

Current measures include loans from BANADE to medium and small enterprises; grants for NC-related studies in colleges and universities; and budget allocation to the R&D Center for Machine Tools (CIMHER) in the National Institute for Industrial Technology (INTI).

Meanwhile, the government of Cordoba Province is constructing a technology center, aiming to cooperate with companies in technology training and R&D. In addition, a part of the center is expected to be allocated to an NC group led by Prof. Apostoli of the National Technological College. Main objectives of the group are development of NC units, development of CAD systems, research on automatic programming such as automatically programmed tools (APTs), and the commercialization of flexible manufacturing systems (FMSs). In addition, based on the results of these activities, the group held a 2-month seminar in 1985 on FMSs, robots and artificial intelligence, with attendants from five countries. It was the first time such a seminar had taken place in Latin America.

The activities of the federal and provincial governments to promote the NC machine tool industry are being carried out separately. There is not enough integrated measures to expand the demand, basic guidelines to promote the technology and clear philosophy on how to encourage the NC machine tool industry. To improve this situation, federal incentive schemes, such as government loans, investment credits, subsidies and preferential treatment in international trade should be introduced.

As for technological measures, though certain schemes implemented by provincial governments are gaining positive results, no coordination is evident for the feedback of the research results in such organizations as the technology center, the NC group. For the effective use of the limited funds available, ways to achieve positive results with clarified targets and well coordination should be investigated.

The level of research taking place in research institutes in colleges has not fallen behind so much from that of advanced countries. Concrete research through industry-university cooperation should be performed so that academic studies can help the R&D needs of private companies.

3-3-3 Suggestions

(1) Clarification of targets of promotional measures

What should be clearly defined at first are the priority of development targets, funds availability, provisions of incentives and duration of measures. In Japan, for instance, various measures existed focused on the development of small and medium NC machine tools, with development term of 5 to 10 years. These measures are, 1) basic promotional measures established under the "Temporary Measures Law for the Promotion of Specific Machinery and Information Industries", enacted in 1978 with 7 years duration, and 2) preferential taxation treatment in the form of special depreciation

allowances for specified composite machines, and special system for streamlining machines for medium and small companies. Measures to modernize facilities necessary for the domestic production of NC machine tools are essential for Argentina.

(2) Promotion of demand expansion

The most urgent problem is how to increase domestic demand. During the survey, it was mentioned that there is a plan to double the currently existing 500 units of NC machines in the coming five years. To realize such plans, well coordinated efforts should be made to create new markets by developing the market in several industries such as electric machinery. Also it is important to develop the replacement needs of a vast number of old machines.

Measures for market expansion are very important, and the following measures are suggested.

- 1) Preferential taxation treatment: Coordinated policies to accelerate purchase incentives (BANADE loans), investment tax credits and special depreciations must be implemented. Also the scrap-and-build schemes of existing machines will be effective to expand domestic markets and to modernize old facilities. Preferential treatment should be provided for such scrap-and-build schemes, so that some percentage of the initial cost of a scrapped machine can be treated as expense and a special depreciation allowance can be applied to a new machine that replaces a scrapped machine.
- 2) Encouragement of diffusion of NC machines: Set up of facilities for diffusion of NC machine in major industrial cities is important.
- 3) Care must be taken regarding import duties to avoid the excessive protection for domestic manufacturers.

(3) Development of technology

It is said that the history of the machine tool industry symbolizes that of technological development of all industries. In Argentina, it is also important to establish the NC technology.

Here proposed are ideas for policies to improve the technological level of NC machine in Argentina.

- 1) The following two items are useful as policies for this purpose.
 - Tax reductions on R&D expenditures
 - Establishment of subsidizing systems for R&D
- 2) Strengthening of technical training

NC technology must be established through the proper combination of hardware and software. Long-term programs should be designed to train NC engineers to perform new tasks, with special consideration on the training of system engineers (SEs) to

develop computer software. The need for system engineers will become stronger as the field system engineering for various fields including factory automation (FA) grows.

There are very few technical training centers because of the long-held belief that on-the-job training is the best method of training. However, because of the strong requests for technological accumulation, the strengthening of technical training is important.

- 3) National technological research institute - review on machine tool centers in INTI and establishment of integrated NC technological center

The NC technology has not only directly improved machining techniques and production technology, but also indirectly influence the Argentine industry as a whole to improve the efficiency and quality of production.

Therefore, the establishment of an integrated technological center is suggested be considered in order to develop and diffuse technologies and software for not only NC machine tools but also robotics, CAD/CAM and automation, whereby the above-mentioned technical training centers may be included in this center as infrastructures.

- 4) Introduction of advanced technology in other countries

Sending engineers of NC machine to advanced countries for training should be promoted.

- (4) Nationwide campaign to enhance awareness of product quality

Few campaigns exist in Latin America to improve product quality and productivity. Quality control (QC) activities and QC circles at factory, and establishment of organizations such as Japan's Productivity Center and Japan Management Association is suggested.

3-3-A Appendix: Profiles of Surveyed Companies

(1) NC machine tool manufactures

(a) Turri S.A. (Buenos Aires)

- 1) A family company established in 1937. It started assembling general purpose lathes in 1945, and is the leader in quality and production in Argentina's lathe industry.
- 2) The operating rate is as low as 40% now. The number of regular workers fell to 30% of its peak (250 in 1979) in 1981. The number of direct labor is around 90, with an additional 20 technicians (high school graduates), 8 engineers (college graduates) and 9 supervisors (foremen). The monthly wage varies between US\$200 and US\$300.
- 3) The company is now producing two types of NC machine tools (with additional production plan of 2 types scheduled after the Machine Tool Show '86), 20 types of conventional lathes (T160 - 400) and 2 types of milling machine. According to production schedules, 30 to 36 units of NC machine tools will be manufactured in 1986, roughly double of last year's record of 14 units.
- 4) The company is establishing its NC-related technologies under a 5-year (1984-1989) license contract with Takizawa Iron Works, a Japanese firm. Major components are imported from Japan, NC devices and servomotors are made by FUNAC, ball screws by Niigata Engineering, and heads and saddles by itself. Its first NC product was completed under its own design in 1979. (The company has manufactured 45 Turri TN 360 CNC in the past ten years.)

(b) PROMECOR S.R.L. (Cordoba)

1) Key points on product development

The company relies heavily on two areas. The first is the development of products through its own technology. The second is services to customers - aiming at establishing domestic and overseas sales networks capable of providing sufficient after-sales services for its products. As a result of this policy, the company has built plants in Venezuela (in 1979) and in Brazil.

2) Machines developed and under development

The company started development of NC machines in 1979, and went into production in 1982 with sales beginning in 1984. The machines that have been developed are NC lathes (small, medium and large) and MCs (horizontal and vertical), and those under development are FMSs.

- 3) Components: NC devices (made by Siemens), ball screws and positioning devices (optical) are imported from West Germany. There are no imports from Japan because of the long distance to transport and the necessary after-sale services.

- 4) Sales volume: Still small with NC lathes and MCs. Sales including traditional types in 1985 stood at US\$7 million. The company has supplied some 40% of the specialized machines to produce Renault Automobiles in Argentina. There are 22 employees in the Planning and Designing Department, of which 10 are engineers in the fields of electronics, mechanical engineering, electric engineering, and pneumatic and hydraulic technology.

(c) CORACERO S.A. (Cordoba)

- 1) The company, established in 1959, produces specialized machines for automated manufacturing, with the main users being Mercedes-Benz, Ford and Fiat, as well as tractor makers such as Massey-Ferguson, John Deer, Perkins, Duetz and Eaton.
- 2) The company first introduced NC technology in response to customer demand. The first NC lathe, displayed in the Machine Tool Show held in May 1986, will be the main production item in future. Other products are a large (TAVR CNC) and small (CAYP 50) NC milling machine, although MCs are now in the designing stage. The company develops products under its own efforts by employing the Siemens-810, an NC unit.
- 3) Needs in various industries are revolve around the modernization and rationalization of plants in order to improve product quality by replacing old machines, a shift which has led to expansion of the domestic market.

(d) DARJE S.A. (Buenos Aires)

- 1) Established in 1960, the company specializes in the manufacture of milling machine. The number of employees, after peaking in 1979 at 75, has decreased steadily, and is now 40, including five design-sales engineers and ten technicians.
- 2) The company made inroads into the field of NC machines in 1979 by producing the AL-63-B4 NC milling machine under license contract with San Kocco Inc., an Italian firm. The company exhibited DARJE Series 7, a series of machines developed through its own technologies, in the Machine Tool Show in May 1986. The series consists of seven types of machines, all of which meet international standards. This development has meant the abandoning of the production of the company's traditional types of machines.
- 3) Response to the market: The demand on vertical milling machine accounts for 80% of the market. The need for NC milling machine has been recently increasing, especially due to demand for parts for automobiles. The company reportedly has decided not to commence production of machines other than milling machine, although some MCs will be displayed in a exhibition scheduled in 1988. In Argentina, the main reason for the introduction of NC machines is the lack of skilled workers, which has resulted from a) much fewer youths who want to become technicians due to the stagnant situation of industrial sector, b) technical training programs in schools which do not fit advanced technologies.

4) Sales records: US\$60,000 on a monthly average in 1986.

(2) NC machine tool users

(a) RESORTES ARGENTINA S.A.I.C. (Cordoba)

1) The company manufactures all kinds of coil springs for automobiles except suspension springs, with stainless steel wires of 0.3 to 13 mm diameter which are imported (48% of import duty). Monthly production is around US\$150,000 and it employs 75 workers, 59 of which are full-time.

2) The company, fully owned by the BURNAS group of the USA until 1982. 85% of capital is owned by Argentine interests and 15% owned by U.S. interests. Thus the bulk of its production technology has come from BURNAS. Production equipment consists of special machines, with lives of around 20 years for some and 5 to 6 years for others. Small machines are manufactured domestically but the larger types must be imported. Most machines were replaced 5 years ago, and automated machines will be installed in the future. A mini-computer with 15 terminals of RCA has been installed for accounting and production control.

3) Quality control has been achieved through control manuals. A system has been established to trace the cause of defects in materials, facilities and production methods. It plans to introduce inspection devices from Mitsutoyo in Japan.

(b) METALURGICA ROMA S.C.C. (Cordoba)

1) Sales reached US\$1.5 million in 1985, but were less than US\$0.2 million for the first half of 1986. It produces machined parts, most of which are custom designed, such as printer parts for IBM, gear columns for NC machines for Turri, and transmission boxes for Ford Brazil.

2) Three have been installed (one MV 35 and two MH 63s) from Mori Seiki, and one unit (BMC-6B) from Shibaura Kikai, because of the necessity to equip MCs in their role as a supplier to IBM. It introduced measuring devices from Mitsutoyo at a time when the first MC was purchased.

The first NC machine was introduced from Japan in 1980, because of the low price and short delivery term. In 1983, some representatives of Mori Seiki visited the plant and sold the machines on credit. The maintenance of these machines is performed by a service agent in Buenos Aires.

The new machines to be installed in the future, though depending on machining accuracy, might be procured from Argentine NC machine tool manufacturer.

(c) VENTURI HNOS. S.A. (Cordoba)

- 1) Founded in 1959, the company is manufacturing parts for agricultural machinery, mainly tractors, which accounts for some 85% of present production. It started to import and sell hydraulic pumps and motors from Linde in West Germany, and later began production themselves. At the same time, it began the production of forklift trucks under license. It is also producing steamrollers.
- 2) The current monthly sales figures includes US\$1 million for parts and US\$0.35 million for forklift trucks. The number of employees peaked at 380 in 1977, fell to 110 in 1980-1981, and is now 260. The present operating rate is 30% to 35%, fairly normal for the domestic market. It produced parts for 20,000 forklift trucks in 1977, but this figure has dropped to 6,000 trucks at present.
- 3) Three NC machines (SR-1 to SR-3) and two MCs (MV 35 and MH 61) were introduced from Mori Seiki in 1984 when it began production of forklift trucks. It will buy domestically produced NC lathes in future, but will continue to import MCs which depend on a high degree of preciseness. Domestic MCs were of low quality in their early stage of development, but have improved since then. While industrial modernization is boosting the demand for NC machines and MCs, only very few manufacturers of these machines are able to respond to such expansion. Venturi has installed the IBM 36 series computers which will be sufficient to perform management tasks for the next ten years.
- 4) Main destinations of parts are MASSEY-FERGUSON. Duetz, Fiat group and Zone Deer.

3-4 World Trend of Computer-related Industry

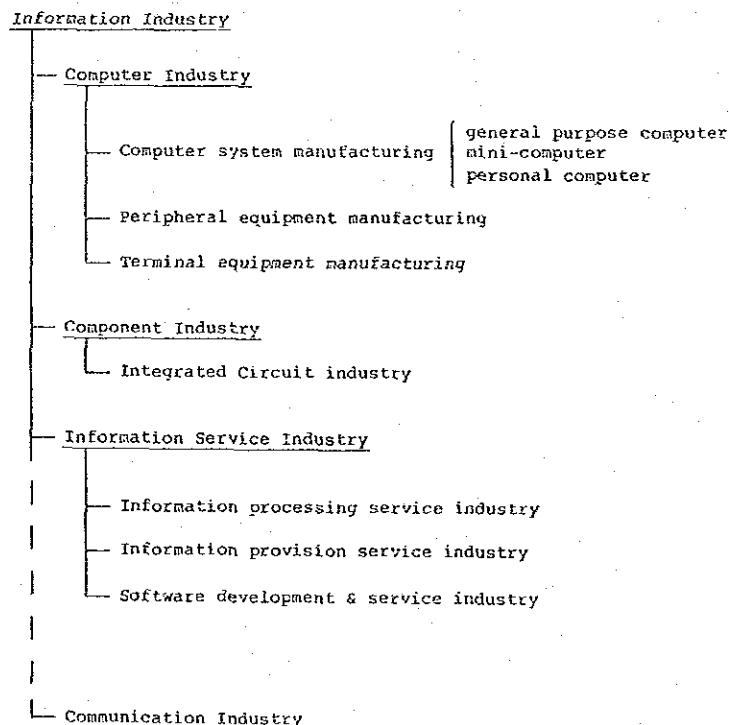
3-4-1 Introduction

(1) Characteristics of information industry (computer-related industry)

The impacts of the information industry on human life are comparable to those of the Industrial Revolution. The continued growth of the information industry is considered to be inevitable in the process of social modernization. Supported by the development of the computer and the progress of computer application technology, information technology is advanced sooner or later in every society, varying according to the needs and technical levels of different societies. In most countries, the question of how to advance information technology is one of the most important national issues. Many governments are attempting to foster the development of information industries as their nation's leading industry.

Information industries can be defined as those industries which process and provide information, or those which manufacture devices and systems that collect, prepare, process, transmit, and provide information.

As shown in the chart below, the information industry has been broken down into the computer industry, the component industry, and the information service industry, and communication industry, which has become increasingly relevant to the above two industries and now bears significant importance.



According to the products manufactured, the computer industry is divided into the followings:

- a) Computer system manufacturing: the manufacturing of central processors or units, peripherals, and terminal equipment.
- b) Peripheral equipment manufacturing: the production of different specified peripheral equipment such as storage devices and input and output devices on direct sales basis or original equipment manufacturing (OEM) basis.
- c) Terminal equipment manufacturing: the manufacturing of different specified terminal equipment, and sales to computer users and mainframe users. In addition, necessary software is developed such as that for the operating system.

The component industry, currently composed of the IC (Integrated Circuit) industry, is characterized by rapid technical innovation in support of technical progress of the computer.

Because of the large scale and sophistication of the computer system, the significance of peripherals and terminals has been growing, and the proportion of these peripherals and terminals in the computer industry has increased over the past few years.

The information service industry can be broken down into areas of information processing services, information provision services, and software development and service. The information service industry has developed during the recent decade; and its growth is remarkable. (For example, in the USA, the average growth rate of the industry for the past five years has been 24-25%, and this year US\$30-40 billion worth of sales is expected.) Particularly in regard to the personal computer, demand for software has sparked rapid development of the industry, along with the formation of many software houses. This has resulted in today's full realization of personal computer development. In Japan and Europe, the field of the personal computer is the industrial field where full-scale development is expected.

Characteristics of the information industry are summarized as follows:

- a) The information industry needs highly-advanced technology and its diversified technology promotes technical development in other industries.
- b) The information industry activities promotes improvement of productivity and energy-saving in business activities. Also, it creates new business lines and products which promotes structural changes in the industrial sector.
- c) The information industry is worldwide in scope and contains many industrial aspects such as research, development, and application, and production and sales of hardware, software, and systems. Adequate policies bring various business advantages.

- d) The final products of the industry are not just in the form of separated hardware and software but also in the form of integrated systems in which hardware and software are combined for provision of specific service.
- e) In the information industry, accumulation of both technical and business know-how is extremely important. Of particular importance to a computer system maker is the accumulation of know-how on applications of its products, through which a company can improve its competitive position in the market.
- f) The computer industry requires an enormous amount of capital. Particularly the mainframe computer manufacturer needs huge funds for research and development, and also needs large amounts of capital for the organization of a system of sales and maintenance systems.

Since 1960, in computer industry, sales have grown at a consistently high pace. They are expected to increase by more than 10% every year in the foreseeable future (see Figure III-3-2). The computer industry is developed worldwide, with IBM holding an overwhelming share. The major general-purpose computer makers referred to as the "mainframers" are six companies in the USA, including IBM, six companies in Japan, and three companies in Europe (Table III-3-14). It is of great importance for every computer manufacturer that its products be compatible with those of IBM, which has a 70% share in the world market.

Among sales of the computer industry, the proportion of peripherals has increased due to the expansion of systems and increased sophistication of applications. The proportion of terminals to all computer related products has been increasing due to the increase in on-line systems and the expansion of computer networks.

(2) Technological progress

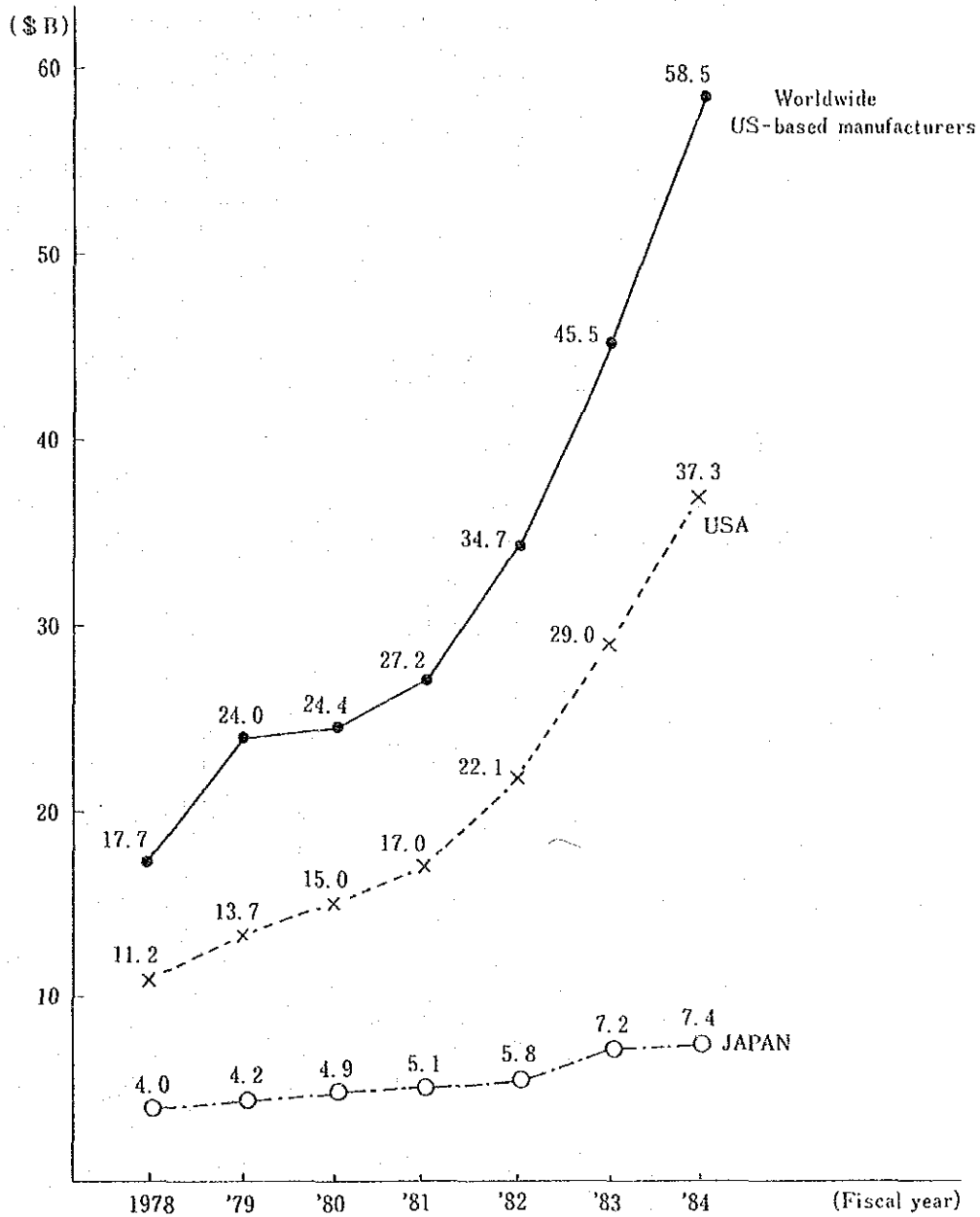
The computer industry can be described as the complex of advanced electronic technologies. The following is a discussion of several important technical trends.

