IV-3-3. The Current Situation of Supporting Industries

(1) Unbalanced Growth of Supporting Industries

Fig. IV.3-1 shows the correlations of supporting industries of the personal computer and peripheral industry.

Major overseas electronic parts manufacturers set up their production bases in Malaysia, following the example of export-oriented appliance industries which created a parts market in Malaysia.

As a result, personal computer and peripheral makers would find no problems with the purchase of parts if they started production in Malaysia now, though they often would have to import standard electronic parts such as general-purpose ICs, transistors, diodes, capacitors and resistors from Singapore.

On the other hand, supporting industries such as metal moulds and processed metal parts are developing slowly in Malaysia. There is only a limited number of the manufacturers of precision parts necessary for making many industrial electronic devices including personal computers and peripherals.

(2) Key Technologies of Supporting Industries

Fig. IV.3-2 shows technologies which are a prerequisite for the assembly of and manufacturing of parts for personal computers and peripherals.

As the figure indicates, the precision technology for processing metal moulds is a basic technology which supports precision casting, precision injection moulding and precision metal pressing. The precision casting technology, precision injection moulding technology, precision metal cutting technology and precision metal pressing technology are key elements which form the basis of technologies for manufacturing precision parts, units and end products.

Development of the above-stated technologies is an urgent task to address for the development of industrial device industries including personal computers and peripherals. In other words, a high-tech parts industry based on the above-stated technologies is a field which should be promoted for the development of the personal computer and peripheral industry. The improvement of the ability of the high-tech parts industry will also accelerate the growth of other electronics industries.

Fig. IV.3-1 Relationship among Personal Computer and Peripherals Industry, and Supporting Industries

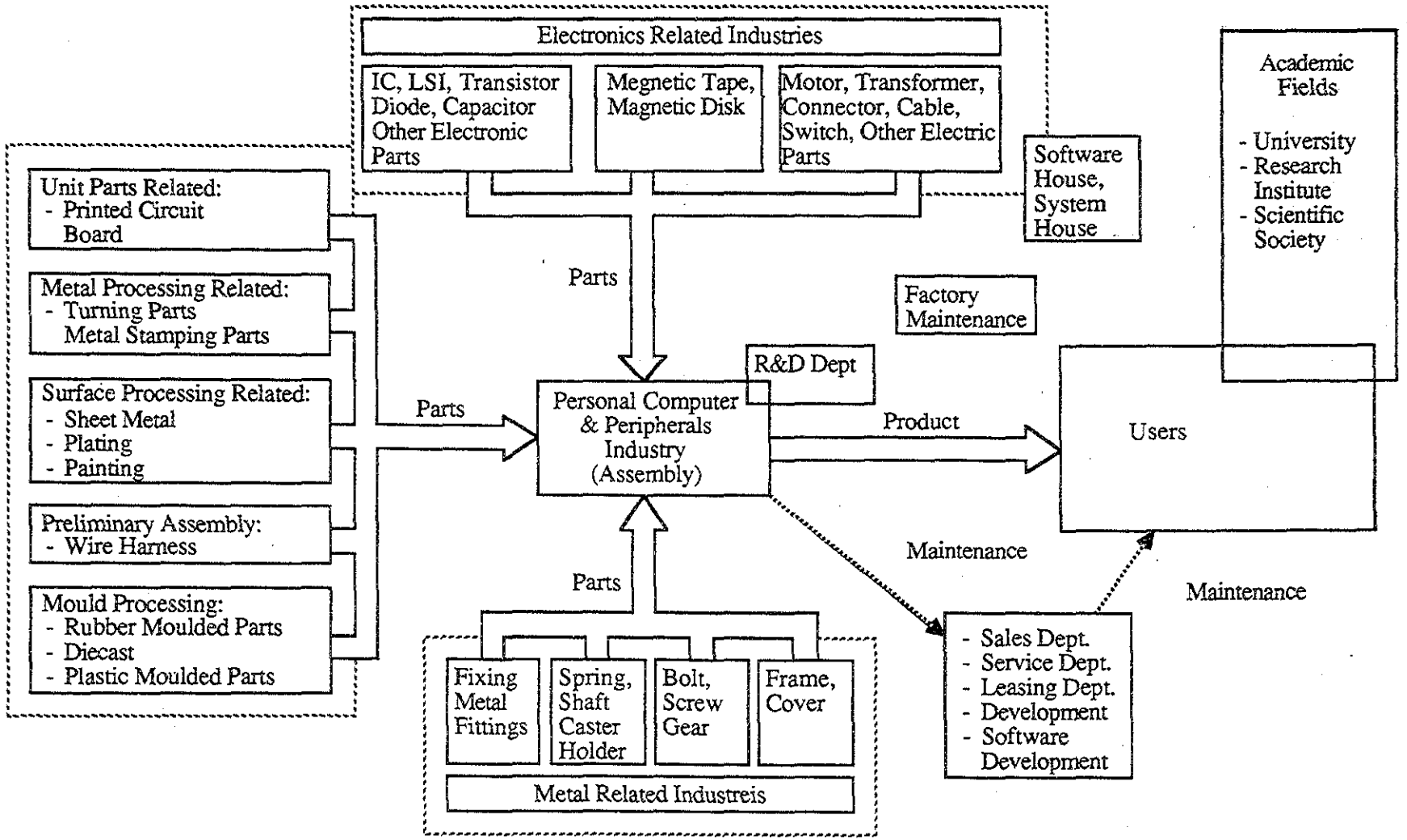
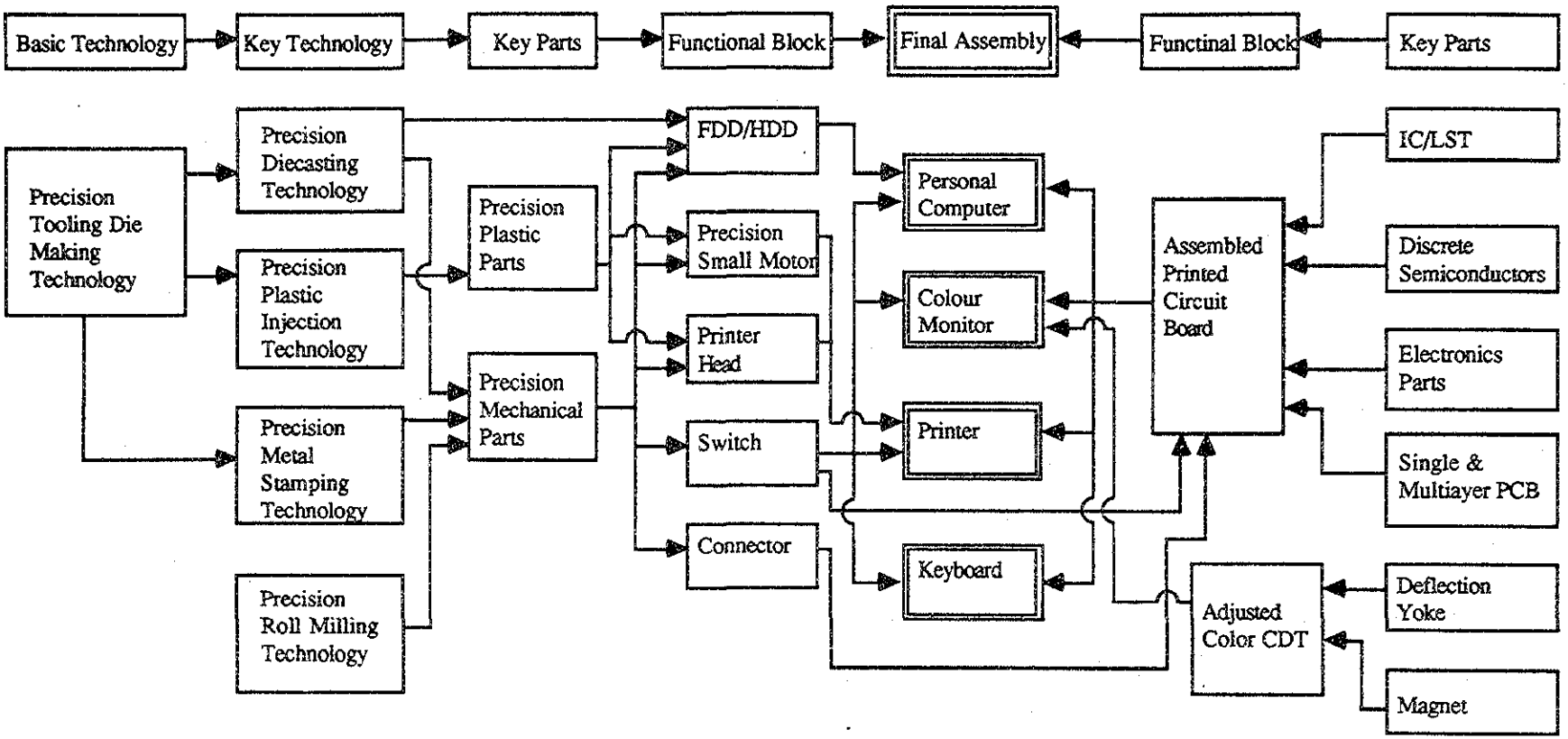


Fig. IV.3-2 Prerequisite Technologies to the Manufacture of Parts and Components and the Assembly of Personal Computers and Peripherals



(3) The Current Situation of and Problems with Supporting Industries

Table IV.3-2 shows specific technologies and facilities required for the expansion of supporting industries related to industrial electronic device industries, particularly the personal computer and peripheral industry.

The current situation and problems of the key supporting industries can be summed up as follows:

1) Metal Mould Industry

High priority should be given to nurturing the metal mould industry which provides metal moulds necessary for parts manufacturing.

Malaysia's metal mould industry is currently on a level to be able to manufacture standard metal moulds and simple jigs and tools. It can repair and remodel these metal moulds. But, when the supply of metal moulds for personal computer and peripheral industry is considered, there are the following problems.

[1] Processing of Metal Moulds

On the level of both production facilities and manufacturing technologies, Malaysia lags far behind Taiwan, South Korea and Singapore. Malaysia's metal mould industry, small in scale, currently supplies metal moulds of low quality for metal press and plastic injection moulding. Because the metal mould industry is small, the number of metal mould makers able to meet the level required by the electronics-related field is very limited. The metal mould makers cannot supply metal moulds sufficiently to the electric appliance industry whose demand for metal moulds is large and acute. The appliance industry relies on in-house production or imports from Japan and other countries.

We found that the facilities in use were outdated and maintenance of machines was insufficient. Many firms did not have the CNC machine tools necessary for manufacturing electronics-related metal moulds. A shortage of skilled labour and ian nsufficient technological level prevented them from fully utilizing the facilities and machinery.

[2] Maintenance of Metal Moulds

Because of insufficient technological ability and problems with facilities, metal mould makers are not able to fully provide their customers with maintenance service. This has forced the metal mould users to send their metal moulds to overseas metal mould makers for maintenance, leading to the lowering of

operating efficiency of plastic injection moulding, casting and metal pressing processes.

[3] Design of Metal Moulds

Only a limited number of metal mould makers can do the integrated work from design through to manufacturing.

Responsible for the shortage in metal mould designing ability of the metal mould makers are the following factors:

- Except for some major metal mould makers, they have not installed facilities such as CAD/CAM or CNC. The number of engineers and technicians who can operate the latest computerized devices is small in Malaysia.
- The number of engineers able to design metal moulds is limited in the industry.

With metal moulds becoming increasingly precise and advanced, ability to design them becomes an important factor in the quality and cost of the products. Production of precision metal moulds and progress metal moulds cannot be done without designers. In the future, the need to install CAD and other devices as well as to hire and train excellent designers will increase.

[4] Training of Skilled Labour

It is becoming harder to secure skilled workers. Official education and occupational training in the field of metal mould technologies are imperfect in Malaysia. Training of engineers and technicians by educational and training institutions is also insufficient. Metal mould processing is a field where experience counts for a great deal. It takes 10 years of on-the-job experience after finishing school before one can handle metal mould technologies at a passable level.

Some firms are nurturing skilled labour through in-company education and training. But costs and lack of educational know-how will limit the firms' efforts to teach everything starting from ABC. Even if the firms successfully train skilled people, full-fledged engineers might change companies. The shortage of skilled people has resulted in the practice of luring technicians away from other firms.

[5] Processing of Precision Metal Moulds

Although some foreign electronics makers are producing precision metal moulds in-house, there are no manufacturers specialized in precision metal moulds in Malaysia. Electronics makers unable to produce precision metal moulds in-houseare therefore forced to rely on imports.

For manufacturing precision metal moulds, such high-priced machines as cemented grinders and CNC are needed. A working environment equal to a clean room is required. Thus, perfection of conditions for manufacturing precision metal moulds will necessitate spending a huge sum. Moreover, these machines have a large productive capacity and demand for precision metal moulds is not very large in the whole Malaysia. Thus, it is doubtful whether there will be enough orders received to assure the full operation of the machines after their installation.

At the same time, there will remain the problem of how to train engineers who can make precision metal moulds. Experience is necessary for the accumulation of know-how regarding the manufacturing of precision metal moulds.

The problems of acquiring know-how and raising funds will limits the ability of existing makers to raise the level of technology step by step and to tackle the processing of precision metal moulds.

2) Metal Machining Industry

In addition to the need for improved metal die fabrication technologies, there is an increasing need for improvement of metal cutting precision. The current level of 0.01-0.05 mm should be upgraded to 0.001-0.01 mm.

Such an improvement will require the introduction of the latest CNC machine tools. Also important is the production know-how needed to master this equipment and produce products with consistent quality. Malaysia currently suffers from a lack of experience and know-how in the manufacture of the high-precision hikimono(?) required by the electronics industry, particularly for industrial applications.

Some of the foreign-affiliate firms are engaged in metal machining in specific fields, but the transfer of this technology to the industry as a whole and the resulting creation of new markets have yet to be realized.

Development of this industry will require very basic efforts, starting with the training and education of engineers and technicians in metal machining.

3) Plastics Industry

In terms of both technology and facilities, the plastics industry consists of a pyramid-like structure, with foreign affiliates located at the top.

Plastic cases and cabinets for televisions, portable stereos, and other finished electrical products are supplied locally by foreign affiliates and leading local manufacturers.

[1] Current Production and Problem Areas

There are approximately 600 firms in the plastics industry, and competition is fierce. Only a few of these companies, however, have the production capacity and quality standards necessary to supply to firms in the export-oriented electronics industry. Rapid increases in production by export-oriented manufacturers of home electrical appliances have meant that the leading plastics manufacturers are hardly able to deal with orders from producers of electrical appliances alone.

Electrical appliance manufacturers source their components from those plastics companies maintaining extremely high technical standards. In those areas which are home to numerous electrical appliance producers, demand from these companies tends to be concentrated at the upper echelon of plastics manufacturers among Malaysia firms.

In the area of quality control, virtually none of the firms were capable of meeting the standards provided by the electronics/electrical equipment assemblers. At one of the Japanese plastics companies, thoroughgoing quality control was achieved only after a long period of technical guidance from the assembler.

Malaysia's electrical appliance manufacturers are working to improve technical standards at the plastics companies through extensive guidance in the areas of production technology and quality control.

As a result of the increase in orders from export-oriented electronics assemblers, the working environment at the plastics companies has deteriorated somewhat. In particular, the storage situation for metal dies and plastic materials is in disarray.

The lack of training for the engineers and technicians in charge of production management is also hindering the improvement of production management.

[2] The Need for Engineering Plastics

Materials currently used by Malaysia's plastics manufacturers include PS, ABS, and other ordinary plastics. Engineering plastics are produced only at a few foreign-affiliate electronics assemblers for use in their own products.

While low-density polyethylene, high-density polyethylene, vinyl chroride, polypropylene and polystyrene are called general-purpose plastics, high-functional plastics are generally called engineering plastics. Representative of the latter group are polyamide, polyacetal resin, polycarbonate, modified PPO resin and polybutylene terephthalate. Components moulded of these materials are excellent in strength, heat-resistance, stability of measurements and vibration resistance, and can replace parts made of metal.

The electronics industry is experiencing a gradual shift from metal parts and components to plastic ones. The development of plastic structures for parts and components is being accompanied by rising expectations for engineering plastics technology. The absence of engineering plastics suppliers in Malaysia is expected to hinder the development of the electronics industry.

When factors such as the lack of experience in engineering plastics, the shortage of engineers well-versed in production management, and insufficient facilities are taken into consideration, it can be seen that numerous problems remain before Malaysia's plastic companies can begin the manufacture of engineering plastics.

[3] Metal Dies

Only a few companies produce their own metal dies. Most of the plastics companies receiving orders from electrical appliance manufacturers are supplied with metal dies by their customers.

[4] Manpower Shortage

There is a shortage in the absolute number of experienced skilled labourers and technicians, and job hopping is common among the former group. Headhunting is also a problem in the industry.

One of the main reasons for this state of affairs is the lack of appropriate training facilities for technicians in plastics technology. Corporations are using on-the-job training to improve the level of skills and technology possessed by their workers, but the training of a capable technician requires a great deal of time.

4) Metal Press Industry

[1] Production

In the area of ordinary pressed components, the metal press industry has both the facilities and technology required to produce products for use by electronics equipment manufacturers. Facilities are also being upgraded. The precision pressed components sector, however, remains in the initial stages of development. Overall, working environments are less than favourable. Storage conditions and warehouse management for metal dies and jigs need improvement. There is a great deal of room for improvement in this type of production management.

[2] Production System

One-shot production is the mainstream in Malaysia. As a result, the production process is labour-intensive.

The introduction of progressive systems would be extemely difficult at present since companies lack the ability to design and fabricate metal dies and since there are no production engineers and technicians capable of handling these.

[3] Precision

The precision of pressed components has yet to meet the standards required for industrial electronics equipment. Achievement of this level of precision will require the introduction of new production facilities and the training of engineers and technicians in the metal die and machining fields.

Increased production of high-tech home electrical appliances is expected to bring about demands for greater precision in parts and components for these products. As a result, there is an urgent need for improvement of mould and die maintenance capabilities and production management technologies.

[4] Plating Process

Operations like plating and painting are often farmed out to subcontractors. The plating process also involves the problem of waste fluid disposal, and there is an urgent need for the development of a safe and efficient waste disposal system at the industry or government level.

Table IV.3-2 Technology and Facilities Required for Supporting Industries

Product Name	Use	Required Technology and Manufacturing Facilities	Present Status of Production in Malaysia
Precision Die	Common	-Precision die making facilities -Die designing technology Die making technique	-Insufficient facilities even for general dies -Lack of high precision die making facilities -Insufficient number of die designing engineers -Low technique level of technicians and lack of technicians
Precision Metal	Common	-Precision metal stamping machine -High speed metal stamping machine -Precision die technology and facilities	-No high precision machine except for in-house use
Precision Roll Milling	Common	-CNC lathe (Length 300 - 400mm) -Centerless grinder (Length 300 - 400mm)	-Insufficiency of high precision machines -Shortage of technicians who can handle precision machines
Precision Plastic Injection	Printer Keyboard	-Engineering plastics processing technology -Precision die technology and facilities	-No experience in engineering plastics
Printer Head	Printer	-Precision metal stamping technology and facilities -High precision plastic injection technology and facilities -Precision die technology and facilities	-No production in Malaysia -One company plans to start production in Malaysia
Precision Small Motor	Printer	-Precision metal stamping technology and facilities -Precision shaft making technology and facilities -Precision die technology and facilities	-No production of precision small motors in malaysia

Switching Power Unit	Common	-Designing of a switching power unit -Manufacturing technology of high-frequency transformers	-Manufacture of general power supplies -Electrolytic capacitors and transformers are produced.
IC/LSI	Common	-Custom IC production technology and facilities	-Manufacture of general-purpose ICs and memory chips
Multi-layer Printed Circuit Board	Computer Printer	-Double-sided through-hole PCB production technology and facilities -Multi-layer PCB production technology and facilities -CNC drilling machine	-Single-sided PCBs and double sided PCBs without through-hole are produced
Colour CDT	Colour monitor	-Colour CDT production technology and facilities -High-resolution CDT production technology -Precision metal stamping technology -Precision die technology and facilities	-One company plans to start production in Malaysia
Deflection Yoke & Flyback Transformer	Colour monitor	-Ferrite core production technology and facilities -Minute wire-rolling technology and facilities	-Start of Ferrite core production -Deflection yoke and flyback transformer for colour TVs are produced
FDD/HDD	Computer	-FDD/HDD production technology and facilities -Precision metal stamping technology and facilities -Precision plastic injection technology and facilities -Precision aluminium diecasting technology and facilities -Precision die technology and facilities -Precision roll milling technology and facilities	-No production of FDD/HDD -Some companies plan to start production in Malaysia

Switch	Common	-Precision small switch production facilities -Precision metal stamping technology and facilities -Precision plastic injection technology and facilities -Precision die technology and facilities	-Production of switches is being planned.
Connector	Common	-Precision metal stamping technology and facilities -Precision plastic injection technology and facilities -Engineering plastic processing technology -Precision die technology and facilities	-Production of connectors only for in-house use

(4) Recommended Policies

Common problems confronting supporting industries include man power training, plant management, and facilitiy modernization, i.e., financing.

