied by equally dramatic decrease in size, due to the emergence of transistors and the evolution of the chip and LSI technologies, has meant two things for software, which has also improved, but not nearly at the same rate as hardware. First, there has been a steady increase in the ratio of software/hardware costs, so that today the software costs are certainly dominant. Second, increased reliability and storage capacity have made it possible to write and operate much larger programs and packages, so that today there is a trend to producing giant software systems involving whole industries. In this study we will focus particularly on four such systems, EFTS (Electronic Fund Transfer Systems), Electronic Mail, Videotex, and Office Automation.

EFTS is a general term embracing a number of trends related to computerizing the transfer of payments. Included are:

- interbank clearing of cheques and similar transactions,

- the use of credit cards to authorize payment of purchases,

- automatic debiting and crediting of accounts, particularly for periodic payments such as occur in salaries, loans, and mortgages,

- capture of transaction data by point-of-sale terminals, including (possibly) immediate deletion from the purchaser's bank account.

Electronic mail is the forwarding of messages or pictures over communication channels as is now common with Telex or facsimile services. As we shall see, the ubiquity of the computer introduces new dimensions to the possibilities.

Videotex is a generic term embracing one way transmission of textual material over broadcast channels (teletext), and two-way transmission based on telephone lines and home TV receivers (Viewdata).

At least six aspects can be identified in office automation, which is an outgrowth of word processing, the fastest growing component of the computer industry. These are:

Conferencing - the traditional two-way telephone call can be expanded in several ways, e.g., more people (teleconferencing), visual presentation and documented records.

Information transfer - a basic function of letters and telephone calls. Here again there is a trend to variety of formats and editing modes.

Information retrieval - data base services (Lockheed, Orbit, New York Times) show one direction. Another is the development of systems to retrieve interoffice reports, contracts, purchase orders, etc., along with the indexing schemes necessary to accomplish this. In a sense, expanded microfiche & microfilm services.

Transaction processing - this is what computers have emphasized in the last 20 years. The enlargement will be for document handling as well as data handling.

Personal processing - the development of electronically aided personal filing systems, for text, graphic, and bibliographic information.

Activity management - appointments, deadlines, conferences, etc.

1.1.2 COMMUNICATIONS

Here we focus only on data communications, and it is convenient to consider first communications using conventional channels (wire, cable, microwave links, etc.), and then communications based on satellite links. The existing switched voice network can be used for communicating data. However, economic as well as technical considerations related to the nature and requirements of data traffic have led to the development of special facilities to serve as data networks. In such networks, the basic transmission facilities are leased from a communication common carrier. Switching and data handling equipment are provided by the network operator, which may or may not be an authorized common carrier.

Data networks are currently at various stages of development in different countries, with a few already offering services to the public. Some of these networks are based on circuit switching. The majority, however, involve some form of packet switching.

In the mid 1960s star connected networks using multi-point operation and polling techniques were employed to connect a multiplicity of terminals to a central computer system; mesh connected networks based on packet switching concepts were later developed to improve circuit utilization. Adaptive routing, made possible by the network topology, led to a substantial increase in availability in the event of circuit or plant outage. Also, the store-and-forward mode of operation provides such additional services as speed or code conversion, error free transmission, etc. Hence, packet switched networks are referred to as Value Added Networks (VANs).

The emergence of data networks, whether circuit or packet switched, in different countries leads to the need to interconnect them. This requires the establishment of internationally agreed recommendations or standards relating to the services and facilities to be provided, procedures for setting up and clearing down calls, international accounting and numbering plan, etc. Interfacing standards are also required to facilitate connection of user equipment. In 1968 the CCITT (Commité Consulative Internationale Téléphonique et Télégraphique) set up a working group entitled "Nouveau Reseau de Donnée" (NRD) to study these issues. The advice of the International Standards Organization (ISO) was also sought to ensure that interface recommendations can be established which are acceptable to the data processing industry.

Three basic types of service have been identified, namely:

1. Virtual Call Service,
2. Permanent Virtual Circuit, and
3. Datagram or Fast Select Facility.

A Virtual Call is equivalent to a dialed telephone connection, except that network resources are allocated only on demand, that is, when data is available for transmission. This leads to better line utilization and allows calls to be charged on a volume basis. A Permanent Virtual Circuit enables communications at any time between two designated points without the need for call set up. Datagram service is based on a self-contained entity that carries sufficient addressing information so that it can be routed through the network without the need for a call to be established. The Virtual Call and Permanent Virtual Circuit are the basic services provided by most existing or planned packet networks. Datagram service is being actively studied by CCITT.

Some of the CCITT Recommendations and Draft Recommendations that have influenced the development of packet networks in various countries, and have led to a considerable degree of compatibility among them, are given in Table I-4.

TABLE I-4

CCITT Recommendations for Packet Switched Networks

Recommendation	Description
X.25:	Defines the interface between user equipment and the network. The Recommendation covers the physical link, the link control protocol and the packet format and flow control procedure.
X.28,X.29:	Define connections to a Packet Assembler and Disassembler. This is a device needed to enable connection of simple, character oriented terminals to a packet network.
X.75:	The procedures required for interconnection of different packet networks via "gateway" exchanges are defined in this Draft Recommendation.

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With few exceptions, notably in North America, public data networks are developed and run by the national Post, Telephone and Telegraph (PTT) authority in each country. Some of the existing networks as well as those under development are given in Table I-5. In most cases each network operates within the boundaries of one country. Examples of networks that overlap national boundaries are NPDN (Nordic Public Data Network) and EURONET. The first serves Denmark, Finland, Norway, and Sweden, while the second interconnects nine European Common Market nations - Belgium, Denmark, France, Germany, Eire, Italy, Luxembourg, the Netherlands, and the United Kingdom. EURONET will initially operate on a semi-public basis, providing service for government and research computer centres, but will later become a general purpose public data network. A number of private networks are also in operation. These include the airline reservation network SITA, the banking network SWIFT and other special purpose and computer time-sharing networks.

The development of data networks, both public and private, has raised a number of policy questions relating to licencing, regulation and fair competition. The approach taken differs from one country to another, and in many cases definite answers are not available. The issues facing the policy makers include:

1. Should VAN services be provided on a monopoly basis?

2. Should organizations other than common carriers be allowed to furnish public packet network service?

3. How can fair competition be guaranteed between a VAN operator and the underlying carrier?

TABLE I-5

National Data Networks

Country	Network	Date*	Comments
Belgium	---	1980	
Canada	Datapac	1977	packet switch
	Infoswitch	1978	circuit switch
Denmark	NPDN	1980	synchronous, circuit switched
France	TRANSPACK	1978	packet switch
Germany	EDS	1979	circuit switched
Japan	DX-2	1979	packet switched
Netherlands	DNI	1980	
Norway	NPDN	1980	synchronous, circuit switched
Spain	RETD	1973	
Sweden	NPDN	1980	synchronous, circuit switched
Switzerland	---	1979	
UK	PSS	1979	packet switched
USA	Telenet	1975	packet switched, store and forward, terminal oriented
	Tymnet	1976	Graphnet
	Compac	1978	ITTDST

*Starting date of public service. Most networks started operation on an experimental basis a few years earlier.

4. Can an organization that operates a private packet network, such as a data processing company, offer any communications services to the public without being authorized as a carrier?

5. On what basis should a carrier supply customer-site equipment? Should such equipment be bundled with the network services, or should it be offered in competition with other suppliers?

6. How should packet network services be priced? A low price will encourage private line users to switch to the public network. However, it implies an investment risk. A high price will protect existing service offerings.

Because of such questions data communication policies are currently being reviewed in almost all of the countries of concern to this study.

The need for interconnection of public data networks has been recognized since the first such network, Telenet, started offering services. There is a strong interest in interconnection among both users and suppliers of network services. The user would like to have access to as many points as possible from a single terminal. Meanwhile, interconnection of a number of networks increases the potential use, hence revenues, of any given network.

A consequence of the wide range of technologies that can be used in data networks is that a number of difficulties arise when inter-network data transfers are to be carried out. This is mainly a result of incompatibility of the services offered. For example, one network may offer datagram service while another network may be based on virtual circuits. Some of the important problems encountered at the interface between two networks are:

- Protocol translation
- congestion at the point of interconnection
- addressing of terminals and hosts
- tariffs and charging procedures, particularly when intermediary networks are used between the source and destination networks.

Interconnection strategies are based on the concept of a gateway. Networks that use the X.25 interface protocol are easily interconnected because it provides most of the functions that have to be performed at the gateway. The X.75 Draft Recommendation of CCITT represents an extended version of X.25 which accommodates special network/network information exchange, such as routing information, accounting information, etc.

A number of interconnections between public data networks are currently in operation, at least on an experimental basis. These include links between Telenet (USA) and Datapac (Canada), between Telenet and PSS (UK) and between PSS and EIN.

A number of regulatory and legal issues arise from network interconnection because of differences in laws and regulations governing the operation of these networks. For example, the British Post Office (BPO) claims the right to inspect the contents of any data message sent across lines leased from it; this right is at variance with the privacy laws being enacted in many countries. Another problem is that interconnection may provide access to services which are considered illegal in the country in which the user is sited. For example, the use of the message service provided via TYMNET by persons in the UK would contravene the BPO monopoly. Similar problems arise from differences in laws that protect personal data files or are intended to prevent computer fraud, and differences in property concepts as applied to computer data.

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The major issue currently facing regulatory bodies is to arrive at precise definitions for different types of services. Unambiguous criteria are being sought to distinguish between such services as data processing and communications; transmission of voice and data; telephone and telegraph; broadcast and point to point links; etc. Technological innovation in areas such as digitized voice, electronic mail, cable television and satellite communications have all but eliminated the boundaries that have historically existed between these services.

Satellite communications has promoted the development of high data rate transmission systems that are necessary to provide efficient data transfer for the applications just noted. Two most important characteristics of communications satellites* in serving this role are the availability of wide transmission bandwidths for long-distance communications, and the multi-point distribution capability, which enables simultaneous transmission to, and reception from, all points in the satellite-connected network. These capabilities enable efficient utilization of the available communications resources to best suit the users needs, whether these needs include complex interactive multi-location networks or point to point communications.

The use of satellite links for data communications networks began in the USA almost with the birth of the first packet switched, data communications network, the ALOHA system developed by the University of Hawaii under ARPA and NASA contracts. The flexibility of digital data traffic

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*Generally speaking, communications satellites are placed in geosynchronous orbit so that they will remain stationary with respect to the ground. The geosynchronous height is approximately 36,000 km.

led to the design of data communications networks which differ from ordinary telephone networks, making data traffic especially suited to satellite links. Although the latter possess many features that appear attractive for data traffic their future roles must, however, be considered in comparison to growing terrestial networks.

Two important digital techniques now implemented in most satellite communications systems include single channel per carrier (SCPC) and Time Division Multiple Access (TDMA). Both techniques can be used to transmit digital voice and data, including data rates up to 60 Mbps per satellite transponder.

A significant feature of both of these systems is that different data rates can be accommodated as required by each user. (For example, typical data rates available include 9600 bps, 50 Kbps, 240 Kbps, and 1.344 to 60 Mbps.)

In general, the services afforded by satellite systems are extremely cost effective, especially when one considers that a 50 Kbps data circuit, operating at a 10^{-7} error rate can be provided by the equivalent cost of a normal quality voice circuit.

Since early 1972, INTELSAT has been offering high speed (50 or 60 Kbps) digital data channels for international satellite communications. The INTELSAT combined low/medium/high speed digital data service, Digisat, in use in the Atlantic and Pacific ocean regions, offers a range of medium-speed channels at three different bit rates (2.4, 4.8, and 9.6 Kbps) which may be subdivided into lower rates of transmission. INTELSAT is also offering a digital data service through the international carriers for use by the USA defense Advanced Research Project Agency (ARPA). This service, utilizing a 50 Kbps circuit, is providing multi-point packet communications switching by satellite. Another international communication satellite system, INMARSAT, has been set up recently to provide communications between ships and shore. It is quite feasible that shipboard computers will use this satellite system to communicate with computers on shore or on other ships.

An experiment to evaluate techniques for direct computer-to-computer communications has demonstrated the feasibility of high-speed, international computer communications via satellite. Conducted in 1978 via the SYMPHONIE satellite between Gaithersburg, Md., and La Gaude, France, it represented the first such link at high data rates (1.544 Mbps). Other experiments are now being planned using the European Space Agency's OTS satellite. One of these, the STELLA experiment, is an on-going project aimed at exploring the usefulness of high-speed data communications for high-energy physics research in Europe. It is partly financed by the EEC in Brussels and will use the OTS to relay large volumes of data from CERN in Geneva to collaborating national high-energy laboratories. A second experiment, SPINE (Space Information Network Experiment), is proposed by ESA in collaboration with the Royal Aircraft Establishment (RAE) in Farnborough, England and DFVLR in West Germany. This experiment will use the OTS module-3 repeaters to complement the STELLA project by providing information that can be used directly in the design of future operational satellite data communications systems.

Most of the areas proposed for investigation are concerned with the network aspects of satellite data communications systems, and in particular, communications protocols.

1.2 TRENDS IN THE GLOBAL ECONOMY

1.2.1. THE GLOBALIZATION OF THE WORLD ECONOMY

The unprecedented advances in communication technology and transportation services have helped shrink the globe over the last three decades. The national economies, encouraged by the free trade environment, have become increasingly interwoven. The world economy today is not yet a system. Even if only a systemoid, interconnection of its parts promotes the tendency to become a unified system each day.

Increasingly, progressive thinkers realize that "the best market in the world is the world" - there is more money there than at any single home base. The global market share (GMS) is now the goal to be sought. GMS determines the long term success or failure of any world class economic unit, or group of units. Over the past few years we have also seen the emergence of the world product - a product with a worldwide appeal, whose major parts can be produced at several different locations around the world, shipped for assembly to several other points, and sold in different countries.

The main agents of such dramatic changes are the world economy integrators - the transnational corporations, trading units and banks.

1.2.2 MULTINATIONALS AND NATIONAL GOVERNMENTS

Important new actors have appeared on the global scene in the last 30 years. Transnational corporations have grown increasingly larger and more prominent. In the 1970s sales figures of the world's largest industrial enterprises had begun to be comparable with the GNP of even major countries. By 1980 estimates indicate that the multinationals contribute about a quarter of the gross world product.

Exxon, the world's largest corporation, has become the world's sixteenth largest economic unit, larger than Mexico, Sweden or Iran. In 1980 the energy giant created Exxon Information Systems (EIS) out of its 15 innovative companies, and confirmed that it wants to become a major supplier of office automation and computer/communications equipment within the next three to five years. Even IBM, the present giant of computer/communications technology, one third the size of Exxon, ranks above countries such as Chile, Israel, or Eire.

Countries are both like and unlike industrial corporations. While admittedly goals of profit are easier to pursue (in theory at least) than the welfare of the nations, few would argue that multinationals are not better managed, with superior long term strategies. Of the top 100 economic units of the world, 60 are countries and 40 are corporations (half US, half others). The ratio is likely to reverse within a decade. Many observers are convinced that within two decades, the world economy may well be run by 300-500 multinationals, with some 10% being third world multinationals.

The multinationals have created an archipelago of export processing zones (EPZ). By 1977, EPZ existed in more than 40 countries. These enclaves are practically beyond the jurisdiction of the national governments. In such a situation, the national strategies in high technology, and the strategies of high technology corporations, will not likely be in harmony. More often than not they might be on a direct collision course making the planning of nation states increasingly difficult.

Nevertheless the actions of strategic interest, such as computers and communications, may very well become more and more trade between government-led coalitions of firms. Whether they succeed or not, the national governments will necessarily try to attempt to exercise control over their industrial activities and foreign trade.

1.2.3 THE INTERNATIONAL FINANCIAL SYSTEM

The international banking system, through development of xenomarkets, (Eurodollar, Asian dollar, etc.) has created unprecedented liquidity (the Euromarket alone is estimated to be over $1 trillion) putting the amount of money at the international level beyond the reach of national government controls. With the speed of an electronic signal an amount of funds, equal to the GNP of smaller countries or the assets of the larger corporations, is moved around the world with incredible ease.

These flows are facilitated by the existence of some 1,000 new "gnomes" - off-line banks in about 27 tax havens such as the Bahamas, Luxembourg, Bahrein, and Hong Kong, accounting for over one third of the Eurodollar market, or over $350 billion. It is no surprise that an international monetary system no longer corresponds to the balance of economic forces.

With last year's increase of oil prices once again came warnings that the world banking system is headed for another jolt, threatening the international financial order. The pessimists claim that the world economy is likely to experience stresses and strains in the coming decade that will deform existing international financial arrangements, as the world will fail to control economies and recycle petrodollars. The optimists point out that by recent central bank regulations of the xenomarkets, and by flooding oil producing countries with goods and services at inflated prices, the industrial countries succeeded in keeping the world financial order more or less balanced and functioning. However, the pessimists have been gaining ground recently, pointing out that the universal controls might not be totally effective and that the system cannot absorb another oil shock. In 1978, OECD countries still boasted an aggregate current account surplus of $31 billion. By the end of 1980, the surplus will disappear, and what is worse, will turn into a huge deficit of $49 billion.

According to the latest UN Conference on Trade and Development "this pattern is expected to persist in 1981 with very much larger deficits of OECD countries (and non-oil developing countries)".

1.2.4 SLOWDOWN OF THE WORLD ECONOMY

The success of post-war growth over the last generation is ascribed by some observers, such as Freeman, to be due to seven clusters of innovations. Now these innovations have been mined to exhaustion, and the consumer markets of western countries have been saturated. No new major innovations comparable to television, plastics or computers are on the horizon. The Western economies had to slow down because technological progress has come to an end, these observers argue. While not denying this argument, the harsh realities that have ended what has been nearly a generation of rising prosperity in OECD countries, and have clouded the prospects for the 1980s, we are convinced that some technologies, especially computer/communications, will provide scope for further growth, even if at rates lower than in the past.

As it enters the 1980s, the world economy is moving towards a recession. According to some the recession will be synchronous; according to others, who observe the polarization in both industrialized and developing economies, the recession will be asynchronous.

World gross product is expected to increase at the anemic rate of 2.3%, with a recovery in 1981 expected at no more than 2.6%, according to Wharton Econometric Associates and Stanford Research Institute. The Western industrialized nations as a whole will show an even more moribund growth of 1.1% increase in their GDP this year. The recovery also will be weak - only 1.6% in 1981 and 2.2% in 1982. The slow pace of growth will not reduce inflation significantly. Only some 2% is expected to be shaved off the average 11% Western inflation of 1981, and only another 1% is hoped for in 1982.

The governments of the West are gradually abandoning Keynesian and embracing monetary policies limiting growth of the money supply and therefore government investment capital. During the 1970s stagflation resulted in the polarization in Western industrial economies - economies such as Japan or West Germany performing significantly better than the weaker economies such as the USA or Canada, to say nothing of the UK. The slowdown in North America is expected to be more severe than in continental western Europe or Japan.

Japan and West Germany are determined to battle their huge oil import deficits by aggressively pushing exports. So far, their export push seems to be working. After holding back for two years, to avoid criticism, they are again well poised to increase their export offensive. This, of course, creates the great danger of a series of protectionist measures in the other industrialized countries of Europe and North America.

1.2.5 STRUCTURAL CHANGES IN THE WORLD ECONOMIC ORDER

1. The North American economy has rapidly been losing its share of the world market. Although it accounted for some 40% of the world economy in 1960, it will account for no more than 20% by 1985. The trend is a

shift away from the US-dominated, non-communist world, towards an increasingly multipolar one.

2. Europe has been maintaining, and will likely continue to hold, its 20% share of the global economy.

3. By 1985, North America and Western Europe will have about an equal share in the world economy. North America has, of course, the significant advantage of its market homogeneity.

4. Japan represents the most dynamic part of the world economy and is increasing her global share two and a half times faster than the second most dynamic section - the communist bloc. Nevertheless, she will not likely exceed a 15% share in the foreseeable future, that is, before 1990.

5. The centre of gravity of world economy has been and will continue to shift from the Atlantic to the Pacific Basin Region.

6. A relatively slow erosion of the total OECD countries' market share is foreseen - a decline from 65% in 1960, to 55% in 1990.

7. A relatively slow advance in the share of less developed countries is foreseen: from 13% in 1960, to 17% in 1990.

8. A relatively fast advance by the communist bloc is expected; its share of the world economy will be about one third by 1990.

9. The triadic co-operation of North America, Western Europe, and Japan is absolutely essential for the retention of a majority control of the world economy; a control once enjoyed by the USA alone.

1.2.6 THE ENERGY CHALLENGE

While it is probably safe to predict that the Western economies can develop and grow without coming up against physical limits of energy and resources supply within the foreseeable future (at least a generation), the main problem is to make a smooth transition from oil to other sources. Other industrial materials are, in principle, ample.

The socio-political challenges to prime material supply is another matter. A serious upheaval in every country of the Persian Gulf in the next decade can be foreseen.

Part of the responses of Western countries to this energy unavailability is a simultaneous desire to move upmarket - to restructure economic machines to produce higher value-added, less energy- and resource-consuming products and services. This of course requires investment. We have witnessed near evaporation of private investment, as the capital/output ratio grew increasingly. What is worse, wealth has been drained from oil consuming countries to the oil producing ones over the last seven years as never before.

Fortunately, some high technologies, such as parts of computer/communications technology, require less capital investment than, say, nuclear energy.

If the national governments do overcome this investment obstacle, they will then be faced with an increasingly competitive global situation in fighting for a global market share in computer/communications technology.

1.2.7 CHANGES IN TECHNOLOGICAL COMPETITIVENESS WITHIN THE OECD REGION

Uneven patterns of technological change between Western countries may lead to serious problems of modernization, re-nationalization, and adjustment.

Uneven rates of technological change tend to lead to pressures for protectionism and government intervention in those countries that perceive that they are falling behind. OECD countries are becoming more sensitive to the competition between themselves, especially in advanced technologies when the whole activity in one country is threatened. Similar tensions may also occur when the relative technological or productivity standing of different countries changes profoundly. In both cases, one can expect increasing government involvement in industrial policies. For example, the recent closing of a gap in technological standing between the USA and Japan, and between the USA and West Germany has created such multiple stresses.

Competition between the developed countries in the field of advanced technologies is bound to intensify.

1.2.8 NICs CHALLENGE

The industrialization of some countries of the Third World - the so called newly industrializing countries (NICs) - such as Brazil and North Korea, will progressively generate deep changes in the productive structures of the Western economies. Ideally, the OECD governments should prepare policies to adapt their industrial structures to the future patterns of international division of labour.

While the long term effects on the OECD countries could very well be positive, the short term or even mid-term effects may well be negative. One of the responses is the reluctant evacuation of so called "soft sectors" and the restructuring of upmarkets, towards more knowledge-intensive entities.

1.2.9 THE EMERGENCE OF JOB WARS, TRADE WARS, AND BLOC PROTECTIONISM

While corporations worry about profits, governments worry increasingly about jobs. The corporation can shift its operation to another country, close down an inefficient operation, or fold up as the demand for its product drops off. And the government is left to take care of the jobless - jobless who are voters, and on whom the politician is dependent.

So it is only natural that governments become increasingly involved in both job creation and job protection programs. Exports are increasingly important as a source of jobs. "Welcome" packages including cash payments and tax holidays have become popular with many governments as inducements to establish manufacturing. The loans, accelerated tax write-offs, tax credits, etc., are some of the weapons used against erosion, or for salvaging existing jobs. Very often these efforts are zero-sum games. A gain in one unit is accompanied by a loss in another. The "job wars" are on the horizon.

The fight for global market shares, differences in competitiveness, the desire to protect domestic jobs, and the reaction to pressures from NICs may, and indeed do, tempt some industrial democracies to partially isolate their domestic or regional markets through protectionist trade policies.

So far we have not witnessed rampant protectionism - the enemy of free trade. GATT negotiations have reduced the main protectionist policy - tariff barriers. These will be progressively dismantled over the next eight years. But as the apostles of protectionism gain ground, new forms of protectionism might be erected - as fast, if not faster, than the old ones are dismantled.

Non-tariff barriers (NTB) will be the new protective weapons. Such measures as standard specifications, government inspections, licencing of technicians, and many more will be the new forms of protectionism.

Trade frictions will therefore not diminish. There is a strong revival of economic nationalism. Trade wars might be on the horizon.

1.2.10 THE NORTH-SOUTH GAP

All these developments bode ill for the Third World countries which, because of higher oil prices, large debts, and eroded bargaining position, find themselves slipping still further behind. The economic order of the last 30 years has rapidly deteriorated. The developing countries have not succeeded in replacing it with their new international economic order. The north-south dialogue on long term structural problems of global economic development has so far degenerated into "le dialogue des sourdes" - two monologues in parallel. Even if the new international development strategy will be unveiled this year, as the UN ushers us into the third development decade, and although there are beginning signs that the North has come to accept, at least in principle, that the new international economic order is here to stay, no action has been seen so far nor is expected soon.

The recently released report of the Brandt Commission "North-South: A Program for Survival" points out that the global development is no longer a question of helping the Third World, but one of survival of the Global Economic System. Nevertheless, the report's recommendations for massive transfers to developing countries will probably go unheeded. In the industrialized countries, challenged with upcoming current account deficits, the protectionism shows no signs of abatement. On the contrary, the evidence is accumulating that the competition in the world trade has increased, with a consequent closing off of domestic markets and a start of beggar-thy-neighbour policies.

1.2.11 A WIDER CONCEPT OF DEFENSE

In the context of the conflicts just described, a wider concept of defense has been gaining ground. "La défense a pour objet d'assurer en tout temps, en toutes circonstances et contre toutes les forms d'agression, le securité et integrité du territoire, ainsi que la vie de la population" is the French definition of the modern concept of defense, quite distant from the traditional view that defense is the sole domain of the armed forces.

In the modern world, where economic activity is so vulnerable (recall the "oil shock of 1973" for instance) conflicts between states do not have to take a military form. The concept of economic defense has been increasingly introduced into the strategic thinking of various countries. The notion of economic blocs and trade is certainly not new, although perhaps the job wars are.

Technological capability and trade, will be increasingly linked as political weapons.

1.2.12 PLANNING DIFFICULTIES AND NEED

Governments have become increasingly involved in support of high technology. The stimulus of government involvement in these technologies has come from the external challenges, such as the arms race and international economic competition.

The dynamics of progress in technology, (and high technology is no exception) has been relatively poorly understood. These programs are undertaken sometimes for civilian, but often for military, purposes. Decisions about them tend to be taken in relative secrecy; they are accompanied by nationalistic calls for technological sovereignty. Often they are initiated on the basis of optimistic forecasts of the outcome. More often than not insufficient consideration is given to economic and social considerations. The available evidence suggests that when governments become involved in commercial technological development supporting the market sector the results, on the whole, have not been successful.

The outcome of GATT is still uncertain; it is difficult to plan the penetration of global markets when one knows that NTB barriers are being erected. National governments are often on a collision course with the strategies of multinationals when they begin to formulate directions in which they are about to go. Moreover, they are handicapped because responsibility is often distributed over various parts and levels of the government system, with jurisdictions often overlapping and in competition.

The above difficulties notwithstanding, the forces outlined in this introduction - globalization of the world economy, the stresses between multinational companies and governments, changes in the world order and international financial systems, energy shortages, slowdown of the economies of the Western nations, challenges from newly industrialized countries, the emergence of trade wars, job wars, and global protectionism - all add weight to the arguments that governments simply have to become involved in national strategies for technological planning and development. The proponents of these arguments are gaining ground even in those Western countries, particularly North America, where national planning is often suspected because it is regarded as a form of interference which stifles innovation and inhibits enterprise. Nowhere more than in the computer/communications industry do we see the global forces at work, the arguments for government intervention being made, and actions taken in response to the arguments. In the chapters which follow the evidence, arguments and responses are presented for the USA, Japan, France, the United Kingdom, Western Germany, Sweden and Brazil.

CHAPTER 2

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2.1 TECHNOLOGICAL CAPABILITY

2.1.1 COMPUTER HARDWARE

In the 1940s the USA pioneered the development of electronic computers for military and scientific applications; in the 1950s they were the first to introduce commercial versions of the machines widely applicable to business applications; in the 1960s they led in producing faster, cheaper transistorized computers along with versatile input-output and storage devices to make the systems very much more powerful. In the 1970s the USA led by developing LSI technology which made it possible to build the first minicomputers, and then microprocessors which carried out the functions of the earlier large machines at a fraction of the cost.

This sequence has meant that the USA through these decades has produced far more computers, has had a greater installed base, and has been a larger exporter of computers than every other country, even those at its level of other technologies. The USA dominance in shipments of all types of computer hardware, and in the installed base is illustrated in Table US-1. Only recently, with the significant production of silicon chips and integrated circuits in Japan, has there been any challenge to this domination.

The predominance of IBM in integrated computer systems was noted earlier. Other companies have significant shares of specialized markets, e.g., Digital Equipment Corporation in minicomputers, and Control Data Corporation in large number crunchers used in nuclear physics and meteorology. For peripheral equipment and plug compatible devices (printers,

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TABLE US-1

SHIPMENTS ($ MILLIONS) AND *INSTALLED BASE* ($ MILLIONS, THOUSANDS OF UNITS) OF *UNITED STATES COMPUTER FIRMS;* UNITED STATES, *OVERSEAS, WORLD;* 1971, 1976, 1981

	1971 ESTIMATE [i]				1976 ESTIMATE [ii]				1981 FORECAST [ii]	
	Shipments		*Installed Base*		*Shipments*		*Installed Base*		*Shipments*	*Installed Base*
	($ Millions)		Units Thousands	($ Millions)	($ Millions)		Units Thousands	($ Millions)	($ Millions)	($ Millions)
	New Build	Net			New Build	Net			New Build	
U.S. *General-Purpose Computer Systems*	4,200	2,400	54.5	26,500	6,300	4,800	69	40,000	10,000	65,000
Mini & Dedicated Application Computer Systems	250		33.5	1,600	1,300	1,100	160	5,800	4,500	18,000
Data Entry & Terminal Equipment	630		553.5	2,800	1,500	1,300	1,800	9,000	4,000	20,000
OVERSEAS *General-Purpose Computer-Systems*	3,300	2,600	36.2	14,300	5,300	3,100	55	30,000	8,500	51,000
Mini & Dedicated Application Computer Systems	60		*	*	700	600	90	3,300	2,000	9,000
Data Entry & Terminal Equipment	*		*	*	800	700	800	4,500	1,500	9,000
WORLD TOTAL *General-Purpose Computer Systems*	7,500	5,000	90.7	40,800	11,600	7,900	124	70,000	18,500	116,000
Mini & Dedicated Application Computer Systems	310		*	*	2,000	1,700	250	9,100	6,500	27,000
Data Entry & Terminal Equipment	*		*	*	2,300	2,000	2,600	13,500	5,500	29,000

All prices are retail list purchase prices, and do not include customs or import taxes.
* No estimate is available.
[i] 1971 estimate in 1971 dollars.
[ii] 1976 and 1981 estimates in 1976 dollars.
[iii] "Net" is shipments less returned equipment.
Source: 1971 data from AFIPS Conference/Workshop, July, 1972; 1976, 1981 data from AFIPS Conference/Workshop, March. 1977.

disk drives, memory units) there is greater competition, and for terminals, plotters and display units there are a very large number of USA manufacturers whose products in bewildering variety are seen at the many computer exhibitions that form part of the USA computing scene.

At the component level of microprocessors and silicon chips IBM is no longer the main supplier, but the five largest companies in the world are all in the USA and continue to dominate. (Texas Instruments, $680 million sales, 1979; Motorola $425 million, Intel $400 million; National Semiconductor $320 million; and Fairchild with $305 million.) Semiconductor production has grown on the average by 50% in volume, and 20% in sales over the past decade. The USA accounted for about 80% of the estimated $6.9 billion production output in 1979 which is expected to reach $13.7 billion by 1984. In spite of these strengths there are serious concerns about the industry. It has become increasingly capital intensive. Expenditures which were 10% of sales in 1975, will be 16% in 1980. One consequence is that major companies have had to sell equity to find capital. In 1979 Fairchild was acquired by Schlumberger; and Signetics, the sixth ranking company in sales, by Philips. There are definite indications of loss of technological leadership and market share to Japanese competition due in part to lower productivity, low investment, and what is regarded as unfair competitive practices. The shortage of skilled people is serious. Maintaining high production yields is critical to success in manufacturing. Nevertheless, the applications of silicon chips and microprocessors to communications, computers, process control, manufacturing and home devices continue to proliferate, and there can be little doubt that chips made in the USA will be the catalyst for the electronic industry in the coming decade.

2.1.2 COMPUTER SOFTWARE

Software as an industry was born in January 1970 when IBM, largely as a result of anti-trust pressures, unbundled (began to separate) charges for software from those of hardware. Although the prospects for the market were overly optimistic at first it is estimated that in 1980 about 6% of computer expenditures, amounting to approximately $2 billion will be devoted to acquiring software, of which about 2% will be for commercial packages.

Software can be grouped into three categories:

System software: - e.g. operating systems, sorting programs, performance evaluation methods, program development and maintenance tools, data encryption. Hardware manufacturers continue to be important suppliers of these programs, thus IBM supplies close to 50% of the software purchased by IBM computer users.

Application packages: - e.g., for payroll, order entry and inventory control, personnel management, production control, literature searching, scheduling, etc. These are often skeletal systems which have to be customized to the user's specifications.

System services: - data base management systems, teleprocessing monitors, word processors, office management systems, electronic mail, videotex systems, electronic fund transfer systems. These last four are discussed separately in the section which follows.

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It is estimated that currently there are about 1,000 companies marketing over 3,000 programs. Among the principals are Computer Science Corporation, System Development Corporation, Planning Research Corporation, Informatics (its Mark IV was the first product to achieve a $50 million sales mark), Applied Data Research, Cullinane Corporation, and Management Science America. Noteworthy are the recent trends to produce inexpensive cassette packages for the low cost TRS-80, TI-90, PET, and Apple computers. In certain areas such as performance measurement, software and hardware are interchangeable, and there are suggestions that more software may be transformed into hardware in the form of read-only memory units (firmware) which are adjuncts to standard machines, or as stand alone special purpose machines for such applications as payroll or file management.

Although the proprietary value of software is clearly accepted, neither patents, copyright, nor any similar scheme has emerged as a common method of protection. At present standard non-disclosure agreements and the usual practice of providing only object code (often with an automatic self-destruct feature on expiry date) have provided sufficient protection. But it is generally agreed that legal protection will eventually have to be established on a better basis.

Just as the USA is the principal supplier of hardware for the world, so is it the principal supplier of software. In part this is because any computer application is likely to appear first in the USA; in part it is because the hardware manufacturer, most often based in the USA, is likely to be the first to recognize a software need. Many countries, especially developing countries such as India and Israel where there is a good base of people trained in mathematics and statistics, have aspired to become suppliers of software to the USA market. So far this has proved to be elusive, partly because software so often has to be customized to the user's specification. The British have been making special efforts to export software to the USA with moderate success and recently the Japanese announced a major thrust in software marketing. It remains to be seen whether they will be able to mount an effective challenge to USA supremacy, as for chip technology and hardware.

2.1.3 DATA COMMUNICATIONS

The situation in the USA is characterized by the existence of a number of data networks operated by private concerns under government regulation. The National Telecommunications and Information Administration (NTIA) and its predecessor organization of the Department of Commerce, and the Federal Communications Commission (FCC) are the principal organizations which establish domestic policy while the State Department is involved in shaping international telecommunications policy. Transmission facilities are owned and operated by the two main communication carriers, AT&T and Western Union. Their facilities are leased to private corporations, such as TELENET and TYMNET, then resold to the public in the form of a Value Added Network (VAN).

TELENET is based on the experience gained from ARPANET, the grandfather of packet switching networks. The user interface to TELENET is based on virtual circuit operation and is compatible with the X.25 protocol. Another public data network is TYMNET which evolved from an earlier private network operated by the TYMSHARE Corp. It is a terminal oriented network that transfers data between terminals and computers a few characters at a time. Access to the network is normally over the dialled telephone network. Two other networks under development are ITT Domestic Transmission Systems Inc., and Graphnet Systems Inc.

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The USA is the world's leader in the utilization of communications satellites for a broad variety of domestic and maritime applications. These include some of the most sophisticated applications in data communications. For example, there are several satellite systems funded publicly such as LANDSAT, the earth resources satellite, and the NOAA weather satellites, which have strong backing by certain sectors of Congress. Visible lack of revenues hampers the transition of an earth resources satellite system to the private sector and may preclude the initation of a public communications satellite for the same reason. However, it is not only the cost that hampers the decision process since the government has funded similar large programs. Congress authorized NASA to enter into a leasing agreement with Western Union for the NASA Tracking and Data Relay Satellite System (TDRSS) amounting to approximately $800 million over the next decade. Only limited controversy was generated on the TDRSS project because a government agency (NASA) established a clear and economical justification based on lower space tracking costs.

Currently, there are nine domestic communications satellites in the USA (WESTAR (3), SATCOM (2), COMSTAR (3)) all operating in the 4/6 GHz range; and a 12/14 GHz satellite is due for launch before the end of the year by Satellite Business Systems (SBS). In addition, COMSAT is operating three maritime communications satellites (MARISAT) providing global communications for ships with the continental USA.

Table US-2 presents a list of the USA domestic communications satellite systems:

TABLE US-2 - USA DOMESTIC COMMUNICATIONS SATELLITE SYSTEMS

SATELLITE	DATE OF LAUNCH	OPERATED BY	MISSION
WESTAR-1	April, 1974	Western Union Telegraph Co.	Provides a fully integrated satellite/terrestrial network between most cities in the US for voice, video, messages and data
WESTAR-2	October, 1974	"	"
WESTAR-3	August, 1979	"	"
SATCOM-1	December, 1975	RCA American Communications Inc.	Provides a full video, voice, and data services network between major US cities
SATCOM-2	March, 1976	"	"
COMSTAR-1	May, 1976	COMSAT for AT&T/GSAT	Provides a long haul telephone/data network for AT&T Long Lines Division. Also provides private line services
COMSTAR-2	July, 1976	"	"
COMSTAR-3	June, 1978	"	"
SBS	Expected 1980	Satellite Business Systems	Provides private, corporate communications networks for video, voice and data using rooftop antennas
MARISAT-1	February, 1976	COMSAT	Provides global communications for ships
MARISAT-2	June, 1976	"	"
MARISAT-3	October, 1976	"	"

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In addition to the above systems, the American Satellite Corporation is leasing channel capacity on the WESTAR satellites and offers integrated value-added network services to their customers for data communications and voice. Furthermore, Hughes Aircraft, General Telecommunications and Electronics, and Southern Pacific Communications Company have filed applications with the FCC for permission to operate their own communications satellite systems. Plans are also well underway to establish a Public Service Satellite System to serve the general public.

2.1.4 SYSTEM SERVICES

Electronic Funds Transfer Systems (EFTS)

There are three principal concerns about EFTS trends in the USA.

(1) The need to spend large sums on hardware and software in order to offer a wide variety of services will lead the banking system, now highly decentralized compared to, say, the Canadian system, to become much more concentrated. This will result in less competition and ultimately will not be in the public interest.

(2) Interconnecting the financial systems offers too many opportunities for invasion of personal privacy.

(3) The consumer may have less protection in a highly automated system. Thus it may be more difficult to stop payments, to protect against escrow, or to obtain refunds for unsatisfactory goods.

These concerns led to the establishment of a National Commission on Electronic Funds Transfer which, in its report issued in October 1977, made a number of policy recommendations, many of which have found their way into state and federal legislation.

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Notwithstanding the restrictive efforts of some of the legislation enacted to protect privacy and consumer interest, there has been a steady increase in the volume of money transactions carried out on computers. From 1970 to 1980 it is estimated that the number of transactions per year increased from 56 billion to 135 billion. It is estimated that in 1975 the value of the installed computer base devoted to banking was $2.5 billion, amounting to 13.2% of the total, and the expenditure on financial services (including insurance which is about equal to banking) was 22.5% of the total expenditure. In addition to Fedware, the government run banking service, over 50% of USA banking resources are now interconnected through Bank Wire II, an EFT system of approximately 200 members operated by the banking industry. Thus EFTS is, and will undoubtedly continue to be, one of the principal forces leading to increased use of communications and on-line computer services.

Electronic Mail

A short message can already be sent by Telex at a cost comparable to that of a letter. Since some 60% of first class mail is related to transfer of payments, and can therefore be accommodated in a short message, this fact alone explains the intensity of interest in electronic mail. In the United States the Postal Service (USPS) is engaged in three distinct electronic mail projects.

- Electronic Computer Originated Mail (ECOM) is to accept billing data directly from a company's computer and forward it to the nearest post office where it would be converted into printed bills for hand mailing with guaranteed two-day delivery. A test involving 25 cities is now scheduled.

- Electronic Message Service System (EMSS) would, in its ultimate form, deliver messages from one home computer to another with no paper intervening.

- Intelpost will use facsimile transmission to forward mail overseas.

The USPS says that it must have an electronic mail capability to carry out its congressional directive to be self-supporting, and it has been backed in this by the Carter administration. But this is challenged by Congress because private industry, including such giants as AT&T, Satellite Business Systems (backed by IBM, Comsat and Aetna Life Insurance), and Xerox Corporation, argue that they can provide better services without tax subsidization. The satellite transmission capabilities of SBS are already impressive, but the interconnection services to the user have only recently been spelled out. AT&T sees electronic mail eventually supplanting telephones as the main vehicle for conducting business, and its long term plans encompass the merging of such different services as teleconferencing, voice store-and-forward, electronic mail, environment monitoring, and computer query and response from data bases. Store-and-forward message services are already built into some of the value added networks, e.g., TYMNET, and facsimile services are also offered by a number of vendors.

In the meantime the FCC has emphasized its jurisdictional authority over common carriers, including the USPS proposed electronic mail services. Some countries have already spent funds on interconnecting their national services to the USPS Intelpost while others are waiting to see what the private companies will offer. In the short run the electronic mail situation will undoubtedly be confused. Before long it is to be expected that a mix of government and private enterprise services will appear, each with some defined mandate. Eventually some few of these may emerge as survivors. At this point it would be difficult to predict which would survive but given the initiative, determination, and financial backing of the large companies involved, and with so much at stake, it is safe to say that there will be an important private enterprise component. Also given the advantage that AT&T has in owning the local loop (i.e., the connection between the user and the telephone exchange) and the very large fraction of the loop costs in the total communications investment, it is safe to predict that AT&T will be one of the survivors.

Videotex Services

Although videotex systems are being tested or actively promoted in several European countries and in Canada the attitude towards them in the USA is one of caution and skepticism. In view of the strong penetration of computers into business and the home in the USA, and the quality and variety of communication services available, this attitude requires some explanation. The following seem to be relevant factors:

- There is a history of unfulfilled promises regarding telecommunications in the last decade. Low-cost, direct satellite communication and interactive cable television with a wide variety of services have not materialized. Videotex seems to be another promise.

- Uncertainty surrounds the market. Surveys continue to leave doubt about what the public will pay for other than entertainment. The uncertainty is heightened by the apparent shift of emphasis in Prestel from home to business services. Also the emergence of self-contained videodisk systems makes it possible that many potential videotex services (games and computer-assisted instruction) could be supplied by stand-alone computing systems.

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- A variety of tests are underway, with results not available yet. These include:

- CBS offering the French Antiope, the UK Prestel, and the Canadian Telidon systems at KMOX-TV in St. Louis.
- The Public Broadcasting System (PBS) and the Department of Health Education and Welfare (HEW) are offering a text captioning teletext system, with five hours of programming per week provided through NBC and ABC.
- The Department of Agriculture is conducting a pilot system, known as Green Thumb for delivering weather, marketing and farm management information.
- Knight-Ridder Newspapers is testing a videotex system called Viewtron in Florida.
- Telecomputing Corporation of America is marketing a system called The Source in which subscribers lease low cost time-sharing terminals at $2.75 per connect hour offering accounting packages, classified ads, games, stock market quotations, electronic mail, etc.
- AT&T has announced Electronic Information System (EIS) using a computerized terminal to access products listed in the Yellow Pages.

- The regulatory climate continues to be highly uncertain. The FCC certainly has some jurisdiction and it is under constant review while Congress, concurrently, is tending to deregulate communication services. Other possible actors include the Federal Trade Commission, the Justice Department, The Copyright Tribunal and state public utility commissions.

In summary, there continues to be considerable interest and activity in videotex services in the USA but the growth of offerings is not likely to increase dramatically in the next five years unless there is some unexpectedly positive reception of the experiments now being conducted.

Office Automation

The fastest growing component of the computer industry is the sale of stand-alone word processors, but office automation encompasses much more than the operations ordinarily associated with processing textual data. In view of the central role that the communicating of information plays in office procedures, the communication aspects of office computers are generally seen to be the focus of development over the next few years. Several automated office systems which were first assembled as demonstrations and then marketed commercially point the way. One is the Paperless Office established by Micronet in Washington and Dallas where, in addition to word processors, optical readers, and data communication equipment, such features as voice input and data management procedures are available. Another is the Datapoint Integrated Electronics Office marketed by TRW Data Systems.

A survey conducted by Booz, Allen and Hamilton estimates that $800 billion will be spent in 1980 in support of office activities. Most of this ($600 billion) will be directed towards furthering the productivity of managers and other professionals, the remainder being spent on clerical and other junior personnel. It is further estimated that this amount would double, rising to $1600 billion by 1990 if systems were to continue as at present, but that annual savings of more than $300 billion are to be had by automation. Such estimates are obviously approximate, but the magnitude of the sums explains the strength of the drive towards office automation. From another viewpoint, the average capitalization for a factory worker is $25,000; for an agricultural worker it is $50,000; for an office worker it is $4,000. There are predictions that office costs could double in the next six years, so there is considerable incentive to acquire equipment to increase productivity in the office.