(a) Progress of semiconductor technology (particularly IC technology)

Among the electronics technologies, it was IC (integrated circuit) technology that made the most remarkable progress and is most responsible for the rapid development of computers. The following table shows the development of electronic device from electronic tube to VLSI (very large scale integrated circuit). Not only did ICs raise computer performance at a stroke, but also enabled advances in miniaturization, lower pricing, and reliability.

Generation	1	2	3	3.5	4
Electronic Device	Electronic Tube	Transistor	IC	LSI	VLSI

Figure III-3-2 Computer Shipments



Source: International Data Corporation, Processor Data Book.

Table III-3-14 Main Computer Manufacturers

	USA	Japan	Europe
General-Purpose Computer	IBM Burroughs Honeywell Sperry (Univac) NCR CDC	Fujitsu Hitachi NEC Toshiba Mitsubishi Oki	ICL (U.K.) Siemens (F.R. of Germany) CII-HB (France) [Small size] Nixdorf (F.R.G.) Olivetti (Italy)
Mini-Computer	DEC Hewlett-Packard Data General Honeywell Texas Instrument IBM Prime Computer	Fujitsu Hitachi NEC Toshiba Mitsubishi Oki Yokogawa HP	--
Personal Computer	IBM Apple Computer Commodore International Tandy Atari Hewlett-Packard Wang	NEC Fujitsu Hitachi Oki Mitsubishi Sharp Casio	--

(b) Progress of processing technology

At first only code data could be processed by the computer, however, advances in processing technology have made possible the processing of other information such as characters, documents, graphics, images, and voices. The improvement of computer capability resulted in higher economic efficiency and expanded application possibilities, fueling the information revolution. Combined with communication technology, information technology will be promoted through new media and integrated networks in the future.

(c) Software technology

Coupled with the progress of hardware technology, software has made progress in all aspects of OS (operating system), language and application. As computer systems have become increasingly complicated and sophisticated, the importance of software in computer industry has further increased. Nowadays, it is desired to develop software which is easier to use and better in quality. Also the improvement of productivity in the production of software is becoming necessary to overcome the shortage of development personnel, and to curb rising development costs, which have far exceeded costs for hardware.

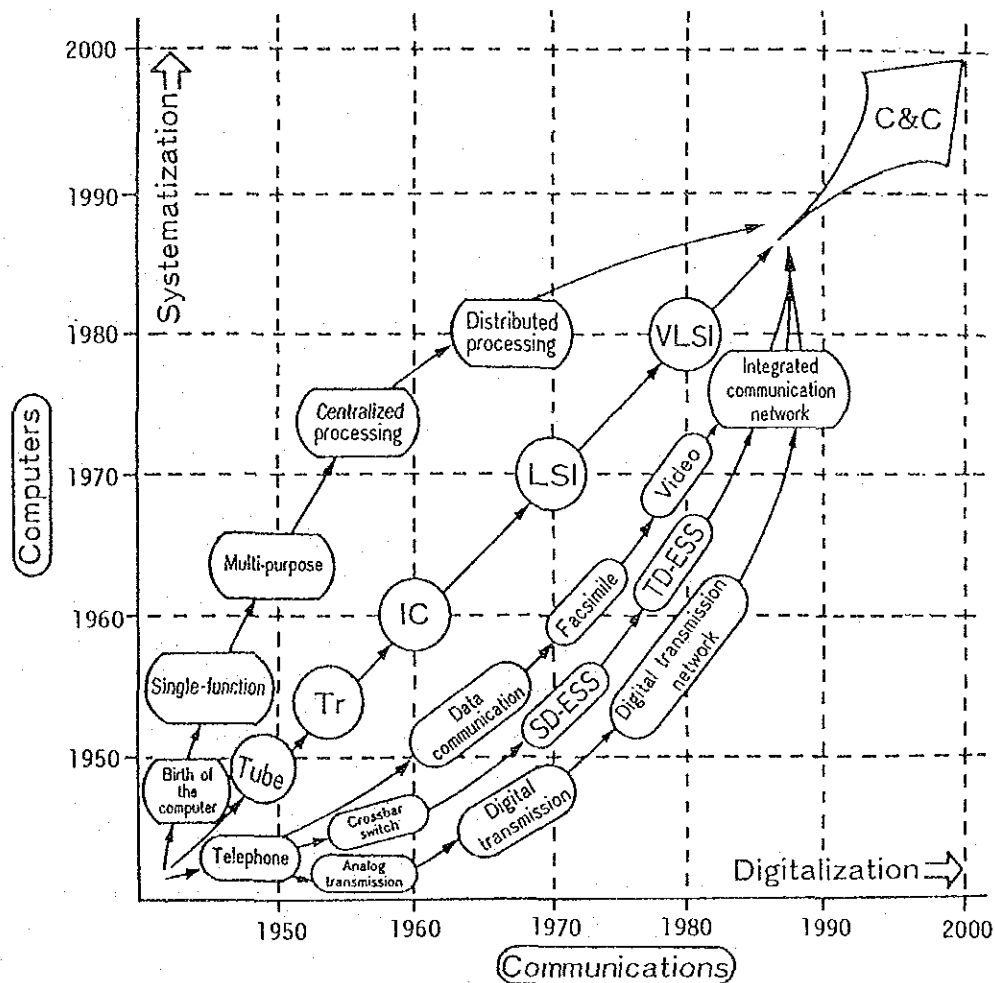
(d) Data base technology

In the information society, necessary information must be available for use at any time in the necessary form. During the past decade, more convenient data bases have been sought. Realization of this effort will substantially support the advance of the information service industry in the future.

(e) Man-machine interface technology

It is important for the advancement of information technology that many people are able to easily use computer systems. Since the advent of the computer, the man-machine interface has been the subject of research, from the aspects of both hardware and software. This subject still today leaves many unanswered questions and will be one of the most emphasized technical areas in the future (see Figure III-3-3).

Figure III-3-3. Development of Computers and Communications



Source : NEC

(3) Demand trends

From installation of the first commercial computer in the USA in 1951 to today, the demand for computers has consistently increased. As computer use has become more sophisticated and its fields of application has expanded throughout society, computer systems have been continually upgraded. The following is a discussion of trends in computer applications.

1) Purposes of computer usage

- Promotion of R&D and quality improvement in universities, public organizations, and industries
- Improvement of productivity and product quality in all industrial activities
- Improvement of speed and quality of service in administrative fields and business activities
- Accumulation, renewal, and application of necessary and useful information in every field

2) Fields of application

- Public use: Collection, analysis, planning, and implementation of information in national defense, administrative systems, and national projects
- Business use: R&D, office administration, production control, distribution, total management systems, etc.
- Home use: Home utility control, home security, hobbies (PC), etc.

3) Forms of systems

- High speed mass computation of simple routine work
- Integrated, centralized processing by large-scale systems (the use of the large high-speed computer)
- Distributed processing system which processes tasks more efficiently (the use of the distributed processor)
- Integrated network computer systems incorporating a large number of related systems and terminals

Moreover, development of the data base system, expert system, and CAD/CAM/CAE (computer-aided design/computer-aided manufacturing/computer-aided engineering) systems is undergoing for more functional, less costly, and higher performing systems.

(4) Industry trends

Since the advent of commercial computers early in the 1950s, the computer business has been developed under the leadership of US manufacturers, especially IBM. Japan and European countries are said to have lagged behind about ten years at the start. Though IBM now holds an overwhelmingly dominant position in sales of general purpose computer as before, some US makers and a few Japanese manufacturers have come to offer competitive systems to the market by utilizing their advantageous position in LSI, communication, and manufacturing technologies.

In today's world information industry market, US makers' sales share accounts for 80% on an installed basis, of which IBM is said to hold a 70% share. Under the present circumstances, Japanese and European computer makers' market shares are both below 10%. Therefore, IBM's product strategies exercise a great influence on the product and sales programs of competitors.

US makers other than IBM (referred to as BUNCH) and the Japanese and European makers have had various cooperative relationships, which can be classified into two areas: a) cooperation for the purpose of introduction of technology under license from the USA, which started during the 1950s and the 1960s, when the computer industry commenced in those countries, and b) other relationships which are results of strategy to increase their smaller share in the market. In either case, the interrelationship between companies changes rapidly (see Figure III-3-4).

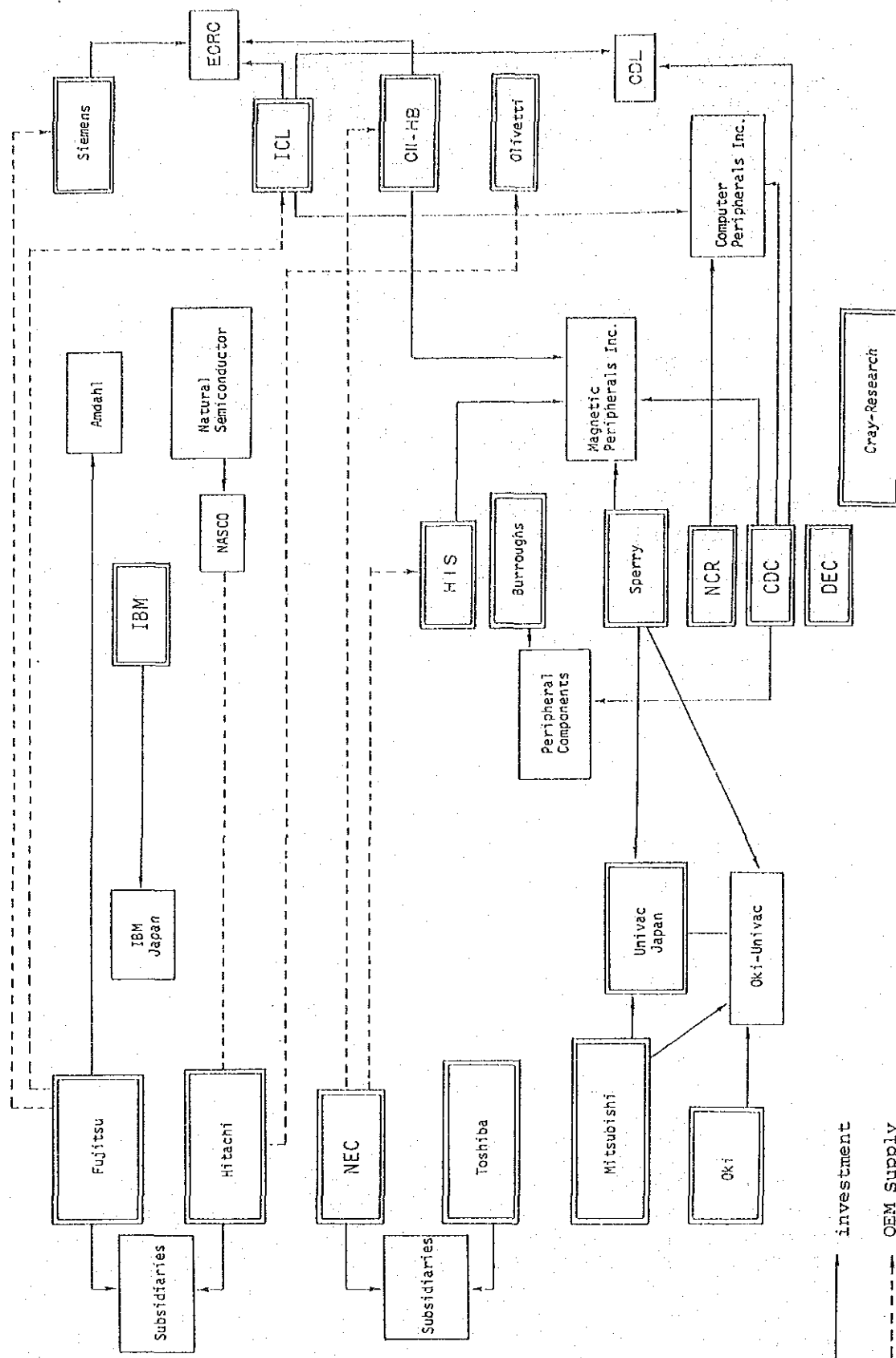
(a) General purpose computers

After IBM, UNIVAC, Burroughs, GE, and NCR launched commercial computers onto the market in the 1950s, demand increased consistent with the rapid technological progress in products. The past experience is that the periods in which the demand for computer grew were the periods when the new IBM computer model was put on the market.

The first stage of progress was brought on by the remarkably highspeed processing machines for routine simple mass work such as IBM models: the 1400 (medium size), and the 7000 (large size), which were sold in 1960. In this period, the US makers expanded their market share in the world, which were followed by some Japanese and European makers for their own commercial computers.

The second stage of progress was brought on by the introduction of series computers: computers featuring a design which allowed the use of common hardware and software interchangeable between small and large computer systems. This concept was employed in the IBM 3600 series, which was launched onto the market in 1964 (after which time such series computers became standard in the market). This is the period that some Japanese and European makers developed series computers and began to compete with US makers. Japanese makers gained strength rapidly, selling a large number of computer systems although major portion of technology were borrowed from the USA. World

Figure III-3-4 Tie-up Relationship Between Computer Manufacturers



economic conditions were quite favorable at the time for computer makers.

In 1970, IBM introduced its 370 series computers in the market. These were followed by the IBM-303X, -3081 (large size), -4300 (medium size) computer series in 1979-1980, which have better cost/performance. About that time, other US makers and Japanese makers introduced competitive series machines. The expansion of fields of application, and construction of high-quality on-line computer networks contributed to the expansion of the computer market. The computer market was growing by more than 10% per year at that time.

In Europe, although ICL (England) and Siemens (West Germany) sold series machines during the 1970-1980 period, their products were not well accepted by the market and only succeeded in maintaining their market share. However, they have been trying to recover from recent setbacks by cooperating with some Japanese and US makers over the past few years.

(b) Mini-computers

Mini-computers, typified by DEC's PDP1, were first introduced in the 1950s. Compared to the general purpose computer, which was designed mainly for office work, mini-computers were relatively inexpensive, highly efficient, and designed for purposes such as process control, scientific use, traffic control, and communication control. Today, mini-computers are not only the most widely used computer system in the application fields, but also are incorporated into other machine systems, enabling utilization in many areas. Sales are said to have now reached US\$10 billion in the USA. Since the beginning, DEC has been the leading company, currently holding approximately 40% of the mini-computer market. Hewlett Packard follows with approximately 15%, trailed by Data General, with about 10%.

(c) Personal computers (PCs)

As a result of the remarkable progress of IC technology, PCs based on the microprocessor were first developed in the latter half of the 1970s. Since 1980, prices have dropped substantially, resulting in a doubling of sales every year. As easy-to-use software has been developed, personal computers are widely used in office work, technical calculations, measuring control, education, and hobby fields, in addition to being increasingly used as the intelligent terminal for on-line systems. In Japan and the USA, personal computers are utilized in large amounts not only in offices, but also in homes. In the USA, sales amounted to nearly 10 million units and almost US\$20 billion in 1984. Competition is fierce, and personal computer manufacturers have been experienced financial fluctuation. In the industry, an oligopoly is formed by IBM, Apple, and Commodore in the USA.

(d) Super computers

In 1980, the progress of LSI technology brought about the super computer capable of processing complicated, high level, scientific, and technical calculations at a super high speed. There is a great demand for super computers in product development in defense, space, nuclear power and other high-tech industries. Keen competition has been developing among US companies CRAY and CDC and Japanese companies Fujitsu, Hitachi, and NEC.

(e) Peripheral or terminal equipment

With the advance of computer technology, peripherals now occupy a significant position in the system; their sales currently accounts for more than half of the entire computer industry. The expansion of networks and increase in the quantity of on-line systems are producing a rapid increase in the number of terminals. In some large-scale on-line systems, the amount of terminals occupies more than half of the entire system cost.

The development and manufacturing of peripherals and terminals requires high-level technology and scale of economy plays important role in production. The areas of peripheral production is large and progress is being made in a variety of high-technology areas such as picture processing, voice processing, large capacity file technology, and optical technology. Product development - the adoption of this new technology into marketable products - is under way. It is expected that as development of the products progresses, it will be divided into two areas such as special-purpose terminals and general purpose terminals, and between easier-to-use low-price terminals and high-function integrated terminals.

There are two types of peripheral makers: mainframers who also make peripherals, and specialized makers who supply one or more products. The latter is comprised both of companies strongly related to mainframers, and independent companies. The sales are divided into OEM supply, and direct sales to computer users. Most of those peripherals are compatible with IBM machines. Makers of peripherals which may be directly connected to IBM machines without alteration in hardware or software are referred to as being "IBM plug-compatible."

(5) International development of computer industry

The computer business, along with the increasing trade in related products, has been worldwide with the development of the world economy.

(a) International development of mainframers

As to the mainframe industry, IBM is promoting its worldwide business through the extension of their marketing network and through the formation of laboratories around the world (West Germany, Japan) and plants (several sites in Japan and Europe). Other US makers tried to expand their market by establishing international sales territories and coordinating with local companies. Japanese mainframers are not

only trading in the international market and increasing their exports year by year, but also providing an OEM supply to the US makers, technical supply to European makers, and business tie-ups.

(b) International development of software houses

Along with prevailing computer systems, software products are becoming important in the world market. Popularity of the personal computer in particular has spurred the formation of independent software companies, many of which produce and sell software as a means of promoting sales of personal computers. Recently, software houses in Japan and the USA, in addition to buying and selling software products, have begun cooperating with one another in marketing and technical areas.

(c) Construction of international networks and international data base services

In 1965, the data base management system was developed by IBM. It accumulated, updated, and offered valuable information to computer users through on-line system. Since then, data base system information services have been expanded to Japan and Europe through the formation of an international network. International data services is expected to be greatly utilized in the future as communication networks featuring the advancement of high technology and low cost. In 1983, the number of companies specializing in information services in the USA stood at 7,000, with annual sales exceeding US\$30 billion. A dozen of companies exceed the annual sales of US\$100 million and many of these companies are considering going international.

(d) Information network systems of multinational corporations

Some multinational enterprises are constructing an international network system to support worldwide business. As the value of information and need for high-speed business processing continues to rise, and technological advances drive costs down, such network systems will become more prevalent. Moreover, systems will not necessarily be wholly contained within individual companies, but will extend between companies. At present, for example, Society for Worldwide Interbank Financial Telecommunication (SWIFT) system network has greatly contributed to the smooth operation of international finance.

(6) Problems of information industry

The information industry has many problems because of the industry's complexity and high growth rate. The following is a discussion of "the software crisis".

Accompanying the rapid technical progress of the computer and its increasing market penetration, a shortage of software personnel and commensurate increase in software costs has become apparent. Since there is no doubt that software will play an increasingly important role in the future, it is highly probable that the shortage of

software personnel will hinder the development of information technology. To avert this, it is important government will take proper policies and the computer industry and users will make aggressive technological break through (personnel rearing, productivity improvements in software development, and automated production).

Other challenges are:

- Development of a man-machine interface which enables easier use of information equipment
- Implementation of data bases and protection of confidential data
- Assurance of computer security (from a technical aspect, as well as from aspects of equipment and general management)
- Providing reliable total systems fulfilling user needs, and devising preventative maintenance measures
- Adequate standardization of hardware, software, and overall networks

3-4-2 The United States of America

The USA has held a dominant position in computer industry since the development of ENIAC in 1946, the world's first computer. According to the Department of Commerce, the amount of computer hardware shipped in 1984 totalled US\$53 billion in the USA, and further, 10 - 20% growth rate is expected to be maintained in the future. The sales of software are estimated at US\$18 billion for 1984 and US\$24 billion for 1985. The rate of increase is expected to be around 30%. The US computer industry, as a major export industry comparable to the aerospace industry, achieved export of more than US\$10 billion in 1983.