1) Manpower Training

In-house training of engineers and technicians in charge of design and production management should be promoted.

Since there are limits to the training a company can provide, however, public facilities must help in the training of engineers and technicians. This assistance could be in the form of the development of a practical curriculum suited to the needs of the industry, the enlargement of training facilities, and the hiring of better-qualified instructors, thereby upgrading the training for technicians and skilled labourers at polytekniks, CIAST, and other public training institutes.

Industry associations in the plastics industry are already sponsoring seminars for engineers and technicians to polish their skills. Measures for solving the shortage of technicians and skilled labourers should also be studied at the industry level in each of the supporting industry sectors.

2) Improvement of Plant Management

With the exception of a few foreign-affiliate companies, there remains a great deal of room for improvement in the areas of plant management and production management. Further guidance and consulting is needed in these areas. The problems being encountered in these areas are very basic ones, and guidance in ways to resolve these problems would have immediate effects.

In the case of technical guidance provided to parts and components suppliers by customers, both sides are very enthusiastic. This type of guidance would be very effective in improving plant management in the supporting industries, since immediate improvements closely tied to daily operations could be expected and concrete solutions easily proposed and implemented. Measures to promote technical guidance by buyers are therefore needed.

Educational activities via the NPC in the field of quality control methods would also contribute to the improvement of plant management and quality control in the supporting industries.

3) Assistance for the Introduction of Advanced Facilities

Facilities throughout the industry are aging, and production of advanced, high-quality products will require the upgrading of current facilities and the introduction of new

ones. Many firms would like to purchase new facilities but are unable to do so because of a lack of financing. The possibility of financial incentives for the modernization of facilities should therefore be studied.

For facilities requiring an investment too large to be borne by a single company, a system in which public institutions would purchase the necessary equipment and lend it out to private companies should be considered for those sectors which are critical to the development of supporting industries.

4) Technological Improvement Measures

Research and developemnt activities at public facilities in new and precision technologies should be further promoted, and their technological guidance and information services for industry enlarged. SIRIM's Plastics Technology Centre, for example, provides the plastics industry with technical assistance in the form of technical guidance, raw material and product testing, creation of industry standards, technical training, and information services. In addition, the Metal Industry Development Centre (MIDEC) is engaged in metal machining R&D and also sponsors related seminars. Further expansion of these types of activities should be investigated.

The promotion of exchanges within the industry as well as with industries in other countries would also help to improve access to the latest technological information.

5) Promotion of Joint Ventures with Overseas Firms and Investment by Foreign Companies

In the case of high-tech parts and components which cannot be manufactured by local companies because of insufficient technology, joint ventures and technical tie-ups with foreign companies as well as investment by overseas manufacturers should be promoted.

Table IV.3-3 Problems and Possible Measures of Supporting Industries in Malaysia

<Mould and Die Industry/Jig and Fixture Industry>

Present Status	(Level of Manufacturing Technology) - At present level, the manufacture of general moulds and simple jigs is possible - At present level, the maintenance and modification of moulds is possible - The number of mould makers which can design and manufacture is limited (Customer) - For the electronics industry, major customers are consumer electronics and audio makers.
Problems	(Equipment) - Outworn machinery is used. - No investment is made in new machinery. - CNC machinery is not used. (Design and Development) - They can not carry out designing and development because they do not have CAD/CAM equipment. - They are not eager to manufacture precision moulds. (Personnel) - There are an insufficient number of mechanical engineers. - It is difficult to employ sufficient skilled workers. - There is the limitation of in-house training. - It is difficult to employ sufficient skilled workers. - There is the limitation of in-house training. - It is difficult to take an active measure to train employees. For example, if they send their employees to Japan for training, these trainees are apt to move to other companies. (Marketing) - Japanese or Taiwanese mould makers in Singapore are strong competitors.
Necessary Measures	(Equipment) - To establish incentives for the promotion of investment in mould manufacturing equipment (Personnel Development) - To examine the governmental financial support for the training of special skilled labourers

<Metal Stamping Industry>

Present Status	(Production) - Small-scale and medium-scale stamping of 300 tons at most are the majority. - Plating and painting are often ordered by outside suppliers.
Problems	(Equipment) - Only a few can do large-scale stamping because most have stamping machines of 300 tons or less. - Obsolete machinery is used. (Production Management) - There is no systematic management of materials. - Work conditions are worse than assemblers and plastic makers. (Production Technology) -It is difficult to make precision parts because they do not have appropriate machinery and measuring instruments. -Their plating technology is low. (Quality Control) - Products with rust are observed. (Waste Fluid Treatment) - Thorough treatment of liquid waste is required in the interest of pollution prevention and workers' hygiene. (Personnel Development) - Excellent technicians and engineers are insufficient. - The number of managers with an active attitude toward management is limited.
Necessary Measures	(Equipment) - To establish investment promotional measures for up-to-date equipment. (Materials) -To improve cost competitiveness by lowering tariff rates of plate springs and superlight alloy materials. (Personnel Development) - To examine the governmental financial support for the training of special skilled labourers. (Activation of Market Competition) - To liberalise the participation of overseas metal stamping parts makers. - To examine incentives for joint venture with an overseas maker (Rationalisation) - To promote the improvement of physical distribution (Waste Fluid Treatment) - To establish an industrial estate which can deal with waste fluid

<Plastic Moulding Industry>

Present Status	(Production) - Production of Plastic parts for audio equipment and consumer electronics is rapidly expanding. - The number of plastic parts makers supplying to electronics makers is limited. (Production Equipment) - Investment in new equipment is actively made. (Production Technology) - They receive technical guidance including QC techniques from customers providing Japanese capital. - The number of employees per company is similar to that of plastic parts makers in Japan. (Personnel) - Night shift is possible.
Problems	(Production Equipment) - They do not have machinery which can handle engineering plastics. (Production Management) - Work conditions have worsened at many factories due to the rapid increase in production . - Moulds are not kept in a good order. - Materials are not kept in a good order. (Production Technology) - The number of plastic parts makers which can maintain and modify moulds. - They often depend on customers for moulds. they are, in general, not eager to improve mould technology. - The number of production engineers is limited. - The recognition of the necessity for precision plastic parts is low. (Personnel) - Workers are not motivated to improve their skill. -(Management Attitude) - Managerial guidance to managers of the next generation is necessary.
Necessary Measures	(Quality Improvement) - To promote the improvement of quality by establishing an inter-industry QC organization (Improvement of Plant Management) - To improve factory management know-how by providing technical guidance (Rationalisation) - To improve physical distribution and stock management by providing technical guidance (Activation of Competition) - To liberalise the participation of overseas precision plastic parts makers in the field of engineering plastics. - To examine incentives for joint venture with an overseas maker in the field of engineering plastics.

IV-4. Present Status of Industrial Promotion Policy and Supporting Measures

IV-4-1. Present Status of Industrial Promotion Policy and Supporting Measures

(1) Industrial Promotion Policies

At the present time, Malaysia does not have any promotional policies specifically for individual industries under laws such as the laws for the promotion of the electrical equipment industries of Japan and Korea. Japan and Korea have established directions for promotion by these policies lasting for limited times and have provided packages of assistances including tax incentives subsides, and human resource development for achievement of the established goals. In Malaysia, the nearest thing to such industrial policiies was "Industrial Master Plan for 1986 to 1995 (IMP)" announced in 1986. The plan analysed the state of 12 industrial sectors and set goals for their future development. One of the sectors it took up was the electrical and electronics industries. However, the IMP is basecally an "indicative plan" and is not necessarily being realised.

The IMP gives the following framework of goals for the electronics industry as a whole:

i) Promotion of export-oriented consumer and industrial electronic products
ii) Reduction of dependence on imported materials and components through the promotion of domestic suppliers and supporting industries
iii) Raising of the added value of the industry as a whole by introduction of design and R & D activities
iv) Promotion of increased local equity in the electronics industry
v) Encouragement of greater sophistication in existing semiconductor assembly and tesging activities

In the above framework, promotion of the computer industry would directly encourage the development of industrial electronics. Further, this is an industry which cannot hope to grow without domestic procurement of condsiderable components. Its development would have a large ripple effect on the supporting industries.

In the IMP, based on the various conditions in Malaysia, a list of strategic products to be promoted for realisation of future targets was made. Computer related products are included finished products which as OEM oriented microcomputers, printers

and keyboards and key intermediate components such as floppy disk drives, hard disk drives. The importance of these is seem to be affirmed.
Further, MAMPU and some organisations are making a national Information Technology industry plan. This IT industry plan aims at the promotion of domestic use of information technology. The greater activity in the domestic market and training of personnel through the implementation of this plan will be expected to create a good enviroment for the computer industry as well.

Regarding the development of technology, "Industrial Technology Development: A National Plan of Action" was announced in February 1990, showing the comprehensive objectives and action plans for the promotion of technology development. The plan recommended that basically private sector should play the leading role in industrial technology development and R&D must be demand-led, market driven and commercially relevant. To achieve the objectives, the plan put forth 42 proposals calling for the establishment of a policy coordinating committee and the enhancement of support for R&D activities by private enterprises and so on. The plan also showed individual action profiles for nine key sectors. Regarding the electronics industry, it took up; 1) development of technological competent in semiconductors, microprocessors and surface mounting, etc 2) design of ASICs, and 3) application of microelectronics technology in process of automation. It also took up development and design of value-added products, such as printers, disk-drives and facsimile machines.

(2) Current Promotional Measures

The exising various promotional measures do not specify any particular industries. Incentives, are applied across the board in the form of investment promotion, export promotion, promotion of medium-and-small scale industry and promotion of R & D.

An explanation will be omitted of the various incentives offered by Malaysia government. Rather the forms of assistance now working effectively for existing computer related industries and expected to work well in the future will be touched upon brieifly.

1) Investment Incentives

Among th various investment incentives, companies wish to make use most of the pioneer status (PS). This is one of the major motivation for investment in Malaysia by foreign affiliated companies. All of local companies now producting personal computers were found to acquire pioneer status. Thus, the

effectiveness of such incentives were confirmed as promoting the entry of local capital into this new field.

2) MIMOS

MIMOS is the only puplic research organisation for electronics in Malaysia. As a part of its activities it engages in the design of PCB and IC chips. It undertakes projects on a consignment basis and has experience in joint development with local electronics companies. Recently, it began joint research with a major local personal computer manufacturer, Accent Technology. At present, the majority of the domestic electronics companies are foreign affiliates with R & D functions handled by the parent companies. There are few companies with R & D divisions in Malaysia. Further, private, local companies would find it difficult capital-wise to engage in R & D in-house. MIMOS may therefore make possible to accumulate technologies locally. However, due to the manpower problem and other factors, it activities are limited.

3) Technology Park

The Technology Park was established in 1988 as part of the promotion of domestic R & D activities. At present, there are 14 companies located in it, of which seven are computer related. Of these, two are engaged in the assembly of personal computers. The merits of the Techonlogy Park are low rental fees and the ability to use common facilities. Entry into the Technology Park requires a certain examination process, with companies with high technical orientations being selected. The park may be said to be contributing to the development of high-tech ventures which lack for capitals. The present Technology Park is presently located in the temporary site and there is a plans to move and expand it.

4) Industrial Technical Assistance Fund

An "industrial technology fund" was proposed for medium and small scale companies in the fiscal 1990 draft budget. It is envisioned that this fund would support feasibility studies and R & D by companies through the provision of subsidies and provision of preferential financing in the case where those activities are commercially suitable. Implementiation is expected to being in 1990. There has been a great need in the private sector for such subsidies but never offered in the past. The preferential application of this measure to the

computer industry can be expected to promote high-tech ventures by local capital.

5) Others

As the computer industry requires a wide range of advanced supporting industries, the development of the industry requires side support from numerous organisations as well. In particular, there are many fields in which support should be given to local companies. The NPC and SIRIM can provide effective support for improvement of quality and technology, MEXPO and MTI for expansion of markets, and MTI, MIDA, for introduction of technology and indutrial promotion, etc.

(3) Education in Computers

Training of computer engineers is essential for the promotion of the computer industry and the strengthening of the foundations of the information industry. According to the Malaysian National Computer Confederation (MNCC), there are now 700 computer engineers of a professional level in the country.

As public training institutes, there is the Computer Training Centre in INTAN. This provides rudimentary data processing training to civil servants using personal computers. INTAN, however, is now engaged in a project to reducate its instructors and therefore move the course to a more advanced level. Computer courses are also being offered in vocational training schools, but private schools specialising in data processing are producing more graduates. At present, the domestic software industry is still undeveloped, so there is not a great demand for programmes and no noticeable shortage of them.

In the future, to increase the number of engineers and bring up advanced computer researchers, it will be imporatnt to instill an interest in computers among the young. Measures to raise what is called "computer literacy" will be necessary. The plan of the Ministry of Education to install computers in secondary schools may be expected to prove effective in this regard. However, there is a shortage of educational personnel and it will first be necessary to provide instructors with the proper training.

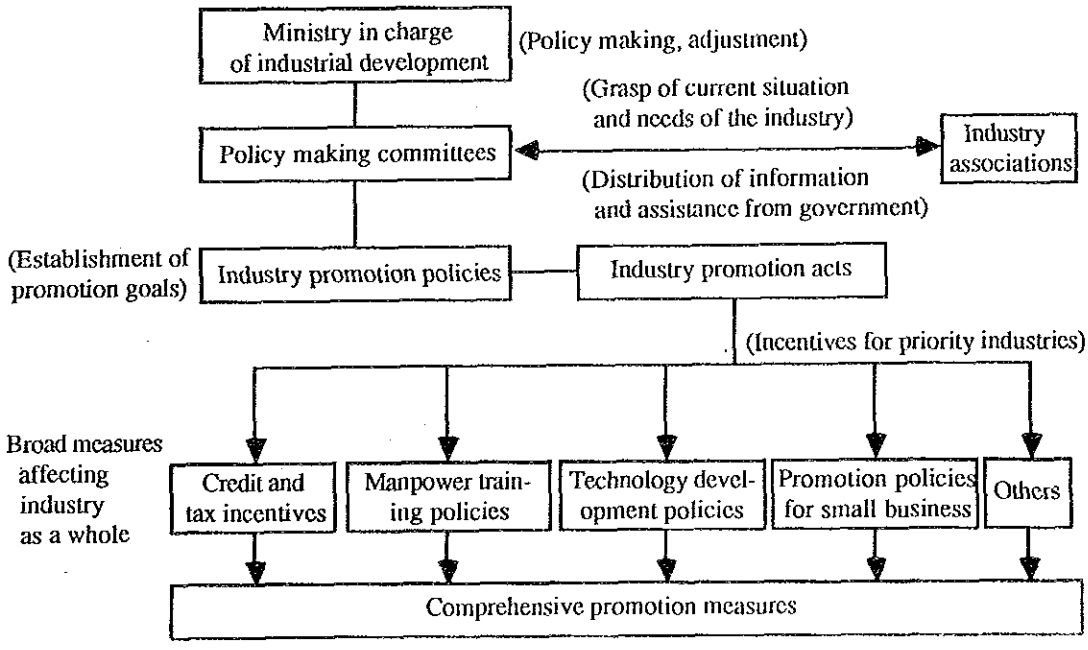
IV-4-2. Promotion Policy of Computer Industry in Third Countries/Areas

With the objective of examining existing promotion and assistance policies for the Malaysian computer industry, the following section will discuss promotion policies in countries and areas with developed computer industries. The cases of Korea, Taiwan, Singapore, and Japan will be introduced.

(1) Industrial promotion policies

Industrial promotion policies, in which individual plans or projects are formulated and intensive assistance and protection provided to promote the development of specified industries, have not been adopted in the countries of Europe and the U.S. With the attention focused on the rapid development of the Japanese economy and the conclusion that industrial policy was one of the important reasons behind this growth, similar type of policies were adopted by Korea and other developing nations. The basic framework of such a series of policies is as shown in Fig. IV.4-1. Budget funds are allocated to certain promotion policies with established targets, and key industries are given priority access to a broad range of assistance measures under the control of various government agencies. When such systems are adopted in other nations, local conditions and differing levels of industrial development can result in cases in which assistance is received from international organizations while drawing up the policies or in which an "industrial promotion act" is replaced by a "promotion plan" which simply functions as a set of guidelines.

Fig. IV.4-1 Japanese-style Framework for Industrial Promotion Policy



[Japan]

Table IV.4-1 shows an outline of computer industry promotion policies in Japan. Although this series of policies was not originally intended specifically for the computer industry, the future importance of this industry and the specialization of electronics industry promotion resulted in their application to the computer industry.

The Law on Temporary Measures for Promoting the Electronics Industry (the Electronics Industry Law) were implemented in 1957, but at the time development of the local computer industry was viewed with skepticism due to the dominance of the field by IBM and the limited size of the Japanese market. In this law, electronics products were divided into three categories, and the following targets were established for each group: 1) testing and technical research; 2) increased production (including both new plants and the expansion of existing ones); and 3) rationalization of production. The Electronics Industry Law emphasized home electrical appliances, with the main computer-related assistance measures being R&D efforts by government-affiliated research organs. In an age in which the "personal" computer had yet to be invented, computers were limited to extremely costly mainframe models. Japan Electronic Computer Company (JECC) was established to expand the local market, and a loan system was set up.

In order to pursue the objectives of the above act from the standpoint of the industry as well, the Japan Electronics Industry Development Association, consisting of leading manufacturers, was established in 1958. Through this organization industry-wide activities such as the collection of statistics and standardization were conducted through the Ministry of International Trade and Industry, the monitoring agency for the act.

1966 saw the announcement of the Policies for Strengthening the International Competitive Strength of the Electronic Computer Industry, the first policy to deal specifically with the computer industry. At the time, local firms were protected by a variety of measures such as tariff barriers and restrictions on computer imports and foreign investment, but this programme represented a full-fledged effort to improve the competitiveness of Japanese hardware manufacturers with an eye on the future liberalization of the market. In 1971 the Electronics Industry Law expired and were replaced by the Machinery and Electronic Industries Law. Under this law, products were divided into two categories, one targeted for testing and one for the rationalization of production. Together with the development of computers, competitiveness was strengthened by streamlining the production of peripheral equipment and terminals.

Concrete measures enacted as part of the above policies included subsidies, tax credits, and low-interest loans. During the period 1957-90, the Japanese government allocated approximately ¥938.6 billion for subsidies and low-interest financing alone.

Table IV.4-1 History of Japanese Government Policy for Promotion of the Computer Industry

Year	Basic policy	Specific measures
Initial phase (1951-65)		
1952	The emphasis of Japanese industrial policy during this period rested on the steel, petrochemical, and automobile industries. Development of the computer industry was viewed with skepticism because of IMB's domination of the field and the limited domestic market. Consequently, policies during this period focused on development by government-affiliated research organs and the sharing of these results with private corporations.	Tokyo University and Toshiba develop vacuum tube model
1953		Tokyo University, KDD, and NTT develop parametron computer
1955		Electronics Laboratory of the Agency of Industrial Science and Technology of MITI develops transistor computer
1957		Implementation of the "the Law on Temporary Measures for Promoting the Electronics Industry (the Electronics Industry Law)" The focus of this act was on the promotion of home electrical appliances, but establishment of the Electronics Industry Council within MITI allowed for better communication with computer manufacturers as well. The main provisions of the act were as follows: 1. Promotion of testing and research (subsidies for key technology R&D) 2. Promotion of new production and expansion of existing production (special financing from the Japan Development Bank) 3. Promotion of streamlining of production (special financing and depreciation based on special tax measures)
1961		Establishment of Japan Electronic Computer Company (JECC). Expansion of the domestic market leads to financial backing for computer sales.
1962		Establishment of Electronic Computer R&D Association, NEC, Fujitsu, Oki Electric and the Agency of Industrial Science and Technology develop a large-scale computer.
1964		Commencement of local production by IBM Japan. Japanese production and foreign currency remittances are permitted in exchange for the right to patents. With the exception of Fujitsu, local manufacturers begin to introduce foreign technologies and establish joint ventures.
Liberalization phase (1966-75)		
1966	The basic objective of this period lie in liberalizing domestic markets and in improving the competitiveness of Japanese hardware on international markets. Japanese manufacturers grouped together and the production of single machines was enlarged in	"Policies for Strengthening the International Competitive Strength of the Electronic Computer Industry" Objectives: Securing of technological superiority Increased market share, improved profitability for local manufacturers Programms: Joint production of large-scale computers Strengthening of JECC

Year	Basic policy	Specific measures
	pursuit of economies of scale. This type of grouping functioned less to concentrate production than as a funnel	Streamlining of peripheral equipment production Training of technical personnel
1971	for government subsidies.	Implementation of "the Machinery and Electronic Industries Law." Integrated policy for the electronics and machinery industries. 1. Testing and research plan Organization of Japanese manufacturers into 3 groups (Provision of ¥57 billion in development subsidies during 1971-76)
1972		Subsidy programm for promotion of computers and related development 2. Production rationalization plan Performance and quality targets for computers, peripheral equipment, and terminals were proposed along with reductions in production costs.
1972		Trade in peripheral equipment (excluding memory devices and terminal units) is liberalized.
1974		Up to 50% foreign capital is allowed for computer manufacture and sales/leasing industries.
Post-liberalization phase (1976-)		
1976	Next-generation computer development and software development are emphasized.	Completion of computer-related trade liberalization. Government establishes a subsidy programm to promote development of next-generation computers to compete with IBM's fourth-generation models. Creation of "VLSI subsidies." Creation of VLSI R&D Association R&D project undertaken by two of the manufacturer groups, The Electrotechnical Laboratory of the Agency of Industrial Science and Technology, and NTT (four-year project costs of ¥72 billion are supplemented with ¥29.1 billion in government subsidies)
1978		Implementation of "the Machinery and Information Processing Industries Law." This act took over for the "the Machinery and Electronic Industries Law" in promoting the improvement of production technology and the streamlining of production. Software was added as a new target. Two research groups were established for basic software technology development under the heading "the Project for Development the Basic Technologies for the Next Generation of Computers" with government subsidies of ¥22.2 billion over a five-year period.
1981	Hopes are placed on the computer industry as one of the leading industries of the 21st century. There is a shift from a dependence on imported technologies to the development of original, advanced technologies.	Report on "The Status and Policies for Information and Information Industries in the 1980's."