2.1.5 RESEARCH AND DEVELOPMENT

The most helpful way in which the USA government has contributed to research and development with regard to computers has been by consistently being ready to purchase and pay for the first model of advanced processors which the various computer companies have proposed. This began with the USA Census Bureau ordering of the first UNIVAC; it continued with such purchases as the IBM 370/195, the UNIVAC LARC, the CDC 7600 and Star computers; and the policy still holds as exemplified by NASA's recently contracting with Goodyear Aerospace Corporation for a $6 million "massively parallel processor" with a speed of about 6000 million instructions per second (MIPS).* The significance of these purchases by the space, nuclear and defense industries is that, with the research costs underwritten for the prototype, the computer companies were in a position to develop marketable versions of the machines, and many commercial series of computers have been launched in this way.

Altogether the various agencies of the federal government make up the largest single user of computer equipment. In 1976 they accounted for 8.7% of the installed base ($2.9 billion) of general-purpose computers, with almost half of this (46%) in the defense sector.

It is important to realize that the computer companies have also invested considerable sums of their own in developing new systems. This

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* the Cray computer, which exemplifies the current state-of-the-art, is 20 MIPS.

is illustrated in Table US-3 where the government and private industry contributions for computer research in 1969 and 1970 are compared. In 1980 71.7% of all research will be carried out by industry; with 13% in the federal government, 12.1% in academic institutions, and 3.0% in non-profit organizations.

TABLE US-3

Government Support for Research and Development in USA Computer Companies

($ Millions)

Company	1969 Expenditures		1970 Expenditures	
	Co.	Govt.	Co.	Govt.
IBM	418	362	188	312
Burroughs	37	107	47	60
NCR	42	85	50	27

More recently fears that the technological gap between USA companies and those in Europe and Japan is narrowing, to the vanishing point in some cases, has led to calls for a greater federal involvement in research and development. The government has responded and the 1981 Federal budget contained a 12% increase for federally backed research, and a 13% increase for research and development, as channelled through such agencies as the Department of Defence (DoD), NASA and the National Science Foundation. The increases, $42 billion in a budget of $361 billion, must be measured against a general pattern of budget cuts. Computer technology receives special attention in the over all plan and included is a $51 million microelectronics program intended for developing commercial VLSI circuits, and $6 million for strengthening experimental computer science in academic institutions. The private sector component of R&D continues to be significant and is estimated as approximately $21 million for 1980.

In the light of the dominant role of IBM in the computer industry its research and development policies and expenditures are particularly important. IBM spends a relatively large amount in research, and maintains laboratories throughout the world. Of these, two in the USA at Yorktown Heights, NY, at San Jose, CA and one in Zurich, Switzerland, are engaged in fundamental research; the others are development laboratories which may have restricted mandates that limit them to projects linked to a defined market. Table US-4 shows the assignments of IBM laboratories outside the USA, but in view of the need to develop co-ordinated ranges of equipment for the global market the R&D functions for hardware design is, in fact, highly centralized within the USA.

Similarly, Burroughs, Univac, Honeywell, and DEC have had to devote significant efforts to research in order to ensure that they can maintain competitive product lines. This is true even though patents have had little effect in restricting the utilization of new ideas. On the whole the technology has changed too fast, and the protection offered by patents has been too uncertain for them to be important. Cross-licensing is very common in the computer industries between the subsidiaries of a company and its parent, and between companies, but unless a computer manufacturer has been prepared to commit a serious effort to research and development the pace of technological change leaves it with little bargaining power and vanishing markets.

2.1.6 EDUCATION AND TRAINING

As in every country, there is strong concern that the growth of the computer/communications technology in the USA will be limited by the

TABLE US-4

Assignments of IBM Laboratories Outside USA

Country	Date of Installation	Assignments
Austria	1961	Programming theory, language definition.
Canada	1967	Terminals, input keyboards, software.
France	1969	Circuit switching systems, switching systems, signal transmission, integrated circuits, software.
Germany	1957	Small systems, medium-size systems, printers, memories on integrated circuits, software.
Japan	1959	Telecommunication and data bank terminals, linguistic problems.
Netherlands	1956	Input devices, software.
Sweden	1960	Telecommunication equipment, software.
Switzerland	1956	Fundamental research in semi-conductor physics, semi-conductor electronics and telecommunication networks.
United Kingdom	1959	Industrial systems, magnetic memory, software.

availability of adequately qualified people. Table US-5 shows the distribution of the computer labour force by occupation for 1974 and projection of the requirements for 1985. Several points should be noted about these statistics, and from others given in Nyborg et al.

(1) The total labour force, 853,000 in 1974, is divided between those working in the computer industry (111,000) and those employed by users (742,000).

(2) Of the 405,000 specialists (systems analysts, programmers and others) 125,000 have university degrees at all levels. The balance received their training through associate programs at the community college level, for-profit trade schools, or received on-the-job training.

(3) From 1964 when, for all practical purposes, programs were first offered at post-secondary institutions, until 1974 the number of computer-related academic degrees totalled 49,700 associates and 30,900 degree holders for a total of 80,617. Comparing the figures in Table US-5 it can be seen that of the specialists, and of the fraction with university degrees, relatively few received their training in computer-related subjects.

These observations are consistent with a general feeling that the computer labour force is making large use of relatively underqualified people.

The National Centre for Education Statistics projects an annual production of computer science graduates in the mid-1980s of approximately 11,500 BAs, 6000 MAs and 470 PhDs. These numbers are far below the estimated needs to meet growth and upgrading. A survey of 289 installations

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TABLE US-5

DISTRIBUTION OF COMPUTER LABOR FORCE BY OCCUPATION (NUMBER EMPLOYED); UNITED STATES, 1974 AND 1985

Occupation	Computer Labor Force		Per Cent Change
	1974 (Estimated)	1985 (Projected)	
Systems Analysts	97,000	160,000	+64.9
Programmers	195,000	290,000	+48.7
Other Specialists	16,000	26,000	+62.5
Equipment Operators	246,000	335,000	+36.2
Machine Repairers	50,000	93,000	+86.0
Keypunch Operators	249,000	200,000	-19.7
TOTAL	853,000	1,104,000	+29.4
TOTAL U.S. Employment	85,936,600	103,355,000	+20.3

Source: Based on data supplied by Bureau of Labor Statistics, U.S. Department of Labor, 1977.

taken in 1979 showed an average vacancy rate of 17% for applications programmers, system programmers and analysts; the greatest shortage being for data communication specialists where the vacancy rate was 27%. The shortages are reflected in the very high number of positions advertised in the professional computer journals and daily newspapers, in intensive recruitment at national meetings, and in a great deal of movement of, especially experienced, people from one company to another in response to competitive bids.

Gilchrist attributes the shortage to a number of factors, the principal one being that users are tied to old programs requiring a great deal of maintenance because they do not want to devote the effort needed to re-program these properly in the presence of growing demands for new applications. He predicts that the shortage will persist because the demand for new applications will continue and computer science departments will not be able to expand to meet the needs, even though the prospective enrolments may be there.

There are other considerations. Some feel that the university courses are not suited to the needs of the market. The university response is that the education they provide is not for present applications, but for those projected which the graduate will encounter later in his/her career. In any case graduates find employment readily. Another point to be noted is that, although the number of computer <u>specialists</u> may be inadequate, very many students take one, two or three courses in their university program - not enough to make them specialists but still useful in helping to meet the need for people with computer skills.

2.1.7 PUBLIC AWARENESS

There are many indicators to show that the USA public and officialdom are highly conscious of computers although this is difficult to measure.

- The steady evolution of the EFTS system means that there is a very large fraction of the public involved daily in transactions carried out on computer terminals for banking, travel reservations, department store sales, etc.

- Computer events and issues feature largely in the press - examples are descriptions of new applications, and reports of regulations and laws relating to the protection of privacy, and computer fraud.

- The USA computer industry maintains a high profile. The American Federation of Information Processing Societies (AFIPS) is a Washington-based umbrella organization of societies embracing over 150,000 individual members. It maintains constant contact with government officials, and organizes a number of annual conventions featuring computer products, communication products, and office automation. Some of these conferences attract an enormous attendance in the form of participants or representatives of the suppliers and they receive wide coverage in the national press.

- Aside from the engineering and scientific periodicals there are a large number of trade publications focussing on computers and communications. Among those with very high circulation are Computerworld appearing fortnightly, and Datamation, a monthly.

All this, combined with the general interests of the USA public in technological matters, means that American society is very conscious of the role played by computer technology and of its importance to the economy.

2.1.8 MARKET SHARE AND EXPORT CAPABILITY

The pre-eminence of all aspects of the USA computer industry is attested to by the market share of the USA (Table US-1). The distribution by geographic area of exports and imports for 1975 is shown in Table US-6.

When one sees how dramatically the costs of oil imports have affected the USA balance of payments (Table US-7), the importance of the positive contribution of the computer industry to the balance of payments is apparent. Table US-8 shows the history from 1961 to 1971 (note the cummulative contribution of licensing and royalty fees) and Table US-9, the more recent import/export flow. The Department of Commerce sees a strong, expanding market for computer exports in the next five years with the installed overseas base growing from its 1976 value of $293 billion to $455 billion in 1981.

Nevertheless there are serious concerns about the challenges to the USA export position and the possible weaknesses in it. Briefly these can be summarized as follows:

- The technological lead of USA computers has been eroded, particularly with respect to Japan, where there is probably no lead whatever in chip technology.

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TABLE US-6

Business machines and computers,
United States exports and imports (1975)

	% million		%	
	Exports	Imports	Exports	Imports
EEC	1026.6	60	46.2	46.7
Canada	230.1	62.2	14.4	48.4
Far East	271.2	3.2	12.2	2.5
Latin America	161.3	-	7.3	-
Near East	44.2	0.6	2	0.5
Eastern Europe	39.4	-	1.8	-
Other areas	360.9	2.4	16.2	1.9
Total	2223.8	128.5		

Source: US Department of Commerce, News, 5/5/1976.

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TABLE US-7

US Trade Balances (Billions of Dollars)

YEAR	Overall Trade Balance	Oil Trade Balance
1965	$ 6.1	-17
1966	48	-17
1967	47	-16
1968	14	-19
1969	20	-21
1970	33	-22
1971	-14	-28
1972	-58	-37
1973	1.9	-71
1974	-17	-234
1975	11.5	-23.9
1976	-5.7	-30.8
1977	-25.1	-41.5
1978		

Source: The U.S. Trade Balance Less Oil
Staff Economic Report, Office of Economic
Research, US Dept. of Commerce, Aug. 1977)

TABLE US-8

Impact of the computer industry on the United States balance of payments

($ million)

	1961	1966	1970	1971	Total 1961-1971
Exports	+111	+295	+1118	+1152	+5084
Imports	- 5	- 6	- 60	- 119	- 278
Direct foreign investment	- 17	- 85	- 30	- 131	- 595
Return flows	+ 7	+ 18	+ 53	+ 64	+ 277
Licences and royalties	+ 2	+ 10	+ 28	+ 34	+ 153
Net impact	+ 98	+232	+1109	+1000	+4641
As per cent of balance of net liquidities (*)	2.0	4.9	23.5	21.0	10.0

(*) Balance of net liquidities over 11 years (1961-1971). The net impact amounts are related to the negative mean of this balance. The percentage therefore indicates the deterioration which would result in the absence of a positive balance resulting from the computer industry trade, i.e. if it were in zero balance.

Source: DAFSA, L'industrie informatique dans le monde, p. 24.

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TABLE US-9

Computers and Related Equipment - Trends and Projections of United States Foreign Trade in 1967-1979

Million of dollars

$ million	1967	1971	1972	1973	1974	1975	1976	1979
Shipments	4049	5118	6108	7361	8000	10000	11600	20900
Imports (excluding parts)	20	119	173	110	115	136	163	490
Exports (including parts)	475	1217	1340	1715	2196	2300	2480	5300
Imports (a) (parts only)	39	113	175	234	273	287	304	470
Export / Shipments %	11.7	23.8	21.9	23.3	27.4	23	21.4	25.4
$\frac{L - X}{L - X + M}$ % (b)	98.4	94.3	93.2	94.3	93.7	94.8	95.1	94.9

(a) Including spare parts for calculators and cash registers
(b) L = shipments
X = exports
M = imports

Source: U.S. Bureau of Census, U.S. Industrial Outlook, 1976

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- Restrictions on the policies and operation of the Export-Import Bank of the United States leave US exporters at a serious disadvantage relative to other countries.

- Access to the Japanese market is unduly restricted*

- Export limitations on high technology products, particularly on computer hardware and software, to the Soviet bloc, South Africa, and other countries, imposed for defence reasons, seriously limit the over all market. Special permission is required to export computers and computer parts to communist countries, Zimbabwe, Hong Kong, and Macao. Before the application is granted, the size, probable applications and possibility of equipment being converted to other uses is considered. Exports to communist countries follow the COCOM (Coordinating Committee) list, composed of all members of NATO except Iceland but including Japan.

- Engineers and scientists working abroad do not receive the same favourable tax benefits, thereby making it more costly for US firms to bid on foreign computer projects.

- In general the regulations of the Export Act are too restrictive and too clumsy.

It is significant to note, however, that recently the government has ruled that sections of the Sherman Antitrust Act which prohibit certain

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* Japan has recently agreed to a sharp reduction of tariffs on computers and semiconductors, but it will be eight years before the reductions take full effect.

marketing and other activities in the United States, do not apply outside the country.

Notwithstanding the above concerns, it is safe to predict that the US export capability with respect to computers will remain strong for the next five years and beyond.

2.2 NATIONAL POLICY

2.2.1 ARTICULATION

The course of USA policy is accomplished through elected officials who are proponents of the wishes of the majority of the people. This influence, however, is of a general nature and can be a long time reacting to issues relating to improving the quality of life on a national basis. Therefore, the shorter term responses are determined by Congressional Committees which develop new legislation for Congressional action. The committees also investigate productivity of government agencies and private industries and recommend funding levels for government programs. Final assignment of responsibility and funding is the prerogative of the full Congress. However, due to the complexity of many of the issues, and the limited time, Congressional members rely heavily on the recommendations of the committees that have prepared in-depth analyses on the subjects of concern. Through this process, Congress establishes laws, organizations, and funding to carry out programs.

There is no formal statement of national policy with respect to computers, not because of oversight, or because of the failure of some designated body to reach agreement on the goals. Rather it is because of a recognition that the sector, with its mix of government and private enterprises is too large, too multi-faceted, too variegated, to be covered by a single policy. Equally, there is an innate national suspicion of programs of the type introduced in countries with centrally planned economies, so that there are few calls for statements of a national policy. But this absence of an articulated policy must not be taken to mean that there is no consensus about goals and practices. Generally there is the recognition that:

- the computer and communication technologies comprise a large and growing sector in the national economy;
- the two technologies are, more and more, becoming linked;
- both government and private enterprise have essential roles to play;
- the lead the country has in the development and application of computers and communications is an important element in its world technological leadership;
- other countries have vital interests in these technologies; they too recognize their importance, and that challenges to the USA lead, particularly from Europe and Japan, are to be expected and to be taken seriously.

Given this consensus, there are frequent statements of policy and goals by special groups, both within government and within industry. These statements are often accompanied by calls for, or announcements of, government actions. In fact the number of bills relating to some aspects of computers or communications which come to the Congress and the Senate is astonishly high. At any given time there may be up to 50 such bills under consideration, many, but not all, concerned with privacy and freedom of information. Only a fraction of the bills which reach the floor of the Senate or Congress end up as legislation. But with so much activity it is not surprising that many of the bills which are eventually enacted, arising as they do from the pressures of groups with conflicting interests, have contradictory elements. One of the most obvious conflicts is that which arises out of the anti-trust actions of the Department of Justice against IBM, pursuing its mandate to enforce the Sherman Act so as to encourage competition in the industry, and the recognition by the Department of Commerce that so much of the export strength in computers comes from IBM that it would not be in the national interest to see a weakened company. Although there have been suggestions that the Department of Justice will seek to divide IBM into several companies it is not certain that a subdivided IBM will result in increased competition. Recently the government has been almost quiescent in pursuit of the action, and there is a general feeling that the pressure on IBM will be lessened.

Although national policy with respect to computers is not clearly articulated, communications, as a regulated industry, receives a great deal of attention and there is an explicit policy formulation. Policy regarding packet-switched network services is based on the Communications Act of 1934. The main regulating body is the FCC. Following the first Computer Inquiry which was launched in 1966, the FCC ruled that data processing services are not subject to regulation. However, data communication services could be offered to the public on a for-hire basis only by regulated carriers. The distinction between the two types of service is based on an ad hoc procedure known as the "primary purpose test". According to this procedure, the status of a company with respect to regulation is determined on the basis of the primary service it offers to the public. Thus, if a company offers data processing as well as communications services, but the latter are judged to be incidental to the over all operation, the company is not subject to regulation. AT&T was prohibited from provision of nonregulated services by a 1965 antitrust consent. Furthermore, the communications carrier's monopoly on line attachments was eliminated as a result of a landmark ruling of the Supreme Court, the Carterfone case, in 1968.

Another landmark decision was arrived at by the FCC following the specialized common carrier enquiry in 1971. In this enquiry, the FCC concluded that the introduction of new specialized communication services and competitive carriers into the market place was beneficial to the public and would be permitted in the future. This represented a fundamental departure from the then current monopoly structure for public communications services. A number of specialized carriers providing a variety of point-to-point transmission facilities have since been licensed.

A 1974 enquiry instituted by the FCC established that sharing of a leased communications channel by several organizations is permissible but only on a non-profit, cost-sharing basis. This opened the door for a number of industry oriented networks such as ARINC for airline reservations, and FedWire and BankWire for the banking community.

The Communications Satellite Act is the landmark law for this type of communications. Congress also passed legislation to establish the Communications Satellite Corporation (COMSAT), and government agencies such as the National Aeronautics and Space Administration (NASA) and the FCC. Additionally, the Congress provided funds for space programs extending the state-of-the-art satellite communications. These satellite development programs were administered by the NASA and the Department of Defence (DoD). The rules required several private corporations to be established as completely separate entities for the sole purpose of competing in the domestic satellite market.

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As a matter of policy, there is strong support for an international carrier (INTELSAT) by virtue of the creation of the national representative, COMSAT. There is less support for Oceanic Satellites for mobile platforms such as ships and aircraft, as evidenced by the cancellation of the AEROSAT program. MARISAT is entering the operational phase and exists with essentially no government funding. The new international maritime program has taken several years to be resolved. US policy strongly supports competition among a few domestic telecommunications satellite systems in which no public funds are expended. The current policy reveals a strong trend towards a competitive market with private industry providing the majority of capital to implement current systems and new technology for future systems. This policy of depending on the private sector to fill the gap has been in existence for several years with no positive indication of interest by any entity that is capable of following through with an operational system. This situation continues to exist in spite of the advanced state-of-the-art of satellite communication technology and apparent willingness of industry to participate.

2.2.2 SUPPORTING ACTIVITIES

In addition to its research and development aid there are other ways which the USA government actively helps the computer/communications industry. These include conducting market surveys to aid exporters, promoting the dissemination of information, providing funds through the Import/Export Bank, and purchasing practices that favour domestic companies and promote competition.

The Department of Commerce regularly surveys the export possibilities for all industries including the computer industry, and follows closely the growth, legislation, and policies of companies in other countries, which might affect the export position. This work is carried out by resident members of the consulates and embassies, and the reports invariably have great detail and show perspicacious judgement about the strengths and weaknesses of the USA companies vis-a-vis foreign competitors. Included are estimates of the domestic market in each country, lists of prospects, and the share which US companies might hope to gain. In all, these annual surveys are most useful aids towards maintaining strength in exports. The Department of Commerce also organizes exhibitions in key centres around the world and covers the shipping costs for USA exhibitors. When sales are made the Import/Export Bank can arrange direct credits to guarantee approximately the second half of foreign payments. Further, guarantees are made for loans for inventory and production by US banks.

Within the United States, the government encourages the distribution of information about computer technology so that best practices will disseminate throughout the industry. It does this by insisting that reports on government sponsored work be made easily available through such agencies as the National Technical Information Service (NTIS), and that rights to products and processes developed with the aid of public funds be made available without charge to other companies working on government contracts. It is worth noting that NTIS reports are also distributed, at slightly higher costs, to other countries illustrating that the United States has, on the whole, been generous in sharing its technological expertise. In fact there has been concern whether the USA has not been too free in its readiness to allow its special position with respect to computers to be eroded, a concern which is reflected in suggestions that the Japanese should not be given open access to the chip technology by virtue of their acquisition of companies in Silicon Valley. The concern is not only about government. Although IBM has traditionally been secretive about its research and forthcoming products, and has only limited licensing agreements with its subsidiaries in foreign countries, other USA computer companies have been much readier to share their knowledge. Thus Honeywell exports its technical developments freely to France through its participation in CII-Honeywell Bull.

The General Service Administration (GSA), in carrying out its mandate of monitoring the spending of federal funds, devotes considerable attention to computers.

The Brooks Bill, directed by the General Services Administration in 1965, authorized the Department of Commerce to undertake the necessary research to establish uniform federal EDP standards. This bill gave the Office of Management and Budget both fiscal and policy control over government-wide computer procurement. Three procedures could be used in purchases:

1. General purpose computers under $50,000 could be purchased directly by each agency, following GSA procurement regulations.

2. Through the Federal Supply Contracts Schedule, contracts could be negotiated individually with each supplier (used for upgrades, small additions to systems from same manufacturer).

3. In competitive bidding, contracts would be awarded on price competition for systems which exceeded a certain benchmark.

The effect of the new system was to improve budget efficiency (by decreasing rentals in favour of purchases). However, it has been found that sole-sourcing, benchmarking and bulk purchases have not been the result of broad and thoughtful policy decisions as to competitive impact.

This situation is not expected to change, the relationships between lowest cost and fair and equitable dealings is not clear. Other studies and presidential documents have voiced some intentions, but nothing has been made clear. To date, the policies with the Brooks Bill are still under scrutiny for revision with many departments still purchasing computers on a non-competitive system by ordering only part of a system at one time, e.g., six new disk drives from IBM followed by six more a few months later.

The main goal of GSA is to keep costs down and to encourage competition in the industry by ensuring that there is open bidding on contracts wherever possible but, at the same time, because of the provision of the Buy American Act, there is a definite favouring of domestic suppliers.

2.2.3 THRUSTS

Several legislative measures recently enacted, or under consideration, emphasize the various concerns about national policies about computer/communications and about technology in general, just outlined.

- An Office of Technology Assessment (OTA) was established by Congress in 1972. It has a forthcoming study on the "Impacts of Telecommunications Technology and National Information Systems", and is carrying out preliminary assessment on the role of the USPS in electronic message systems, on electronic funds transfer systems, and on policy issues in national information systems.
- The National Technology Innovation Act of 1979 (S 1250, HR 4672) is intended to create centres for industrial technology, and establish an Industrial Technology Review Panel.

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- On October 31, 1979, President Carter announced an Industrial Innovation Program having the following goals.

  - Encouraging the transfer of information ($1.2 million allocated to set up a centre for the utilization of federal technology in NTIS).
  - A joint government/industry/university research program funded through a $20 million fund administered by the NSF.
  - Strengthening the patent system and making the store of information in it more accessible.
  - Fostering innovation in small firms by providing equity funding.
  - Using federal purchasing to promote innovation.
  - Improving the regulatory system by establishing a regulatory council consisting of the 35 heads of regulatory agencies.
  - Establishing, in the Departments of Labor and Commerce, a Labor/Technology forecasting system.

- The creation in June 1979 of a National Commission to study Scientific Implications of Industrial Technology in Education (HR 4326). For 1981 $6 million will be allocated by the NSF for strengthening programs in experimental computer science in academic institutions.
- The Paperwork Reduction Act of 1980 (H.R. 64100), approved in March establishes an Office of Federal Information Policy (OFIP) in the Office of Management and the Budget (OMB). The new office is to "provide over all direction in the development and implementation of federal information

policies, principles, standards, and guidelines, including review of information requests ... privacy of records pertaining to individuals, inter-agency sharing of information, and acquisition and use of automatic data processing and other technology for managing information resources".

Finally, mention was made earlier of the long term thrust of the FCC towards de-regulation. This started in 1968 with the Carterfone decision, and the decision to allow Microwave Communication Inc. to promote inter-city communication services. It continued with the creation of Specialized Common Carriers in 1971, the "Open Skies Decision" creating five domestic satellite systems in 1972, and the creation of Value Added Networks in 1976. It was reinforced in 1977, by the unwillingness of Congress to pass the Consumer Communications Act, to give more regulatory powers to the state governments which would in effect have strengthened AT&T's monopoly. In general the reaction of the government, and particularly of the FCC, to the merging of computers and communications has been towards de-regulating the communications industry rather than introducing regulation into the computer industry. The most far reaching action of this type was the 'final decision' in the Second Computer Inquiry, rendered by the FCC in April 1980. According to this decision all network services will be classified as either basic or enhanced (i.e., basic services with computer processing applications which provide additional, different, or restructured information). Only basic services will be regulated. AT&T will be permitted to offer unregulated enhanced services through arms length companies, to the point that it can market complete computer systems as well as data links and have computer terminals and services. At the same time companies such as IBM and Xerox have been given free entry into the enhanced service field. Moreover 'carrier-provided customer premises equipment' (CPE), is to be unbundled from the basic service and de-regulated. This includes the rotary dial desk telephone as well as data communication devices. It will be years before the full implications of these decisions make themselves felt.

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CHAPTER 3

JAPAN

3.1 TECHNOLOGICAL CAPABILITY

3.1.1 COMPUTER HARDWARE

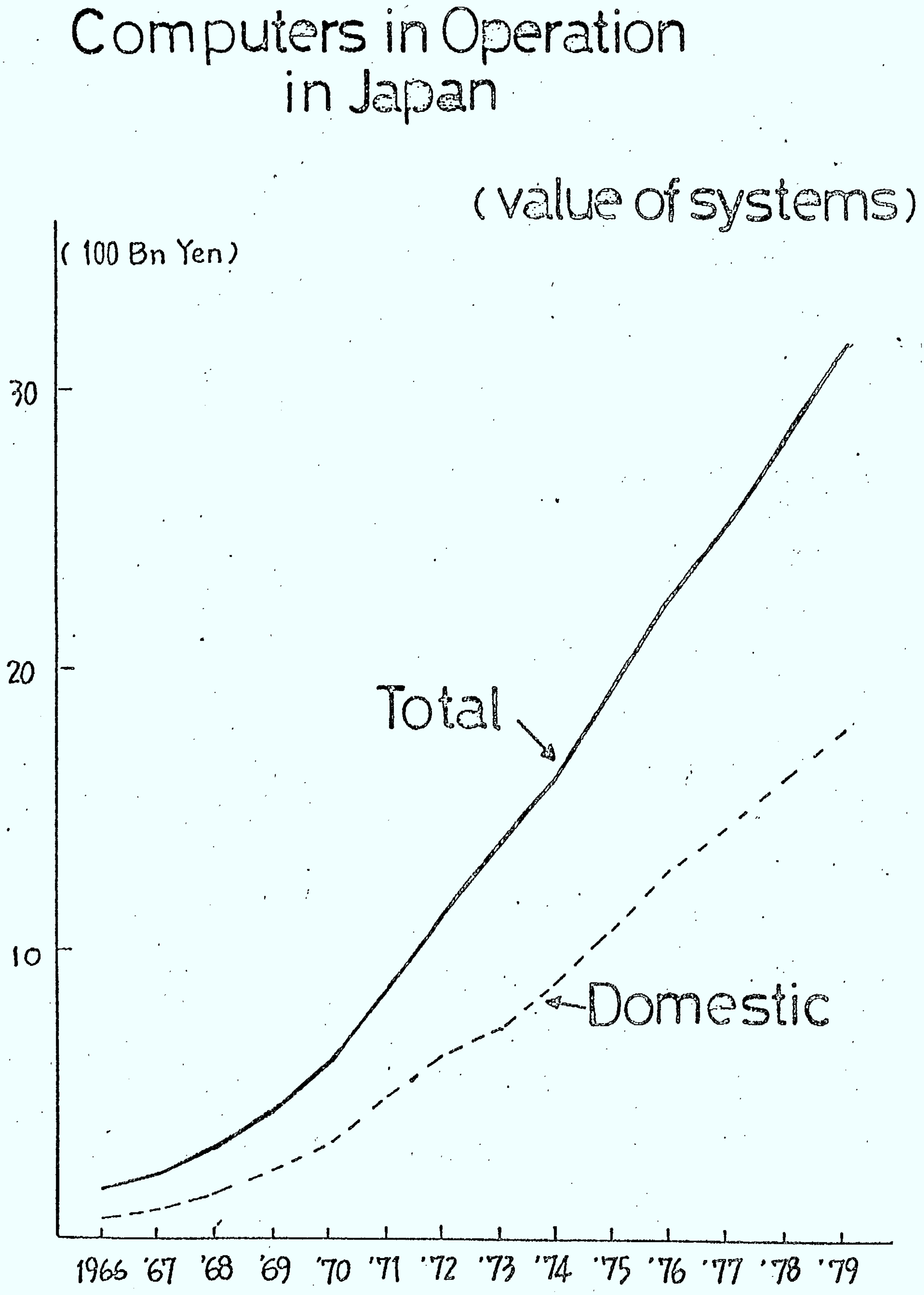
Mainframes: Technological level and size of the market

The Japanese did not produce their first electronic digital computer until 1956 approximately 10 years after the USA. Japanese industry did not participate in the early development of computers, but rather stepped in directly at the second-generation stage, using transistors instead of vacuum tubes. The National Electro-Technical Laboratory completed the ETL-MARK III in 1956 and the ETL-MARK IV in 1958. During this same period the Electricity Transmission Laboratory of the Nippon Telegraph and Telephone Public Corporation (Nippon Denshin Kenva Kosha) introduced the Musashino-1 in 1957 and the University of Tokyo the PC-1 in 1958. The technologies developed were followed up by leading local producers who then entered the market.

Japan is the only country other than the USA which uses more domestic computers than those made in USA. In 1976, for instance, there were 25,000 Japanese computers, compared to 14,000 foreign units. By 1979, some 64% were domestic.

Although Japan was a latecomer to computer manufacture its industry, with strong government support, has developed with extraordinary speed and strength. Today, second only to the USA, its production far exceeds that of European countries. While the USA still exports more computers to Japan than it imports from it, and while USA companies, IBM in particular,

FIGURE J-1


Computers in Operation
in Japan
(value of systems)
(100 Bn Yen)
30
20
10
Total
Domestic
1966
'67
'68
'69
'70
'71
'72
'73
'74
'75
'76
'77
'78
'79

play a critical role in computer production in Japan, the speed and scale of Japan's computer growth have led a good many observers to wonder whether the USA dominance will continue. The Japanese computer industry is not only producing computer hardware considered comparable to that of the USA but it is challenging that industry for production of the next level of computer sophistication.

The dynamics of the Japanese installed computer base is shown in Fig. J-1.

The computer models of 1979, such as Fujitsu's FACOM M and H series, Hitachi's HITAC M series, model H, as well as ACOS 250 of NEC, or Mitsubishi's Cosmos 700 incorporate 64K dynamics RAM VLSI circuits, and the capability to process ideographic language information. Computerworld concluded in November 1978 that the gap between Burroughs, CDC and Univac, and the Japanese companies had now been closed. In 1980, the Japanese regard the USA as competitive only in aircraft and agricultural products but, significantly, not in semiconductors or computers. To illustrate, note the characteristics of some most recent Japanese computer models in Table J-1. Charles Lecht, the president of the Advanced Computer Techniques Corporation has observed in his forthcoming book Tsunami that, without the IBM "Future System" in the offing, Fujitsu would have technically superseded IBM in 1979. The Japanese response in the spring of 1979 to IBM's fourth generation computer demonstrated that she is able to anticipate the advances even in IBM's latest innovations.

The Japanese are ready to surge ahead into the next generation of computers. The Ministry of International Trade and Industry began work in 1979 on the indigenous fifth generation computer. This model represents a basic departure from conventional computers - it will be the so-called

TABLE J-1
Installed Computer Base

Outline of features of new models.

(1) M series

Item / Model Name	M-130	M-140	M-150	M-160	M-170	M-180	M-190	M-200	M-220
Q'ty of CPU	1 set	1 set	1 set	1 set	1 or 2 sets	1 or 2 sets	1 or 2 sets	1~4 sets	1~4 sets
Central memory capacity									
Max.	512KB	1MB	1MB	2MB	4MB	8MB	16MB	16MB	
Increasing unit	64KB, 128KB	128, 256KB	64, 128, 256KB	256KB	512KB	1MB	1MB		
Buffer memory									
Capacity					8KB	16KB	16KB		
Addition	7.53μS	4.72μS		1,360ns	340ns	82ns	60ns		
Subtractinn	34.56μS	33.81μS		1,360ns	340ns	82ns	60ns		
Multiplication	28.86μS	22.53μS		5,760ns	2,890ns	760ns	210ns		
Devision	5.4 μS	4.2 μS		7,320ns	7,140ns	2,020ns	1,530ns		
Average time of order process	24 μS	16 μS		2,100ns	1,300ns	310ns	155ns		
Channels	• Bite multiplexer channel • Block multiplexer channel • Integrated file processor 3MB/sec.	〃	• Bite multiplexer channel • Block multiplexer channel 4MB/sec.		• Bite multiplexer channel • Block multiplexer channel • Selecter channel				
Max. no. of connecting units (per CPU)				6 sets	8 sets	6 sets	16 sets		
Total through put (per CPU)	3MB/sec.	4MB/sec	4MB/sec	4MB/sec	8MB/sec	16MB/sec	20MB/sec		

(2) COSMO series

	Model name		Model 300	Model 500	Model 700	Model 900
Main memory	Memory capacity		32~192k bite	32~256k bite	64~1,024k bite	512~4,096k bite
	Cycle time		800ns	800ns	450~900ns	
	General register		2 units	16 units	16 units (4 sets)	
Arithmetical control unit	Kind of order		54	160	180	180
	Arithme-tic time	decade (5 digits)	57.5μS	25.0μS	8.7μS	
		floating decimal point (32 bit)		12.0μS	4.8μS	
	External offering level		8 level	8 level	64 level	
I/O control	Total transmission speed		1MB/s	3MB/s	3.5MB/s	
	Highest transmission speed		1MB/s	1MB/s	2 MB/s	

Source: Japan Fact Book '80

"non-Von Neumann" type, based heavily on artificial intelligence (AI) research. This project, headed by Professor Tatsu Motooka of the University of Tokyo, is the beginning of a 10 year national research program. The Japanese also seem to be winning the race to produce Japanese language processing capability.

In January 1977 President Ford stated, in his International Economic Report of the President that "Japan is expected to become the chief and probably the only foreign competitor of the USA in all varieties of computers by the mid-80s".

In terms of absolute worldwide production and usage, Japan now ranks after the USA though there is a large gap between the first and second position. However, use of computers in Japan is increasing dramatically. Also, as can be seen when comparing computer usage and gross domestic product (GDP), although there is a large gap between the number of systems in the USA and Japan, on a relative GDP basis Japan's usage is greater. Whereas Japan's GDP in 1976 was roughly one-third that of the USA she had almost half the number of computer installations.

The Japanese computer industry has grown dramatically (Fig. J-2) to the point where it becomes competitive with that of the USA and it became genuinely international by 1977. The present Y1000 billion ($4 billion) Japanese computer industry - about the size of USA exports - is growing in aggregate at a 16% rate. In some segments it is expanding at the rate of 40%. Its size is now about one-third of the European computer industry and approximately one-sixth of the North American volume; these figures however, are likely to change.

Creative Strategies of San Jose, California forecasts that in the early 1980s the Japanese computer industry will be approximately one-half the size of the European and about one-third that of North American competition. The Industrial Structure Council of Tokyo predicts, conservatively, that there will be over 100,000 computer units in Japan by 1985, and that domestic yearly production alone will reach a volume of $5 billion. Japan Electronic Computer Company (JECC) forecasts 147,000 computers by 1985. While EIAJ forecasts a volume of $7 billion for 1982, the prediction of the Ministry of International Trade and Industry (MITI) is even more optimistic; it estimates the Japanese market alone will be worth $11 billion by 1985. The proposed computerization of the postal and social services provides the basis for such optimism. MITI further projects that by 1985 the total installed base will have risen to 4% of the GNP, that is, to a level of some $64 billion. The present computer base is worth over $8 billion. To reach the MITI target, the base would have to double every two years.

MITI officials confidently predict, moreover, that within two years there will be only four computer companies left in the world - two USA and two Japanese. These predictions are difficult to accept, but clearly only time will tell. If this forecast is even approximately correct, we might witness dramatic changes in the world computer market.

Japan's Computer Trade

As shown in Table J-2, domestic production accounts for most of Japan's computer consumption (consumption equals production plus imports minus exports). Table J-2 is distinguished from other tables in this chapter by not including parts, for which we were unable to obtain production data. The scale of the difference in trade, whether parts are included or not, is to be seen in the 1978 data. Where parts are excluded, Japan's exports were $331 million; (Table J-2). When, as in Table J-3, parts are included, Japan's exports were $497.4 million, an increase of approximately 50%. Because the yen/dollar alignment changed so significantly between 1977 and 1980, the data of Tables J-3, J-4 and Fig. J-2 are given in yen.

Table J-4 and Fig. J-2 best show the dramatic changes taking place in Japan's computer trade. In 1974 exports were roughly one-fifth of imports. While imports remained relatively constant exports grew fourfold, almost equalling imports by 1978; however, a significant amount of the domestic production is supplied by foreign firms manufacturing locally. Foreign firms' total share of the Japanese market is about 43%. Table J-3 makes it clear that Japan is no longer dependent on imports of computers and related equipment. By 1979, Japan started to export its computer, under its own brand-name for the first time.

By 1980, Japanese computers were installed in 20 countries from Bulgaria to Zambia. The present level of exports is still small at the $250 million level. Japan is not yet a net computer exporter.

As far as future exports are concerned, the US Department of Commerce projections indicate that Japan could be a $1 billion exporter by the mid-1980s, but the Japanese government expects $2 billion in computer exports by 1985. The Japanese industry intends to double this figure to $4 billion.

The joint venture with companies such as Siemens of West Germany indicates that Japan is building up a global manufacturing capability. The areas to watch are Australia, Brazil, Southern and Eastern Europe, and above all the People's Republic of China. The successes there will increase the likelihood of the large-scale computer invasion of North America.

TABLE J-2

Japan's Market For
Computers and Related Equipment
(excluding parts)

	1974	1975	1976	1977	1978
			(millions)		
Production in Japan	$2,020.6	$1,823.6	$2,087.0	$2,678.5	$4,324.5
Exports	83.2	107.7	132.5	152.7	331.1
Imports	398.6	323.9	319.5	408.1	391.3
Consumption	2,336.0	2,039.8	2,274.0	2,933.9	4,384.3
Production as % of consumption	86.5%	89.4%	91.8%	91.3%	98.5%

Note: Yen/dollar conversions made from International Financial Statistics, International Monetary Fund.

FIGURE J-2

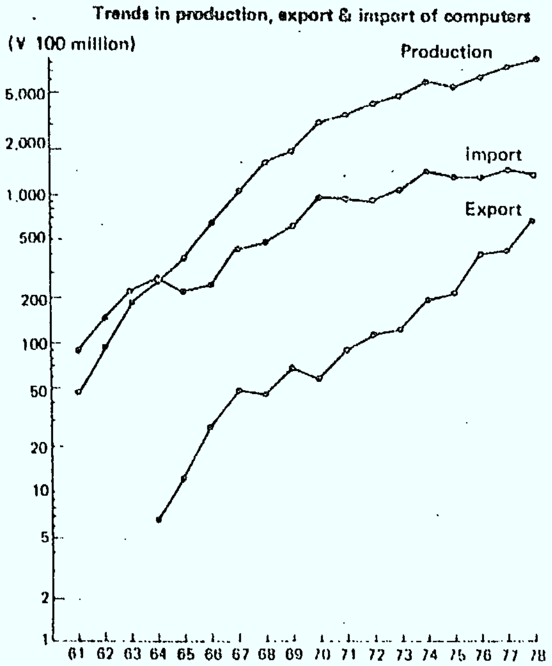

Trends in production, export & import of computers
(¥ 100 million)
Production
Import
Export
5,000
2,000
1,000
500
200
100
50
20
10
5
2
1
61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78

TABLE J-3

Japan's Market for
Computers and Related Equipment
(excluding parts)

	1974	1975	1976	1977	1978
	(billions of yen)				
Production in Japan	589.0	541.2	618.9	719.2	910.2
Exports	24.3	32.0	39.3	41.0	69.7
Imports	116.2	96.1	94.7	109.6	82.3
Apparent consumption	680.9	605.3	674.3	787.8	922.9
Production as % of consumption (minus exports	86.5%	89.4%	91.8%	91.3%	98.6%

TABLE J-4

Japan's Exports of Computers and Related Equipment
(including parts)

	1974	1975	1976	1977	1978
	(billions of yen)				
To World	30.0	42.9	60.3	66.6	104.7
To U.S.	4.9	10.0	29.6	26.0	45.9

Source: The computer production figures, 1974-76, are from the Computer White Paper, 1977 Edition, published by the Japan Information Processing Center, p. 14. The production figure for 1977 is from the Current State and Progress of The Computer Industry in Japan, 1973, Japan Electronics Industry Association, p.3. The 1978 production figure was taken from an article appearing in Electronic News, April 24, 1978. The import and export figures are from year-end volumes of Japan Exports and Imports-Commodity by Country, published by the Japan Tariff Association.

JAPAN

Computer Manufacturers in Japan

There are about 50 computer makers in Japan producing general purpose, mini office, control, and other computers. Among them the big six, namely, Fujitsu, Hitachi, NEC, Toshiba, Mitsubishi and Oki, produce most computer equipment and almost all peripheral and terminal equipment. (For the production status of main computer equipment, see Table J-5.) Fig. J-3 shows the relationship of principal computer makers in Japan, including foreign makers, concerning financial and technical collaboration among these makers.

Six major producers: Fujitsu, Hitachi, NEC, Toshiba, Oki, and Mitsubishi* were among the originators of Japan's computer industry and, as of March 1976, accounted for 97% of the 56.6% share of the Japanese market held by Japanese firms. Fujitsu is the largest of the Japanese manufacturers with a 19% market share, second only to IBM. It is also the only Japanese producer whose major source of revenue is derived from computer production. (Table J-6).

Table J-7 indicates the shares of the Big Six in the Japanese computer market.

The stunning disclosure that Fujitsu's completely automated manufacturing plant in Nagano had begun to produce some 70 varieties of computer presented the world with what we call "The Nagano Challenge".

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* Toshiba and Oki withdrew from mainframe manufacturing but in 1980 Oki returned. A similar reversal by Toshiba cannot be ruled out, therefore we have kept that company in our overview.

