I-3-2. Analysis of the Financial Feasibility for the Start of Domestic Production of Investment Castings

(1) Outline of the Model Plant

There are presently no investment casting factory making the industrial use products or their parts in Malaysia, so it is not possible to compare the manufacturing cost of investment casting products in Malaysia with those in other countries, and to evaluate the price competitiveness of Malaysian products. As an alternative measure, the establishment of a model investment casting plant in Malaysia was posed, and its financial viability was investigated. The outline of the model investment casting plant posed was as follows:

Outline of the Model Investment Casting Plant

Total Land Area	:	5,000m^2
Total Building Area	:	2,400m^2
Total Initial Investment Costs	:	Apprx..M$6.5 million
Number of Employee	:	38
Production Item	:	18-8 Stainless steel valves
		18-8 Iron golf club heads
Production volume	:	Valves 8,500pcs./month
		Club heads 8,500pcs./month

The major assumptions used for the evaluation were as follows:

Basic Assumptions for the Project Evaluation

Project Life	:	15 years
Construction Periods	:	1 year
Prices	:	At November, 1989 constant prices
Investment Incentives	:	1) Exemption from import taxes on imported equipment and materials
		2) The exemption of corporation tax of 5 years based on Pioneer Status (PIO) or the use of Investment Tax Allowance (ITS:50%)
Exchange Rates	:	M$1.00=¥53, US$1.00=M$2.70

(2) Production Item and Production Capacity

1) Production Item

With the application of investment casting methods, the manufacturing of the following types of various kinds of products would become possible:

a) Machinery parts of high precision and complex shapes such as parts for sawing machines;

b) Machinery parts the finishing work of which by machining is difficult due to the complexity in shapes and hardness in materials, such as stainless steel machine parts;

c) Various kinds of engineering parts of high precision and surface finishing making use of abrasion-resistant alloys; and

d) High precision engineering parts of heat-resistant alloys, such as aeroplane parts, the melting and pouring of which have to be made in vacuum atmosphere.

From the lack of sufficient volume of domestic demand for the above products and the lack of accumulated experience of investment casting, the production of the following items which are mainly for the export market were tentatively assumed:

[1] 18-8 stainless steel valve for chemical plants

[2] 18-8 stainless steel golf club heads

The major reasons of the selection of the above production items were (1) the demand volume for a model is large in the overseas market, and (2) the skill requirement is relatively low and the training of workers at its initial production stage would be easy.

With the progress of the accumulation of production technology in investment casting and the growth in domestic demands for high precision machinery and engineering parts in Malaysia, the production items of the assumed investment casting plant are expected to diversify. For the convenience of the financial projection, the project evaluation was conducted based on the assumption that the production items would not be changed during the project period.

2) Production Capacity

The maximum production capacity of the model plant would be defined by the capacity of the melting furnace installed. In the model plant, the installment of a furnace of melting capacity of 500 kg/day was assumed. Thus, the maximum melting capacity of the model factory would be 11,000 kg/month (22 working days per month). From this melting volume, the actual production volume of the model plant per month would be 8,500 pieces of stainless steel valves and 8,500 pieces of golf club heads. The details of the estimation is shown in Table I.3-13.

Table I.3-13 Estimation of the production Capacity of the Model Plant

	Production/month
Melting volume	11,000kg
	(500 kg/day)
Product weight	5,000kg
(Stainless steel valve)	(2,000kg)
(Golf club heads)	(3,000kg)
Production in pieces	20,000pcs.
(Stainless steel valve)	(10,000pcs.)
(Golf club heads)	(10,000pcs)
Yield ratio	85%
Actual production in pieces	17,000pcs.
(Stainless steel valve)	(8,500pcs.)
(Golf club heads)	(8,500pcs.)
Number of moulds	1,459pcs.
(Stainless steel valve-16pcs./mould)	(624 pcs.)
(Golf club heads-12pcs./moulds)	(834 pcs.)

(3) Initial Investment

1) Total Initial Investment Costs

Based on the following assumptions, the initial investment costs of the assumed model plant were calculated:

a) As the site of the model plant, the Shah Alam Industrial Estate in the State of Selangor was assumed. This selection is only for the convenience of cost estimation, and is not based on the precise site selection study;

b) The production and office building is a concrete steel building with air conditioning facilities; and

c) Major production facilities would be mostly imported from Japan, and the sea transportation costs from the port of Japan to Port Kelang were added to the procurement costs.

The details of the calculation of the initial investment costs are shown in Table I.3-14, which are briefly summarized as follows:

a) Land Costs	M$ 672,750
b) Building Construction Costs	M$3,030,000
c) Machinery & Equipment Costs	M$2,046,792
d) Vehicles & Stationery	M$120,000
e) Contingency (a+b+c+d)x 10%	M$586,954
Total	*M$6,456,496*

Table I.3-14 Estimation of Initial Investment Costs

(Unit: M$)

Item			Investment Costs
a) Land	5,000m²	M$134.55/m²	M$672,750
b) Building Construction			M$3,030,000
Factory and Office Buildings 2,400m², M$850.00/m²			M$2,040,000
Auxiliary Facilities (Air conditioners, Underground pond)			M$960,000
Exteriors and gurantee for water supply, etc.			M$30,000
c) Machinery and Equipment			M$2,046,792
Imported Machinery (FOB)			M$1,574,092
Transportation and Installment			M$277,700
Machinery and Equipment locally procured			M$195,000
d) Vehicles & Stationery			M$120,000
One Truck			M$100,000
Necessary set of stationary			M$20,000
e) Contingency (a)+b)+c)+d)) x 10%			M$586,954
Total Initial Investment Costs			M$6,456,496

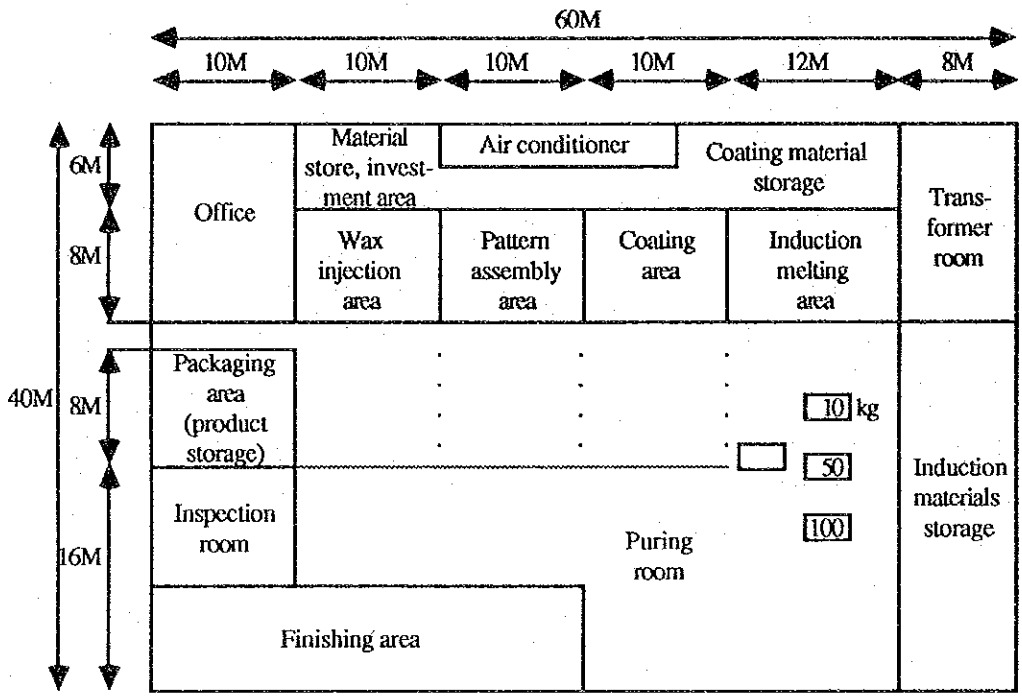
Depreciating Costs

1) Building	;	20 years straightline	M$102,000
2) Auxiliary facilities	;	10 years straightline	M$96,000
3) Machinery/equipment	;	10 years straightline	M$204,679
4) Vehicles/stationary	;	5 years straightline	M$24,000
Total Annual Depreciation Costs			M$426,679

2) Land and Building

The layout of the model investment casting plant is shown in Fig. I.3-1. The total size of the building required would be 2,400 m², and the total land area to be needed would be about 5,000 m².

Fig. I.3-1 Layout of a Supposed Investment Casting Plant



3) Machinery and Equipment

The major machinery and equipment to be installed in the model plant are listed in Table I.3-15. In order to secure the high quality control, most of the machinery and equipment are assumed to be procured in Japan. In practice, however, some items of these could be procured domestically in Malaysia.