Source: Compiled from "Industrial Policy of Japan" (Ryutaro Komiya)

[Korea]

Korean government policy for promotion of the computer industry is the closest in form to the Japanese model of those to be studied here.

Table IV.4-2 provides an outline of Korean assistance policies for the electronics industry. Until 1969 these policies were included under those for the machinery industry. The proposals of Professor Kim (Columbia University) in 1967 and a report by a U.S. study mission, however, suggested the future possibilities for this industry, and independent promotion measures were established. The policies designated specific electronics equipment and components for promotion at each stage and provided tax-related and financial assistance for their development and production.

1976, the year in which the third five year economic plan was announced, marked the first appearance of the computer industry as an industry for promotion. In the early stages, products such as monitors and terminals, which inherited the tradition of home electrical appliances, took precedence over personal computers themselves. In this sense, it was the electronics industry promotion policies, which began in 1969 and made possible the growth of the home appliance industry, which provided the foundation for the development of the computer industry in the 1980s.

Development efforts were the recipient of especially large government assistance, but in the commercialization stage as well companies were provided with a "testing ground" of sorts in the form of government procurement. In 1981, for example, the Korean government proposed the development of 8-bit personal computers. Samsung developed such a machine, and the unit was summarily adopted by the government for use in CAI in primary and lower secoundary schools across Korea, resulting in the creation of a sizeable ready-made market for Samsung.

Starting in 1987, the Electronics Technology Research Institute (ETRI) implemented the Tullerance Project, in which the U.S. firm Tullerance and five local manufacturers cooperated on the development of a main frame computer. The budget for this project included the establishment of a computer network for government agencies, so that the finished products were guaranteed a market of at least several hundred units. As a result, companies participating in the project were able not only to acquire valuable technologies but also to secure markets.

1986 saw the integration of the Electronics Industry Promotion Act into the Industrial Development Act, but in fact the promotion plans and measures of the Electronics Industry Promotion Act are being continued as before. At present, the focus of development efforts is being shifted to computers of medium size and larger, while in the personal computer and peripherals sectors the government is working to localise the

components. At the same time, future problems such as the expansion of domestic demand and the training of personnel for the software industry are being discussed.

Table IV.4-2 History of Korean Government Policy for Promotion of the Computer Industry

Year	Basic policy and Assistant measures	Remarks
1969	Establishment of the "Electronics Industry Promotion Act" of the electronics industry	Content: Designation of electronic equipment to be promoted Formation of basic plans for promotion Plan for implementation of the basic plans Quality inspections Establishment of a foundation for promotion Technological development and training Creation of electronics industry industrial parks Establishment of an electronics industry council Registration of producers
1969	First basic plan Objectives: Development and promotion of items to be promoted Achievement of export targets Improvement of local content ratios	Items to be promoted • Development of production technology 51 • Specialization and mass production 65 Note: Some items fall under both classifications.
1974	Second basic plan Objectives: Increased exports of electronics products Self-sufficiency in electronic components and materials Preparation of production and distribution mechanisms Concentration of electronics industry technology and know-how	Items to be promoted • Development of production technology 93 • Specialization and mass production 102 Note: Some items fall under both classifications.
1976	Third basic plan Content: Determination of development strategies for 56 key promotion items based on basic plans for each item. Policies: Assistance with construction and operating costs. Utilization and guidance of government and other research facilities, priority eligibility for various industrial assistance measures, assistance for capital investment (use of the National Investment Fund) Note: These policies were common to the first, second, and third basic plans. From the third plan onwards, however, corporations had to be designated for eligibility, and government control was tightened.	Items to be promoted • Development strategy items 31 • Key development items 25 (includes computers and peripheral equipment) Note: The standards for selection were changed; listing under both classifications was abolished.

Year	Basic policy and Assistant measures	Remarks
1981	Revision of "the Electronics Industry Promotion Act" Electronics industry advancement plan Objectives: Aggressive development of internal demand Introduction of foreign technology and promotion of local technology Creation of design and commercialization technologies Standardization for mass production Improvement of production technology, processes, and management Local sourcing of raw materials Cooperation in related fields of technology Surveys of foreign technology trends	Items to be promoted • Research and development items 4 (including computers and peripheral equipment) • Industrialization items 10 (including computers and peripheral equipment) • Rationalization items 15 Note: Some items fall under more than one classification.
1982	Strengthening of the high-tech promotion policies as part of the fifth five-year plan. Characteristics: Emphasis on private sector activities, with a shift from assistance to designated corporations to research joint groups.	Targeted items: Falling across a broad spectrum but focusing on semiconductors and computers.
1984	Establishment of the Information and Telecommunications Training Center	Objective: Training of information processing technicians
1986	Establishment of "the Industrial Development Act" • The electronics industry advancement plan is integrated into the industrial electronics and component materials localisation plan. • Assistance measures remain virtually unchanged.	Content: Approximately 3,000 items are to be developed by 1991, with 70% of parts to be sourced locally.
1987	Implementation of "the Computer Programm Protection Act"	
1989	Announcement of the medium- and long-term development forecast for the electronics industry together with policy-related topics.	Objectives: 1991 16-M DRAM production 1992 64-M DRAM production 1993 Minicomputer development 1994 High-performance workstation development, etc.

[Taiwan]

Taiwan's policies for promotion of the computer industry have a less centralized character than those of Korea, and the policies themselves are not actual laws but rather plans which function more as a series of guidelines. While Korea and Japan both worked to promote the growth of local manufacturers, Taiwan has maintained a consistently open policy with regard to foreign investment. This policy has been effective, and foreign-affiliate and local manufacturers have peacefully coexisted from the start. Investment incentives have been the main form of assistance for companies. Table IV.4-3 provides an outline of computer industry promotion policy, including investment policy.

Fig. IV.4-2 shows the impact of these policies on the industry. Investment promotion measures and assistance for technology development were strengthened in order to achieve the targets set out in the industrial promotion plans. Investment promotion measures included the extension of favorable tax treatment to firms producing specified items, establishment of the Hsinchu Science-based industrial park to attract firms in high-tech sectors.

Outline of the Hsinchu Science-based Industrial Park

• Year of establishment:	1981
• Total area:	264 hectares
• Usage fee:	NT$8.23/$m^2$/month (rental system)
• Requirement:	Product exports (indirect exports also possible)
• Benefits:	Exemption from customs duties and corporate taxes
• Number of tenants:	Approx. 50 (as of 1987)

Numerous foreign-affiliate computer manufacturers began operations in Taiwan, while at the same time local assemblers with experience shifted product lines from home electrical appliances to personal computers and peripherals, resulting in a rapid increase in the number of firms in the computer industry. The mass production of computer-related products by foreign affiliates, in particular, brought about an increase in demand for intermediate components and a need for supporting industries. In Taiwan, with its tradition of a thriving small business community, the development of supporting industries comprising small local firms made possible a supply of low-cost components, thereby increasing the competitiveness of Taiwanese manufacturers. Furthermore, intermediate components themselves have become a leading export item, and today many

of the intermediate components used in the personal computers and peripherals being assembled in Southeast Asia are in fact imported from Taiwan.

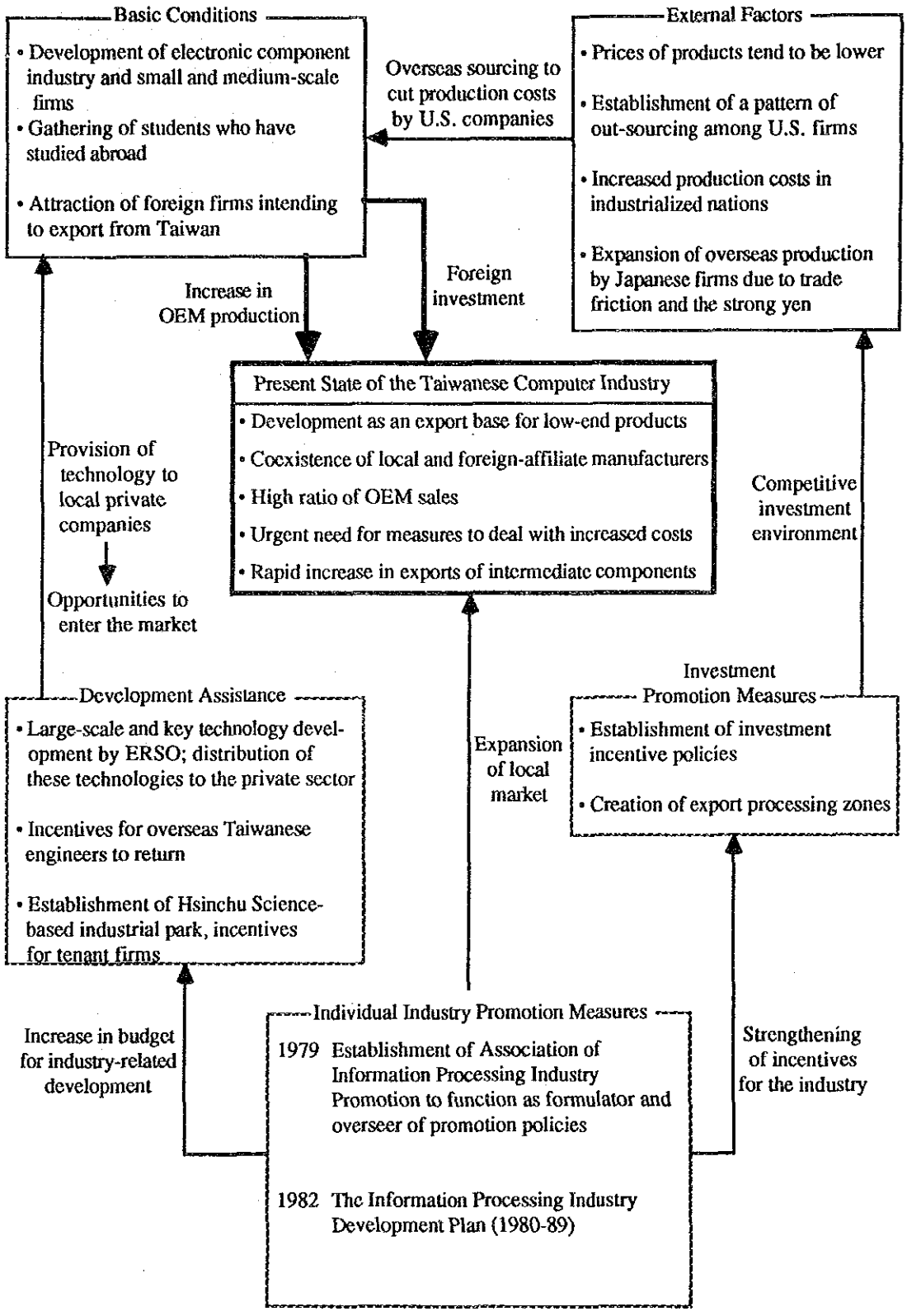
Some of the local manufacturers, such as Acer and Mitac, have also achieved the capability for in-house development. The government research institutes have had some impact on this. Electronics Research & Service Organisation (ERSO), for example, conducted computer-related development and brought together engineers at a time when most local firms were too small to conduct their own development, and later, when corporate activities expanded to include development as well as production, technology was transferred to the private sector in the form of joint research or spin-offs by engineers.

Table IV.4-3 History of Taiwanese Government Policy for Promotion of the Computer Industry

Year	Basic policy	Specific measures
1954	Establishment of "Statue for Investment by Foreign Nations	
1955	Establishment of "Statue for Investment by Overseas Chinese"	
1960	Establishment of "Statue for Encouragement of Investment"	
1962	Establishment of "Statue for Technological Cooperation"	
1965	Establishment of "Processing Exit Zone Facility Management Act"	
1974	The Industrial Technology Research Institute established the Electronics Research & Service Organization (ERSO)	
1976	Announcement of the Six-year development plan for the electronics industry	Assistance measures: • Promotion of introduction of advanced technology and foreign capital • Tax incentives for research and development • Increased budgetary allocations for expansion of technological education • Budgetary allocation for improvement of IC technology
1979	Establishment of the Association of Information Processing Industry Promotion	
1980	*Establishment of the Hsinchu Science-based* Industrial Park Announcement of ten-year plan for development of the electronics industry (1980-89)	
1981	Designation of the electronics and information processing sectors as key strategic industries	
1982	Announcement of the Information Processing Industry Development Plan (1980-89)	Assistance measures: • Priority financing from related development funds and financial institutions • Attraction of computer firms to the Hsinchu Science-based Industrial Park • Designation for priority investment incentives • Priority purchasing of local products by the government
1983	Development of 16-bit personal computers begun with assistance from ERSO	
1984	Establishment of the Marketing Information Center (MIC) as part of the Association of Information Processing Industry Promotion	
1985	Completion of PC-AT computer at ERSO	

Source: Complied from "Information Processing Industry in Taiwan" (Taiwan Interchange Association and Others.

Fig. IV.4-2 Outline of Computer Industry Promotion Policies in Taiwan



[Singapore]

In Singapore, there has been no industrial promotion policy for specific industries. Since it was the infusion of foreign capital that provided the driving force behind the country's industrialisation, manufacturing industries remain heavily dependent on foreign affiliates. Since the realisation of almost full employment, the introduction of foreign capital continues to be the main direction of government policy to upgrade industrial structure. Due to the Singapore's limited geographical and manpower size, a decision was made concerning the production sector to move away from labor-intensive industries and towards high value-added industries in early time of industrialization, regardless of whether they were local or foreign. Specifically, this meant the preparation of a suitable infrastructure, the improvement of labour force quality, and the focusing of targets for investment incentives.

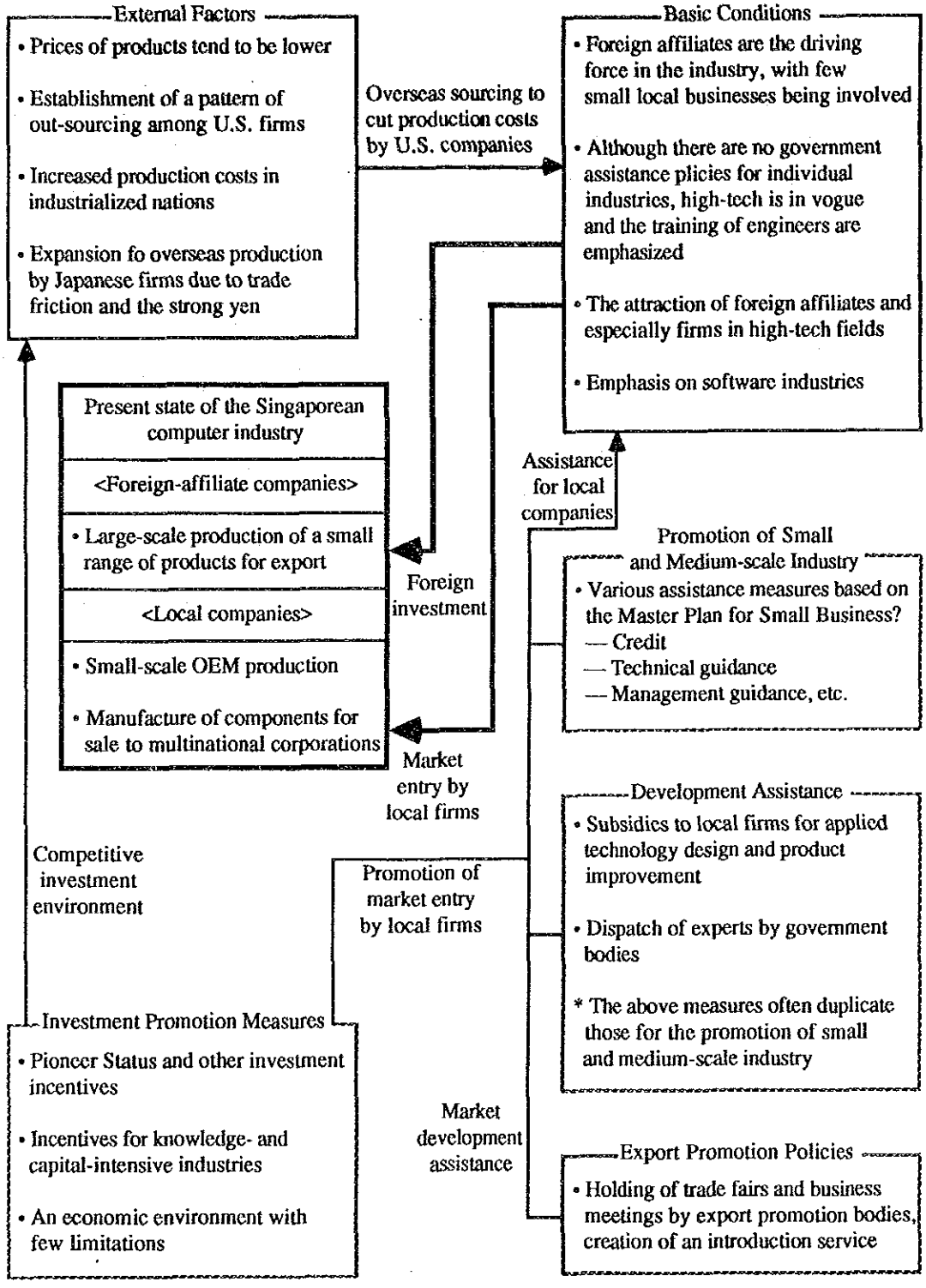
In a paper published at the beginning of the last decade and entitled, "Economic Development Plan for the 1980s," the computer industry was designated as a sector for promotion along with such areas as aircraft components and biotechnology. In the same plan, high-tech industries were clearly given the most emphasis among the manufacturing sectors, and the computer industry was accorded high priority as a target for investment incentives.

Fig. IV.4-3 shows government policies related to the promotion of the computer industry and the effects thereof. A glance at the current status of the industry shows that a clear distinction has developed between the activities of foreign-capital and local firms, with the former group being engaged in large-scale production of a small range of products for export and the latter, with the single exception of Wearnes, consisting of small firms engaged in limited-scale OEM manufacture and the production of intermediate components for multinational corporations operating in Singapore.

Investment incentives have constituted the main type of assistance, although small and medium-scale industry promotion policies, technology development policies, and export promotion policies have had some effect in helping local firms gain access to the computer market and have made an indirect contribution to expanding supporting industry markets and improving their level.

The government, which early on recognized the possibilities of computer software as an export industry, has also established computer software training centers jointly with Japan and France and has worked to train programmers and system engineers. 1989 saw the number of experts in the information processing sector reach 8,000. A steadily increasing number of multinational corporations have established software development centres in Singapore, and some local software firms have succeeded in exporting their products to the U.S.