JAPAN

TABLE J-5

Computers manufactured by six Japanese large makers

Classification / Manufacture	Large sized	Medium sized	Small sized	Very small sized	Mini computers	Control use computers
Fujitsu	FACOM 230 45S 230-50 230-55 230-60 230-75 230-48 230-58 FACOM M180II M200 M190	FACOM 230-20 230-30 230-25 230-35 230-28 230-38 M150F M160F M160S	FACOM 230-10 230-15 230-28S 230-15III M130F M140F M130 M140	FACOM 230-10E Vo Mate	FACOM-R R/F U200 PANA FACOM U300 U400	FACOM 270 10 270-20 270-25 270-30
Hitachi	HITAC 5020 E 8500 8700 8800 HITAC M170 M180 M200 H	HITAC 8200 8210 8250 8300 8350 M150H 8400 M160H 8450 M160II M150	HITAC 8100 8150 85 M140H	HITAC 1 5 55	HITAC 10 10II 20	HIDIC 150 350 500 700
NEC	NEAC 2200-500 2200-575 2200-700 ACOS77 NEAC500 NEAC600 NEAC700 NEAC800 NEAC900	NEAC 2200-100 2200-150 2200-175 2200-200 2200-250 2200-275 2200-300 2200-375 2200-400 ACOS77 NEAC300 NEAC400	NEAC 2200-50 2200-75 3200-30 3200-50 3200-70 ACOS77 NEAC200 NEAC250	NEAC 1240. D system 100 system 150 50	NEAC M4 M4n MS50	NEAC 3100 3200-30 3200-50 3200-70
Toshiba	TOSBAC 5600-130 5600-140 5600-160 5600-160E 5600-170 5600-180 ACOS77 TOSBAC500 TOSBAC600 TOSBAC700 TOSBAC800 TOSBAC900	TOSBAC 3400-21 3400-31 3400-41 3400-51 5100-20 5100-30 5400-10 5400-20 5400-30 5400-150 5400-150 B ACOS77 TOSBAC300 TOSBAC400	TOSBAC 1500 10 1500-20 1500-R 1350 1350III 1350V ACOS77 TOSBAC200	TOSBAC 1100,D,F 1150 1250	TOSBAC 40A 40B 40C 40N 10 10E 7	TOSBAC 3000 7000-20 7000-25 ICD 507N ICD200N
Mitsubishi	MELCOM 7500 7700 MELCOM- COSMO700 COSMO900 COSMO700II COSMO700S	MELCOM 3100 10 3100-20 3100-30 3100-40 9100-30F MELCOM- COSMO500	MELCOM 88 80/31 MELCOM- COSMO300	MELCOM 83 84 86 80/11	MELCOM 70	MELCOM 350-5F 350-7 350-30F
Oki Electric	OKITAC- COSMO700	OKITAC 7000 6000 OKITAC- COSMO500	OKIMINITAC 710 OKITAC- COSMO300	OKIMINITAC 500 610 system 9	OKITAC 4400	OKITAC 4300C 4300E 4300S 4500C
(Oki Univac)	OUK 9700 9700I 9700II 90/600 90/700 90/800	OUK 9200II 9250 9300 9300II 9350 9400 90/300	OUK 9200 1004			

Source: Japan Fact Book, Dempa Publications, Tokyo, 1980

FIGURE J-3

Capital tie-up configuration of Japan's computer manufacturers

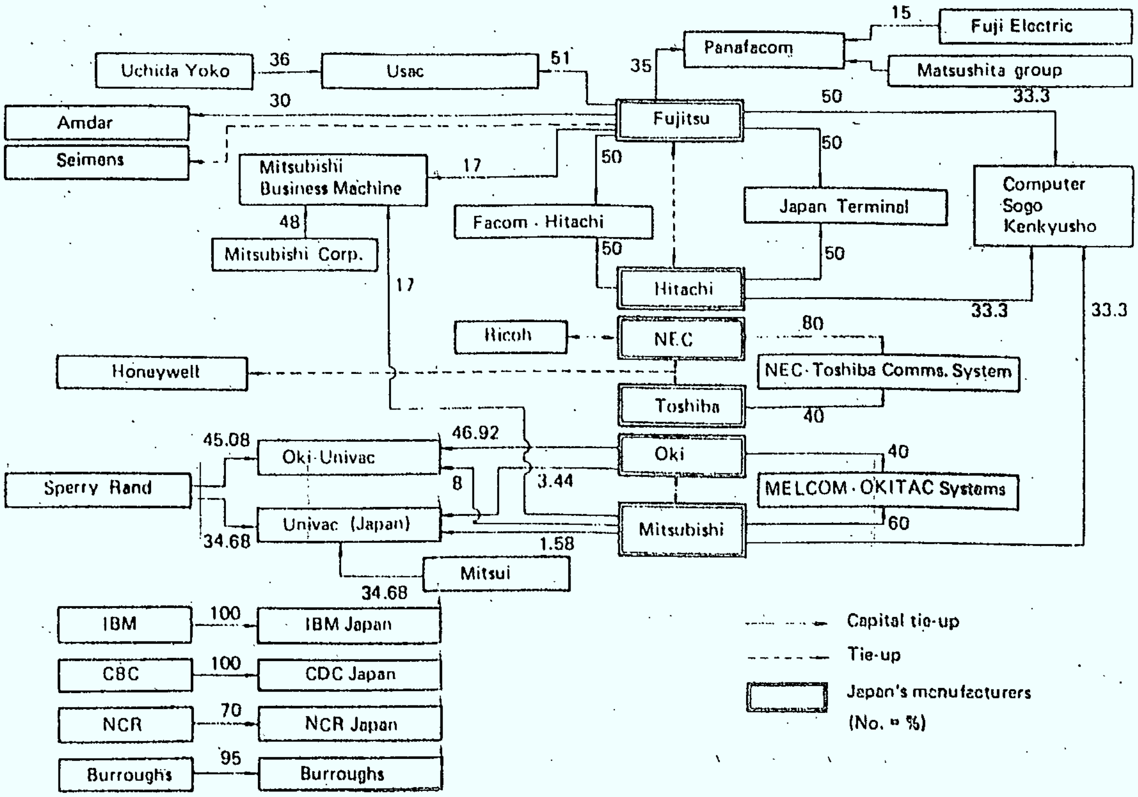


TABLE J-6

Major Japanese computer mfrs' sales trends in 1978 (Value: million ( ): compared with term before (%))

		Fujitsu	NEC	Oki Electric	Hitachi	Mitsubishi	Toshiba	IBM of Japan	Univac of Japan
1977	Gross sales	387,420	538,535	127,784	1,388,570	792,179	1,060,946	293,841	67,782
		(18.1)	(10.8)	(1.9)	(7.2)	(13.8)	(10.0)	(6.7)	(△ 4.0)
	Sales of Computer	274.497	137,551	44,423	160,000	38,000	59,100	293,841	67,782
	Dept.	(14.6)	(20.7)	(△ 8.0)	(12.7)	(18.8)	***		
	Share of total (%)	70.8	25.6	35.0	11.5	4.8	5.6	100	100
1978	Gross sales	440,921	615,440	136,685	1,509,445	934,700	1,240,023	315,343	71,622
		(13.8)	(14.3)	(7.0)	(8.7)	(18.0)	(17.0)	(7.3)	(5.7)
	Sales of Computer	302,991	166,851	47,873	190,000	45,000	43,000	315,343	71,622
	Dept.	(10.4)	(21.3)	(7.8)	(18.8)	(18.4)	(△27.2)		
	Share of total (%)	68.7	27.1	35.0	12.6	4.8	3.5	100	100
1979 Expectation	Gross sales	490,000	690,000	155,000	1,585,000	1,200,000	1,300,000	347,000	72,500
		(11.1)	(12.1)	(13.0)	(5.0)	(9.0)	(4.8)	(10.0)	(1.2)
	Sales of Computer	343,000	191,000	57,400	220,000	53,000	50,000	347,000	72,500
	Dept.	(13.2)	(14.0)	(20.0)	(15.8)	(17.8)	(16.3)		
	Share of total (%)	70.0	27.7	37.0	13.9	4.2	3.8	100	100

TABLE J-7

Market share of major computer companies in Japan

Company	Share of Japanese computer market	Ratio of computer production to company's total production
	(percentage)	
Fujitsu	19.0	73
Oki	4.0	39
NEC	11.0	23
Hitachi	14.0	11
Toshiba	4.5	6
Mitsubishi	2.5	5
Others	1.5	-
	56.5	

Fujitsu is special, even in the Japanese context. It is the national policy company, Type 6 in the classification of MITI, and designed as a "national champion company".

Small Business Computers

Small business computers - called office computers in Japan - made their debut after 1960, several years after the largest mainframes. They kept expanding during the 1960s at the same rate as medium and large models. However, in the 1970s the rate outstripped that of the larger systems (Fig. J-4).

There are many more manufacturers in the office computer field than there are in mainframes. In addition to the six major producers, other manufacturers of business equipment, industrial equipment, precision instruments and portable calculators have entered commercial production of business computers in the past several years. In total, some 50 manufacturers are in the race. Small business computers are used as stand alone units, or more and more as pre-processing terminals of distributed information processing systems.

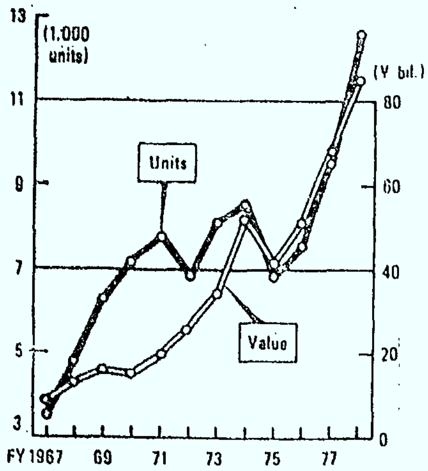
To conclude, in the minicomputer market Japan is fast closing its two-year lag with the United States. It is estimated that by 1980 both markets will be about equal.

Microcomputers

Common use of minicomputers began about 1969. Ever since the Japan Minicomputers Co. was established as the first special minicomputer maker in May 1971, the minicomputer industry has been looked upon as independent.

FIGURE J-4

OFFICE COMPUTERS IN OPERATION



As Fig. J-5 shows, the market for microcomputers has expanded considerably in recent years.

Since 1977 one-chip microcomputers have been introduced into virtually all mass-produced machines, transforming anything from servicing machines to elevators to tractors into "smart" products. As Table J-8 shows, even a partial list of applications is impressive. To illustrate the sweep of the "chip wave", consider the concrete product applications introduced in Japan in 1978, listed in the Tables J-9a to 9g. Now in 1980 microprocessors have been incorporated into so many consumer and other products that products without microprocessors are considered obsolete.

The outlook for the next five years is even more dramatic as Figs. J-6 and J-7 show. It is expected that sooner or later the microprocessing market will outstrip that of minicomputers.

Peripherals

So far peripherals and terminal units have been considered only as auxiliary equipment of actual processors, but technological progress rapidly changes their role to intelligent points of entry to the system. Sophisticated and low-cost production technology of microcomputers is having a considerable impact on the configuration of computer systems. Control and operation processes, previously performed by CPUs, are now being partially taken over by microcomputers. This trend has been observed not only in large-capacity computers but also in small business computers. An example of the trend is the application of microcomputers in magnetic disk drives, CRT displays and other terminals. In this way, the performance of peripherals has been improved, while the work load of the CPU is relieved, and over all system throughput is improved. Studies are now

FIGURE J-5

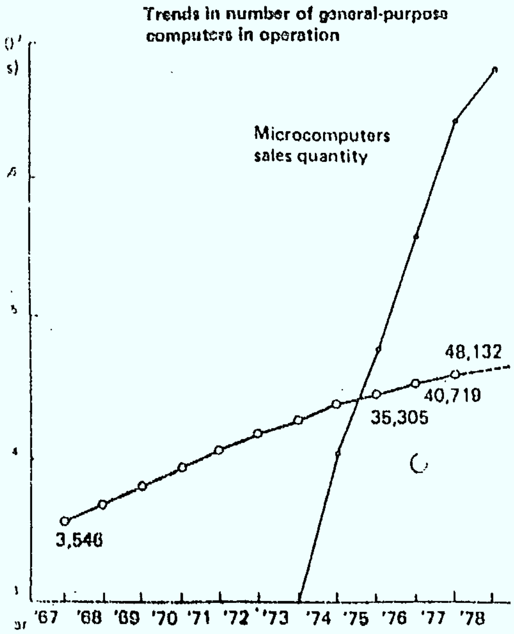

Trends in number of general-purpose computers in operation
Microcomputers sales quantity
48,132
40,719
35,305
3,546
'67 '68 '69 '70 '71 '72 '73 '74 '75 '76 '77 '78

TABLE J-8 Microcomputer applications in existing products

Kind of product:	Functions performed by microcomputers
Microwave ovens	Setting of cooking time; setting of heating temperature; setting and display of cooking temperature; clock display; setting of cooking sequence, including defreezing, keeping dishes warm; conversion of °C and °F, timer; chime; alarm
Refrigerators	Setting and display of temperature; automatic defrosting; alarm for open doors; kitchen timer
Room air conditioners	Setting and display of temperature and humidity; automatic switchover of fan speed (wind velocity); automatic switchover of fan outside room; prevention of restart for 3 minutes; 24-hour timer; display of compressor operation; time display
Kerosene stove	Setting and display of temperature; automatic ignition; 24-hour timer; indication of filter exchange; indication of abnormal operation
Washing machines	Setting of washing, rinsing and drying time; setting and display of washing sequence; setting of water flow strength
TV sets	Automatic station selection and memory; program booking and timer; clock display; channel display; remote control; soft touch operation
Auto radios	Automatic station selection and memory; clock display; frequency display; soft touch operation
Cassette decks	Automatic cueing; repeat playing of designated musical numbers; remaining tape, tape counter; 24-hour timer; soft touch mechanism; time display
Open reel tape decks	Automatic program search; tape counter; tape speed deviation display; pitch control display
Turntables	Automatic cueing; selection of musical numbers; programming; automatic play; remote control
Program Timers	1-week timer; station selection; clock display; power supply switching

TABLE J-9

Listing TV models equiped with microcomputers in 1978

Mfr.	Name	Model
itsushita	Remote control for TV	TY-670
.arp	Micon TV	
atsushita	Micon channel selection TV	TH20-B7
oshiba	Color TV	20T70E
tachi	Color TV	C20-668P
nyo	Remote control TV	C-20Z5
oshiba	Color TV	20T72D
ctor	TV with remote control	CX-200
ny	Plus trinitron color TV	KV-2085R
tachi	Video TV	C20-880V
nyo	Color TV	C-26Z5
oshiba	Color TV	20T73F
itsushita	Programmable TV	TH20-B3
nyo	Program reserved TV	CS-1800P
nyo	Picture and picture TV	CZ-2050W
:C	Picture and picture TV	CV-22C96P

Table VTRs equiped with microcomputors

Mfrs.	Name	Model
oshiba	Program reserved micon channel VTR	V-7100
itachi	Video Mastax	VT-5500
atsushita	Programmable 4H VHS VTR	PV-1500

Microcomputers built-in audio products announced in 1978

Mfrs.	Name	Model
Matsushita	Programmable unit	SH-9038P
Sony	Program timer	PT-70
Mitsubishi	Car radio	AR-9060SDB
Sony	Digital radio	ICF-D11
Sony	Digital radio	ICR-D9
Hitachi	FM use synthesizer tuner	FT-8000
Hitachi	Multi-band radio	KH 3800
Sony	Fully automatic Turntables	PS B80
Sharp	Radio-computer	CT-610
Victor	FM stereo tuner	T-M1V
Pioneer	Automated sound correction equipment	

Table Microcomputer built-in cassette decks announced in '78

Mfrs.	Products	Model
Sharp	Cassette deck	RT-3150
Sony	Auto-reverse cassette deck	TC-K96R
Matsushita	Cassette deck	RS-M56
Hitachi	Three head cassette deck	D-5500DD
Sony	Cassette deck	TC-K80
Pioneer	Cassette deck	CT-911
Victor	Cassette deck	KD-A8

Table Microcomputer built-in washing machines announced in '78

Mfrs.	Products	Model
Matsushita	Fully automatic washing machine	NA-890L
Sharp	Fully automatic washing machine	ES-770MC
Hitachi	Fully automatic washing machine	PF-1500
Hitachi	Washer and dryer pair type	PA-650
Mitsubishi	Fully automatic washing machine	AW-300W/G/Y

Table Microcomputer built-in cooking equip. announced in 1978

Mfrs.	Products	Model
Matsushita	Microwave oven	NE-6900
Sharp	Microwave oven	R-9000
Mitsubishi	Microwave oven	ET-700T
Matsushita	Gas cooking equip.	GO-2300
Hitachi	Microwave oven	MR-8000A
Toshiba	Microwave oven	ER-788BT
Mitsubishi	Steam oven	RO-7000
Matsushita	Microwave oven with temperature sensor	NE-7910
Sharp	Microwave oven	R-9750
Mitsubishi	Microwave oven	ET-710C

Table Microcomputer built-in air conditioners announced in 1978

Mfrs.	Products	Model
Hitachi	Room air conditioner	RAS-2204SI
Sharp	Room air conditioner	AH-22E1M
Matsushita	Air conditioner	CS-228BKX
Mitsubishi	Room air conditioner	MS-1807R
Toshiba	Room air conditioner	RAS-225BKR
Sanyo	Air conditioner	SAP-K2291S
General	Room air conditioner	ALS-20KM
NEC	Room air conditioner	RC-ME221K

JAPAN

FIGURE J-6

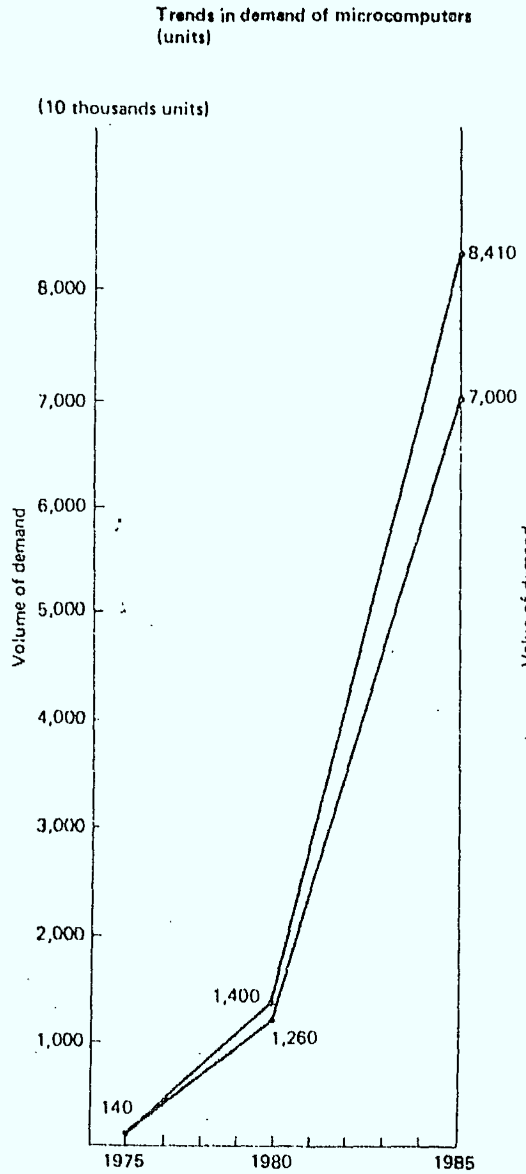
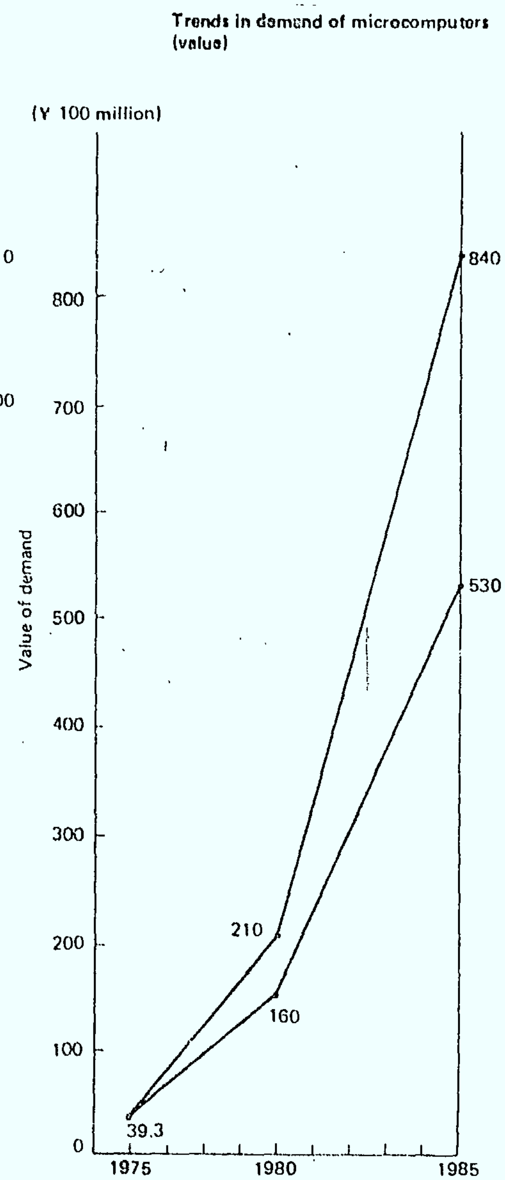


FIGURE J-7



Source: Japan Electronic Industries Promotion Association underway on the application of microcomputers to floppy disks, communication control devices and intelligent printers.

With printers, 8-bit microcomputers are mainly used in serial printers but also in pattern recognition and display devices. However, 8-bit microcomputers are expected to be replaced by 16-bit models in the 1980s. Also, composite peripheral equipment is becoming increasingly intelligent. Voice and graphic input are bound to increase further the Japanese public's acceptance of computers.

3.1.2. SEMICONDUCTOR INDUSTRY

Production

Starting from a far smaller base than its USA counterpart, the Japanese semiconductor industry has rapidly expanded output during the past five years. Data compiled by the Ministry of International Trade and Industry on production for the merchant market as well as for the captive market indicate that semiconductor output (excluding parts) increased from Y347.1 billion ($1.2 billion) in 1974 to Y532.6 billion ($2.5 billion) in 1978. Most of this 53.5% gain occurred in 1976, when shipments rebounded from their 1975 recessionary level, and in 1978, when production rose 11.8% (see Table J-10). With this growth, Japan's semiconductor output edged up from about one-third that of the USA in 1974 to roughly two-fifths in 1978.

Several years ago, USA semiconductor executives were estimating that they were still two years ahead of Japanese technology. By 1978, however, this gap had been closed. At that point, NEC, Mitsubishi Electric, Toshiba and Fujitsu announced a 64K VLSI semiconductor containing some

150,000 transistors as well as other elements. NEC, Mitsubishi Electric and Fujitsu have since announced that they will be using these semiconductors for all their computer lines by 1980.

As far as future plans are concerned, NTT expects to produce a 256K chip before 1980, whereas Sanyo is pouring $50 million into its development for 1982.

Consistent with worldwide trends, stepped up production of integrated circuits has accounted for almost all of the growth in the value of Japanese semiconductor output in recent years. Between 1974 and 1978, for example, the value of IC shipments climbed 124.2% to Y281.4 billion ($1.3 billion) from Y125.5 ($0.4 billion) in response to a 246.1% jump in the number of devices produced (see Table J-11). Although this gain steadily boosted the share of integrated circuits in total output from 36.2% in 1974 to 52.8% last year, ICs continued to play a less important role in the semiconductor product mix in Japan than in the USA.

The expansion of IC output in Japan as in the USA has been spurred by a substantial growth in digital MOS ICs. In just the four years to 1978, Japanese manufacturers boosted their MOS circuit production from 45.6 million units to 250.4 million units. Last year alone output was expanded by 100 million units. So large were these gains that, even with rapidly falling circuit prices, the value of MOS shipments advanced 180.8% to Y131.7 ($0.6 billion). Japanese production of digital bipolar ICs has continued to expand at a relatively slower rate than MOS circuits, increasing 146.5% in value to Y40.9 billion ($0.2 billion).

Linear integrated circuits provide the sharpest contrast between the Japanese and USA industries, both in terms of growth rates and IC product mix. Between 1974 and 1978, Japanese output of linear circuits soared

295.3% to 608.1 million units - a reflection of Japan's position as the world's largest manufacturer of consumer electronics, and the value of shipments climbed 150.3% to Y79.1 billion ($0.4 billion).

In 1979, for the first time, the production value of active components exceeded that of the passive components. The wave of integrated circuits was the most characteristic feature of this year, as can be seen from the 33% growth rate of 1979 of Table J-10. IC production is expected to grow at least 15% in the 1980s. Their exports doubled in 1978.

At Y251.2 billion ($1.2 billion) in 1978, Japan's production of discrete devices was 13.4% greater than in 1974, but it was 6.3% less than the previous year (see Table J-11). This decline, plus the relatively rapid rate at which integrated circuits have already displaced discrete devices suggests that output has peaked, at least in value terms. It is also probable that the 1978 production volume of nearly 10.6 million units represents the industry's maximum output level, even though the number of discrete devices rose steadily in the post-1975 period. Still, the production outlook for specialized discrete devices remains bright since the power and/or frequency requirements of many products preclude the use of integrated circuits at present. Power transistors, thyristors, RF devices, and light emitting diodes are just a few of the discrete devices with favorable growth prospects in Japan.

Domestic Semiconductor Markets

There are several striking differences between semiconductor usage patterns in Japan and in the USA. The most obvious is the virtual lack of any semiconductor consumption by the government in Japan. The relative importance of the consumer goods and computer industries as purchasers of

TABLE J-10

OUTPUT OF MAJOR ELECTRONIC
COMPONENTS IN CALENDAR 1979

	Value (Y million)	Chg. from 1978 (%)
Passive components		
Resistors	135,320	+ 8.0
Capacitors	219,710	+ 8.7
Transformers	165,460	+ 3.0
Audio parts	107,550	+ 4.1
Mechanical parts	254,560	+10.8
Active components		
Electron tubes	282,992	- 2.4
Discrete semiconductors	257,537	+ 2.5
Integrated circuits	373,465	+32.7
Semiconductor ICs	335,350	+33.2
Hybrid ICs	38,115	+28.3

Source: Electronic Industries Association of Japan

TABLE J-11: Portion of Semiconductors in Japan, 1974-1978*

(value in bills of yen; quantity in thousands of units)

	1974	1975	1976	1977	1978
Value					
Discretes					
Transistors	128.2	90.6	140.3	135.0	115.8
Rectifiers	39.0	26.2	45.0	47.2	49.6
Diodes	27.2	20.1	33.6	37.4	33.0
Thyristors	13.6	8.2	13.4	18.7	17.9
Light Emitting Diodes	n.a.	4.3	8.9	11.4	14.2
Other	8.3	9.3	16.0	18.5	20.8
Subtotal	221.6	158.8	275.2	268.1	251.2
Integrated Circuits					
Linear	31.6	27.1	58.9	64.8	79.1
Digital Bipolar	31.4	22.3	31.6	35.5	40.9
Digital MOS	46.9	55.3	85.8	85.0	131.7
Hybrid	15.6	12.9	20.9	23.3	29.7
Subtotal	125.5	117.7	197.1	208.5	281.4
Total Production	347.1	276.4	454.3	476.6	532.6
(in millions of dollars)	($1,190.6)	($931.4)	($1,531.8)	($1,774.9)	($2,530.4)
Quantity					
Discretes					
Transistors	2,966,986	2,238,331	3,996,477	4,238,062	4,077,159
Rectifiers	915,556	609,598	1,196,554	1,313,869	1,620,296
Diodes	1,687,091	1,277,514	2,357,924	3,254,750	3,605,354
Thyristors	35,322	27,998	61,528	104,814	98,070
Light Emitting Diodes	r.a.	58,172	130,208	300,318	494,668
Other	465,970	362,610	666,663	680,623	671,072
Subtotal	6,070,925	4,574,223	8,409,354	9,892,436	10,566,619
Integrated Circuits					
Linear	153,815	153,056	373,047	437,438	608,082
Digital Bipolar	106,096	78,573	120,418	170,648	261,541
Digital MOS	45,598	70,566	131,059	150,385	250,404
Hybrid	34,352	27,432	42,058	44,654	56,125
Subtotal	339,861	329,627	666,582	803,125	1,176,152

*Does not include semiconductor parts.

Source: Japan, Ministry of International Trade and Industry, Kikai Tokei semiconductors in the two countries provides another contrast. The consumer electronics, household appliance, calculator, watch, camera, and other consumer products industries are the major markets for semiconductors in Japan. Manufacturers in these industries are the dominant users of discrete devices, absorbing perhaps as much as half of all output. In addition, they are the largest single market for integrated circuits, accounting for 35.3% of domestic IC sales in 1978, according to the ITC's data. Their market share appears to be edging down, however.

The Japanese computer industry represents a considerably smaller market for integrated circuits than its American counterpart - a reflection of the size difference of the two industries. In 1978, the computer industry bought just 8.8% of the ICs produced in Japan - about $85 million worth, compared with IC purchases of roughly $740 million by the USA computer industry for a 35.5% share. Moreover, the Japanese computer industry's share of integrated circuit sales dropped by almost half during the 1974-78 period, even though the value of its purchases doubled.

Two other end markets that account for a smaller proportion of integrated circuit sales in Japan than in the United States are industrial equipment, with a 1978 share of 4.5%, and communications equipment, with a 5.5% share. In contrast, the automotive industry is a larger market for integrated circuits in Japan than in the United States, both relatively (a 4% share versus a 1.1% share) and absolutely.

Industry Structure

The structure of the Japanese semiconductor industry differs in several fundamental repects from that of its American competitor. Japanese semiconductor production is dominated by five large, vertically integrated, end equipment manufacturers: Nippon Electric Company Ltd. (NEC), Hitachi Ltd., Toshiba Corporation, Matsushita Electronics Corporation (a joint venture between Matsushita Electric Industrial Company Ltd. and Philips of Holland), and Mitsubishi Electric Corporation. These five companies are Japan's largest electrical equipment makers and, with the replacement of Matsushita by Fujitsu Ltd., her only computer mainframe producers. The ITC estimates that they supply about 66% of total Japanese integrated circuit production, and it appears that they account for an equally substantial proportion of the country's output of discrete devices. The next five largest semiconductor manufacturers in Japan - Tokyo Sanyo Electric Company Ltd. (an affiliate of Sanyo Electric Company), Fujitsu Ltd., Sony Corporation, Sharp Corporation, and Oki Electric Industry Company Ltd. - are also vertically integrated, end product firms. Together, they account for another 16% or so of IC output and probably a similar share of discrete production.

There are no major independent semiconductor manufacturers in Japan comparable to Texas Instruments or National Semiconductor Corporation, nor are there any examples of the entrepreneurial start-up type of firm formed during the 1960s in the USA (Intel Corporation or Advanced Micro Devices Inc.). Moreover, none of the 10 large Japanese semiconductor manufacturers is a captive producer in the sense that IBM or Western Electric is. All of them turn out semiconductors for the merchant market as well as for in-house use. NEC, Japan's largest producer, reportedly has the lowest level of internal consumption, while big consumer goods makers like Sanyo and Sony apparently use much of their semi-conductor output in-house. Over all, the ITC data indicate, approximately three-fifths of Japan's domestic integrated circuit sales have been to the merchant market in recent years - a ratio that is probably characteristic of discrete sales as well.

Until recently another striking difference between the Japanese and American semi-conductor industries was that Japanese manufacturers, at least up to now, have built relatively few offshore assembly and testing plants. NEC, for example, had only four overseas production facilities, located in Eire, Malaysia, Brazil, and the USA. Hitachi had factories only in Malaysia and Taiwan and a new assembly plant in the USA; while Toshiba had offshore facilities only in Korea, Malaysia, and Mexico. To give just two examples of how this situation contrasts with that of the USA semiconductor industry, Texas Instruments has plants in 14 countries and National Semiconductor in ten.

Over the past two years, however, Hitachi has established a semiconductor production plant in Dallas, Texas, and in Landshut, Bavaria. Similarly Fujitsu is to open a plant in San Diego. NEC has shocked the USA semiconductor community with its purchase of Electronic Arrays, a California-based company; it has also formed a new wholly-owned subsidiary, NECTRON Inc., based in Santa Clara, California. It expects to sell semiconductors in the North American market to the tune of $5 million in this financial year. In March 1980, Toshiba has become the fourth semiconductor maker to open a plant in the USA. It has recently been announced that Oki will also manufacture semiconductors in Silicon Valley. In April 1979, Shin Etsu Hondokai set up a wholly-owned subsidiary in the United States to manufacture single crystal silicon for semiconductors. Following research carried out in the VLSI project, JEOL has developed machines for the production of VLSI chips, based on an electron beam device capable of drawing the patterns for up to 64K bits. One trend that characterized semiconductor production in Japan as well as in the United States is the movement of new end equipment manufacturers into the field, although their entry is through investment in internal production capabilities rather than through acquisition. Nippondenso Company Ltd. (a Toyota Motor Company Ltd. subsidiary), Nippon Gakki Company Ltd. (Yamaha brand),

and the Seiko group are among the companies already producing semiconductors for in-house use. They will soon be joined by Pioneer Electronic Corporation and by other firms like Ricoh Company Ltd. and Canon Inc. within the next two years.

Trade

As the technological capability of domestic manufacturers has improved during the 1970s Japan has switched from being a net importer of semiconductors to being a net exporter. In 1974, for example, the country posted a deficit of Y31.8 billion ($0.1 billion) in its semiconductor trade; by 1978, it registered a trade surplus of Y19.4 billion (0.1 billion) (see Table J-12). Interestingly, however, Japan ran a deficit in its trade in integrated circuits throughout the 1974-78 period - a situation that has continued this year.

The shift in Japan's semiconductor trade position has been mainly the result of a sizeable boost in overseas sales. Between 1974 and 1978, total Japanese exports of semiconductors climbed 165.1% to Y101.2 ($0.5 billion), and in the first seven months of this year, they jumped by an additional 47% (see Table J-13). Most of this gain, which raised the ratio of exports to domestic production from 11% to 18.9% last year, reflected stepped up shipments of integrated circuits. From 1974's small base of just Y6.7 billion, IC exports soared to Y43 billion in 1978 - a 545% gain. In January-July 79, sales went up another 80.3%. In the process ICs surpassed discrete devices in total export value for the first time. In 1979 even IBM purchased chips from the Japanese for its IBM 4300 model.

Japan's semiconductor imports reveal a less clear-cut trend than do its exports, since foreign purchases have fluctuated considerably in

TABLE J-12: Japan's Apparent Consumption of Semiconductors, 1974-1978

(in millions of yen)

	1974	1975	1976	1977	1978
Exports (f.o.b.)	Y38,161	Y41,794	Y70,038	Y83,185	Y101,169
Imports (c.i.f.)	69,993	54,273	89,450	80,824	81,729
Trade Balance	-31,832	-12,479	-19,412	2,361	19,440
Production	347,070	276,436	454,249	476,578	532,621
Apparent Consumption	378,902	288,915	473,661	474,217	513,181
Total Exports as Percent of Production	11.0%	15.1%	15.4%	17.5%	19.0%
Total Imports as Percent of Apparent Consumption	18.5%	18.8%	18.9%	17.0%	15.9%
Exports to U.S. as Percent of Production	2.2%	4.2%	2.5%	3.7%	4.6%
Imports from U.S. as Percent of Apparent Consumption	10.6%	10.5%	9.6%	9.0%	9.1%
(in millions of dollars)					
Exports (f.o.b.)*	$131	$141	$236	$308	$477
Imports (c.i.f.)**	240	183	301	299	385
Trade Balance	-109	-42	-65	9	92
Production***	1,191	931	1,532	1,775	2,530
Apparent Consumption	1,300	973	1,597	1,766	2,438
Total Exports as Percent of Production	11.0%	15.1%	15.4%	17.4%	18.9%
Total Imports as Percent of Apparent Consumption	18.5%	18.8%	18.8%	16.9%	15.8%
Exports to U.S. as Percent of Production	2.3%	4.2%	2.5%	3.7%	4.5%
Imports from U.S. as Percent of Apparent Consumption	10.6%	10.5%	9.6%	8.9%	9.1%

*The following average annual exchange rates, calculated by the Ministry of Finance, were used to convert the yen export figures: 1974, 291.52; 1975, 296.71; 1976, 296.99; 1977, 270.42; and 1978, 212.18.

**The following average annual exchange rates, calculated by the Ministry of Finance, were used to convert the yen import data: 1974, 291.39; 1975, 296.69; 1976, 297.01; 1977, 270.53; and 1978, 212.17.

***The following average annual exchange rates, which reflect the midpoint rate on the Tokyo spot foreign exchange market, were used to convert the yen production data: 1974, 291.51; 1975, 296.80; 1976, 296.55; 1977, 268.51; and 1978, 210.47

Source: Derived from following tables.

TABLE J-13: Total Japanese Exports of Semiconductors, 1974-1978*

(In millions of yen)

	1974	1975	1976	1977	1978
Finished Discretes					
Transistors	20,120.2	16,647.3	25,348.1	25,237.5	22,746.6
Diodes and Rectifiers	6,446.2	5,342.0	10,296.2	13,905.1	13,033.1
Other	1,683.6	1,794.5	5,556.7	6,819.4	7,535.7
Subtotal	28,250.0	23,783.8	41,201.1	45,962.0	43,315.4
Finished Integrated Circuits	6,672.4	13,497.9	16,805.1	26,795.6	43,036.6
Unfinished Semiconductors					
Discretes	3,238.9	4,512.3	6,113.6	5,541.0	5,632.5
Integrated Circuits			5,918.2	4,886.6	9,184.0
Subtotal	3,238.9	4,512.3	12,031.8	10,427.5	14,816.5
Total Japanese Exports	38,161.3	41,793.9	70,037.9	83,185.1	101,168.5
(In millions of dollars)	($130.9)	($140.9)	($235.8)	($307.6)	($476.8)

*Does not include semiconductor parts, which are combined with parts for electronic tubes in the export data. Data are on a f.o.b. value basis.

Source: Japan, Ministry of Finance, Japan Exports and Imports: Commodity by Country.

recent years (see Table J-12). Data for 1978 and this year suggest, however, that semiconductor imports are on the upturn again. After declining in 1977, semiconductor imports edged up 1.1% in yen terms and 28.9% in dollar terms last year to Y81.7 billion ($0.4 billion), and then jumped 49.1% in yen terms (62.4% in dollar terms) in the first seven months of 1979. Although this expansion reflected a strong rebound in purchases of integrated circuits, which account for two-thirds or more of total semiconductor imports, there is no question that Japan's dependence on foreign made semiconductors has declined. In 1974 imports accounted for 18.5% of apparent domestic consumption; last year, they represented 15.9 per cent.

In the near future there will be a need to take another look at the traditional classification system. There is a trend towards developing a product incorporating the functions of multiple products into one unit. There has been an emergence of such products as optical fibre and liquid crystals which, coming with the development of optoelectronics, defy efforts of conventional classification.

3.1.3. COMPUTER SOFTWARE

In software Japan is not regarded as equal to the United States. Purchases of ICL software from the UK should help to bridge the software gap, which is considered to be the weakest part of the Japanese computer industry. A large software technology project, Joint Systems Development Co., was set up in 1977. MITI is helping in this area by allowing tax benefits for general purpose software. The major software houses are NEC, Hitachi and Facom. Aggressive forays into software are expected by Fujitsu and Hitachi. Early in 1979 seven computer companies (Fujitsu, Hitachi, Mitsubishi Electric, NEC, Toshiba, NTIS and CDL) started a joint five-year project for software development. The project will be partially government funded, and costs are estimated at the $250 and $350 million level. MITI will provide support of $8.5 million in 1979. Total government support is 50 per cent.

In applications software, the Japanese have achieved admirable results. Today they are probably the world's leader in electronic funds transfer and in on-line banking. The reservations system of the Japanese National Railways is second to none.

Japan is already a fledgling computer software exporter to the Southeast Asian market. The first Japanese software company, DPC, opened its office in California in 1979. Other examples of software exports are Hitachi Software Engineering sales of its language programs for automated control of a chemical plant in the UK (ICI Ltd.) by the Japanese Scientific Engineers Inc.

3.1.4. DATA PROCESSING AND INFORMATION SERVICES

Japan's data processing industry has grown at an annual rate of over 30% for these several years, and it is considered as one of the country's most promising industries with sales running to Y400 billion a year. About 1,300 companies with a total work force of 70,000 share the market (Table J-14). Although this is still a small industry by USA standards, it is expected to maintain an annual growth rate of about 30% and is rapidly reaching the technical level of its United States counterpart.

The mainstay of business lies in processing scientific and engineering data and development of software under contracts with clients. Reports from leading members of the industry indicate that software development is becoming more and more important in sales.

TABLE J-14

SCALE OF DATA PROCESSING INDUSTRY

	Number of firms	Work-force	Yearly sales (Y million)
1974	1,065	58,723	245,263
1975	1,015	57,164	275,090
1976	1,010	59,025	306,966
1977	1,309	71,641	412,580

DEMAND FOR DATA PROCESSING
TECHNICIANS
(In 1,000 persons)

	1972	1985 (est.)	Average yearly growth rate (%)
Systems Engineers	19.6	120.4	15.0
Programmers	43.5	154.8	10.3
Operators	21.6	80.1	10.6

Time-sharing services are experiencing an influx of foreign capital. CDC and Tymshare, in particular, are trying to catch up with the three companies already functioning in Japan: NTT, IBM and ISI.

In data services, Nihon Keizai Shimbun has started the largest Japanese economic databank, NEEDS. Maruzen is offering Lockheed's Dialog and the Predicasts Inc. Prompt Literature searches. The Japan Information Centre of Science and Technology is offering on-line searches of Japanese literature, and ISI is available through Dentsu.

3.1.5. TELECOMMUNICATIONS

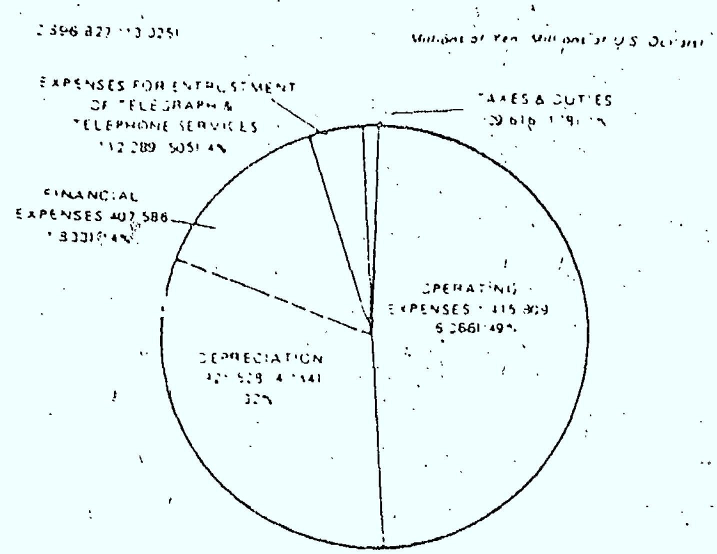
NTT and its "Family"

The Nippon Telegraph and Telephone Corporation (NTT) is the only company in Japan empowered to approve the use in Japan of communications equipment supplied by any company - Japanese or foreign. As the primary developer, operator, and regulator of the Japanese communications system, NTT in effect has absolute control of the Japanese communications market. The applicable requirements and procedures to be followed for sales of equipment to either the direct procurement (exchange and transmission segments) or interconnect (terminal segment) market are essentially identical for products manufactured inside and outside Japan.

Japan has repeatedly, in the MTN and elsewhere, argued that NTT is not a government agency on the basis that NTT is not subject to the recently negotiated MTN government procurement code. However, the facts indicate that NTT is in effect a government agency. NTT was founded in 1952 with government money as a public corporation to handle domestic communications. NTT's operating expenses and revenues for 1977 are shown in Figs. J-8 and J-9. Its budget is reviewed annually by the Japanese Diet

FIGURE J-8

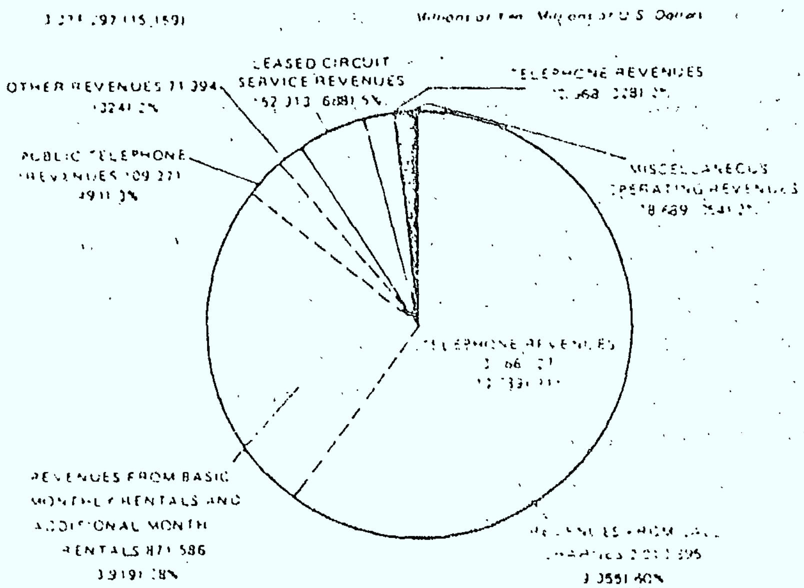
NTT'S TOTAL OPERATING EXPENSES (FISCAL 1977)



Source: Annual Report 1977/78; Nippon Telegraph and Telephone Public Corporation.

FIGURE J-9

NTT'S TOTAL OPERATING REVENUES (FISCAL 1977)



Source: Annual Report 1977/78 Nippon Telegraph and Telephone Public Corporation.

which also approves the appointment of its directors. The public Telephone Communications Law provides for the creation of NTT, while its operations are regulated by the Nippon Telegraph and Telephone Public Corporation Law.

What is commonly referred to as NTT's family consists of its four major suppliers: Nippon Electric, Oki, Fujitsu and Hitachi, and some 200 smaller subcontractors. A variety of telecommunications, technology, and service related research and development projects are being conducted to provide improved telecommunications in Japan. This R&D, especially in the telephone exchange and transmission markets, is carried on with close technical coordination - in the words of one Japanese official, "a joint effort" - between NTT and its family.

NTT obtains virtually all of its equipment for the exchange and transmission markets from one or several of its four family members, with a negligible amount from one of the 200 other "designated" suppliers. Roughly 96% of NTT's procurement is on a negotiated basis, largely from NTT family members. The remaining 4% is on the basis of tenders from "designated" suppliers with only 0.4% of these tenders being awarded to foreign suppliers. Table J-15 shows a breakdown of consumption of telecommunications equipment in Japan by type of equipment and by sector. As indicated, the public sector accounts for over one-half of consumption of telecommunications equipment, with NTT alone accounting for 44% of total consumption in 1977. The private sector and exports each account for about a quarter of total consumption. Figure J-10 describes the relationships of the NTT System. NTT and its family supply virtually the entire interconnect market.