4) Depreciation

The depreciation methods assumed were as follows;

Buildings	:	20 year straightline depreciation
Auxiliary facilities	:	10 year straightline depreciation
Production facilities	:	10 year straightline depreciation
Vehicles & stationery	:	5 year straightline depreciation

Table I.3-15 List of Major Machinery and Equipment

(Unit : M$1,000)

	Item	Capacity	Number (set)	Procurement Cost
(1)	Wax Moulding Section			
	Injection Machine	5 tons	2 sets	188.68
	Wax melting pot	20 litre	1 set	11.89
	Wax Holding Tank	6 cartridges	1 set	12.26
(2)	Coating Section			
	Slurry Mixer	@600 x 600h	2 sets	113.21
	Fluidized Bed	@600 x 850h	3 sets	70.75
	Dust Collector	-	3 sets	35.66
	Dewaxing Unit		1 set	169.81
	1) Autoclave furnace	10kg/cm^2		
	2) Boiler	kg/cm^2		
	3) Steam tank	1,800 little		
	4) Water softener	0.75m^2/h		
	5) Water tank			
(3)	Melting Section			
	Shell Firing furnace	1,000°c	1 set	231.13
	Induction Melting Furnace	100 kg	1 set	660.38
(4)	Finishing Section			
	Sand Blast		1 set	117.92
	Shot Blast		1 set	188.68
	Cutting Machine		1 set	141.51
(5)	Inspection Section			
	X-ray inspection set		1 set	104.91
	1) X-ray generator	(Power 160-260Kv)		
	2) Automatic developing equipment			
	Total Machinery and Equipment Costs			2,046.79

(4) Raw Materials and Utilities

1) Raw Materials

The raw materials required for producing the planned volume of stainless steel valves and golf club heads are shown in Table I.3-16. rod stainless steel bars and most of other raw materials would be imported. Although some of the materials such as zircon sand or silica sand are available in Malaysia, their quality levels are still insufficient due to the lack of processing capability in Malaysia, and the imported materials would be used at the initial stage of the production.

2) Utilities

The utilities to be consumed for the production of planned volume of products are shown in Table I.3-17. A set of electric furnace would be installed, and those production facilities as wax injection machines, slurry mixer or autoclave furnace are all dependent on electricity. Thus, the electric power is the major utilities required in the proposed model plant. Those facilities as shell firing furnace or boiler use heavy oils.

Table I.3-16 Costs of Major Raw Materials

(Unit : M$)

Item		Monthly Consumption	Unit cost	Monthly Costs
(1)	Main Materials			46,392
	18-8 Stainless Steel Rods			
	ø50-80 x L300-350	5,800kg	@M$7.92/kg	45,936
	Ferrosilicon	40kg	@M$3.20/kg	128
	Ferromangan	25kg	@M$4.60/kg	115
	Calcium-silicon	25kg	@M$8.50/kg	213
(2)	Sub Raw Materials			43,848
1)	Wax Moulding Materials		8,820	
	Moulding Wax	500kg		
	Remover	50 bottles x 500cc		
	Correction Wax	-		
	Others	-		
2)	Coating Materials	16,407		
	Zirconium Sand	350kg		
	Zirconium Flour	500kg		
	Fused Quartz	1,500kg		
	Colloidal Silica	1,400kg		
	Others	-		
3)	Furnace Maintenance materials			8,433
	Coil Cement	10kg		
	Magnesium tamp	50kg		
Material for Ladle		250kg		
Mica	2 pieces			
	Others	-		
4)	Finishing Materials			10,188
	Grindstone	50 pieces		
	Whetstone for grinder	2 pieces		
	Abrasive for sand blasting	500kg		
	Steel Shot	30kg		
	Others	-		
Total Major Raw Materials Costs				90,240

Table I.3-17 Costs of Major Utilities

(Unit:M$)

Item	Consumption/month	Unit cost	Annual costs
Electric power	65,400 kwh	M$0.18/kwh	11,772
Water	500 m^3	0.88/m^3	440
Total	-	-	12,212

(5) Production and Sales

1) Production

The production capacity of the proposed model plant is planned to be 10,000 pieces of stainless steel valves and 10,000 pieces of golf club heads per month in total production and their defect ratio are both about 15%. Due to the lack of accumulated technology in investment casting, however, this maximum production volume is assumed to be achieved at the third year of operation, and the production volume in the initial year was posed at 80%, and that in the second year, at 90% of the maximum production capacity. The flow of the production volume at the model plant is shown in Table I.3-18.

Table I.3-18 Flow of Production Volume at the Model Casting Plant

(Unit: piece)

Item	1st year	2nd year	3rd year
Total Production Capacity			
Stainless steel valves	10,000	10,000	10,000
Golf club heads	10,000	10,000	10,000
Production Capacity of Salable Products			
Stainless steel valves	8,500	8,500	8,500
Golf club heads	8,500	8,500	8,500
Operating Ratio	80%	90%	100%
Actual Sales Volume			
Stainless steel valves	6,800	7,650	8,500
Golf club heads	6,800	7,650	8,500

2) Unit Sales Prices

Unit sales prices of the products are a very influential factor in judging the feasibility of a project. The major countries that manufacture and export stainless steel valves and golf club heads at present are those Asian NIES as Taiwan and Korea. Thus, the products of the proposed plant would have to have enough price competitiveness with those of NIES.

The major importing countries of these products are Japan, the U.S. or Asian NIES. However, there are no published reliable data on the international prices of these products due to the fact that most of these products are manufactured based on each contract basis. From the results of the field interview survey in Japan with user companies, the average import prices of these products from NIES were obtained, and the following ex-factory prices of the products from the proposed plant were assumed:

18-8 Stainless steel valves (net weight of 200g) : M$11.32/piece
18-8 Stainless steel golf heads (net weight of 300g) : M$16.98/piece

3) Sales Forecast

Sales forecast was made taking into consideration the projected production volume and unit sales prices. The flow of sales forecast is shown in Table II.4-19.

Table I.3-19 Sales Forecast of the Proposed Plant

(Unit: M$1,000)

Item	1st year	2nd year	3rd year and after
Stainless steel valves	924	1,039	1,155
Golf club heads	1,386	1,559	1,732
Total Sales	2,310	2,598	2,887

(6) Personnel Costs

According to each job category, the number of personnel necessary for the operation of the proposed plant was investigated. Because most of the sales are projected to be directed for export market under sub-contract basis, the number of sales and other general administration staff was set to a minimum size. Average personnel costs in each job category are assumed based on the result of field interviews and various kinds of statistical data. In the calculation of an average unit cost of personnel, not only the basic salary but also various fringe benefits and bonuses were included.

The personnel costs thus calculated is shown in Table I.3-20.

(7) Fund Recruitment

As for the initial investment costs necessary for the start of the proposed project, M$3.25 million which cover around a half of the total costs were assumed to be procured from paid-up capital and another M$3.25 million from a long-term borrowing. The short-term borrowings would be used in order to cover the lack of working capitals.

Fund Recruitment Programme

Paid-up capital	.....	M$3.25 million
Long-term borrowing	.....	M$3.25 million
Short-term borrowing	.....	Working capital

The terms of borrowings were assumed as follows:

Long-term borrowing;		
Principal repayment	.....	10 years of equal repayment
Interest payment	.....	9.0% per annum
Short-term borrowing;		
Principal repayment	.....	Within 1 year repayment
Interest payment	.....	9.0% per annum

Table I.3-20 Monthly Personnel Expenses

(Unit:M$)

	Job Category	No. of Personnel	Average Wage	Monthly Costs
(1)	Manufacturing Section			
	Factory Manager	1	2,800	2,800
	Engineer (Foreign) 1)	1	9,500	9,500
	Engineer	1	1,500	1,500
	Technician	2	1,000	2,00
	Foreman	1	750	750
	Skilled Worker	20	600	12,000
	Semi-skilled Worker	6	350	2,100
	Sub-total	32	-	30,650
(2)	Sales & General Administration Section			
	General manager (Foreign)	1	13,200	13,200
	Administration Manager	1	2,000	2,000
	Clerical worker	2	1,500	2,000
	Typist	1	600	600
	Driver	1	600	600
	Sub-total	6	-	19,400
	Total	38	-	50,050

1) costs for foreign engineer would be needed at initial 3 years

(8) Projection of Long-term Profit and Loss

Projection of long-term profit and loss flow of the proposed project was made based on the estimated flow of sales and other various kinds of costs made in the previous sections. For those cost items that were not calculated separately, a 2.0% of the total sales value was measured as other manufacturing costs, and another 2.0% as other general sales and administration costs, based on the experience of Japanese companies manufacturing investment casting products. The results of long-term profit and loss projection are shown in Table I.3-21.