Fig. IV.4-3 Outline of Computer Industry Promotion Policies in Singapore



(2) Technology Development Policies

[Japan]

Specific Japanese assistance policies related to the promotion of technology development can be grouped into the following four categories:

i) Subsidies, tax incentives, and low-interest loans for R&D

ii) Government research organs

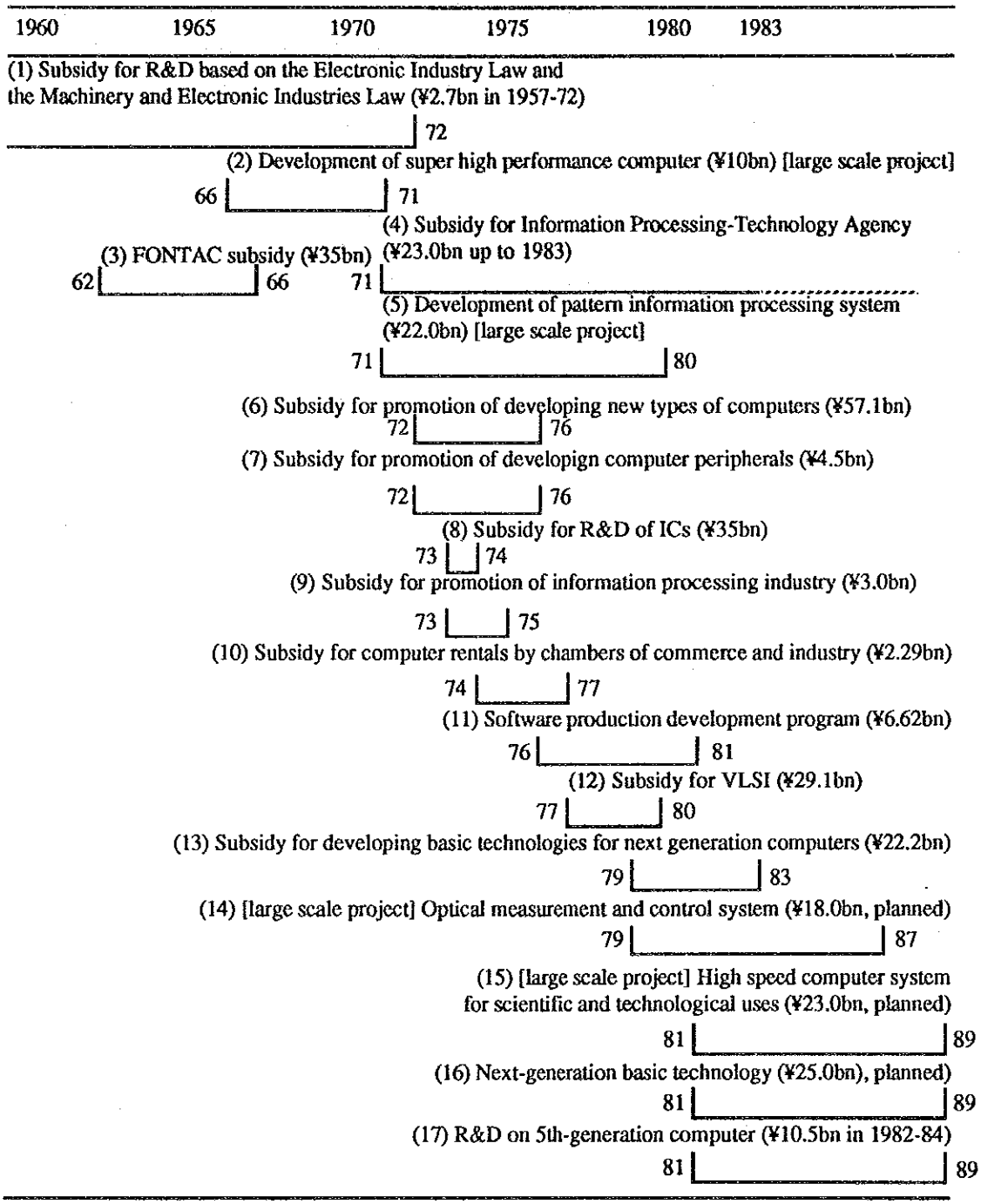
iii) Establishment and assistance for R&D associations

iv) Awards system

The history of assistance for technology development in the computer industry will be briefly summarized. In the first phase (the 1950s), development by government-affiliated research organs constituted the focus of development plans, and all of the results of research done by the Agency of Industrial Science and Technology were shared with private (Japanese) companies. In 1962 the Electronic Computer R&D Association was founded, and joint research efforts by private companies were subsidized. Together with the development of private companies, subsidies became the most common form of assistance.

The content of Japanese subsidies for the computer industry is shown in Fig. IV.4-4.

Fig. IV.4-4. Subsidies to the Computer Industry



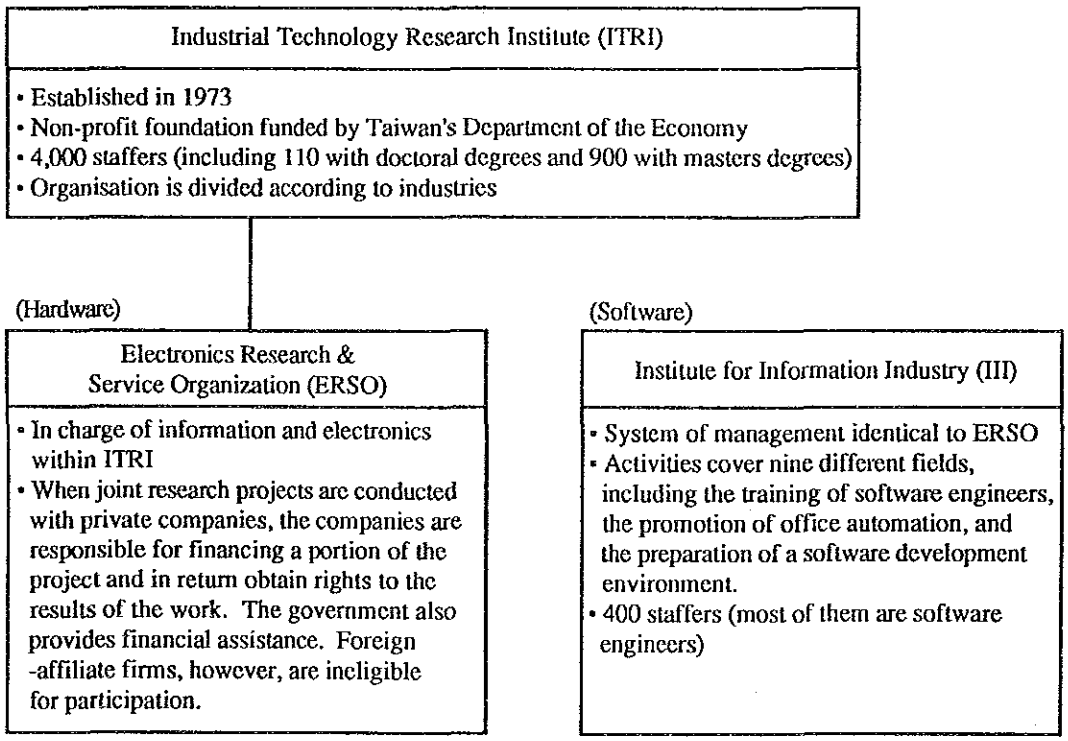
Source: JECC, Computer Note, each year.
Note: Large-scale projects are wholly subsidized. Other projects are subsidized about one-half.

[Taiwan]

Most of the local computer manufacturers in Taiwan are small firms, and because of their inability to allocate sufficient personnel and budgetary resources to development it was the national research institute ERSO that was primarily responsible for Taiwanese R&D. The gathering of development experiences at the public research organ was transmitted to the private sector via joint development projects.

Taiwan has sent a sizeable number of students to study in Europe or the U.S., but in the past these engineers, unable to find suitable work within Taiwan, instead opted to find employment abroad. Government policies to encourage the return of overseas engineers and the increase in development-related positions which began in the second half of the 1980s, however, have resulted in an increasing number of "returnees," and this is also contributing to an improvement in the technical standards of the Taiwanese computer industry.

Fig. IV.4-5 Government Organisation for Assisting Computer Industry Development



[Singapore]

Singapore's policies for promotion of technology development can be broadly divided into two categories. For the large firms, most of which are foreign affiliates, the government has tried to vitalize R&D activities by providing tax incentives encouraging the establishment of R&D divisions in Singapore and establishing Science Park with facilities for research. At present, however, most of the R&D divisions which have been set up by foreign affiliates are for software development. Firms eligible for direct assistance from the government are small local (i.e., those with at least 30% local capital) companies. The assistance consists of funding and technical aid with an emphasis on the development of products and processes rather than on basic development (for specifics on these assistance measures, see the Singapore section under (3) Small and Medium-scale Industry Promotion Policies). Large local companies like Wearnes, however, have established their own research institutes in the U.S., and when viewed from the standpoint of the computer hardware industry, the impact of the development assistance policies is at best indirect.

(3) Small and Medium-scale Industry Promotion Policies

[Taiwan]

Even in Taiwan, which boasts a healthy small business sector, the limited scale of the firms is creating an ever-increasing gap in terms of technology and rationalisation as the industry as a whole grows more specialized and advanced. In response, the government has adopted a "Satellite Plant Programme" said to have been based on the model of the Japanese subcontracting system. Under this programme, customers and subcontractors form a team, the former providing the latter with a wide range of guidance and assistance in the areas of technology and quality control. Companies which have registered for this programme are also eligible for government assistance, and this has helped to make the programme a popular one.

Subcontractor promotion policies in Taiwan

Cooperative plant programme (Central/satellite plant programme)

Objective: To improve technical standards and efficiency throughout the industry via the promotion of supporting industries such as component manufacture. To create an effective linkages bewteen large corporations and the numerous small businesses and to promote the specialization of small business and the modernization of facilities.

Large corporations (the central plants) are to provide the cooperating plants with a steady supply of orders, technical guidance, and opportunities for overseas market development and the procurement of raw materials.

Possible combinations:

i) Central plant = Assembler/manufacturer
Cooperating plant = Component manufacturer

ii) Central plant = Supplier of raw materials or intermediate materials
Cooperating plant = Processor of finished goods

iii) Central plant = Trading firm engineering companies
Cooperating plant = Licensed processor

Forms of assistance: Companies registered under this system benefit from technical and management guidance and other types of assistance from the Bureau of Industry, the Agency of Industrial Technology, the Productivity Center, vocational training institutes, and financial institutions.

Results: Registered companies as of January 1987 were as shown below.

40 groups (equal to the number of central plants) with 791 plants

Of these, 13 groups (190 plants) were in the electrical and electronics sectors.

Note: Each central plant is required to have at least 10 cooperating plants.

This programme is said to have been based on the cooperative relationship that exists between the production and subcontracting structures at Japanese affiliates in Taiwan. Because they have already established their own subcontracting systems and require no external assistance from the Bureau of Industry, etc., none of the Japanese affiliates have registered for this programme.

[Korea]

Small business promotion policies have been in effect for approximately 20 years in Korea, with the government providing a wide range of assistance, including development subsidies, facility modernization aid, and assistance in rationalising production.

In Korea, where the big business groups have played the main role in industrialisation, the recognition that the establishment of integrated production systems (including in-house fabrication of components) at each of the groups not only increases manufacturing costs but also takes away business opportunities from small businesses has led to the designation of "small business products," i.e., areas in which the activities of large corporations are restricted. In most of these sectors the manufacturing process is relatively simple, making production possible with a small capital investment. As of 1989, 237 sectors had been thus designated. Furthermore, in order to deepen linkages between the two groups, the grouping of small businesses has been promoted since 1979. Under this programme, a parent company and small businesses draw up a plan for division of labour for one of the products specified by the government. Firms whose plans which are approved by the Department of Commerce and Industry become eligible for special funding assistance and other incentives. As of June 1969, 322 parent firms and 2,060 small subcontractors had been approved under this programme, and these figures are growing, albeit gradually. In addition, in order to increase efficiency within these groups, subcontractor committees have been established at each parent company for cooperation in joint R&D, purchasing of materials, and market development. The parent firms themselves are also increasing assistance for their subcontractors. Although funding is the most common form of aid, the number of cases of assistance in quality certification, management, and technology is rapidly increasing.

In recent years the role of small business has been very favorably evaluated. The "Business Creation Assistance Act" was announced in 1986, and by 1991 an estimated 100 billion won in private sector financing will have been distributed under this act. The number of establishment of small business has also risen, from a figure of 2,000-2,500 in the years up to 1985 to 4,000-6,000 annually since 1986.

[Singapore]

As a result of the leading role played by foreign affiliates in the industrialisation of this country along with the nation's status as a free port, Singapore has developed as a base of operations for assemblers and processors. Consequently, development of the supporting industries has lagged behind. Since the 1980s, there has been increasing

awareness of the need for supporting industries, consisting of small local businesses, from the standpoint of improving the investment environment. The improvement of local supply is very beneficial for the multinationals, and for local firms work as a supporting industry both guarantees a local market (due to the presence of numerous MNCs within Singapore) and, when beginning exports to industrialised nations, makes it possible to avoid trade friction in the areas of parts and materials. Most of the small businesses in Singapore, however, are in sectors which are difficult to justify in a Singapore attempting a shift to knowledge- and capital-intensive industries, and their development has lagged behind.

In the period since 1985, said to be the worst recession since the country's founding, the importance of small local businesses has come to be reevaluated, and in 1987 an SME Committee consisting of the following six bodies was established with the Economic Development Board (EDB) as coordinator.

*National Computer Board (NCB)
*National Productivity Board (NPB)
*Singapore Industrial Standards Research Institute (SISIR)
*Singapore Tourist Promotion Board (STPB)
*Trade Development Board (TDB)
*Economic Development Board (EDB)

These six bodies were the implementing bodies of the existing Small and Medium-Scale Enterprise(SME) Assistant Programme, tried to search out new directions for small business in Singapore and reconsider existing programmes, making them better suited to current industry conditions and hence more effective.

After local surveys and overseas case studies (in Japan, Korea, Europe, etc.) conducted by working groups which included 300 representatives from chambers of commerce, consulting firms, and private manufacturers, the Committee proposed a "Small and Medium-scale Enterprise Master Plan" to the Ministry of Trade and Industry in June 1987, and since then a more systematic programme of small business promotion has been carried out based on this plan. Table IV.4-4 shows current small business assistance policies covering seven different fields.

Table IV.4-4 Outline of Singapore's Small Business Assistance Policy (SME Initiative)

Programme	Agency in charge
1. Credit/taxation	
(1) Tax incentives	EDB
*Investment allowances	
*Pioneer Status	
*Double tax deductions	
*Overseas investment incentives	
*Venture capital incentives	
(2) Funding assistance	EDB
*Small Industry Technical Assistance Scheme (SITAS)	
-Costs related to the improvement of productivity and the strengthening of production and management know-how.	
*Business Development Scheme (BDS)	
-Costs related to participation in business missions for business negotiations, searches for technical tie-up partners, etc.	
*Product Development Assistance Scheme (PDAS)	
-Up to 50% of costs incurred in product and process development.	
*Software Development Assistance Scheme	
-Software development costs.	
*Research & Development Assistance Scheme	Science
-Long-term development project costs.	Council
*Market Development Assistance Scheme (MDAS)	TDB
-Up to 50% of costs incurred in developing overseas markets for products and services with a local content of at least 25%.	
*Initiative in New Technologies Scheme (INTECH)	
-Costs of manpower training related to technology development and design.	
*Skill Development Fund (SDF)	
Approved-in-Principle Scheme	
Introducing Training Opportunities Scheme	
Generic Training Plan Assistance Scheme	

Programme	Agency in charge
Training Needs Analysis Grant Scheme	
-Designed to encourage training.	
(3) Loans	
*Small Industry Finance Scheme (SIFS)	
-Soft loans for costs related to facilities and equipment, buildings, operating funds, and export promotion.	
(4) Venture capital	
2. Technology, development, and automation	SISIR
(1) Provision of information	
*Technology Transfer Programmes	
-Technical expert dispatch service.	
Cooperating agencies:	
Canadian Executive Service Organization	
International Development Associates Prgm.	
Japan Expert Service Abroad	
Exchange et Consultants Techniques Internationaux di France	
Resources of the UK	
UNDP Short Term Advisory Services Scheme	
*Provision of technology-related information	
(2) Technology transfer	SISIR
*Technology Competence Centers	
-Provision of R&D and technical consultants together with testing services related to development of products and manufacturing technologies.	
Material Technology Center	
Design and Development Center	
Microprocessor Application Center	
*Training Institutes Center	EDB
(3) Quality improvement	
*Electronics Test Center	SISIR
-Inspection service for local components intended for IPO.	
*Good Manufacturing Practice Scheme	SISIR
*Certification Mark Scheme	
-Quality guarantee programme	
(4) Automation	
*Automation Application Center (AAP)	EDB

Programme	Agency in charge
-Guidance for automation.	
(5) Product improvement	
*R&D Incubator Center	SISIR
-Provision of consulting and facilities.	
3. IT industry promotion	NBC
(1) Provision of information	
*Information Center	
-Provision of information relating to IT industries.	
(2) Training and education	NBC
*NTI Data Comunications Training Center (with the cooperation of Racal and DEC)	
*Information Communication Institute of Singapore (with the cooperation of AT&T)	
(3) Sponsoring of seminars	NBC
(4) Promotion of computer use	
*Small Enterprise Computerisation Programme (SECP)	NBC, EDB
4. Productivity and training	
(1) Small business consultation	NPB
*Enterprise Development Center	NTI
-Credit-related consulting.	
*Consultancy Referral Scheme (CRS)	NPB
-Introduction to private consultants.	
*Associate Consultants' Scheme	
-Registration programme for CRS.	
*Consultant Attachment Programme	
-Dispatch of NPB staff or consultants for a specified period with	NPB
the goal of improved productivity.	
*Industry Assistance Programme	
-Joint resolution of productivity-related problems with industry groups.	
(2) Training	
*Management training	
-Provision of training for modern management and productivity.	NPB, NTI
CEO Training Programme, etc.	NUS
*Training of technicians	

Programme	Agency in charge
-Programmes to improve skills in jig and component design, production, and automation; held at six training institutes. *Worker training -Provision by SDF of up to 70% of the costs incurred in worker training by small businesses. Increasing Training Opportunities Scheme (INTRO) -System allowing the dispatch of workers to in-house training programs at lareg corporations.	EDB
5. Business development	
(1) Business planning *Participation in EDB seminars and workshops *Introduction of external consulting by SITAS and assistance therefor	EDB
(2) Advice concerning new business activities *Business Development Advisory Panel (BDAP) -An advisory panel made up of EDB staff and individuals from the financial community.	EDB
(3) Business development missions *Business Development Scheme -Dispatch of missions to find partners for technical tie-ups, joint ventures, etc. *Matching service -Registration of companies desiring matching in the Joint Venture information.	EDB
(2) Collection of designs -Consulting services. -Sponsoring of design seminars and workshops with invitation of overseas instructors.	TDB
(3) Establishment of a design center	TDB
(4) Subsidies for design improvements *Design Venture Programme	TDB
7. Assistance for local firms	
(1) Local Industry Upgrading Programme -Support for the creation of linkages between local companies and multinational corporations based in Singapore.	EDB

Source: Compiled from the SME Master Plan (EDB)

Local industry assistance policies in Singapore

Local Industry Upgrading Programme (LIUP)

Objective: To improve linkages between local small businesses and multinational corporations operating in Singapore and to improve the efficiency and competitiveness of local supporting industries.

Targets: Each year four to five companies, mainly those dependent on multinational corporations or having potential as suppliers to these firms, will be selected by the EDB. Companies may nominate themselves. Selection criteria include management policy, business plans, performance, quality, delivery times, and competitiveness.

Content: Phase I Improvement of production efficiency
Phase II Increase in number of production items and introduction of new production processes
Phase III Joint product and process development efforts with the MNCs

Assistance policies: Businesses will be provided with consulting services, subsidies, and technical guidance under the EDB. As a further attraction, assistance can also be obtained from the MNC partners participating in the programme at the request of the EDB.

Results: Established in 1986
Results as of December 1988 are as shown below.
Registered MNCs: 21 (eight of these, including Philippes, HP, AT&T, Maxstor, Matsushita,and Olivetti, have already started the programme)
Registered SMEs: 65 (most are in the following sectors: jigs, metal dies, stamping,plastic injection molding, precision machining, and electronic components)

IV-4-3. Necessary Supporting Measures

Table IV.4-5 lists the computer industry-related promotion and assistance policies currently being implemented by the Malaysian government. Since 1986 these policies have adapted in accordance to changes in the industry situation, as evidenced by the introduction of incentives for R&D and in-house training. In some cases, however, revisions of existing measures have been incapable of dealing sufficiently with industry changes, and their effectiveness has been limited. Thus, frequent reevaluation of these policies in light of current industry conditions will continue to be important. Indicated in the Table are problems found in existing programms as well as possible solutions. A questionnaire (hereafter to be referred to as the "local survey") was distributed to electronics firms currently operating in Malaysia as part of the present study, and areas which might serve as reference in the drawing up of government policy will be briefly introduced below.

Note: For details on compilation of the local survey, please refer to ANNEX-III-4.

(1) The Need for Industry Associations

Industry associations aid in reflecting the needs of private corporations in government assistance programms. A task force centering around MTI and MIDA has been established for review of the IMP, and the Malaysia American Electronics Industry Group (MAEI) and the Japan Electrical/Electronics Industries Group (JEEF) have been active participants. In addition, the Federation of Malaysian Manufacturers (FMM) and various chambers of commerce have provided advice through numerous dialogues and seminars, and the government is also trying to incorporate the ideas of the private sector.

At present there is no industry association limiting membership to firms in the electronics industry, but 77 of the companies responding to the local survey (63.1%) belonged to some type of industry association, such as the ones mentioned above. The most commonly-noted merits were the acquisition of marketing-related information (62 firms) and greater bargaining power in dealings with the government (60 firms). 97 firms (81.5%) indicated the need for an industry group exclusively for the electronics industry.