TABLE J-15

Consumption of Telecommunications Equipment in Japan 1972-77

(millions of yen)

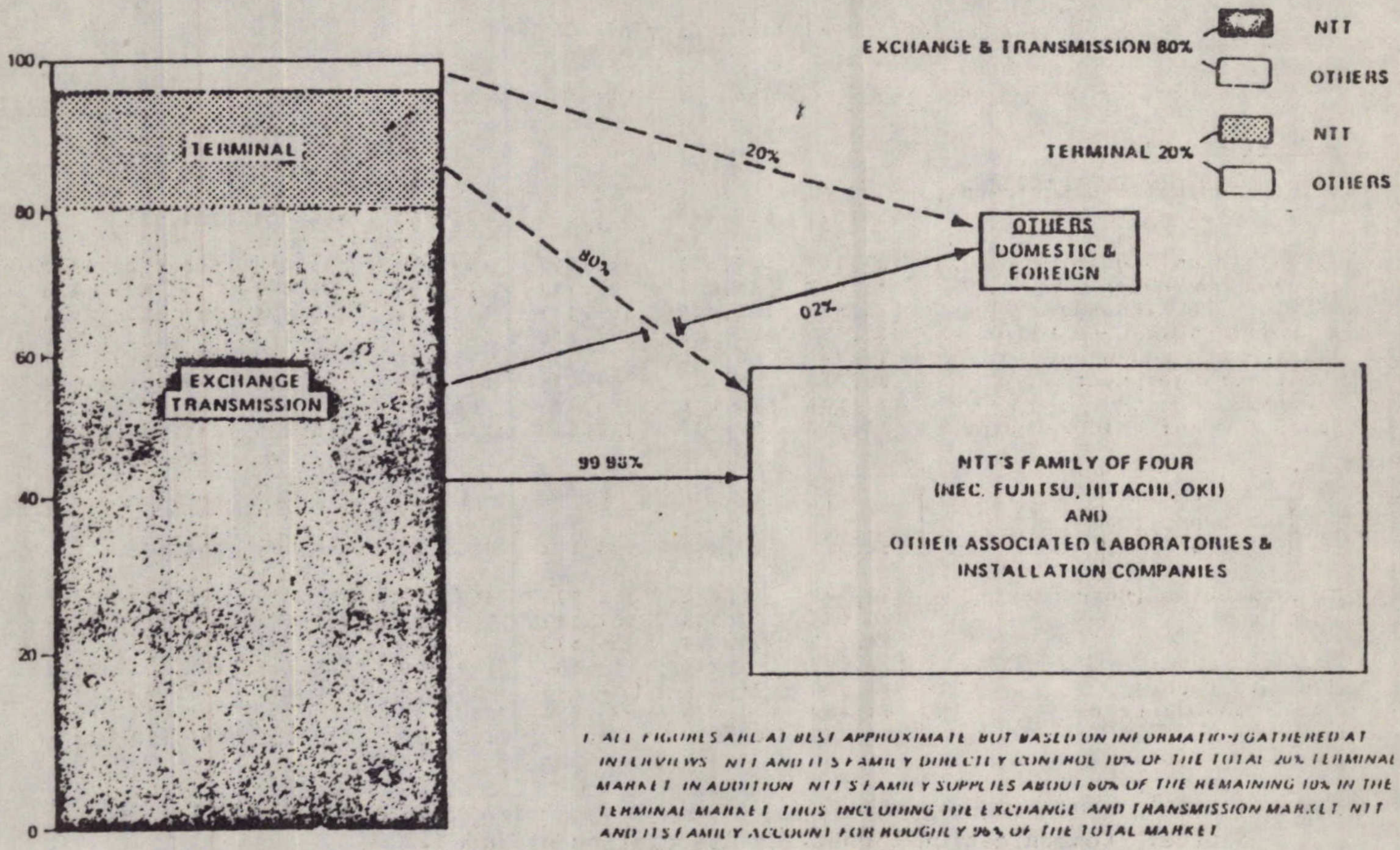
	1972	1973	1974	1975	1976	1977	1977 % of Total
Type of Equipment							
Telecommunications Equipment, Total	554,521	617,449	595,102	621,763	586,304	704,538	
Wire Telecom. Equip.	467,169	524,532	484,557	489,500	471,054	568,890	80.7
Telephone Equip.	41,957	44,011	35,787	31,569	31,948	30,583	4.3
Telephone Exchange	175,530	185,930	169,471	183,616	175,922	207,452	29.4
Applied Telephone Equip.	32,730	52,998	47,928	47,009	50,223	64,352	9.1
Telegraph Equipment	59,741	66,535	73,338	55,586	38,222	47,091	6.7
Carrier Equipment	85,710	95,422	94,638	107,235	105,990	139,591	19.8
Parts	71,501	79,616	63,395	64,485	68,990	79,821	11.3
Radio Communications Equip.	77,352	92,917	110,545	132,263	115,250	135,648	19.3
Sector							
Total Consumption (See Line 1 Above)	554,521	617,449	595,102	621,763	586,304	704,538	
Public Sector (Government)	350,770	361,452	358,126	353,268	300,353	370,574	52.5
NTT	306,535	307,858	301,549	303,530	259,492	310,611	44.0
Other	44,235	53,594	56,577	48,738	30,861	59,963	8.4
Private Sector	132,542	175,344	148,503	139,960	146,745	167,154	23.0
Manufacturers	43,970	71,344	54,645	59,321	66,149	77,080	10.9
Non-Manufacturers	88,482	103,675	93,858	80,639	80,596	90,074	12.7
Exports	61,299	80,653	88,473	129,535	139,206	166,810	25.6

Source: Communication Industries Association of Japan.

Note: Figures do not in all cases add. Cited as in source.

FIGURE J-10

MARKET SHARE AND SUPPLY SYSTEM IN JAPANESE TELECOMMUNICATIONS MARKET



Source: Compiled by the U.S. General Accounting Office (GAO) from interviews with us and Japanese Telecommunication Industry Representative and others.

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Size of the telecommunications market

The total telecommunications market including both NTT direct procurement and the peripheral market was estimated at close to $4 billion in 1977. The US Department of Commerce does not expect the market to expand rapidly over the next two years. It forecasts an average annual growth of about 5.3% per year, which would mean that the Japanese telecommunications market could reach $5.1 billion by 1982. This anticipated growth is largely expected to be supported by advances in facsimile and fiber optics equipment and by anticipated increases in the number of telephones in private automobiles and other vehicles. Another area of growth potential is in digital switching equipment which will modernize Japan's communication network.

In 1977 imports accounted for only about 2.7% of the market. Sales by foreign companies to the telecommunications market are essentially limited to specialized equipment and it is anticipated that domestic suppliers will continue to maintain a strong market position in the next several years.

Fig. J-11 shows Japan's imports and exports of telecommunications equipment. As indicated, Japan's surplus in trade with the world in telecommunications equipment approached $2.2 million in 1978. Fig. J-14 shows the source and market for Japan's imports and exports. The USA is the primary supplier in the import market accounting for a 53% share of the $14.7 million import market; and it receives about 7% of Japan's exports of $23.5 million. Japan is a leading exporter to the North American market.

Data Communications Services

NTT acts as a common carrier in supplying data communication services in Japan. Initiated in 1964, following the adoption of seat reservation systems by the Japanese National Railway (JNR) and Japan Air Lines (JAL), the data transmission system has grown rapidly since 1971. Since 1965, despite strict regulation of computer centre hookups with subscriber terminals over NTT's communication network, data communications grew very rapidly as shown in Fig. J-12. The ratio of computers utilized in telecommunications systems to the total number of computer systems in Japan reached 4.9% by March 1975. Fig. J-13 explains the types of activities and transactions which are effectively conducted by data transmission systems.

Commercial data transmission by private companies was initiated by a USA firm in Japan in 1972 and by a Japanese firm in the same year. In 1976, 29 companies were offering these services in Japan (See Fig. J-14.). At present these firms are offering services such as transmission of stock information, commercial analysis, management computation, program development and statistical and analytical services for small and medium sized companies.

Data Communications Networks

NTT's New Data Network Service is a digital switched system. The circuit switching service has been offered from March 1979 in Tokyo, Osaka, Nagoya and Yokohama and the packet switching service DX-2 from June 1979 in Tokyo, Osaka, Nagoya, Yokohama, Fukuoka, Sendai and Sapporo. Work on an experimental version, DDX-2, has been in progress since 1972. The

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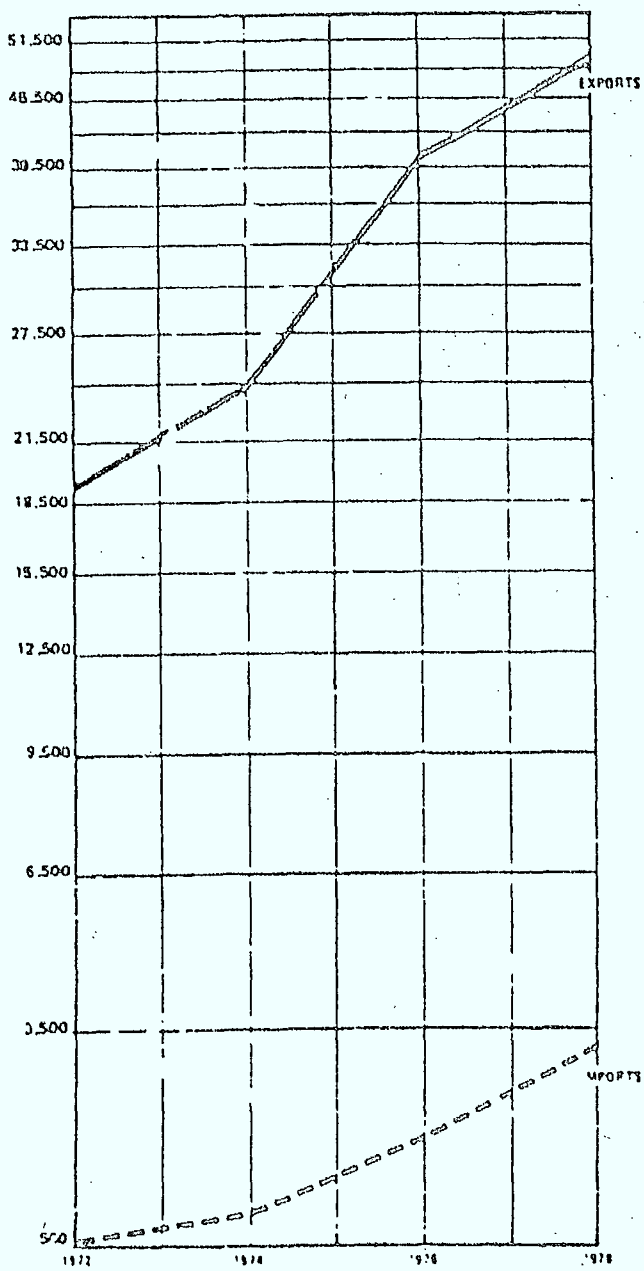
FIGURE J-11

JAPANESE IMPORTS AND EXPORTS OF TELECOMMUNICATIONS EQUIPMENT 1972 - 1978 (YEN - MILLIONS)



Source: Japan Exports and Imports,
Japan Tariff Assoc.

FIGURE J-12

GROWTH OF DATA COMMUNICATIONS SYSTEMS 1965-1977

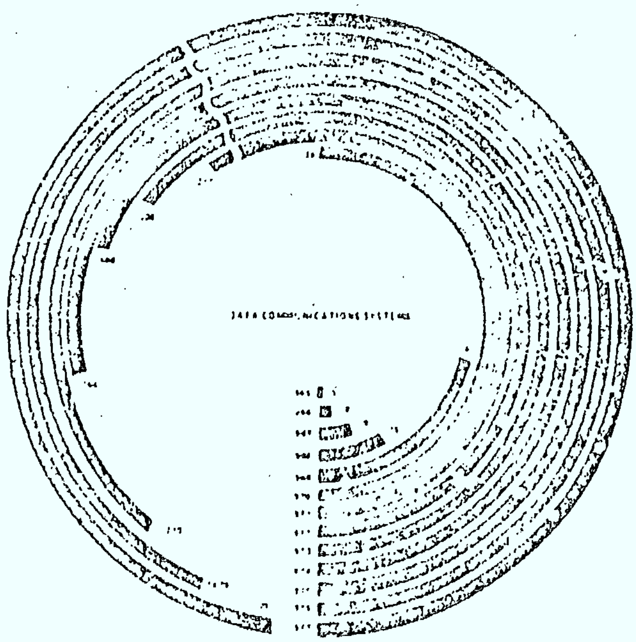
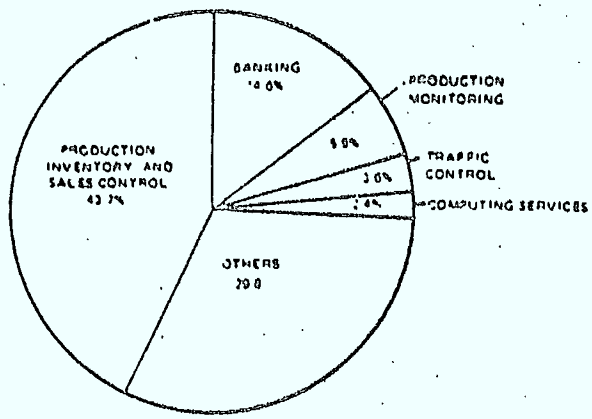


FIGURE J-13

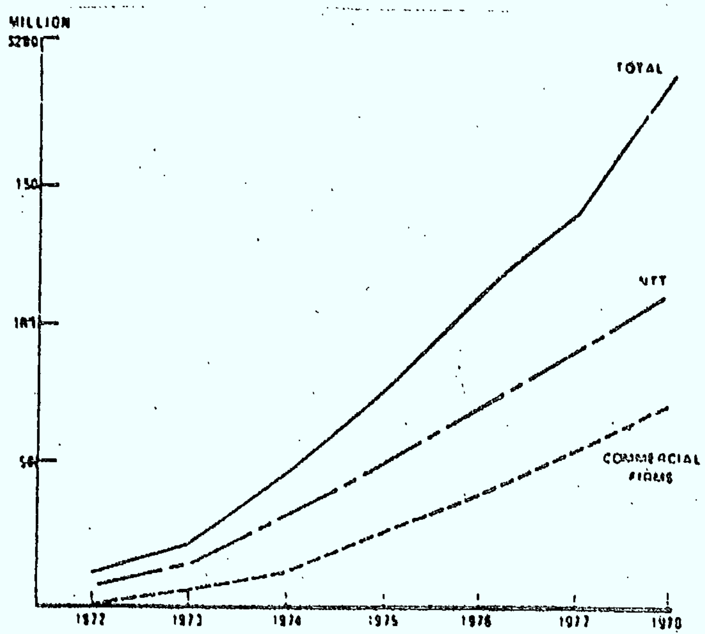
DATA COMMUNICATIONS MARKET BY APPLICATION
(AS OF MARCH 1977)



Source: EDP in Japan 1976, Japan Electronics
Computer Co. Ltd.

FIGURE J-14

DATA COMMUNICATIONS MARKET AND SUPPLIES



DX-2 network is based on CCITT Recommendations for virtual circuit operation. Particular attention was paid to the design of the Packet Assembler and Disassembler (PAD) which is required to connect terminals having no packet handling capability. A number of terminals are connected via a character multiplexer to a PAD which, in turn, is connected via a high speed link to a packet switch. The logical interface between the terminals and the PADs accomodates a wide variety of terminals and control procedures.

At present KDD is moving ahead with its International Subscribers Data Service, as part of its VENUS project, to meet the future demand for data communications. Packet switching technology is used to construct an international digital data network, setting up various services and integrating them into the packet network, making possible the linking of computers and high-speed fax terminals in different countries.

Serious work has been started on computer networking. Fibre optics, for instance, is being considered for computer link-ups. Nippon Telegraph and Telephone Public Corporation has decided to begin tests of an optical fibre communication link between Tokyo and Yokohama. Elsewhere, Sumitomo Electric Industries Ltd. has succeeded in combining an optical fibre with an electric power cable, thereby achieving a significant cost reduction.

In January 1979, Oki exported its first fibre optics system to India's Telecommunications Research Centre in Poona. Since then, optical fibre communication systems, based on the so-called MRT process, have been exported to Taiwan, Australia and to Disneyworld in Orlando, Florida. A new data communications network, DDX, with a supercapacity MMS memory storage (equivalent to a 36-page daily newspaper running for 200 years) has been developed by NTT to compete with the IBM 3850. It has a capacity of between 35 to 472 gigabytes of information. MITI is known to be financing work on laser communication of computer data.

By far the largest system of data communications has been developed by the general trading organizations - Sogoshosha - transmitting data anywhere in the world in less than five minutes.

3.1.6. FACSIMILE INDUSTRY

Capability

Emphasis on facsimile (FAX) as a medium of graphic communication was helped, in no small way, by the ideographic nature of the Japanese language. Its growth is shown in Table J-16 and Fig. J-15 and J-16, and both wire and wireless technology can be used for transmission of information by facsimile. Since the opening of telephone lines, telephone based FAX systems have increased rapidly. The already mentioned DDX network of NTT is expected to play an important role in the growth of FAX.

Among the most important private FAX systems are those of the police, The National Railways system, the Tama system, and the wireless systems of the Sogoshosha, the newspapers, fishing combines and the banks.

Recently, specialized FAX exchange systems have been installed in government offices and industrial corporations. Some of these have an efficient and economical storage function:

1. Mitsubishi Heavy Industries system (FAMSS)
2. Bridgestone system (FAXLINE)
3. Administrative information system (AICON)

TABLE J-16: Facsimile equipment output value and quantity.

Year	Quantity (unit)		Value (Y million)	
		Growth rate (%)		Growth rate (%)
1973	18,016	85	6,977	38
1974	29,855	66	23,348	77
1975	19,492	35	12,150	-2
1976	23,374	20	23,389	93
1977	31,400	34	32,336	38
1978	53,417	70	44,874	39

Source: MITI

FIGURE J-15

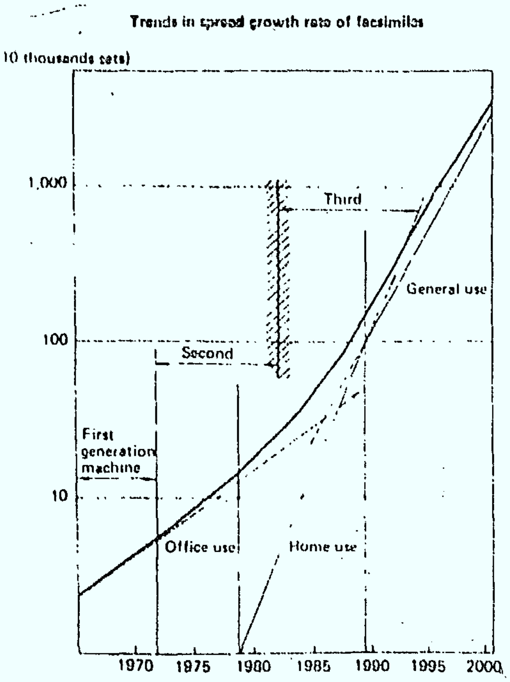

Trends in spread growth rate of facsimiles
(10 thousands sets)
1,000
100
10
Third
Second
First generation machine
General use
Office use
Home use
1970
1975
1980
1985
1990
1995
2000

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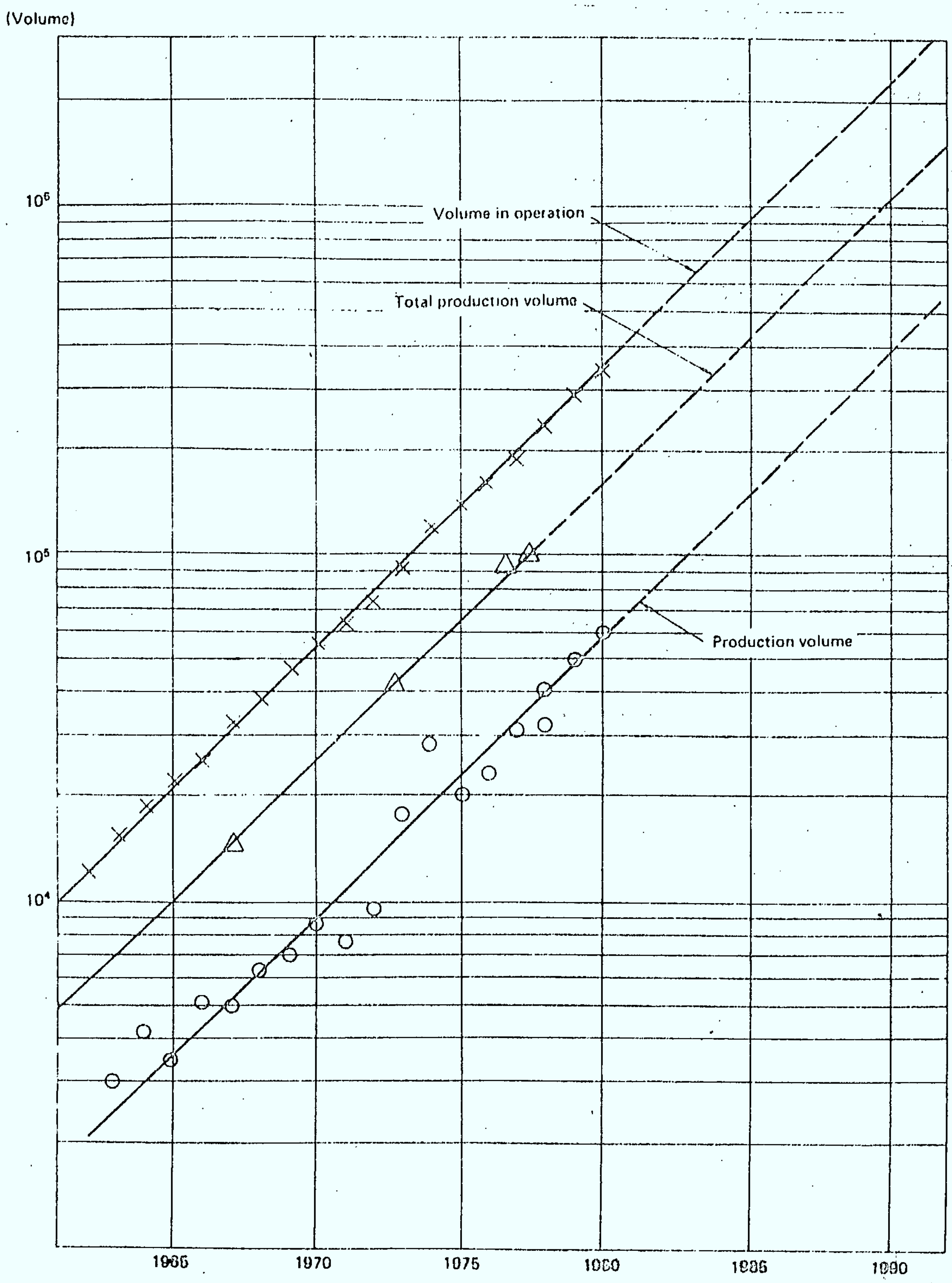
FIGURE J-16

Trend in production, operation of facsimiles



Source: Japan Fact Book '80.

4. Justice Ministry system (FESS)
5. Nikko Securities Co.'s facsimile system (APEX51)
6. Toshiba Corp.'s intra-enterprise system (FESS)
7. Kawasaki Heavy Industries's system (FEDEX70)
8. Teijin's system (FEDEX70)
9. Industrial Bank of Japan's intra-enterprise international facsimile system (HI-PANET).

Before 1973 some facsimile systems were in use within individual companies or agencies. From the opening of the telephone links facsimile communication between companies and agencies expanded quickly with some 150,000-160,000 units in operation by 1980. Table J-17, provides the list of the leading manufacturers.

Toshiba Corp., Hitachi Ltd., Nippon Electric Co., Matsushita Graphic Communications Systems and Ricoh have now mastered the Read system of low-cost, high-speed facsimile communication. Matsushita Electric has just announced its high-speed data entry for transmission by this mode (Odefas System). Hitachi Central Research Laboratory has developed an optical memory disc which performs the same function as microfilm. Being electrical, however, the system is much easier to connect to both communication networks and computers.

NTT began telephone facsimile to ordinary subscribers in 1973 and now offers two types of service, Telephone Fax 40 (6 min/4 min. systems) and Telephone Fax 20 (3 min/2 min systems) with about 14,000 subscribers by March 1979. These systems are provided as accessory equipment to telephones and are available on a rental basis. Facsimile transmission is achieved between subscribers through telephone switchover to a facsimile system. Also during 1979 NTT began Telephone Fax 10, a high-speed system.

TABLE J-17

Japanese Facsimile Equipment Manufacturers

Anntsu Electric Co. Ltd.	Japan Radio Co. Ltd.
Murata Data Equp. Corp.	Oki Electric Ind. Co. Ltd.
Fujitsu Ltd.	Ricoh Co. Ltd.
Fuji-Xerox Corp.	Sanyo Electric Co. Ltd.
Hitachi Co. Ltd.	Sharp Corporation
Casio Computer Co. Ltd.	Tamura Electric Works Co. Ltd.
Matsushita Electric Ind. Co. Ltd.	Toshiba Corporation
Matsushita Graphic Communication	Yamura Shinki Seisakusho
Mitsubishi Electric Co. Ltd.	Canon Inc.
Nippon Electric Co. Ltd.	Iwatsu Electric Co. Ltd.

NTT is also developing a multiple facsimile communication device to be used together with the Telephone Fax 20 to meet a growing demand for the transmission of the same document to two or more receivers.

Because of demand from the ordinary public (apart from business), NTT is developing a Public Facsimile Communication System and is producing lightweight, compact and highly reliable system prototypes. The combination of facsimile systems and computers as outlined will greatly expand the demand for facsimile systems over the next five years. Over a longer range, in the coming information society, it is expected that information networks will be formed and expanded through combining computers and facsimile communication in order to allow the public to obtain social and personal information efficiently in an integrated way.

In this information society, facsimile systems will play a major information transmission role, not only for business but also for other organizations and homes.

Exports

Exports of FAX equipment are increasing year after year. In 1978 the growth rate of exports was 90%, about half going to North America and about 40% to Western Europe.

Overseas demand was stimulated by CCITT standardization of specifications in anticipation of the emergence of international facsimile networks and Kokusai Denshin Denwa (KDD) began international service in 1979.

3.1.7. DOMESTIC COMMUNICATIONS SATELLITES IN JAPAN

For many years Japan has pursued an independent space policy which has led to the establishment of a National Space Development Agency (NASDA) and a very strong space telecommunications industry. She has launched, on her own, 17 satellites in the last decade including three geosynchronous experimental communications satellites and one experimental broadcast satellite. These communication satellites plus the 11 that are expected to follow between 1980 and 1984 provide Japan with superior data communications facilities.

Table J-18 summarizes the present extent of space satellite capability of Japan. The government's 1980 expenditure on satellites is expected to be Y90 billion ($450 million).

Last but not least, Nippon Electric Company has become the world's largest supplier of INTELSAT earth stations.

3.1.8. SYSTEM SERVICES

Videotex

During the early 1970s experiments with Videotex were begun in the new town of Tama, north of Tokyo. The CCIS project was sponsored mainly by the Ministry of Posts and Telecommunications.

The Tama experiment served as a stepping stone to the Hi-Ovis system, also based on cable TV. The district of Higashi-Ikoma in the Napa Prefecture was chosen for field trials of this interactive system in 1978. The name of the system is derived from Higashi-Ikoma Optical Visual Information Systems with 158 homes and 15 public places connected. The project

Table J-18: JAPAN - DOMESTIC COMMUNICATIONS SATELLITE SYSTEMS

SATELLITE	LAUNCH DATE	OPERATED BY	MISSION
ETS-II	February, '77	NASDA/RRL	Engineering test satellite intended to test geosynchronous operations.
CS	December, '77	NASDA/RRL	Domestic medium capacity communications satellite for experimental purposes.
BSE	April, '78	NASDA/RRL	Domestic medium-scale broadcasting satellite for experimental purposes (TV and radio.).
ECS	February, '79	NASDA/RRL	Domestic communications satellite for experimental purposes.

Footnote:

NASDA = National Space Development Agency

RRL = Radio Research Laboratories.

has been a collaborative effort of Sumitomo Electric (optical fibres), Fujitsu (computers) and Matsushita (audio visual technology). Sponsored by MITI because of its interest in the manufacturing potential of the new system, it is the world's first system to use fibre optics. The goal is to produce a nation-wide Videotex System by 1985.

The CAPTAIN System is an interactive Videotex system, developed jointly by the Ministry of Posts and Telecommunications and NTT (support by NTT - $10 million) with transmission via the public telephone network. It differs from all other Videotex systems in that it uses pattern, rather than code, transmission. In 1979, 160 information providers formed an association and the CAPTAIN system will be experimentally tested between 1980 and 1982. Tests will include 1,000 participants and 100,000 pages of information.

Besides the CAPTAIN System, the TELETEXT system developed by NHK and other broadcasting companies is available. It is designed to be compatible with CAPTAIN.

Lastly, NTT developed the Video Response System (VRS) capable of transmitting moving pictures, still pictures, and voice over wideband telephone cable. VRS is expected to form the basis of the next generation of Videotex.

Electronic Mail

Electronic mail is following the rapid developments in the facsimile industry described above. The arrival of the small size for home use is expected to provide further impetus to the system that by 1978 linked over 22,000 postal branches throughout Japan.

EFTS

In the on-line banking area, including electronics funds transfer (EFTS), the Japanese lead the world.

The data communications network supporting Japan's banking system, began operation in 1973. ZENGIN was an early on-line system providing service to some 90 banks, each with numerous branches - 7,200 in total. Any branch could communicate with any other in the on-line system, believed to be the largest in the world. In 1979 the Tokyo Bankers Association and NTT replaced the ZENGIN system with one which covers all 705 banks and all of their branches. In the next couple of years fully automated unstaffed branches will be added.

Office Automation

The largest firm in the office automation industry, Ricoh Co., is a pioneer in this equipment and these services. In 1972 Ricoh was the first Japanese company to develop a word processor for a European language and several years later the first company to develop a Japanese language word processor. By 1980 the company claims to have developed an integrated office automation system that includes word processing, reproduction, information storage and retrieval, as well as communications.

3.2. NATIONAL POLICIES

3.2.1 NATIONAL GOALS

For the last 100 years Japan has struggled to catch up with the West in achieving a level comparable to other industrial societies; today the goal has been achieved. A new national goal has now emerged: "Dai-ichi" to become Number One. At present Japan is formulating how to lead the world into the 21st century.

The new civilization envisaged in these formulations should be based on knowledge and technology; it will certainly be an information society. A transformation "upmarket" to the higher value-added (knowledge intensive) production should liberate Japan from her permanent weak points of lack of natural resources and energy.

Besides the prosperity of the population, another Japanese long term policy objective often cited is in national security, understood to include economic security as well. The development of innovative and original technology is to be promoted to help Japan to stabilize foundations of so broadly stated security. These public policy objectives are often developed further to promote:

- self-sufficiency or assurance of safe supplies of resources and energy;
- favourable balance of payments;
- full employment;
- technological sovereignty.

3.2.2 INDUSTRIAL AND TECHNOLOGICAL STRATEGY

Japan's computer strategy can be understood only as the linchpin of its present wider industrial strategy. The basic philosophy of Japanese industrial strategy, as implemented by the complex formed by the government, banks, traders and big business groups, is to rely on its human resources which, if used imaginatively, will offset the lack of industrial resources. Flexible thought and action is to be helped by Japan's unique problem solving capability. This industrial strategy has been formulated in a number of documents among which the key ones seem to be:

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1963 "The Industrial Structure in Japan" (ISC)
1969 "Japanese Economy 1975" (JERC)
1971 "The Vision of MITI Policies for 1970s "(ISC)
1974 "Vision" (MITI)
1974 "Japanese Economy 1985" (JERC)
1974 "Outlook" (Economic Council)
1975 "Outlook" (JERC)
1976 "Long Term Path" (Kojima)
1977 "Essay Two" (Keindanren)
1979 "Twenty First Century" (NIRA)
1980 "The Vision of MITI Policies in 1980s" (ISC)

Industrial and Technology Policy: Historical Analysis

The Japanese approach is believed by many to stem from an original balance of payments problem. The approach used the mechanism of financial controls for instruments of an industrial and technological strategy, with technological independence as the final objective. The goal of industrial nationalism was reached by the twin policies of foreign investment restrictions and control of imported goods. The goal of technological sovereignty was reached by similar tools: regulation of technological imports to increase the industry's technological level and to increase indigenous technological production.

The outstanding characteristic of the Japanese technological strategy is that it constitutes a deliberate effort for technological development. Probably no western country has launched as comprehensive an undertaking, tackling all constituent elements: the external flow of technology, the balance of foreign technology and indigenous technology, the process of internal production of technology, and the increase in the pace of industrialization. The Japanese technological strategy constitutes a technological development strategy.

The essence of the Japanese economic policy was the organization of a controlled, competitive system using protectionist mechanisms and competitive measures. This subtle balance of control and promotion was modulated to reach industrial development and trade goals, as well as technological development objectives.

The Japanese scheme is very interesting since it dramatizes the value of protectionist measures, and the control and regulation of external flow, as instruments for progressive industrial and technology strategies. It also shows the limitations of using these measures as ends in themselves and not as part of a strategy. If we analyse in greater detail the controlled competitive system in Japan we can identify other elements of interest. All of them are part of a strategy that controls and funnels competition among industrial firms so as to increase their technological competitiveness and promote their utilization of imported technology.

The control of imported technology was achieved through the following steps:

- First, the spreading of imported technology to various local firms was ensured. This created competitive pressures to improve the imported technology.

- Second, through market-sharing quotas, competition was organized between foreign technology and indigenous technology, to promote the utilization of indigenous technology and to test its competitive strength.

- Third, by opening the technology package to incorporate indigeous technology, the basic technology was purchased from abroad and the peripheral technology was generated locally. The improvements reached through better auxiliary technology tended also to increase competition among Japanese firms buying the same basic technology. Three paths are opened: modifying foreign technology by improving it, establishing new technology on its merits, or preparing a new package.

- Fourth, the concerted action by government and importing firms amounted in effect to the creation of a technology imports cartel controlled by the government ("Japan Incorporated").

The essence of the Japanese technological development strategy was the regulation of the flow of technology transfer in order to orientate and stimulate the internal production of technology (R&D and indigenous industry). In other words, the strategy was to control trade in order to promote and protect the infant technology developed locally. The liberalization of goods and technological imports was done gradually to promote industrial technological development and competitiveness. The key element was the progressive path to liberalization, not continued protectionism.

Japan organized a process of technological development and reached increasing levels of technology capability using a strategy based on importing technology. We call this a process of technological development in reverse; technological development does not follow the internal, research-based, supply-push approach, but is based on external inputs. The direct, open approach is too costly and too slow unless autarchic formulae, even slower and more costly, are chosen. In an interconnected world, when the starting point is relatively low, international trade of technology constitutes a formidable obstacle to development of an indigenous technology capability. Consequently, some kind of "reverse" model, with regulation and control of the external flow, seems inescapable.

But how can this be done? In a balanced move, the Japanese strategy moved from the earlier, more interventionist, phase (government laboratories as direct intermediaries in the process of importation of technology) to a more liberalized approach (regulatory action by government through MITI). The Japanese model moved away from the route of socialist countries where public laboratories act as full intermediaries, towards the route of liberal countries with direct contacts between firms. But the regulatory function always remained in government hands. The function of regulation was undertaken with the clear-cut objectives of industrial and technological nationalization, through a collective mechanism of shared decision making.

The decision making process organized by MITI involved technical subcommittees with the participation of MITI's own staff, as well as representatives from the largest national laboratories, business associations, consultants, technical specialists from universities and industry, and officers from the firms involved. Among the latter, special attention was given to representatives from the producers of the product (who tend to prefer imported technology with no risks involved), consumers of the product (who tend to prefer import of the product for commercial reasons), service industries (manufacturers of the necessary equipment because they prefer indigenous technology), and from the national S&T system (who tend to promote the utilization or development of industrial technology). The different groups, by combining several opposing objectives, provide the final outcome; an exercise of balance of power in collective decision making to reach a final consensus.

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It is noteworthy that the most important instrument favouring national technology (the improvement of imported technology and the creation of domestic technology) is controlled competition through market sharing - balancing the market between a few firms using alternative foreign technology and others using indigenous technology has brought competitive pressures among them to force improvement and the development of new technology.

The Japanese experience also shows that the direct import of technology at the level of the firm must be improved by a government regulatory mechanism. It should include specifically the public S&T system in order to initiate the technological development process.

Industrial and Technology Policy: Some Strong Points

Ignoring for the moment weaknesses of Japanese industry, some of the following characteristics more than others have contributed to the present Japanese industrial strength:

1) Industry management
2) Financial management
3) Government/industry relations
4) Dynamics of growth
5) Business strategies
6) Design and engineering capabilities

Industry Management

The dual sector economy continues to characterize to a significant degree the Japanese economy, having a high-volume, capital-intensive sector on one side, but still a widespread network of small factories that are able to supply components and parts, and able to maintain a balance in terms of labour force utilization on the other. In terms of flexibility - the ability to re-tool and to maintain a network of widely diversified component and parts manufacture - the Japanese seem to have a fair edge on anyone else.

A second observation is the flexible factory manning structure, with a high ratio of technical to factory personnel. The Japanese are able to bring technical capability and precision to production engineering, reflecting on unit cost and on "zero defect" quality control that no other country has in its industrial operations.

A third observation is that the labour absorptive capacity of a high growth economy allows for greater automation.

Finally, the rotation of assignments for managers and technicians is an important part of maintaining dynamic, progressive, constant product engineering. Industrial management books used to talk about the continuing articulation between the market demand and the redesigning and reproduction engineering of products. The Japanese have brought this to a very high pitch. This has something to do with the way they manage their managers and technicians. Managers are technicians, constantly thinking about a small innovative change and extremely responsive to it.

Financial Management

In the financial category a very important part is the willingness of banks and stockholders to wait out the long term return. Banking systems and stockholders support a long term profit prospective in Japan and private growth capital from banks is a chief source of funding. The tax structure encourages long term R&D investments. There is a high selectivity on the part of people who control investment capital in Japan to favour investments in what is considered the long term areas.

Government-Industry Relations

The basic feature of Japan is the mutual supportiveness between government and industry. Granted, the efforts of the Japanese government to establish administrative guidelines and directives sometimes work very effectively, but other times certainly fall short of the mark. While in steel and shipbuilding they have been more effective, in the automotive industry the Japanese government has tried for years to consolidate, merge, and so forth, but the industry itself has not wanted to and Japanese policies to this end have not been effective.

Even in Japan, one has some breakdown of this supportive and consensus relationship. But, on balance, it is very important that in Japan industry and government have a sense of a common cause. "Export or Die" is a very real thing. Japan seems to have a co-operative mode without needing a war. Business and industry have a common cause and the sense that, as old Ben Franklin put it about the American Revolution: "We must all hang together, or assuredly we shall all hang separately."

The Japanese do support growth industries. They have determined that in such areas as aircraft and, particularly, computers, the government role is predominant. It is concerned with the vitality of industry and, for the foreseeable future, this is the great strength of the Japanese.

Dynamics of Growth

The need for high export levels of higher value added products in the Japanese economy contributes to its high growth and productivity, with emphasis on the advancement of technology. One of the dimensions of this dynamics of growth is the position in international world trade. There is a very interesting effect of the changing currencies. The appreciating currency in Japan has put pressure on Japanese exports, which have become much more productive. As the yen has gone up, they have had to absorb price changes in order to remain competitive. In one year, the yen had gone up 22% and they had only raised their prices by 6%. The Japanese thus absorbed 16% in what must have been largely productivity. Thus, the challenge of the price changes beneficially incited industry to become more productive and more proficient.

Business Strategies and Marketing Techniques

The Japanese learned the "learning curve phenomenon" (like so many other things such as quality control) from American advisers like the Boston Consulting Group. They go very quickly for the built-up volume, and move rapidly down the learning curve, therefore achieving unit cost reductions. In many industries the Japanese very ably took over the tail-end of the learning curve, abandoned (prematurely, according to some) by other advanced manufacturers. They used this as a stepping stone to new product development. The newest strategy is not to take over again the tail-end of technology, but to pre-empt the forward edge of new generations of technology.

The Japanese have developed a very detailed and extensive style of operating up and down the product cycle and, as mentioned, evolved the state of the art manufacturing know-how from less sophisticated products.

The challenges of reduced demand for some products have produced cost competiveness through redesigning, retooling and above all automating. The new cost effectiveness is accompanied by zero defect quality control.

The aggressiveness in international marketing allows for economies of scale and, in fact, they are interlinked. Japanese high technology industry typically is geared for anywhere up to and beyond 50% export with plants redesigned, re-engineered, and retooled to export at least this level (Honda exports 75% of its product). Part of moving down the learning curve thus means going very aggressively after markets. For the Japanese, aggressiveness in the international arena is now part of their marketing strategy. The flexible approach to retailing in Japan expands their market possibilities.

The Japanese offshore movement has nearly always been to facilitate a counterpart domestic shift into automation. The offshore based manufacturing has nearly always aimed at non-Japanese, not domestic, markets. Even in this area, public interest of constant build-up of technological capability can be traced to government guidance of offshore movement.

Design Engineering Capabilities

As mentioned before, the key feature of design capability is a strong commitment to constantly redesign, re-engineer and upgrade the production process. The stress is on common components between products, and on building into the design an international product versatility. The Japanese have modularized and internationalized design, obtaining great versatility in international markets. To repeat, the common component, the ability to get volume and versatility in market access, is a very important feature of the Japanese design engineering approach.

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Propensity for Risk and Reward Structure

The punishments associated with failure in Japan are shared - employment is guaranteed and consequently the propensity for risk taking is high. The Japanese reward their people according to results. Bonuses often form a half of the income of managers, engineers and workers.

Industrial and Technology Policy: Summary of Present Articulations

At least a part of the explanation of the nature of the competitive thrust is the pre-eminence of technology in Japanese industrial thought.

The long term Japanese technological strategy can be summed up in the term "from imitation to leadership". The imitation stage is well known but the Japanese have done an enormous amount of learning and absorbing. They have used government, state enterprises, government licensing and investment control to acquire technology from foreign sources on terms favourable to their own long term economic development. The Japanese information gathering system has become well known, less well known has been the rapid diffusion of gathered information throughout their home industry.

Another plank in the imitation stage of technology policy has been the heavy use of, and some 0.2% of GNP, devoted to licensing. Consequently, of the 1979 R&D expenditure (2% of GNP) 64% went to development, whereas indigenous research absorbed only 14%, and applied research somewhat more at 21%. Most of the research has been carried on in the private sector, where 70% of all researchers are employed.

The imitation period essentially ended by 1980. It could perhaps best be characterized by the following typical absorbtion process cycle.

1. import technology;
2. imitate technology and improve it;
3. select the weakest point in world market product lines of this technology and start to produce it;
4. protect own fledgling industry until it becomes competitive, i.e. capable of exporting;
5. export to second and third world markets to build up the global market share (GMS);
6. reduce costs, improve quality, enlarge product line;
7. export to the first world from a strong global base;
8. shift to a higher value added innovation and repeat the cycle.

The absorption process cycle has been carefully managed, by visions of MITI, with government intervention definitely bolder than in any English speaking country reviewed.

The technological leadership stage started in late 1970s. In the 1980s Japan intends to develop her own new technologies, with emphasis on energy-related technology and on creative, knowledge-intensive technology. This period is to be characterized by an increased expenditure in R&D. While in 1960 Japan spent 1.3% of its GNP on R&D, by 1980 it is spending close to 2%. Recently, a reversal in flow of licences has been observed. The Japanese now hold the highest percentage of USA patents. With R&D population of nearly 600,000 nominal or 400,000 real, Japan already has 50% more researchers per million of population that the United States. The Japanese university participation rates are comparable to North America, moreover most students have the hard sciences training. With this base the Japanese are achieving some technological firsts - such as a floating pulp and paper plant, artificial coral reefs or artificial blood, to name the few.

And in the future Japan intends to spend even more on research. Although some projections indicating 4.5% of GNP expenditures by 1985 might be judged overly optimistic, a target of 3% by 1990 could be accepted. The share of government R&D should be raised from the present 30%. Large-scale international co-operation in R&D is to be stressed. The first examples are the Five Year Pact on Japanese-American Direct Collaboration in Basic Research of May 1980, the US-Japanese Energy Research and Development of May 1979 or Australian-Japanese Energy Research Cooperation earlier that year.

A Delphi study involving more than 4,000 participants, conducted in 1977 by the Science and Technology Agency in the office of the Prime Minister, concluded that the greatest period of Japanese innovation is to come in the late 1980s.

Industrial and Technological Strategy: Knowledge Intensification of Industry

In 1976 Prof. Kojima coined the term "knowledge intensive industries". The I&T strategy is to move towards those industries. Still rather poorly defined these industries include the four areas:

1. R&D intensive industries:
   computers, aerospace, electrical cars, robots, nuclear power, oceanics, new materials, medical electronics, etc.

2. Sophisticated assembly industries:
   communications, office equipment, process control, pollution control, automatic warehouses, unmanned factories, etc.

3. Fashion industries:
   fashion, furniture, musical instruments, consumer electronics, etc.

4. Knowledge industries:
   information processing, information, educational video, software, systems engineering, consulting, advertising, etc.

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Very much in line with Kojima's thinking, the "Vision of MITI Policies in the 1980s" has identified the following eight industries of the future:

1. Assembly - lineable industries
   - including small business computers
2. Computers
   - including fifth generation computers
3. Tertiary industries
   - e.g. hotels
4. Distribution
5. Fashion and Culture
6. Social systems
   - medical, educational, traffic control, waste management
7. New materials
8. Energy industries

In addition to the selected knowledge intensive industries (c/c, space, oceans) as major industries in Japan, knowledge intensification is to be promoted in all sectors.

1. Energy and Resource industries
   - introduction of large scale computer controls
2. Manufacturing industries
   - computer control of processing
   - flexible automation of assembly
   - systematic vertical integration of generic technologies
3. Services
   - systematization of medical, health, banking and traffic management are some of the highlights of the over all systemization effort.

To this end, Japan is preparing a long term vision for technological development - a technology development plan - and has already selected a set of national projects. Besides the projects dealing with energy, such as ATR and FBR reactions, the four projects directly relevant to our report are: communications, laser beam, VLSI, and space satellites. Finally, the two new MITI target industries for the 1980s are computers and robotics. The Japanese are now clearly ready to run top technology and run with it on their own.