Further, the long-term cash flow projection is shown in Table I.3-22. The fund procurement conditions are as has been assumed in the financing plan. From the cash flow table, the annual interest payment costs are calculated for each year, which is feedback to Table I.3-22 as non-operating expenditure.

(9) Evaluation of the Results of the Feasibility Study

Based on the results of long-term profit and loss projection, the financial internal rate of return (FIRR) has been calculated. FIRR is the discount rate at which the accumulated net present value of both investment and return would balance, the details of which calculation are shown in Table I.3-22.

The FIRR of the proposed project was calculated at 8.2%, the loan repayment period at 6 years after starting operation, and the investment payback period at 9 years after starting operation. The results would be judged to be more or less a satisfactory level as an investment project of this type of an industry.

For reference, the project (at the 3rd year's operation) was compared with the operation of a Singapore company (X Company) which is manufacturing various kinds of investment casting parts for aeroplane and other engineering components markets, the results of which are as follows:

Item		X Co. (Singapore)	Proposed Project
Land Area	:	4,200 m	5,000m
Building Area	:	2,800m^2	2,400m^2
Paid-up capital	:	S$4.5 million	M$3.25 million
Production Items	:	Aeroplane parts Other engineering components	Stainless steel valves Golf club heads
Annual Sales	:	S$6.0 million	M$2.9 million
No. of Employees	:	95	38
Cost Structure	:		
Total Sales		100.0	100.0
Raw Material Costs		30.0	37.5
Personnel Costs		35.0	20.1
Other Costs		20.0	25.6
Gross Profit		15.0	16.8

X Company in Singapore is reported to expect the increase of annual sales for coming 3 years as 15% and that of gross profit as 15-20%. Judging from their experience, the proposed project is considered to have a high potential to future growth by diversifying its production items to high precision engineering parts.

Table I.3-21 Investment Casting Plant Projection of Long-Term Profit and Loss Flow

(Unit: M$1,000)

	1st year (%)	2nd year (%)	3rd year (%)	4th year (%)	5th year (%)	6th year (%)	7th year (%)
Annual Sales	2,310	2,598	2,887	2,887	2,887	2,887	2,887
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)
Manufacturing	1,877	1,995	2,112	1,998	1,998	1,998	1,998
Costs	(81.3)	(76.8)	(73.2)	(69.2)	(69.2)	(69.2)	(69.2)
Materials	866	975	1,083	1,083	1,083	1,083	1,083
Utilities	147	147	147	147	147	147	147
Depreciation	427	427	427	427	427	427	427
Labour	368	368	368	254	254	254	254
Others	69	78	87	87	87	87	87
Sales & General	279	285	291	291	291	291	291
Administration	(12.1)	(11.0)	(10.1)	(10.1)	(10.1)	(10.1)	(10.1)
Labour	233	233	233	233	233	233	233
Others	46	52	58	58	58	58	58
Operating Profit	154	318	484	598	598	598	598
	(6.7)	(12.2)	(16.8)	(20.7)	(20.7)	(20.7)	(20.7)
Non-operating	304	277	228	182	151	68	0
Expenditure	(13.2)	(10.7)	(7.9)	(6.3)	(5.2)	(2.4)	(0)
Net Profit	-150	41	256	416	447	530	598
	(-6.5)	(1.6)	(8.9)	(14.4)	(15.5)	(18.4)	(20.7)

Table I.3-22. Investment Casting Plant Cash Flow Projection

(Unit: M$1,000)

		Before operation	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year	9th year	10th year
Carry-over from previous year		0	86	85	39	8	269	771	1,184	746	1,771	2,796
Capital payment		3,250	0	0	0	0	0	0	0	0	0	0
Operating balance	Sales revenue	0	2,310	2,598	2,887	2,887	2,887	2,887	2,887	2,887	2,887	2,887
	Cost of products	0	1,877	1,995	2,112	1,998	1,998	1,998	1,998	1,998	1,998	1,998
	Administration	0	279	285	291	291	291	291	291	291	291	291
	Balance	0	154	318	484	598	598	598	598	598	598	598
Working capital balance	Working capital	0	0	193	217	241	241	241	241	241	241	241
	Working capital for this year	0	193	217	241	241	241	241	241	241	241	241
	Balance	0	-193	-24	-24	0	0	0	0	0	0	0
Investment balance	Depreciation	0	427	427	427	427	427	427	427	427	427	427
	Investment	6,456	0	0	0	0	0	120	0	0	0	0
	Balance	-6,456	427	427	427	427	427	307	427	427	427	427
Financing balance	Long-term borrowing	3,250	0	0	0	0	0	0	0	0	0	0
	Principal	0	350	350	350	350	350	1,500	0	0	0	0
	Interest	146	277	245	214	182	151	68	63	0	0	0
	(Amount borrowed)	3,250	2,900	2,550	2,200	1,850	1,500	0	0	0	0	0
	Balance	3,104	-627	-595	-564	-532	-501	-1,568	0	0	0	0
	Short-term borrowing	200	400	300	0	0	0	0	0	0	0	0
	Principal	0	200	400	300	0	0	0	0	0	0	0
	Interest	9	27	32	14	0	0	0	0	0	0	0
	(Amount borrowed)	200	400	300	0	0	0	0	0	0	0	0
	Balance	191	173	-132	-314	0	0	0	0	0	0	0
	Balance	3,295	-454	-727	-877	-532	-501	-1,568	0	0	0	0
Corporation tax		0	0	0	0	0	0	0	0	0	37	209
Total balance		89	-65	-6	10	493	524	-663	1,025	1,025	988	816
Carry-over for next year		89	24	18	27	520	1,044	382	1,407	2,432	3,420	4,236

Table I.3-23 Investment Casting Plant Cash-Flow for FIRR Calculation

(Unit: M$1,000)

	Cash Outflow		Cash Inflow		Net
	Physical Investment	Working Capital	Operating Revenue	Depreciation	Cash Flow
0	-6,456				-6,456
1		-193	154	427	388
2		-24	318	427	721
3		-24	484	427	887
4			598	427	1,025
5			598	427	1,025
6	-120		598	427	905
7			598	427	1,025
8			598	427	1,025
9			561 2)	427	988
10	+1,693 1)		389 3)	427	2,509

1) Residual Value: Land (673) + Buildings (1,020)

2) After reducing corporate tax (37)

3) After reducting corporate tax (209)

Financial Internal Rate of Return (FIRR) = 8.2%

(10) Sensitivity Analysis

In order to examine the financial stability of the assumed investment casting plant operation project, the senstivity test has been conducted for the following six alternative plans.

Outline of the Alternative Plans

Alternative Plan I	:	Unit Product Sales Prices	5% Up
Alternative Plan II	:	"	5% Down
Alternative Plan III	:	Initial Investment Cost	10% Down
Alternative Plan IV	:	"	10% Up
Alternative Plan V	:	Parts & Material Costs	5% Down
Alternative Plan VI	:	"	5% Up

For each of the alternative plans, the long-term profit and loss projection and cashflow projection have been made and FIRR has been calculated. The results of the analysis are briefly summarized as follows.

Summary of the Sensitivity Test

Original and Alternative Plans	FIRR	Loan Repayment Period (After Operation)	Investment Payback Period (After Operation)
Original Plan	8.2%	6 Years	9 Years
Alternative Plan I	10.0%	5 Years	8 Years
Alternative Plan II	5.9%	7 Years	10 Years
Alternative Plan III	9.9%	5 Years	8 Years
Alternative Plan IV	6.8%	7 Years	10 Years
Alternative Plan V	9.5%	5 Years	9 Years
Alternative Plan VI	6.3%	7 Years	10 Years

The results of sensitivity tests reveal that the factor that has the largest impact on the project profitability is the change of unit sales prices of the manufactured products. In case that the average unit sales prices increases 5%, the FIRR of the project would increase to 10.0% from 8.2% under the original assumption.

The decrease of the initial investment costs of the project or the parts and material costs would also give favourable effects on the projects. The decrease of initial investment costs by 10% would raise the FIRR of the project to 9.9%, and that in parts and material costs by 5% would also raise the FIRR to 9.5%.