Other typical merits to such associations which can be seen in other nations include the opportunity to prepare industry-related data based on company interviews conducted by the association, to make government policy a closer reflection of reality, and to achieve better transmission of information.

Table IV. 4-5 Sub-sector Promotion Measures for Computer Industry

	Present supporting system/programmes	Problems	Presumed additional measures for support/improvement
1. Investment	• Investment incentives through pioneer status and ITA		
2. Export	• Exemption from and reduction of duties on intermediate goods at FTZ and LMW • Export Credit Refinancing (ECR) • Abatement of adjusted income for exports • Information supply, inquiry services and holding of exhibitions by MEXPO	• All of these are small in scale	• Expansion of MEXPO
3. Financing	• MIDF loans	• High interest rates • Access is difficult for small and medium -scale firms	• Creation of low interest rate loan scheme for industry • Strengthening credit guarantee scheme
	• CGC loans	• Ceiling on loans is too low • Applicants are limited to small firms	• Expansion of qualified applicants and loan limits of CGC loan scheme
4. Human resource development	• Tax deduction for building and costs required for in-house training	• Difficulties in obtaining approval	• Review of current application standards and announcement of new standards
	• Fostering of skilled workers at vocational training schools/Politechnics	• Mismatched with needs of the industry, insufficient numbers • Obsolete curriculum	• Examination of establishment of government /private technical training centers • Expansion of vocational training schools • Review of curriculum
	• Fostering of engineers through education at universities	• Electronics education lagging behind at universitied	• Strengthening of electronics courses in universities' curricula
	• Widespread use of P/Cs at primary and junior high schools	• Insufficient number of instructors • Low level of utilization	• Fostering of instructors • Review of plans for widespread use of P/C

	Present supporting system/programmes	Problems	Presumed additional measures for support/improvement
5. R&D	• Tax deduction of building and cost required for R&D	• Difficulties in obtaining approval • Small number of companies with R&D divisions	• Review of current application standards and announcement of new standards • Strengthening of incentives • Creation of research funds
	• Joint research by MIMOS	• Small capacity at MIMOS	• Review and expansion of MIMOS functions • Training of MIMOS staff • *Invitation of engineers from overseas*
	• Establishment of technology park	• Small benefits for companies located in the park • Temporary operation	• Preparation of blueprint for the future technology park
	• Fostering of system engineers at INTAN	• Training of SEs and programmers, for which strong demand exists, is lagging behind due to a reduction in basic courses	• Expansion of basic courses
		• Training is limited to government officials	• Reception of instructor-trainees from firms
6. Quality control activities	• Establishment of courses and holding of seminars by NPC	• Limited coverage area • Many firms lack know-how	• Implementation of guidance through visits to firms • Increase in the number of seminars and preparation and supply of manuals • Introduction of consultants
		• Unclear quality standards	• Introduction of inspection system • Promotion of guidance and support for parts manufacturers by assembly manufacturers
7. Development of supporting industry and others	• Subcontracting scheme by MTI	• Low level of utilization	• Expansion of schemes and PR • Preparation and supply of directory of parts manufacturers
	• Tax incentives and financial support scheme for small and medium-scale firms		
	• MIDA services for introduction of technological tie-up and joint venture partners	• Low level of utilization	• Expansion of services and PR
	• Establishment of industrial technology assistance `fund	* At the moment, details of the plan are undecided.	

(2) Anticipated Government Assistance

According to the local survey, the most common management-related problems faced by the companies were shown in Table IV.4-6. There was some variation in responses, however, depending on the size of the company. None of the firms with 1,000 or more employees indicated that they had difficulty in "raising funds", while fully 40% of those with fewer than 100 workers replied in the affirmative to this question. Common regardless of corporate scale was the problem of hiring.

Table IV.4-6 Problems in Management

(plural responses)

	Total No. of respondents	Ratio	Ratio of respondents by number of employees (%) Type 1	Type 2	Type 3	Type 4
Raising funds	16	3.7	0	0	13.6	40.0
Introduction of new technology	25	21.4	18.8	20.0	18.2	28.0
Purchase of raw materials	35	29.9	28.1	20.0	31.8	36.0
High rent for land and building	5	4.3	3.1	0	4.5	8.0
Difficulty in recruiting	61	52.1	53.1	53.3	54.5	48.0
Stiff competition	13	26.5	31.3	13.3	27.3	28.0
Low rate of operation	13	11.1	3.1	6.7	13.6	20.0
Others	154	12.8	12.5	33.3	11.4	4.0

Note: Type 1: Firm with 1,000 or more employees — No. of corresponding firms 33
Type 2: Firm with less than 1,000 employees 15
Type 3: Firm with less than 500 employees 48
Type 4: Firm with less than 100 10

Respondents were asked to choose from 24 assistance programs in a total of six fields (including manpower training and financing) those which they felt to be most important to the development of the electronics industry. Multiple responses were allowed.

The results are as shown in Table IV.4-7. The most common responses were: (i) assistance for quality control activities at local parts manufacturers (66 firms); (ii) preparation of local parts manufacturer directories (63 firms); (iii) establishment of high-tech industrial parks for the electronics industry (62 firms); (iv) establishment of an inspection system for the improvement of local parts quality (53 firms); and (v) the expansion of university-level electronics education (52 firms). For reference, Table IV.4-8 provides a comparative breakdown of the most frequent responses according to number of employees, products, and nationality.

Questionnaire items which might serve as reference in the preparation of individual programmes will be introduced below.

1) Quality Control Activities

The term "quality control" has disseminated throughout the electronics industry; not a single firm answered that it had "no knowledge of quality control," and fully 92.6% of all companies responsded that they were involved in quality control activities.

Of all the types of government assistance, quality control-related aid was the most highly anticipated. In terms of actual assistance, (i) the holding of seminars (58.3%) and (ii) the provision of quality control manuals (50.4%) were the most popular. Some variation based on company size could be seen for "training of management-level staff in Japan," with 43.3% of those firms with at least 1,000 employees looking forward to this type of assistance as opposed to only 12.5% of those companies with fewer than 100 workers. "Company visits and instruction by experts" was most popular among those companies with fewer than 500 employees.

In conclusion, the following types of measures would be effective in promoting quality control activities.

- Holding of seminars
- Preparation of quality control manuals
- Training of management-level staff in Japan for firms which wish to attend
- Company visits and instruction for smaller businesses by quality control experts

2) Technical Tie-ups

40.7% of all the responding firms indicated that they had been involved in technical tie-ups or OEM business in the past. This ratio increased in reverse proportion

Table IV.4-7 Expectations of Supporting Policies

	Total no. of responses	Percentage (%)
Human resource development		
Expansion of vocational training schools	45	40.5
Review of curricula at vocational training schools	37	33.3
Establishment of politechnics in local areas	24	21.6
Review of curricula at politechnics	34	30.6
Expansion of electronics courses at universities	52	46.8
Establishment of university-industry joint R&D system	49	44.1
Establishment of government-private sector vocational training organisations	47	42.3
Finance		
Simplification of procedures for loans from financing organizations	45	40.5
Establishment of long-term investment funds for new investment	40	36.0
Introduction of low interest rate financing scheme for small & medium-scale firms	46	41.4
Expansion of CGC scheme	7	6.3
Management/Marketing		
Preparation of domestic parts manufacturers directory	63	56.8
Improvement of MEXPO's inquiry services and strengthening of its activities for development of overseas markets	19	17.1
Holding of exhibitions and business talks for electronics parts manufacturers and subsidies for participation	34	30.6
Subsidies for the utilization of management consultants by small & medium-scale firms	23	20.7
Holding of management seminars for small and medium-scale firms	15	13.5
Quality		
Support for QC activities at domestic parts manufacturers	66	59.5
Creation of inspection system for quality improvement of domestically produced parts	53	47.7
R&D		
Expansion of MIDA services for introduction of partners for technological tie-ups/OEM agreements	37	33.3
Supply of subsidies for R&D activities and review of tax incentives	51	45.9
Creation of public sector research institutes for electronics	43	38.7
Others		
Establishment of hi-tech industrial estate for electronics industry	62	55.9
Incentives for support of subcontractors by assembly manufacturers	47	42.3
Review of MTI's subcontracting scheme	8	7.2

Note: Percentage = Responses/Total number of respondents

Table IV. 4-8 Anticipated Government Assistance by Type of Company

(Unit: %)

[By size]

≥ 1,000 employees		500-1,000 employees		100-500 employees		< 100 employees	
Expansion of university-level electronics education	61.3	Assistance for R&D	80.0	Assistance in quality control activities	73.3	Preparation of parts manufacturer directories	57.9
Assistance in quality control activities	58.1	Preparation of parts manufacturer directories	66.7	Preparation of parts manufacturer directories	55.6	Parts inspection system	57.9
Creation of high-tech industrial parks	58.1	Parts inspection system	60.0	Creation of high-tech industrial parks	55.6	Assistance for R&D	57.9
Total number of companies	33	Total number of companies	15	Total number of companies	48	Total number of companies	26

[By products]

Consumer electronics equipment		Industrial equipment		Electronics components		Other	
Preparation of parts manufacturer directories	62.5	Preparation of parts manufacturer directories	58.8	Assistance in quality control activities	64.1	Assistance in quality control activities	80.0
Creation of high-tech industrial parks	62.5	Assistance in quality control activities	58.8	Preparation of parts manufacturer directories	56.3	Preparation of parts manufacturer directories	40.0
Expansion of vocational training institutes	50.0	Parts inspection system	58.8	Creation of high-tech industrial parks	56.3	Low-interest financing for small businesses	40.0
Total number of companies	26	Total number of companies	24	Total number of companies	66	Total number of companies	6

[By nationality]

Japanese		U.S. and European		Other Foreign		Local	
Creation of high-tech industrial parks	68.2	Assistance in quality control activities	72.7	Expansion of vocational training facilities	65.0	Parts inspection system	68.4
Assistance in quality control activities	63.6	Expansion of university-level electronics education	59.1	Preparation of parts manufacturer directories	65.0	Expansion of MIDA services	52.6
Preparation of parts manufacturer directories	59.1	Preparation of parts manufacturer directories	54.5	Simplification of borrowing procedures	60.0	Assistance for R&D	47.4
Total number of companies	46	Total number of companies	22	Total number of companies	23	Total number of companies	25

to the number of employees. As a means of finding a tie-up or OEM partner, offers from the partner firm were the most common. Of the 44 companies expressing interest in moving into computer-related markets in the present survey, 16 showed interest in technical tie-ups, 12 in OEM business, and 18 in establishing a joint venture with a foreign partner. (Multiple responses were allowed.) Again, the smaller companies were more likely to desire such tie-ups, as were local-capital firms and foreign affiliates from countries/areas other than Japan, the U.S. or Europe. 11 of the 18 companies expressing interest in joint ventures were local-capital firms. RICOM of MIDA is a public service which introduces prospective partners for technical tie-ups. The system is not very well known, however; fully 75.2% of the responding firms answered that they knew nothing of it. Only 5.1% of the companies responded that they had made use of RICOM in the past. 52.6% of the local-capital companies, however, indicated that they would like to see expansion of MIDA's partner introduction service.

3) Manpower Training

(Labour Force Demand)

The most common management-related problem indicated throughout the electronics industry was "hiring of new workers." Since 1986 foreign investment in Malaysia has increased rapidly, and the electronics industry in particular has been host to numerous large-scale investment projects. The average number of new employees hired for each such project grew from 164 in 1986 to 316 in 1988. The estimated number of jobs created as a result is shown in the Table below; a total of 63,901 jobs were created during 1986-88 as a result of newly-approved investment. Although the figures for 1989 remain unclear, if 1988 hiring scales continue unchanged an additional 50,000 workers will have become necessary by the end of the year.

	No. of approved projects of investment	No. of employees created (est.)	No. of approved projects of electronics-related investment	No. of electronics-related employees created (est.)
1986	447	40,230	56	9,201
1987	333	59,779	71	24,666
1988	732	136,647	95	30,034
1989	600	-	163	-

Source: MIDA

Table IV.4-9 shows a breakdown of 1989 hiring in the electronics industry by job category and educational history based on a questionnaire survey of local firms. The 101

responding firms employ a total of 60,730 workers, and this figure can be broken down by job category as shown below.

Unskilled workers	58.4%
Skilled workers	33.3%
Supervisors	2.5%
Technicians	4.3%
Engineers	1.3%

Concerning the relationship between education and job category, 94.1% of the skilled workers have completed upper or lower secondary school graduates, while 76.0% of the technicians have graduated from polytekniks or vocational training institutes. 46.0% of the supervisors are high school graduates. 2.9% of all high school graduates went on to become supervisors, with the figure being 13.9% for polyteknik graduates, 17.0% for vocational training institute graduates, and 19.6% for university graduates.

Table IV.4-9 Breakdown of Employees by Job Category and Educational Background

Unit: Person

	System Engineer	Programmers	Engineers	Technicians	Supervisors	Skilled workers	Unskilled workers	Total
Primary school	0	0	0	5	3	455	1861	2324
Middle school	3	3	1	148	63	9712	19119	29049
Secondary school	1	11	8	355	708	9301	14358	24742
Polyteknik	4	3	129	973	208	157	19	1493
University	23	38	604	126	202	4	33	1030
Vocational training school	0	11	66	1031	356	585	43	2092
Total	31	66	808	2638	1540	20214	35433	60730

Note: The above figures indicate total hiring at the 101 firms responding to this item in the questionnaire.

19 of the responding firms (16.0% of the total) indicated that the current labour shortage is a "serious problem," with another 69 (58.0%) suggesting that there were

"some problems." When broken down by job category, 64 firms indicated difficulty in hiring technicians; 57 firms, in hiring workers; and 51 firms, in hiring engineers.

Since 1987 Malaysia's manufacturing industries have been in the midst of an investment boom, with the current influx of foreign capital making it impossible to predict future growth. As a result, it is difficult to make predictions concerning future demand for labour. Table IV.4-10 provides a summary of hiring plans at existing companies for the next five years as learned from the local survey. While 42.1% of the firms had employment plans for within 1 year, however, only 13.1% had employment plans for over five years. It must also be remembered that the Malaysian electronics industry is an export-oriented sector relying on the U.S. as its main market and hence easily influenced by fluctuations in external demand. As a result, it is difficult to determine long-term production plans.

79 of the existing firms responded to this question, and their total planned hiring for the next five years amounted to 30,088. This figure can be broken down by job category as follows: unskilled workers, 72.0%; skilled workers, 19.8%; and technicians, 3.5%.

Table IV.4-10 Breakdown of Expected Employees by Job Category and Educational Background (in the next five years)

Unit: Person

	System Engineers	Programmers	Engineers	Technicians	Supervisors	Skilled Workers	Unskilled Workers	Total
Primary school	0	0	0	0	0	0	1290	1290
Middle school	0	0	0	12	0	2881	12041	14934
Secondary school	0	2	0	19	241	2628	7911	10801
Polyteknik	0	13	35	618	511	217	183	1577
University	45	44	312	56	110	0	20	587
Vocational training scholl	5	1	4	343	96	235	215	899
Total	50	60	351	1048	958	5961	21660	30088

Note: The above figures indicate total expected hiring at the 79 firms responding to this item in the questionnaire.

(In-House Training)

95 of the responding firms, or 79.8% of the total, were currently engaged in in-house training. Of the 24 companies which were not conducting such training, eight had plans to do so. Only 48 of the firms (50.5%), however, were satisfied with their present

in-house training programmes. Dissatisfaction was voiced with (i) training facilities and materials (55.3%); (ii) training programme content and level (48.9%); and (iii) the number of employees undergoing training (34.0%). 70 of the responding firms (76.9%) had plans to expand their in-house training activities, indicating the overall trend towards expansion of such programmes.

Table IV.4-11 provides a breakdown of in-house training methods by job category.

On-the-job training is the main method used for all job categories, although the dispatch of employees (excluding ordinary workers) to outside training institutions and parent firms is also noteworthy. In particular, firms sending their engineers to parent companies for training outnumbered those providing on-the-job training. A great need was indicated for having supervisors attend in-house seminars and sending them to outside training institutes.

Common problems indicated with in-house training included the following: (i) supervisors too busy to provide sufficient instruction (58.1%); (ii) lack of well-organised training system (44.2%); (iii) the levels of trainees vary widely (26.7%); (iv) lack of prepared manuals (23.3%); and (v) instructors are not trained within a company (23.3%).

It can be seen from these results that more time must be provided for the supervisors, who act as both students and instructors in in-house training programmes.

Table IV.4-11 Methods of In-house Training by Job Category (multiple responses allowed)

Unit: Companies

	On-the-job training	Company seminars	External training institutes	Dispatch to parent company	Other
Workers	91	15	0	6	0
Supervisors	55	38	38	39	2
Technicians	69	26	29	38	4
Engineers	42	18	33	54	6
Programmers	30	16	31	23	4
System engineers	19	13	19	22	4

(Use of Training Incentives)

In order to encourage employee training, the Malaysian government provides incentives in the form of tax credits for expenses incurred in training, including the

construction of buildings. Although fully 95 of the responding firms were engaged in in-house training, however, only 11 were benefitting from these incentives. Problems voiced with the incentives were tabulated in Table IV.4-12.

Table IV.4-12 Problems with Training Incentives (multiple responses allowed)

	Respondents	Percentage
Little effect	44	14.9%
Complex procedures	20	21.3%
Difficult to obtain approval	16	17.0%
Lack of knowledge concerning incentives	55	58.5%
Other	9	9.6%

(Use of Outside Training Institutes)

Table IV.4-13 shows the utilisation of outside training institutes for employee training. NPC was the most frequently used. Concerning the necessity of expanding external training facilities, 45 firms indicated that it was "extremely important" in the case of the NPC, followed by the MARA vocational training schools (38 firms) and vocational training schools (38 firms).

Fields in which greater efforts were requested were as follows: at the worker level, machinery operation (43 firms) and quality control (39 firms); at the supervisor level, quality control (86 firms) and instruction training (74 firms); and at the technician level, electronics engineering (88 firms) and electrical engineering (67 firms).

Table IV.4-13 Utilisation of Outside Training Institutes (multiple responses allowed)

Unit: firms

	Using	Have used in the past	Have not used	Unaware
MARA vocational training institute	5	5	47	6
CIAST	7	5	42	13
Vocational training schools	10	7	42	7
NPC	35	14	32	4
MIDEC	3	0	42	12
Other	38	2	17	6

(Public-Private Joint Training Centers)

As industry becomes increasingly specialised and advanced, improvements in the quality of the labour force also become necessary. In order to prevent an imbalance in labour supply and demand, it is important for education and training institutes to obtain an accurate understanding of industry needs and incorporate these when revising curricula and establishing new courses. As one means of reflecting industry needs in worker training programmes, Thailand and Singapore have been successful in establishing training centers run jointly by the government and private sector. In Malaysia as well, 1989 saw the establishment of a Skills Development Center in Penang with the joint cooperation of electronics corporations and the state government.

110 out of the local electronics firms responding to the local survey (91.7% of the total) indicated the need for such joint training centers. 107 of the companies indicated willingness to dispatch trainees when such a center to be established. The firms desired training programmes for technicians (102 firms) and supervisors (91 firms). 87 of the companies said that they would be willing to provide assistance to such a center. Possible forms of assistance included: (i) dispatch of instructors (45 firms); (ii) provision of funds (28 firms); and (iii) provision of equipment (17 firms).

4) Promotion of Supporting Industries

(Local Content)

Table IV.4-14 shows current local content along with the figures predicted for five years from now for electronics firms currently operating in Malaysia. At present the greatest number of firms have local content ratios lying in the 20-50% range, while five years into the future those in the 50-80% range are expected to become the mainstream. The prospects for increased local content are bright, with 30 firms (26.5% of the total) responding that improvements "could be expected" and 69 (61.1%) that there were "plans to raise local content." Common methods for increasing local content were "in-house fabrication," noted by 30 firms, "utilisation of local subcontractors," noted by 56, and "invitation of overseas parts manufacturers," noted by 20. These results suggest that if the products of local firms can achieve desired levels of quality and performance they will be welcomed by the market.

Methods of finding local suppliers indicated by the firms were as follows: "directories and other publications" (62 firms), "sales efforts by the supplier" (58 firms), and "word of mouth communication in the industry" (41 firms). (Multiple responses were allowed.)

Table IV.4-14 Local Content at Existing Electronics Firms

Unit: firms

	Current local content	Expected local content five years from now
0~10%	21	6
10~20%	15	10
20~50%	34	19
50~80%	23	39
≥80%	6	23
NA	24	26
Total	123	123

Government policy measures thought to be effective in increasing local content for electronics products are as shown in Table IV.4-15. "Instruction in quality control for local components" was the most commonly noted, indicating the emphasis placed on improving technical and quality standards at existing components manufacturers.