The US manufacturers hold 80% share in the world computer market. IBM in particular controls about 55% of the world market. IBM's decisions have great influence on the rise and fall of the world's computer manufacturers.

(1) Government policies

The development of the US computer industry is supported by government policies in two respects. Firstly, non-intervention in industrial activities by the government; and secondly, a great emphasis on research and development, particularly in the form of increased military-related budgets. Even in the recent few years of huge financial deficit, the research and development budgets of the Department of Defense (DOD) and other government agencies have been showing a growth rate of more than 10% per annum.

(a) Huge research and development investment within the government budget

A little less than 50% of research and development investment in the USA is reportedly disbursed by the Federal Government, most of which is spent in the high technology area (including computers and semiconductors) out of the budgets of DOD, NASA (National Aeronautics and Space Administration) and NSF (National Science Foundation). Research and development projects within these government budgets are mostly contracted to private companies.

The development of computers has been pushed forward by studies commissioned by DOD and the results of such studies have been utilized effectively for development of computers for use in the private sector. DARPA (Defense Advanced Research Projects Agency), a part of DOD, has been taking the lead in the promotion of development projects, thus greatly contributing to the development of the computer industry throughout the world. These projects include the followings:

- Development of the world's first super-computer
- Development of time-sharing systems
- Development of packet exchange system
- Development of ARPANET (digital transmission network)
- Computer graphics applications

The following are the principal government-financed development projects which are under way at present:

- VHISC Plan (Very High Speed IC) (1979-1986)
- SCI Plan (Strategic Computing Initiative) (1984-1990): This is a computer development project under the leadership of DARPA, aiming at the development of AI (artificial intelligence) and new computer architectures.
- Development of Super-Computers: Feeling uneasy about the recent advances of Japan in the field of super-computers which threaten the dominant position of the USA, both the US government and the private sector are undertaking various projects. One of them is the NSF plan for setting up of Super-Computer Centers. It envisages establishment of ten centers in the USA between 1984 and 1990 to support research and development projects related to the super-computer. Furthermore, NASA is also pushing forward the development of super-computers to be used for the design and control of satellites.
- Space Station Plan (1985-1992): This is a project undertaken by NASA, which is reported to be commissioning studies involving some 500 private enterprises. At the present it is a stage of preliminary design.
- Ada Plan: The DOD, aiming at improved efficiency in software development and sophisticated software applications within the department, has selected a new programming language, "Ada", and is currently carrying out the necessary development for the spread of the language and for promotion of its applications.
- Development Plan for Optical Computers: This plan includes a joint development project carried out by McDonnell Douglas and Honeywell under contract from the US Navy, as well as a development project under way at University of California with the back up of DOD.
- Establishment of SEI (Software Engineering Institute) (1985-1989): This Institute, which is being established at the Carnegie Mellon University with a DOD subsidy amounting to US\$103 million, has the primary objective of improving computer reliability.

In addition to the above-mentioned government-financed projects, there are joint projects in the private sector, such as:

- Establishment of the Center for Integrated Systems (CIS) (1983): This center, set up at Stanford University with financing from 19 companies including IBM, GE, HP and TI, is the basis of industrial-academic joint research and development of high-performance ICs.
- Establishment of the Microelectronics & Computer Technology Corporation for Research and Development (1983): This organization, in which more than 20 companies participate, is engaged in research and development on advanced computer architecture over a period of five to ten years.

(b) Governmental utilization of computers and application of the Buy-American Act

The Federal Government is one of the largest user of computers, purchasing about 10% of all computers sold in the USA. The government was reported to have 21,234 computers (with 8,281 units held by DOD alone) as of 1982. Under the Buy-American Act, it is mandatory for all federal agencies to buy preferentially products of the US manufacturer, except the several cases such that 1) they are not produced in the USA, 2) they are unreasonably high in price (by more than about 10%) or 3) this purchase is against public interests.

(c) Legislative protection for semiconductor chips

Ten-year protection is provided by the Copyright Act covering the mask-designs of chips, which require a high financial outlay for their development.

(d) Others

Although they are not specifically intended to serve the computer industry, the following government measures also provide significant help.

- Tax reduction for research and development costs.
- Tolerant stance on the application of the Anti-Trust Law.
- Preferential tax treatment of exports.
- Relaxation of COCOM (Co-ordinating Committee for Export Control) restraints on computer exportation.

(2) Market trends

In the area of the information industry, the USA has been the principal country where new technology is first developed and commercialized, and new applications have been devised ahead of other nations. Although Japan now compares favorably with the USA in the field of hardware, the USA still has the absolute edge in the development of new technology, and also overwhelming strength in the field of software. Since both the US government and the private sector are exerting their utmost efforts side by side to preserve the nation's advantage in the area of high technology, this dominant position will be continued in the near future.

The US information industry or computer industry should be viewed from the following two angles, namely, the US industry as product suppliers to world markets, and the US industry in relation to the domestic market. Because shipment of US manufacturer occupy about 80% of world total shipment of computer, meanwhile the USA as a computer market is keeping 40% share of world total computer market.

(a) Recent trends in computer utilization

- 1) New developments in OA (office automation) and FA (factory automation)

Although computer systems have so far been employed mainly for uniform processing of large amounts of similar data, the recent advances in technology have made it possible, over the past few years for the computer to process small amounts of diversified work, which could not be dealt with in the past for technological and economic reasons. Now there is a move towards efficient systematization of the entire work of an office, or of overall factory operations.

- 2) Sophisticated production using CAD/CAE/CAM

Computer-aided design, engineering and manufacturing process control are making it feasible to manufacture high-quality and high-performance products.

- 3) Establishing the artificial intelligence market

Recently, requirements have arisen for the development of intelligent systems, capable of working flexibly in response to a changing situation, and the demand is also growing for expert systems, visual recognition systems, voice recognition systems, AI computers, etc. Some forecasts predict that the market for intelligent systems will reach a scale of US\$4 billion by 1990.

- 4) Development of networks

The development of computer systems has been the progress from batch processing to on-line processing. Computer systems and information systems are currently used effectively in many areas of economic and social activity, and as these systems have come to work in closer correlation, they have been combined to form networks, either as total systems or sub-systems, on an appropriate scale according to the application. In particular, the market for LAN (local area networks) has recently been expanding in scale.

- 5) Combination of computers and communications

As a result of the digitization of communication circuits, which were previously only a transmission medium, the integration of communications and computers is coming to be a reality. The expansion of digital networks is further promoting computerization and the development of information systems, and the achievement of higher efficiency.

- 6) Growth of the information service industry

The increased value of information, together with improved data base systems and expanded networks, have resulted in the rapid growth of the information service industry, which has lead to the expansion of the VAN (value-added network) software market.

(b) Product trends

It is said that currently there are nearly US\$300 billion worth of computers in the world, of which 80% have been manufactured in the USA, and a little less than 50% are used inside that country.

The nation's computer ownership as of the end of 1983 amounted to 10,717,500 units, valued at US\$126 billion, which can be broken down as follows by value:

General-purpose computers 57%
Mini-computers 20%
Small business computers 9%
Personal computers 14%

During the first half of the 1980s, computer ownership in the USA increased about 20% overall, while general-purpose computers showed the lowest growth of 5%. Mini-computers grew by 25%, small business computers by 15%, and personal computers showed an extraordinary 60 - 90% increase.

A decline of the annual growth rate to 15 - 16% is forecasted for the latter half of the 1980s, but there will not be any change in the present growth rate rankings, with personal computers at the top followed by mini-computers, small business computers and general-purpose computers.

Trends by size of computer are outlined as follows (for size classification, see Table III-3-15).

Table III-3-15 Size Classification of Computer

Size	Typical System Price
Large-Scale Systems	
General purpose computers	
High-speed scientific computers	US\$1 million -
Medium-Scale Systems	US\$100,000 - \$1 million
Small-Scale Systems	US\$ 5,000 - \$100,000
Personal Computers	US\$ 50 - \$ 20,000

1) Large-sized computers

As of the end of 1984, in the USA there are 10,570 large-sized computers, valued at US\$54 billion. The sales of large-sized computers have showed remarkable growth in the past. In 1981 sales

showed a nearly 20% decline from the preceding year, because of users' hesitancy in buying machines prior to the unveiling of new IBM products. However, the following year of 1981 saw a remarkable upturn of more than 50% in shipments, due to the marketing of new products by IBM and other manufacturers which developed machines to compete with IBM. In the year after that, the growth of sales leveled off at 20%. The sales of large-sized computers are expected to continue increasing at the same rate along with development of advanced systems, such as large-scale on-line data base systems.

2) Medium-sized computers

Medium-sized computers owned in the USA at the end of 1984 numbered 82,800 units, valued at US\$33 billion. During the period 1981 to 1983, sales performance of medium-sized computers was not so well. This was attributable not only to the slump in the overall economy but also to the confusion on the part of users, resulting from the emergence of high-performance mini-computers, personal computers and their network systems. In 1984, however, the shipments showed a 40% increase from the previous year, because of economic recovery and marketing of new products, such as the IBM-4381, and other machines manufactured by DEC and other mini-computer makers.

Medium-sized computers with considerably advanced capacity are used at present for a wide range of functions in large corporations, such as office systems, file serving, communications switching, engineering. They are also quite suitable for use as the central machine in small- and medium-scale companies. It is therefore generally expected that the demand for this category of computers will continue to be firm in the future at an average annual growth rate of 12 - 13%.

3) Small-sized computers

As of the end of 1984, there are 1,216,700 units, valued at US\$41 billion of small-sized computers in the USA. This category of machines are used in various ways such as small business systems or the 32-bit super-minis produced by mainframers such as IBM, utilizing high-performance microprocessors. The small-sized computers compete directly with personal computers in many ways, but they will certainly continue to be used widely because of their special features of low price and popularity. Since these computers have recently become compatible with communications and data base systems, while the prices are gradually declining, the demand is expected to keep growing at an average annual rate of 13 - 14%.

4) Personal computers

Personal computers showed a remarkable growth in the first half of the 1980s with the shipments doubling year by year. In 1982 there was a significant sales increase of 4.4 times in terms of the number of units and 2.2 times in terms of the value as compared with the previous year's performance (from 644,000 units in 1981 to

2,813,000 units in 1982, and from US\$1.9 billion in 1981 to US\$4.2 billion in 1982). IBM entered the area of personal computers in 1981, and by 1983 already occupied the position of leading manufacturer, with a 40% share (including compatible machines). Consequently, IBM's machines are expected to become the standard in the field of personal computers too. An increasing number of manufacturers are making their machines compatible with IBM's (at present, there are 25 major manufacturers making such compatible machines).

Although personal computers for home-use showed a rapid and substantial growth in demand in the beginning, and many manufacturers advanced into this area, most of them have since dropped out due to the subsequent slump in demand. On the other hand, personal computers for business use have been making a good showing, achieving a substantial growth rate.

Furthermore, portable computers, which made their debut in 1981, have been growing steadily. At present they are divided into two categories: low-end machines priced at US\$1,000 or less, and high-end machines priced at US\$2,000 - 4,000. There were 240,000 portable computers used in 1984, representing a 9% share in the personal computer market.

Table III-3-16 shows figures for the market size and degree of maturity for computers and peripherals.

(3) Business trends

The US market is completely dominated by the US manufacturers. But there are a few foreign products sold on an OEM basis such as large-sized machines imported, by Amdahl from Fujitsu, and by National Advanced System Corp. from Hitachi, and some peripherals imported mainly from Japan. There are reportedly about 500 hardware manufacturers in the US computer industry, who can be categorized into two groups: six main-framers led by IBM, as compared with other mini-computer and personal-computer manufacturers and makers specializing in peripherals.

Business competition in the computer industry is very keen in the USA, as demonstrated by the failure of GE among the large mainframe manufacturers. Also a large number of mini-computer manufacturers, except for several fast-growing companies, have disappeared from the market, which is expanding at an annual rate of about 20%. Furthermore, although many manufacturers started producing personal computers in 1980 and the present number of manufacturers said to be about 200 companies, it is reported that as the top four manufacturers occupy 70% of the market nowadays. Many of the other manufacturers, including some major companies, are dropping out.

The performances of the USA-based manufacturers for 1984 are as shown below (Figures III-3-5 and III-3-6):

	<u>Shipments</u>	<u>Installed</u>
Worldwide	(10 million units) US\$58.5 billion	(24.5 million units) US\$253.9 billion
USA	(7 million units) US\$37.3 billion	(17.7 million units) US\$156.7 billion

(a) Main-frame manufacturers

IBM occupies a share of about 70% in the US market. The main-framers are sometime described as "one giant and five pygmies" or "IBM and a bunch", and IBM holds an absolutely dominant position. The other companies' product plans may well be said to be merely countermeasures against the product strategy of IBM. IBM's share in the world market and USA market in 1984 are shown below:

	(World market)		(US market)	
	<u>IBM</u>	<u>IBM Compatible</u>	<u>IBM</u>	<u>IBM Compatible</u>
Large-scale	67%	77%	67%	77%
Medium-scale	23%	-	22%	-
Small-scale	14%	-	12%	-
Personal computers	20%	-	24%	-

(b) Movement towards development of super-computer

The USA has been taking the initiative in both development and application of super-computers for very-high-speed scientific calculation, which are indispensable in the fields of military utilization, space development, atomic power and new computer development.

The first machine termed a super-computer was the Star-100 developed by CDC in 1974, which was adopted by NASA, ERDA (Energy Research and Development Agency). Subsequently, CDC developed the Cyber 203 (in 1979) and the Cyber 205 (in 1980). Thereafter, Cray Research entered this field, developing Cry-1 and Cry-2. It is reported that in early 1984 there were 85 super-computers operating in the world, of which 50 were in the USA.

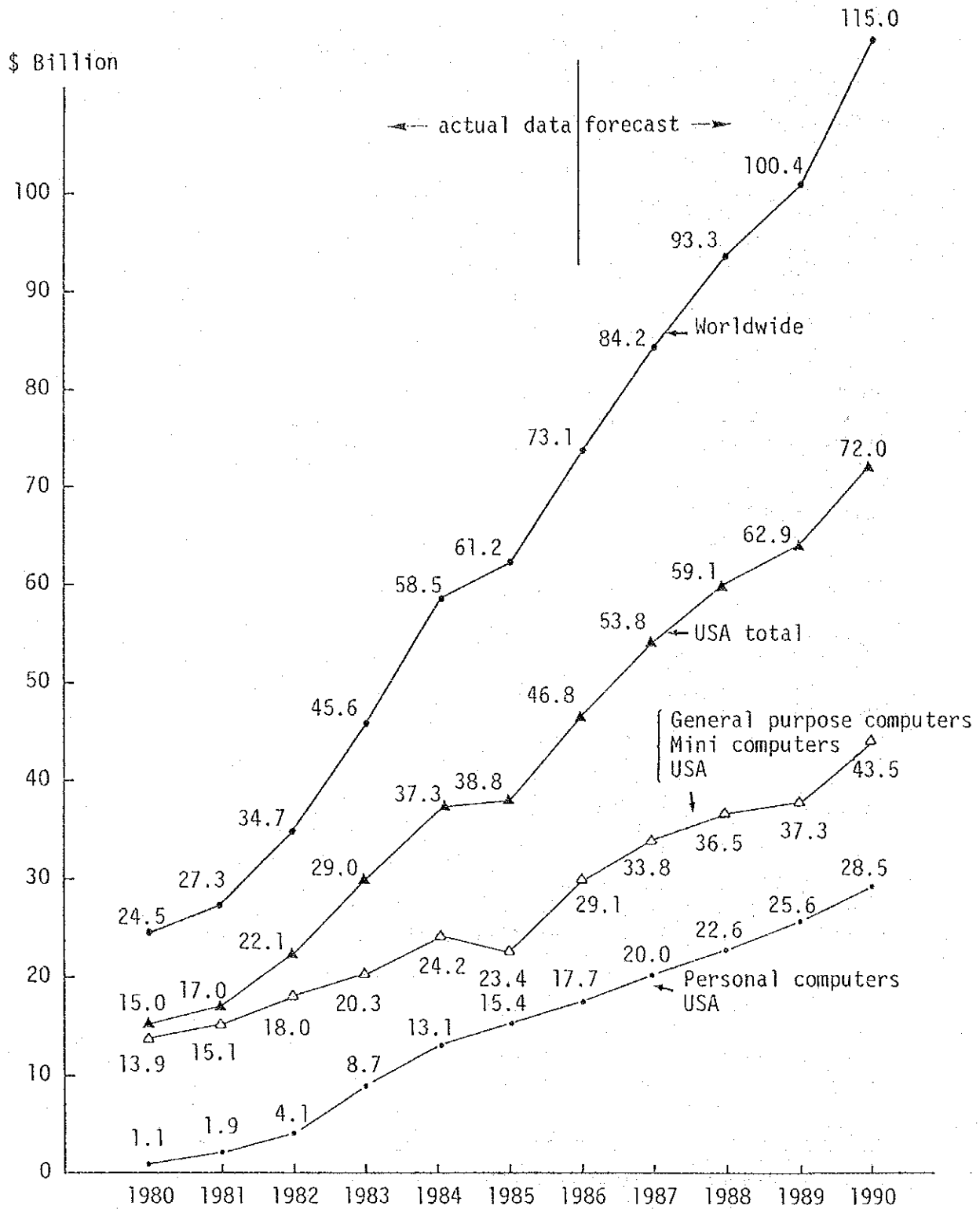
Meanwhile, Japanese main-framers, Fujitsu, Hitachi and NEC have successively entered the manufacturers market with their own newly-developed super-computers, giving rise of serious concern in the USA about the possible threat to its dominant position not only in the area of computers but also in the field of high technology. Consequently, the US government, academic institutions and private enterprises are now pushing forward various research and development projects, including the VHSIC plan and NASA projects, as mentioned above.

Table III-3-16 Computer Market

	(Market Size)		1984	1989	1994
USA Computer Market					
General Purpose	large	- expanding	Growing	Matured	Matured
Special Purpose	small	- large	Embryonic	Growing	Growing
Plug Compatible	very small		Matured	Aging	-
Small Business	small	- medium	Growing	Growing	Matured
Desk Top	medium	- small	Growing	Matured	Aging
Component	small	- medium	Growing	Matured	Matured
Terminals					
Dumb TRs	small		Matured	Aging	-
Intelligent TRs	medium		Growing	Matured	Aging
Multifunctional TRs	small	- large	Growing	Growing	Matured
Standalone WPs (Word Processor)	small	- very small	Matured	Aging	Aging
Clustered WPs	small	- very small	Matured	Aging	Aging
Application- Unique TRs	small	- medium	Growing	Matured	Matured
Peripherals					
Storage	large	-expanding	Growing	Growing	Growing Matured
Document Processor	very small-medium		Embryonic	Growing	Growing
Document Output	medium		Growing	Matured	Aging
Document Input	very small		Matured	Matured	Aging
Voice Input /Output	very small-small		Embryonic	Growing	Growing
Software (Standard or Semi-standard Software Products)					
System Utility	medium	- large	Growing	Growing	Matured
Application	medium	- large	Growing	Growing	Growing Matured

Source: Arthur D. Little Service

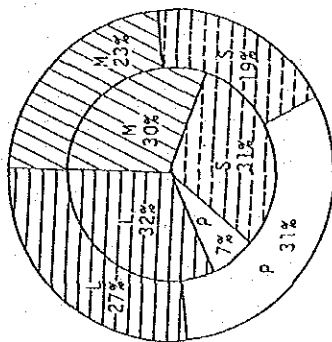
Figure III-3-5 Computer Shipments
- USA-based Manufacturers -



Source: IDC, Processor Data Book, 1985.