II. Computers and Computer Peripherals

II. Computers and Computer Peripherals

II-1. Overview of the Industry

II-1-1. The Domestic Market

According to the Association of the Computer Industry Malaysia (PIKOM), the size of the computer market in Malaysia for the years 1984 through 1989 is estimated as follows:

1984	M$ 480 million
1985	M$ 570 million
1986	M$ 490 million
1987	M$ 560 million
1988	M$ 650 million
1989	M$ 880 million (estimate)

While recorded a drop by 14.0% in 1986 as a result of the recession of the Malaysian economy, the demand for computers in Malaysia has been increasing significantly since 1987

A breakdown of the domestic market in 1989 estimated by PIKOM is as follows:

	Share (%)	Value (M$million)
Main frame, mini computers	38	335
Peripherals	16	140
Personal computers	15	132
Software	12	106
Maintenance & communication costs	15	132
Bureau services	4	35
Total	100	880

The computer market in Japan was worth roughly M$100 billion in 1989. Malaysia's computer market is approximately one-hundredth of the Japanese market which considering the fact that Malaysia's population is one-seventh of that of Japan and also that per capita GDP is one-fourteenth of that of Japan, the size of the market in Malaysia is not inappropriate. The smallness of the market has been a significant factor in preventing the domestic personal computer industry from taking off.

An overview of the markets for the 4 items covered by this survey is provided below:

(1) Personal Computer Market

— Market Size

Personal computers were first brought in one the Malaysian market around 1978-1979. Annual demand for personal computers increased from 11,000 units in 1984 to 18,000 units in 1985 and to 22,000 units in 1986 and the average growth rate was more than 60% per annum during this period. It is estimated that the market size for 1988 was somewhere between 30,000 and 33,000 units. Because a unit price of a single system is low, the market is not as large in terms of value as it is in terms of the number of units sold. When taking into consideration the fact that the Malaysian market is still at the introduction stage, that communications networks are well developed, and that per capita income is relatively high, the industry regards the Malaysian market as one with considerable potential for future growth. Because of favorable recent economic conditions, the domestic personal computer market is expected to expand by 20-30% over the coming several years.

Comparing markets by region, the largest market is formed around Kuala Lumpur area. 30-40% of the total market concentrated in Kuala Lumpur and Petaling Jaya.

— Structure of the Market

IBM personal computers and IBM compatibles hold a significant portion of the market in Malaysia, so much so that IBM machines have become the standard type of personal computer. As a result, it has become common to use classifications such as XT and AT when referring to personal computer models. As for market share by type of machine, low grade machines, XTs, comprised 85% of the market in and around 1985. ATs has increased considerable since then. Today both the XT and AT each hold about 40% of the market share. In addition the market for SXs has also grown over the past few years. However, because the functions of XT are sufficient for personal use and also because a set (excludes a printer)made in Taiwan can be purchased for as low as M$2,000, XTs maintains a very firm market share.

Because there is no dominant local personal computer makers, major brands in the world market have entered the Malaysian market. Major brands classified according to country or region is shown below:

USA:	IBM, Hewlett Packard, Wise, Compaq, Apple, Tandy
Europe:	ICL, Olivetti, Phillips, Amstrad
Japan:	NEC, Epson, Sharp Toshiba
Asia (except Japan):	Pineapple, Bondwell, Acer, Wearnes (ALR)

There are also a number of local brands of personal computers besides personal computers made by the large overseas makers as listed above. Personal computers of American and European companies, such as IBM and Olivetti, comprise the larger share among large companies and the public sector, which are also users of main frames and mini-computers, while medium and small-scale enterprises and personal users buy machines made in Taiwan and Singapore as well as those assembled in Malaysia. Locally assembled personal computers can be divided into two categories:

i) Those made by large manufacturers which sell personal computers under their own brand and provide maintenance and after-sales services; and

ii) Those assembled by "non-brand" makers who are mostly computer dealers and assemble personal computers on a small scale to sell them at their retail outlets using kit sets imported from Taiwan.

The latter compete with low-end products imported from Taiwan and Singapore. However, even though non-brand makers keep assembling cost low, their profit rests small as far as all components are imported.

Users can be divided into four main groups:

(a) businesses;

(b) government offices;

(c) educational institutions; and

(d) private individuals

Businesses comprise by far the largest group of users. The financial sector accounts for the greater part of this group. Businesses are followed by private individuals. Users of this group are expanding. Personal computers are spreading among managers of companies. But the situation in Malaysia has not yet reached the stage where university students have their own personal computer as is common in advanced countries because the price of personal computer are still rather expensive for them. Instead, computer clubs organized in schools offer students in Malaysia the opportunity to come into contact with computers.

The structure of the market may be summarised as follows:

Segment	Characteristics
High grade personal computers (20% of total market share)	These are high grade machines which are linked to host computers. Direct selling by makers is usual. Although they are expensive, they come with after-sales services such as maintenance, etc. IBM, Hewlett Packard and Olivetti are major brands in this category.
Medium grade personal computers (40%)	These are mainly imported products, and are sold only by dealers. Brands belonging to this group include NEC, Epson, and other Asian brands such as Acer and ALR.
Popular personal computers (40%)	This category includes personal computers made in Taiwan and Singapore as well as personal computers which are assembled locally. Active promotion activities are not taken for the brand penetration among users. Their positioning is close to private brand products.

(2) Printer Market

The size of the printer market in volume is estimated to be four-fifths of personal computers. Sales of printers in 1989 is estimated at roughly 24,000 units. The smaller number of printers compared to personal computers can be attributed to the fact that most new users buy only personal computers at first. Looking at the proportions of 9 pin and 24 pin printers, the increase in the percentage of high grade 24 pin printers shows that Malaysia is following the worldwide trend away from 9 pin to 24 pin printers. At present, in the Malaysian market, 9 pin and 24 pin printers hold comparable shares, with a very small share held by laser printers.

There are about 10 or so Japanese brands, which dominate the market. These include companies such as Epson, NEC, Star, Seiko, and Oki Electronics. There are still very few Asian manufacturers involved in the manufacture of printers, with Japanese manufacturers holding a large share of all the printer markets around the world. As the trends of overseas production of Japanese companies, there are a few companies which start production of printers in Southeast Asia. Their overseas productions seem concentrated in Europe as the result of anti-dumping actions take against Japanese printers.

(3) Monitor Market

Taiwanese and Korean Manufacturers maintain a tight hold on the larger part of the domestic monitor market. Among them two Taiwanese manufacturers (ADI and TVM) and one Korean manufacturer (Samsung) account for a significant share of the market. Monochrome monitors account for 80% of the total market. Most colour monitors are CGA monitors with low resolution, and at the present stage price takes priority over performance. It is not unusual that users buy a monitor of which brand is different from a personal computer.

There is already one Japanese manufacturer which has commenced the production of monitors in Malaysia. They put a part of their products on the domestic market on a very limited scale.

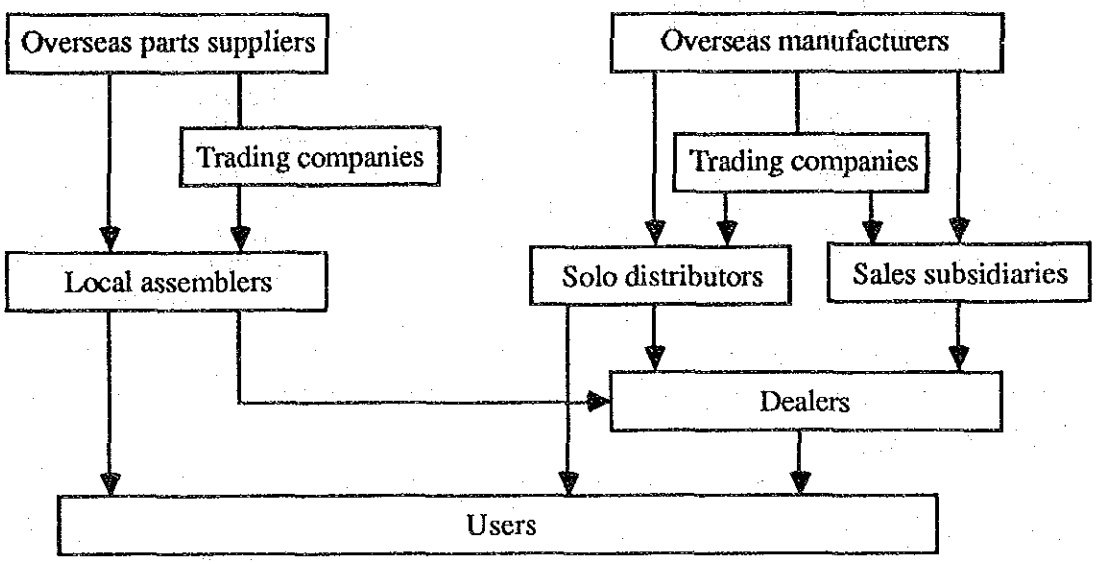
(4) keyboard Market

It is normal practice that a personal computer is traded, being equipped with a keyboard. With the exception of special products, keyboards are not sold separately. Keyboard manufacturers sell nearly all keyboards to personal computer makers. The country of origin of keyboards sold on the Malaysian market is not know. All keyboards which are produced domestically are exported.