Industrial and Technological Strategy: Institutional Set-up

In this section, we can describe only several key social actors in the formulations of Japanese industrial and technological strategy:

- MITI
- JETRO
- TOKUSHU HOJIN
- MAGNIFICENT SIX

The full list would be extremely long, consequently, only the list of social actors relevant to c/c strategy will be presented in the next section.

MITI

The key institution in the Japanese Industrial and Technology Strategy Formulations is MITI - the Ministry of International Trade and Industry. Born in 1945 from the wartime Ministry of Munitions, it has reached the importance of the Department of Defence in the USA.

MITI manages the Japanese economy, in a fashion similar to the way the National Basketball Association manages the individual clubs, as Ezra

Vogel in his book Japan as Number One observes. Its administrative guidance to individual sectors and industrial groups is more important than either its Industrial Fund (that by 1980 is a relatively small $2 billion) or than is government regulation.

The real planning of Japanese industry is done in MITI, in its Industrial Policy Bureau rather than in the Economic Planning Agency, which is reduced to no more than window dressing. MITI's indicative planning stresses social Darwinism - it supports the strong. While supporting future industries it is merciless in shedding the industries of the past.

MITI directly controls close to thirty public policy companies. Furthermore, it has influence in the Export-Import Bank of Japan and the Japan Development Bank.

JETRO

Formally JETRO is a "tokushu hojin", but in fact it is an operating arm of MITI. Its purpose is two fold; it serves as an export (and now even import) promoter for small and medium enterprise; more importantly it constitutes a world-wide commercial intelligence service. Present in some 50 countries of the world, it is staffed by several hundred, of whom one third are MITI officials.

TOKUSHU HOJIN (PUBLIC POLICY COMPANIES)

To serve as levers for Japanese industrial and technological strategies, Japan now has some 112 entities of several types that can only be called public policy companies. Their budget presents some 40% of government's budget, i.e. 5% of GNP (about $50 billion a year). MITI is guiding close to 30 of these Public Policy Companies.

MAGNIFICENT SIX

The dual structure of the Japanese economy makes MITI's task of focusing on the efficient part of the economy easier. Representing the more efficient portion of the Japanese economy, 185 large and strong companies are aggregated in the Magnificent Six Industrial Groupings. Together, this sextet represents over 25% of the Japanese GNP.

- MITSUBISHI (28 companies)
- MITSUI (23 companies)
- SUMITOMO (21 companies)
- FUJI/FUYO (29 companies)
- DKB (45 companies)
- SANWA (39 companies)

Each group links a group of manufacturing companies with a bank and a trader (sogoshosha). Incidentally, each group has its own computer manufacturer.

3.2.3 COMPUTER/COMMUNICATION STRATEGY

General

Computer/communications are as important for Japanese as the defense industry is for the USA. In all Japanese plans computer/communications technology plays an enormous role. According to Takusai Sakai of MITI, the computer industry should be the principal future foreign exchange earner of Japan. According to W. Givens of Twain Associates (U.S. experts on Japan-U.S. trade and investment matters), computers are Japan's next target industry and will be the key to Japan's economic dominance of the world economy.

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Japan has adopted an approach opposite to that of the United States. Just as the American authorities stress a lack of intervention in the computer/communications industry, the Japanese government strives to co-ordinate and channel action which will promote a powerful national industry. Of all the countries reviewed, Japan provides the most intensive government intervention in the computer/communications industry. The pivotal role here was played by MITI.

MITI's philosophy is best embodied in the two "visions" for the 1970s and 1980s.

1) Report on Measures for the Development of Information Processing and the Information Industry

2) Report on Informatization and Information Industry: Desirable Development and Necessary Measures

Policy measures of MITI for the computer/communications industry may be generally divided into two - direct and indirect. The direct supporting measures are, above all, setting administrative guidance and R&D assistance. The main inhibitory instrument is the protection of the fledgling industry from foreign competition. The indirect measures are equally important. The strongest measure used successfully in Japan is awareness raising. The Computers and Society Week, replicated most recently in France, had its origins in Japan.

Japan has developed several very interesting institutional set-ups worth describing throughout the following historical section of this chapter.

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The following list of social actors indicates the multiplicity of interests in the formulation of computer/communications strategy.

Selected C/C Policy Actors in Japan

Government

- Prime Minister's Office
  Science and Technology Agency
- Ministry of International Trade and Industry (MITI)
  Agency of Industrial Science and Technology
- Ministry of Finance
- Bank of Japan
- Economic Planning Agency
- Economic Council
- Research Development Corporation of Japan
- Ministry of Posts and Telecommunications
- JETRO/JIS Mark
- Industrial Structure Council
  Inf. Industry Committee

Think Tanks

- National Institute for Research Advancement (NIRA)
- Nomura Research Institute
- Mitsubishi Research Institute
- Institute for Future Technology

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Industrial Groups

Mitsubishi Group (28 companies)
- Mitsubishi Electric
- Mitsubishi Bank
- Mitsubishi Corp.

Sumitomo Group (21 companies)
- NEC
- Sumitomo Bank
- Sumitomo Trading Organization

Mitsui Group (23 companies)
- Toshiba
- Mitsui Bank
- Mitsui & Co.

Fuji Group (29 companies)
- Hitachi
- Fuji Bank
- Marubeni Trading

Sanwa Group
- Oki Electric
- Sanwa Bank
- Nissho-Iwai, Nichimen Trading

Dai-Ichi Kangyo Group
- Fujitsu
- Dai-Ichi Kangyo Bank
- Nissho-Iwai, Kanematsu-Gotjo Trading

Banks

- Industrial Bank of Japan
- Long-Term Credit Bank of Japan
- Dai-Ichi Kangyo Bank
- Sanwa Bank
- Fuji Bank
- Mitsui Bank
- Mitsubishi Bank
- Sumitomo Bank

Banks (Cont'd.)

- Tokai Bank
- Daiwa Bank
- Kyowa Bank

Sogoshosha (general trading companies)

- Mitsui
- Mitsubishi
- Sumitomo
- Nissho-Iwai
- Marubeni
- Kanematsu-Gosho
- Nichimen

Public Policy Companies

- Nippon Telegraph and Telephone (NTT)
- International Telegraph and Telephone (KDD)
- Export/Import Bank
- Japan Development Bank
- Japan Information Center for Science and Technology
- Information Technology Promotion Agency (IPA)
- Japan Electronic Computer Company (JECC)

Industry

- Keindanren

C/C Industry

- Japan Telecommunications Industries Federation
- Jeida (computer industry association)
- Japan Computer Usage Development Institute (JACUDI)
- Japan Information Processing Development Center

C/C Industry (Cont'd.)

- VLSI Project: CDL, NTIS
- Joint System Development Corporation (JSD)

Others

- Japan International Technology Association
- Japan Standards Association
- Japan Techno-Economic Society
- The Council for Science and Technology
- Japan Society for the Promotion of Science
- Engineering Advancement Association of Japan

Selected Computer/Communications Companies

Mainframes

Fujitsu (Japan)	IBM (U.S.)	SBCs
Hitachi	Univac	Mitsui
NEC	Burroghs	Toshiba
Mitsubishi	NCR	NEC
	CDC	Matsushita
		Mitsubishi Electric

Calculators

Casio
Sharp
Canon

Communications

NEC
Oki
Fujitsu
KDD

Software

DPC
Intec

KKNK
Nippon Computer System

Software (Cont'd.)

KKE	Nippon Time
Computer Applications	NEC Software
Century Research	NEDC
TDC	Japan Business Automatic
Nomura Computer	Nippon Business Consultants
Facom	Mitsui Knowledge Industry
Melcom-Okitac	Mitsubishi Research Institute

Components (Manufacturers)

NEC	Toshiba
Hitachi	Mitsubishi
Fujitsu	Tokyo Sanyo
Sharp	Oki
Matsushita Electronic	Sanyo
Sony	

Development of Japanese Computer/Communications Strategy

Soon after the development of its first computer, Japan began to implement its strategy to become number one in computer/communications technology.

The Japan Electronic Industry Development Association (JEIDA) was formed in 1958. Among its main tasks was the co-ordination of computer manufacture but, above all, the study of computer/communications technology abroad.

In 1957, the Diet passed the law, Temporary Measures for Promotion of Specified Electronics Industries and Special Mechinery Industries, which prohibited foreign computer firms from establishing subsidiaries in Japan. The first supporting initiatives of the government occurred about 1960 - a decade after the support for the car industry.

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MITI first pressured IBM in 1961 to part with patents on computer technologies and make them available to Japanese firms. MITI then encouraged the competition of selected firms. Seven entrants (later reduced to five, now increased to six) assured competitiveness.

In the 1960s MITI permitted licensing agreements between Japanese and foreign companies. Hitachi, Mitsubishi, Nippon Electric, Oki, and Toshiba licensed second generation computer technology from RCA, TRW, Honeywell, Sperry Rand and GE respectively. Fujitsu was the only Japanese manufacturer allowed to license computer technology from abroad at the time.

MITI also created the Industrial Science and Technology Research Institute that quickly diffused all available know-how free of charge to all the entrants.

In 1961 the government created the Japanese Electronic Computer Company (JECC) to support the acquisition of computers. JECC or Nihon Denshi Keisanki, financed by the Japan Development Bank, purchased computers from Japanese manufacturers and leased them to users. All the users participated by equal share of capital equity. Consequently the stronger users of computers drained the weaker ones. Simultaneously MITI called all leading universities into national service to aid the fledgling Japanese computer industry.

The Ministry of International Trade and Industry has attempted to co-ordinate the development of the local computer industry. The Buy Japanese procurement policy has been the strongest supportive instrument. In addition to providing substantial subsidies for research and development, in 1971 in its Improvement Plan for Computers, it recommended a loose consolidation of the six Japanese computer firms into three government supported producer associations, each specialized in a different portion of the industry.

Thus, the big six manufacturers teamed up: Fujitsu with Hitachi (M-series), Toshiba with NEC (ACOS series), and Mitsubishi with Oki (COSMO). Furthermore, two research cartels have been created, CDL and NTIS. CDL, which links Fujitsu, Hitachi and Mitsubishi, planned to produce by 1980 an IBM compatible VLSI computer, one hundred times more powerful than IBM's workhorse, the IBM 370. By 1981, the project should produce a 1000K memory chip - 60 times larger than the present 16K byte chip. This project has already generated about one hundred patents. The other research cartel, NTIS, comprises Toshiba and NEC. It has original big computers as its objective.

In 1971 the Pattern Information Processing Project (PIPS) was initiated. Pattern Information Processing in Japan means an amalgam of pattern recognition and artificial intelligence. This eight year program was successfully finished as witnessed by the schedule in Fig. J-17.

The pattern information processing system is a new system which enables the direct input of such pattern information as characters, pictures, 3-D objects and speech, and provides such built-in functions as parallel operation, associative information retrieval, inference and learning capability.

Basic and internal studies in the project were conducted by the Electrotechnical Laboratory. Contracts to industries were awarded by the co-operative action of the AIST (Agency of Industrial Science and Technology), and the ETL (Electro-technical Laboratory). Besides these studies,

FIGURE J-17

Schedule for development of PIPS

(Million Yen)

		1971	1972	1973	1974	1975	1976	1977	1978
1. Pattern Recognition Subsystems									
(1) Character Recognition	ETL	29.5	78.3	68.8	67.1	57.9			
	contractors			62.3	118.9	193.8			
(2) Picture Recognition	ETL	23.1	57.7	64.1	40.6	34.3			
	contractors			63.3	99.0	183.4			
(3) 3-D Object Recognition	ETL	13.6	65.0	66.3	57.9	62.7			
	contractors			17.6	46.0	48.2			
(4) Speech Recognition	ETL		51.9	64.1	62.9	84.4			
	contractors			20.0	37.0	98.7			
(5) Common Language and Natural Language Processing	ETL	21.6	80.3	48.8	41.8	32.5			
	contractors								
2. Materials and Devices	ETL		111.6	123.6	105.3	106.6			
	contractors	77.8	270.5	558.8	873.1	1,176.8			
3. Information Processing System	ETL	24.6	323.2	401.1	467.9	492.1			
	contractors				91.9	536.3			
4. Planning and Consolidated System-Prototype	ETL	6.0	14.7	16.7	18.1	62.1			
	contractors					200.4	Prototype System		
Total		196.2	1,053.2	1,575.5	2,127.5	3,370.2			

an important role of the ETL was the co-ordination and technical supervision of the entire project. Participation by university researchers was relatively insignificant. Table J-19 shows the contractors and their research themes.

The cost of the program was $100 billion, provided by the AIST (part of MITI) from the National Research and Development Programs (NRDP).

In the software area, MITI also created the Information Technology Promotion Agency (IPA) in 1970. The primary purpose of this public policy company (type: Gaikaku Dantai - IV) is to develop computer software. In the area of software promotion the government reviewed its 1972 Plan for Improving Computer Use and in March 1976 announced a new Improvement Plan with a target date of March 31, 1980. The new Plan calls for appropriations totalling Y5.47 trillion by the end of fiscal 1980 and will be directed to the development of software production technology, the compilation of a program register, the conducting of qualification tests for information processing technicians, and implementation of financial measures for the promotion of information processing. Aid grants extended to the Information-Technology Promotion Agency came to Y1.16 billion in 1978 (Y1.2 billion in 1977) whereas appropriations for the Program for Developing Software Production Technology amounted to Y1.11 billion in 1978 (Y850 million in 1977). The Agency also received information technology promotion loans of Y8.0 billion in 1978 (Y11.0 billion in 1977).

Recognizing the need to develop large scale LSIs of even greater density and higher speeds, in 1976 the government launched a new program under the name Financial Assistance for Promotion of the Development of Large Scale Integrated Circuits for Use in Next-Generation Electronic Computers.

Table J-19

Contractors and their research themes

R & D Item	Contractor
Pattern Recognition Subsystems	
Character Recognition	Hitachi, Toshiba, Fujitsu
Picture Recognition	Mitsubishi, Toshiba
3-D Object Recognition	Hitachi
Voice Recognition	NEC
Materials, Devices and Subsystems	
Semiconductor Laser	NEC, Toshiba
Bubble Domain Memory	Hitachi, Hitachi Metal NEC, Tohoku Metal
Reversible Photosensitive Material	Fujitsu, Sanyo, Konishiroku
Charge Coupled Device	Fujitsu
Spatial Modulation Device	Hitachi, Matsushita, Hoya Glass
Large Scale Integrated Circuit	Toshiba, Hitachi, NEC
Consolidated System-Prototype	Toshiba, NEC, Fujitsu, Hitachi

Under this program, the government supplies 50% of the R&D funds used by the research association which has been set up by five domestic computer manufacturers. Government appropriations for this program were Y3.5 billion in 1976, Y8.64 billion in 1977 and Y10.05 billion in 1978. Moreover, in order to strengthen the sales potential of the domestic manufacturers the government increased its support by raising the level of loans begun in 1977 from the Japan Development Bank (JDB) to the Japan Electronic Computer Corporation (JECC). It has also augmented previous loan programs of the JDB to the JECC for structural improvements and software development in the industry and to provide rental funds. This program amounted to Y35.5 billion in 1978.

In 1976 MITI formed the Joint System Development Corporation (JSD). The Kyodo System Kaihatsu, capitalized at $10 million, groups 17 software companies and 13 banks to pool their resources for national projects and exports. JSD's first project (1978-1983) aims at automatic programming.

The new focus on software development and the promotion of information systems such as health care networks, visual information systems for home use, energy saving urban systems and trade information systems, was a result of the enactment of the law, Temporary Measures for Promotion of Specified Machinery and Information Industries. The Act and subsequent Improvement Plan provide for financial assistance, tax measures to promote use of the new software, and measures for collaboration and rationalization of firms. A new association, the Computer Basic Technology Technical Association, has just been created to develop basic software and terminals for the next generation of computers.

Early in 1979 seven computer companies (Fujitsu, Hitachi, Mitsubishi Electric, NEC, Toshiba, NTIS and CDL) started a joint five year project for software development. The project is partially government funded and costs are estimated at the $250 to $400 million level. MITI provided direct support of $8.5 million in 1979. The government also helps by purchases of software technology from ICL and other software leaders. In 1977 MITI formulated the Standard on Electronic Computer System Security Countermeasures and provided funds for implementing security measures through loans by the Small Enterprise Finance, a public policy company.

The Ministry of International Trade and Industry began work in 1979 on the indigenous fifth generation computer. As mentioned, this model represents a basic departure from conventional computers - it will be the so-called "non-von Neumann" type, based heavily on artificial intelligence (AI) research. This project, headed by Professor Tatsu Motooka of the University of Tokyo, is the beginning of a ten-year national research program. The Computer Basic Technology Technical Association (CBTTA) was set up to guide it.

In the information systems area the Ministry of International Trade and Industry gave Y192 million in 1978 (Y440 million in 1977) as assistance toward the development of a comprehensive medical information system, Y39 million in 1978 (Y439 million in 1977) toward the development of an international trade information system and Y2.5 billion in 1978 (Y2.92 billion in 1977) toward the development of a pattern information processing system.

In the computer training area, information processing technician qualification tests are now conducted under the aegis of the Information Technology Promotion Agency.

Telecommunications Policies

In telecommunications the EC policy was guided by a series of NTT five year plans. The current sixth plan has focussed on electronic switching and home facsimile.

The partial revision, in 1971, of Japan's Public Electric Communications Law allowed communications circuits to be used to a certain extent by third parties. It also became possible at that time, in principle, to interconnect electronic equipment, including computers and terminal devices, with the communications circuits.

Buy Japanese government procurement policies are applied to all telecommunications equipment purchased by NTT. The company also has sole responsibility for the procurement of equipment for the exchange and transmission segments of the market (direct procurement market). The terminal segment - the interconnect or peripheral market - is theoretically open to more direct competition.

NTT's definitions of the direct and interconnect markets, however, are substantially different from the Canadian definition. In NTT's view any piece of equipment which connects or plugs into NTT transmission lines is within the central communications system and thus subject to NTT regulation.

While the interconnect market was open to the point where, in theory, anyone may supply equipment either directly to NTT or to end-user, in practice, according to an informed Japanese business official, supplying this market is at best difficult because of complex procedural problems.

NTT also has a primary instrument requirement which essentially requires that in every installation at least one piece of equipment must be NTT equipment to maintain the integrity of the total system. Furthermore, subscriber equipment must be installed by NTT licensed installation companies which also maintain the equipment. On the basis of these definitions it could be argued that there is no interconnect line in Japan. Major equipment procurements are made mainly through contracts which, in many cases, call for NTT and the manufacturers to jointly develop equipment and communications systems.

There is no normal procedure for becoming one of the NTT designated suppliers, and it is NTT's stated policy not to add any companies, domestic or foreign, to the list. The customary advice to most foreign manufacturers attempting to market equipment in Japan is to suggest that the manufacturer select a Japanese licensee to produce the equipment in Japan, thereby ensuring that the equipment will meet NTT standards.

NTT subsidizes a large proportion of the family's R&D. Allegedly, over 2% of their profit is expended on R&D conducted by family members, but this is not documented. One closely related program is the $150 million plan for NTT to develop and produce new telecommunications devices based on VLSI components. In parallel with the technical effort aimed at the production of VLSI circuits, the existing Computer Structure Improvement Financing Fund set up in 1972 will be used increasingly to reinforce the marketing capabilities of the Japanese telecommunications equipment manufacturers.

Finally, satellite technology has become one of the national projets of Japan. The government's space development budget for 1980 is expected to be Y90 billion ($450 million).

3.2.4 KEY SUPPORTIVE AND INHIBITIVE INSTRUMENTS

Besides strong administrative guidelines, the two key supportive instruments are government procurement policy and financial subsidization of the industry.

Needless to say the national and local government offices in Japan use computers on a very extensive scale, in number of installations and in the value of the equipment in use. A look at the state of general purpose computer operation in government by the end of June 1977 shows that the value of computer systems used by the national government was Y101.3 billion, that of systems used by government related organizations was Y219.8 billion and that of systems used by local governments was Y56.1 billion. In total, this amounts to Y377.2 billion and accounts for 14.7% of all operating systems in Japan. This large share accounted for by government systems is by no means surprising in light of government promotion of the computer industry.

As far as financial support of the industry is concerned the 1978 Computer White Paper states that under the 1971 law government subsidies between 1971 and 1977 amounted to $450 million. Total government subsidy for computers between 1972 and 1980 is estimated by ACT New York to be between $0.8-1.0 billion. The peak yearly subsidy was $100 million in 1974. This amount, matched yen for yen by the manufacturers, indicates R&D expenditure for this period between $1.6 and $2.0 billion.

These funds were dedicated to
38% VLSI
24% new computers
15% pattern recognition

13% data communications

10% others (I/O, software, traffic control, etc.)

A number of projects are designed to promote computerization of small business. The computer rentals of small companies are partially subsidized by prefectual governments via local chambers of commerce.

As the Japanese industry gained strength, the government gradually liberalized its tariff barriers in six stages to reach a complete liberalization by 1976. At present the duties on computers are 10.5% and for peripherals 22.5%. As a result of the GATT negotiations they will be lowered over eight years to 4.9% for computers and 6.0% for peripherals. However, the non-tariff barriers are being erected as fast, if not faster, than tariff reductions.

The most prominent NTBs are Buy Japanese policy for NTT, the distribution system, and the language barrier, where the capability to process Japanese language was so far mastered only by IBM Japan and Burroughs. Other skilfully used NTBs are the Japanese specifications and performance requirements, qualification tests for certain computer engineers, or on-site inspections by NTT personnel.

Other policy instruments used include tax incentives and financing by government affiliated banks, but these are of relatively small importance. Limitations on the market share of IBM Japan and other foreign manufacturers is still in force.

Gulliver and Clever Lilliputian Contrasted

"Government of Japan welcomes activities of IBM, Gulliver in the computer world, so far as it makes wise use of its dominant position to co-prosper with a cleverer and more diligent part of Lilliputians", stated Mr. Norihiko Maeda, chief architect of the Japanese computer/communications policy during the Informatique et Societé in Paris in September 1979.

However, Japanese policies are slanted very heavily against foreign owned subsidiaries. For example, IBM Japan is forced to manufacture its most advanced products in Japan, is excluded from government procurement, has a restricted market share (29% in 1977), must licence its technology to its Japanese competitors, and is morally induced toward Japanese language processing.

This treatment could be contrasted with the preference for the chosen company - the national champion - Fujitsu. Fujitsu is always the first to obtain government subsidies, a leader in computer/communications sales to the government, and promoted to be a global actor.

3.2.4. CURRENT POLICY THRUSTS AND OUTLOOK

As a result of her far-sighted, sustained and consistent policies, Japan has today become number two in global computer/communications technology. In 20 years Japan has closed a 10-year gap with the USA and is now well poised to challenge the present number one. So far it has succeeded in matching each IBM challenge.

By 1978 the computer industry had become internationalized. The computer exporters seemed to follow the strategy described above; global market share is the name of the game. Exports to second and third world countries preceded exports to the first world. It is reported that $40 million was allocated for training of computer salesmen. Over the last two years the big six computer manufacturers were seen to be building a world base for their global operations. To this end global alliances, some only temporary, had to be built. Fujitsu gained footholds in Australia (Facom Australia), Brazil (Facom do Brasil/Edisa), Spain (Facom Espana), Korea (Facom Korea), Phillipines (Facom Phillipines), Canada (Consolidated Computer Canada), Bermuda (Amdahl International), West Germany (Siemens link), and finally, the USA (Amdahl, and most recently TRW).

The Fujitsu-Amdahl relationship has been increasingly uneasy. After the recent merger of Amdahl with Storage Technology Corporation in April 1980 Fujitsu might now be tempted to sell its share of its resources out of Amdahl. After seven years of negotiations Fujitsu arranged in May 1980 a $100 million joint venture with TRW (Fujitsu, 51%; TRW, 49%) to market its small and medium sized computers. But the venture could expand to mainframe computers if the pull-out from Amdahl takes place.

In one bold action Fujitsu gained not only the distribution network but also a fair application software production capability. The new company is to have sales between $500 million and $1 billion by 1990 according to Sidney Webb, TRW-Fujitsu president.

Hitachi is teaming up with Italian Olivetti and British ICL in Europe and with Tonoyano in Korea. Hitachi also pins big hopes on the Chinese market where it has achieved significant sales since 1979. In North America Hitachi has traded its tie-in with Intel for a new link with National Semiconductor, marketing under the National Advanced Systems flag (AS/3000, AS/5000, AS/7000). By 1982 Hitachi will sell under its own brand name, Hitac.

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NEC is linking with Honeywell and with the French CII-HB. By 1982, NEC will go it alone. In the USA so far NEC goes it alone, building up its own distributions network.

Mitsubishi Electric is also not a joiner, its Melcom Business Systems will market the company's SBCs, so far without any USA partner. It has so far been less than succesful.

Finally, to sum up, the Japanese have set themselves the goal to become a major world force in computer/communications technology. They have developed a splendid policy package to achieve this. Today they seem to be in a position to invade the North American market. We are to be presented with the NAGANO CHALLENGE - Japanese computers entering our lives en masse.

JAPAN

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CHAPTER 4

UNITED KINGDOM

4.1 TECHNOLOGICAL CAPABILITY

4.1.1 COMPUTER HARDWARE

The United Kingdom's presence in the computer field starts with the very beginnings of electronic computers. Wartime experience in pulsed circuits and radar naturally led to research in electronic computers and by the late 40s a team led by F.C. Williams at Manchester University produced a successful cathode ray tube store, a vital component in putting together an electronic digital machine. Research at Cambridge University and the National Physical Laboratories, Teddington, kept pace with the earliest developments in the United States and this was soon followed by parallel work in UK industry. Table UK-1 shows some milestones in computer developments. Notable are:

- the early and continuing collaboration between Ferranti and Manchester University;
- the beginning of programming with EDSAC in 1949;
- the entry of various companies including Lyons (LEO), English Electric (DEUCE), Elliot Bros., EMI, British Tabulating Machines, GEC, etc.;
- the technical innovations (multiprogramming and virtual memory) introduced in the Ferranti Atlas operating system
- a steady increase in the number of computers installed in the UK, with the machines quickly becoming absorbed by government, universities, and industry at a rate that was surpassed only in the USA.
- an early recognition of the importance to the computer industry of semiconductors and microelectronics, accompanied by efforts to assure British capability in producing these components. By 1980 £10.1 million had been spent in support of various programs, including:

TABLE UK-1 - COMPUTER MILESTONES in the UK

1946	William's Tube Memory, Manchester University
1949	EDSAC, Cambridge Univeristy (M.V. Wilkes) ACE, National Physical Laboratory (A.M. Turing)
1951	MK 1, Ferranti delivered to Manchester University LEO, Lyon's Tea Co.
1952	MK1, Ferranti delivered to University of Toronto DEUCE, English Electric Elliot Bros.
1956	Metropolitan Vickers MU 950 First Transistorized Computer
1962	Ferranti - ATLAS — Multiprogrammed Virtual Memory FP 6000 — From Ferranti Packard (Canada) Advanced Computer Technology Project
1965	Computer Advisory Office Central Computer Agency (Gov't Procurement)
1968	Formation of ICL - Gov't participation
1974	2/3 of Gov't computers from UK suppliers
1979	Announced intention to reduce direct support of computer industry; NEB brought partly under control of Department of Industry

- the Microelectronics Support Scheme (£6.6 million);
- the Electronic Components Industry Scheme (£.3 million);
- the Microelectronics Industry Support Scheme (MISP);
- the Microelectronics Application Project (MAP) (£3.9 million spent by 1980, with £18.2 million committed);
- Computer Systems and Electronics Requirements Board (£1,750 million);
- Advanced Computer Techniques Project (£.35 million).

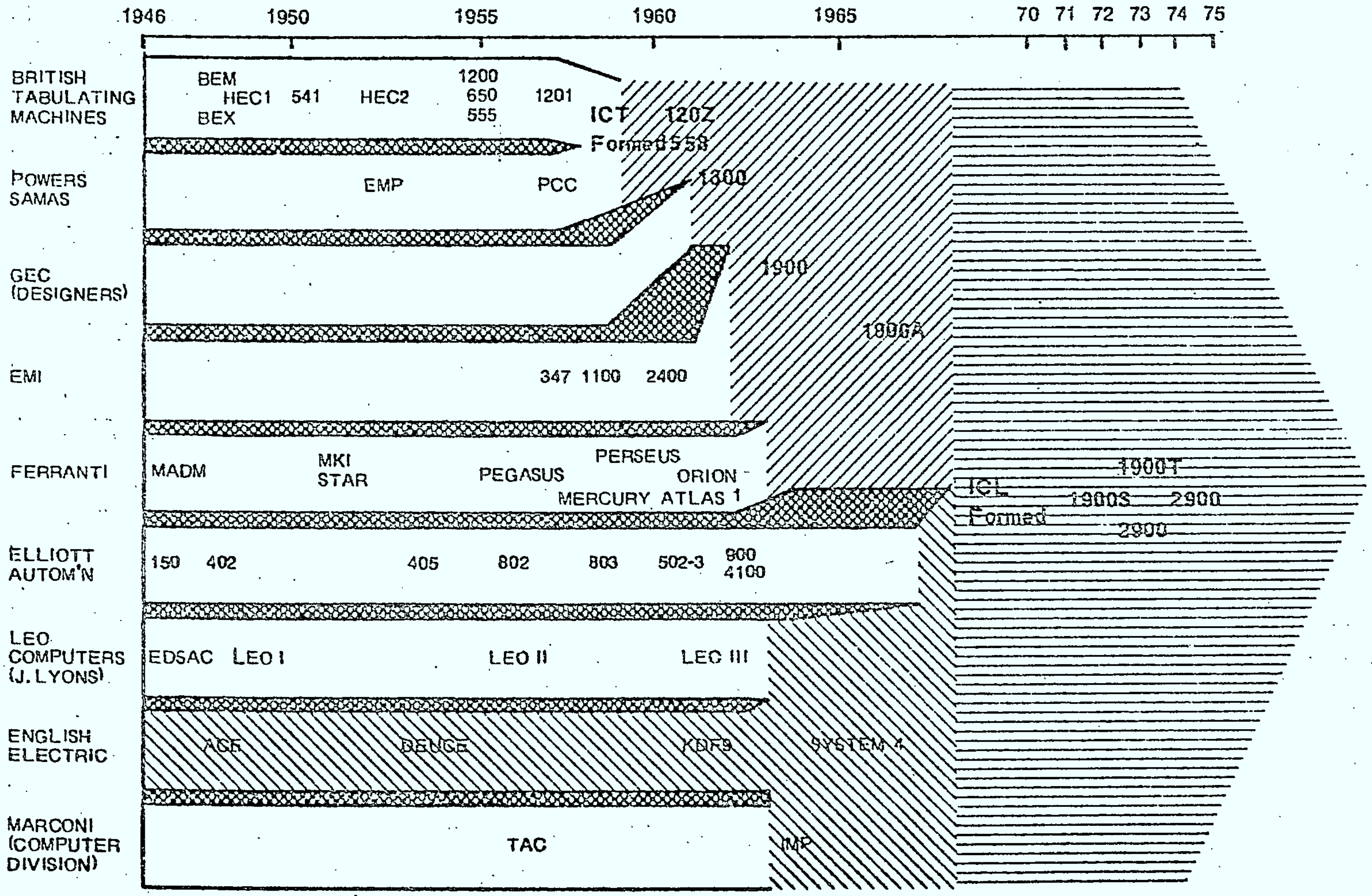
- In addition there are major programs supported by the National Research Development Corporation (NRDC) and the National Enterprise Board (NEB) of which the latter's INMOS semiconductor program with £25 million spent and £25 million committed is especially important.

Although the various UK companies received support through assured government purchase none achieved a market base sufficient to survive, and the 50s and 60s are marked by a series of mergers (Fig. UK-1). The key merger was the foundation of International Computers Ltd. (ICL) in 1968, with a 35% government holding. The British hopes for maintaining an IBM-independent presence in the international computer main frame market - i.e. the industry spanning the full range of complete computers from minis through peripherals to the very largest systems is now centred in ICL. Besides holdings in ICL, NEB also took positions in Ferranti (50%), Computer and System Engineering, CASE, (50%), Plessey (25%) and INMOS as noted earlier. In December 1979 the whole National Enterprise Board, from the chairman down, resigned and was replaced. One of the issues was that a decision had been taken to sell off £100 million of assets to promote private enterprise*; another was that NEB was to be brought under closer control of the Department of Industry. Although the continued strong

*Thus in April 1980 NEB divested itself of its holdings in ICL.

Figure UK-1

THE GROWTH OF THE BRITISH COMPUTER INDUSTRY



Source : EDP EUROPA REPORT, 24/10/1976.

government presence in the hardware and software computer industry may be lessened, there have been indications that the commitment to provide INMOS with the second £25 million allocated to it would be met. This is in response to the recognized need to make British industry as a whole more competitive by adopting microprocessor technology. In its effort to achieve this through the MAP program, DoI has indicated that in two years the fraction of companies using microelectronics grew from 5% to 17%, although 50% of companies were still unaware of the possibilities.

4.1.2 SOFTWARE AND APPLICATIONS

The contributions to coding and programming centred around EDSAC, and to operating systems centred around the Ferranti computers, have already been noted. These were early steps in the evolution of a software effort with emphasis on the dual aspects of system software and applications. Table UK-2 illustrates the present diversity of applications in computer use in the UK and especially the fact that, although government use is important, it is only a small component of the total. As the cost of hardware decreases the service bureau industry, which is increasing steadily in the UK as it is in other countries, becomes more labour intensive. It is estimated that the UK service bureau revenues for 1979 were about $720 million with a growth rate of some 30%.

The emergence of a software industry was greatly helped by the establishment of the National Computer Centre (NCC) in 1965 with its emphasis on portable software, programming standards, job classifications, user's forum, etc. Especially important was its Software Product Scheme, in which £1 million was made available as risk capital for software development. The extent of the government's involvement in hardware and software to 1976 is shown in Table UK-3.

Table UK-2

ANALYSIS OF MACHINE VALUE BY APPLICATION

- ONE MACHINE MAY HAVE MORE THAN ONE APPLICATION.

E RANGE (£K)*	APPLICATIONS														
	SALES	ORDERS	PURCH -ASES	STAFF	FINANCE	STOCK	PROD- UCTION	TRANS -PORT	BANKING + INSUR	ENGIN- EERING	EDUCA -TION	MEDICAL	MATHS+ STATS	ON-LINE	BUREAUX ETC.	TOTAL
<15	1005	252	808	754	689	517	256	107	204	213	216	62	250	627	1308	3427
15-25	415	179	366	344	304	355	229	173	2320	68	63	14	89	136	192	2948
25-50	550	316	457	424	430	440	291	82	121	168	111	34	254	389	339	1439
50-100	890	551	764	733	730	766	476	204	160	111	112	16	178	155	330	[illegible]
100-250	738	450	662	664	701	635	442	212	237	165	85	26	255	120	317	956
250-500	613	388	556	598	643	525	373	224	314	227	115	61	354	177	344	[illegible]
500+	396	214	380	458	450	350	239	186	289	260	139	76	368	153	309	[illegible]
TOTAL	4607	2350	3993	3975	3947	3588	2306	1188	3645	1212	841	289	1743	1788	3139	[illegible]

* Based upon information with normal peripherals using, where appropriate, the best selling price when withdrawn by manufacturer.

Source: The National Computer Index dated 15-08-78

TABLE UK-3
Calendar the British Government's total expenditure on data processing

	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79
ICL						£13.5 million				£40 million for marketing the new series							
Advanced Computer Technology Project	£5 million																
Software Products Scheme & Application Programs & Software Development										£700,000 £2.68 million							
Microelectronic Support Scheme											£10 million						
Total	£75 million																

<u>Sources</u>: SCST Session 1970-71, *op. cit.*

Announcement by the Department of the Industry, DGRST, Le Progrès scientifique n° 181, March-April 176.

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In 1977 the government involvement in software increased significantly with the establishment, under the National Enterprise Board, of the wholly owned INSAC corporation, set up to inject capital into promising software enterprises and to market UK software products overseas. INSAC took up holdings in various companies including:

- Systems Designer Ltd. (SDL)
- Logica (20% held by INSAC, the rest being held by two UK, one French, and one Dutch company)
- CAP - markets packages produced elsewhere in the UK and produces own products
- SYSTIME - markets both hardware and software
- SPL - System Programming, associated with British Robotics System (BRS), a company specializing in factory automation
- AREGOV (formerly INSAC Viewdata), a company to promote Prestel.
- ALTERGO - a software company formerly a subsidiary of a USA company.

In view of the December 1979 reorganization of the National Enterprises Board mentioned above it is not clear what the direct role of the UK government will be, although it has indicated that it wishes to create incentives for private companies to play greater roles.

4.1.3 TELECOMMUNICATIONS

A number of studies in the late 1960s, e.g. the Scicon Report and the report of the 1969 Parliamentary Select Committee on Science and Technology, predicted a rapid increase in the need for data communications. The British Post Office (BPO) argued for integration of the data network with the existing voice network. There were obviously gains to be made with this approach because of the economy of scale. On the other hand UK computer and computing firms maintained that the needs of computer communications would be best served by a separate, packet switched network. The BPO was persuaded to start the development of a packet switched network following a number of experimental studies.

The structure and concepts of a packet switched network were conceived at the National Physical Laboratory, (NPL) as early as 1965. The EPSS network (Experimental Packet Switching Service) became operational in 1973. This was among the first packet switched networks in the world.

Finally, in 1979, the BPO inaugurated its public data network, PSS. Rather than using the experimental protocols of its forerunner the PSS network is comparable to CCITT. The BPO operates the PSS network on a monopoly basis. In order to encourage its use the BPO intends to follow the practice of other European countries by increasing charges for leased lines. This would increase the operating costs of private VANs such as SWIFT, SITA and EIN. It may also encourage large European multinationals such as ICI, Shell, Siemens and large banks and insurance companies to transfer their corporate data bases to the USA where leased line costs are dropping. Such a move would have highly undesirable effects on UK industry.

In addition to the services mentioned above users in the UK have access to TYMNET and Telenet networks in the USA. Data transfer takes place over an experimental transatlantic link. It is expected that this will evolve into a permanent public international packet switched data service. Such a network will use the operating procedures of Euronet.

Except for the military the UK does not have any communications satellites of its own but, as a member of ESA, shares the regional and maritime communications satellites of the Agency.

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The UK has a relatively strong aerospace industry (British Aerospace) which plays a very active and visible role in ESA's activities, but so far the UK has not pursued an independent policy in space telecommunications as have France and West Germany.

The communications satellites available to the UK are listed in Table UK-4.

TABLE UK-4

REGIONAL COMMUNICATIONS SATELLITE SYSTEMS

SATELLITE	LAUNCH DATE	OPERATED BY	MISSION	COVERAGE
OTS-2	May, 1978	ESA	Experimental regional communications satellite	Europe
ECS	Expected Nov. 1981	ESA	Regional communications satellite	Europe
MAROTS	Expected Nov. 1980	ESA	Maritime regional communications satellite	Europe Atlantic Mediterranean

4.1.4 SYSTEM SERVICES

Videotex

The most important feature is the strong initiative the BPO has taken in developing and implementing Prestel. In September 1979 Prestel became the first videotex service publicly available anywhere. An early key decision was that the BPO would retain the major position with respect to hardware, and private information providers would be encouraged to build up the software and the databases. The current rate of expenditure for Prestel by the BPO is an estimated £2 million per month aside from expenditures of the information providers. There are several regular publications for Prestel users and information providers. Although 10,000 users were planned for by the end of 1979, in February 1980 there seems to be only about 2,000 subscribers. Production of terminals is said to be a bottleneck but in view of the long experimental period and the great publicity of Prestel the number of users to date must be regarded as small. Special attention is being given to attracting small business users and building up umbrella organizations for small-sized information providers. Moreover, the BBC has formed a company, BBC Data, intended to market Prestel services to users in Europe, similar to the information provided by the New York Times Information Bank.

Electronic Mail

Plans for Electronic Mail in the UK seem to be built on providing this service through Prestel.

EFTS

Banks have long been heavy users of computers because London is a major financial centre. In 1968 the Banks Automatic Clearing Service was set up to serve four principal banks. Evolution to a full EFTS system is being encouraged by greater use of credit cards, more point-of-sale terminals, terminals in the banks, and eventually payments through Prestel. However, problems of pricing and authentication of purchases are expected to restrain the pace of implementation. A recent attempt to set up a Clearing House Automatic Payment system (CHAPS) in London, similar to a system in the USA, ran into technical problems and has been abandoned, at least temporarily.

Office Automation

Word processing and office automation are recognized as being potentially important and NEXOS, a company specializing in office technology, is one of those supported by NEB. NEXOS has working arrangements with the US-based Delphi corporation, to use the Delta processor, and with Ultronics Data Systems, a British company that markets products made by the Japanese firm Ricoh. Redifon Computers, whose annual turnover is £38 million, is marketing an office system based on viewdata with data entry devices that will accept handwriting.

Recently the BPO started to market microcomputers for business applications. The most important product is IVS-3, a private viewdata system, compatible with Prestel and with portable software residing on Systine or PDP-11 minicomputers. The applications include:

- fast distribution of up-to-date corporate information such as press releases, service manuals, legislation, sales manuals, administrative procedures, product descriptions, personnel records;
- communication and retrieval of corporate data such as sales forecasts, P/R statements, budgets, plans, production schedules;
- interactive facilities (reservations, ordering, commissioning);
- distribution of product information such as delivery, stocks, and prices to agents;
- office communication (diaries, memos, company calendars, project reports, travel expense accounts, personnel returns).

This system seems to be finding acceptance in the UK and elsewhere in Europe.

4.1.5 RESEARCH AND DEVELOPMENT

Even in the 1940s the National Research Development Council acted as a catalyst by encouraging research in computers as one of many fields and by encouraging companies to take out patents. It has supported several research laboratories emphasizing computer technology. Many government laboratories in the UK have devoted a great deal, or even all, of their efforts to research related to computers. Among these are the National Physical Laboratories where ACE was built, and the Computer Aided Design Centre in Cambridge. The Advisory Council for Applied Research and Development (ACARD) has operated since 1973 as an advisory board to the cabinet*.

The other role government has played is through the Universities Grants Committee which provides funds for research. This funding has been long term and extensive but the results tend to appear in the open scientific literature rather than being channelled into industry.

The over all effect of all these research activities has been the recognition of the UK as a leading centre for research in computers from the beginning of computer technology but it has been difficult to translate this lead in research into an industrial advantage.

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*One of its recommendations was to devote £5 million per year to industrial development and training in semi-conductor technology. Recently it also recommended that the National Engineering Laboratory and the Computer Aided Design Centre should be coordinated into a single Institute for Computer Aided Engineering, with £1.5 million allocated for the purpose.

4.1.6 MANPOWER, EDUCATION, AND TRAINING

It is generally accepted that there is, and will continue to be, a serious shortage of manpower having computer/communications skills. The Civil Service College devotes half of its places to data processing specialists. At the junior level the Manpower Services Commission of the Department of Employment along with private companies have offered retraining courses in technical colleges (TOPS) and graduated 14,000 students in 1978.

The universities and technical colleges have good programs in computers, communications and electrical engineering, and the British Computer Society provides professional standing, but inspection of the classified advertisements in the trade publications makes it clear that there is a persistent shortage of well trained people. The annual output of university graduates is estimated at 1,400, a number which is considered insufficient to meet the requirements of the service bureaus alone apart from other needs. The Director of the National Computing Centre has urged the adoption of a program to introduce data processing and computing programs in the 6,000 secondary schools of England and Wales, and a similar call has been made to have the polytechnic institutes assume a larger role but there has been no significant action on these proposals. Two programs which are beginning to show results are the Initial Programmer, and the Threshold schemes launched as a result of a 1978 study of the Manpower Services Commission. These are 42 week programs directed to young people who have left school and are either unemployed or given leave to take the courses. The scheme provides for up to 1,200 grants of £1,500 per year but the participation of industry has not been strong. At the end of 1978 there were 46,800 people employed in the computer sector, the highest recorded, but still below the figure of 50,000 which was foreseen in 1972.

4.1.7 PUBLIC AWARENESS

Stamperer, in his review prepared for Data for Development, maintains that general interest and political debate about computers only really started in 1978 triggered in part by the BBC film "Now the Chips are Down". However, the long, continuous government support of the computer industry described above is evidence that there always has been a cadre of Members of Parliament who appreciated the importance of the computer/communications technology and industry. Privacy has been debated at length, even though there is still no privacy legislation in the UK. The implications of microprocessors and robotics on employment have attracted the concern of the unions, especially ATMS and TUC, and it is certain that the interest will be lasting. Public awareness of the technological change is beginning to be significant.

4.1.8 MARKET SHARE AND EXPORT CAPABILITY

The efforts to sustain a UK computer industry have enabled her to meet 30% to 40% of the demand from domestic suppliers (Table UK-5), a fraction appreciably higher than that in other countries.

TABLE UK-5

Shares of UK Computer Market - 1976

U.K. Companies	%	Foreign Companies	%
*ICL	31.7	*IBM	37.7
GEC	1.9	*Honeywell	6.2
Ferranti	1.7	*Burroughs	5.5
CTL	0.3	*Univac	4.2
Plessey	0.1	*NCR	2.6
Digico	0.1	*CDC	1.5
Others	0.3	Digital	1.3
		Xerox	1.1
		Philips	0.8
	36.1		63.9

* signifies mainframe as principal market sector
Source: NCC internal report

An important factor has been the buy-domestic policy of the Central Policy Review Staff (CPRS) which in 1976 resulted in 62% of computers in central government being British supplied, as was 57% in local government, and 48.5% in public corporations. Thus, although 25.4% of the computers in private industry are of domestic origin, the average is in the range indicated.