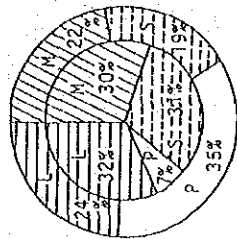
Figure III-3-6 Composition of Computer Shipments

(1) To World computer market



Shipments
1980 US\$24.5 billion
1984 US\$58.5 billion

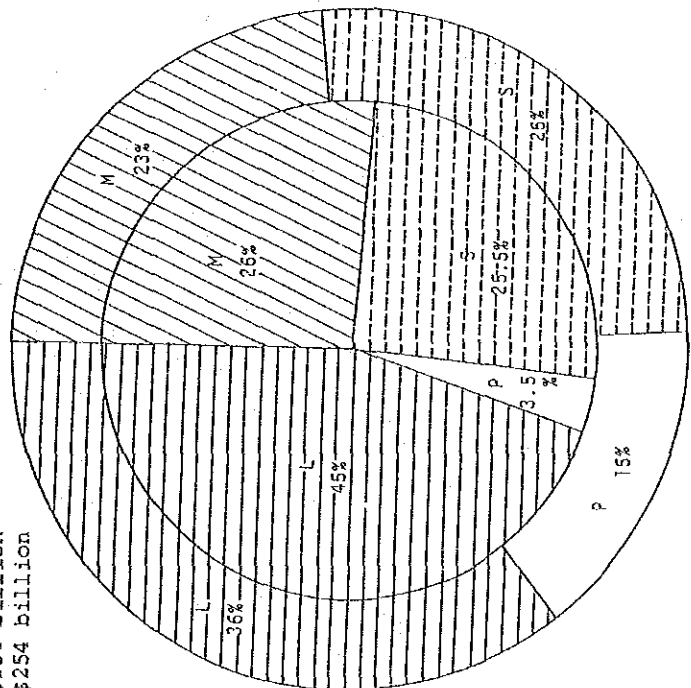
(2) To US computer market



Shipments
1980 US\$15.0 billion
1984 US\$37.3 billion

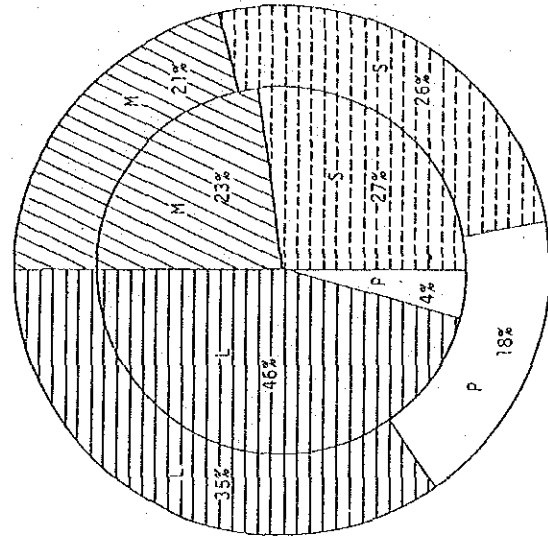
Installed base

1980 US\$134 billion
1984 US\$254 billion



Installed base

1980 US\$75.0 billion
1984 US\$156.7 billion



L: Large scale
M: Medium scale
S: Small scale
P: Personal computer

(c) IBM plug-compatible main-framers

IBM plug-compatible makers are firms which manufacture hardware compatible with the IBM machines for sale to IBM users at prices 15 to 20% below those of IBM products, without making getting involved in software development, which requires huge amount of investment. Their first success was in the area of peripheral units, and, with the support of consumers, they have grown along with the market expansion of IBM machines. Furthermore, in 1975 Amdahl first announced the sale of CPU products, and thereafter, several companies followed the movement.

However, in the face of IBM's counterattack in the form of repeated price reductions and new product introduction, many manufacturers were forced to drop out in and after 1970. At present, there are only two plug-compatible main-framers, Amdahl and NASA, and their future seems not so easy.

(d) Mini-computer manufacturers

DEC has taken the lead in this area since it put PDP-8 on the market in 1965. VAX-11/780, released by DEC in 1977, was a 32-bit machine of highly improved performance, and its capacity for a wide range of applications gave momentum to the increasing demand for mini-computers. These models, known as super-mini-computers, are currently leading this field. However, the situation does not necessarily warrant optimism because of the recent development of super personal computers and high-performance engineering work stations, in addition to the price cuts for small high-performance general-purpose computers.

Mini-computer shipments in the US market for 1983 amounted to US\$5.5 billion (\$25 billion on an installed basis), and sales are expected to continue to increase at an annual rate of about 20%. DEC, DG, HP, Prime Computer Corp. are the major manufacturers, and recently AT&T has commenced marketing its new project.

(e) Personal computer manufacturers

The personal computer is said to have originated with the Intel-4004, developed in 1971. However, the form of the present-day personal computer was not completely developed until BASIC came to be used for software, along with the development of Apple I in 1976, and further with the release of Apple II in 1977. Although the demand rose rapidly in and after 1979, keen competition among many producers, overproduction and stagnant demand for home computers resulted in a sharp rise in inventories in 1984, thus forcing many manufacturers, especially those producing home computers, to withdraw from this line of business (TI, Victor Technology, etc.). Apple Computers, Inc., at first showed a high growth, registering a 4.5-fold increase in sales (US\$1.5 billion) in the three years between 1981 and 1984. However it was forced to close down four factories in March 1985, reflecting the severe business climate.

IBM, which advanced into this field in 1981, has been rapidly expanding its operations, placing emphasis on personal computers for

business use. It achieved the position of top manufacturer, securing a one-fourth share of the market in only two years.

The market is dominated by only a few manufacturers: IBM (34.1%), Apple (32.3%) and Commodore (15.2%), with these three companies occupying 80% of the market. Other manufacturers include DEC, DG, HP, Wang, etc. It is reported that, reflecting IBM's market superiority, the number of manufacturers making IBM-compatible machines has increased of late, reaching a total of 25 companies.

Recent trend and forecast of demand for personal computer in the world and in the USA are shown in Figure III-3-7.

(f) Semiconductor manufacturers

The US semiconductor market, after continued high growth, encountered a depression in 1982, but rapidly recovered in 1983 along with the general economic recovery. Peaking in December 1983, however, the B/B ratio (orders/shipments) began to fall, reaching a low of 0.58 in December 1984. Under such circumstances, even major manufacturers were compelled to take such countermeasures as employee relocation, temporary suspension of factory operations, and selling off of IC factories. The intensified competition among manufacturers has lead to a sharp reduction in prices, decreasing further the business' profitability.

As a result of an upturn in demand after the last half of 1985, the B/B ratio has recovered, exceeding 1.0. However, imports of Japanese ICs, which have high competitiveness both in quality and in price, are on the increase, sparking off the USA-Japan debates on trade friction.

According to the estimates of SIA, the value of shipments of American semiconductors amounted to US\$11.8 billion for 1984, accounting for 45% of the world's total.

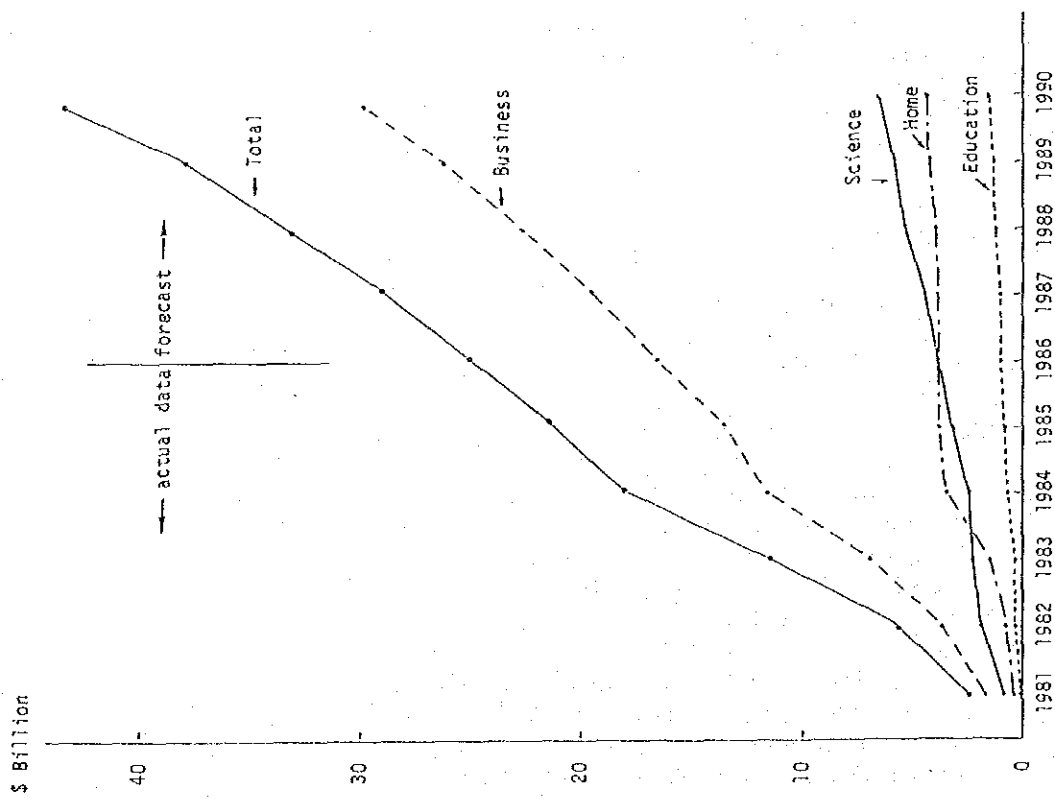
(g) Peripherals manufacturers

The market for disk units, enjoying the highest demand among peripherals products, grew steadily until 1983 and manufacturers expanded their business accordingly. Around the latter half of 1984, however, many companies including major manufacturers began to reduce their production levels, making a switchover to overseas production in the face of the Japanese products' advance into the US market and keen price competition. Nowadays, there is a tendency for manufacturers of the USA to produce only the large-capacity and high-performance units in the USA, while relocating the production of low-priced units in cheap-labor and high-technology countries such as the Republic of Korea, Taiwan, Hong Kong, and even Japan.

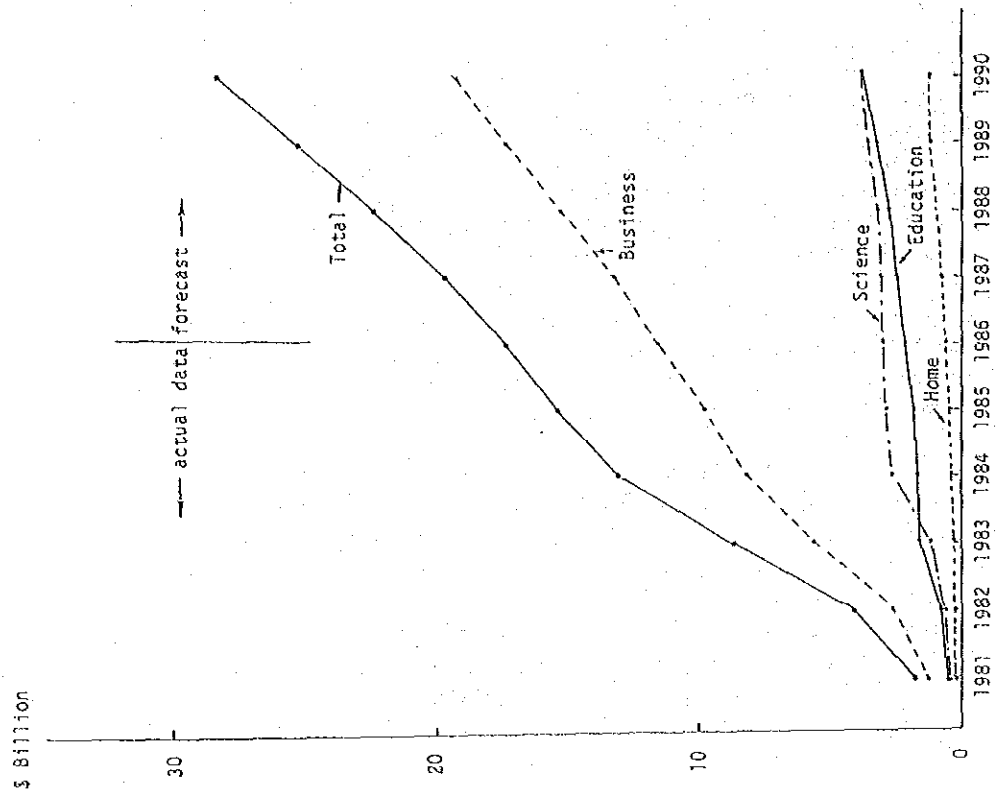
Displays, having high marketability, are reported to account for 17% of the peripherals market in the USA. In this field, there is also a movement to transfer the production to overseas, in order to cope with the cut-throat competition.

Figure III-3-7 Personal Computer Trends by Application

(1) World



(2) USA



Source: IDC, Processor Data Book, 1985.

Table III-3-17 Information Service Companies by Type of Business (1983)

Business type	No. of companies	Sales (US\$ million)		Growth rate* (%)	Employees		Sales per employee (US\$1,000)
		1982	1983		Number (1,000)	Growth rate* (%)	
Processing service	2,150	12,743	14,570	14	215	-5	68
Software products	2,250	5,408	7,507	39	94	38	80
Professional services	1,400	5,329	6,424	21	98	-11	66
Turn-key systems	1,200	3,322	4,125	24	52	13	79
Total	7,000	26,803	32,626	22	459	2	71

Source: ADAPSO

Note : * To the previous year.

Printers account for about 10% of the USA peripherals market. This market is completely dominated by three Japanese manufacturers with automatic and large-quantity production facilities.

(h) Information processing services

There were reportedly about 7,000 information service companies in the USA as of 1983, with 460,000 employees and sales amounting to US\$32.6 billion. By type of business, software product companies are the largest in number (2,250, or 31%), while processing service companies have the biggest number of employees (215,000, or 45%) as shown in Table III-3-17. Software product companies show a high rate of growth, with application software companies in particular making a good showing the annual growth rate of 38%.

(4) Import/export trends

In the USA, which is currently suffering from a large trade deficit, the electronics industry still remains one of the leading exporters. The computer industry in particular is showing a good performance recording a substantial surplus in the total trade account, taking advantage of its overwhelming strength. In its relationship with Japan, however, import of the USA from Japan exceeded the exports of USA to Japan in 1982, and thereafter the gap

has been widening year by year, with the result that this has become a point of conflict between the two nations.

According to the Department of Commerce, US exports related to computers for 1983 amounted to US\$10,570 million (increase of 16% from the previous year), and imports totalled US\$4,360 million (increase of 90% from the preceding year), giving a surplus of US\$6,210 million.

About 53% of the exports went to seven European countries and Canada in 1983, with around 20% going to Asian countries.

The recent trend is characterized by the following points:

- 1) A narrowing trade surplus due to a sharp increase in imports despite the continued growth of exports;
- 2) Expanding exports to Asian countries, although European nations remain the largest consumers;
- 3) Substantial increases in imports of peripherals and components; and
- 4) The widening trade deficit with Japan.

3-4-3 Western Europe

The European countries have trailed behind the USA and Japan not only in the development of computer and associated industries, but also in the computerization of society and industry. So far, the UK and France have pumped a great deal of capital into such measures as developing main frame manufacturing companies, to form the nucleus of the computer industry, but the hoped-for results have not been fully realized due to the necessity of frequent review and revision of these plans. It is certain, however, that such efforts will lead to future development in the computer industry of those countries. Having formed a new appreciation for the recent rapid advances in technology, the brisk pace of development of social information systems and the magnitude of their impact on other industries, the major European countries are now endeavoring to close the gap on the USA and Japan by pushing forward large-scale projects, either as an EC group or individually and making positive investment based on various promotion plans. The average annual growth rate of 17% forecast in the International Data Corporation (IDC) Report for the European computer market may not, in fact, prove over-optimistic, considering the trend toward increased use of computers not only in business fields such as research and development and office and factory automation, but also for various areas such as government administration, medicine, education and home use.

(1) Government policies

The European electronics industry, and the computer industry in particular, is influenced both by overall policy decisions taken by the EC group as a whole, and by specific measures adopted by individual countries' governments.

The EC group's common measures are as follows:

- Emphasis on the importance of the electronics industry, particularly computers, and measures for promotion of the industry,
- Manufacturer collaboration within the EC,
- Joint research and development on new architectures, hardware and software,
- Standardization of technological products, setting of common standards for hardware, development of common software and improvement of standardized networks,
- Upgrading of data bases,
- Development of VLSIs and joint efforts toward the development of advanced information processing technology.

Through these measures, the EC group aims to catch up with the USA and Japan, not only to meet expanding local demand but also to foster an export industry. The largest EC project currently underway

is a ten-year plan called ESPRIT (European Strategic Programme for R&D in Information Technology) which was begun in 1984. Many European enterprises participate in the project including major electronics and computer manufacturers such as ICL, CII-HB, AEG-Telefunken, Nixdorf, Siemens, IBM Deutschland, Philips and Olivetti, and it is funded 50% from the EC budget and 50% by participating enterprises (amounting to about US\$1,160 million over the first five years).

(a) United Kingdom

The UK, where the importance of the electronics industry was realized at an early stage, has been taking measures to promote the growth of the computer industry in particular since 1960, but thus far no satisfactory results have been obtained. Today the government, while endeavoring to improve economic efficiency through austerity measures and the lifting of protectionist measures against the background of a harsh economic climate, is positively pushing the development of new technology. It is also fostering the information industry through participation in the EC ESPRIT project and also through the promotion of various domestic projects in concert with manufacturers and academic institutions.

1) Measures taken to promote the information industry

1963: ACTP (Advanced Computer Technology Project) - Financing for R&D activity

1968: ICL (International Computer Ltd.) was created under the auspices of the government, by consolidation of ICT (International Computer Tabulating) and EE (English Electric). The government owns a 10.5% share.

1972: CCA (Central Computer Agency) was created - in 1980 renamed "CCTA" (Central Computer and Telecommunication Agency) - as an agency for the promotion of public sector preferential purchase of UK-manufactured computers.

1973: SPS (Software Product Scheme) created for subsidization of the development, sales and spread of software, mainly of application packages.

1978: - Inmos Ltd. established by NEB (National Enterprise Board), and placed under private management in 1984, for the development, production and sales of VLSI and micro-processors. The government has a 75% share and has provided financing up to a total amount of £100 million.

- MISP (Microelectronics Industry Support Programme) has been created for extensive subsidization of the microelectronics industry in relation to activities ranging from R & D to commercialization. MISP 2 was announced in 1984 and is to continue the programme until 1990.

- MAP (Microprocessor Application Project) - This project aims at the subsidization of the microprocessor industry in areas such as promotion, education and training in microprocessor technology.

2) Other research and development subsidies

- Subsidization of CAD/CAM
- OAP (Office Automation Project)
- Grants to all secondary schools and primary schools for the installation of personal computers
- Robotics - assistance for robotization including consultancy fees
- Expansion of the ITC (Information Technology Center) network for education and training of unemployed young people in computer skills, and helping them find jobs
- Measures for promotion of data communications - utilization of videotex and teletext

3) The Alvey Plan (begun in April, 1983)

Commenced as a part of "A Programme for Advanced Information Technology", this is a project to develop the next-generation super-computer through collaboration between the government, manufacturers and academic institutions and is expected to spend £350 million (£200 million provided by the government and £150 million by manufacturers) over five years. Under the plan, research and development related to VLSIs, voice recognition devices and high-speed data communication systems is already underway.

4) Liberalization of telecommunications activities and privatization of British Telecom (BT)

These measures aim at the vitalization of the telecommunications industry by removing the BT monopoly and also at developing BT as an enterprise to compete with AT&T and IBM by lifting past limitations on its activities. Privatization enables BT to engage in the manufacture of computers and semiconductors, sales of communication equipment, home banking and shopping services, etc.

(b) France

In France, too, great emphasis is placed on the computer industry, which is considered to be a high technology industry of great promise and also important in its contributions to productivity improvement in other industrial areas.

The Ninth Five-year Economic and Social Development Plan (1984-1988) also puts the highest priority on the development of the electronics and computer industry, calling for preferential investment, reorganization of the industry and international cooperation in this field.

1) Promotion programs for the industry

Motivated by the acquisition of Machine Bull, the largest French computer manufacturer, by GE (USA) in 1964, and by the US embargo on computer exports to France, the French government has pushed the following measures for promotion of the computer industry with emphasis on developing domestic manufacturers.

- The First Plan Calcul (1966-1970): Principally concerned with the development of CII (Compagnie Internationale Pour l'Informatique)
- The Second Plan Calcul (1971-1975): Strengthening of CII, upgrading of software and computer parts, etc.
- Support of CII-HB (1976-1980): Positive backup for the domestic manufacturer formed by the merger of CII and Honeywell Bull in 1975
- Assistance for development, manufacture and export of peripherals (1976-): A budget of Fr 600 million for the buildup of the IC industry
- The Third Plan Calcul (1979-1983): This was a comprehensive promotion plan for the computer industry, pulling together the above-mentioned measures in addition to strengthening of applications technology, with a budget of Fr 2,250 million.
- Strengthening of office automation technology (1981-1985): Budget of Fr 1,000 million
- The government's complete take-over and rehabilitation of CII-HB (1983-): This was intended to develop an organization capable of producing and marketing general-purpose computers ranging from the large-scale to the small-scale, mini-computers, OA (office automation) equipment and peripherals.