(5) Distribution Channels

In regard to sales channels manufacturers can be divided into those which sell their products through subsidiary sales companies and those which use sole distributors Most of the foreign affiliates tend to use distributors to sell their products. But, manufacturers such as Olivetti, Hewlett Packard and NEC sell their products to dealers either directly or through their subsidiary sales companies. IBM looks after its direct sales and at the same time it uses Mesinjaga as its distributor for sales which are carried out through dealers. General sales channel in Malaysia is as shown in Fig. II.1-1.

Fig. II.1-1 Distribution Channel for P/Cs and Peripherals



In the case of personal computer assembled locally it is common for vendors which carry out the assembly of products to sell through their own affiliated dealers.

There are some 450 companies in Malaysia which sell personal computers. As this number also includes dealers which have more than one sales outlet, it is estimated that there are between 600 and 700 computer sales outlets in the country. One distinguishing feature of Malaysian dealers is that it is common to deal with a number of different brands and to change over to other brands. They are all too ready to change over to a brand with an only slightly higher margin than that of handling brands, and to sell with a low margin of between 10-15%. As a result, market prices tend to drop.

Printer and monitor dealer are almost the same as personal computer dealers. But distributors play a bigger role in the distribution of such peripherals. In some cases there is a two-tiered structure where goods are passed from one distributor to another distributor and then to a dealer. Because of this structure it is difficult for the manufacturer to retain control over the sales channels as well as price.

II-I-2. Trends in Production and Exports

(1) Production Trends

Based on MIDA's list of electronics companies in production for June 1989, there are 22 companies engaged in the manufacture of computer-related products, including parts, in Malaysia.

Eight of these manufacturers are engaged in the assembly of personal computers, but among them, one manufacturer has already stopped producing personal computers. In addition, there are two companies producing keyboards, and two producing monitors.

Estimates of the domestic production of these three products personal computers, keyboards, monitors according to the information provided by these companies, are shown below. (Further information on each individual manufacturer will be provided later.) However, as for personal computer, the figure should not be taken as an accurate reflection of the true situation because each manufacturers output fluctuates from month to month and also because there exists a production of personal computers by assemblers which do not hold a manufacturing licence.

Personal computers:	Approx. 10,000 units
Keyboards:	Approx. 2.6-3.0 million units
Monitors:	Approx. 240,000 units

(2) Export Trends

Trade statistics show that the export of computer-related products (SITC 75220, 75230, 75250) has increased at an annual average rate of 43.7% over the period from 1985 through 1987. Total exports of these items have grown from M$3.83 million in 1985 to M$3.92 million in 1986, M$11.38 million in 1987. In terms of value, peripherals comprise the largest export item. Singapore is the largest importer of Malaysian computer-related products. Because many companies manufacturing in Malaysia possess sales offices in Singapore which import products from Malaysia and then re-export them to a third country. (Refer to Table II.1-1)

Trade statistics show neither export volumes nor destination by product item. Based on the information on individual companies obtained through the field survey, it world appear that, in the case of personal computers, with the exception of one manufacturer, most of products are directed to the domestic market. As for monitors and keyboards, the production is made by foreign affiliated companies which were set up in Malaysia with the intention of exporting their products to third countries. Therefore,

almost all of their products are exported. A breakdown of export markets is estimated as below:

Monitors: USA (majority), Singapore and Malaysia (small amount)
Keyboards: USA (70%), EC (20%), Japan (10%)

Two companies producing keyboards receive the GSP for their exports to the EC market and they consider that this is one of the advantages of the production in Malaysia. As for the United States, keyboards are not subject to tariffs due to the reciprocal tariff exemption agreement between Malaysia and the U.S. Also, no import duty is levied on keyboards in Japan

Table II.1-1 Export Trend of Computer and Peripherals in Malaysia

(Volume: unit, value: M$thousand)

		1985		1986		1987		1988	
		Volume	Value	Volume	Value	Volume	Value	Volume	Value
Complele digital data processing machines (SITC 75220000)	Singapore	45	374.2	63	993.2	115	2,353.9	90	461.2
	U.K.	14	37.6	13	49.6	2	22.7	1	2.5
	U.S.A.	2	115.4	1	15.7	8	672.7	20	149.9
	Total	75	583.5	105	1,262.6	195	3,546.4	163	1,135.9
Complete digital data processing units (SITC 75230000)	Singapore	41	582.5	62	613.4	95	2,943.2	204	2,778.1
	U.S.A.	—	—	5	123.2	26	200.6	10	127.8
	Philippines	—	—	34	41.8	205	187.6	140	168.3
	Total	58	1,838.5	127	935.9	386	3,606.2	419	4,196.0
Peripheral units inc. control & adapting units (SITC 75250000)	Singapore	265	1,042.9	245	764.6	441	3,240.4	—	927.2
	U.S.A.	34	201.9	42	198.1	18	239.4	—	107.3
	Hong Kong	14	237.7	36	246.1	44	92.5	—	12.0
	Total	366	1,410.9	441	1,725.6	726	4,232.1	—	1,234.0
TOTAL		—	3,832.9	—	3,924.1	—	11,384.7	—	6,565.9

Note: As classification of statistics changed from 1988, the figures for peripherals in 1988 = Input or output units where or not presented with the rest of a system & where or not CTG storage in some housing (SITC 75260000) + Storage units where or not presented with the rest of a system (SITC 75270000).
Including re-exports.

Source: Malaysia Annual Statistics of External Trade 1985, 1986, 1987, 1988

II-1-3. Outline of Production Companies

Outline of the companies engaging in the production of personal computers, keyboards and monitors in Malaysia is shown in Table II.1-2.

(1) Companies Producing Personal Computers

All companies involved in the production of personal computers are either local capital companies or those the majority of which shares are held by local capital. These local companies can be classified into two categories. The first category is those companies which have a certain level of technical capability and which are engaged in a production with the aim of securing a firm position in the domestic market for their own brands. Their strategies are targetted the market of imported brands such as Wearnes (ALR) and Acer. They run advertisements and provide a after-sales maintenance service. The other category is so- called non-brand manufacturers, many of whom do not hold a manufacturing license. It is said that these companies have a higher output than those in the first category.

Major local companies are Accent Technology and Microcomputer Systems. Both of them employ several technical experts involved in the designing of PCBs and they place products of a higher level on the market. Their brand are well known and they supply a certain number of products to the public sector. Their respective shares of the domestic market stand between 8-10%.

The growth of these two companies to their present size can attributed to the fact that they are affiliated to large company groups. Accent Technology is a member of Melewar Co. and Microcomputer Systems is a member of the Lion Group. Neither have any problems in regard to finance or acquiring staff and they are, therefore, able to concentrate on operational aspect of production and on the expansion of their business. This is part of a wider trend which is often seen today in Malaysia among hi-tech companies. According to this trend large conglomerates offer to put up the finance for a company founded by a technical expert who has studied abroad, and who, as the minority shareholder, takes charge of the running of the company.

Their scale of business is too small, in spite of their leading position among local makers, to realise an efficient operation. Their production cost is relatively higher because they order custom-made motherboards from Taiwanese suppliers. In addition, they have to bear the overhead cost for a support system. Their personal computers, therefore, are no match for Taiwanese products or local non-brand products, which are assembled by putting imported parts together, in price. Moreover, their inability to

compete with the large overseas manufacturers in terms of product image also places them in a difficult position. Despite the advantages held by local manufacturers in relation to producting in one's own area and having personal contacts, the smallness of the domestic market prevents them from expanding production. Viewed from the standpoint of production size, these companies would have to expand a production to the level of a minimum of 1,000 units per month in order to become competent enough to compete in the market. To sustain this size of production, a larger part of products should be directed to exports. Both Accent Technology and Microcomputer Systems plan to expand their exports in 1990. It is considered rather difficult for them to advance into overseas markets as the only advantage they have against competing Taiwanese-made products is at present, lower labour cost for assembly. In order to acquire a higher level of production technology, they have to accumulate the experience in larger scale production in steady condition. As long as the size of the domestic market does not offer them the opportunity of expanding sales, the first step they must take to overcome this problem is to turn to exports. They must create opportunities to get involved in OEM for export as OEM exports afford a realistic means considering their sale capabilities to enter the world market.

In order to support the efforts made by local assemblers, it might be worthwhile to examine, promotional measures such as export promotion measures, and protective measures, for example, to integrate local assemblers into some big firms, or to set up import barriers.