Nevertheless, computer imports contribute significantly to the imbalance of trade which has been growing steadily (Table UK-6 and UK-7).

4.2 NATIONAL POLICIES

4.2.1 ARTICULATION

Although the UK has not enunciated a national policy with regard to computer/communications it has supported the technology under various legislation enacted to support science, technology and industry. Typical are the Science and Technology Act (1965), the Industry Act (1972, 1975 amended 1976) and the Collaborative Development Contracts (CDC).

In 1978/79 the Callaghan government gave special importance to the microprocessor and computer industries. Government policy, as enunciated by Ray Atkinson of the Department of Industry, is intended to:

1) exploit information technology for progress;
2) establish an indigenous manufacturing industry;
3) promote vigorous competition within the industry;
4) provide government subsidy and purchasing to stimulate competition.

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TABLE UK-6

United Kingdom Foreign Trade in Computer and Associated Equipment

	$ million					£ thousand	
	1970	1971	1972	1973	1974	1978	1979
Exports	77	91	144	208	169	556,726	817,181
Imports	148	152	171	259	346	814,434	1012,008
Balance	- 71	- 62	- 27	- 51	- 76	- 257,708	- 194,827
Turnover				353	415		
$\frac{\text{Exports}}{\text{Turnover}}$				58.9	64.8		
$\frac{CA - X}{CA - X+M}$				35.9	29.7		

Source: From the Department of Trade and Industry, MLH, 366

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(1) J.E. Tilton, International Diffusion of Technology, op. cit.

(2) Ibid.

(3) Le Monde, 4th March 1977.

The conclusion must be that in spite of sustained, expensive efforts to maintain a British computer industry, the results have been uneven and the prospect, particularly with regard to ICL, remain uncertain.

TABLE UK-7

Trade in Computers and Related Equipment - 1st Q. 1978

(entries £m or (%) change from 1st Q. 1977)

Commodity	Imports		Exports		Balance 1978	1st Q. (1977)
Computers & CPUs	35.7	(+17%)	22.9	(+44%)	-12.8	(-14.5)
Analogue & hybrid	4.2		5.2		1.0	
Digital	18.5		12.3		-6.2	
CPUs	13.0		5.4		-7.6	
Peripherals	86.2	(+15%)	50.3	(-8%)	-35.9	(-20.4)
Main Storage units	1.6		0.4		-1.2	
Peripherals	7.1		4.0		-3.1	
1/0 devices	12.9		6.9		-6.0	
Off-line DP eqpt	4.2		3.3		-0.9	
Other	60.4		35.7		-24.7	
Parts	65.1	(+10%)	33.3	(-10%)	-31.8	(-22.5)
Related equipment (word proc., calculators, cash registers)	13.1		4.3		-8.8	
Micro cricuits	26.3		13.9		-12.4	
TOTALS	226.4		124.7		-101.7	

Source: Datalink 5.6.78, compiled from Business Monitor - quarterly statistics for electronic computers.

Most dramatic was the £400 million earmarked to support the electronics industry and applications (chip manufacturing, microprocessor applications, export support, investment in joint ventures). However, as indicated earlier, the status of this commitment is in doubt in view of the Thatcher government's avowed goal of reducing government involvement in industry.

4.2.2 INSTRUMENTS

A fairly large number of instruments and organizations have already been identified (NCC, NEB, MAP, ACARD, etc.). Key bodies are the Central Policy Review Staff (CPRS) in Cabinet, and the Central Computer Agency (CCA) which has encouraged the buy-domestic policy. However, it must be noted that Britain's membership in EEC now requires it to relinquish the practice of favouring domestic manufacturers so this important help will be weakened.

In general the UK has the decentralized computer government apparatus which characterizes Western developed countries with their mixture of free market and regulation. This has meant that there is no unique, centrally planned computer/communications policy, but rather a series of instruments and policies since the late Forties, some with long history and some ephemeral. This multiplicity of effort makes it difficult to identify which actions have been the most effective, but the over all effect has been to keep the UK in the front line of EEC and OECD countries with respect to computer technology.

4.2.3 THRUSTS

One thrust has been to make ICL the national champion for the UK computer industry. ICL has a significant share of the domestic market and is marketing vigorously in other countries including the USA and Eastern socialist countries. In spite of the various supports outlined above, Chris Wilson, ICL's president maintains that the British government support to the computer industry in the form of direct loans, grants, research contracts and preferential business is meagre compared to that extended by the USA and Japan to their respective computer industries. In any case it is too early to say whether ICL will survive as an international computer company in the main frame market. ICL is making a concerted effort to gain the cooperation of other European governments in limiting the role which IBM and other USA subsidiaries will be allowed to play in the European computer market, but the record of cooperation by European governments in this matter does not suggest that agreement will be reached easily.

A major current policy issue in the UK is that of the telecommunication monopoly. The provision of local telecommunication distribution services is recognized as a natural monopoly of the BPO that would not benefit from competition. However, monopoly of services such as long distance trunks, value added networks and line attachments (user-site equipment connected to the telephone network) is strictly statutory.

According to the monopoly structure under which the BPO operates, modems are considered to be line attachments or DCEs (Data Communications Equipment) when connected to the public switched telephone network and must be obtained from the BPO. Data Terminal Equipment (DTE) which connects to the network via modems are not subject to the BPO monopoly. This situation is counter-productive from the point of view of British industry. It prevents equipment manufacturers from integrating modem functions in their product. Such integration is highly desirable since it enables them to take advantage of advances in LSI and microprocessor technology.

The BPO has made a notable exception in this respect regarding terminals for Prestel. In general, line attachments available from sources other than the BPO can obtain type approval for direct connection to the switched network. About 1,800 types have been so approved for data communications.

A number of studies, including the Carter Committee of Review which was appointed in November 1975 to review the status of the BPO, recommended liberalization of the supply of telecommunications equipment. These recommendations were rejected by the government in favour of increased monitoring of the operations of the BPO and its relations with industry.

A related problem is the ability of the BPO to keep pace with a very fast moving technology. This situation is dramatically represented by the Prestel situation. Before the first customer was connected, the BPO has already started working on the third generation of the service. In many ways the Prestel service has strengthened the BPO's hand by demonstrating its capability for innovation. Britain's early lead in Prestel, and the sales it has already made to other countries, suggest that it has an excellent chance of being a significant exporter of this service. But this will only happen if the home Prestel market expands steadily.

In summary, the UK for all of its early start in computing, sustained government support, and awakening national interest, is one of the countries still fighting to carve out a position in the presence of the USA and Japanese giants. In this it finds itself in much the same position as do the other advanced OECD countries.

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CHAPTER 5

FRANCE

5.1. TECHNOLOGICAL CAPABILITY

5.1.1. COMPUTER HARDWARE

France is one of four countries in the world with an independent computer/communications technology and capability. The most striking feature of the French computer industry is the strong government presence. Through a series of moves beginning in 1966 following a decision by the USA not to sell Control Data computers to France, the government has been engaged in strengthening the national capability with a view to countering USA domination. By 1979 the partially state-owned, French-controlled, Compagnie Internationale pour L'Informatique-Honeywell Bull (CII-HB) not only had the highest data processing revenues of any non-American, non-Japanese company but also, more significantly, increased its share of the European markets to $566 million, exceeding the Americans (IBM, Control Data and Honeywell), with just under $500 million.

Mainframes: CII-HB

The relevance of CII-HB to the French computer industry cannot be overstated for in tracing the evolution of the company one would have, more or less, recorded the development of the industry as a whole.

Of the two constituents that merged to form the present entity in 1976 Honeywell Bull is the older. Founded as Machines Bull in 1931 the Company maintained a technological edge over IBM for several years following its success in introducing the world's first germanium diode computer. The edge was lost to IBM when that company introduced second generation computers in 1960. With this technological advantage was lost much of the business; a loss which remained unrelieved by the licensing agreement with RCA for the sale of that company's 3301 computers under a new designation, the Bull Gamma 40. In 1964 General Electric Corp. obtained a 50% interest in the company and acquired managerial control. An investment of more than $200 million over three years infused some strength in to the company. In 1970, however, with the decision of GE to accept a minority participation in a GE-Honeywell joint venture, Honeywell Information Systems (HIS), Honeywell Inc. acquired a majority of GE shares in Machines Bull, and as a result came to be known as Honeywell Bull.

In pursuance of its objective to form a national company, rendered more urgent by the decision of the US government against sale of advanced computers to it, the French government set about forming the Companie Internationale pour l'Informatique (CII) by merging two small French companies: the Compagnie d'Automatisme Europeéne (CAE) and the SEA. Shareholders in the new group were the Compagnie Générale d'Electricité and CST, who jointly owned CAE, and the Schneider group, SEA's principals. Despite more than half a billion dollars in government subsidies between 1966 and 1975, CII continued to operate at a loss. In 1973 it temporarily joined forces with Siemens of West Germany and N.V. Philips of Holland in an European Computer Consortium known as Unidata which was to dissolve in late 1975 with the announcement of the merger agreement between CII and Honeywell.

An important feature of the agreement was the transfer of 19% of Honeywell's share in its subsidiary to French interests, thus reducing its own ownership in the new entity to 47%. In a more recent development backed by the Government, Saint-Gobain-Pont-a-Mousson, the French company engaged in the manufacture of building materials, have increased their interest in CII-HB with the purchase of 20% of Honeywell Bull.

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Series 60 computer systems are the major item of manufacture. Consolidated turnover reached $1.13 billion in 1978, up 17.6% over the 1977 figure. Consolidated sales for the initial nine months of 1978 reached $720 million, up 15.7% over the same period the previous year.

Recent acquisitions/joint ventures:

- In September 1979 Systems Industries Inc., USA, merged with CII-HB. The Company brought in expertise in disk controllers to strengthen the D-100 line of disk drives.

- Agreement was reached with Rumania in 1979 for cooperative production of CII-HB products at the Citroen plant in Rumania.

- Maintenance and after sales service of Rank Xerox Computers in France was taken over in May 1976.

Small Computers:

In 1976 the small computers division of the original CII merged with Telemecanique of the Thomson Group to form the Societé Européene de Mini-Informatique et de Systems (SEMS). Assigned a prime role in the DP group established by Thomson-CSF, the electronics conglomerate, SEMS:

- accounted for $120 million out of a total $350 million in sales for the whole group in 1978;

- was responsible for 30% of the group's exports;

- formed its first subsidiaries in Belgium and West Germany followed by a UK operation in 1979.

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CII-HB is also involved in the mini-computer sector, its presence marked by its series Mini 6. Table F1 reveals the growth rate in this segment of the computer industry.

TABLE F1

MINI COMPUTERS

	Percentage average growth 1970-74	Output 1973	Percentage average growth 1975-78	Output 1978
Industrial	40	5000	35	16000
Office	30	5000	25	12000
TOTAL:	35	10000	30	28000

Terminals/Peripherals:

The group initiated by the Compagnie Générale d'Electricité (CGE), in association with Sintra and Transac, holds a leading position in terminals manufacturing. A further consolidation is mooted by attempting to draw into the group two other major peripherals manufacturers, Logabax, a subsidiary of the Belgian group, Electrosel, and Intertechnique. Although the growth in peripherals is less impressive when compared to minicomputers it has, nevertheless, been high, recording 130% over a five-year period (Table F2). Terminals, on the other hand, have been growing at a rate of 40% on an average between 1970-74, and 35% between 1975-78 (Table F3).

Current research is sharply focussed on facsimile terminals.

Word Processors

Two companies here are of interest, CIT-Alcatel and St. Gobain.

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The fourth largest industrial group Compagnie Générale d'Electricité (CGE) (1979 sales $8.2 billion) has created its subsidiary CIT-Alcatel (1979 sales $1.6 billion) to move into office automation technology.

TABLE F2

PERIPHERALS

	Percentage average growth 1970-74	Output 1973	Percentage average growth 1975-78	Output 1978
Memories	30	4000	25	10000
Input-Output	20	2000	20	4000
TOTAL:	27	6000	23	14000

TABLE F3

TERMINALS

Percentage average growth 1970-74	Output 1973	Percentage average growth 1975-78	Output 1978
40	6500	35	22000

In 1978 it signed an agreement with Canadian AES Data Ltd., in 1979 it picked up Friden Mailing Equipment Corp. of California, and added Romeo-Vicker of Great Britain. In 1980 it plans to acquire US telecommunications and microcomputer companies in order to market complete sophisticated systems that include telecommunications, computer services, and mail room equipment. CGE has set up a research and development unit - Telecommunications Switching Systems - in Reston, Virginia, to develop PBXs. Two CGE subsidiaries in the USA already sell French made switching and transmission equipment.

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The strong feature of CIT-Alcatel is its inexpensive digital facsimile machine, marketed in the USA by Burroughs Corporation.

The $230 million deal in April 1980 between France's third largest group, St. Gobain-Pont-a-Mousson (1979 sales $8.3 million) and Italy's electronics company Olivetti (1979 sales $2.9 million) is the beginning of a large conglomerate entering the electronic office equipment field.

The conglomerate intends to form a joint research company with CII-HB, acquire a telecommunications company and a USA based component company. St. Gobain also set up a joint venture, Eurotechnique, with National Semiconductor to make semiconductors in France.

Components

The French components industry is manifestly weak as evidenced by the fact that no French company develops and supplies its own products. The situation is due to the ability of the USA manufacturers to maintain their technological advantage. For instance, when the Thomson-CSF group was ready to put 16K chips on the market, the USA brought out its 64K chips. As a result even such a leading group as Thomson-CSF markets the 6800 micro under licence from Motorola. Additionally, the group has also signed a five-year joint agreement with Motorola on VLSI technology, and entered into deals with two USA peripheral companies, Pertec and Calcomp, for cost-effective technology.

To overcome this weakness Matra SA of Paris and Harris Corp. of Florida have set up a joint venture, Matra-Harris Semiconductors SA, for production of integrated circuits. With the financial help of the French government the $40 million plant is scheduling first deliveries for the end of 1980. Further, the National Telecommunications Research Centre (CNET) has begun construction of a special centre near Grenoble for the development of rapid, high-density MOS technology.

Foreign manufacturers

An IBM plant at Corbeil-Essonnes produces exclusively for the group's internal requirements. Other US manufacturers include Texas Instruments located at Nice and Motorola at Toulouse. European industry is represented by Radiotechnique-Compélec, a Philips/SCS-ATES subsidiary of Italian origin.

5.1.2 COMPUTER SOFTWARE AND APPLICATIONS

Computer Software

A noteworthy aspect of the French software industry is its remarkable success in the absence of substantial government help. Of the top 30 firms operating in Europe in 1977 seven were French. In 1978 sales in this sector amounted to about $1.2 billion, split between service bureaus and software engineering and consulting firms.

Among the leading manufacturers are:

- CAP - SOGETI - GEMINI

- Société Générale Deux (SG2), one of France's and Europe's biggest software companies.

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- Compagnie Internationale de Services en Informatique (CISI), a subsidiary of the French atomic energy agency. Until recently, it was France's largest service bureau. Much of its activities centre in its research institutions and its subsidiary in London. Its APL drive got a boost with the acquisition of Proprietary Computing Systems.

- Générale de Service Informatique (GSI); a unit of CIT-Alcatel, it is the largest of the software manufacturers with a turnover of $150 million in 1979. It has recently bought Spain's largest service bureau and Transcomm of the USA. Among the planned acquisitions is Datatab of New York and Chicago.

- Thomson-CSF DP Group: Software accounts for about 45% of the market share of SEMS. In 1979 the software and service companies in the group were drawn together in a closer association as a consortium. Also, a new architecture, Semsnet, was conceived for the purpose of realizing network software, among other things.

Applications

There has been a considerable lag in applications. For example, only about 100 systems using computer-aided design are in operation compared to an estimated potential of 2,000. An obvious reason for the lag is the lack of enthusiasm on the part of managements to adopt new EDP-based methods. A reversal of the situation can, however, be seen in the aggressiveness of Benson which has taken over the USA company Varian and also captured 80% of the European market.

The public sector has taken the lead in initiating policies for extended and fresh applications. Antiope, the two-way videotex system, is a case in point. Another notable effort is Transpac, a public packet data network, inaugurated in March 1979.

5.1.3 SYSTEMS SERVICES

Videotex

The Videotex service, to be inaugurated in 3,000 homes in the Paris suburb of Vélizy at the end of 1980, is a communication service involving the use of a television set or terminal screen to display text or graphic signs. The service employs two systems.

Télétel: Based on the utilization of both the telephone and television, the system enables an interactive dialogue with data processing centres by means of an alphanumeric keyboard. The system, thus, makes it possible for professional and private users to consult different data banks of information - timetables, news or stock quotations - or to conduct multiple transactions such as banking operations, booking flights or ordering goods. Already over 200 companies have contracted to subscribe to the system. The SNCF (French Railways) will provide a home booking system as part of the experiment.

Antiope: Basically a one-way broadcast service, the system involves relaying of signals through the television network. The user selects requested data for display on the home screen using, again, an alphanumeric keyboard.

In order to strengthen the existing capability and increase export potential the government, in 1979, entered into a technical agreement with the Canadian government pledging maximum cooperation in research and development of new systems and services in Videotex and Teletext.

The most sweeping proposal to promote Videotex is a plan to abolish paper telephone directories replacing them with electronic terminals consisting of a visual display screen and a keyboard by which a subscriber can summon the required number/information from a local computer. A mass trial, involving 250,000 subscribers, will begin December 1981 in Ille-et-Vilaine. Targeted to reach a figure of 34 million by 1992, the terminals would later be upgraded to provide other services such as Viewdata which would give the user access to a library of information on news, restaurants, business statistics and so on.

Electronic Mail

The Postes Télécommunications et Télédiffusion (PTT) has been introducing a number of types of equipment as part of its program for developing an electronic form of postal service at the same time assisting the growth of the telecommunications industry.

Among the equipment introduced are:

- Telefax: a telecopying service designed to meet the needs of business and government administration; introduced in 1978, the service is under expansion.

- Mass fax: Desk top facsimile machines that will send a page of information down the telephone line in two minutes. Low-priced consumer units are to come on the market in 1981. It is estimated that between 10-15 million telephone lines will be equipped with the low-cost units in the early 1990s.

- Communicating word-processor: a computerised typewriter linked to the telephone, it offers the facility of correcting a letter in the process of communication. Another facility is that standard letters needing slight modifications can be processed through the machine.

As well, the PTT is cooperating with the USPS in preparing a high-speed, facsimile transmission service between post offices in Washington D.C., the World Trade Centre in New York City and the Palais des Congrès at Porte Maillot in Paris.

Electronic Funds Transfer System

Three developments mark the inauguration of the electronic funds transfer system.

- the PTT is acting as technical advisor to banks on the purchase of equipment for use in a system which enables a customer to make payment for purchases by inserting a plastic card into a point-of-sale terminal.

- the Centre de Commutation de Message Bancaire (Banking Message Switching Centre) to transmit information regarding financial transfers between French banks is scheduled to become operational in the second half of 1980.

- Simplex-Com, a commercial teleprocessing development for automated processing and transmission of documents relating to dispatch and receipt of goods in both national and international trading, is to take effect in 1981.

5.1.3. TELECOMMUNICATIONS

Telecommunications services in France are provided by the government-owned monopoly, the PTT, which controls the access of any equipment supplier to the market. Thomson-CSF and CIT-Alcatel serve as privileged suppliers of transmission, and lately, switching equipment. There are, in all, four major manufacturers in the telecommunications field: Thomson-CSF, CIT-Alcatel, Matra, and Sagem. Thomson-CSF and CIT-Alcatel share the videotex (i.e., TÉLÉTEL) market, while Matra is designing the application system for Télécom 1. The growth of the telecommunications industry in recent years is phenomenal, most visible on two fronts:

- the number of telephone subscribers has jumped to 14 million from only 6 million in 1974. Future projections are much more impressive: 20 million subscriber lines by the end of 1982; 28 million in 1987; and 34 million in 1992. The estimated cost of the program is $30 billion;

- foreign ownership of the industry, already on the wane, fell by 40% with the acquisition of LMT and Ericsson-France by Thomson-CSF in 1976. With the help of the government the French group has been spearheading technological advancement while the CGE subsidiary, CIT-Alcatel, seeks a leadership position in TDM switching systems.

The following developments mark the technological advancement made by the industry:

Transpac

This is an outcome of years of experimental research carried out as part of the project, Réseau à Commutation par Paquets (RCP) or Packet

Switching Network. The system, commissioned in December 1978 covers all of France and now has some 850 subscribers.

The network accomplished a number of objectives:

- provision of internal networks to large companies and encouragement to small and medium businesses to use teleprocessing;

- access to data bases by professionals and the public by Videotex and by interconnecting test equipment;

- better rates, not based on distance;

- compliance with international standards.

A number of new services became available as a consequence.

- Touriste Téléprocessing Service (Service de Téléinformatique Touristique) which gave travel agencies access to the booking systems of national carriers.

- An integrated standard terminal connected to a message switching unit via Transpac conducted the record or language conversions necessary for dialogue between mutually incompatible systems.

Téléfax

The facsimile service launched in 1978 is being supplemented by a message switching service for delayed delivery, multiple delivery, and authentication of documents. By January 1979 about 350 terminals had been installed.

Transfax

Designed for use by enterprises and administrations this service will operate through the TRANSMIC network pending commission of the Télécom 1 satellite in 1983.

Conference Calls

A public teleconferencing service has been in operation since 1976. It requires specially equipped rooms on specific premises which can be connected by the national analog network. Groups in conference may discuss and transmit documents by facsimile or tele-writing. There is also a video conference network between four major cities (Rennes, Nantes, Paris, and Lyons) for image transmission. Another application of the conference call idea is a two way sound link and one-way video link.

Fibre Optics

Successful studies have been conducted on fibre techniques and the manufacture of lasers. Current studies focus on optical switching.

Two trials have been planned. One, between two urban exchanges in Paris, has been developed by a Thomson-CSF subsidiary, Lignes Télégraphiques et Téléphoniques, to be established in 1980. The other, on a larger scale with 20,000 subscribers to be installed in Biarritz in 1982, in addition to using fibre optic cable for trunking, will include the local loop to the subscriber's terminal. This will take full advantage of the high capacity of optical fibres and result in considerable improvement in cablevision and videophone services.

5.1.4 SATELLITES

Table F4 summarizes the communications satellites that are used or planned by France for domestic and regional communications, including data.

A more detailed description of four of the systems is offered here:

INTELSAT (International Telecommunications
Satellites Organization):

France is the third largest user of the system in which it holds 6% of the capital. Currently, 1,300 telephone circuits provide links with the system, through 10 earth stations in France and its overseas territories.

Orbital Test Satellite (OTS):

As one of the principal participants in the satellite programs of the European Space Agency the French network has made extensive use of the service since its launching in 1978.

As part of its commitment to the development of the European Communications Satellite (ECS) to be launched in 1981 the French administration is building Ariane, a heavy duty, high capacity launch vehicle, for ESA. Access to this new service will be through stations currently in use for the OTS tests.

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TABLE F4

FRANCE - DOMESTIC AND REGIONAL**

COMMUNICATIONS SATELLITE SYSTEMS

SYMPHONIE-1	DECEMBER, 1974	CNES/DFVLR France/W. Germany	Exp/Oper. Dom./Reg'l. Communications Satellite	Europe N. Africa M. East East. U.S. East. Can.
SYMPHONIE-2	August, 1975	"	"	"
OTS-2	May, 1978	ESA	Exp. Regional Communications Satellite	Europe
ECS	Expected November, 1981	ESA	Regional Communications Satellite	Europe
MAROTS	Expected November, 1980	ESA	Maritime Regional Communications Satellite	Europe Atlantic Mediterran.
TELECOM	Expected 1983/84?	France/W.Germany	Domestic/Regional Communications Satellite	Europe N. Africa M. East East. U.S. East. Can.
INTELSAT*				

* France is also leasing 1/4 transponder from INTELSAT for communications with the Island of Reunion.

**The SYMPHONIE and TELECOM satellites are joint national ventures by France and West Germany, providing both domestic and regional coverage as shown above. The others are regional communications satellites available to France through ESA

SYMPHONIE:

Two satellites launched in 1974 and 1975 under this Franco-German venture permit transmissions of major events between earth stations in the two countries.

TELECOM:

This national system designed for domestic communications will become operational in 1983. The system will serve two primary functions:

- provide an intra-company link offering high-speed, wide-band digital communication between separate branches of a subscriber organization. Subscribers will have access to the satellite through a TDM access system using earth stations with three meter antennas.

- establish links between France and its external territories for telephone and television traffic.

The system is expected to facilitate the development of new applications requiring greater bandwidth - including video conference, high-speed facsimile and the rapid transfer of file data between computers.

5.1.5 MANPOWER, EDUCATION AND TRAINING

Manpower

The information industry employs 320,000 people of which 72,000 are in computers alone. The industry created 25,000 new jobs in 1978. Employment in DP related industries owes its growth, in no small measure, to the influence of the Government's Plan Calcul. It is estimated that the plan created a net 5,000 jobs during 1970-73, as a result of efforts taken to set off the rapid growth process witnessed a few years later. The jobs thus created were 1,000 in the research and development sector, 2,000 in the production sector, and 2,000 in the administrative and commercial sector. The CII, a product of Plan Calcul, was soon to be a major factor in job creation in the industry. Though its market share was less than 20%, it accounted for 55% of the new jobs created between 1968 and 1973 as can be seen from Table F5.

Education and Training

The program to have the greatest impact in training is the microelectronics plan which involves education at the industry, university and school levels. Major elements of the plan are:

- introduction of computer techniques to university students.

- increased investment in computer training and expertise within the industry.

- installation of 10,000 microcomputers in schools.

The two grand ecoles - ENST (École Nationale Supérieure des Télécommunications) and ENS-PTT are centres of excellence for training in computer/communications technology.

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TABLE F5

Job Creation due to the Plan Calcul

Number of jobs	Total creation of jobs	Geographical division		Type of jobs	
		Paris	Other regions	Research, production	Commercial, administrative
C.I.I.	6,000 (55%)	3,000	3,000	3,000	3,000
American manufacturers	5,000 (45%)	2,500	2,500	2,000	3,000
Total	11,000	5,500	5,500	5,000	6,000

5.1.6 MARKET SHARE AND EXPORT CAPACITY

Market Share

An important factor with regard to the computer and telecommunications market is the declining American dominance. In 1974 US companies accounted for 83% of the market, of which IBM-France alone held 71%. By 1978, however, IBM's share had dwindled to 25% - two per cent less than the share of the national company, CII-HB. In minicomputers the national leader, SEMS, holds 45% of the market, while in peri-informatics the share of the national firms is around 40% as compared to 30% in 1974. As already noted the French share of the European market is now greater than that of any single nation.

Export Capacity

As with the domestic market, so with foreign trade in computer/telecommunications equipment.

Belying the forecast contained in Table F6, France succeeded in balancing exports of computer products with imports in 1978, the total worth being $1.25 billion. France now ranks as the second largest exporter of computer goods, the USA being first.

Some of the noticeable trends in this respect have been:

- exports now constitute 20% of the total sales and are expected to grow to 50% by 1985;

- nearly one-third of the terminals and peripherals, worth some $250 million, are targeted for export by 1982;

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TABLE F6

France's imports and exports of data-processing equipment, 1970 - 1975

Million Frs.	1970	1974	1975 (est.)	Forecast for 1980	
				Favourable	Unfavourable
Exports	1592	2756	2920	6690	5620
Imports	1730	3164	3180	6910	6520
Balance	-138	-408	-260	-220	-900
Turnover	3709	6999	n.a.	19820	15100
$\frac{\text{Exports}}{\text{Turnover}}$	42.9	39.4	n.a.	33.8	37.2
$\frac{\text{G.A. - X}}{\text{C.A. - X+M}}$	55	57.3	n.a.	65.6	59.2

Key: C.A. = turnover
X = exports
M = imports

Source: Rapport du groupe sectoriel sur les biens d'équipement électronique, informatique et télécommunications, Préparation du VIIème Plan, Paris, La Documentation française, 1976.

- a large part of the IC production is slated for export. St. Gobain/ National Semi, for instance, expects to export 40% of its goods by 1983;

- total exports of telecommunications equipment amounted to $600 million in 1979. This represented about 19% of the industry's turnover. Total orders for the same year amounted to another $925 million.

5.2 NATIONAL POLICIES

5.2.1 OVERALL TECHNOLOGICAL STRATEGY

Considering that France is a western country its practices are judged to be highly interventionist. Of special interest is its emphasis on the instruments of planning.

The most relevant aspects of the French experience are given below:

1. Importance is given to the concept of formulating a technological strategy. The actual planning stages are preceded by a preliminary phase of defining the main technological policy orientations, coupled with a review of the most important options.

2. Great emphasis is put on "concerted action", involving all the social agents who should play a part in the process. The concerted action has replaced the previously less than successful purely technocratic approach. Disappointed with the performance of theoretical technological planning procedures, the planners now place more emphasis on dialogue between the government, industry and academic community.

3. Shortcomings of an exclusive supply-push approach to technological development became apparent during the 1960s. Since 1968, a demand-pulled approach has been given preference.

4. There exists an interesting linkage between the technology and the industrialization policies and strategies. The various stages of the process of industrialization correspond to different technological capabilities and different mix of science and technology services. Their centre of gravity is seen to move away from the traditional engineering fields to applied research and development.

5. The French have so far been richer in instrumentation than in over all strategy formulation. France faces acute linkage problems with corresponding difficulties for vertical and horizontal diffusion of innovation.

Research and Development

In the computer industry, early R and D efforts were mostly undertaken by IBM and CII, with the latter giving greater priority to R and D than any foreign firm. As can be seen from Table F7, CII, which accounted for 22% of the total staff, employed 37% of the researchers in the sector.

In telecommunications, R and D programs are mainly conducted by the government's National Telecommunications Research Centre (CNET) in co-ordination with the domestic industry. Coordinated efforts have resulted in a number of studies and numerous developments relating to the services network and components. In addition, firms, having their own research centres, carry out specific development projects at government request.

TABLE F7

Job Distribution in Computer Companies

Number of jobs	Industrial jobs		Commercial and administrative jobs	Total
	Production	R. & D.		
I.B.M.	5,100	1,200	11,500	17,800
Honeywell-Bull	3,700	1,200	5,600	10,500
C.I.I.	2,500	1,400	4,100	8,000

Table II. Division of jobs among the three main manufacturers in 1973.

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Public Awareness

Probably the best known public awareness-raising project in France, to date, is the seminal and influential report, L'Informatisation de la Société, the so-called Nora-Minc Report published in 1978. It has had an extraordinary impact on the French establishment.

Subsequently, a nationwide campaign to increase public awareness of information in society culminated in 1979 with a Semaine Informatique et Société (Computers and Society Week). The participation of the President, Valery Giscard d'Estaing, stressed the importance attached by French political leaders to computer/communications technology. All political parties, in power and in opposition, have definite policies with regard to the role of computer/communications in over all national development strategy.

National Defence

Accorded primacy under the re-ordered national priorities, the role of technological development in nation-building was redefined. Reflecting this is the enhancement in the functions and responsibilities of those agencies and personnel concerned with industrial/technological development. One of the more important initiatives has been the appointment of a senior defence official to the State Secretariat for Posts and Telecommunications.

5.2.2. COMPUTER/COMMUNICATIONS STRATEGIES

Goals

The national goals have been broadly stated to be:

- development of indigenous capability;

- promotion of informatics within the whole economy;

- rationalization of computer manufacture and telecommunication equipment industry;

- major upgrading of telecommunications.

Ever since the American embargo of 1966 there has been a definite move towards attaining a national capability, not only in large computers, software, and peripherals, but also in all components.

Taking into account the advances made since 1966, when the Plan Calcul was launched, the Seventh Economic Plan (1976-80) articulated a fresh set of objectives:

- to give the entire population access to the telephone, thus reducing the inequalities of service in different parts of the country and economy;

- to promote regionalization and regional development;

- to press ahead with the development of electronic switching in which France possesses advanced time-division techniques enabling industry, as a whole, to convert to electronic techniques very quickly.

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Articulations

France has already gone through three Calcul plans. At present, Le Plan de Dèveloppement et Informatique, 1979-83 is underway. The priority sectors established by the plan for diffusion of computer/communications technology are: government, health information system, as well as small and medium enterprise.

Instruments and Supportive Measures

Procurement

Government purchases of computer equipment represent 30% to 40% of annual industry revenues. The application of the policy can be seen in Table F8. The marked preference for the national company, CII, is quite evident.

Government also controls some 30% of computer power, both in government and in para-public companies, which makes it the largest purchaser.

Somewhat routinely contracts are awarded to mini and peripheral makers under the "contracts for growth" policy, the ostensible purpose of which is to encourage development of up-to-date products. The contracts average about $10 million a year.

In the telecommunications area the priviledged treatment accorded CSF-Thompason and CIT-Alcatel by the PTT leads many observers to believe that the companies are considered "national champions".

TABLE F8

French Government Purchases of Computers

(Changes from Jan. 1, 1970 to Jan. 1, 1974, expressed in terms of value)

	Jan. 1 1970	Jan. 1 1971	Jan 1. 1972	Jan 1. 1973	Jan. 1 1974
I.B.M.	55 %	46.5 %	41 %	40 %	37 %
Honeywell-Bull	15 %	16.3 %	16 %	12 %	11 %
C.I.I.	10 %	16 %	22 %	26 %	29 %
Other manufacturers	20 %	21.2 %	21 %	22%	23 %

Analysis of computers installed within the French public administration

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Subventions

· CII-HB obtained $98 million in subsidies from the government in 1976.

Sales promotion

The Direction Générale des Télécommunications (DGT), the telecommunications body of the PTT, in attempting to increase the French presence abroad, undertakes to represent the national industry in international markets by offering advice to prospective clients on products and systems manufactured in France.

Also, to foster exports, the government sponsors an insurance system that protects the price of goods from the time of signing the contract to delivery of the equipment. In addition, generous government financing and credit terms enable French companies to win export orders; the payoffs from the policy are most noticeable in the increase in the volume of trade with East bloc countries, particularly the USSR and Rumania. Primarily due to vigorous government efforts, CII-HB succeeded in securing orders in 1979 from Tass, the Soviet news agency, for its computer systems.

Investments

- The government spent $30 billion during 1975-80 to improve the telecommunications network and increase the competitiveness of the national industry. In 1975 and 1976 the annual rate of investment was comparable to the actual turnover in the telecommunications sector. In order to bring about such a level of investment, external funding had to be relied on heavily. Consequently, 40% of the total investment came from sources outside the industry.

- To develop a domestic components industry covering the full range of products, the government spends close to $30 million annually under a program that will last until 1983.

- To encourage new applications and to introduce DP into the curricula of high schools and universities, over $500 million has been committed.

Plans

Table F9, which provides details of government expenditure under the 1st and 2nd Plan Calcul, needs no elaboration except to point out that software remained very much under-represented with a share of 2.2% under the 1st plan and 11.8% under the second.

In telecommunications the national strategic plan has been instrumental in bringing about rapid progress:

- 14 million lines had been installed by the end of 1979, the fourth year of the plan, averaging an annual growth rate of around 18%;

- quality of service, as measured on a global index running from 0 to 100, had reached the mark of 80 in 1979 from 57 at the end of 1975;

- record productivity was achieved; the number of operators per 1,000 main lines dropped to 12.5 in 1978 from 19.3 in 1974.

Plan Peri-Informatique proposed that France's peripheral sector should cover 50% of domestic requirements and the deficit in trade balance be reduced from 60% to 30%. The objective called for a policy of industrial reorganization around strong poles. Consequently, a number of small firms were merged to form SEMS, now Europe's biggest mini-computer firm.

FRANCE

TABLE F9

French Government expenditure on supporting data-processing

	66 67 68 69 70	71 72 73 74 75 76
	First Plan Calcul	Second Plan Calcul
Computers	Frs. 411.5 million	) ( ) (Frs. 910 million
Peripheral equipment	90 million	
Components	91.6 million	155 million
Software	15.9 million	165 million
Specific action	22 million	) ( ) (95 million
C.R.I.	9 million	
IRIA Budget	86.1 million	
TOTAL	726.1 million	1,315 million

Source: J.M. Treille, L'économie mondiale de l'ordinateur

Research and Development

The R and D efforts of the National Telecommunications Research Centre (CNET) have led to the development of electronic telephone switching, digital transmission, satellite communications, optical communications systems, data transmission and other new services.

Promotion of Computer/Communications Technologies

Table F10 reveals the expenditure levels reached in promoting the informatics industry in the initial years of its development. Budgetary allocations play a crucial role today in the development of the telecommunications industry.

Inhibitive Measures

Licensing

Foreign firms are denied licences if they are perceived to create competition for national industries. Thus, in 1976, Digital Equipment Corp. was denied permission to build a plant on the grounds that it would create competition for CII-HB.

Suasion

- In 1979, Société Lorraine and Meridionale de Laminage, the French steelmaker, was persuaded to cancel an order for the Sperry Univac 1100-82 dual processor computer system and instead order a system manufactured by CII-HB.

FRANCE

TABLE F10

Expenditures in Informatics

Millions of French Francs	1969	1973	Annual rate of increase 1969 through 1973
Hardware	525 (53.1%)	1153 (49.7%)	22%
Studies and personnel	351 (35.2%	898 (38.8%	25.5%
Background and miscellaneous	111 (11.7%)	266 (11.5%)	23%
TOTAL	987 (100%)	2317 (100%)	23.5%
Percentage in relation to the budget of the State	0.55%	1.13%	

Expenditures for informatics in the French public sector 1969-1973.

- Assisting the drive of Thomson-CSF to keep up with rapid advances in technology, the government prevailed upon the ITT subsidiaries, LMT & CGCT to sell to Thomson-CSF.

Import levies

A 15% duty on components imported into the country is designed mainly to protect the fledgling national IC manufacturers.

Standards

As part of its strategy to challenge IBM's pre-eminence in the computer field, a set of standards different from those of IBM are insisted upon.

Institutions

Ministère de l'Industrie and
Le Secretariat d'Etat aux Postes et Télécommunications

In 1978, these two key ministries were charged with over all responsibility for the French Computer/Communications strategy.

Direction Générale de L'Industrie (DGI)

Within the Ministry of Industry, the DGI has the responsibility for industrial strategy of France.

FRANCE

Direction des Industries Électroniques
et de l'Informatique (DIELI)

Set up by the Ministry of Industry and Research at the end of 1974, the office took over the functions of the Délégation à l'Informatique which was responsible for implementing the Plan Calcul. Its major responsibility is to promote application of informatics by ensuring:

- consistent development;
- coordinated use of data processing in the public services; and
- supervision of IRIA and CNES (see below for description of the agencies)

La Mission à l'Informatique (MI)

Closely connected with DIELI, MI harmonizes government procurement policy and government industrial policy with para-public and private sectors. Its Centre Technique Informatique (CTI) helps them in choosing the technology. MI is linked to CEESI, created in 1978, whose task it is to develop management information systems for various French administrations.

Comité Consultatif de la Recherche
en Informatique (CCRI)

Its functions are to offer advice on data processing research and to ensure coordination of research activities.

FRANCE

Institut de Recherche en Informatique (IRIA)

The functions of the Institute are performed by four divisions:

- Service de Synthèse et d'orientation de la Recherche en Informatique (SESORI) ensures implementation of the recommendations of the CCRI;

- Laboratoire de Recherche d'Informatique et d'Automatique (LABORIA) conducts research;

- Service Technique Informatique (STI) makes up-to-date evaluation of equipment and evolves policies for standardization.

- Service de Formation et d'Information (SEFI) develops information and training activities within the IRIA.

It is worth noting that the Nora-Minc report recommended a pivotal role for the IRIA in the development of computer/communications policies.

Postes, Télécommunications, et Télédiffusion (PTT)

A typical government monopoly, the PTT initiates and coordinates manufacturing efforts and finances volume production by placing orders and promoting new products.

Direction Générale des Télécommunications (DGT)

A branch of the PTT, it:

- oversees the domestic and foreign operations of French telecommunications;

- coordinates the modernization of the French telephone network;
- monitors standardization efforts made by appropriate international bodies;
- determines technical equipment characteristics which it specifies to its suppliers;
- maintains contacts with foreign telecommunications administrations, particularly regarding questions connected with French operations abroad;
- works on medium and long term cooperative agreements with foreign administrations.

National Telecommunications Research Centre (CNET)

Performs five primary functions in coordination with the domestic industry:

- research aimed at predicting trends in technology and preparing for future developments;
- development of specific equipment for French and foreign markets;
- operating assistance;
- development of architecture and technical management of the national network.

Centre National d'Études Spatiales (CNES)

As the name suggests, it is responsible for the French space program.

5.2.3 THRUSTS

The Seventh Economic Plan (1976-80) declared computers and telecommunications the number one national priority. Major initiatives planned, therefore, have been in this field and are expected to result in the following:

- Given the PTT's commitment to total national coverage, the electronic directory service will develop into a massive system serving 40 million terminals. Present studies are, therefore, focussed on production plans for low cost, functional terminals.

- Use of electronic switching and digital transmission will assist the development of a national data transmission service.

- Through rigorous standization policies, the newly developed techniques will be made internationally functional thereby giving a boost to the nation's electronics exports.

The computer/communications industry of France is expected soon to be the equal of the chemical or aerospace industries. The mastery of computer/communications technology is seen as essential for international competitiveness.

To sum up, France has built up a rather impressive governmental development program to assure itself an autonomous capability in an increasingly more competitive global environment. Only time will tell whether it will succeed.

FRANCE

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CHAPTER 6

WEST GERMANY

6.1. TECHNOLOGICAL CAPABILITY

6.1.1. COMPUTER HARDWARE

The emergence of the German computer industry has been characterised by two important developments, the rapid growth of the industry itself and the considerable progress made by the two German companies in the field, Siemens AG and Nixdorf AG.

The annual compound growth in the number of computers for the period 1970-77 was 19%, roughly the growth rate recorded by the United States. Although the population/computer ratio is still considerably higher than in the UK (2130:1340), the 50% faster growth rate would ensure parity in the near future (Table G1). Table G2 which gives the turnover of the leading computer producers in Germany offers evidence of the growth experienced during the period 1975-78. The turnover is over 50% for every producer except IBM Germany whose rate of 23% is still high considering the volume of production.

Unlike other countries the indigenous industry in Germany could not benefit from military programs aimed at development of computer technology, given the historical reality which prevented a similar growth process. One of the consequences of this handicap has been an excessive reliance on USA manufacturers and their technology. Thus, foreign ownership came to dominate the German computer industry. This is still true but the trend is being reversed thanks to the success recorded by Siemens AG and Nixdorf AG, rated as two of the world's 20 largest data processing companies.

WEST GERMANY

TABLE G1

COMPUTERS IN WEST GERMANY

1	Population	61,513,000	
2	No. of computers (1978)		
	Mainframes	10,385	
	Process control and mini	18,446	
	Total	28,831	
3a)	Population/Computer Ratio (1978):		2,130
b)	Annual Compound Growth in number of computers (1970-77):		19%

4 Computer distribution by industry (1977):

	Per cent
Agriculture, Industry and Construction	46
Commerce & Finance	32
Public Administration	5
Transport & Communications)	
)	17
Others)	

5 Terminals in Use (1978):

a) Number by Type:

Screen displays	93,000
Printers	15,000
Others	16,000
Total	124,000

TABLE G1 (Contd.)

b) Distribution by Industry:

	Per cent
Agriculture, Industry and Construction	39
Commerce and Finance	37
Public Administration	6
Transport & Communications) Others)	18

6 ADP Staff (1978):

a) Total	500,000
b) ADP Staff per computer	17.3

7 User Costs or Spending for ADP Services (1978):

	Million US $	Per Cent
Personnel	2,621	41
Computing equipment	2,410	37
Consulting Services) Data Services)	469	7
Supplies	366	6
Others	559	9
Total	6,425	100

TABLE G2

Turnover of some computer producers in Germany

DM million	1975	1976	1977	1978	Increase 1975/78
Siemens data processing division	900	1,200	1,300	1,600	78%
Nixdorf Computer AG	620	690	840	1,000	63%
Philips Data System GmbH				about 1,000	64%
Kienzle Apparate GmbH	290	340	390	450	55%
Triumph Werke AG	180	210	310	564	213%
IBM Germany	5,100	6,100	6,400	6,300	23%

Siemens AG

Siemens proceeded to develop its technological capability by first producing under licence to CDL of the United States. Progressively gaining autonomy, it strengthened its position considerably with the acquisition in 1974 of Telefunken Computer GmBH, whose joint owners were AEG Telefunken and Nixdorf. Its product line consists of 13 models in the 7700 family of medium and large scale general purpose computers. As a result of a recent manufacturing agreement two high performance models above the 7700 family will be added to the line. In the small business segment its products include office computers, communications computers and display terminals.

Some notable features of the Company's growth are acquisitions of the data equipment line of the Tandberg Electronics group, Norway, in February 1979; of the assets and business of Microwave Semiconductor Corp., USA, makers of microwave devices and parts, in July 1979; of Aerotron Inc., makers of CB radios and mobile telephones in October 1979; and of a 23.5% stake in Threshold Technology Inc., USA, in April 1980. Siemens entered into international joint ventures with Advanced Micro Devices for manufacture of micro-computers, in August 1979; with the Kuwait Co., NGEECO, to assemble and manufacture electrical equipment, in September 1979; and with Hungary to produce electronic components in Szombathely, Hungary, in February 1980.