2) Five-year Electronics Plan (1982-1986)

Objective

- Reconstruction of the large-scale personal computer industry
- Increased security of technological independence
- Wiping out the trade deficit
- Attainment of growth in the electronics industry at an annual rate of 3 - 9%, and a production level equivalent to 4% of GNP by 1986.
- Raising the level of technological expertise to match that of the USA and Japan.

Research & Development Projects

- Design of VLSIs by computer
- CAD/CAM
- Software development

- Translation by computer
- CAI (computer-aided instruction)
- Visual displays
- Basic module for mini-computers and microcomputers
- Home electronics systems

Investment in the plan, in which electronics enterprises including foreign-affiliated companies are participating, is estimated to total Fr 140 billion, of which Fr 50 billion will be appropriated by the government.

3) Mobilization plan

This plan aims at the improvement of international competitiveness in computer and associated industries by placing emphasis not only on scientific research but also on the promotion of industry through the invitation of selected experts to participate in specialized training activities. The plan will promote:

- intensified research activity at the national level;
- coordination and improvement of efficiency in the activities of public research institutions; and
- transfer to private enterprises of the research results obtained in national projects.

The budget for the plan is Fr 3.3 billion for 1984 and Fr 4 billion for 1985.

(c) West Germany

Unlike the UK and France, West Germany did not need to establish a nucleus manufacturer at the initial stages, since the prominent company Siemens was already in existence. During the 1970s, West Germany carried out general and wide-ranging computerization programs under the first to the third plans, and in the 1980s, it has pushed forward various development programs. At present, the greatest emphasis is being placed on the micro-electronics industry, focusing on semiconductors in particular.

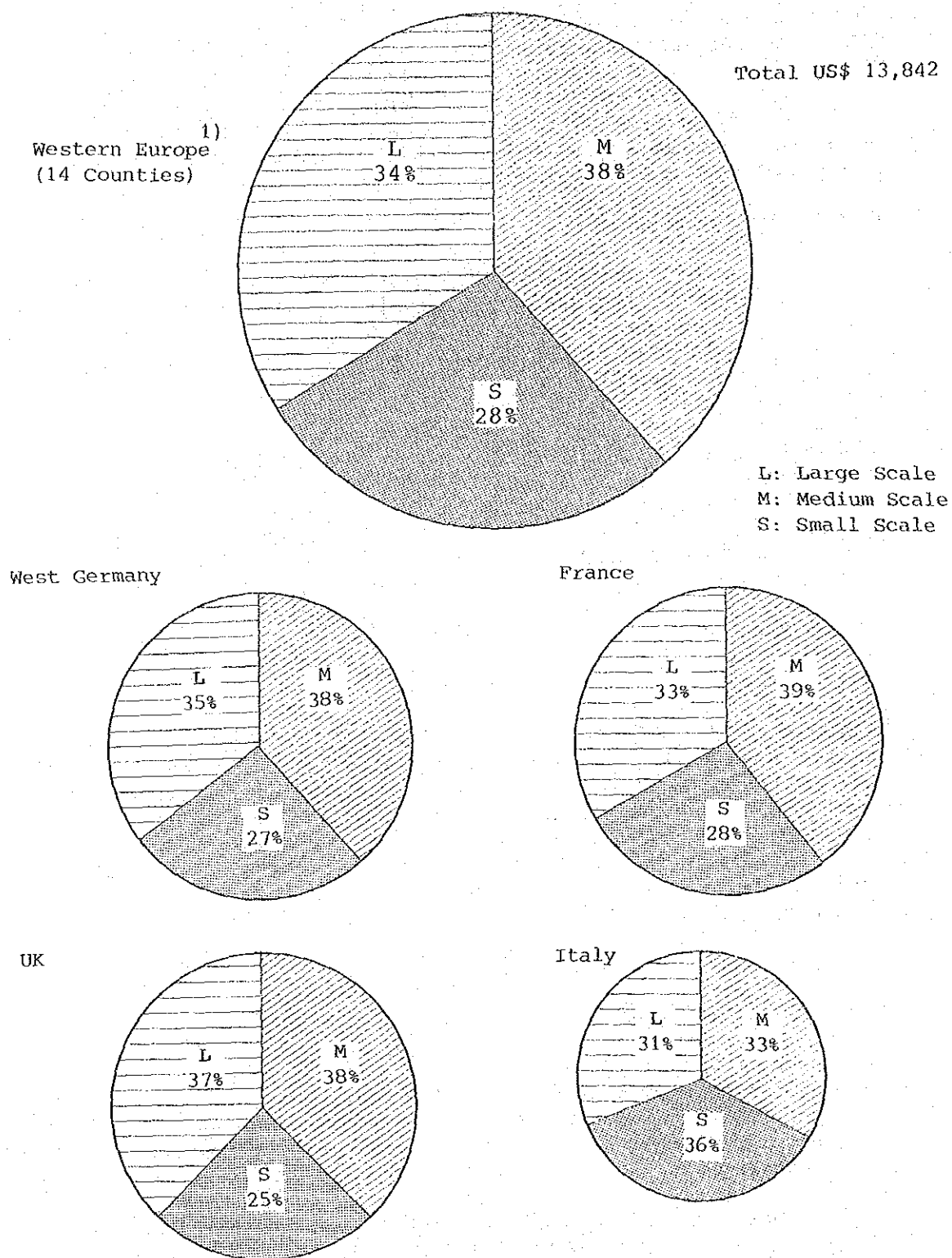
1) Promotion programs for the industry

a) The First Promotion Plan (1967-1970)

- Budget: DM 353 million,
- Objectives: Development of an advanced computer system and the introduction of a network for governmental and public offices, and development of various computer systems and their improvement.

In 1968, GMD (Gesellschaft für Mathematik und Datenverarbeitung mbh) was set up under BMFT (Bundesministerium für Forschung und Technologie: Ministry of Research and Technology) to implement the promotion plan.

Figure III-3-8 Computer Shipments by Size (1984)



Source: International Data Corporation

Note: 1) West Germany, France, UK, Ireland, Italy, Netherland, Belgium, Sweden, Denmark, Norway, Finland, Switzerland, Austria and Spain.

b) The Second Promotion Plan (1971-1975)

- Budget: DM 1,110 million,
- Priority was given to subsidization of computer manufacturers, education of their personnel and development of applications technology.

c) The Third Promotion Plan (1976-1979)

- Budget: DM 1,575 million,
- The plan followed up and expanded the second plan, spending DM 1,100 million for research and development in the computer industry and in the area of applications.

2) New 5-year Development Plan (1984-1988)

Budgeted at DM 3 billion, the plan includes the following major projects:

- Development of optical technology and fundamental optical communications technology
- Development of software for interfacing between different types of computers for inter-laboratory networks.
- Development of peripherals for microelectronics
- Development of key microelectronic components
- Development of CAD technology for ICs, computers and software
- Development of new computer architectures
- Development of pattern recognition technology, etc.
- Development of production technology such as CAD/CAM systems, robotization, etc.

3) Other promotional measures

- Subsidization of venture businesses
- Subsidization of labor costs for research and development

(2) Trends in computer market

Computer shipments in 14 West European countries for 1984 amounted to about \$14 billion. Assessed by size, large-scale computers made up 34%, medium-scale computers 38% and small-scale computers 28% of this total (see Figure III-3-8). Broken down by country, West Germany occupied 20%, France 19%, the UK 22% and Italy 11% of the market, with these four nations accounting for 72% of the total (see Table III-3-18).

Although computerization in Western Europe has progressed at a slower pace than in the USA and Japan thus far, the use of computers is steadily increasing, and higher growth is expected from now on for all sizes of computers, particularly medium-scale computers.

While the above-mentioned four major countries account for 72% of the West European market, other European countries are also expected gradually to increase their use of computers, although the shares of these major countries will not vary much over the coming five years.

The shares of major computer manufacturers, in terms of US dollar value of 1984 sales are shown in Table III-3-19. IBM's share of the European market stands at around 40%, while the share of all US manufacturers including DEC, HIS, Burroughs ranges from 60 to 80%, although it varies a little from country to country. On the other hand, the European manufacturers have certain shares of their own home markets, and their share in Western Europe as a whole stands at a little over 20%.

(3) Movements among manufacturers

(a) United Kingdom

The UK produced about US\$2.6 billion worth of computers and related products in 1983, or about 4% of the world market, showing an annual growth rate of 12%. The country is said to be seriously concerned, however, about its inferior position as compared to the USA and Japan, and also about its dependence on imports in this field, which amount to over 50% of sales.

1) Developments at ICL

ICL, having become the leading computer manufacturer in the UK with backing from the government, is presently showing good performance and is making positive approaches to development of new products through joint research with other major European manufacturers and in technical tie-ups with Fujitsu. Its line of products ranges from very large-scale to small-scale computers. Recently it has begun to produce personal computers and is also aiming at entry into the VAN service field jointly with AT&T.

2) Mini-computer and office automation equipment manufacturers

There are many local manufacturers in these fields, but they are inferior in strength to the American manufacturers led by DEC. However, leading manufacturers of electronics, electrical and communications equipment, such as GEC (General Electric Co.), Ferranti Group and Plessey Group are endeavoring to upgrade their mini-computer series, while at the same time are concentrating on the development of OA-related equipment and network systems.

3) Semiconductor industry

Local producers include Ferranti, Plessey and Immos (formed in 1978 as a publicly-owned enterprise, but placed under private management in 1984). Leading American and Japanese manufacturers are also producing semiconductors in the UK. The output for 1984 amounted to US\$500 million, and the production for 1985 is estimated to exceed US\$700 million.

4) Information processing service industry

The sales of software and information services have grown at an annual rate of 13% since 1971. Sales amounted to some US\$3 billion in 1984 and 15,000 firms were operating in this field, employing

Table III-3-18 Computer Shipments by Country and Size

(US\$ million)						
	1984			Total	%	1990 Forecast
	Large	Medium	Small			
West Germany	(225) 990	(3,770) 1,079	(28,670) 749	2,819	20.3	7,417
France	(195) 875	(3,925) 1,039	(31,650) 728	2,642	19.1	6,630
U.K.	(264) 1,132	(5,370) 1,143	(35,150) 746	3,022	21.8	7,574
Ireland	(6) 31	(121) 28	(1,520) 29	88	0.6	218
Italy	(118) 470	(2,110) 514	(25,750) 547	1,530	11.0	3,843
Netherlands	(45) 200	(1,090) 245	(6,300) 165	610	4.4	1,516
Belgium	(44) 212	(705) 189	(3,800) 101	502	3.6	1,237
Sweden	(47) 201	(800) 194	(4,900) 124	520	3.7	1,472
Denmark	(28) 133	(395) 101	(5,000) 105	339	2.5	838
Norway	(14) 75	(415) 92	(4,280) 115	283	2.0	720
Finland	(12) 51	(354) 80	(2,390) 58	189	1.4	490
Switzerland	(40) 138	(960) 219	(5,250) 130	487	3.5	1,376
Austria	(20) 79	(355) 105	(2,840) 77	261	1.9	582
Spain	(37) 162	(675) 185	(9,650) 203	550	4.0	1,422
Total	(1,095) 4,750	(21,045) 5,214	(167,150) 3,878	13,842	100.0	35,332

Source: International Data Corporation

Notes: (1) Figures in parentheses indicate number of units.

(2) Average annual growth rate between 1984 and 1990 is 17%.

Table III-3-19 Computer Sales by Manufacturers

	(%)						
	IBM	DEC	Siemens	Nixdorf	ICL	Bull	Olivetti
(1) Share by Computer Size:							
Large-scale (US\$4,750 million)	56	-	10	-	6	7	2
Medium-scale (US\$5,214 million)	35	8	-	-	4	10	-
Small-scale (US\$3,878 million)	16	9	1	5	3	5	8
Total (US\$13,842 million)	37	5	3	2	4	7	3
(2) Share of National Markets:							
West Germany (US\$2,819 million)	35	4	22	5	-	2	1
France (US\$2,642 million)	38	5	-	1	2	25	1
U K (US\$3,022 million)	33	9	-	-	15	-	1
Italy (US\$1,530 million)	43	4	-	2	1	-	19

Source: International Data Corporation

more than one hundred thousand workers. Leading companies are mostly subsidiaries of computer manufacturers, while the others are generally small-scale companies.

(b) France

Production of computers and related products in France amounted to about US\$3 billion in 1983. However, imports amounted to US\$2.6 billion as against export of US\$1.8 billion, illustrating the large trade deficit in this field.

1) Bull Group

CII-HB, a main framer which evolved through a series of government assistance packages was re-consolidated into the Bull Group in 1983, together with the holding company, CMB, to become an integrated manufacturer with a product range stretching from large-scale to small-scale computers, peripherals and office

automation equipment. In addition to its past product line, the group is placing increased emphasis on micro-computers and OA equipment, pursuing positive development opportunities for tie-ups with leading manufacturers in the USA and Japan.

2) Personal computer manufacturers

Although the US manufacturers occupy 70% of the French personal computer market local producers have embarked on a course of new product development and increased production since 1980, and they are now endeavoring steadily to expand their shares.

3) Semiconductor industry

The French government spent Fr 600 million in this area during its five-year IC plan (1979-1983). There were formerly three semiconductor producers - Harris-Intel, Eurotechnique and Sescom, which tied up respectively with Intel, National Semiconductor and Motorola of the USA. These companies were reorganized, however, in 1983 into two groups, Matra-Harris Semiconductors and Tomson-CSF under governmental policies for improvement of investment efficiency.

4) Information processing service industry

The French software and information service industry is the largest in Europe, accounting for 23% (US\$2.8 billion) of total sales in Western Europe (US\$12.2 billion) for 1983. Bull has an overwhelming share amounting to about US\$1.4 billion, followed by Tomson-CSF, registering sales of US\$340 million.

(c) West Germany

The 1983 output of computers and related products in West Germany amounted to US\$4 billion. Imports stood at US\$3.4 billion as against US\$3.0 billion of exports, and this imbalance of imports over exports has not changed significantly since then.

1) Computer manufacturers

Siemens, the largest domestic producer in West Germany, developed its large-scale computer series in 1978 in a technical tie-up with Fujitsu of Japan as an attempt to catch up with the USA and Japan. In 1983 the "Glendale" series of medium-scale computers was introduced, supplied by Fujitsu under an OEM contract. Siemens is also planning to introduce super-computers on an OEM basis.

Nixdorf has shown a steady growth as a manufacturer of small-scale computers, marketing its products world-wide. The company holds a five percent share of the domestic market behind IBM (35%) and Siemens (22%), and in 1984 it added a 32-bit super-mini-computer to its range of products. The company's sales amounted to DM 3.3 billion for 1984, one half of which was earned in overseas markets.

BASF A.G. entered the large-scale computer market in 1980, supplied by Hitachi of Japan on an OEM basis, and since that time has performed well. In 1985 it released a new product to compete with the IBM 3090 series.

IBM West Germany is the largest overseas base of the US computer giant, possessing extensive laboratories and factories.

2) Semiconductor industry

Siemens, attaching great importance to the semiconductor field, has been engaged in joint development with AMD (Advanced Microprocessor Devices) of the USA since 1978. It embarked on the "Mega Project" in 1985, with plans to spend DM 1 billion by 1990. The company also envisages development of 1-mega-bit and 4-mega-bit RAM semiconductors during 1984 to 1989, in a linkup with Philips, with a budget of DM 2.2 billion.

3) Information processing service industry

West Germany is the second largest market of this type in Europe after France, and an annual growth rate of 10 to 20% is predicted for the future.

3-4-4 Newly Industrializing Countries

(1) Introduction

The computer industry is classified as the most important industry which should be fostered and developed in newly industrializing countries. This is based on the recognition that with the rapid expansion of an information-oriented society, computerization in economic activities is indispensable for the modernization of the nation and development of its economy. Even when there has been no government support, computerization has advanced gradually in these countries in spite of several problems such as shortages in foreign currency and in human resources. Promotion of the computer industry aims at the replacement of imported computer equipment with domestic products, but sometimes it also seeks the export of their own products. There are two points for adequate development of the computer industry:

- 1) Supply side; Development, production and sales of computers (hardware, software, systems and components), and
- 2) Demand side; Expansion and sophistication of computer applications.

The development of supply side alone cannot lead to the expansion of the domestic market. In many cases the development of application technology stimulates the development of supply side technology in turn.

The computer industry encompasses a wide and diversified range which includes the supply of a various products such as components, devices, systems, software and applications. Each of these can constitute an individual industry or can be integrated in groups. Each country can thus choose its appropriate field based on its own characteristics and potential.

The computer industry, as evidenced by the examples of the USA and Japan, develops on the basis of long-term business efforts (technology, production, sales methods and application methods). Without the long-term perspective, healthy development cannot be realized.

The appearance of micro-computers added momentum to the computerization movement, and regardless of the level of industrialization, computerization has made remarkable progress in these countries. In many of them, domestic production of computers is in progress, starting from the micro-computer level and proceeding gradually toward medium- and large-sized computers.

Another important factor is software. In some countries, software development is not simply an auxiliary activity to promote more efficient computer applications, but the beginning of an independent industrial sector.

(2) Brazil

In Brazil, computers were first introduced in around 1959, and rapid progress in computerization started in about 1969. The government gave it strong support and made efforts to cultivate and develop the computer industry, and as a result rapid progress was made. Especially since 1980, growth has been remarkable. During the four years from 1980 to 84, the number of units introduced increased by 17 times (from 8,844 units in 1980 to 153,202 units in 1984), and the amount increased by 2.6 times (from US\$1.65 billion in 1980 to US\$4.34 billion in 1984).

At present, the government clearly states and carries out its computer industry promotion policies such as,

- Fostering domestic computer manufacturers
- Preferential use of domestic computers by government organizations
- Promotion of software development
- Promotion of technical developments in microelectronics

(a) Government policies

The government has been keeping rigid restrictions on imports and fostering domestic manufacturers. The following is a chronological change of its policies.

In 1973, the government announced the policy of fostering the computer industry and established CAPRE (Commissao Coordinacao das Atividades de Processamento Electronico) within SEPLAN (Secretaria de Planejamento). With this as the acting policy organization, the government made efforts in domestic manufacturing and elimination of foreign manufacturers. The following are the two main aspects:

- 1) Import restrictions to foster the development of domestic products
 - From 1975 Enforcement of strict import restrictions
 - From 1977 Complete ban on mini-computer imports
 - 1978-1979 Ban on the import of small-sized computers
 - From 1980 Ban on the import of medium-sized computers

Imports, which had increased rapidly until 1975 were banned in principle, and only those under license to Brazilian enterprises or those with the approved investments were permitted to be imported. For this reason, imports in 1976 decreased drastically to the amount of US\$820 million.

2) Protecting and fostering domestic manufacturers

In 1977, a public invitation was made for a mini-computer production project using foreign technology. The following five cases were approved. This was the start of domestic production by local Brazilian enterprises.

COBRA/CYCOR (USA), LABO/Nixdorf (West Germany), SID/Logabax (France), SISCO/Data General (USA), EDISA/Fujitsu (Japan)

In 1974, DIGIBRAS (Empresa Digital Brasileira S.A.) was established as a subordinate of BNDE (the National Bank for Economic Development). This government-supported organization has been performing activities in the field of electronics in general covering a wide range from providing administrative guidance for enterprises and loans for computer introduction and software development, to subsidizing various projects for the promotion of an information-oriented society and personnel training.

In October 1979, SEI (Secretaria Especial de Informatica) was established under Conselho de Seguranca Nacional (National Security Committee), and was assigned to control computer industry. This organization actually executes the promotion programs for the computer industry. The guidelines for its activities published by the government in December 1979 are summarized below.

- Development and introduction of techniques concerning hardware, software, components and maintenance
- Upgrading domestic enterprise technology and securing the market
- Promotion of the software industry and information service industry
- Establishment of quality assessment standards for hardware and software
- Establishment of a nationwide data network
- Establishment of safety measures for the protection of data, privacy and national security
- Coordination of the interests of domestic enterprises and the nation
- Promotion of international cooperation for upgrading technology and for protecting national interests
- Administration and provision of funds for investment, etc.

The administration authority of SEI covers:

- 1) Import control of electronics-related parts and information-related devices,
- 2) Approval of national development plans for computer related industry and of federal government's contracts related to computer industry,
- 3) Control of international data communication links.

After establishing SEI, the government intensified its protection policy for domestic production. It banned imports of larger computers in addition to the mini-computers. They tried to start the domestic production of larger size of computers but it was not succeeded. Finally the government gave up the development of medium-class computers and approved the following three projects under license with foreign manufacturers.