Concerning the need for support by public institutions, 44 of the responding firms answered that such support was "necessary," 54, that it would be "utilised if available," 10, that it would "not so effective," and one, that it was "not necessary." Desired activities included "periodic publication of parts manufacturers directories" (81 firms), "periodic holding of exhibitions" (36 firms), "establishment of an information service office" (32 firms), and "creation of a data base information service (20 firms). The low popularity of the data base service is noteworthy. During interviews of assembler/manufacturers, the information thought to be most important when introducing component manufacturers was that concerning level of products which can be produced indicating the desire for detailed information concerning production items and existing customers along with photographs of the products. MTI's Small and Medium Scale Enterprises Unit provides a subcontracting scheme using a data base for the introduction of subcontractors. Only 21 of the responding firms (17.1% of the total) were aware of this service, however, indicating the need for further promotional efforts.

Table IV.4-15 Policies thought to be Effective in Increasing Local Content (multiple responses allowed)

	No. of responses	Percentage
Incentives for use of local components	64	57.1%
Quality control guidance for local components	76	67.1%
Invitation of foreign parts manufacturers	37	33.0%
Distribution of information of local parts manufacturers	28	25.0%
Other	3	7.1

Note: "Percentage" indicates the the number of responses for the given item divided by the total number of responding firms.

(Assistance to Local Suppliers)

73 of the responding firms (59.3% of the total) answered that they provided their local suppliers with some form of assistance. The types of assistance are shown in Table IV.4-16.

Problems with local suppliers as seen from the standpoint of their customers included "lack of product development ability," indicated by 64 firms, "lack of awareness concerning quality control," indicated by 45, "lack of long-term management policy," indicated by 30, "lack of engineers," indicated by 21, and "lack of marketing skills," indicated by 16.

Table IV.4-16 Methods of Assisting Local Suppliers (multiple responses allowed)

	No. of responses	Percentage
Technical assistance for improving product quality	64	80.0%
Assistance for employee training	13	16.3%
Financial assistance	2	2.5%
Raw material supply	20	25.0%
Provision of machinery and facilities	12	15.0%
Introduction to new customers	16	20.0%
Other	7	8.8%

Note: "Percentage" indicates the the number of responses for the given item divided by the total number of responding firms.

IV-5. Present Status of World Market

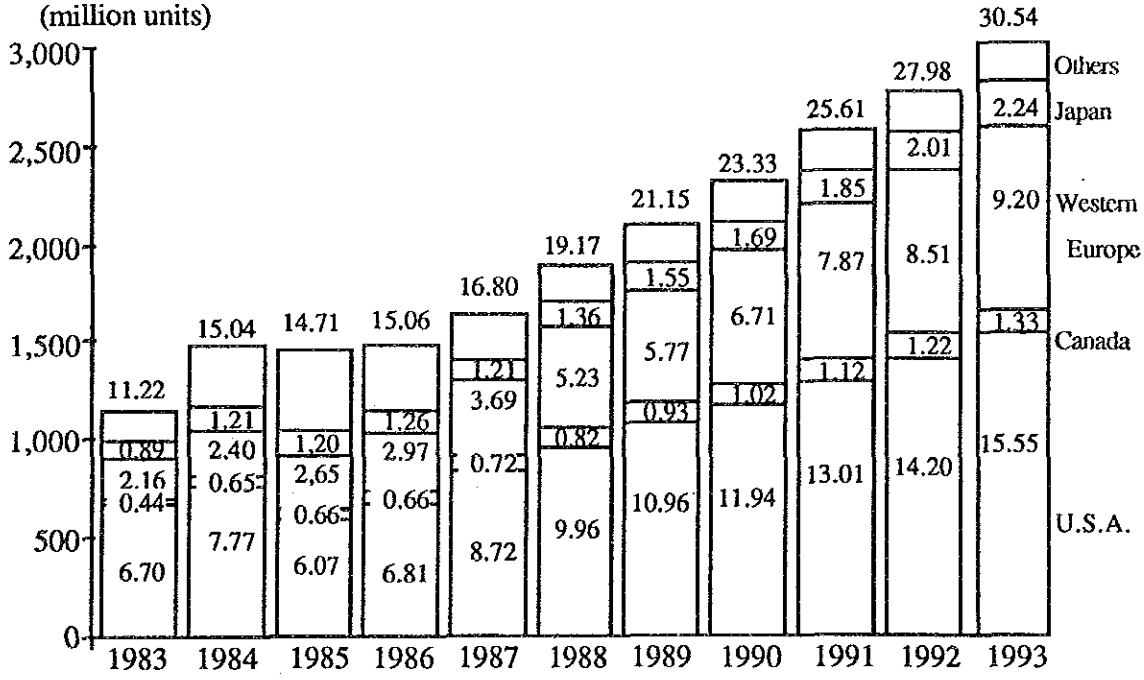
IV-5-1. Overview of World Market

(1) Markets

1) Demand

Demand in major countries/regions is as shown in Fig. IV.5-1. The U.S. constitutes the largest single market for personal computers and peripheral equipment, followed by Europe. The second half of 1988 saw a downturn in U.S. demand for personal computers, but Japanese and European demand remained healthy. In particular, the European market, which is said to lag behind the U.S. by two years, is experiencing a major increase in demand. During the period 1983-1989, the European market grew at an annual rate of 17.8%, significantly higher than the worldwide average of 11.3% for the same period. However, Data Quest Co. predicts that during 1990-1993 U.S. demand will pick up again, with European market growth to drop off somewhat. Although small in terms of absolute size, Asian market demand is increasing at a rapid pace, with growth rates in Korea and Taiwan exceeding 50% for each of the last three years. The world market is expected to continue expanding, with annual growth of 9.4% predicted for 1990-1993.

Fig. IV.5-1 Domestic Demand for P/Cs by Country/Area



Source: Data Quest

Average annual growth in the leading countries/areas is as follows:

	1983/1989	1990/1993
U.S.	8.5%	9.2%
Europe	17.8%	11.1%
Japan	9.7%	9.8%
Other	5.1%	4.4%
Worldwide	11.3%	9.4%

Table IV.5-1 provides a comparison of the computer markets (including all computer-related products) in leading countries/areas. Concerning the market scale per 1,000 population for 1987, that of the U.S. was far larger than those of others, those of Europe and Japan were in the US$2,000-3,000 range. The figure was also high for the small nation of Singapore, which is striving to become an "information-oriented country."

Table IV.5-1 Computer Markets in Various Countries/Areas

(Unit: US$million)

	Market scale (A)	Hardware production value (B)	(A)/(B)	GNP (C)	Population (in thousands) (D)	(A)/(C)	(A)/(D)
U.S.	134,500	45,400	33.8%	4,456,200	244,884	3.12%	US$549
Japan	42,200	21,200	50.2	2,,459,700	122,918	1.72	US$343
U.K.	14,800	5,900	39.9	657,700	56,360	2.25	US$263
France	11,500	5,300	46.1	554,600	55,602	2.07	US$206
W.Germany	17,300	8,100	46.8	1,171,000	60,821	1.47	US$284
Italy	9,100	4,300	47.3	659,900	57,416	1.39	US$159
Singapore	300	2,300	13.0	21,300	2,620	1.62	US$132
Hong Kong	500	900	55.6	40,700	5,600	1.16	US$84
Korea	1,100	1,500	73.3	111,000	42,070	1.02	US$27
Taiwan	900	3,800	23.7	99,700	19,455	0.86	US$43
Total	232,300	—	—	10,231,900	667,746	2.27	US$348

Source: MIC (Taiwan)

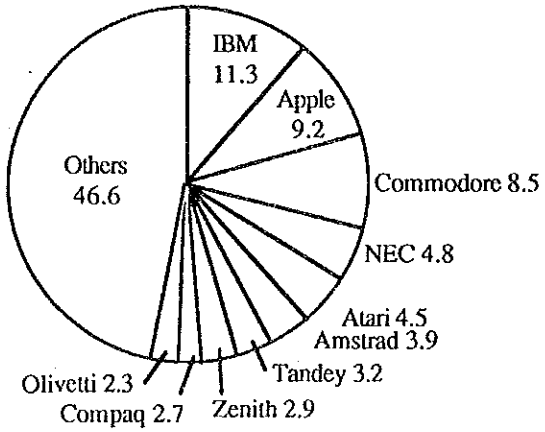
2) Supply

Fig. IV.5-2 shows manufacturer shares in the world personal computer market. Sales by firms in the "Other" category are increasing on an annual basis, growing from 36.8% in 1987 to 46.4% in 1988. Companies in Japan, Taiwan, and Korea account for the majority of these firms, with the Asian region as a whole estimated to account for about 25% of worldwide personal computer production.

U.S. manufacturers, which hurried to secure their shares during the expansion phase of the personal computer market, are establishing plants in Singapore and Taiwan, which are relatively open to foreign investment, and are establishing OEM production

agreements in Korea and Taiwan, where local firms have built up technical expertise over the years in the production of consumer electronics products, and are thereby increasing outside sourcing of computer-related products from the NIEs.

Fig. IV.5-2 Share of World P/C Market (on a volume basis), 1988



Source: Data Quest

Table IV.5-2 shows printer markets in leading countries/areas. Although there are no separate figures for each nation, Japan is said to be the world's largest supplier of printers. Japanese production totaled 4.2 million units in 1987 and 4.9 million units in 1988, of which roughly 80% was exported.

With the levying of anti-dumping tariffs against Japanese printers in the EC starting in 1988, Japanese printer manufacturers soon began overseas production in Europe.

The size of the market for monitors and keyboards is unclear.

Table IV.5-2 Printer Demand in Leading Countries/Areas

(Unit: thousands)

	1987	1992 (predicted)
U.S.	6,900	9,940
Europe	4,200	6,770
Japan	1,430	2,340
Other	270	450
Worldwide	12,800	19,500

Source: Data Quest

(2) Competition

The main competitors for Malaysian products are those from Asian NIEs such as Korea and Taiwan. Current conditions in the computer industries of these countries/areas are summarized in Table IV.5-3.

Table IV.5-3 Computer Industries in Competing Countries/Areas

	Korea	Taiwan	Singapore
1. History of development	1975: Production starts 1981: Export starts 1984: Korea becomes the largest P/C exporter in the world	1980: Production starts 1981: Mass production of monitors starts 1982: Mass production of P/C starts	In early 1980s: Foreign affiliated manufacturers of computer-related products moved into the country.
2. Industrial structure	The industry involves 70 major manufacturers, mainly large business group manufacturers. Since the middle of the 1980s, moves by foreign affiliated manufacturers have increased as shown in the case of approval of IBM. Almost all major international firms are represented in Korea.	Including small and medium-sized firms in related industries, the number of manufacturers is estimated at 600. The industry is characterized by the dominance of small scale firms with about 50 employees. At the same time, because of the open door policy for foreign investment, there are many foreign-affiliated manufacturers.	Except for Wearnes, there are no domestic manufacturers of any considerable size. The industry is characterized by offshore production bases of foreign affiliated firms.
3. Main manufacturers	Daewoo Communications Samsung Electronics Sampo Computer Hyundai Electronics Goldstar Dongyang Nylon	Acer Mitac Plus & Plus Daido Zenith Philips	Wames HP DEC Apple Compaq
4. Production volume in 1989 (1,000 units)			
P/C	2,500	1,800 (semifinished products: 2,300)	888 (semifinished products: 720)
Printer	800	100	240
Monitor	Colour: 4,000 Monochrome: 4,200	Colour: 4,200 Monochrome: 3,800	Colour: 360 Monochrome: 24
Keyboard	—	7,500	480

	Korea	Taiwan	Singapore
5. Exports and Imports in 1987 (computer -related items)	Exports: US$250 million of which, U.S.: 23.6% Imports: US$180 million of which, Japan: 46.3%	Exports: NT$67,410 million of which, U.S.: 48.0% Imports: NT$19,760 million of which, Japan: 55.2%	Exports: S$960 million of which, U.S. 61.8% Imports: S$310 million of which, Japan: 38.0%
6. Domestic market size (P/C) in 1989	US$173.79 million	100,000 units	37,000 units
7. Features of production	The government has been systematically raising the required local sourcing ratio for components. The current local sourcing ratios stand at 80 percent for P/Cs and 50 percent for printers. Overall, Korea is lagging two years behind Taiwan. In terms of quality control, Korea is ahead of Taiwan. Orientation toward the production of completed product is strong.	Supply of main components such as ICs is heavily dependent on imports. Taiwan has strength in intermediate components such as power supplies, keyboards and motherboards with exports of these showing a rapid increase. The industry is very labor intensive.	About 90 percent of components are imported. Singapore is the largest supplier of hard disc drives in the world.
8. Features of sales	Exports started with the United States as the main target market. Development of the European market has been underway in recent years as part of plans to diversify markets. OEM sales to major P/C dealers are dominant. OEM production for shipment to the U.S. by Japanese manufacturers is conducted. A main selling point is the low price and profit deteriorates substantially.	Exports started with the United States as the main target market. Development of the European market has been underway in recent years as part of plans to diversify markets. Taiwanese products have penetrated the U.S. direct mail market, relying on low prices as a selling point. Although the ratio of OEM sales to exports is declining, it remains at as high as 70 percent. acer is faring well in sales of its original brand products.	Because most manufacturing is dominated by foreign affiliated firms, products are sold under parent firms' brands and through their distribution channels. Small domestic manufacturers are producing under OEM contract except for Wearnes, which has already established its own brandname in the Southeast Asian market.

	Korea	Taiwan	Singapore
9. Present status of R&D	Almost all major manufacturers have their own research institutes. ETRI, a government R&D organization, has provided support to the private sector through joint development programmes. In the early stages, a large bedget was allocated based on government sponsored development programmes. At present, ETRI's activities focus on developing general-purpose computers	Because the industry is dominated by small and medium-scale firms, domestic R&D activities take place mainly at ERSO, a government research institute. Hsinchu Science-based Industrial Park was built to attract the R&D sections of foreign firms and to provide support for technology-oriented local manufacturers. To make use of the expertise of the large number of students who study abroad, students are encouraged to return home after study.	There are no large scale R&D activities under government initiative. Because the manufacturing industry is dominated by foreign affiliated firms, the government is using promotion measures such as tax incentives and the construction of a science park to attract the R&D sections of foreign firms in Singapore. Subsidies for product development are provided to local small & medium-sized firms.
10. Problems	• Related industries such as mechatronics and device industries are lagging behind • Insufficient exploitation of domestic demand • Competitiveness erodes with the labor shortage and higher exchange rate	• Except for a limited number of firms, most manufacturers are small in size and have problems in the area of R&D, quality control and productivity improvement. • Competitiveness erodes with the labor shortage and higher exchange rate	• The industry is still relying heavily on foreign affiliated firms • As a result of the tight supply of labour, the manufacturing sector is shifting abroad.

Note: ETRI: Electronics Technology Research Institute
ERSO: Electronics Research & Service Organization
Source: Production volume: Electronic Industries Association of Japan
Export & import: Trade statistics of each country/area

Until recently Korea and Taiwan were dominant in the field of low-end personal computers and monitors, but the dramatic changes in the production environment that have taken place since 1988 have shaken this position, thereby increasing the opportunities for Malaysian products to penetrate markets in Europe and the U.S. At present Taiwan is the world's leading supplier of keyboards, with products being exported to both Korea and Japan, but there are excellent opportunities for Malaysia to penetrate these markets in the future. With overseas production by Taiwanese firms on the rise, the most realistic scenario is for an increase in Malaysian production by Taiwanese manufacturers. Malaysia's greatest potential competitor in the keyboard sector is Thailand, which achieved production of 2.4 million units in 1989.

(3) Export Environment

(Generalised System of Preferences)

Table IV.5-4 shows tariffs for personal computers and peripherals in leading markets. Malaysian products are eligible for generalised system of preferences (GSP) in all of the countries/areas and are exempt from tariffs.

The Asian NIEs with which Malaysia must compete have already been excluded from GSP in the U.S. In the EC, the NIEs remain eligible for GSP, but a ceiling has been established on imports of Korean personal computers.

Generally, tariffs for computer-related products do not exceed 5% in any country, and hence the significance of GSP is less than in the case of home electrical appliances.

Table IV.5-4 Customs Duties in Leading Markets

	U.S.		EC		Japan
	General	Special	Autonomous	Conventional	—
Personal computers	3.9%	0	11%	4.9%	0
Monitors	3.7%	0	11%	4.9%	0
Keyboards	0	0	11%	4.9%	0
Printers	3.7%	0	11%	4.9%	0

Note: Personal computers are classified under tariff code 847120; the other products, under 847192.
"Special" indicates those nations singled out for GSP. "Conventional" indicates those nations given most favored nation status.

(Overseas Production)

Overseas production by manufacturers in Japan, Taiwan, and other Asian NIEs is on the rise. This situation is the result of two factors: rising production costs at home and a surge of protectionist measures in the world's leading markets. In response to increasing production costs, suppliers are shifting production of their low-end products to countries offering cheaper labour. Since the markets for computer-related products in these countries are usually quite small, most of the production is exported. In response to protectionist measures, manufacturers set up production operations in the targeted market in order to circumvent the trade barriers.

The following is a summary of the main trade barriers which have been erected in leading markets.

Implementing country/area	Target country	Products	Remarks
U.S.	Japan	Personal computers	100% duty in retaliation for semiconductor dumping
EC	Japan	Printers	Local content of at least 40% is required since the products are counted as domestic production
EC	Japan	Personal computers	*Subject to price monitoring

IV-5-2. Present Status of Major Markets

(1) Japan

1) Domestic Market

(Personal Computers)

— Market Scale

Domestic shipments of personal computers during 1984-1988 are summarized in Table IV.5-5. With the exception of the mid-1980s computer slump, steady growth has been recorded.

Table IV.5-5 Personal Computer Shipments in Japan

	1981	1982	1983	1984	1985	1986	1987
Volume (1,000 units)	229	683	885	1,196	1,187	1,236	1,203
Value (¥billion)	—	—	266.8	341.4	374.8	431.9	526.3

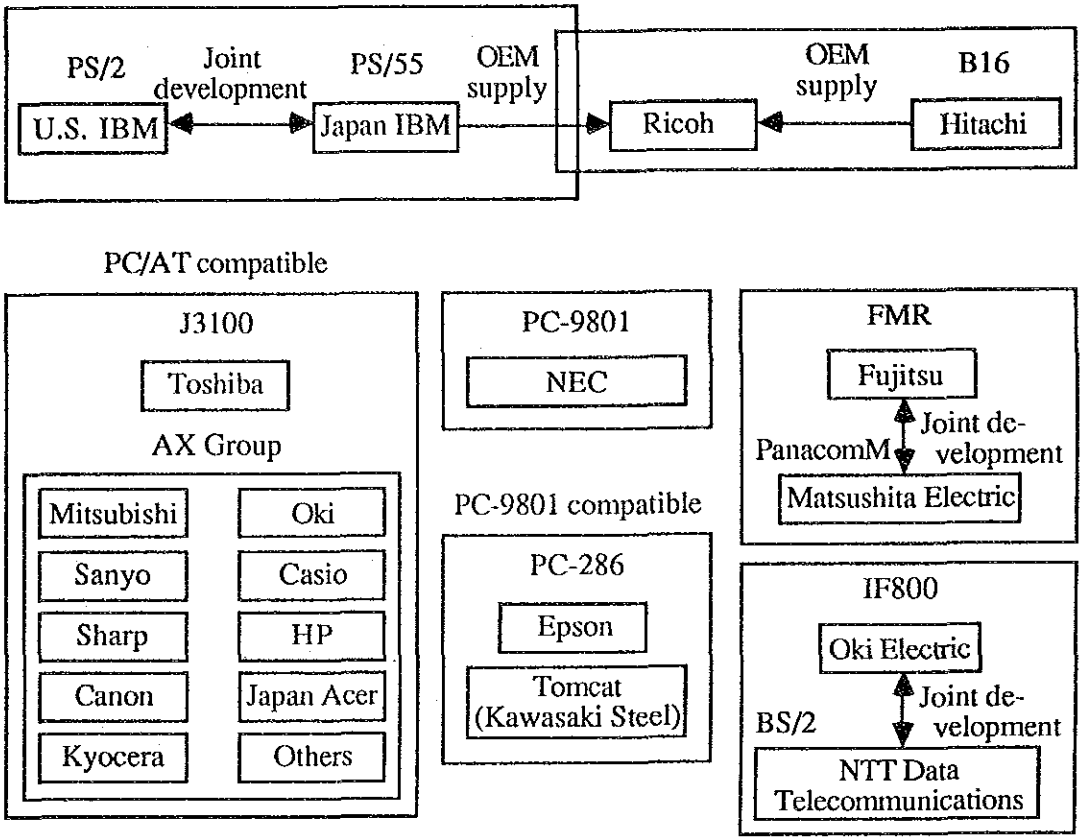
Source: Japan Electronics Industry Development Association (JEIDA)

There are no independent trade statistics for imports of personal computers, which are included along with main-frame computers and minicomputers under the heading "digital automatic data processing equipment CPUs" (HS code 847191000). As a result, it is difficult to obtain an accurate grasp of the present situation. 1989 imports totaled ¥196,946.1 million (an increase of 40.9% over 1988), of which 88.1% originated in the U.S.