Some of the recent Siemens contracts of interest in 1979 and 1980 were:

- $1.8 billion for renovation of the Egyptian telephone system.
- $65.5 million for telecommunications and electric-power equipment in Nigeria.

- $250 million for telephone equipment in the Phillipines.
- $28 million in Australia for a control system for a power plant in New South Wales.
- $1.62 billion for a nuclear power plant in Argentina.

Siemens is internationalizing its base with entry to consortia such as the European telecommunications consortium with Austria and Thomson-CSF of France or the Consortium of French and West German companies.

By 1978 annual sales reached a level of $18 billion. Figures available for the last quarter of 1979 indicate that sales were up by 16% over the 1978 figure.

Nixdorf AG

Established as a leading maker of small and medium-sized computers, the Company attempted to branch out into the production of mainframe computers in a joint effort with AEG-Telefunken for a brief period between 1972-74. The attempt having failed, the Company concentrated on peripherals and satellite computers and has been making considerable progress helped by the decision of the Deutsche Bank in 1975 to take a 25% interest in the Company for $132 million. In 1977 it acquired Entrex Inc., makers of data acquisition systems, to strengthen its USA marketing. In 1979 it bought the rights to handheld, electronic translators made by Lexicon Inc.

Net earnings for 1978 were $21.8 million against a mere $9.2 million in 1977. Sales in the same period increased by 21% to $660 million. In 1979 the figure reached $730 million, recording a 23% growth over 1978.

Volkswagenwerke

In 1979, this German auto manufacturer embarked on an aggressive diversification program into the office automation market as a hedge against fluctuations in car sales and the long-term decline in automotive business. In pursuance of the program, Volkswagenwerke took a 52% stake in Triumphwerke, Nurenberg, which owned Royal Business Machines Inc. and Adler-Royal Business Machines Inc., and obtained a 55% share in Litton Industries' West German subsidiary. Another major move to buy majority interest in Nixdorf Computer failed to materialize.

6.1.2. COMPUTER SOFTWARE

Nixdorf AG

In the software field, Nixdorf AG holds a leading position in Germany and is among the leaders in the international market. Makers of distributed data processing systems, data entry equipment and word processing systems, their product line includes the Entrex 80 Series of data entry systems, the Entrex 600 Series of distributed data processing systems, and the Nixdorf Multi-text 8840 word processing system.

Its USA subsidiary, Nixdorf Computer Corp., has planned custom-tailored software in an effort to double its minicomputer sales by 1983. To this end the Company has designed a wide array of standard interchangeable software modules that can be combined in a variety of ways to perform many common data processing tasks.

AEG-Telefunken

Since discontinuing its large computers the Company has been specialising in industrial process control, with microprocessors and their associated software.

6.1.3 SOFTWARE APPLICATIONS

Telephone Network

The network, characterised by an already high degree of automation, has introduced an electronic dial system supported by excellent software.

Criminal Records

The Bundeskriminelamt (Federal Bureau of Investigations) and the corresponding state agencies currently operate 18 large computer facilities with a network of 1,298 remote fixed and mobile data stations installed in police stations, airports, at the borders, and in vehicles.

Local Governments

AG PLIS, a task force on planning information systems, created by the Cooperative Committee of the federal, state and local governments, reports that the 40 largest local jurisdictions operate at least one system and that 34 of the smaller cities have at least one operational planning and decision making information system. A problem faced by these local systems is the lack of a fully developed array of methods and techniques for data manipulation, analysis and report generation. An interesting development is the initiative taken by the public sector to develop its own software to overcome the problem which is, evidently, related to the increasing complexity of integrated circuits which demand highly sophisticated software for design and testing of the circuits.

6.1.4 PERIPHERALS

The industrial sector accounted for the largest share, of the 124,000 terminals in operation at the beginning of 1978, followed by banks and insurance businesses. The public administration sector was one of the small users, perhaps because of the centralized DP structures.

6.1.5 SYSTEMS SERVICES

Videotex

The Videotex system, Bildschirmtest, was first introduced to the public in the autumn of 1977 using the Viewdata system as a basis. The technical concept of the interactive Videotex system provides for the setting up of a large number of interactive video centres. These centres, for which flexible extension of up to 70,000 subscribers is envisaged, will communicate with one another over the planned public data packet switching network. This computer system will also include private data bases and private data processing systems. Subscribers may call up information from the assigned centre as well as from all other interactive Videotex centres and from the connected private data bases. The modem at the subscriber's end will be equipped with a facility for dialing the assigned interactive Videotex centre and with an automatic response unit permitting identification of the subscriber's station by the centre.

Based on the belief that information retrieval services alone will not create viable levels of demand for the medium, the system emphasizes implementation of transaction services.

WEST GERMANY

A number of trials were conducted to test both the technical and social aspects of the service, the first at the Berlin Radio Fair in 1977 by way of demonstrations to the public. Beginning in 1978 information providers including newspapers, magazines, banks, mail order houses, insurance companies, and travel agencies have been participating in technical trials. A major field trial which includes in-depth surveys intended to determine which type of household or business would be likely to use the new service is to be conducted during 1980. The design features of the trial includes the participation of a local community group to guide and motivate users of the proposed system pointing out the importance of social aspects.

Electronic Mail

Figure G1 shows the volumes of traffic which can or cannot be transmitted electronically. According to another estimate, 6% of the letter volume currently handled by the Bundespost can be forwarded by teletransmission.

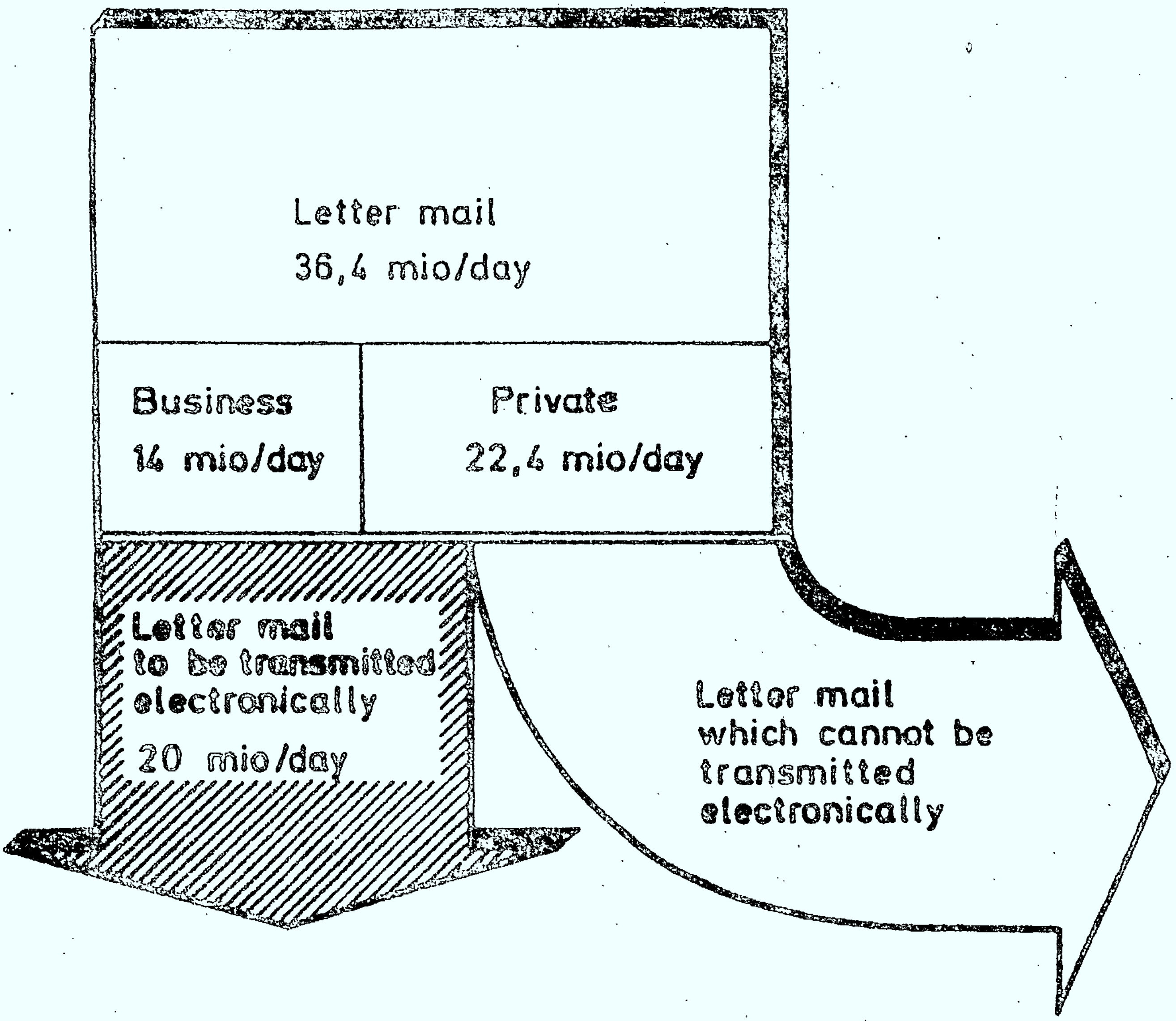
In recognition of the possibilities and in view of the speed and economy the Bundespost has evolved an electronic mail program which consists of television text, telex service, telex and Euronet. The postal service plans the introduction of the display of text on home television screens on a test basis in high density areas and contemplates the possibility of offering the service to all telephone users by 1982. As recommended by the KtK-Commission for the development of communications system Teletex Service for business correspondence will be introduced in 1981.

The installation of an integrated telex and data network to accomodate office telexing and high speed telecopying has a high priority.

WEST GERMANY

FIGURE G1

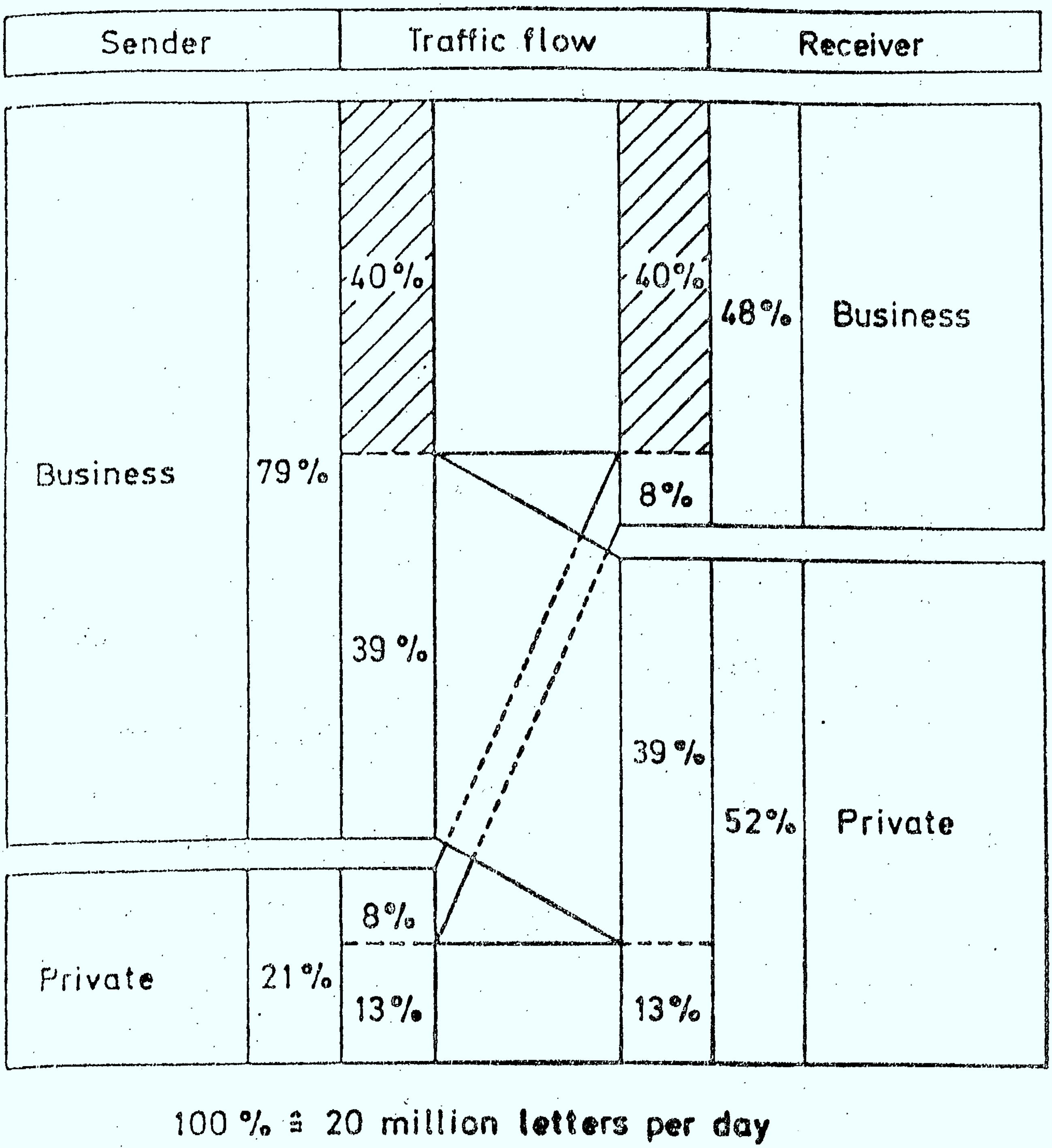
TRAFFIC VOLUME



WEST GERMANY

FIGURE G2

LETTER MAIL TO BE TRANSMITTED ELECTRONICALLY



The postal service is also participating in the installation of Euronet which will allow international access to large data banks.

Electronic Funds Transfer System

Data exchange takes place between branches of a bank and its central facility via on-line cash register terminals, and between different financial institutions and the State central banks via magnetic data carriers. International financial transactions are carried out via the SWIFT Network (Society for World-Wide Interbank Financial Transactions). There is, however, no formal Clearing House organization (ACH) since the economies of central clearing facilities are not apparent because large banks have agreements with one another for the exchange of magnetic tapes on a bank-to-bank basis so that the business relating to handling consumer payments now processed by the savings banks and postal giro services will be lost to them.

Office Automation

The actual and projected developments of telecommunications in the office are shown in Figure G3. There is also the more recent Telefax Service which uses the telephone network and terminals to transmit messages.

Intelligent typewriters employing microprocessors have been introduced. As well, screen terminals with a central minicomputer controlling the storage and the output of text are replacing mechanical typewriters.

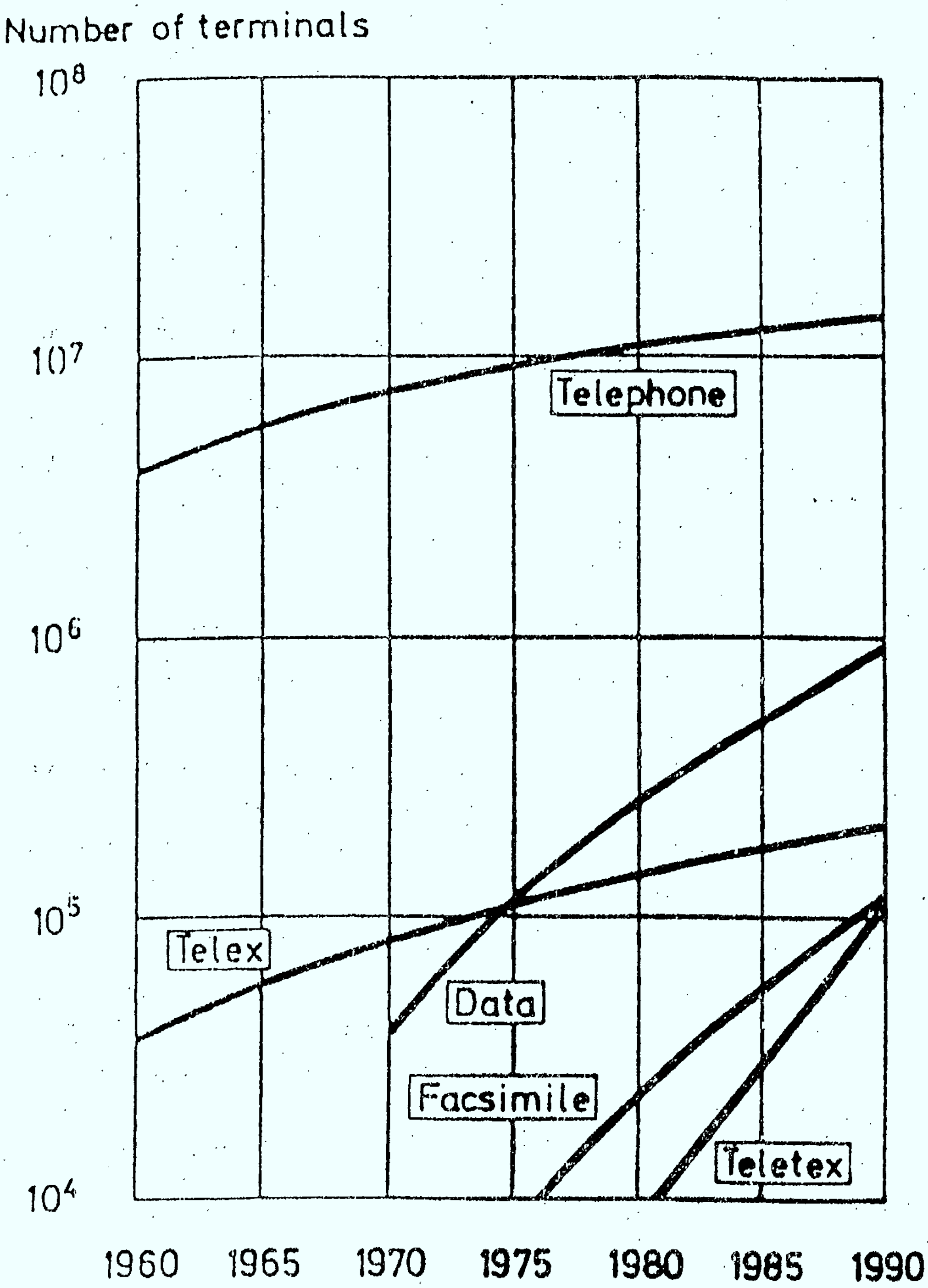
Since 1970 the number of office computers has more than tripled. Table G3 shows that the number of installations within the trade sector increased from 21.9% to 28.8% due to the wide use of office computers in smaller businesses. In the service sector, growth has been by a factor of

FIGURE G3

TELECOMMUNICATIONS IN THE OFFICE

Its Development in the Federal

Republic of Germany up to 1990



11.4%; caused by the increased use of computers and calculators in tax consulting and accounting businesses. It is estimated that by 1985, 240,000 office computers will have been installed.

Decentralized information systems with rapid access features are expected to be introduced soon, particularly designed for those commercial sectors where rapid information exchange is necessary, eg., airline booking systems, stock market, etc.

6.1.6. TELECOMMUNICATIONS

With its 17.6 million main terminals, its intermeshed structure with four network levels and its thousands of circuits for individual trunk groups, the telephone network is the most prominent among all the communication networks. It has reached a relatively high level of development with a station density of 40.4 stations per 100 population. Further expansion has a high priority on the recommendations of the Commission for the Expansion of the Technical Communication System.

With more than 123,000 terminals, the Telex network is the next most important. At present it is in a state of transition and will eventually form an Integrated Data and Telex Network (IDN) together with the datex network which has 65,000 terminals. The new network planned for initial operation during 1980 is based on EDS, a stored program controlled switching system developed for the purpose.

Equipped with centrally controlled electronic switching stations, the digital transmission network will integrate all telephone services resulting in a service-integrated network.

A special legal status has been given to those telphone stations taking part in the telefax service, described earlier.

Under the direction of the Ministry of PTT and Research a fibre optic trial system has been developed. Said to be the first such effort in Europe, the system has been installed as a link between two telephone central offices within the local area of Berlin. It carries up to 480 telephone channels over a pair of fibres each 0.1 mm thick.

6.1.7 SATELLITES

The most important satellite projects are in the European Space Agency (ESA) where West Germany is playing a key role in the Skylab project.

ESA is also developing an advanced direct broadcast satellite system. Another major project is the Franco-German venture which developed the Symphonie-1 (1974) and Symphonie-2 (1975) communication satellites and has since been engaged in building Telecom, a second generation communication satellite.

Table G4 summarizes the communication satellites in use or planned by West Germany for domestic and regional communications including data.

6.1.8. MANPOWER, EDUCATION AND TRAINING

Manpower

Total ADP staff in 1978 numbered 500,000 for a ratio of 17.3 per computer. Despite the fast growth the industry is unable to create fresh employment opportunities, as larger growth would only engender process

WEST GERMANY

TABLE G3

Office Computer Installations by Individual Sectors

Sector	1970		1977	
	Number	%	Number	%
Industry	11,200	56.0	28,500	43.2
Construction			2,000	3.0
Trade	4,380	21.9	19,000	28.0
Banking & Insurance	1,460	7.3	2,000	3.0
Service	700	3.5	8,000	12.1
Public Administation	1,200	6.0	3,500	5.3
Others	1,060	5.3	3,000	4.6
Total	20,000	100 %	66,000	100 %

Source: Diebold Management Report - September 1977

TABLE G4

WEST GERMANY - DOMESTIC AND REGIONAL**

COMMUNICATIONS SATELLITE SYSTEMS

SATELLITE	LAUNCH DATE	OPERATED BY	MISSION	COVERAGE
SYMPHONIE-1	December, 1974	CNES/DFVLR France/W. Germany	Exp./Oper. Domestic/Regional Communications Satellite	Europe N. Africa M. East East. U.S. East. Can.
SYMPHONIE-2	August, 1975	"	"	"
OTS-2	May, 1978	ESA European Space Agency	Exp. Regional Communications Satellite	Europe
ECS	Expected November, 1981	ESA	Regional Communications Satellite	Europe
MAROTS	Expected November, 1980	ESA	Maritime/Regional Communications Satellite	Europe Atlantic Mediterranean
TELECOM	Expected 1983/84?	France/W. Germany	Domestic/Regional Communications Satellite	Europe N. Africa M. East East. U.S. East. Can.

**The SYMPHONIE and TELECOM satellites are joint national ventures by France and West Germany providing both domestic and regional coverage as shown above. The others are regional communications satellites available to West Germany through ESA.

automation, needed to maintain international competitiveness. Given the competitive edge of the USA and Japan stabilization of employment by exporting information technology is questionable.

Education

The first data processing program from 1967-70 initiated a number of moves to encourage informatics curricula in schools and universities. By 1979 a total of $171.6 million had been spent on 105 research groups with 550 scientists in 14 universities. About 1,500 students leave each year with a degree in informatics, and about 2,800 pass the examination in informatics with a degree in mathematics, engineering or economics. In secondary schools, informatics has been introduced as an optional subject.

Table G5 shows the marked increase in state investment in EDP education reflecting the general awareness of the need for informatics knowledge.

Training

Use of apprenticeship programs to fill the needs for skilled workers is extensive. In 1978 about 1.4 million apprentices were being trained. Firms and government support vocational training programs and, in 1978 for example, Siemens spent $225 million to train 10,800 apprentices.

6.1.9 NATIONAL AWARENESS

Awareness of the effects of foreign ownership of the domestic computer industry was made more acute by the realization that the funds remitted by foreign companies to their home country were, in fact, financing R and D efforts in the laboratories of the parent. The funds

TABLE G5

Subsidies for EDP Education

	Total	Higher Education Budget	Professional Training Centers
1967-70	47.0 Million DM	43.0	4.0
1971-75	919.9 Million DM	757.9	162.0
1967-75	966.9 Million DM		

strengthen, in fact, the technological capability of the firm's country of origin. In consequence most of the R and D activity by German firms which spend on an average 8% of their turnover, is carried out inside the country. Siemens spends far more than the average; it earmarked some 30% of its data processing turnover in 1975-76 for R and D. 80% of this was allocated to product and systems development, the remainder to components and manufacturing techniques.

The trade unions, while actively supporting training and re-training programs in automatic data processing, have also taken a strong stand in representing the interests of the employees affected by the growing application of information technology. They are not only keen to protect existing jobs which might become redundant due to automation, but they also play a major role in determining the working conditions and environment of those employees handling information technology equipment. There are at least eight on-going projects to study the impacts of c/c technology on employment. The Deutsche Gewerkschatzbund (German association of unions) has, since 1975, played an important role in influencing the development of job descriptions, improvements in working conditions, negotiation of tariff treaties, and the promotion of training. The IG Metall (Industrial Union for Metal Industries) has proposed a legal framework for individual organizations involved in the data processing field. One of its clauses states that the employer must submit to the employees' representatives for their approval every proposal directed towards the introduction of computer-assisted information and processing systems.

In several trade union agreements the working conditions for employees using screen terminals are determined to ensure protection of employees' eyesight.

The proposal to introduce a personal identification number (PIN) to facilitate government administrative tasks and record linkages for statistical purposes has, in the wake of controversy surrounding it, contributed to considerable public awareness on the issues related to privacy and data protection. The Law Committee of the Bundestag argued that the system was contrary to the principle of privacy in the constitution. The proposal became an issue in the federal election of 1976. A survey of German public opinion revealed suspicion of the efficacy of controls over the exchange of data. In view of the general opposition, the bill providing for the introduction of the scheme was allowed to expire in the 1976 legislative session.

New provisions in the Federal penal code make all violations of secrecy by professionals and officials involved in statistical activities punishable. In addition, it is the task of the Federal Commissioner for Data Protection to ensure that the data protection measures in the area of federal administration are implemented in accordance with the law.

A trend towards decentralization in data processing can be discerned following dissatisfaction expressed by several local governments over the power of central facilities to impose technical solutions on them that require changes in their internal administrative structures.

Discussion on vulnerability centres on internal risks rather than the external. The increasing complexity of technical systems and their applications are perceived to constitute a risk, not only because they make the systems non-transparent, uncontrollable and resistant to modifications, but also because they have a retroactive effect on the organizations themselves.

A set of proposals has been evolved to master better the computer communications system including systems with distributed processing, storage and controlling, self-organizing systems, techniques for a continuous check of the system and its parts during building and operation, and models and languages for the description of the system, its software and its automated development.

Public awareness of the new Videotex technology is being developed by encouraging community groups get to involved in experimental projects. As mentioned earlier, the Berlin Bildschirmtext trial will be guided by a local community steering group consisting of representatives of churches, local newspapers and numerous community associations.

6.1.10 MARKET SHARE AND EXPORT CAPACITY

Market Share

Table G6 shows that the internal market grew by 77% or by an average of 21% per year over the 3-year period. Relatedly, the market for integrated circuits increased from $277.2 million in 1975 to $561 million in 1978 and market predictions forecast $1.4 billion for 1985.

An interesting feature of the growth is the share of German-based computer companies whose share in total value of existing installations increased to 33% from 14% in 1969. With the increase in the share of the domestic market has grown the share in the international market, as evidenced from the record of Siemens AG and Nixdorf AG.

On a different level efforts are under way to capture a greater share of the world market through the EEC. A scheme drawn up by eight major European electronics corporations, under the aegis of the EEC, aims at capturing one-third of the world market by 1990.

Export Capacity

Germany's foreign trade in data processing equipment is marked by two features. Domestic production supplies less and less for the home market thus increasing dependence on imports. A resultant export orientation is the outcome of the regional system of production and distribution. The main categories of imports are components, input/output peripherals and complete central processors. On the export side, parts, peripheral memories and complete systems are the main classes. Thus imported input/output peripherals are combined with domestically manufactured peripheral memories to produce complete systems which are then exported. In 1974, for instance, 32% of imports were components, 19.7% were complete central processors and 18.8% were input/output peripherals. Of the main exports, 48% were parts, 18% peripheral memories and 11% were complete systems.

Another notable feature of the trade pattern is that while the bulk of the imports come from the USA, other EEC countries receive 60% of Germany's exports.

TABLE G6

Shipments of data processing equipment in the Federal Republic of Germany

DM million	1975	1976	1977	1978	Increase 1975/78
Production	3,450	3,968	5,098	5,439	58%
- exports	2,165	2,830	2,850	2,808	30%
+ imports	2,030	2,399	2,859	3,248	60%
market	3,315	3,537	5,107	5,879	77%

Source: Fachgemeinschaft Buro- und Informationstechnik im Verein Deutscher Maschinenbau-Anstalten e.V.

WEST GERMANY

6.2 NATIONAL POLICIES

6.2.1 ARTICULATION

A comprehensive national information technology policy does not exist. However, several steps at the national level can be identified as efforts towards creating a national policy. Some of these are:

1. Germanisation of computer manufacture;

2. research aimed at developing applications for export markets, information systems, telemedicine, education, computer assisted design, process control and user support;

3. increased use of data processing both in the public and the private sector;

4. strengthening of STC in telecommunications as a means to spur development of the computer industry; and

5. prevention of intensification of social control made possible by the increased use of information technology.

6.2.2 INSTRUMENTS

Supportive Measures

West Germany has supported its c/c industry in its five-year computer development plans. Under the first plan, drawn up in 1967, 70% of the aid was allocated to R and D on new systems. Under the second plan, covering

1971-75, priority was given to introducing data processing into the German economy and to further strengthening the competitive position of German industry. Table G7 provides the figures of expenditures under the first two plans. The third plan (1976-1981) aims at establishing a national data processing industry providing all types of equipment. It encourages manufacturing of small computers and terminals, particularly in areas allied to data processing and telecommunications; and, it attempts to develop applications projects to open new markets for German manufacturers by encouraging the spread of data processing to all sectors of the economy.

Details of allocation of resources under the plan is provided in Table G8. It is important to note that the resource allocation is over twenty five times as much as the first plan.

Primarily due to the thrust of the plans, there has been a greater diffusion of computers. The number of computers in process operations rose to 5,600 by 1974 and to 8,400 by 1975.

Procurement Policy

The 1971 public procurement policy gave a slight preference to German or European products where, in the event of equivalent tenders, German or European firms were given preference over others.

The aims of the third development program are to establish, between now and the 1980s, a national data processing industry providing all types of equipment apart from large systems.

WEST GERMANY

TABLE G7

German Government expenditure under the first two computer plans

Millions of DM.	Hardware	Education	Applications	Fundamental research	Total
1967-70	240.6	47	57	42	386.6
1971-75	705.4	919.9	558	226.6	2409.9
Total 1967-75	946	966.9	615	268.6	2796.5

Source: EEC, Report concerning the developments in the data-processing sector ... op. cit.

WEST GERMANY

TABLE G8

Allocation of resources under Germany's third computer plan

Millions of DM.	1976	1977	1978	1979	Total Millions of DM.	%
Teaching and training	93.7	64.5	57	49	264.2	17
Applications	127.6	133	144	157	561.6	36
Industrial R & D	140.3	133	138	143	554.3	35
Mathematics & Data Processing Company	43.8	48.3	50.8	51.9	194.8	12
Total	405.4	378.8	389.8	400.9	1574.9	100

(1) EEC, Report concerning developments in the data processing sector ... op. cit., p. 107 of French.

R and D and DP Programs

The Federal Ministry for Research and Technology has initiated a plan of support of $120 million for five years for research and development in the IC industry in order to achieve a VLSI capability. The data processing program puts primary emphasis on the promotion of German information technology industry. 95% of the financial commitment to the program is being allocated to the private sector to enable it to better meet international competition. Pilot projects testing cable TV technology and research on satellite communication and technology are other R & D projects of the Ministry.

Educational and Employment Policies

The Federal Ministry of Education and Science and the Federal Ministry of Labor have evolved educational and employment policies which prepare the employee in the area of new information technology applications. The Ministry supports basic training in data processing in schools and professional colleges.

Financial Aid

Between 1971 and 1972 government aid to electronics component manufacturers increased by 223% and declined by 15% between 1976 and 1979.

Export Aid

In the over all industrial policy foreign aid is an important instrument. To make Germany's exports more competitive the government gave exporters additional financial assistance in the form of loans or guarantees extended by private firms for the purchase of West German goods and services by an underdeveloped country.

Inhibitive Measures

Software products and related copyrights are regulated so as to ensure protection of the rights of the originator and proper utilization.

The Office of the Federal Commissioner for Data Protection could be used under the pretext of privacy as an extremely useful inhibitory NTB instrument.

Technologies such as cable television can only be run under the authority of existing broadcasting institutions. The regulation prohibits the utilization of cable TV technology for private business programs.

Utilization of data and information transmission is regulated by the Ministry of Postal and Telephone Services through its fee policies and network design; and above all by standardization norms for devices and networks to ensure compatibility. Standardization is therefore another powerful NTB instrument used by the West German government.

6.2.3 INSTITUTIONS

Governmental institutions perform two distinct functions in fulfilling their role in the development of information technology. One, they operate to assist in the growth of the industry, and two, they introduce and coordinate EDP activities within government.

WEST GERMANY

Assistance to Industry

Ministry of Scientific Research and Ministry of Economic Affairs:

The two ministries are jointly responsible for overall development of the computer industry.

Ministry of Research and Technology:

The Ministry promotes information technology research and development through its many programs such as the data processing program, the program of technical communication, and the program for electronic components. It has initiated jointly with the Ministry of Labor the 'Humanization of Work' program to analyse possible negative implications of information technology on workers. It has furthermore sponsored pilot projects to test cable TV technology and research on satellite communication. Finally, it has sponsored the Information and Documentation program for the development of these systems.

Board of the German Economy for Rationalization and Simplification (RKW) and the Institute for Systems Technology and Innovation Research (ISI)

The two bodies attempt to strengthen the competitiveness of medium sized industries.

EDP Activities within Government

Interministry Coordinating Committee and the ADP Cooperation Committee for Federal, State and Local Governments:

The Interministry Coordinating Committee is concerned solely with activities of the agencies at the federal level, whereas the Cooperation Committee, consisting of data processing representatives from the federal, state and local government levels, acts as a forum for exchange of experience and information, coordination of individual group interests and determination of research and development priorities.

The outcome of the committees' work is used by the Federal Ministry of the Interior in its recommendations to other federal agencies, the German League of Cities in its recommendations to local governments on EDP activities, and by the state governments in formulating laws and ordinances relating to the data processing field.

Society for Mathematics and Data Processing (GMD), Local Authorities Centre for the Simplification of Administration and the Datum c.V. (Institute for ADP assisted development planning)

All three bodies are consultancy agencies for public administration.

Mathematics and Data Processing Company (GMD)

A research body set up jointly by the Federal government which owns 90%, and the County of Rhineland-Westfalen. Its function is to: promote the introduction of data-processing in public administration; manage the research budgets of the Federal government and Nordrhein-Westfalen; and to engage in research activities.

State and Local Governments

As institutions, state and local governments play an important role in developing and controlling state-wide ADP activities exercising their legislative authority and executive power.

6.2.4 THRUSTS

The third five-year computer development program, in progress, has four major thrusts:

- to promote the development of mini- and micro-computers and peripherals;

- to promote research and technology activities in telecommunications;

- to accelerate developments in pattern recognition;

- to promote the developments of user aids facilitating man-machine interaction.

The thrusts in other areas focus on the application of data protection laws at the state level, introduction of broadband communications networks, extension of computer applications, protection of jobs, and assessment of technological growth. By 1978 all but three states had adopted data protection laws similar to those at the federal level. Pilot projects to test the capabilities of a cable network are scheduled to start during 1980. Most of the local authorities' administrative functions will be covered through an integrated approach linking the data processing needs of different local governments.

Tariff treaties between unions and employers' associations and agreements on special payments in connection with shift duties are two ways in which job protection is sought. Fresh agreements along these lines will be made.

An action program on Technology Policy by the Ministry of Research and Technology seeks to create a forum for various interest groups to assess the opportunities and risks of future developments.

6.2.5. OUTLOOK

Based on the assumption that the information technology industry and established users have reached a level of competence which enables them to be fully competitive and keep pace with the fast technical development on their own, the thrust of the federal government's initiative can be expected to be selective. Some of the areas where the involvement is likely to be greater are:

- some fields of technology of outstanding importance where the technical development is extremely fast, e.g., large-scale integrated circuits, optical communications, teleprocessing;

- vulnerability of society caused by the dependence of an individual and the dissatisfaction of employees as a result of the increasing use and complexity of information systems;

- public communications network, public administration and public services with a view to promoting broadband communications, computer-based information system, social services, office automation;

- medium and small-sized enterprises for the purpose of transferring to them the gains of the new technology.

The West German perception is that the export market of the future will deal largely in patents, technologies and blueprints. Therefore, the policy thrust is towards gaining and retaining a competitive advantage in industrial technology.

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CHAPTER 7

SWEDEN

7.1. TECHNOLOGICAL CAPABILITY

7.1.1. COMPUTER HARDWARE

In Sweden the computer industry went through the same stages of development as in other countries. The armed forces, government laboratories and industry joined in presiding over its birth with the BARK computer, a project launched in 1946. Several machines were developed between 1946 and the mid 1960s, many with the Army's help.

The history of Datasaab, the largest Swedish firm to manufacture hardware, sums up the history and evolution of the Swedish computer industry. Spurred by military contracts it built up a technological capability enabling it to bring out the D21 computer in the early 1960s. In 1962, it took over FACIT's data processing systems. Up to 1975 it produced a complete range of hardware such as the D23, a large computer with a microprogrammable central processor; the medium-sized D223; and the D5 microcomputer line. Some 15% of its products consisted of hardware (the CK37 computer) incorporated in fighter aircraft manufactured by the SAAB-SCANIA group.

More recently, however, in the face of international competition Datasaab had to make substantial structural changes. It set up a marketing organization jointly with the Univac group termed Saab-Univac, winding up its own production of medium-sized and large computers and marketing Univac's similar equipment instead. In 1977, the government, by means of an Act, decided to merge Stansaab owned jointly by the State Investment Bank and Saab-Scania, with Datasaab to create a new computer company, Svenska Data. The new company, started with a contribution of $42 million by each of the joint owners, Saab-Scania and the government, focussed its activity on business and office computer systems based on mini- and micro-computers. Two years later continued losses made the company a promising merger candidate and the British computer giant, ICL, is favored to buy either a majority or all of its interests.

Some of the features of the Swedish computer/telecommunications industry are described below.

Investment pattern

Computer investments are concentrated in very large centralized systems and partly on smaller systems working either in isolation or as satellites for distributed systems. Computer production, including software, technical services etc., which normally follow the hardware, was nearly $480 million in 1976, a figure projected to reach $840 million in 1980 at an annual rate of increase of 15%.

Consumption pattern

At the end of 1975 the total number of computers stood at 3,700 which, by 1980, was expected to reach about 9,800. The growth, however, is largely accounted for by the increased number of mini and office computers (Table S1 and S2).

Sectoral composition

The state controls 15% of the industry while the leading private companies control 40%. Small companies predominate the services market (Table S3).

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TABLE S1

Computers installed and supplied in Sweden 1975 and 1980

	Installed			Supplied		
	1975	1980	Annual growth %	1975	1980	Annual growth %
Mini-computers	900	3000	27	220	840	31
Office computers	1220	3700	25	375	830	17
General computers[2]	1580	3100	14	275	510	13
Total computers	3700	9800	22	900	2200	20

TABLE S2

Number of computers, terminals, tape stations and disc drives within different branches at the end of 1975

Branch	Companies	Computers	Installations	Terminals	Tape Stations	Disk Drives
Commercial, restaurant & hotel trades	114	149	125	693	223	411
Insurance Companies & agencies	35	52	33	1007	150	240
Real estate management & transactions, consultancy activities excluding the running of computer centres & hire of machinery	20	25	21	224	72	52
Running of computer centres	81	167	102	5884	779	915

Source: National Board for Economic Defence, Statistical Office

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TABLE S3

Main firms manufacturing data-processing equipment in Sweden (1975)

Company	Activities	Comments
Datasaab	Manufacture of small computers and bank terminals	SAAB-SCANIA group 2650 staff 1975 turnover: Sw.Kr. 515 million
Stansaab AB	Censor 900 system Dedicated systems: air traffic control, medical Terminals (display screens)	Datasaab: 50 per cent Government: 50 per cent Ex-ITT 1760 staff 1973 turnover: Sw.Kr. 85 million
ASEA Automation AB	Real-time systems	ASEA group 160 staff
ELLEMTEL	R&D in computerised telecommunications	Ericsson: 50 per cent; Telecommunications; Adm.: 50 per cent
L.M. ERICSSON	Computerised telephone exchanges (AXE)	
AB Bofors	Terminals	70 staff 1974 turnover: Sw.Kr. 1500 million
FACIT AB	Dedicated minicomputers OMN peripherals	Electrolux group Systems activities taken over by Datasaab in 1962 1974 turnover: Sw.Kr. 204 million
IBM Svenska AB	Line printers	3531 staff, including 209 in R&D
Philips Svenska AB	Bank terminals	4300 staff, including 450 in R&D

Source: Based on M.F. Samuelsson, The Swedish Data Industry

World Manufacturers

Subsidiaries of Burroughs, CDC, DEC, CII-HB, IBM, NCR, ICL, NIXDORF, SIEMENS, OLIVETTI operate in the capacity of importers of hardware, while ASEA and ERICSSON are engaged locally in the manufacture of components.

7.1.2 COMPUTER SOFTWARE AND APPLICATIONS

As can be seen from Table S3 investments in software are higher than in hardware. In relation to investments in physical transportation, software constitutes 20% while hardware accounts for about 13%. The distinct gap is, perhaps, due to faster growth tendencies in such sectors as information retrieval, text processing and industrial processing. It could be also attributed to slack in demand resulting from saturation in certain branches of trade and industry.

Applications

1) Civic Registration and Taxation

A new ADP system has been developed at the National Tax Board which introduces a combined central/regional system in which a central computer at the NTB will be connected to regional computer systems of 21 county councils.

2) Social Insurance

The National Social Insurance Board (RFV) data system links the insurance offices to a central computer system by means of some 1,000 terminals over a nationwide communications network. A large proportion of insurance matters pass through or are carried out by the computer system. The system is also used to a great extent for enquiry services for public insurance, and also for the accounts of other authorities and outsiders. Such issues resulted in 86 million transactions in the system in 1978. On the busiest days 445,000 transactions are handled, nearly 55,000 of these during the busiest hour.

3) Policing

The National Police Board (RPS) computer system consists of a main system section and a communications section. The latter includes about 340 screen terminals distributed throughout the country. The on-line system gives direct nationwide access to certain registers, eg. those of persons and offences, goods, wanted persons, and missing cars. Furthermore, the terminals are linked on-line to the central car and driving licence register via a computer-to-computer link between RPS and the Road Safety Board's establishments.

4) Industrial Production

Automated production techniques are quite advanced. For instance the Volvo factory uses industrial robots to weld car bodies. It is estimated that about 600 industrial robots were in use in the country in 1977.

Directions in Software Development

The two directions consist of program production in independent and specialized program stores for both hardware suppliers and users, and production of programs by the final user.

7.1.3 SYSTEM SERVICES

Videotex

The Swedish Telecommunications Administration started experimental work with Videotex in March 1979 and plans to continue to about September 1980. Also participating in the experiment are the Swedish Central News Agency (TT), a number of newspapers, industries and organizations, as well as the Commission on New Information Technology. In the first phase, with 60 terminals, the information consists of about 3,000 pages. Examples of areas of application are distribution of news and weather forecasts, as well as communication within the pharmaceutical industry. Based on the study of terminal concepts, cost performance, applications, and customer requirements, the STA has undertaken to produce a display-oriented teletext terminal to be equipped with different system components. It should also be possible to adapt the equipment to a cluster configuration. The first delivery is scheduled for June 1981.

The Swedish Broadcasting Corporation (SR) has been carrying out practical tests with broadcast teletext since 1979 intended for those with impaired hearing. At present there are terminals in the homes of a selected test audience of 160 people. The technical methods applied are the same as those in the British broadcast teletext systems, Ceefax and Oracle.

The Swedish Philips Company has also been carrying out experiments with Videotex. A mini-computer connects a limited number of terminals to a database comprising several hundred pages in order to try out new types of mass media information, especially interactive services. The Philips system is primarily intended for communication within industries.

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On the basis of recommendations made by the Office 85 study group which was set up as a continuous project aimed at reducing paper in the office, and the CCITT's proposals for a super telex, the Swedish PTT is engaged in setting up a teletex service to be commissioned in mid-1981.

Electronic Mail

In the first phase of the Electronic Postal Service (EPS) letters will be electronically transmitted to 10 regional centres where the hard copy will be hand delivered to the addressee. An eventual goal is electronic distribution of letters direct to home TV sets.

Electronic Funds Transfer System

A large proportion of transactions between banks and large companies are now computerized and will to a great extent take place on-line between bank accounts. In many cases salaries and pensions are paid by authorities and companies with the help of computers connected directly to banks or the post office. Cash register terminals in banks, post offices and sales outlets provide even small companies and private individuals with considerable opportunity to take advantage of the computer.

In order to rationalize banking activities automatic withdrawal machines have been introduced. Those used so far have been rather simple in construction. Machines which savings banks are now beginning to use are connected on-line and when a withdrawal is made the account is updated immediately. Since control can be exercised so that an account cannot be overdrawn, larger sums can be paid out by these new machines. To reduce the banks' costs for handling money over the counter it is likely that automatic machines will also handle deposits. So far over 300 have been installed or ordered, by the end of the 1980s the total is forecast at around 2,000.

The banks' internal transactions are now almost completely computerised in the same way as every large company uses ADP. Transactions between banks at the national level are also on the way to being computerized, especially clearing operations.

The Post Office is well along the way to the computerization of its banking tasks; postal giro, and deposits and withdrawals over the counter. About 3,200 cash terminals have been installed. However, only a few of these can work on-line with a central data system.

Following a study made by Swedish bankers in the early 1970s establishing the possibility of transition to a cashless system, certain banking companies have evolved plans in cooperation with nationwide business chains to issue debit cards which can be used for shopping. Probably this will soon come into effect.