ELEBRA/DEC (VAX-750), ITAUTEC/Formation (4000 system), SISCO/IPL (4400 series)

CTI (Centro Tecnológico para Informatica) was established in 1982 as a research institute under the direct control of SEI and is performing research in the field of information technology and also performing guidance for the private sector for the promotion of an information-oriented society. At present, there are four research departments:

- 1) Automation Research Department: Emphasis is placed on CAD/CAM and robots, as well as the fields of process control, automated production and software engineering.
- 2) Microelectronics Research Department: Development and production of ICs with cooperation between industry and universities is considered to be an important task.
- 3) Computer Research Department
- 4) Instrument Research Department

In October 1984, for further protection of domestic manufacturers from foreign computer manufacturers, the "National Information Industry Encouragement Law" was established. This law states the government's goals more clearly, defining the information industry as a strategic industry, and stating the purpose of the law as the protection of domestic manufacturers from large and stronger international businesses. By this law, the market for small- and medium-sized computers was to be secured for domestic manufacturers, and foreign manufacturers were thus to be virtually shut out. In addition, under this law, CONIN (Council of National Information Science and Automation) was established as the highest organization for the execution of computer industry policies under the direct jurisdiction of the President's Office, and SEI was to be under CONIN.

Among the actual measures for protecting and strengthening domestic manufacturers, the following should be noted:

- 1) Preferential taxation treatment such as exemptions from import duties for equipment, devices and parts necessary for research and manufacture.
- 2) Exemption from export taxes.
- 3) Preferential treatment on income taxes for enterprises engaged in the development of useful software.
- 4) Establishment of an Information Technology Center.

(b) Trends of computer demands

In the 1970s, the number of computers produced increased by more than 10% per year. In the 1980s, under the government's intensive promotion measures, remarkable increases of 160 - 180% over the preceding year were achieved. The following is a general outlook, classified by size and by form of application.

1) Trends in computer demand classified by size

SEI classifies computers into six categories by price as follows:

Class 1	US\$	20,000 -	90,000
Class 2	US\$	90,000 -	180,000
Class 3	US\$	180,000 -	670,000
Class 4	US\$	670,000 -	1,900,000
Class 5	US\$	1,900,000 -	3,000,000
Class 6	over	US\$3,000,000	

The trends in computer demand based on the number of computers are shown in Tables III-3-20 and III-3-21. Class 1 shows the highest rate of increase recently and as of 1984 covers 94% of all units installed. Demand increased 30 times from 1980 to 1984 (from 4,720 units to 144,000 units). In 1983, an increase over the preceding year of 43 times was recorded. Of the four sub-classes, namely microcomputers, text processors, billing machines and banking terminals, the rate of increase in microcomputers is the largest. At present, its number of units installed is 116,392 units, covering more than 80% of Class 1. This is due to the rapid increase in the number of manufacturers, which resulted in the decrease of prices. At present, on the installed basis Class 1 covers 94% of all 6 classes in terms of number of units and 13% of the dollar amount.

Class 2 showed the greatest increase in the 1970s, but the increase slowed and is now staying at around 20% over the preceding year. Since the rates of increase of all classes are high, the share of Class 2, in terms of the number of operating computers, decreased from 19% in 1981 to 3.4% at present. In terms of amount, this class accounts for 10.7% of the total dollar amount of all units installed.

The increase rate in the number of computers in Class 3 has stayed at over 10% straight through, but the percentage of this class occupies in the total number of units installed dropped sharply from 20% in the 1970s to 1.6% now. Rather than by stagnant demand, this has been caused by decreased supply due to the import ban and the immaturity of domestic manufacturers. From now on, with the growth of domestic manufacturers, their entry into the market and their market share is expected to increase. In terms of amount, this class accounts for 10% of the total amount of all installed computers.

The number of installed computers in Class 4 amounts to 442 in 1984, and the annual increase is no more than 10 - 30 units. Due to the import ban and non-existence of domestic manufacturers, the share of this class in the total number of computers is quite small. Among the existing brands, a domestically manufactured IBM 4341 and medium-sized Burroughs series cover 60% of the market share. 99% of the machines in this class are foreign brands. On the installed basis, this class occupies only 6.8% of the all market.

Table III-3-20 Computer Installation Trends (Brazil)

Class	1977		1978		1979		1980		1981		1982		1983		1984	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
1	3,846	64	4,290	62	4,791	60	4,722	53	8,756	61	17,702	73	76,289	90.8	143,997	94.0
2	356	6	656	10	1,015	13	1,675	19	2,719	19	3,571	14	4,133	4.9	5,182	3.4
3	1,296	21	1,378	20	1,494	18	1,688	19	1,858	13	1,950	8	2,224	2.7	2,418	1.6
4	353	6	370	5	377	5	388	5	408	3	400	2	430	0.5	442	0.3
5	122	2	166	2	226	3	248	3	374	3	544	2	711	0.8	826	0.5
6	87	1	93	1	97	1	123	1	134	1	172	1	232	0.3	337	0.2
Total	6,060	100	6,953	100	8,000	100	8,844	100	14,249	100	24,339	100	84,019	100	153,202	100

Source: SEI

Table III-3-21 Increase in Number of Computers Installed over Previous Year (Brazil)

Class	1977/78		1978/79		1979/80		1980/81		1981/82		1982/83		1983/84		1984/85		1977/84	
		(%)		(%)		(%)		(%)		(%)		(%)		(%)		(%)		(%)
1	12	12	12	12	2	2	85	102	102	331.0	88.8	185.8	67.8					
2	84	84	55	55	65	65	62	31	31	15.7	25.4	20.5	46.6					
3	6	6	8	8	13	13	10	5	5	14.1	8.7	11.4	9.3					
4	5	5	2	2	3	3	5	2	2	7.5	2.8	5.1	3.3					
5	36	36	36	36	10	10	51	46	46	30.7	16.2	23.2	31.4					
6	7	7	4	4	27	27	9	29	29	34.9	45.3	40.0	21.3					
Total	15	15	15	15	10	10	61	71	71	245.2	82.3	150.9	58.6					

Source: SEI

Source: SEI

Class 5 showed annual increases of 30 - 50% in most years, but in 1984, the increase slowed down to 16%. The total number of computers installed is 826, and the market percentage in terms of number of units is as low as 0.5%. In terms of amount however, this class occupies the largest portion, or 36.2% of the total amount of all computer units installed.

Class 6 is also a totally imported-model market. The number of units has increased substantially since 1980. The number of units installed is 337 or only 0.2% of the total number. In amount, this class occupies 23.3% of the total.

2) Forms of application

According to the user survey taken by SEI, the uses or forms of application are shown in Table III-3-22. Classes 4 - 6 are fairly sophisticated computers but mostly are the batch-processing system type. Sophisticated application of on-line systems with the use of communication circuits remains a task for the future.

Table III-3-22 Application by Size (Brazil)

	(%)					
	Class 1	Class 2	Class 3	Class 4	Class 5	Class 6
General use	37	53	70	83	96	88
Science, engineering, financial computation	4	2	5	3	3	10
On-line	1	6	8	-	1	-
Data entry (stand alone)	24	7	4	-	-	-
Data entry (on-line)	21	25	7	-	-	-
Process control	4	1	2	1	-	-
Others	9	6	4	13	-	2
Total	100	100	100	100	100	100

Source: SEI

(c) Trends of the industry

1) Rapid increase of small computers and microcomputers

With the intensive policy for fostering domestic manufacturers, the number of manufacturers has increased gradually, especially in the sector of small computers. It is reported that as of 1982,

computer-related enterprises reached 83 in total number. A survey in 1983-1984 reports that 25 new enterprises participated either in manufacture or distribution of Class 1 equipment or devices. Investment for development is also quite active and stays as high as approximately 10% of sales proceeds. The number of personnel engaged in this industry also is showing a gradual increase along with the development and expansion of the industry, from 4,000 in 1979 to 12,600 in 1982.

2) Expansion of domestic manufacturers' market share

The growth of domestic manufacturers is resulting in a steady increase in domestic manufacturers' market shares. Domestic computers occupied 17% of the total number of computers sold and 7% of the sales amount in 1980, but that grew to 95% in number and 25% in amount in 1984. The fact that, at present, the market share of domestic computers in Class 4 is 1% and Classes 5 and 6 is 0% is indicative of how fast the growth has been in the smaller computer categories. Since a powerful domestic manufacturer has begun Class 3 production, in which the domestic share is 30%, the domestic market share as a whole is expected to grow steadily in accordance with the improvement of technical level (Figure III-3-9).

3) Industry distribution

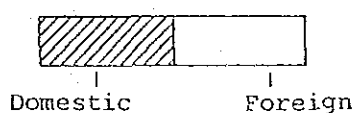
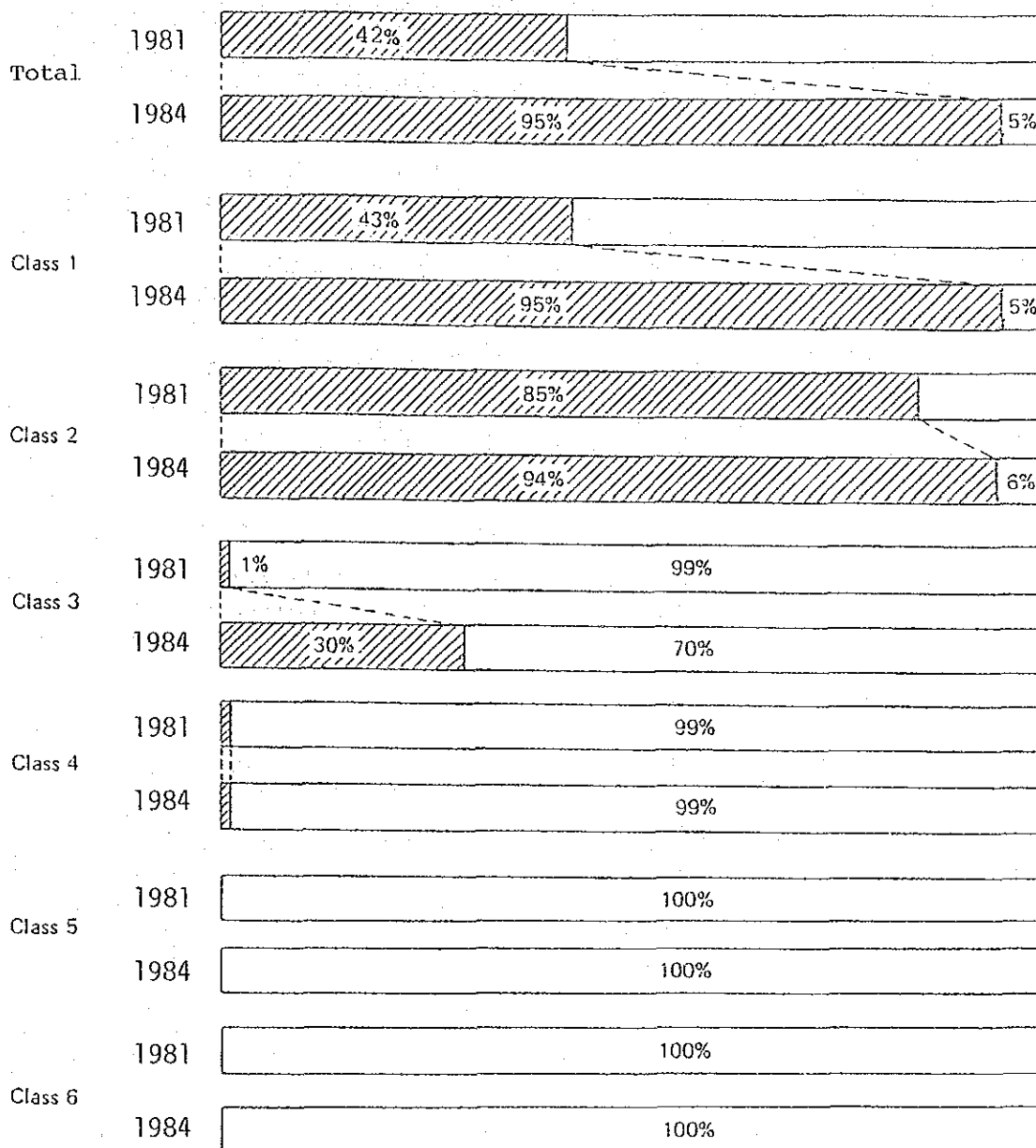
In Class 1, dozens of domestic manufacturers occupy 95% of the market. Especially Prologica (37%) and Microdigital (29%) occupy 66% of the market share. In Class 2, five main domestic manufacturers cover 93% of the market, and foreign manufacturers cover only 6%. In Class 3, the production allotted to IBM, Burroughs and Hewlett Packard has continued. But recently the domestic share led by COBRA (20%) has grown to 30%. In Classes 4, 5 and 6, US computer manufacturers are still overwhelming. This market is still an oligopoly with Burroughs (49%) and IBM (34%) covering over 80% of market share.

(d) Import/export trends

Under the government policy, the import of computer-related equipment and devices is severely restricted and only large-sized models and necessary parts for domestic products are allowed to be imported. This has been kept within the range of about US\$200 million. It is said that there will be not so much an increase in imports, because the import restriction is expected to continue and the domestic manufacturers are gradually replacing imported parts with domestic products. On the other hand, since 1980, exports have been growing rapidly with peripherals and terminals for personal computers as leading items. (1982: US\$150,000, 1983: US\$1,200,000, 1984: US\$18,600,000 (estimate)). Major destination countries are the USA (50%), Latin American countries (30%) and West Germany (8%).

From the above, it is evident that PC peripherals and terminals have been replaced with the domestic products to a substantial extent, and export can take place. In medium-sized computers, however, dependence on imported parts is still so large that production is affected by the quantity of parts imported.

Figure III-3-9 Domestic/Foreign Trends (Brazil)
(based on value)



Source: SEI

(e) Problems in promotion of computer industry

The following problems for domestic manufacturers have been pointed out in an SEI Bulletin:

- 1) Problems of availability of imported parts including prices, quality and delivery
- 2) High interest rates on borrowed funds
- 3) Problems in quality, prices, delivery date of peripheral equipment, components, assembly, etc.
- 4) Amount of credit extended for imports is too small, and import procedures take too long.
- 5) Rising labor costs.

(2) Mexico

Regarding the computer industry in Mexico, the following two basic points should be noted.

- Locating next to the USA, this country is under strong USA's influence in economic activities. Major US manufacturers engage in manufacturing in Mexico, in the form of joint ventures. The majority of imported goods are US products.
- Although Mexico is on a course of recovery from the monetary crisis of 1982, it still suffers under a large accumulation of foreign debt, a financial deficit and stagnant industries.

The government is very much interested in the computer industry. It expects to replace imported goods with those of domestic manufacturers, together with the encouragement of technical development in the industry in general and, in the future, export computer products. Information related computer industry in Mexico after 1982 are very limited. The following descriptions come from available information in Japan.

(a) Government policies

In 1981, based on the National Industry Development Plan, the government formed the "Program for Encouraging Domestic Production of Computers", and established a policy to tackle domestic production of small-sized computers, microcomputers and peripherals. Its outline is as follows:

1) Objectives

- Domestic computers to supply 70% of the total market within five years.
- Replacement of imported goods with domestic products, and cultivation of potential for international competition within a short period.

- Development of diversified computer-related industry to raise the market share of domestic products, and to aim at fostering a computer parts industry.
- Development of technology and training of personnel.
- Actual plans for fostering the industry.

2) Support for manufacturers and vendors

- Preferential taxation on equipment investment by domestic manufacturers and on purchase of domestic parts.
- Enforcement of import quota system on computers and peripherals which are the targets for domestic production.
- Under the quota system, import permission and reduction or exemption of import duty for three years on computers and computer-related parts.
- Establishment of plans to introduce computers into public institutions.
- Tax deductions for computer purchasers.
- Fostering of computer exports.
- Restrictions on establishment of foreign-owned enterprises.
- Setting target years for accomplishing projected domestic production goals and promoting them.

(b) Trends of computer demand

Computers demand showed remarkable increase in the 1970s. It is said that annual increase rate of 30% were recorded during this period. Demand dropped in 1982 but made a gradual recovery. The computer industry is now regarded as the sector which could expand faster than any other industry, depending on the recovery of the economy and development of government policies in the future.

The number of computers in operation at present is estimated at: computers: 10,000 units; micro-computers: 100,000 units. It is estimated that about half of these are in government institutions, followed by the engineering sector, service sector, commercial sector, financial sector and then academic sector.

(c) Trends of the industry

In the present market, IBM occupies more than half, followed by other US computer manufacturers such as Honeywell Information Systems (HIS), NCR, Burroughs, Sperry, etc. With the recent increase in the number of micro-computers, such specialized micro-computer manufacturers as Apple, Wang and others have made an entry into the market.

There are about 50 computer manufacturers who are registered by the Domestic Production Encouragement Program and have either started production or are in preparation. Of these, 42 are analysed as follows (some figures are partially overlapped.):

	100% Domestic Capital	Joint Venture	100% Foreign Capital
Micro-computers	17	3	0
Small computers	6	1	5
Peripherals	12	4	1
Computers for processing	4	0	0
Total	30	7	5

(d) Import/export trends

Because of economic stagnation import has been decreasing since 1981. Even if the economy recovers from now on and demand increases, the government's acceleration of domestic computer manufacture will work to keep imports down. At present, items from the USA occupy an overwhelming portion of the imported goods.

Export is an issue for the future and depends on the promotion of domestic computer manufacture and its competitiveness in the international market. It is said that recent exports of finished products are showing a gradual, though very slight, increase.

(3) Korea

The government maintains a policy in which the computer industry is regarded as an especially important industrial sector. The government plans to accelerate the upgrade of computer related technology and try to develop domestic manufacture to eventually create an export industry in both hardware and software.

The government designated 1983 as "Year of the Information Industry", and is carrying out various plans such as:

- Establishment of long-term basic plans
- Fostering and developing the software industry
- Fostering computer education

In response to these, active movement toward development and production of domestic micro-computers in the private sector has been seen.

(a) Government policies

The government enumerates the followings as its basic policies.

- 1) Acceleration of computerization together with its effective application

- 2) Development of the software industry
- 3) Establishment of an information industry fostering system
 - Establishment of organizations for accelerating this goal
 - Establishment of a financial system for helping and fostering smaller enterprises
 - Standardization
- 4) Strengthening of the information industry with the support of technical development
- 5) Fostering people's interest in a computer
- 6) Training of computer specialists

(b) Trends of computer application

Demand for computers in Korea expanded remarkably from the latter half of 1970s. Then, for the three years, 1980-1982, the annual rate of increase remained within 20%. After the designation of the aforementioned "Year of the Information Industry", however, the annual growth rate once again came close to 50%. As of June 1985, the total number of general purpose computers in operation was 1,860. However, this number is small in consideration of the present level of the Korean economy and industry. With the government's promotion policy, a rapid increase is expected (Table III-3-23).

Application sectors are (based on number of computers):

Business corporations	60%
Education & research institutes	22%
Financial & insurance sector	11%
Government	7%

Classified by size, different sized computers are used in each of those sectors, probably indicating a rational application commensurate with actual conditions (Table III-3-24).

(c) Trends of the industry

Korea is a US manufacturers' market. In terms of the number of computers, IBM (18%), DEC (14%) and HP (7%) are the leading brands. In the micro-computer sector, Wang and Prime are important contenders. In addition to US brands, Fujitsu (Japan) holds a 4.2% share (Table III-3-25).

As for domestic production of computers in Korea, a micro-computer developed by the Korea Science and Technology Research Institute, under license with GTE, USA in 1974, was said to be the first. Then later, with the four major financial and business groups as the central core, assembly-line production was started by introducing the US or Japanese technology. The number of such manufacturers is said to now exceed 70. IBM established a 100% owned subsidiary, and it was to start partial production in 1985.

The dollar amount of computers and peripherals produced in 1984 reached US\$452 million which was more than twice that of the preceding year. Now, a rapid expansion in computer production, supported by many years of accumulated technology from the electric equipment and precision machine industries, is being planned. Computers are expected to gradually occupy a portion of the export industry.

In April 1984, plans to foster a semiconductor industry were announced and include a large amount of investment, the establishment of technical development procedures and a production base.

Table III-3-23 Trends of General-Purpose Computer Use in Korea by Institutions

Institutions	(Number of Computers, %)								
	1977	1978	1979	1980	1981	1982	1983	1984	1985 (June)
Government	35	39	48	56	60	68	81	109	122
Education and Research Institutes	49	60	87	103	144	178	247	371	417
Financial and Insurance Sector	35	36	55	67	78	94	135	182	201
Business Corporations	57	120	237	296	351	426	651	984	1,130
Total	176 (39.7)	255 (44.9)	427 (67.5)	522 (22.2)	633 (21.3)	766 (21.0)	1,114 (45.4)	1,646 (47.7)	1,870

Source: Ministry of Science and Technology Publication

Note : The figures given in () are increase rates.