— Market Characteristics

[1] The greatest single characteristics of the Japanese personal computer market is the dominance of the NEC 9800 series as opposed to the IBM compatible models which maintain a 70% share of world sales and constitute the standard in every other leading market. Fig. IV.5-3 shows representative manufacturers broken down into their respective groups. NEC and the group engaged in production of NEC-compatible units together account for approximately 50% of the entire market.

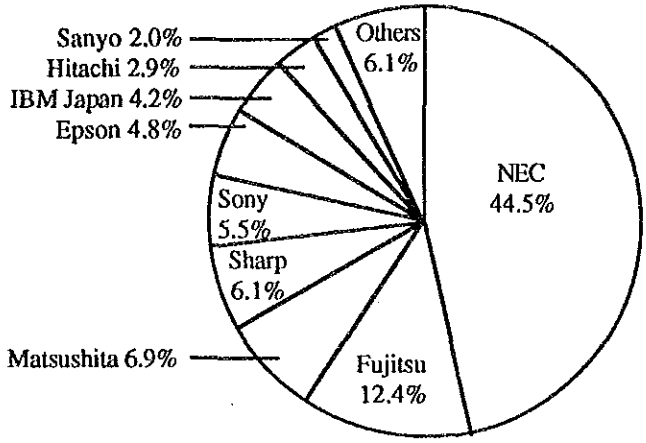
Fig. IV.5-3 Grouping of Japanese Personal Computer Manufacturers



Source: Nihon Denshi Nenkan (1988)

[2] In Japan, there are often said to be "four strong and six weak" computer manufacturers. NEC, IBM, Fujitsu, and Hitachi continue to maintain high individual shares in the total market for computers. Respective shares in the personal computer market for leading manufacturers are shown in the Fig. IV.5-4.

Fig. IV.5-4 Manufacturer Shares in the Japanese Personal Computer Market (1988)



Source: Yano Research Institute

[3] Products are becoming increasingly advanced, with sales of 8-bit machines falling off dramatically and 32-bit machines garnering a share of more than 10% in 1988. The two figures for the U.S. market in 1988 were 27.5% and 8.1%, respectively. Table IV.5-6 shows a breakdown of domestic shipments of personal computers by bit size.

[4] The lack of available office space has led to the rapid growth in popularity of laptop computers since their appearance in 1987. The trend towards an age of "one man, one computer" is expected to grow even stronger.

[5] The increased performance of personal computers and the reduced prices of workstations have served to intensify competition between the two. Workstation market share is growing, though not as rapidly as that of laptops.

Table IV.5-6 Breakdown of Personal Computer Shipments by Bit Size

(Unit: 1,000 units)

	1986	1987	1988	1989	1990	1991	1992
8-bit	55%	35%	19%	14%	10%	7%	5%
16-bit	45%	63%	71%	71%	69%	68%	64%
32-bit	—	2%	10%	15%	21%	25%	31%
Total units	1,236	1,203	1,350	1,500	1,650	1,800	1,980
Breakdown							
Laptops	—	2%	15%	20%	24%	28%	30%
Workstations	—	4%	7%	9%	10%	12%	13%

Source:JEIDA

(Monitors)

— Market Scale

Domestic shipments of monitors during 1984-1988 are as shown in Table IV.5-7.

Table IV.5-7 Shipments of Monitors in Japan

	1984	1985	1986	1987	1988
Volume (1,000 units)	576	763	774	910	1,410
Value (¥million)	37,057	42,716	49,658	61,845	71,192

Source: JEIDA

It is impossible to obtain an accurate grasp of the import situation from available trade statistics, in which monitors are included in the I/O device category (HS code 847192900). 1989 imports totaled ¥28,619.2 million, of which 67.1% originated in the U.S.

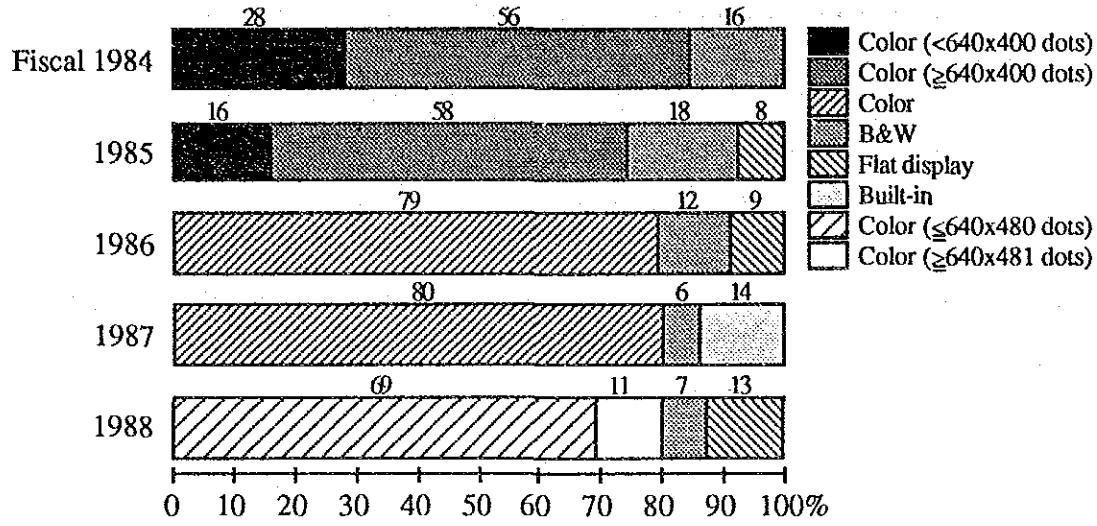
— Market characteristics

[1] Color monitors account for more than 80% of the Japanese market. This situation has remained unchanged since 1986. Recently 14-inch color monitors have become the mainstream, with high growth expected for high-resolution 14-inch units in the future.

[2] The market share of B/W monitors has become established at less than 10%.

[3] The market share of flat panel monitors is increasing. Since roughly 80% of those monitors which come integrated into the main body of the computer are estimated to be flat panel units, it is thought that flat panel monitors now account for about 13% of the entire market. The continued proliferation of laptop computers is expected to spur further growth in this sector.

Fig. IV.5-5 Breakdown of Domestic Monitor Shipments



Source: JEIDA

(Printers)

— Market Scale

Domestic shipments of printers during 1984-1988 are as shown in Table IV.5-8.

Table IV.5-8 Japanese Printer Market

	1984	1985	1986	1987	1988
Volume (1,000 units)	455	517	568	703	893
Value (¥million)	70,201	81,804	88,405	122,733	149,576

Source: JEIDA

It is impossible to obtain an accurate grasp of the import situation from trade statistics, in which printers are included in the I/O device category. At present Japan is the world's leading supplier nation, and since local demand in this country is centered around more expensive products than are common in foreign markets, imports are thought to be limited.

— Market Characteristics

[1] Demand for thermal printers centers around the personal/household market, while most dot matrix printers are sold for business use. In recent years, however, both sectors have experienced a shift towards higher-end products.

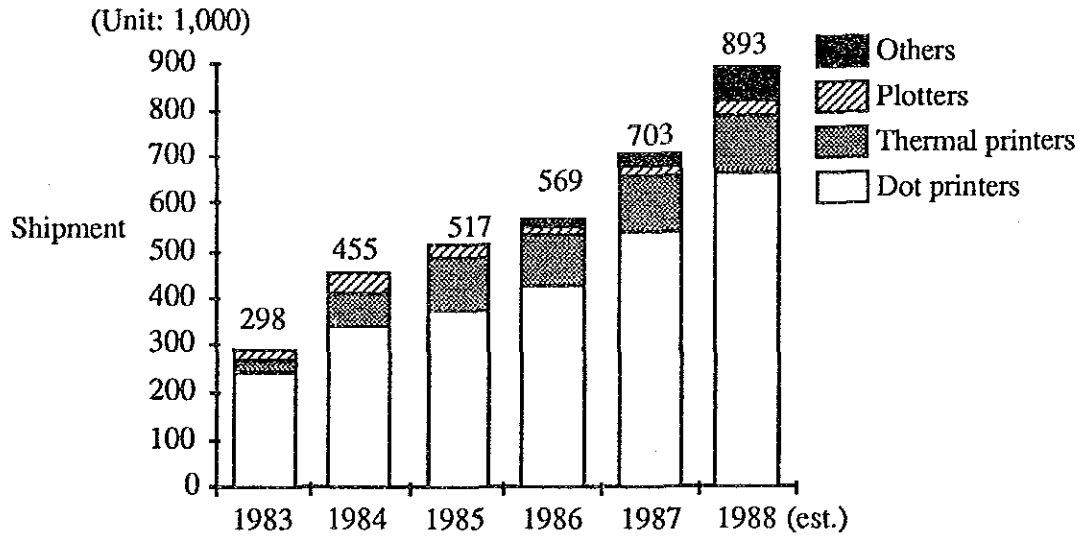
[2] In 1987, 84.7% of the dot matrix printers sold carried at least 24 pins.

[3] Thermal printers have held a 20% share of the market for the last two years. Low-cost and low-noise, these units are often used with laptop computers, and steady growth is expected.

[4] Although laser printers are silent and allow high-speed printing, their use was limited to commercial situations in the past. Recently, however, units with price tags of ¥300,000-500,000 have appeared on the market, and future reductions in price are expected to make them the printer of choice for use with personal computers in business.

(5) 1988 manufacturer shares in the dot matrix printer market were as follows: (1) Epson (20.9%); (2) Star Precision (12.9%); (3) Tokyo Electric (10.5%); (4) Oki Electric (8.9%); and (5) Kyushu Matsushita (7.8%).

Fig. IV.5-6 Breakdown of Domestic Printer Shipments



Source: JEIDA

Note: Keyboards are generally treated as components, with computer manufacturers purchasing them for use in their personal computers. Consequently, the size of this market is thought to be almost the same as that of the personal computer market, but market characteristics are unclear. This is also true of the production and export trends to be discussed below.

(Future Outlook)

In 1989 the Ministry of International Trade and Industry established a committee consisting of representatives from leading manufacturers and industrial associations. The results of this committee's study of the mid- and long-term outlook for the electronics industry in the 1990s were summarized in a report entitled, "A Vision for the Electronics Industry in the 1990s." According to this report, domestic demand for computer-related products is expected to grow from the ¥3,240 billion of 1987 to ¥16,460 billion by the year 2000. This accounts for average annual growth of 13.3%, slightly higher than the 11.9% figure predicted for world demand as a whole during the same period. As a result, Japan's share of worldwide demand is expected to increase from the 10.9% of 1987 to 14.2% by 2000. Demand for personal computers in particular is expected to show healthy growth, with the advent of the aforementioned "one man, one computer" society. In the field of peripherals as well, the development and proliferation of advanced products such as optical disks and laser printers is expected to allow for further market expansion. With the exception of the main-frame computers which require the support of advanced technology, production of personal computers and peripherals is expected to undergo a shift overseas, with an increase in re-imports being predicted.

Table IV.5-9 Demand Forecast for Computer-related Products

(Unit: ¥billion)

	1987	1995	2000	Average annual growth
Domestic demand				
Computers	3,240	8,770	16,460	13.3%
Main-frame, office, etc.	1,360	3,010	4,940	10.4%
Personal computers	260	820	1,640	15.1%
Peripherals	1,620	4,940	9,880	14.9%
World demand				
Computers	29,610	65,930	115,710	11.9%
Main-frame, office, etc.	9,340	20,050	32,290	10.0%
Personal computers	2,650	6,880	12,460	12.6%
Peripherals	14,920	39,000	70,960	12.7%

Source: Ministry of International Trade and Industry, "A Vision for the Electronics Industry in the 1990s"

2) Production and Export Trends

(Personal Computers)

Japanese personal computer production began in 1977. Production grew steadily throughout this decade and then increased dramatically with the advent of the 1980s, with production exceeding 1 million units for the first time in 1983. This represents an increase of more than ten-fold over 1980. Since 1985, production volume has levelled off.

Approximately 40% of total shipments in 1986 were destined for overseas markets, but this figure is much lower than the comparative numbers for printers and other peripherals. Deterioration of the export environment and the resulting growth in overseas production have resulted in a reorientation of domestic production towards the domestic market and a switch to high-end machines and laptops.

Table: IV.5-10 Personal Computer Production in Japan

	1984	1985	1986	1987	1988
Shipment volume (1,000 units)	1,874	1,983	2,060	1,976	2,192
Export ratio (%)	36.2	40.1	40.0	39.1	37.3
Shipment value (¥million)	2,429	2,809	3,206	3,609	4,657
Export ratio (%)	25.2	29.0	26.8	21.7	20.0

Source:JEIDA

Exports of personal computers alone are impossible to determine from trade statistics, under which they are classified as the CPUs of digital automatic data processing units (HS code 8453200). 1989 exports of personal computers totaled ¥204,981.38 million (up 15.6% over 1988), with the leading destinations being (1) the U.S. (56.0%), (2) West Germany (13.0%), (3) France (5.7%), (4) the U.K. (4.6%), and (5) Australia (2.8%).

(Monitors)

Monitor production continues to grow at a rapid pace, with 21.4% growth being recorded in 1988. As can be seen from the drop in export ratios, this increase was due mainly to increased domestic demand. The proliferation of high-resolution color monitors in Japan helped to boost domestic production. Concerning low-end products, exports to third countries from overseas production bases and OEM producers have already become established, and this sector is one in which the reorganization of domestic production has proceeded smoothly.

Table: IV.5-11 Monitor Production in Japan

	1984	1985	1986	1987	1988
Shipment volume (1,000 units)	576	2,054	2,167	2,305	2,799
Export ratio (%)	—	62.9	64.3	60.5	49.6
Shipment value (¥million)	37,057	78,024	91,989	108,815	137,570
Export ratio (%)	—	45.3	46.0	43.2	48.3

Source:JEIDA

Since 1988, monitors have occupied an independent category in Japanese trade statistics. 1989 exports totaled ¥160 billion (up 4.5% over the previous year), with the leading destinations being (1) the U.S. (58.1%), (2) West Germany (15.1%), (3) the U.K. (6.6%), (4) France (4.1%), and (5) Australia (2.3%).

Products for export include a higher percentage of B/W monitors, and the ratio grew from 69% in 1987 to 83% in 1988. The ratio of flat panel displays was low, at 2%.

(Printers)

Growth in printer production was the highest of any type of peripherals, with production increasing roughly ten-fold from 1984 to 1988. Printers contain numerous precision mechanical components, and the lack of development in this sector by the Asian NIEs has meant continued market dominance for Japanese manufacturers. The levying of anti-dumping tariffs in the EC, however, has forced a shift in domestic production to laser printers and other high-end products, with production volume itself showing signs of contraction.

Table: IV.5-12 Printer Production in Japan

	1984	1985	1986	1987	1988
Shipment volume (1,000 units)	455	2,391	4,279	4,204	4,907
Export ratio (%)	—	78.4	86.7	83.3	81.8
Shipment value (¥million)	70,201	145,253	293,356	297,601	404,093
Export ratio (%)	—	43.7	69.9	58.8	63.0

Source:JEIDA

The export ratio for printers peaked in 1986 and has been gradually declining since, but the figure still exceeded 80% in 1988. Just as with monitors, independent trade statistics for printers have been available only since 1988, and long-term trends are unclear. 1989 exports totaled ¥505.7 billion (an increase of 8.4% over 1988), with the leading destinations being (1) the U.S. (50.7%), (2) the Netherlands (11.3%), (3) West Germany (10.4%), (4) the U.K. (5.1%), and (5) Singapore (2.8%).

In contrast to the dot matrix printers destined for the domestic market, of which 84.7% have at least 24 pins, those printers for export tend to be dominated by low-precision models with fewer than 9 pins (45.3%). One of the reasons for this is the need for Japanese-language word processing programmes to handle Chinese characters, which require much greater precision than alphabetics.

3) Leading Manufacturers

(Industry Structure)

The Japanese computer industry has developed with a great deal of assistance from the government, and Japanese manufacturers of computer-related products can be broadly divided into two groups. One consists of the mainframe producers which received such assistance during the early years of the industry, succeeded in developing mainframe computers, and are still engaged in the sale of such systems. This group includes 10 firms, four of which are foreign affiliates like IBM Japan and Univac Japan.

The other group includes the numerous companies which entered the field in the 1970s as computers began to become accessible to the masses and which are referred to as non-mainframe producers. By this time, basic computer technologies had been established and it was possible to put a product on the market without any accumulation of advanced technologies. As a result, there is a great gap between the two groups in terms of technical expertise and capital, but this dual structure has become established in the industry.

The mainframe producers are engaged in producing main-frame computers, office computers, personal computers, peripherals, ICs and other components, and software. The non-mainframe group, on the other hand, consists of a wide variety of companies. Some are engaged in high-volume production of personal computers and various types of peripherals and may maintain large market shares for certain products due to strengths in particular fields, some specialize in production of a specific type of peripherals, and some produce only through OEM agreements.

Fig. IV.5-7 Classification of Manufacturers

(Personal Computers)

The six Japanese mainframe producers mentioned above are typical of computer equipment producers in Japan. In the case of personal computers, firms from such diverse industries as iron and steel and precision equipment have been making inroads into the market, resulting in a significant increase in the number of producers. There are generally thought to be a total of 24 main producers, all of which cooperate with the periodic statistical surveys conducted by JEIDA. IBM Japan and the other foreign affiliates are not included in this total, however.

Table IV.5-13 Outline of Japanese Mainframe Producers

Company	Year of establishment	1988 capital (¥billion)	No. of employees	1987 sales (¥billion)	Remarks
Oki Electric	1947	43.5	13,813	416.2	Computer equipment manufacturer
Toshiba	1875	201.2	70,288	2,682.7	General electronics equipment manufacturer
NEC	1899	146.9	38,004	2,304.4	Computer and telecommunications equipment manufacturer
Hitachi	1920	180.3	77,581	2,919.5	General electronics equipment manufacturer
Fujitsu	1935	168.8	50,617	1,714.4	Computer and telecommunications equipment manufacturer
Mitsubishi Electric	1921	151.3	48,562	1,954.1	General electronics equipment manufacturer

Note: Figures for the general electronics equipment manufacturers include sales and employees for other divisions as well, such as home appliances and heavy electrical equipment.
Source: Computer Note

(Monitors)

Since the technologies required for monitor production are virtually the same as those needed to produce television sets, the leading monitor manufacturers include television producers as well as computer manufacturers.

(Keyboards)

Keyboards are often treated as intermediate components, and producers are often electronics component manufacturers. Some of the representative manufacturers are Alps Electric, Mitsumi Electric, Minebea, and SMK. In the case of in-house production at the large computer manufacturers, keyboards are usually assembled by group firms or subcontractors.

(Printers)

Computer and office equipment manufacturers are the major producers of printers, with the leaders in the field tending to maintain very large market shares. (See the section on the Japanese domestic market for details concerning market shares.) Epson and

Canon, precision equipment manufacturers with a great deal of expertise in precision mechanical components, are two examples.

JEIDA undertakes periodic production surveys concerning monitors, keyboards, and other types of peripherals. At present, 54 companies take part in these surveys, and these firms are considered to be the main producers.

(Future Production Outlook)

Table below shows the expected world market share for Japanese products in 1995 according to predictions by the Nomura Research Institute. With the two exceptions of FDDs and CRT display devices, all of the products are expected to increase their share. In addition, the following trends are expected to emerge for production in Japan:

- Increased production share for laptop computers
- Increased production share for laser printers
- Increased production share for flat panel displays

These production trends correspond to domestic demand trends and are indicative of the increasing importance of domestic demand for domestic production.

Figures concerning the ratio of overseas sales accounted for by overseas production are unavailable for 1986, making a comparison impossible, but it is clear that overseas production is on the rise. This is in response to sanctions by the U.S. and the EC, particularly in the case of personal computers and printers. (For a discussion of the overseas production plans of Japanese corporations, see Section IV-5-4.)