Pitted against these large companies are non-brand manufacturers which do not hold manufacturing licences. Fortune, Amsco, Nation-Tech, and K.T. Technology are typical examples of such companies. They are referred to as "value added dealers" as they import kit sets from Taiwan which they assemble and then sell at low prices. Although there are no available information on production volume of these companies, it would appear that the output of some of them is larger than that of such large manufacturers as Microcomputer Systems. However, they frequently turn to new ventures in other industries and, therefore, should be classed as belonging to the retail industry rather than the manufacturing industry.

Malaysian manufacturers which fall somewhere between these two categories of Manufacturers are the same as non-brand manufacturers in regard to production process. But it would also seem that some companies headed by technical experts are concerned with quality, and it is, therefore, reasonable to expect that, if they receive financial assistance from large groups, some of those companies will grow to belong to the category of large local manufacturers previously mentioned.

Table II.1-2 Outlines of Companies Which Are Engaged in Manufacturing Computer and its Peripherals

Company name	Location	Year of establishment	Capital structure and others	No. of employees	Products	Production volume per month	Market
1. Accent Technology	KL	1985	Local: 100% Melewar Co.	55	PC	300 units	Export: 70% Domestic: 30%
2. Techtrans Computer Systems	KL (T. Park)	1985 (Production started in 1989.)	Local: 100%	5	PC:XT	Production capacity: 50-100 units	Domestic
3. Micro Computer Systems	KL	1985	Local: 100% Lion Group (from 1988)	50	PC:XT, AT (Main), SX	200-300 units	Domestic
4. Micro Base Electronics	KL	1986	Local: 70% Singapore: 30% Advanced Micro Computer	70 (including sales staffs)	PC:XT, AT	Production capacity: 300 units	Domestic
5. Computer Resources	KL (T. Park)	1983 (Production started in 1988.)	Local: Majority Australia	15	PC:XT, AT SX	100 units	Domestic
6. Meranti Computer	KL	1984	Local: 100%	9	PC software	—	—
7. Compex Systems	KL	1986	Local: 100%	15	PC interface cards	60 units	Domestic

Company name	Location	Year of establishment	Capital structure and others	No. of employees	Products	Production volume per month	Market
8. Fujitsu Components (M)	Batu Pahat, Johore	1980 (Production of keyboards started in 1986.)	Japan: 100%	2,000	Keyboard	100-120 thousand units	USA: 50-60% EC: 15% Japan: 20%
9. Mitsumi Technology (M)	Batu Pahat, Johore	1986	Japan: 100%	400	Keyboard	120-130 thousand units	USA: 70-80% EC: 20-30%
10. Sharp -Roxy Electronics	Batu Pahat, Johore	1980 (Production of monitors started in Nov. 1986.)	Japan: 50% Hong Kong: 50%	1,700	Monitors	20 thousand units	USA Singapore Malaysia
11. Wearns Electronics	Pontian, Johore	1983 (Production of monitors will start in April 1990.)	Singapore: 100%	1,300	Monitors	4,000 units	Singapore: 100%

(2) Keyboards & Monitors

The two companies engaged in keyboard production are both Japanese companies which carry out mass production for export. The main markets for these companies' products are in Europe and the U.S. while the fact that they are subject to GSP in regard to export to the EC market is given as one of the advantages of producing in Malaysia, low labour costs was the main reason for setting up operations in Malaysia initially. However, if these two manufacturers are to strengthen their competitiveness, they must raise their rations of local procurement and many improvements are necessary as for supporting industries in Malaysia. Because both companies are at a disadvantage geographically as they are located away from areas where there is a concentration of manufacturers, they are turning towards increasing in-house production process. But they cannot be involved in -house manufacture of moulds and dies, and point out the importance of promoting the mould and die industry as an supporting industry.

As for the production of monitors, there is a Japanese manufacturer which produces 2.6 million colour televisions a year and which has started making monitors as part of its moves towards producing items with a higher added value. Because the production of monitors is basically more or less similar to the production of televisions, there are many companies in Malaysia which possess the potential to manufacture monitors. As the two key elements here are markets and competitiveness, success will depend upon whether or not it will be possible to compete successfully with low-priced Taiwanese and Korean products which flood the world market. This hinges on the domestic supply of CDTs. CPT of Taiwan and Matsushita of Japan have already announced intentions to produce CRTs for colour TVs in Malaysia, and the latter has a plan to produce CDTs for monitors in the future.

II-1-4. Potential Future Production

30 corporations obtained licences for the manufacture of computer-related products from 1987 through to November 1989, and 11 of these have already begun operation. The number of firms obtained such licences is increasing year by year, from five in 1987 to nine in 1988 and 16 in 1989 (January - November). As a whole, components for disk drives and other similar units are the most common, and most of the projects are foreign-affiliate companies with export ratios exceeding 90%. Singapore is the most common partner in such ventures, with 10 companies, followed by Japan, with six, Taiwan, with five, and the U.S., with four. (For concrete descriptions of these projects, please refer to the Addendum).

For subject product items of the survey, three firms are to start monitor production. In addition, Acer, Taiwan's largest manufacturer of personal computers, has announced the move of some of its operations to Penang, where it plans to begin production of keyboards, monitors, and personal computers, in that order, starting in late 1990. This plant will represent the first case of mass production of personal computers in Malaysia and will provide an indicator of Malaysia's future as an offshore production base for personal computers.

(1) Trends in investing countries/regions

Singapore is presently the world's leading supplier of hard disk drives. The number of firms which started production of parts for hard disk drives in Malaysia to supply to assemblers in Singapore are increasing. At the same time, some hard disk drive manufacturers in Singapore shifted a part of their process to Malaysia, and some of them are starting production of finished products in Malaysia. In other production items as well, there are limits to Singapore's production capacity, so firms which will shift a part of production to Malaysia are likely to increase.

Although Taiwan is currently the largest supplier of personal computers at the low end of the market in the world, the rise in the exchange rate and the sharp increase in labour costs have had a negative effect on production and are forcing companies to take appropriate measures. Companies which have a high level of technical capacity and a strong financial position are trying to shift their production to high value-added products, and, at the same time, their low-end products are shifted to overseas production. This latter development provides Malaysia with a opportunity.

In summarizing moves taken by Japanese companies for the overseas production of computer-related products, finished products are produced in Europe and the U.S.A. so as to avoid trade friction, and Asian countries, including Malaysia, are considered as production bases for parts supplied to their plants in Europe and the U.S.A. It would, therefore, seem that any shift towards the production of finished products would most likely be made by Taiwanese manufacturers. The existence of highly developed supporting industries is considered to serve the Malaysian electronics industry with the functions of settling foreign electronics assemblers, which has a way of moving from one country to another in search of lower labour cost, in the country, and motivating them to bring in R&D activities for designing and product development and to start a production of a higher value-added product in Malaysia

In addition, exports of high-tech parts and components for industrial electronics equipment to advanced countries will have good prospects considering the trends of the world market.

Viewed from a long-term perspective, the development of export-oriented parts manufacturers would contribute much to the development of the Malaysian economy as well as the electronics industry.

(2) Trends in the Malaysian computer related industry

According to the results of a survey distributed to Malaysian electronics firms currently in operation, 26 companies showed interest in the production of computer related products including components, while another 18 already have concrete plans for such activities. In these figures, such firms which are already engaged in the production of computer-related products and are simply considering diversification of their activities are included

Table II.1-3 provides a breakdown of these companies by type. The general trend is for local companies with fewer than 500 employees currently engaged in parts production to show considerable interest in production of computer related products. Concerning specific production items planned to be produced, intermediate components such as printed circuit board assembly, parts for disk drive, and power supplies were often noted.

As to start the production, technical know-how and establishment of sales channel are necessary, many companies have desire for technical tie-ups and so forth with foreign affiliated firms which already have technology and market. 16 firms indicated a desire for technical tie-ups, 12 a desire for OEM arrangement, and 18 a desire for the establishment of joint ventures (multiple responses permitted). In the future, the success of existing electronics firms in breaking into the computer market will probably depend on the type of cooperative relationships that can be established with foreign affiliates.

Table II.1-3 Interest in Production of Computer-related Products among electronics firms

		By number of employees				By nationality of parent company				By product			
	Total	A	B	C	D	Japan	Europe /U.S.	Other foreign	Local	Consumer products	Industrial products	Compo-nents	Others
Have concrete plans	18	2	2	6	7	5	2	3	8	2	6	10	0
Have interest	26	4	2	14	6	5	2	11	7	6	5	12	3
Total	44	6	4	20	13	10	4	14	15	8	11	22	3

Note: * Number of employees: A = > 1,000; B = 500-1,000; C = 100-500; D = <100
* For detailed results of the questionnaire, please refer to the Annex-III-4.
* For a list of the companies expressing interest in production of computer-related products, please refer to the Addendum.