Table III-3-24 Current Status of General Purpose Computer Use by Size

(Number of Computers, %)						
	Super large above US\$1.5 million	Large computer US\$700,000 to 1.5 million	Medim computer US\$300-700 (thousand)	Mini computer US\$100-300 (thousand)	Micro computer US\$50-100 (thousand)	Total
Government	15	17	32	17	41	122
Educational and Research Institutions	7	8	39	107	256	417
Financial and Insurance Sectors	32	34	45	48	42	201
Business Corporations	68	97	169	340	456	1,130
Total	122 (6.5)	156 (8.3)	285 (15.2)	512 (27.4)	795 (42.5)	1,870 (100.0)

Source: Ministry of Science and Technology Publication

Table III-3-25 Current Status of General-Purpose Computer Use by Brand

(number of computers, %)									
	1977	1978	1979	1980	1981	1982	1983	1984	1985
IBM	47	54	75	99	126	161	219	306	336 (18.0)
FACOM	19	25	40	42	46	50	57	64	78 (4.2)
UNIVAC	28	31	28	29	32	37	42	51	52 (2.8)
CYBER	11	11	17	18	19	19	21	26	27 (1.4)
PRIME	0	0	18	28	39	46	59	75	84 (4.5)
VAX (PDP)	14	25	83	83	85	99	142	229	260 (13.9)
NCR	10	16	20	22	23	26	38	52	57 (3.0)
HP	0	17	35	40	46	53	78	115	131 (7.0)
ECLIPSE	7	9	17	22	23	26	39	60	69 (3.7)
HONEYWELL	0	0	0	0	16	18	28	37	41 (2.2)
BURROUGHS	6	11	12	14	15	16	22	30	38 (2.0)
FOURPHASE	0	0	6	8	11	14	24	33	35 (1.9)
WANG	16	22	28	33	33	35	57	69	106 (5.7)
NOVA	11	13	16	20	20	20	33	52	61 (3.3)
Others	7	21	32	64	99	146	255	427	495 (26.5)
Total	176	255	427	522	633	766	1,114	1,646	1,870 (100.0)

Source: Ministry of Science and Technology Publication

Note: The figures given in the parentheses are percentile rates.

4. AGROINDUSTRY (PACKAGING)

4-1 Introduction

The purpose of this section is to examine the current situation of the packaging technology and to provide practically useful suggestions on the necessary conditions for its improvement with a view of developing marketability of the food related agroindustry in Argentina.

Argentina is one of the major producers and exporters of agricultural and livestock products such as cereals, oil seeds and meat, and has been holding relatively strong competitiveness in the international markets of these products. The agricultural products also contribute largely to the whole Argentine economy, accounting for over 50% of the total exports while the agricultural sector occupies about 15% of GDP in recent years.

The agroindustry using such ample agricultural products as raw materials plays a very important role in the industrial sector in Argentina. Since the packaging is the most indispensable to the food processing among the industries in the agroindustrial sector, this part, prior to examining the packaging technology, will briefly review the present situation of the food processing industry including beverage and tobacco (hereinafter referred to as "the food processing industry"). According to the latest RIN (Registro Industrial de la Nacion) data published by Secretariat of Foreign Trade and Industry, in 1984 the food processing industry accounts for 22.1% of the total registered establishments, 23.9% of the total employees, and 28.3% of the total production value in the whole manufacturing sector (Table III-4-1).

Within the food processing sector, the category of food industry altogether prevail over those of beverage and tobacco; the food industry holding 78.5% of the total establishments, 83.2% of the total employees, and 81.6% of the total production value. The more detailed structure of the different activities in this sector shows predominance of meat processing (production value 17.2%), oils and fats (15.1%), dairy products (11.3%), and sugar (11.4%). The bread and pastry industry ranks first in the number of establishments and second in the number of employees despite its lower ranking in the production value. With respect to the beverage sector, the non-alcoholic and soft drink industry is the most important whichever indicator is used.

Unlike the manufacturing industries which are highly concentrated in urban areas, the food processing industries are more widely spread over the whole country. In the case of manufacturing industries 85.3% of the total establishments and 81.3% of the total production value is accounted by the Federal Capital and the three most industrialized provinces, namely Buenos Aires, Santa Fe, and Cordoba. While these figures reach only 69.1% and 71.8% respectively for the food processing industry (Table III-4-2).

The Argentine exports of processed food amounted to US\$2,177 million in 1985 accounting for 25.9% of the total exports of the country (Table III-4-3). This figure is far below the aggregate export share of

Table III-4-1 Structure of the Food Processing Industries (1984)

	Number of Establishments (%)		Number of Employees (%)		Production Value (A thousand) (%)	
Meat and Derivatives	536	7.5	54,698	23.0	150,433.1	17.2
Dairy Products	536	7.5	19,832	8.3	98,859.9	11.3
Fruit and Vegetable Processing	307	4.3	15,670	6.6	26,434.5	3.0
Seafood Processing	85	1.2	7,697	3.2	10,549.0	1.2
Oils and Fats	139	1.9	9,546	4.0	132,159.2	15.1
Milling	284	4.0	11,383	4.8	57,138.0	6.5
Bread and Pastry	3,076	43.1	35,546	14.9	47,987.6	5.5
Sugar Manufacturing	29	0.4	18,633	7.8	99,927.0	11.4
Cacao and Conserve	96	1.3	7,984	3.4	23,913.9	2.7
Various Food Products	406	5.7	14,471	6.1	45,864.3	5.2
Animal Feed	105	1.5	2,428	1.0	22,215.1	2.5
Total Food Industry	5,599	78.5	197,888	83.2	715,481.5	81.6
Alcohol and Spirit	57	0.8	2,777	1.2	21,508.1	2.5
Wine	486	6.8	10,917	4.6	31,603.4	3.6
Beer and Malt	10	0.1	3,870	1.6	10,049.5	1.1
Non-alcoholic and Soft Drinks	952	13.3	16,594	7.0	38,329.4	4.4
Total Beverage Industry	1,505	21.1	34,158	14.4	101,490.4	11.6
Tobacco	33	0.5	5,741	2.4	59,353.5	6.8
Total (Food, Beverage & Tobacco)	7,137	100.0	237,787	100.0	876,325.4	100.0
Total Manufacturing Industry	32,315		996,461		3,096,909.4	
Food, Beverage & Tobacco/Total M.I. (%)	22.1		23.9		28.3	

Source: Dirección General de Información Industrial, Registro Industrial de la Nación 1985.

Table III-4-2 Distribution of Food Manufacturing Industries by Province (1984)

	Number of Establishments			Production Value		
	Food Industries		Manuf. Total	Food Industries		Manuf. Total
	unit	share(%)		1,000 A	share(%)	
Capital Federal	923	12.9	7,957	77,594	8.9	450,330
Buenos Aires	2,365	33.1	13,836	368,074	42.0	1,572,637
Catamarca	23	0.3	52	369	0.0	6,206
Cordoba	675	9.5	2,111	69,831	8.0	197,374
Corrientes	128	1.8	182	11,228	1.3	19,355
Chaco	100	1.4	281	2,943	0.3	19,258
Chubut	46	0.6	198	2,909	0.3	61,123
Entre Rios	321	4.5	567	31,719	3.6	39,426
Formosa	48	0.7	118	260	0.0	2,633
Jujuy	32	0.4	100	33,975	3.9	51,946
La Pampa	78	1.1	189	3,840	0.4	6,875
La Rioja	32	0.4	91	1,932	0.2	17,036
Mendoza	607	8.5	1,058	29,202	3.3	93,659
Misiones	179	2.5	607	14,053	1.6	28,734
Neuquen	32	0.4	96	1,243	0.1	12,507
Rio Negro	123	1.7	255	7,269	0.8	15,996
Salta	85	1.2	189	16,461	1.9	27,440
San Juan	113	1.6	178	3,986	0.5	9,091
San Luis	40	0.6	139	8,013	0.9	19,362
Santa Cruz	10	0.1	30	221	0.0	387
Santa Fe	988	13.8	3,621	115,654	13.2	296,317
Santiago del Estero	46	0.6	97	1,421	0.2	5,147
Tucuman	138	1.9	298	73,962	8.4	111,300
Tierra del Fuego	5	0.1	65	165	0.0	32,773
Total	7,137	100.0	32,315	876,325	100.0	3,096,909
						100.0

Source: Direccion General de Informacion Industrial, Registro Industrial de la Nacion 1985.

Note : Including beverage and tobacco.

Table III-4-3 Exports of Manufactured Food Products (1970 - 1985)

	1970 (%)	1975 (%)	1980 (%)	1981 (%)	1982 (%)	1983 (%)	1984 (%)	1985 (%)
	(US\$ million)							
Meat and Related Products	441 (62.1)	288 (36.5)	966 (38.8)	930 (41.5)	805 (39.7)	603 (26.8)	404 (16.7)	386 (17.7)
Dairy Products	2 (0.3)	22 (2.9)	21 (0.8)	27 (1.2)	52 (2.6)	49 (2.2)	16 (0.7)	16 (0.7)
Preparations of Fish and Shell Fish	1 (0.1)	3 (0.4)	8 (0.3)	5 (0.2)	6 (0.3)	5 (0.2)	4 (0.2)	2 (0.1)
Preparations of Fruits and Vegetables	15 (2.1)	27 (3.4)	84 (3.4)	75 (3.3)	81 (4.0)	72 (3.2)	70 (2.9)	73 (3.4)
Coffee, Tea and Maté	10 (1.4)	17 (2.2)	38 (1.5)	33 (1.5)	35 (1.7)	43 (1.9)	63 (2.6)	48 (2.2)
Products of Milling Industry	9 (1.3)	39 (4.9)	23 (0.9)	11 (0.5)	11 (0.5)	22 (1.0)	27 (1.1)	25 (1.1)
Fats and Oils	104 (14.6)	91 (11.5)	524 (21.1)	395 (17.6)	429 (21.2)	538 (23.9)	930 (38.4)	993 (45.6)
Sugar and Confectionery	13 (1.8)	116 (14.7)	320 (12.9)	288 (12.8)	64 (3.2)	196 (8.3)	108 (4.5)	34 (1.6)
Beverage	1 (0.1)	12 (1.5)	52 (2.1)	43 (1.9)	37 (1.8)	27 (1.2)	26 (1.1)	23 (1.1)
Residues from Food Industry/Animal Feed	114 (16.1)	141 (17.9)	413 (16.6)	397 (17.7)	439 (21.7)	644 (28.7)	724 (29.9)	515 (23.7)
Tobacco	-	30 (3.8)	27 (1.1)	28 (1.2)	59 (2.9)	50 (2.2)	46 (1.9)	57 (2.6)
Other Processed Food	n.a.	3 (0.4)	12 (0.5)	10 (0.4)	9 (0.4)	8 (0.4)	4 (0.2)	5 (0.2)
Total Processed Food	710 (100.0)	789 (100.0)	2,488 (100.0)	2,242 (100.0)	2,027 (100.0)	2,247 (100.0)	2,422 (100.0)	2,177 (100.0)
Total Exports	1,773	2,961	8,021	9,143	7,625	7,746	8,125	8,396
Processed Food/Total Exports (%)	40.0	26.6	31.0	24.5	26.6	29.0	29.8	25.9

Source : World Bank and INDEC

agricultural primary products. Though the share of processed food in the total exports has been fluctuating year by year during the period of 1970-1985, the share of the 1980s is smaller than that of the 1970s. This can be attributed mainly to the decrease in meat export reflecting the import restrictions and the export drive of beef by the EC. It is shown, however, that even excluding meat, the export performance of the food industry has been less favorable than that of the other manufacturing industries as a whole since the 1970s in terms of export growth.

In the export of processed food products the shares of fats and oils (45.6%), residues including animal feed (23.7%) and meat and related products (17.7%) are the three largest. The other exports of manufactured food have quite small shares. Even summing up all of them, the amount is far below each share of the largest three groups.

In Argentina unprocessed or only with primary processing agricultural products are competitive in the international market. Considering the apparent comparative advantage of agricultural products and the higher level of industrialization in Argentina, there seems to be considerable possibilities of development of food processing industries generating higher value added therein.

Apart from economic issues, it can be pointed out that there are several technical problems to be improved concerning sanitary and quality control, product standardization and packaging which are all essential to food processing, and that efforts for the improvement have been retarded by several factors including unstable economic situation in the past. With a view to developing marketing potentialities of processed food, this study, focussing on the field of packaging, examines the present conditions based mainly on the interviews and observations at related institutions and factories, and provides practically useful suggestions.

4-2 Packaging in Argentina

4-2-1 Introduction

Packaging covers a wide variety of materials and technologies, with every material and technology having a possible use. But naturally, economical materials and technologies have the most practical use for packaging.

The purpose of packaging is roughly divided into the two following types. Packaging for transportation, which protects the goods from physical damage while they are moved from the manufacturer to the consumer; and packaging for the consumers' advantage, which prevents the goods from rotting or spoilage by bacteria or surrounding conditions, and in addition, this packaging can be used to promote sales.

Goods come in various sizes and shapes with different physical or chemical properties. Their distribution channels also have individual features. Consequently it is impossible for us to deal with such a wide variety of goods collectively. Packaging should be relevant to the kinds of goods and the situation.

The following seven items are usually regarded as the typical functions of packaging.

1) Protective property

This is the most important and covers its barrier properties, stability and physical strength.

2) Convenience

Convenience to consumers is an important function of modern packaging. It is required that packaged goods can be consumed whenever and wherever desired. Other requirements are to be compact enough to be portable and to be easy to open. The distribution cost depends directly on the size of the unit to be handled.

3) Attractiveness of goods

As previously stated "packaging is a silent salesman", to make the goods distinguishable from other diversified commodities gains them a high reputation.

4) Working suitability of packaging

It is a starting premise that packaging should be carried out by a packaging machine from the standpoint of economy and sanitation. The most important points are dimensional stability for smooth production, heat sealing property for complete sealing and adaptability to high speed machines.

5) Economy

General purpose commodities must be cheap and high quality. In considering economy, it is necessary to cut down the total cost, not simply from studying it in parts but from an overall point of view.

6) Social circumstances

It is important to enact regulatory laws and to determine the producer's responsibilities. It is necessary to make efforts to solve problems of packaging garbage, resource saving and energy saving.

7) Sanitation

Safety and sanitation are especially important for drugs taken orally and food. Possible problems are contamination by foreign substances, and pollution by germs and mildews. As aseptic packaging or other sterile methods have become common recently, the adhesion of germs and mildews to packaging materials poses a problem.

Packaging materials which are mass-produced, stable in quality and low in price should be selected for goods consumed in large amounts. The materials which meet these requirements include paper, paperboard, corrugated cardboard, plastics, metal and glass. Wood is a traditional packaging material and was convenient as well as being suitable for packaging, but it is now unsuitable for modern needs.

Changing from wooden boxes to corrugated cardboard boxes triggered a remarkable progress in packaging in Japan. This progress in packaging technology was due to the rapid growth of the corrugated cardboard industry in Japan and the resultant low costs. The technology was investigated and developed in cooperation with those who were involved in loading and unloading, transportation and storage.

As to the packaging for consumers' advantage, there is a difference in reaction between the Argentine and Japanese consumer. Japanese consumers are very discerning and demand perfect goods, whether it is fresh food or processed food. They worry about defects in quality and shape, such as a break in a box, a dent on a can or a hole in a bag, and they also expect a date of manufacture and a pleasant design. If goods are in any of these ways a little inferior to those of other companies, its sales will fall considerably. Japanese companies carry out research not only into the goods themselves but also into the packaging of the goods. This competition creates a strong will to improve packaging.

Argentine consumers on the other hand are not so fussy, and this may be desirable in some respects, but a similar attitude of consumer cannot be expected in the international market. The degree of packaging quality varies with producers in Argentina. Some packaging in Argentina is at a considerably high level in terms of its quality of paper or laminate and in printing technology, but some are still in low level.

4-2-2 Packaging Material

As stated at the beginning, there are various kinds of packaging materials. The most suitable materials are mass-produced, stable in quality and low priced. Materials which meet these requirements are paper, plastics, metal and glass. These materials are required to have good physical properties so that automation of the packaging operation can be introduced.

(1) Paper, cardboard, corrugated paperboard

The amount of paper production in Argentina is about 3% of Japan. It is not easy to evaluate this situation. However it is apparent that the demand for paper will increase according to the replacement of wooden box with corrugated paper in transport packaging which occurs in Japan in 1960s (Table III-4-4).

It seems that at present corrugated paper is not commonly used in Argentina because the manufacturing costs are comparatively high. We observed several papermills, which were generally of a small manufacturing scale which can not seek the economy of scale (Table III-4-5).

(a) Corrugated cardboard

Technology in the corrugated cardboard industry has made remarkable progress in the past several years. Among the factories we visited in Argentina, only one had introduced new equipment, while others still employed conventional ones. A certain major manufacturer was still operating with equipment which was ten to fifteen years old, and had problems with quality and productivity.

In advanced countries, corrugated cardboard plays the leading role in packaging for transportation. The reason that it is not commonly used in Argentina is that its merits have not been recognized yet. The advantages of corrugated cardboard as a packaging material are as follows:

- 1) Light weight: It is about one-fifth the weight of a wooden box and therefore has high efficiency in transportation.
- 2) High productivity: Production of 150 to 200 cases per minute is possible.
- 3) Foldable: Volume can be remarkably reduced by folding. This depends on the size of a box, but it can become one-tenth to one-twentieth of its volume when it is a box. This gives great efficiency when loading and unloading, and transporting.
- 4) Easy sealing: Sealing operation can be easily done using pressure sensitive tape.
- 5) Easy automation: Many machines can automatically manufacture, fill, and seal boxes.

Table III-4-4 Demand Structure of Paperboard (1985)

	Argentina (A)	Japan (B)	(tons) (A)/(B) x 100
Paperboard	220,000	6,150,000	3.5
Liner	127,500	-	
Medium	92,500	-	
Kraft Paper	80,000	1,855,000	4.31
Multi-ply Sacks	55,500	355,000	15.63
Others	24,500	1,500,000	1.63
Coated Light Cardboard	35,800	1,200,000	2.98
Bleached	4,200	-	
Paper	27,100	-	
Water & Greaseproof	6,200	-	

Source: Japan Packaging Institute, Argentine Packaging Association and others.

Table III-4-5 Production of Paper in Different Countries

	Number of factories		Production (1,000 tons)		Production/ Factory (1,000 tons)		Consumption of paper & paperboard/ per capita per year
	Paper, Paper- board	Pulp	Paper, Paper- board	Pulp	Paper, Paper- board	Pulp	
Japan	593	65	23,495	12,519	39.6	192.6	169 kg
Argentina	86	20	1,200	815	14.0	40.8	32 kg
Brazil	25	48	4,140	3,990	25.2	83.1	25 kg
Chile	22	7	433	900	24.1	128.6	22 kg
Mexico	30	20	3,098	1,068	47.7	53.4	30 kg
U.S.A.	581	195	65,998	51,837	118.5	265.8	287 kg

Source: Pulp & Paper International 1985 World Review Number

- 6) Colorful printing: Printing machines and the sticking technology of photogravured liners (preprint) have been developed.
- 7) Safety: This is due to the light weight and the softness of the box.
- 8) Easy disposal: In cities, it is important to be able to dispose of the used corrugated cardboard. The used cardboard is collected and can be reused as material for paper manufacturing.

However, corrugated cardboard also has some disadvantages compared with a wooden box.

- 1) Weak in water and high humidity: Usually this condition makes it difficult to change from a wooden box to a corrugated cardboard box. It is necessary to take measures to reinforce the box against this defect. There are various techniques available with the help of plastics.
- 2) Costs: It is said that in Argentina a wooden box is lower priced than a corrugated cardboard box, while in Japan the former is generally more expensive than the latter. This fact is related to the production costs for paper and personnel expenses. It is expected that a corrugated cardboard box in Argentina will be less expensive than a wooden box someday.

It is evident that a corrugated cardboard box has more advantages compared to a wooden box. After considering all the factors, including the packaging operation, we think a move away from wooden boxes towards corrugated cardboard boxes is advisable.

(b) White paperboard

It seems that research into the printability of white paperboard used for paper containers has not generally been done in Argentina. Consequently their printing does not turn out very well. Paper containers are generally used for the packaging units displayed in supermarkets, which means they must also have the function of promoting sales. The highest printing technology should be used on these white paperboard containers.