World Market Share of Japanese Products

(Unit: %)

	World market share		Overseas production/ (Exports + overseas production) (1995)
	1986	1995	
Personal computers	12	20	—
HDD	49	53	16
FDD	74	70	13
Display devices	36	48	1
CRT	26	24	3
Flat displays	98	96	—
Printers	92	94	10
Dot impact printers	81	88	—
Non-dot printers	98	95	14

Source: Nomura Research Institute

(2) United States

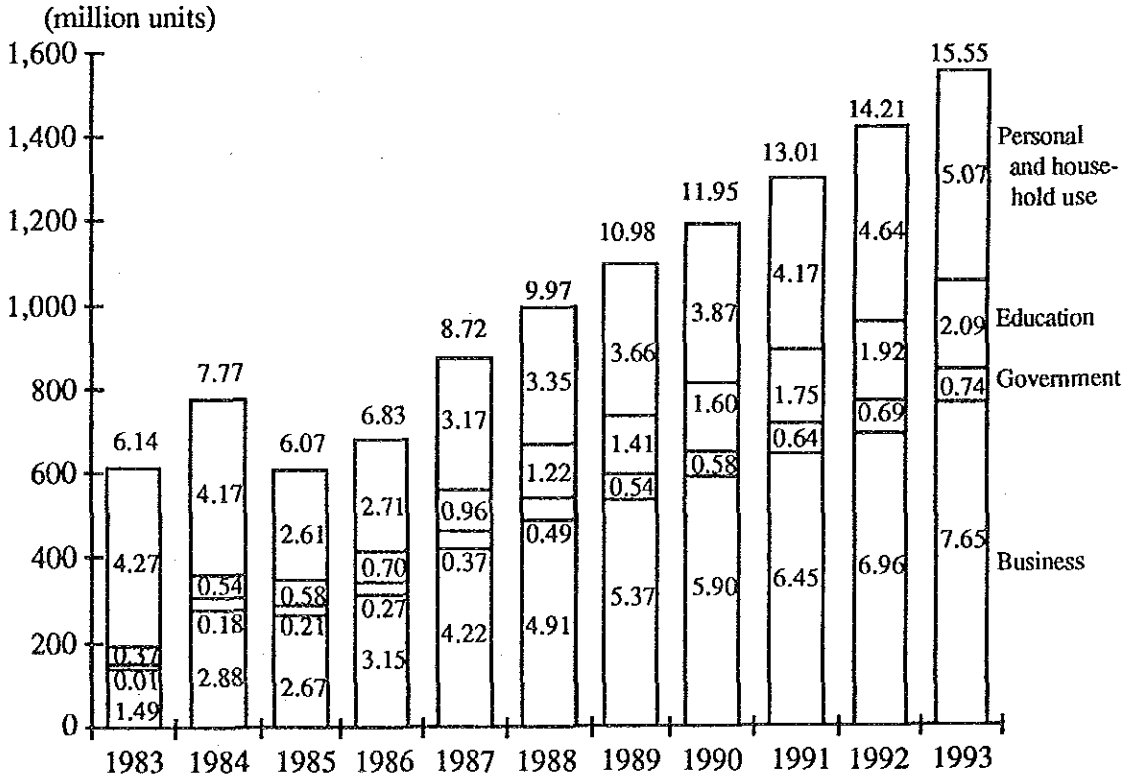
1) Domestic Market

(Personal Computers)

— Market Scale

The U.S. boasts the largest demand for personal computers in the world, showing average growth of 8.5% over the past six years. 1989 demand was estimated at 1,098,000 units. Fig. IV.5-8 shows a breakdown of current and predicted demand by the type of user. The largest market segment is business, followed by personal and household use, these two sectors together accounting for 80% of the entire market.

Fig. IV.5-8 Breakdown of U.S. Personal computer Market by Users



Source: Data Quest, May 1989

Table IV.5-14 shows shipments by U.S. manufacturers over the past three years. As can be seen from the Table, domestic shipments accounted for more than 60% of total shipments. A simple comparison with the figures of Fig. IV.5-8 suggests that 95.4% of all domestic demand is being supplied by U.S. firms, with the market for foreign products working out to 460,000 units in 1987. Low-end products are imported in large

quantities in the form of OEM production from Korea and Taiwan, but it is impossible to grasp the size of the import market since it is unclear whether OEM products are treated as U.S. manufacturer shipments or not. According to figures from the exporting countries/areas, the U.S. imported 660,000 personal computers from Taiwan in 1987 and 1,910,000 from Korea, which together would account for about 30% of the total market that year.

The U.S. is the world's leading importer of personal computers, but it is impossible to obtain an accurate grasp of the import situation from trade statistics. Personal computers are classified as "data processing machines" (SITC 7530020). 1989 imports totaled $4,453.04 million, the leading suppliers being (1) Japan (60.6%), (2) Taiwan (13.2%), (3) Korea (8.4%), (4) Canada (8.1%), and (5) Singapore (3.4%).

Table IV.5-14 Personal Computer Shipments by U.S. Manufacturers

(Units: 1,000 units, US$million)

	World market			U.S. market			Non-U.S. markets		
	1986	1987	1988	1986	1987	1988	1986	1987	1988
Shipments									
Volume	10,490	13,030	13,990	6,750	8,920	9,500	3,740	4,410	4,490
Value	20,760	28,979	32,120	14,170	20,542	22,830	6,590	8,437	9,290
Installations									
Volume	41,801	53,930	64,150	28,760	37,003	43,650	13,050	16,900	20,500
Value	73,200	91,700	121,200	52,500	65,500	86,300	20,700	26,200	34,900

Source: I.D.C.

— Market Characteristics

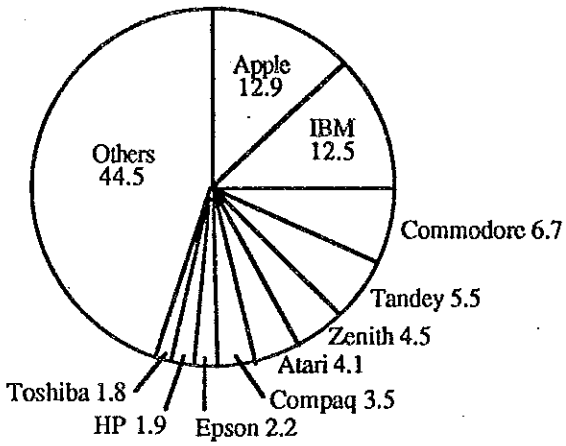
[1] The personal computer was born in 1976 with the advent of the Apple I, and personal computers continues to maintain a higher share of the market than in any other nation. In 1987, based on installation value, the figure was 43% (the same figure for Japan was only 20%).

[2] In the U.S. IBM and IBM-compatible machines dominate the market. On the occasion of its entry into the personal computer market in 1981, IBM adopted an open architecture strategy and gradually increased its share. By 1983 it had replaced Apple as the leading manufacture of personal computers in the U.S. In addition, IBM personal computers have established themselves as the industry standard, with the companies involved in production of IBM-compatible units ranging from large manufacturers like Compaq, Tandy, Zenith, AT&T, and Unisys to small venture-capital operations. Since development costs are only minimal for the compatible machines, they have excellent cost competitiveness, and IDC predicts that the market share of these "clones" will increase from the 28% of 1986 to 44% by 1991. NEC

also produces an IBM-compatible machines for sale to the U.S. market in place of its standard 9800 series.

Fig. IV.5-9 shows manufacturer market shares for 1989. Apple has regained the number one spot with a 12.9% share.

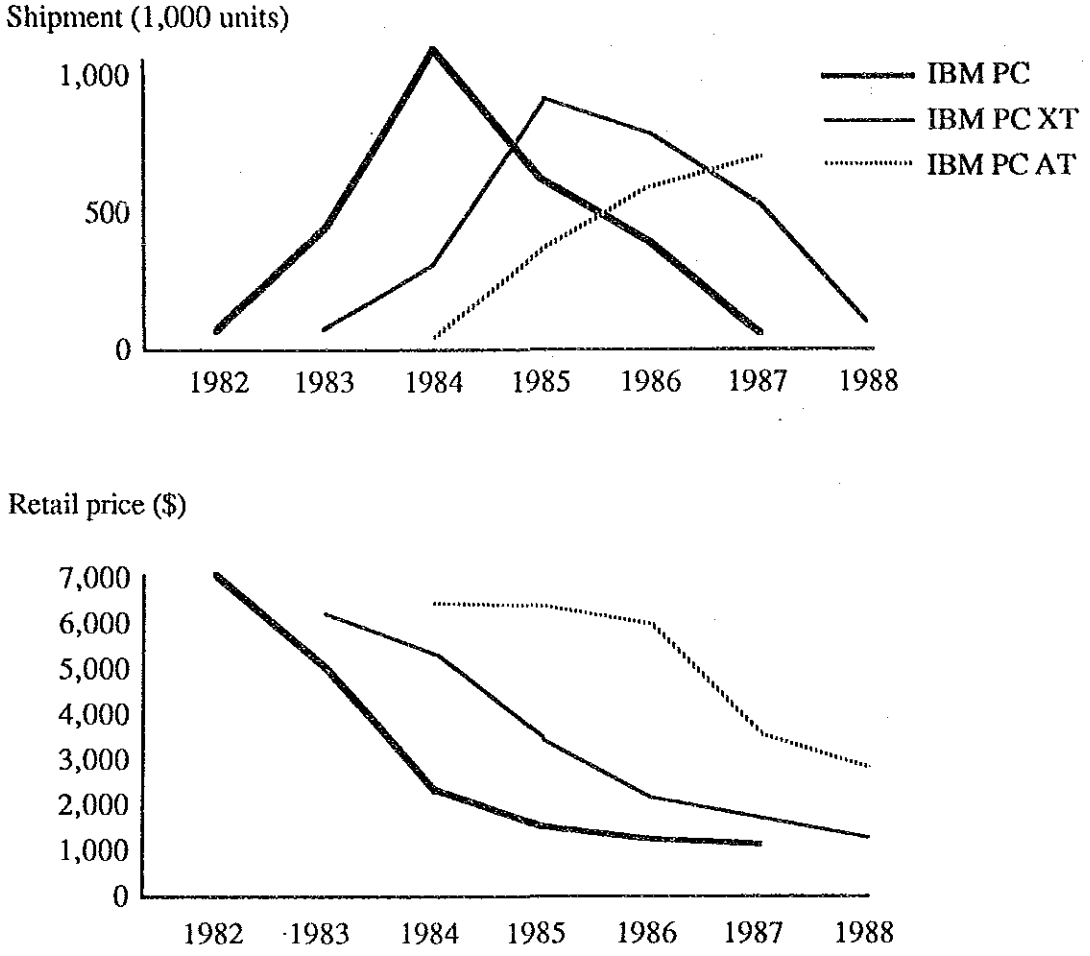
Fig. IV.5-9 Manufacturer Shares in the U.S. Market



Source: Data Quest

[3] Proliferation of the AT and compatible models began in 1986, and by 1987 they had achieved a market share equal to that of the XT and its clones. Sales of XT models began to flounder starting in 1985, with the share expected to drop to a mere 1.7% by 1993. The portion of the market garnered by the AT as well peaked in 1988 at 39.0% and is expected to shrink to 18.5% by 1993. Instead, the SX, whose sales took off in 1989, is expected to have a 30.4% share by 1993. The relationship between personal computer life cycles and prices is as shown in Fig. IV.5-10.

Fig. IV.5-10 Personal Computer Life Cycle and Pricing



Source: Data Quest

[4] The market share of laptops in the U.S. personal computer market remains small in comparison with the figure for Japan, but sales grew from 410,000 units in 1987 to 720,000 in 1988 and are expected to further increase to 1.8 million units by 1992. Manufacturer shares for 1987 were as follows: (1) Zenith (25%), (2) Toshiba (22%), and (3) Grid (11%).

[5] In the U.S. the highly developed market for personal and household use provides a large outlet for low-end machines. Computerland and other dealer franchises are well-established, and products from Taiwan and Korea can be sold through these dealers together with after-sales service, thereby eliminating the need for exporters to establish their own sales channels.

[Peripherals]

With the exception of printers (6.9 million units in 1987) there are no detailed figures available on the size of the U.S. market for peripherals. Keyboards are automatically counted as personal computer components, however, and monitors are usually sold one-per-computer, so the market is expected to be roughly the same size as the personal computer market itself.

Since it is impossible to determine the size of the import market from U.S. trade statistics, export statistics from the leading supplier countries/areas were summarized in Table IV.5-15. The U.S. market is a significant presence for all of the exporters.

Table IV.5-15 Exports of Computer-related Products to the U.S.

	Monitors	Printers	Keyboards and other products
Japan (1988)	¥89,560.26 million =US$698.87 million (58.5%)	¥240,885.57 million =US$1,879.74 million (58.1%)	¥15,854.97 million =US$123.72 million (46.6%)
Taiwan (1987)	— (56.7%)	NT$890,260,000 =US$31.24 million (63.1%)	NT$1,082,410,000 =US$37.98 million (24.0%)
Korea (1988)	US$468.24 million (58.2%)	US$2,841,454 (18.1%)	US$3,333,459 (26.5%)
Singapore (1988)	—	S$178,410,000 =US$88.66 million (50.7%)	—

Source: Compiled from respective trade statistics
Note: The figures in branket = Exports to the U.S./total exports

2) Domestic Production

Although Japan is gradually moving up, there is no doubt that the U.S. remains in terms of both technology and production value the world's leading computer producer.

In the late 1970s, soon after the birth of the personal computer market, Apple, Tandy, and Commodore were the dominant firms in the market, but in the 1980s IBM and other large corporations followed to make inroads. By 1983 IBM's overwhelming superiority had been established, and numerous producers of IBM "clones" appeared on the scene. During the mid-1980s an unprecedented slump overtook the industry and resulted in the streamlining of the industry. At present, there are approximately 20 main companies engaged in the production and sales of personal computers. The leading producers are listed in Table IV.5-16.

Table IV.5-16: Leading U.S. Computer Manufacturers

Classification	Company	Description
Main frame producers	IBM	• Adopted current name in 1924. Marketed first computer in 1948. Introduced third-generation series in the 1960s and has since been the world's leading computer manufacturer. • Entry into the personal computer market was delayed until 1981, but within three years had achieved the largest share of the U.S. market and become the industry standard. Established subsidiaries in leading markets across the world and maintains a large share in these markets. • Worldwide sales for 1988 totaled US$59,681 million.
	Unisys	• Formed in 1987 as a merger of Sperry and Burroughs undertaken in order to survive the computer slump of the mid-1980s. The third largest manufacturer after IBM and DEC. • In the personal computer field this firm contracts out OEM supply to Mitsubishi Electric (Japan), Multi-Tech (Taiwan), and Lucky Goldstar (Korea). • 1988 sales totaled US$9,902 million.
	Control Data Co. (CDC)	• Established in 1957 by former employees of Sperry. • Largest OEM supplier of peripherals. Withdrew from the supercomputer field in the mid-1980s computer slump. • 1988 sales totaled US$3,268 million.
	Bull H.N. Information Systems Inc.	• Established in 1955 as the computer division of Honeywell. Honeywell Bull was newly founded in 1986 through joint investment by Honeywell, Bull (France), and NEC (Japan), and the current name was adopted in 1988. • 1988 sales totaled US$2,200 million.
	NCR	• An office equipment manufacturer which entered the computer market in 1952. An IBM-compatible machine was marketed in 1987. • 1988 sales totaled 5,990 million.
	Amdahl Co.	• Established in 1970 by former employees of IBM. Fujitsu of Japan is the leading shareholder. • 1988 sales totaled US$1,801 million.
	Cray Research Inc.	• Established in 1976 by former employees of CDC. Specializes in supercomputers. • 1988 sales totaled US$756 million.

Classification	Company	Description
Mini-computer producers	Digital Equipment Co. (DEC)	• Established in 1957. IBM's main rival in the minicomputer field. Weakness in the personal computer sector has led it to establish technical tie-ups with numerous PC manufacturers, including Apple, Compaq, and Olivetti. • 1988 sales totaled US$11,475 million.
	Hewlett Packard Co. (HP)	• Established in 1939. The second-largest manufacturer of minicomputers after DEC, and the world's leading producer of measuring devices. In recent years, growth in sales of printers and disk drives has been remarkable. • 1988 sales totaled US$9,831 million.
	Data General Co.	• Established in 1968 by former employees of DEC. The third-largest manufacturer of minicomputers after DEC and HP. • 1988 sales totaled US$1,365 million.
	Prime Computer	• Established in 1972. Marketed an IBM-compatible machine in 1984. • 1988 sales totaled US$1,590 million.
	Wang Laboratories Inc.	• Marketed an IBM compatible in 1985 and a laptop model in 1986. • 1988 sales totaled US$3,068 million.
	Tandem Computers Inc.	• Established in 1974. • 1988 sales totaled US$1,315 million.
Personal computer producers	Apple Computer Inc.	• Established in 1977. The father of the personal computer, and IBM's greatest rival in this field. • 1988 sales totaled US$4,071 million.
	Compaq Computer Co.	• Established in 1982 and immediately marketed an IBM-compatible machine. Has grown rapidly since, with average annual growth in sales exceeding 50%. • 1988 sales totaled US$2,066 million.
	American Telephone & Telegraph Company (AT & T)	• Production of most computers and related products is licensed out to Olivetti (Italy). During the computer slump, in 1986, all computer development and production was shifted to this firm. • 1988 sales totaled US$35,210 million.
	Tandy Corporation	• Acquired Radio Jack, a leading computer dealer, in 1977 to begin personal computer sales. Began marketing IBM compatibles in 1984. Purchased Grid Systems, a leading producer of laptop computers, in 1988 and established a tie-up with DEC to obtain its own manufacturing division. • 1988 sales totaled US$3,795 million.

Source: Compild from "Computer Notes 1989"

(3) European Market

1) Domestic Market

(Personal Computers)

Table IV.5-17 shows shipments of personal computers in the major European countries. West Germany has the largest market, followed by England, France, and Italy, this order remaining unchanged for the past ten years. Markets in West Germany and the U.K. are roughly the same size as the Japanese market.

Table IV.5-17 Personal Computer Shipments in Europe

	1986		1987	
	Shipment (1,000 units)	Value (¥million)	Shipment (1,000 units)	Value (¥million)
U.K.	1,157	1,803	1,327	2,250
France	757	1,534	1,013	2,165
W.Germany	1,292	1,935	1,380	2,382
Italy	515	1,085	554	1,275
Other	1,358	2,829	1,705	3,696
Total	5,106	9,186	5,979	11,768

Source: IDC

U.S.-affiliate manufacturers dominate the European market, with Amstrad, Commodore and IBM each maintaining steady high shares on a volume base. In value terms, however, it is the business use-oriented IBM which is the largest supplier, its models and compatibles constituting the market standard.

Among the European manufacturers putting up a strong challenge are Olivetti of Italy and Nixdorf of West Germany.

Table IV.5-18 European Personal Computer Shipments by Company

1986			1987		
Company	(1,000 units)	Share (%)	Company	(1,000 units)	Share (%)
1.Amstrad	1,140	22.3	1.Amstrad	1,423	23.8
2.Commodore	1,111	21.8	2.Commodore	1,312	21.9
3.IBM	410	8.0	3.IBM	584	9.8
4.Olivetti	230	4.5	4.Atari	418	7.0
5.Apple	120	2.4	5.Olivetti	296	5.0
Other	2,095	41.0	Other	1,946	32.5
Total	5,106	100.0	Total	5,979	100.0

Source: IDC

2) Leading manufacturers

Europe, which lags noticeably behind in the high-tech industries, can boast few strong manufacturers of computers.

Table IV.5-19 provides a list of the leading European personal computer manufacturers. The January 1990 merger of the computer division of Siemens, the largest in West Germany, and Nixdorf, the second largest, resulted in the birth of Europe's largest computer manufacturer, Siemens Nixdorf Information Systems.

The activities of European computer manufacturers have until now been limited by national boundaries, and these firms have developed their operations around local markets. Consequently, there was a great gap in corporate scale with the U.S.-affiliate companies, which had the enormous U.S. market to rely on. The newly-established Siemens Nixdorf Information Systems, however, will boast annual sales of ¥1 trillion and a payroll of 50,000 employees, putting it on an equal footing with leading U.S. manufacturers such as Unisys and DEC.

Table IV.5-19 Leading European Computer Manufacturer

Nationality	Company	Description
U.K.	ICL (ICL Public Limited Co.)	• Established in 1968 via the government-initiated merger of ICT and EE. Nationally-owned for a time. Deals in a wide variety of products ranging from mainframes to personal computers. • Purchased by a subsidiary of ITT (U.S.) in 1984. • 1988 sales totaled £23.6 million.
	Plessy	• Leading manufacturer of communications and electronics equipment. Also a major force in the field of semi-custom ICs.
	Apricot	• One of the three leading personal computer manufacturers in England. • Acquired by Mitsubishi Electric in April 1990.
France	Group Bull	• Originally a French firm but was under the control of GE (U.S.) for a time. Was merged into the national company CII in 1976. Group Bull was formed in 1983 from CII-HB, Bull Micral, and two other firms. • 1988 sales throughout the group totaled FFr31,500 million.
W. Germany	Siemens	• West Germany's largest general electrical equipment manufacturer. • Purchased Nixdorf, the country's second-largest computer producer, in 1990 in a move to strengthen its personal computer division. With this move Siemens is expected to become Europe's largest manufacturer of personal computers. • 1988 sales totaled DM59,374 million.
Italy	Olivetti	• Established in 1930 as an office equipment manufacturer. Moved into the mainframe computer field in a tie-up with Bull (France) in 1960. Withdrew from this field in 1968, but is second in Europe only to Siemens in the field of information processing equipment. • 1987 sales throughout the group totalled Lit7,375.5 billion.
Netherlands	Philipps	• A general electrical equipment manufacturer that entered the computer field in 1962. Began personal computer production in 1979. • 1988 sales totaled 13,816 million guilders.
Spain	Secoinsa	• Established in 1975 by joint investment from the National Institute of Industry of the Spanish Ministry of Industry, the Telephonica, and Fujitsu (Japan) for the production of micro- and minicomputers. Acquired by Fujitsu Espania in 1986.

Source: Compild from "Computer Notes 1989"