Office Automation

The Swedish Telecommunications Administration (STA), the State Railways (SJ) and the State Power Board (Vattenfall) - government-owned technical enterprises - have been among the earlier users of ADP. Efforts to rationalize and improve their activities have led them to develop large advanced data systems. All three enterprises have large computer installations comprising an on-line system and a system for batch processing. Batch processing includes routines for the administration of the enterprise itself and also routines having large volumes of data, eg., for

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TABLE S4

Gross Investment 1972
Some Transportation and Communication Categories

	US $ millions
Gross investments in roads and streets, in total	498.7
Gross investments in means of transport, in total	748.1
Gross investments in posts and telecommunications	166.2
Gross investments in machinery and inventory (excluding posts and telecommunications), in total	2,285.8
Investments in data systems	249.4

billing subscribers to STA and Vattenfall. On-line systems have been created to perform some of the work of running the enterprises more satisfactorily.

Office automation has evolved greatly over the last two years. Calculating machines approaching the computer in function are now part of ordinary office equipment. Typewriters have been developed into word processing machines with functions for automatic rewriting, text editing, managing of data registers etc. The STA"s Teletex terminal, which can also be used as a typewriter will likely take the place of the office typewriter. More effective information storage and retrieval in registers and archives has been made possible by the introduction of COM (Computer Output Microfilm). Table S4 provides a comprehensive view of the extent of office automation.

7.1.4 TELECOMMUNICATIONS

The industry is specialized, notably in the manufacture of telecommunications equipment and bank terminals. In telephones per capita, Sweden leads all countries with the exception of the USA.

Ericsson

The progress made by Ericsson Ltd., the telephone company, is noteworthy. Engaged in the delivery and installation of automatic exchange electronic telecommunications systems (AXE), it is regarded as one of the world leaders. The extent of its transnational operations can be gauged by the number and volume of the projects it has been awarded or engaged in from 1977.

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Country and year	Job description	Value
		US $ Millions
Libya, 1977	Delivery and installation of equipment for Tripoli telephone system.	50
Australia, 1977	Newly developed AXE switched system	500
South Korea, 1978	Installation of automatic telephone system.	-
Kuwait, 1978	Extension to computer controlled telephone exchanges.	15
Kuwait, & Malawi, 1978	Supply of switching equipment.	28
Zambia, 1978	Supply and installation of telephone exchanges.	6
Brazil, 1979	Supply of telephone equipment.	
Mexico & Agentina, 1979	Supply of computer controlled equipment.	47
Colombia, 1979	Supply of computer controlled installations.	20
Ireland, 1980*	Supply of telephone switching equipment.	488

* Order shared with CIT-Alcatel(France)

As well, the company is part of the following consortia/ joint ventures:

Consortium/Partner(s)	Project/Activity	Value US $
Bell Canada, Philips of the Netherlands	Expansion of automatic telephone network in Saudi Arabia.	3.1 billion
Star Industrial Consortium (comprising seven European nations)	Expansion of automatic telephone network.	

The company's pre-tax profit for the first half of 1979 was $100.9 million compared with $93.8 million in 1978. Sales reported for the same period were $1.25 billion, 9% higher than 1978.

The high growth rate is a continuation of the rate recorded in the previous year. The 1978 pre-tax profits of US $201.8 million was 30% over the 1977 figure of $154.8 million. Sales rose to $2.53 billion - a 15% increase from 1977.

STA

The STA is responsible for planning, projection, expansion, maintenance and operation of the Swedish telecommunications network. In brief the task of the STA is to supply up to date telecommunications at low cost. The plans for expansion of the existing telecommunicaticns services and provision for future services are largely steered by business economics. On the basis of market surveys and forecasts of traffic volumes and consumer requirements the STA carries out technical and economic planning.

Specifically, the STA,

1) hires out modern equipment;

2) lays down technical standards for systems; and

3) tests new equipment for the network.

The STA offers a number of services such as telephones, telex, data transmission and the public telephone service. Early studies reached the conclusion that a generally available public data network would support the development of Swedish computing. Working to this end STA developed the Swedish Public Data Network as part of the Nordic Network (NPDN) which is a synchronous, circuit switched data network based on time division multiplexing serving four Scandinavian countries. The Swedish network uses circuit switching with plans to offer packet switching in the early 1980s with a number of services available on the network.

Data Transmission has hitherto been almost exclusively analog; in the future a change to digital transmission can be expected. Fibre optics is also under development with a field study in preparation for the Stockholm area.

During 1975 a Working Group analysed the use of telecommunications to aid regional development initiated in consultation with the National Swedish Board for Technical Development and the Expert Board for Regional Development, Ministry of Labor.

A number of projects were selected for implementation. These are:

1) promotion of local small-scale business;

2) joint planning for northern Nordic regions;

3) health care;

4) distributed education;

5) increased communication for the handicapped;

6) telecommunications and energy consumption.

Office 85 - Text Communications

In recognition of rapid developments in the office world and the growing demands for effective telecommunications a joint project, Office-85, was established in 1976. The major customers of STA in the project are the automobile manufacturer VOLVO, ASEA in manufacture of power equipment, and an insurance company, Skandia.

To gain practical experience tests of new essential equipment were undertaken with the objectives of evaluating the work environment, terminal functions, complexity, understanding by operators and the most suitable communication means. Based on this experience a new specification for a terminal was developed with the functions of information production, text communication, storage, and retrieval. At present pilot installations are awaiting tests by the customers and the STA, the results of which will be used in planning new services. Besides text communication the Office-85 project includes such other projects as conference services.

7.1.5 Satellites

As a member of the European Space Agency (ESA) Sweden shares in the communications satellite programs of the Agency and thus has access to these satellites for regional and domestic communications. Sweden is also investigating together with other Nordic countries the possibility of implementing a direct broadcast satellite system within that area.

Table S5 summarizes the communications satellites that are used or planned by Sweden for domestic and regional communications including data.

7.1.6 MANPOWER, EDUCATION AND TRAINING

In 1976 the number of persons in Sweden whose main occupation was in ADP was estimated to have grown to 15,000-20,000. This figure does not include those employed in ADP by hardware and data service companies. The total number of persons directly employed in ADP was estimated in the same year to be 30,000-35,000. This should be considered against the background of a population of c. 8 million. Those using ADP as a tool in other jobs, such as terminal users, were calculated to exceed 100,000 in 1976.

Up until 1975 the total number of jobs which disappeared or failed to materialize as a result of ADP was estimated to be between 60,000-90,000 with office workers being most seriously affected. Rationalization by computers was estimated to have made about 4,000-6,000 office and other administrative jobs disappear in the early 1970s. According to previous estimates this will be about 14,000-30,000 jobs by 1980.

However, computerization also gives rise to a number of new occupations. New jobs in the field of computers are calculated to have been

TABLE S5

SWEDEN - REGIONAL COMMUNICATIONS SATELLITE SYSTEMS*

SATELLITE	LAUNCH DATE	OPERATED BY	MISSION	COVERAGE
OTS-2	May, 1978	ESA	Exp. Regional Communications Satellite	Europe
ECS	Expected November, 1981	ESA	Regional Communications Satellite	Europe
MAROTS	Expected November, 1980	ESA	Maritime/Regional Communications Satellite	Europe Atlantic Mediterranean

*Sweden does not have a national communications satellite system, but as a member of ESA has access to the regional communications satellites listed above.

about 30,000 up until 1975. Five thousand to 10,000 new jobs are estimated to come into being within the data field each year. Many require special education which must often be revised to keep pace with new technical development. Education in data processing is being given at upper secondary school, and in a number of post secondary courses and extensively in universities.

7.1.7 NATIONAL AWARENESS

Public awareness of computerization has been quite high; all the major political parties have data policy programmes. The government has set up many temporary task forces or commissions to prepare proposals on various aspects of the information revolution.

The Swedish Parliament has in various contexts touched upon the need for investigation of the effects of computerization and electronics on production and working conditions.

The trade unions have played an active role in supporting automatic data processing, training and retraining, and in negotiating to protect their members from possible negative impacts of the technology.

Against the background of increased computerization and computer technology's actual and feared effects the trade union organizations became actively interested in the consequences for company democracy in the 1970s. For example, union action programs have been put forward in certain organizations.

A special commission for the computer industry handed in a number of conclusions regarding the need for a national computer policy in 1974 based on the following considerations:

1. information technology is key to increased efficiency and profitability in public administration and private enterprise;

2. competition is of a particular type since IBM has such a large share of the market; and

3. many other countries formulate computer policies which will affect Sweden directly or indirectly.

The commission consequently outlined four increasing levels of ambition:

1. absolute user competence;

2. software competence;

3. the capacity to produce specialised computers; and

4. the capacity to produce general purpose computers.

The goal is to provide Sweden with a sound user and software production potential which in a number of areas can meet the standards of world technology, one enabling it to play an effective if only secondary role in the international data processing market.

7.1.8 MARKET SHARE AND EXPORT CAPACITY

Despite the small population base and, consequently, the narrow market size, the electronics industry has been able to sustain itself due to the demands generated by the sophisticated banking industry and telecommunications infrastructure. As already noted the total number of computers (about 3,700 in 1975) is expected to reach about 9,800 by 1980.

The early lead taken by Sweden in the computer manufacturing industry was lost more recently on account of stiff international competition. Still, Sweden is greatly dependent on the world market for sale of the products it specializes in - small computers and bank terminals. In 1965 it exported 92% of its output and in 1974, 84%.

In telecommunications Sweden's position in the world market is preeminent given the fact that L.M. Ericsson is one of three companies to share the bulk of the international telephone business. In Brazil, for instance, the company had control of 45% to 50% of the market until 1979 when the Brazilian government pressured it to surrender majority stock to Brazilian interests.

The company, assisted by the Nordic American Banking Corp., has made considerable inroads in the USA market too, where its expansion activities brought about a suit by Teletronics Services in March 1979, charging conspiracy to gain control of its operations.

Imports are extensive. The balance of trade for computer equipment from 1965 to 1975 was negative; domestic output then consistently met less than 20% of Sweden's requirements.

7.1.9 OUTLOOK

In 1976 the total computer market in Sweden involved some 4 billion Swedish kronor (Sk 4 billion). The gross national product in the same year went up to SK 322.8 billion. In terms of 1976 prices the market is expected to reach about Sk 7.4 billion by 1980, of which Sk 4.3 billion are expected to be spent on computers and Sk3.1 billion on services. This corresponds to an annual growth rate of 17%. Total direct costs for ADP in central government reached almost Sk 2 billion by 1978/79. Between 1974/75 and 1977/78 the average annual increase in costs have been about 31%.

The basis for the investment/expenditure optimism is outlined in a report drawn up by the Commission of the Computer Industry (1978) on the development of the Swedish computer industry and on the marketing trend for computers and data communication equipment. Entitled The Computer Market in the Perspective of the Eighties, the report forecast an annual growth of more than 20%. According to the report, owing to an increased concentration on terminal-based systems, the market for terminals is expected to grow quickly while the proportion of small computers is also expected to increase.

7.2 NATIONAL POLICIES

7.2.1 Articulation

As spelt out by the Special Commission on National Computer Policy the goal is to provide Sweden with a sound user and software production potential which in a number of areas can meet the standards of world technology. The following objectives were specified for the attainment of the goal:

1) absolute user competence;

2) software competence;

3) capacity to produce specialized computers; and

4) capacity to produce general purpose computers.

Two important initiatives were recommended:

1) increased R & D with regard to national projects for social purposes: health, employment, traffic control, etc.

2) measures in support of education and training equalling those for industry.

The growing recognition of the broader implications of technological developments in computers and communications has resulted in a de facto overview policy development. The overview approach is leading towards a National Data Policy encompassing all the important facets of policy requirements in this area.

Among those facets identified in the report prepared by the Commission on New Information Technology (1978), two are of particular relevance.

1) Protection of freedom of expression and the promotion of means for expression.

   In recognition of the need to make access to media as widely available as possible, emphasis is laid on provision of better opportunities, especially for individuals and groups unable to express themselves in mass media or other opinion moulding channels.

2) Counter-acting the negative effects of commercialism.

To this end it is suggested that the state offer alternatives to the profit oriented, speculative, private supply of culture with an aim to change the actual pattern of demand.

7.2.2 Institutions

The Swedish Agency for Administrative Development (SAFAD), the central authority in charge of efficiency measures within the public administration, has overriding responsibility for coordination within the ADP sector. In that capacity the Agency advises the government on procurement policy; ensures maximum utilisation of ADP capacity through coordination of the needs of individual bodies, operates as a clearing house for computer utilisation, and handles technical standardization for ADP within the public sector.

The Data Inspection Board (DIB)

DIB screens applications to run ADP-based person registers in order to ensure observance of the regulations of the Data Act; studies developments concerning the use of ADP for personal information, and advises and informs authorities, organizations and individuals on issues concerned with ADP and personnel information.

The Central Bureau of Statistics (SCB)

SCB produces government statistics and gathers statistical information, coordinates between governmental and other statistical production, and works out nomenclatures and classification norms for statistics.

The National Defence Rationalization Institute (FRI)

FRI is responsible for rationalization of administration within the Ministry of Defence and purchase and use of computers within the defence sector.

The National Accounting and Audit Bureau (RRV)

RRV carries out the accounting of the public administration; audits government purchases; stipulates the prices at the State Computer Fund; and develops methods for sector planning, budgeting and auditing within public administration.

The Computer Centre for Administrative Data Processing (DAFA)

DAFA carries out administrative data processing and related methods and developments within the field of national government.

Statskonsult Ltd.

Statskonsult Ltd undertakes consulting work within the field of administrative development.

7.2.3. Instruments

In the report, The State-owned Public Enterprises, Their Objectives and Control Methods published in 1972 by the Swedish Government Commission on State-owned Public Enterprises a control system appropriate to the policy goals has been outlined.

The proposals call for two types of control mechanisms.
Supportive mechanisms:

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1) Public ownership of PTTs. In an effort to shore up Datasaab the government took a 50% interest in the company and invested $43 million in a support program.

2) Operating subsidies - used to influence the buying of special equipment or to increase the use of communication or computing.

3) Tax regulations - suitably manipulated to make special allowances for the depreciation of certain types of equipment.

4) Education and R & D - the government has put into effect the recommendations made by the Computer Industry Commission (1972-74) for increased investment in education and research and development measures.

5) Procurement: A capital fund, the State Computer Fund, was established in 1968 for the acquisition and financing of ADP equipment in public administration.

6) Tariffs: Government owned public utility enterprises base their calculations on socio-economic cost benefit analysis and not only on traditional business economy calculation.

Inhibitive mechanisms:

1) Investment as an instrument to influence decisions within the PTT. By means of appropriate regulation of the availability of budgetary funds, a desired change is brought about.

2) Protection and regulation. Imports, monopoly, prices and foreign investments are regulated suitably to meet the national policy objectives.

3) System standards. Industry is made to adapt to standards set by the PTT and the standards organizations.

4) Legislation. The Data Act passed in 1973 aims to protect privacy and freedom of the press against undue encroachments from the application of the new technology. It can be used as an efficient NTB.

7.2 Thrusts

Table S6 outlines the program of aid to the computer industry as proposed by the Special Commission on a National Computer Policy in 1972. The aim of the program, obviously, is to ensure that measures in support of education and training equal those for industry.

The Computer Industry Commission (1972-74) studying the growing dependence on foreign production concluded that a certain production dependence had to be accepted by small countries faced with resource difficulties.

A parliamentary commission has been set up to investigate more clearly the effects of computerization and electronics on the development of industry and commerce over the next 5-15 years and the consideration of possible government measures to stimulate greater and most effective use of this technology.

TABLE S6
Programme of Aid to the Computer Industry
Proposed by the Commission
(millions of Sw.Kr.)

Commission proposal	1973/ 1974	1974/ 1975	1975/ 1976	1976/ 1977	1977/ 1978	1978/ 1979
Industrial policy						
Applied R&D	13	20	33	40	47	55
National projects		3	15	15	15	15
Special support		25	25	25		
Purchasing			5	5	5	5
User promotion measures		0.5	1.5	1.5	1.5	1.5
Marketing		2.5	2.5	*	*	*
Public data networks	0.7	1.0	2.0	2.0	2.0	2.0
Standardization	0.4	0.5	0.5	1.0	1.0	1.0
Permanent bodies		0.5	0.5	0.5	0.5	0.5
Total measures of industrial policy	15	54	85	90	72	80
Other measures						
Education						
- elementary schools	0	*	*	*	*	*
- secondary schools	15	18	21	24	27	30
- post-secondary	21	30	41	43	45	45
- other education	*	*	*	*	*	*
Nordic and international co-operation		1	1	1	1	1

* indicates that no quantitative estimate can be made.

H. F. Samuelsson, <u>The Swedish Data Market</u>

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The governmental coordination proposals of 1978, based on the recommendations of the public Data Coordination Committee (1972), call for the following:

- planning and coordination of public computing policies;

- decentralization possibilities for certain sectors;

- organization of government data centres; and

- system development methods and other topics.

In March 1975 the National Board for Economic Defence issued special instructions for the planning of information handling in wartime, in view of the absence of any rules concerning the removal and destruction of computers and registers in a state of war.

A commission has been set up to analyse the effects of computerization on employment and suggest special measures to facilitate better readjustment from the point of view of the employee. The Joint Regulation Act (1977) provides for employees to take part in discussions regarding the use of ADP at their place of work.

The Data Act (1973) protects citizens against invasion of privacy that increasing use of ADP was feared to bring in its wake. The Credit Information Act and the Debt Recovery Act strengthen this protection in special fields.

The Swedish Commission for New Technology was set up in August 1978 to study the questions relating to cultural policy, freedom of speech and freedom of the press.

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The Committee on the Vulnerability of Computer Systems (SARK) was set up in 1977 to study the Vulnerable Computer Society both in peacetime and in time of war. The Committee has called for a Vulnerability Act to safeguard against the unacceptably high risks in today's computerized society. The vulnerability protection rules contained in the Act would cover administrative data processing, international processing systems, and also distributed processing and storage.

An advisory body with the power to supervise the rules would focus on:

1. catastrophe planning;

2. protection of documentation and data bases;

3. contingency planning providing for return of processing capabilities six weeks after an emergency;

4. back-up manual operation of information systems including staff training;

5. improved stores of spare parts by requiring vendors to guarantee availability within Sweden for all sale or leased equipment; and

6. certain protections against data trespass, such as logging sensitive data.

SWEDEN

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CHAPTER 8

EUROPE: COOPERATIVE EFFORTS

In a continuing effort to achieve independence cf the USA computer manufacturers, and IBM in particular, there is a long history of European based companies attempting to engage in cooperative actions. For the most part these have been effective with regard to telecommunications but much less so with regard to computers. Among the supranational institutions that directly impact the communication and computer industries are the PTTs, the European Economic Community (EEC), the Council of Europe, and the European Parliament. In addition, there are numerous bilateral agreements between countries.

8.1 COMPUTERS

ICL, Europe's largest manufacture of integrated computer systems is eighth in size among world computer companies, and only one twentieth the size of IBM. Europe's share of the world market for peripherals, terminals and minicomputers decreased from one third in 1973 to one fourth in 1978; its share of its own integrated circuit market is about 10%. All of this points to the difficulties that national computer manufacturers in Europe are having in establishing a position in the international market, and explain the continuing attempts at concerted action. As an example of an attempt at a cooperative effort, in 1975 CII (France) joined forces with Siemens (West Germany) and N.V. Phillips (The Netherlands) to form a European consortium known as Unidata. (ICL decided not to participate.) By 1975, the takeover by Siemens of the computer operations of AEG-Telefunken, an action which competed directly with CII's marketing of large systems in Germany, convinced the CII management that Siemens was not committed to the Unidata approach. CII merged with Compagnie Honeywell Bull and the consortium was dissolved.

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In 1976 the European Computing Services Association (ECSA) was formed to further the interests of the European Services Bureau. To date ECSA has:

- Written a formal commentary on the EEC four-year program for DP.
- Submitted a position paper on PTT monopoly and tariffs to the EEC.
- Joined with the EEC in commissioning the First Annual Survey of the European Computing Services Industry.
- Submitted a position paper to the Council of Europe.
- Met with officials of the CSTD in Brussels to discuss relationships between the PTTs and the computing services industry.
- Joined an EEC working party to India to study relationships between Indian and EEC software companies.
- Taken observer status at the Consultative Committee on International Telephone and Telegraph (CCITT) in Geneva.

These studies and positions are not aimed at producing cooperation in hardware production. In December 1980 purchasing practices in EEC countries favoring national suppliers are to end. Working against this deadline, the commission of the EEC has for some time been attempting to formulate plans for the European computer industry intended to protect it from American and Japanese competition. In January 1980 the Commission issued a report prepared by Viscount D'Avignon which proposed a number of measures including:

- Community preference, with purchasing on a community rather than a national basis by 1985.

EUROPE: COOPERATIVE EFFORTS

- Specialized agreements between companies.
- Use of large European international funds (the Social Fund, the European Regional Development Fund, the European Investment Bank).
- Transnational projects, including support of the micro-electronics industry.
- Harmonization of terminologies and creation of data communication standards.
- Training projects.
- European satellite policies.

Notwithstanding these calls for cooperation there is little evidence that truly joint European actions will emerge. Most countries continue to favor their national champions or encourage bilateral arrangements, sometimes but not always, between European partners. Recently ICL has been urging that European companies be given a preferential position in their home markets for the next 20-30 years. On a scale from one to seven IBM, Honeywell, Burroughs or NCR and Sperry Univac, as foreign owned suppliers operating in Europe would be in the fifth category, and CII-Honeywell would be in the fourth because of the presence of Honeywell, a non-European partner. However, after four years of joint ownership, French shareholders in CII-HB are attempting to renegotiate the agreement, claiming that the present arrangements favor Honeywell.

Certainly cooperative efforts are not being limited to European partners. Siemens, which has long had agreements with RCA, recently bought into the USA semiconductor industry through its acquisition of Litronic Inc., and its 20% share in Advanced Micro Devices, a microprocessor company, and has also entered into a reciprocal agreement with Fujitsu Ltd. ICL has a limited technology exchange with Hitachi Ltd., and continues to buy disk drives from Control Data Corp. and other peripherals from Computer Peripherals Inc., a USA-based company in which it has a 20% share. In France l'Compagnie Générale d'Électricite recently acquired Friden Mailing Equipment Corp. in Hayward, California and is planning to acquire USA production facilities for telecommunications and minicomputers. Another recent move which is potentially of considerable significance is the already mentioned merger between France's St-Gobain-Point-à-Moresson, a recent entry into the data processing field, and Olivetti. A joint research and production facility with CII-HB is planned with emphasis on office automation.

These examples show that computer companies in Europe are indeed proceeding to establish international connections, but that the actions are on a case-by-case basis, according to specialised needs and opportunities, and there seems to be only a slight preference, if any, that the ventures be only between European companies.

8.2 TELECOMMUNICATIONS

In Europe the PTTs are all nationally owned, and through their participation in the CCITT there is already the opportunity for a considerable amount of concerted action. Also European telecommunication manufacturing companies are, relatively, in a much better position than their computer counterparts; 30% of the world market in telecommunications equipment is supplied by European companies.

There is nevertheless considerable concern that the two most profitable public services of the PTTs, Telex and the public switched telephone network, are being affected by recent developments in data communications, especially the move to divert traffic onto the more economical private leased lines. Because of the huge investment of the PTTs in new services such as packet switched networks, they are trying to force customers away from leased lines onto the networks, either through pricing structures or regulation. It was considerations such as these that undoubtedly led West Germany to announce that it was cutting down on certain internationally leased lines, because they were no longer supposed to be in conformity with Bundespost standards, and to require users to go to either the packet switched network (datex-P) or the circuit switched voice grade network (datex-L). This announcement was confused because privacy issues relating to transborder data flows seemed to be a factor, but the economic aspects are probably the main driving forces. A somewhat different example of promoting national services is the action taken by France which makes it much more expensive for users of bibliographic network services to access databases in the USA than databases in France. Here the tariff structure is being used as an instrument to favor a national software industry. These examples serve to show that there are likely to be an increasing number of cases where telecommunication tariffs and regulations will be instruments of national policy.

With respect to communication by satellites, the massive scale of the investment and undertakings, as well as the USA dominance makes cooperation much more desirable. The prevailing situation is now being reviewed by both the telecommunications authorities and the large potential user organizations in Europe. It is already evident that the systems being developed in the USA cannot be directly transferred to the European environment. In fact, both the institutional and technical features of the systems must be adapted to conditions in Europe, where public service telecommunications are the vested prerogative of the Post, Telephone and Telecommunications (PTT) administrations. This is certainly the case in the UK, France, West Germany and Sweden. Nevertheless, the prospective roles of the European satellite link as a data communications medium can be broadly identified and it is clear that such systems will be implemented in Europe in the next decade.

In Europe, the capabiities of the growing terrestrial networks must be taken into account and, as a result, the satellite and the terrestrial data communications networks should be complementary. Whereas domestic terrestrial data communications networks have been implemented in the UK, France, West Germany and Sweden, these countries, plus most other European countries, have always regarded communications satellites as being the domain of a "united Europe", and indeed it is the European Space Agency (ESA) which has so far played the key role in implementing communications satellite systems (OTS, MAROTS, ECS, etc.).

This is not to say, however, that all countries allowed ESA to play an exclusive role in space in Europe. As described earlier France and West Germany have very strong nationalistic interests which have manifested themselves in independent or joint space ventures (SYMPHONIE-1, SYMPHONIE-2, ARIANE, etc.). Both are now moving rapidly towards final decisions to set up their own national communications satellite systems. France has already decided to start a business service of data, voice, etc., and may launch a direct broadcasting satellite, while West Germany is developing an even more advanced system of direct broadcasting. In both countries the pressure for fast action has come from the aerospace manufacturers. To varying degrees the national telecommunications authorities are also keen. They look to satellites to provide a greatly increased capacity, and at lower costs, than terrestrial networks.

Neither Sweden nor the UK is considering a national communications satellite. Sweden, however, is studying together with others in the bloc the possibility of implementing a direct broadcast satellite for Nordic countries.

CHAPTER 9

BRAZIL

9.1 TECHNOLOGICAL CAPABILITY

9.1.1 COMPUTER HARDWARE, SOFTWARE AND USE

Tables and statistics on Brazil's computer hardware must be viewed in the context of the government's national policy with respect to computers. Briefly the industry has been recognized as a key sector and it is regarded as highly desirable that the country should achieve the capability of designing, producing, and exporting computers. This goal is promoted in a number of ways, of which the most important are the government's participation in joint enterprises with private industry, and regulation which takes the form of granting licenses to manufacture minicomputers only to foreign companies which are prepared to import technology, and build up a design capability in Brazil.

Table B-1 shows the number of computer installations in Brazil, classified by capacity, for the years 1974 to 1980, and Fig. B-7 shows the distribution, according to manufacturers, for 1978.

Regionally, there is a heavy concentration in Sao Paulo and Rio de Janeiro which between them account for over 60% of the installations in the country. From these statistics certain observations can be noted:

- the number of minicomputers is increasing at a significant rate; for all other sizes of machines there is a slow, steady growth;
- there was a sharp decrease in growth rate in 1977; this decrease corresponds to a change in import and manufacturing regulations;

- IBM has a major share of the market (55.6%) for machines other than minicomputers but is prohibited from importing or manufacturing minicomputers because it has not been ready to meet the conditions set by the government for doing so.

Table B-1 Computer Installations in Brazil

Capacity	Value US $	July 1974	July 1975	July 1976	Date July 1977	Dec* 1977	Dec* 1978	Dec* 1979	Dec* 1980
Mini	30,000	1573	2271	3315	4105	4454	4491	5445	5823
Small	30,000 to 180,000	781	1046	1256	1296	1333	1392	1436	1471
Medium	180,000 to 600,000	289	327	338	353	356	361	365	367
Large	600,000 to 1,200,000	71	82	99	122	134	159	182	198
Very Large	1,200,000	42	61	72	87	92	100	107	113
Total		1754	3787	5078	5963	6349	7003	7535	7972
Growth rate %			37	34	17		10	7.6	5.8

*estimated
Source: Technical Bulletin, Capre, Jan/Mar, 1979

Although the number of computer installations is large for a developing country, on the basis of population it is much smaller than that found in the developed countries of the OECD or the European Common Market.

Table B-2 shows the expenditure according to area of use, in the private and public sectors.

From Table B-3 it can be seen that expenditures for software in Brazil are about 0.5% of all expenditures, a fraction considerably lower than the 5% to 6% found in the USA or Canada. Table B-4 shows how software costs are distributed between purchase and rental, and according to type. It is clear that software is still a fledgeling industry in Brazil.

Table B-2
Computer Expenditures in Brazil by Branch of Activity

Branch	Value*	%	Public Sector Value*	%	Private Sector Value*	%
Industry	4,543,153	29.2	1,020,047	14.4	3,523,106	41.6
Finance	2,206,014	14.2	779,859	11.0	1,426,155	16.9
Commercial Service Bureaus	2,364,720	15.2	1,023,872	14.4	1,340,848	15.8
Teaching and Research	593,879	3.8	487,916	6.9	105,963	1.3
Data Processing	5,444,194	35.0	3,378,484	47.6	2,065,710	24.4
Other	404,176	2.6	404,176	5.7	--	--
Total	15,556,136	100.0	7,094,354	100.0	8,461,782	100.0

* In thousands of cruzeiros
Source: Technical Bulletin, Capre, Jan/Mar 1979

Table B-3
Distribution of Data Processing Expense (1976)

Category	Expense*	%
Personnel	5,592,787	58.5
Computers and Peripherals	2,387,005	25.0
Off-line equipment	283,839	3.0
Software	51,417	0.5
Maintenance - computers	135,499	1.4
Maintenance - off-line	56,457	0.6
Installation costs	321,584	3.4
Storage materials	87,384	0.9
Suppliers	635,706	
		100.0

*thousand of cruzeiros

Source: Technical Bulletin, Capre, Jan/Mar 1979

Table B-4
Distribution of Software Costs

Type	Until 1975	1976	1976	Until 1976
System	27,989	9,589	30,615	514
Administrative	14,573	13,909	2,268	313
Scientific/Technical	5,985	1,056	698	188
Total	48,547	24,554	33,581	1015

* thousand of cruzeiros
# no. of packages

Source: Brazilian Computer Resources, Capre, 1977

Table B-5
Data Entry Equipment in Brazil

Type		Year 1975	1976	1977	1978
Programmable Concentrators	• Keyboard	1396	1883	4204	5966
	• Central Unit	146	191	317	535
Non-programmable Concentrators	• Keyboard	329	323	300	300
	• Concentrator	47	86	85	84
Without Concentrator	• Keyboard	5532	5816	6642	6963
	• Decoder	574	589	703	707

Source: Technical Bulletin, Capre, Jan/Mar 1979

To date there have been no statistics on the expenditures for the more sophisticated software systems such as EFTS, or office automation where there is interest but no real activity as yet.

In fact activity in such systems is necessarily retarded because of the restricted availability of data communication facilities, which in turn are limited by the quality of the public telephone system, and the difficulties in obtaining service. Data entry equipment is relatively new, and Table B-5 shows the growth from 1975 to 1978.

There is considerable interest in satellites in Brazil, because these are seen as the only practical way to improve communications in the large underdeveloped regions. In past years Brazil conducted some satellite communication experiments using ATS-3 (The U.S. Applications Technology Satellite). Definite steps towards establishment of a domestic satellite communications system have been taken, with specific proposals being submitted to provide telephone circuits and distribution of educational television. The government, however, has not given the final green light for such systems, but meanwhile is leasing 1 1/2 transponders from INTELSAT for domestic communications. A co-operative effort for a satellite system between Brazil and Argentina is also being explored.

9.1.2 MANPOWER, EDUCATION AND RESEARCH

Generally in developing countries the shortage of qualified personnel is a critical factor in the growth of computer activity. Table B-6 shows the labour force distribution and the estimate of deficits for 1976 in Brazil.

Table B-6

Computer Labour Force - Distribution and Deficits, 1976

Occupation	No. of employed	Estimated Deficit	% Deficit
Data preparation	13,560		
Key-punch operators	26,905	1283	6
Computer operators	8,475	684	8
Programmers	6,780	1237	18
Analysts	6,780	856	12

Source: Brazilian Computer Resources, Capre 1977

In the light of these needs the federal government has actively supported computer programs in Brazilian universities. It has done this by:

- establishing undergraduate and graduate programs in the federally supported universities;
- installing computer equipment for teaching and research;
- providing special funds for a two-year technologist program, established in the universities because there are no institutions corresponding to community colleges or CEGEPs in Brazil.

Whereas in 1972 about 47% of analysts were recruited internally by companies due to the lack of qualified graduates, in 1976 this figure dropped to 22% and it is estimated that it will likely be about 15% in the future. The current production of technologists, graduates and postgraduates, is regarded as more than enough to meet the demands for trained personnel. Table B-7 shows the educational level of computer analysts and Table B-8 compares the estimated number of graduates with the need for analysts during the period 1977 to 1980.

Table B-7
Education Level of Computer Analysts

Level	Incomplete Univesity	Bachelor's degree in computing	Technologist	Degree in other areas	Postgraduate degree in computing
%	15	24	16	35	10

Table B-8
Graduate vs. Analyst needs, 1977-1978

Year	No. of graduates	Needs	No. of graduates/needs
1977	1,003	828	1.21
1978	1,089	811	1.34
1979	1,200	937	1.28
1980	1,210	1,091	1.11
78/80	3,499	2,839	1.23

Source: Technical Bulletin, Capre, Jan/Mar 1979

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In Brazil almost all computer research is carried out in universities as part of post-graduate activities. The 1978 report of the National Council of Scientific and Technological Development, Evaluation and Perspectives, lists 14 post-graduate institutions with computer laboratories. The oldest and best known is that at the Catholic University of Rio de Janeiro (PUC/RJ) established in 1967. Other important centres are at the Federal University of Sao Paulo where the basic design for a minicomputer which was eventually marketed nationally evolved, and at the Federal University of Rio de Janeiro (COPPE). Most of the research is software oriented, e.g., language design, databases and other rather traditional topics, but the faculty maintains some connections with industry.

This main transfer of technology to industry is through the licensing agreements which foreign companies must sign before importing or manufacturing computers in Brazil. In December 1979 there was a proposal to initiate computer research in some of the government laboratories but details have not been released.

9.2 NATIONAL POLICY

9.2.1 PRINCIPAL AGENCIES AND BRIEF HISTORY

Until very recently the principal agency responsible for enunciating and implementing national computer policy in Brazil was CAPRE - the Commission for the Coordination of Electronic Data Processing. CAPRE was created in April 1972 but in February 1976 its terms of reference were enlarged and it took a much more active role in the regulation of the computer industry, both for national and foreign-based companies, a role which resulted in major changes in the industry. Besides CAPRE other organizations of importance are:

SEPLAN - Secretario de Planejamento de Presidencia, the central planning authority;

CNPq - National Council for Scientific and Technological Development;

DIGIBRAS - a government holding company that works with national computer firms;

SERPRO - the federal government service bureau and software organization employing 15,000 people within the Ministry of Finance.

In October 1979 by presidential decree information processing was brought under the jurisdiction of SEI (Secretaria Especial de Informatica), a newly created organization within CSN, the National Security Board.

9.2.2 DEVELOPMENTS UNDER CAPRE

In 1976 computer imports amounted to US $200 million and the number of installations was increasing at a rate of 37% per year (see Table B-1). In a deliberate attempt to reduce the balance of payments deficit, and to increase the national computer capability, the powers of CAPRE were enlarged. In addition to the general powers it already had to direct activities in proposing policies for the public sector and state owned companies, and to coordinate training programs, it was given explicit authority to rule on proposals to acquire hardware, software, and services, both purchased or leased, in all the public sectors, and to formulate financial policies governing data processing in the private sector. CAPRE exercises these powers in three ways:

1) limited imports to US $100 million in 1976 and US $130 million for 1977 and 1978, about one half to one-third the demand. Licenses were granted according to four priorities;

- spare parts
- parts and assemblies for local manufacturing,
- expansion of existing systems,
- new systems.

Special priorities were also given to research and applications of social value, and to service bureaus since these met the needs of many customers.

2) undertook to build up the national computer industry by granting minicomputer import licenses only to foreign manufacturers who were prepared to set up joint operation with Brazilian companies. Not only did these companies have to establish plants with export goals, they also had to transfer technology which in five years would result in an independent design capability. No such conditions were attached to medium and large scale machine imports. Five domestic companies received government approval to make minicomputers. These were:
   - COBRA (Computadores e Sistemas Brasileiros S.A.) affiliated with Sycor (Canada)
   - Sharp Equipanentos, associated with Logabax, France
   - EDISA (Electronica Digital S.A.) associated with Fujitsu, Japan
   - Labo Electronica, associated with Nixdorf, West Germany, and
   - SISCO, an all Brazilian company.

3) entered into joint ventures to provide financing for computer manufacturers through DIGIBRAS. In addition to companies making minicomputers, companies making peripherals and software were supported. Those making minis were not allowed to diversify but had to concentrate on CPU, allowing the peripherals to be made by others who were given a favoured, but not completely protected position.

By the end of 1979 the growth rate was reduced substantially (see Table B-1), an association consisting of some 30 Brazilian owned manufacturers of computer and peripheral equipment (Abicomp) had been formed, and a significant export market to other Latin-American countries established. Moreover, two of the five domestic minicomputer companies were given approval to manufacture medium scale machines, US $40 million in private and government money had been invested towards achieving 100% domestic reliance on parts, and a proposal for developing a local semiconductor manufacturing capability had been drafted.

9.2.3 CURRENT THRUSTS

Given the momentum just described the November 1979 decree placing computers under the jurisdiction of SEI, and reducing the role of CAPRE to an advisory body came as a surprise to many, although it was preceded by a study group (the COTRIM Commission) with strong diplomatic and military representation. Decentralization and privatization of the industry have been announced as goals, but there is concern that SEI resides in the National Security Council. There is some evidence that Brazil has been influenced by the NORA-MINC report in France, and that the change in jurisdiction is to be interpreted as an upgrading of the role of information processing in the national economy.

The Brazilian approach to computers, under CAPRE, has been held up as a model of the type of action third world countries can take with respect to modern technology. Its proponents argue that it asserts national control, but not in so heavy handed a way as to make multinationals such as IBM, Burroughs, Honeywell, and Sperry Rand leave because of divestiture of majority control. Thus Brazil's actions can be compared with India's, where IBM has withdrawn because of insistence on majority control there.

And Brazil has achieved a position in the export market for minicomputers and assembled systems. To this point at least, Brazilian policy seems to be producing effective results. But in looking beyond the statistics and the newly established, government protected companies, it is important to remember that Brazil is still very much a developing country. Much of the infrastructure to support effective use of computers is still lacking. Data communication capabilities, and even such essentials as reliable air conditioning equipment, are hard to come by. Insisting, for example, on dependence upon local suppliers of semiconductors would be disastrous if rigorous quality control is not built into the production. Certainly growth in computer use and application is slow; in the main this, as noted above, is deliberate, but the result is a restricted utilization of the potential of computers. Opportunities for effective employment of highly trained people, a chronic problem in developing countries, seem to be limited. The results of Brazil's over all computer policies have yet to be judged.

BRAZIL

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CHAPTER 10

COMPARATIVE ASSESSMENT AND RELEVANCE TO CANADA

10.1 GENERAL OBSERVATIONS

The conclusions which can be drawn from the accounts of the seven countries just given are in line with the general observations about the attempts of government to draw upon computer technology in coping with change as presented in section 1.2, but it is useful to restate them in the context of computers and communications. Briefly these can be summarized as follows:

1. No company in the computer/communications industry can survive by catering only to its domestic market - the capital investment and the amount of research and development required to stay in the race on this basis only are too great. No country can expect to have a domestic capability in this industry if it is not prepared to support champions in the internatonal arena.

2. In the United States the adversaries to an explicit formulation of national policies with respect to computers rightly point out that this technology has been developed by a rich and inventive industry. They argue that government interference, however well meant, is likely to have negative impacts. All other OECD governments think differently and spurred by the adversary, competitive global environment, have become directly involved in the industry. With regard to communications, even the government of the United States, while championing deregulation and competition domestically, is necessarily involved at the international level.

3. The unit of investment is very large. Almost all of the programs mentioned in the reports by country were over $5 million dollars; many were over a $100 million dollars. The planning horizon for companies, from research to product conception, design, production, marketing and post-sales support is very long, typically 10 years and longer. Governments must think in these terms as they become involved.

4. As the market for computer/communications technology becomes increasingly international, the highly competitive drive for technological and engineering advances, as well as the long planning cycle, to marketing-sale support, is forcing the computer/communications makers to consider new partnerships, joint ventures, alliances and mergers. Today there are about a dozen large computer companies and a dozen global communications companies. The trend is obviously towards more concentration of computer/communications companies around the world. The Japanese, for instance, predict that there will be only four computer manufacturers left in the world after the rigors of world-wide competition shake the computer/communications industry down. Cooperation is going to cross oceans and national boundaries and grow. Few companies will have the capability to go it alone - not even if they get government help as national champions. Government help is therefore inevitable even if it is only transitory, as the "constellations" of the future grow to global size.

10.2 NATIONAL STRATEGIES

Although in the past 16 years there have been numerous studies of computers and communications conducted in Canada by the Department of Communications, the Science Council of Canada, the Department of Industry, Trade and Commerce, and by other bodies, no explicit policy has emerged to the point where detailed plans of action have been laid out and adopted. The difficulty in arriving at such a formulation has been pointed out in the introduction to this report. But before arguing for such a course it is reasonable to ask whether a formulation of national strategy is desirable for Canada. To answer this question we ask to what extent producing a national policy has led to implementing effective plans in the countries under study. But what do we mean by effective? In what is perhaps a simplistic approach, we have chosen to focus on four particular aspects:

(1) the percentage of the domestic market for computers and communications that is met by indigenous industry;

(2) the export capability of the industry;

(3) the extent to which the computer technology has diffused throughout industry, manufacturing and business as a whole; and

(4) the sensitivity to the social impacts of computers, particularly to such aspects as privacy, unemployment, and social justice.

In Table C 1 we show a comparison of the national strategy articulations and effectiveness of the seven countries. It should be noted that the first column on Strategy Articulation refers to computer policies only. For all of the countries there is in fact an explicit policy with respect to telecommunications, and for all but the USA the implementation of this policy is the responsibility of national PTTs. Similarly, in Column 2 we have indicated only the indigenous share in the domestic <u>computer</u> market. For all countries with the exception of Brazil there is a strong capability for satisfying the domestic communications market by products manufactured nationally. In Columns 3 and 4, Indigenous Share and Export Capability, it would be possible to provide quantitative data and to some extent this has been done in the report. However, for present purposes it is adequate to limit ourselves to the qualitative indicators as shown.

As can be seen from this table only Japan, France and Brazil have well articulated national strategies. In the other countries there are calls for formulating a policy, except in the USA where the pressures are not high. The most important observation is that the presence of an explicit policy is no guarantee of effectiveness. Nevertheless, the formulation of a policy does help to focus attention on the criteria we have adopted for measuring effectiveness. When comparing the national

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TABLE C1: Comparison of National Strategy Articulation and Effectiveness

Country	Computer Strategy Articulation	Effectiveness of Computer Strategy			
		Indigenous share in domestic computer market	Export Capability	Technology Diffusion	Awareness of social impacts
U.S.A.	Implicit	Almost total	Strong	High	Medium
Japan	Explicit	High	Medium	High	Low
U.K.	Implicit	Modest	Medium	Medium	High
France	Explicit	Modest	Medium	Medium	High
West Germany	Implicit	Modest	Medium	Medium	High
Sweden	Implict	Low	Weak	Medium	High
Brazil	Explicit	Low	Weak	Low	Low

approaches we may say that Japan has a clearly articulated national strategy which seems to be very effective. An interesting case is France, where the national strategy recently formulated seems to be starting to show some visible results. The national strategy of Brazil, although rather well formulated, has yet to prove itself. The other side of the spectrum is the case of the USA which, having no explicit national computer policy, nevertheless has the most effective computer communications industry. The remaining three countries, the United Kingdom, West Germany, and Sweden, not only do not have explicitly articulated strategies, but also show rather modest performance.

In attempting to relate the relevance of this categorization to Canada it first must be said, although we have not presented the evidence to this effect, that Canada is among the countries which have no well articulated policy and have at best a weak performance in computer/communications. This puts it in company with the United Kingdom, Germany and Sweden. However it is important to note that in all three of those countries, although there has not been an over all strategy there has been, over several decades, a sequence of important steps which have had the effect of strengthening the national capability, especially with regard to supporting domestic industry, promoting education and increasing national awareness of the importance of the industry. In each case the sums of money which have been spent have been far beyond those committed in Canada. A result of these supports is that, if the effectiveness is not all that might be wished, nevertheless those countries are in a considerably stronger position with respect to export capability and meeting the needs of domestic markets than is Canada.

Should Canada emulate those countries which have formulated national policies and, if so, how should it go about the task? The answer to these questions cannot be provided within the framework of this report. To do so it would be necessary to have a critical evaluation of the results of the previous policy formulations and recommendations. A careful examination of the technological capabilities of Canadian industry with regard to communications and computers would have to be juxtaposed with that critical review. It is safe to say that another round of general policy recommendations would not be adequate. Unless these were fleshed out with detailed proposals for actions in specific sections of the computer communication industry, the exercise would be repetitious. Against the backdrop of other national approaches and experience, and guided by the knowledge of what has been done and where Canadian industry stands, a Canadian computer communications strategy could emerge.

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