II-2. Status of Production

II-2-1. Current Status of Production

(1) Personal Computers

1) Production

Eight firms, all of which are locally capitalized, have acquired industrial licenses for the manufacture of personal computers. Seven of these companies were visited in the present survey, and one had shut down production. It was also learned that there are several unlicensed personal computer assemblers.

2) Production Process

All of the companies visited are engaged exclusively in final assembly. Only one of the firms, however, was involved in surface mounting of devices on the motheroard. Techtrans Computer System is engaged in manual insertion and soldering of chips on the motherboard. Accent Technology performs manual insertion in-house while relying on outside firms for surface mounting.

Two of the firms visited had plans to purchase surface mounting equipment. The company which had shut down computer assembly operations already had such equipment, but it was being used in the assembly of printed circuit boards for other products.

At Malaysian manufacturers, the typical assembly process takes place in a workshop provided only with tables and chairs only. Operators install the motherboard and such components as the power supply and the disk drive(s) manually using screwdrivers, and then test machine operations. During the inspection process, only a soldering iron (for the repair of bad soldering) and oscilloscope are used.

Manufacturing technology at Malaysian computer assemblers is at a level suited to the manual assembly of personal computers for the domestic market in very limited production volumes (60-1,000 units per month).

3) Purchase of Components

Virtually all parts and components are imported from such countries as Japan, Taiwan, and Singapore for CKD or SKD assembly in Malaysia.

There are numerous manufacturers of IBM compatibles (computers which will run all standard IBM software but which are not entirely hardware-interchangeable with IBM models) and IBM clones (which are direct copies of IBM machines) in the world market. Far East Asian producers, and Taiwanese firms in particular, are well-known in this field.

As a result of the success of IBM compatibles and clones in the market, component manufacturers began to supply "standardized" parts and components for these machines. Companies throughout Asia and especially in Taiwan currently provide low-cost components to computer manufacturers around the world.

In their search for a source of low-cost, relatively high-quality parts and components, Malaysian personal computer assemblers have turned to parts manufacturers in countries like Taiwan, Singapore, Korea, and Japan for motherboards, power supplies, disk drives, chassis, monitors, keyboards, and other key parts. Taiwanese components are the most commonly used in the IBM-compatible personal computers assembled in Malaysia.

4) Research & Development

Two of the Malaysian assemblers of personal computers are also engaged in the design of printed circuit boards. This operation becomes necessary when attempting to produce an IBM-compatible machine with an original system configuration.

One firm, Microcomputer System, employs four engineers for the design of printed circuit boards. This company formerly entrusted such design work to the Malaysian Institute of Microelectronics Systems (MIMOS) on a contract basis.

The other firm engaged in printed circuit board design, Accent Technology, is equipped with a CAD workstation and logic analyzer for use in R&D. This company designs motherboards and peripheral cards and accepts orders from other firms as well. Design work is presently limited to two-layer configurations, but development is being conducted on four-layer designs as well. At present there is no shortage of engineers, but with future expansion the R&D division will probably find it difficult to secure capable personnel.

Accent Technology also purchased a BIOS prototype from a U.S. firm in 1987 and upgraded this system with the help of a U.S. consultant. The resulting BIOS is now used on Accent products.

5) Problem Areas

The scale of production at Malaysia's assemblers of personal computers is too small for them to reinvest earnings in production facilities, market-expansion activities, and research and development work for the continuous upgrading of production scale.

In order for companies to achieve sales capable of supporting such economies of scale, the limited domestic market will have to be supplemented with sales to foreign markets.

There exists a large gap in manufacturing technology between the small-scale manual assembly operations of Malaysian computer manufacturers and the automated, mass-production operations seen at leading PC producers.

Malaysian PC assemblers have yet to outgrow their status as value-added dealers. They do not have the necessary facility, production management, and quality control-related technologies required for mass production, and they do not have access to personnel versed in these technologies.

Malaysian PC assemblers rely on imports for major components. Even on the domestic market, it would be difficult for them to compete with the low-priced Taiwanese components. Consequently, the promotion of local production of parts and components is needed in order to promote domestic sourcing of major parts and components.

R&D activities at Malaysian PC assemblers are primitive and remain limited to printed circuit board design. Current R&D systems and capabilities are insufficient for the design of highly-functional original products and IC technologies.

The design of ASICs (Application-Specific ICs), PLAs (Programmable Logic Arrays), and BIOSs requires a large investment in development costs as well as access to experienced engineers and technicians and the latest development tools. At present in the world market, it is only the largest manufacturers of personal computers that are able to support an in-house development process and bear the heavy burden of development costs.

(2) Keyboards

1) Production

Two firms, Fujitsu Component and Mitsumi Technology, are engaged in the production of keyboards in Malaysia. Fujitsu Component was established in 1980 as a subsidiary of the well-known Japanese computer manufacturer and began production of keyboards in 1986. Current production volume is 100,000-120,000 units per month. Mitsumi Technology is a subsidiary of a Japanese manufacturer of electronics components and has a current production volume of 120,000-130,000 units per month. In addition to these two firms, SMK Electronics plans to begin keyboard production at a monthly rate of about 50,000 units.

2) Production Process

The two companies presently engaged in keyboard production have adopted the same manufacturing processes used by keyboard manufacturers in Japan. Manufacturing

technology and production volume at the two firms is virtually on a par with those of Japanese plants.

Fujitsu Component has internalized metal pressing, plastic injection moulding, and plating operations due to the lack of supporting industries in Malaysia. The same is true for plastic components at Mitsumi Technology.

Malaysia's mould and die industry lags behind in metal die maintenance, and metal pressing and plastic injection moulding operations suffer from poor efficiency. Repair and modification of moulds and dies must be done in Singapore, resulting in reduced operation rates, loss of earnings opportunities, and delivery date setbacks.

3) Purchase of Components

Fujitsu Component uses local sourcing for 40% of its components, turning to neighboring ASEAN countries for another 30% and Japan and Taiwan for the remaining 30%. Membrane films, rubber contact springs, and printed components for keytops are imported from Japan. Virtually all of the electronic components are supplied by Singapore.

Mitsumi Technology imports roughly 30% of the raw materials for its continued-production models from Japan, while the figure for new models is 60%. Local content remains low, at about 10%.

4) Research and Development

Product design and development are carried out by the Japanese parent firms, and as yet there has been no relocation of R&D operations to Malaysia.

5) Problem Areas

Malaysian keyboard manufacturers are competitive on the world market in terms of both quality and price.

Key switches, which account for roughly 30% of all raw material costs, will continue to be imported from Japan for the production of key switch keyboards. For other components, however, local sourcing or in-house production are viable options. The resulting increase in local content ratios would also contribute to greater added value by Malaysian parts manufacturers.

In order to emphasize the priority of keyboard production in Malaysia, it is extremely important that technological standards at supporting industries in the country be upgraded. This will require support for manufacturers of precision metal dies, precision metal pressed components, and precision plastic components.

Most keyboards are sold in sets under the brand names of computer manufacturers. Viewed worldwide, keyboards are either manufactured in-house or else produced under OEM agreements with affiliated companies or parts and components manufacturers. In Malaysia it is the foreign-affiliate parts and components manufacturers and computer manufacturer affiliates, which have come to Malaysia in order to reduce production costs, that are engaged in keyboard production. Despite their status as "computer peripheral equipment," keyboards require relatively little technology to produce. Consequently, while keyboard production may contribute significantly to Malaysia's foreign currency earnings, it is unlikely to contribute to greater added value.

(3) Monitors

1) Production

Sharp-Roxy Electronics, a subsidiary of the Japanese electronics equipment manufacturer, and Wearnes Electronics, an affiliate of a Singapore computer manufacturer, have been engaged in the production of 14-inch CGA monitors for personal computers since 1986 and 1989, respectively.

Production volume at Sharp-Roxy Electronics is roughly 12,000 units per month. Wearnes Electronics is currently engaged in pilot production of about 2,000 units per month, with plans to increase to the full capacity of 4,000-5,000 units per month by April 1990.

2) Production Process

Sharp-Roxy Electronics has adopted the same manufacturing process used by its parent company in Japan. Since its establishment in 1980, Sharp-Roxy has been engaged in the assembly of television sets for export to Asia and the Mideast. Before the firm ever began production of computer monitors, therefore, it had accumulated sufficient assembly experience in Malaysia. Production technology at the firm is on a par with that at similar manufacturers in Japan.