We can judge the printing technology of a country by its picture postcards or the color prints of its quality books as an example. Printing technology for the postcards and books which we bought in Argentina does not seem good as that of advanced countries.

The quality of a piece of printing depends on a combination of several things, and these include the ink, printing block, materials to be printed, printing machine and printing operation. High quality print cannot be achieved if any one of these are inferior. It seems that Argentina is lacking in the basic research necessary for these techniques. Printing on packaging will progress only as printing technology is improved.

However, it is quite difficult to achieve. Smoothness of surface, absorbency of ink, thickness and uniformity of moisture are

required for high quality printing on paperboard. The size of particle, weatherability of vehicle and wear resistance are problems concerning the ink. The technology of color analysis and the manufacture of the pre-sensitized plate are important to plate-making. Also, accuracy and speed are required for a printing machine. Printing technology will not be improved until technology in each of these fields is researched into, and it may still be a long time until the technology affects the field of packaging. However, it is important that Argentina starts to research into these fields as early as possible, considering the competition in the international market.

(2) Plastics

Plastics are used in a wide range of food packaging materials. An advantage of plastics is that various functions are carried out by one materials. The general characteristics of plastics are as follows:

- 1) transparent, therefore able to see contents
- 2) adequate physical strength
- 3) excellent moisture resistance and water resistance
- 4) excellent chemical resistance and oil resistance
- 5) excellent heat resistance and cold resistance
- 6) contamination-free
- 7) excellent weatherability

These characteristics are advantages, more or less, common to every plastic, which enable the production of the various kinds of packaging listed below:

- 1) efficient packaging by automatic machines
- 2) bottles for holding liquid, made of plastic processing paper as is seen for bottles of milk, fruit juice and wine
- 3) vacuum packaging
- 4) gas-filling packaging
- 5) close contact packaging by shrinkable film

The plastic films and bottles which are usually used for food packaging materials are shown in Table III-4-6.

The plastics produced in Argentina are low density polyethylene (LDPE), linear low density polyethylene (LLDPE), high density polyethylene (HDPE), polyvinyl chloride (PVC) and polystyrene (PS). On the other hand polypropylene (PP) and polyethylene terephthalate (PET), commonly used in advanced packaging countries, are not produced in Argentina.

The international comparison of the plastic consumption is in Table III-4-7.

(a) Low Density Polyethylene (LDPE)

LDPE has such excellent heat sealing, flexibility, strength and moisture resistance properties, that it is largely used for food packaging in the form of a single film. It is used for heavy weight bag packaging of grains and beans, middle weight packaging of sugar

Table III-4-6 Plastic Packaging

Classification	Product Name	Properties and Uses as Food Packaging Materials
Single Plastic Film	Polyethylene (PE) Polypropylene Polyvinyl Chloride (PVC) Polyvinylidene Chloride (PVDC) Ethylene, Vinylacetate nylon Polyester (PET) Polyvinylalcohol Ionomer	A sheet of single film can be used as a food packaging material. But most plastic films are used in making composite films, which are used for packaging powdery food, solid food and liquid food.
Composite Plastic Film	Laminated film	Two or three sheets of plastic film are laminated by using adhesives. Three films are used for the packaging of retort food, marine products, livestock products and confectioneries.
	Extruded laminated film	This is laminated film made by the extrusion of polyethylene and polypropylene with printed plastic film.
	Co-extruded film	This is a sheet of film formed by plastic extrusion from two or five extruders. The film is used for the packaging of meat and processed meat.
Vacuum Metalizing Film	Aluminum-vacuum metalizing film	This is a sheet of polyester film, on which mainly aluminum metalized in a vacuum is used for the laminate base materials.
Plastic Sheet (rolled form)	Polypropylene Polyvinyl chloride Polystyrene Composite laminate sheet	This is a single plastic sheet or a composite plastic sheet which is rolled up in a continuous packaging machine
Plastic Bottle	Vacuum forming product	Molded cups, ice cream cups, etc.
	Blow molding product	Composite blown bottles which are used for condiments.
	Injection molding products	This is used for a tray for expensive food.

Source: Study Team

Table III-4-7 Supply-Demand Situation of Plastics in Major Countries

Country	Production		Import		Export		Domestic Consumption		Consumption per capita (kg/year)	
	1982	1983	1982	1983	1982	1983	1982	1983	1982	1983
	(1,000 ton)									
U.S.A	16,605	19,404	154	263	2,079	1,900	14,880	17,767	63.3	75.8
Japan	7,135	7,812	426	363	1,146	1,265	6,415	6,910	54.1	58.3
West Germany	6,274	7,032	2,007	2,252	2,606	3,040	5,675	6,244	92.1	101.9
France	3,089	3,320	1,253	1,246	1,676	1,813	2,666	2,753	49.5	50.6
Italy	2,395	2,720	1,070	1,200	700	900	2,765	3,020	45.8	53.0
Netherlands	1,975	2,135	596	655	2,672	2,491	228	299	43.0	46.0
U.K.	1,734	1,774	901	1,103	534	567	2,101	2,310	37.6	41.0
Spain	1,195	1,345	193	197	233	311	1,155	1,231	30.4	32.2
Canada	1,293	1,254	313	454	326	287	1,280	1,421	52.0	57.3
Australia	683	680	101	106	100	112	684	674	44.6	43.7
Austria	454	549	373	418	292	400	535	567	70.6	77.7
Finland	400	418	226	248	103	110	523	556	108.0	114.0
South Africa	336	350	133	125	55	45	414	430	16.2	17.2
Norway	282	337	139	158	197	234	224	261	54.6	63.7
Switzerland	128	130	414	456	138	150	404	436	62.5	67.6
Denmark	0	0	341	395	43	48	298	347	58.0	69.0
Belgium	-	-	-	-	-	-	-	592	-	-
New Zealand	42	-	120	130	-	-	-	-	31.5	39.7
Sweden	487	-	420	-	243	-	664	-	86.0	-
Argentina	221	-	101	-	33	-	289	-	10.0	-

Source: Japan Plastics, Jun. 1985

and salt and flexible packaging of confectioneries, bread and dried food. Perforated film is used for vegetable packaging. LDPE is used as a sealing layer for laminate film, and is most commonly used for extruded laminate film. Compared with LDPE, LLDPE has the improved mechanical properties of tensile strength, tear strength and pinhole resistance, and has better heat sealing properties. The main uses of single film are for packaging processed liquid food, fish cake, liquid soup and middle weight food. As LLDPE has poor film forming properties, it is used in making co-extruded film with LDPE.

The total production of LDPE in Argentina is shown in the Table III-4-8. Meanwhile, a breakdown of LDPE use in the last five years is shown in the following Table III-4-9. According to the table, use for film occupies the largest share. Film production is the most common use for LDPE. Demand for the LDPE film market in past is shown in the Table III-4-10.

1) Shrink film

PE shrinkable film is used largely for shrink packaging of processed food and is widely used for pallets, construction materials and electrical appliances. The film is made to shrink by passing it and the goods it encloses, through a hot air tunnel. The appearance of shrink packaged food is the same as the appearance of vacuum packaged food. The figure for the growth rate of shrink film between 1978 and 1985 was the astonishingly high of 32% per annum. It is said that these trends show a diversification in processed food and that an improvement in food presentation is aimed at by using shrink packaging in Argentina.

2) Stretch film

Stretch packaging is used for fresh food such as vegetables, fruit, fish and meat. Fresh food is packaged in a tray by stretching film over it, this increases the products value because the food is shown to be fresh. Stretch packaging is becoming increasingly popular and is widely used for pallet packaging and direct packaging of vegetables and fruit to keep them fresh. Production figures for stretch film before 1985 have not been issued, and it is understood that stretch film was not commonly sold in supermarkets till then.

3) Milk sachets

After reaching a peak, the demand for milk sachets started to decrease. It is predicted though that future demand will increase slightly. Milk sachets are a type of packaging not seen in Japan, as although it is sterilised, Japanese consumers are concerned about sanitary conditions.

According to POLARSA S.A., all of the milk bottles were made of glass until 1967, when they were changed into PE sachets. Now PE sachets cover 70% of the market, with carton bottles (1 liter), which appeared about 1978, and PE bottles (1 liter) taking the remaining 20% and 10%, respectively. It is expected, that judging

Table III-4-8 Plastics Market in Argentina

(1,000 tons, %)

	1978	1980	1982	1983	Increase Rate
<hr/>					
LDPE					
Capacity	35	35	225	225	85.94
Demand	67.8	68.8	122.7	118	20.29
Import	37	38	9	1.3	-67.25
Export	0	0	23	66.8	-
Production	30.8	30.8	136.7	183	81.12
<hr/>					
HDPE					
Capacity	0	0	0	42	-
Demand	12.9	22.6	25.3	37.8	43.10
Import	13	23	25	29.8	31.85
Export	0	0	0	9	-
Production	0	0.3	0.3	17	-
<hr/>					
PVC					
Capacity	0	0	0	57.5	-
Demand	36.9	53.1	53.5	70.9	24.32
Import	5	20	7	18.4	54.39
Export	1	1	0	0.3	-33.06
Production	32.9	34.1	46.5	52.8	17.08
<hr/>					
PS					
Capacity	51.2	51.2	51.2	51.2	0.00
Demand	18.8	25	23.4	26	11.41
Import	0	3	1	0.7	-
Export	0	0	0	1.2	-
Production	18.8	22	22.4	26.5	12.12
<hr/>					
PP					
Capacity	0	0	0	0	-
Demand	11.9	18.6	23.3	25.9	29.59
Import	11.9	18.6	23.3	25.9	29.59
Export	0	0	0	0	-
Production					-

Source : Stanford Research Institute

Table III-4-9 Usage of Selected Plastics in Argentina

LDPE	(%)	HDPE	(%)	PP	(%)
General Film	65	Blow Moulding	42	Synthetic Raffia	53
Industrial Film	15	Injection	34	Injection Film	21.8
Blow Moulding	8	Extrusion	20	Extrusion	9.5
Injection	6	Others	4	Multifilament	9
Coating	2	Total	100	Blow Moulding	4.3
Pipes	2				2.4
Others	2			Total	100
Total	100				

Source : DUPERIAL, Argentine Packaging Association and Study Team

Table III-4-10 LDPE Film Market

	1978	1979	1980	1981	1982	1983	1984	1985	Increase Rate
General Film	16.700	20.600	18.000	23.500	32.650	34.900	37.500	31.000	9.24
Shrink Film	770	1.160	1.300	2.500	5.200	5.900	6.400	5.395	32.06
Stretch Film	190	290	220	150	150	120	190	180	-0.77
Embossed	1.360	1.610	1.400	1.750	2.500	3.000	3.200	2.500	9.09
Agriculture	5.800	6.380	5.830	4.200	5.300	4.600	4.800	4.000	-5.17
Milk Sachets	800	1.100	1.000	2.000	3.700	4.300	4.500	3.600	23.97
Printed Film	4.500	6.300	6.600	8.000	10.000	11.000	11.700	9.400	11.10
Sacks	900	1.070	1.050	1.300	1.700	2.000	2.100	1.680	9.33
Coating					250	550	550	820	
Diapers									
Total	31.020	38.510	36.400	43.400	61.450	66.370	70.940	58.621	9.52

Source : DUPERIAL

from the cost of contents and the purchasing power of the consumer, cheap bottles such as sachets will become more popular in the near future.

4) Sacks

Confectionery and powdery food are mostly packaged in bag shapes. Most bags are in a flat form with a three-sided seal or a four-sided seal, or alternatively are pillow type with a both-sided seal. Food is filled and sealed in bag form by a fill and sealing machine. In Japan blown bottles of LDPE are used for bottles of honey and drinks. LDPE is also used as a constituent material for multi-layer blow molding bottles (for mayonnaise, ketchup, edible oil), which make use of its flexibility. In Argentina, the only LDPE bottles seen were 1-liter milk bottles.

(b) High Density Polyethylene (HDPE)

Compared with LDPE film, HDPE film has better strength, toughness, readiness of opening, moisture resistance, chemical resistance, oil resistance and heat resistance properties, but has worse impact strength and heat sealing properties. Its uses are in packaging dried food, frozen food, bread and confectioneries, and as garbage bags and as carrier bags for supermarkets. Uniaxial stretched film is a special kind of HDPE film. This film has good transparency, toughness and twisting properties and is therefore used for the twisted packaging of candies and wheatglutens.

In Argentina, demand for HDPE did not increase so much as LDPE. This is because there was not enough capacity of supply by domestic producers (Table III-4-8).

(c) Polyvinyl Chloride (PVC)

PVC film is used for three kinds of products; soft film (plasticizer content: 30 - 60%), semi-rigid film (plasticizer content: 10 - 15%) and rigid film (no plasticizer). Soft film is used as a stretch film as it has good elongation and tear strength properties. It is mainly used for packaging food in a tray which cannot be subject to heat, such as vegetables, fruit, fresh meats and seafoods. Stretched shrinkable film can also be used for this purpose.

Semi-rigid PVC film is used for packaging food such as bread and dried food, but recently it has been replaced by PE film because of the sanitary problems associated with plasticizers.

Non-plasticized rigid PVC film (sheet) has good transparency, gas barrier, moisture resistance, heat sealing, chemical resistance, printing and rigidity properties, and is so cheap that it is widely used for packaging jam, confectioneries, pharmaceuticals, and making cases and packs for fruit, and trays.

Blow PVC bottles are largely used for mineral water, juice, edible oils and condiments. In the case of mineral water, six 1.5l PVC bottles containing mineral water are multi-packaged by shrinkable film and are commonly sold in supermarkets.

The growth rate for the production of PVC from 1978 and 1985 was high marking 24% per annum.

(d) Polypropylene (PP)

PP film is the lightest plastic film and has so many excellent properties such as mechanical strength, transparency, chemical resistance, moisture resistance and heat resistance, that demand for it as a food packaging material is rapidly increasing in many countries.

There are two kinds of PP film; cast film (CPP) and oriented film (OPP). CPP single film is the most frequently used for the packaging of bread and cakes. Other uses are for automatic bag packaging of fishery products, frozen confectionery and sugar, and for twisted packaging of candies, wheat-glutens and biscuits.

OPP film has excellent physical properties, such as tensile strength, fatigue strength, impact strength, low coefficient of friction and toughness and it is also very suitable for printing. It also has good moisture resistance and transparency but poor heat sealing properties. So when using a single film, OPP film of improved heat sealing property should be used. Single side heat sealing type OPP film is used for automatic packaging of biscuits, candies and sausages. Double side heat sealing type is used for overlapping, such as for individual packaging as with a caramel case, or overlapping integrated packaging or stick packaging of powder such as sugar.

Molded bottles are produced by injection molding, blow molding and sheet forming, and are used for bottling dairy products, desserts, oils, fats and confectioneries.

At the moment all the PP is imported to Argentina. The figures for the PP market in the last four years are shown in Table III-4-8.

In Argentina, the following new PP plant is now under construction. When this plant is completed, it is thought that Argentina will not have to depend on imports of PP in the near future (Source: Hydrocarbon Processing/International/Section 2 June, 1984).

Company (Location)	Production Capacity (kilo.tons/Y)	Process	Year of Completion
Petroquimica Cuyo SAIC (Lujan de Cuyo)	40.0	BASF	1987

(e) Polystyrene (PS)

There are various kinds of PS such as General purpose polystyrene (GPPS) which is colorless and transparent, high impact polystyrene (HIPS) which is milk-white and is reinforced by synthetic rubbers such as butadiene resins, expanded polystyrene (EPS), and polystyrene paper (PSP).

PS is usually used for cups and trays molded from its sheet of it. HIPS is used for cups for refrigerated confectioneries, drinks, confectioneries, and for trays for puddings, jellies, margarine, butter and fermented milk. EPS is used for cups to hold drinks. PSP is used for meat trays (to hold processed products of pre cooked fresh fish, vegetables, fruit and fresh meat) and for cups for food and drinks. Multilayered bottles made from GPPS or HIPS are widely used for dessert foods.

(f) Market trends in plastic packaging materials

Taking into account the previous analysis, the following points outline the market trends of plastic packaging materials in Argentina.

1) Shrink film

- a) Promising ... The use of this film is expected to increase at a considerably high rate.
- b) Uses ... For multi packs for mineral water, canned food and bottled food, and for shrink packaging for transportation of empty bottles.

2) Stretch film

- a) Currently PVC film and not PE film is used for wrapping meat, fruit and vegetables put on trays.
- b) This film is also used for wrapping meat at the slaughter house or freezing companies, and for wrapping vegetables, fruit and bread at the supermarkets.
- c) Wrapping operation is done manually at present. If automatic operation is introduced, the demand for this film will increase.

3) Milk sachets

- a) They are packed at dairy companies and sold at supermarkets and stores.
- b) At present, 70% of the milk containers in Argentina are PE bags (for 1 liter, thickness of 80 μ), 20% are paper containers and 10% are PE bottles.

4) Coating

- a) Paper with coating is used for tiny sugar bags and flow packs of icecream.
- b) Ionomer coating is beginning to be used. It is about twice as expensive as PE, but is replacing PE for confectionery.

5) Co-extruded film

Annual consumption is 1,300 tons. 80% of this has three layers. For example, nylon/lonomer Resin LDPE is used for casing sausages.

20% of the co-extruded film annually consumed has two layers. For example, LDPE/HDPE or LDPE/EVA is used for bags for flour.

6) Bottles

- a) PVC bottles for holding mineral water and edible oil are gradually replacing PE bottles.
- b) PET bottles are being used for Coca-Cola and detergent.
- c) The PET consumption market is still too small to establish a manufacturing plant there.
- d) In Argentina, there is neither the technology to produce multi-layer blow molding nor the processing machinery for it. If a company began to manufacture it, its market is considered to be promising.
- e) At present LDPE bottle or glass bottles are used for ketchup and mayonnaise.

(3) Metals and others

(a) Tinplate

Tinplate is used for producing cans. CENTENE RA S.A., which has a 45% domestic market share being the largest producer of can in Argentina, producing various kinds of cans except beverage cans. It produces tinplate three piece cans. It does not produce welded seam or lap cemented cans. It would be advisable to use tin-free steel as a material, and introduce the production of welded cans, lap cemented cans and drawn and ironed cans.

According to tinplate users, following are pointed out.

- a) It takes considerable time from order tinplate to its delivery if ordered to a domestic producer.
- b) Tinplate supplied is not uniform in quality.
- c) As the width of the plate is limited to one size, when the body and the end of the can are stamped out, a great deal of scrap remains. Canned goods manufacturers bear the brunt of the unstable supply of tinplate to can manufacturing companies, as it is impossible for them to keep large amounts of empty cans in stock as this ties up their capital.

A system of technical cooperation with countries industrially advanced in the field of iron should be taken to develop Argentine tinplate's international competitive power and improve its quality.

(b) Aluminum

In Argentina bauxite, the raw material of aluminum is imported from Australia. Aluminum ingots are produced from bauxite solely by

Aluar, and therefore domestic producers of aluminum processed goods can only buy them from Aluar.

The output of aluminum in Argentina is at present 144,000 tons per year, with 45% of this consumed domestically and 55% exported.

21% of the domestic consumption is taken up by packaging. A breakdown of its uses is given in Table III-4-11.

The followings are the characteristics of aluminum industry in Argentina.

- 1) The demand in the domestic market is still small. For example, the amount of aluminum consumed in packaging per person in Argentina is 0.49 kg (1985 figure of 14,800 tons, divided by total population), while that of Japan is 1.72 kg (202,300 tons divided by total population).
- 2) Aluminum is generally used for aerosol cans, tubes and foils, but not very commonly for fish cans.
- 3) The yearly production capacity of 300 ml DI (Drawn and Ironed) cans for beer, which one enterprise has recently developed, is 200 million units, but the scale of consumption in Argentina is said to be only 80 million units and it is therefore not necessary to produce them by using this technique at present.
- 4) Aluminum beverage cans are not produced at present as there is no demand for them. If they were produced, they would be the most expensive cans, at 25 cents a unit.
- 5) New investment is necessary to produce thinner aluminum, but as the market is still small, the investment to renew the facilities is not considered.
- 6) There is a possibility of opening up new markets, but Argentine are unfamiliar with aluminum at the present.

Table III-4-11 Packaging Usage of Aluminum

	(tons)
Aerosols and tubes (Impact extruded)	2,200
Lids (Easy-open, pilfer etc.)	5,600
Foil (cigarettes, confectionery, beverages and pharmaceuticals)	7,000
Total	14,800

Source: Argentine Packaging Association