For the past 15 years Wearnes Electronics has been engaged in the assembly of audio products, printed circuit boards, and camera components exclusively for Japanese companies. As a result, there were few technical problems encountered during the startup of computer monitor production. Although currently in the stage of pilot production, Wearnes receives full technical support from its parent company in Singapore in terms of engineering and quality certification.

3) Purchase of Components

CDTs, which account for about half of all raw material costs, are imported from Japan and Taiwan.

Sharp-Roxy Electronics imports roughly 50% of all its materials from Japan. Another 15-20% is supplied by neighboring countries like Singapore and Thailand, while the remainder is sourced locally. After it enters into full-scale operation, Wearnes Electronics expects to begin local sourcing of general-purpose electronic components such as capacitors, resistors, diodes, and transistors as well as single-layered printed circuit boards.

4) Research and Development

Sharp-Roxy Electronics set up an R&D division in 1988 for the design of television sets to be exported to Asia and the Middle East. This division consists of 25 staffs, of which three have been dispatched from the parent company in Japan, and is involved in the design of 14-inch television sets. It has yet to begin work on the design of computer monitors.

5) Problem Areas

As a result of their dependence on Taiwanese and Japanese imported components, Malaysian manufacturers are at a disadvantage to Taiwanese and Korean manufacturers in terms of cost. Color CDT, which account for a significant portion of total manufacturing costs, are not produced in Malaysia, forcing companies to rely on expensive imports from Japan and Taiwan.

Despite the shift in world demand towards monitors of higher quality, only CGA color monitors are being produced in Malaysia. In the future, the production of higher-quality monitors will become necessary.

In order to resolve these problems, monitor manufacturers hope that domestic production of color CDTs and other key components will be initiated.

At present, the only monitor producers are affiliates of foreign manufacturers of computers and peripheral equipment. Just as in the case of keyboards, Malaysia's role is as a production base for exports. Upgrading of the technical standards of the Malaysian electronics industry as a whole will require the transfer of technology from these monitor manufacturers to Malaysian firms.

At present, the production and design process for television sets is being transferred to Malaysian companies. It is hoped that the same kind of transfer will be undertaken for monitors. In order to upgrade design and development capabilities, the securing and training of capable engineers and technicians will also become necessary. Assistance in these efforts would be helpful.

(4) Printers

At present there are no printer manufacturers in Malaysia.

Printer production involves the assembly of precision mechanical components. This requires high-precision metal processed parts and metal dies, for which supporting industries capable of producing high-precision products are needed.

Printer assembly also requires the technology to produce precision equipment. Capable engineers and technicians trained in production management are needed.

In the future, these types of improvements in the production environment will also be important factors in promoting printer production in Malaysia.

(5) Production Technology

Technical standards at Malaysian companies engaged in the assembly of personal computers and peripheral devices were evaluated and compared with those at Japanese-affiliate manufacturers of home electrical appliances.

1) Survey Methodology

Technical levels at leading Japanese electronics equipment manufacturers were used as the standard for comparison. Evaluations were carried out using the following procedure.

[1] A factory checklist was drawn up.

[2] Production conditions at the factories visited during the local survey were evaluated based on the checklist.

The plants were given evaluations ranging from A to C for each item, A indicating standards equivalent to those at advanced plants in Japan, B and C growing progressively worse.

[3] The small items on the checklist were grouped together under the following large items: Facilites, Operation Management, Production Management, Physical Distribution/Stock, Quality Assurance, Cleanness/Safety, and Workplace Morale.

[4] Each of the small items were weighted A, B, and C in descending order of importance.

[5] The evaluations were multiplied by the weightings, each A being treated as 3 points, each B as 2 points, and each C as 1 point. These were then totaled for each large item. This was divided by the total number of possible points to obtain the evaluation index for each large item.

Large item evaluation index = Σ (Small item weighting x small item evaluation) / Σ (Small item weighting x 3)

Under this system, an evaluation index of 1.0 would indicate technical standards equivalent to those at advanced electronics manufacturers in Japan.

2) Evaluation Results

Production sites were surveyed and technical standards evaluated at three manufacturers of personal computers and peripheral equipment and two related equipment producers. These results were compared with the technical standards found at Japanese-affiliate manufacturers of home electrical appliances evaluated using the same method. The results are as shown in Tables II.2-1, Fig.II.2-1.

The Japanese-affiliate manufacturers of home electrical appliances, which had adopted the latest facilities, maintained technical standards on a par with those of Japanese plants. In the case of computer and peripheral equipment manufacturers, however, the standards were significantly lower, even at Japanese affiliates.

Table II. 2-1 Technology Level Evaluation of Assemblers in Malaysia

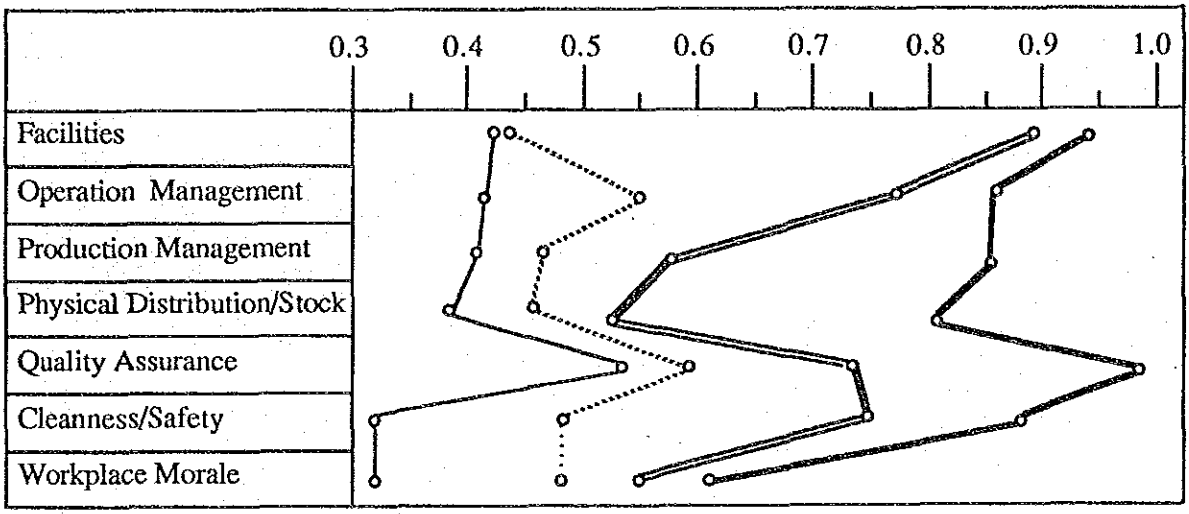
Evaluation Items		Importance Grade	Computer Peripherals						Components for Peripherals				Consumer Electronics Assembly							
			Monitor		Keyboard				Power Supply				TV		Audio				VTR	
			Other Foreign		Japanese		Japanese		Malyasian		Malaysian		Japanese		Japanese*		Japanese*		Japanese	
Facilities	Use of Latest Equipment	B	C		A		B		C		C		A		A		A		A	
	Operation ratio	B	B	0.44	A	1.00	A	0.78	B	0.56	( )	0.33	B	0.78	A	1.00	A	1.00	A	1.00
	Maintenance	B	C		A		B		B		( )		B		A		A		A	
Operation Management	Standard time	B	B		B		B		( )		C		A		A		A		A	
	Standard work instruction	A	B		A		B		B		B		A		A		A		A	
	Work efficiency and Operation speed	B	C		B		B		( )		B		B		A		B		( )	
	Job allocation	B	C		A		B		B		( )		B		A		B		A	
	Efficiency of line balancing	B	C	0.43	A	0.83	A	0.72	( )	0.67	C	0.44	A	0.79	(B)	0.89	(B)	0.79	A	0.97
	Layout of working desks	B	B		B		B		B		B		B		(B)		(B)		A	
	Parts supply	B	C		B		B		B		C		B		(B)		(B)		A	
	Work movements	B	C		B		B		C		C		B		(B)		(B)		B	
	Products handling	B	C		B		B		B		B		A		(A)		(A)		A	
	Use of tools	A	C		A		B		B		C		B		(A)		(B)		A	
	No. of staff	B	C		A		A		A		C		B		(A)		(A)		A	
Production Management	Production control system	B	C		A		B		C		C		A		B		A		A	
	Schedule and delivery control	B	C		B		B		B		C		B		A		B		A	
	Order cycle	B	C	0.42	C	0.67	C	0.52	C	0.45	( )	0.48	C	0.82	C	0.82	C	0.82	A	1.00
	Progress recognition	A	B		B		B		C		B		A		(A)		(A)		A	
	Flow condition	B	C		B		B		B		( )		A		(A)		(A)		A	

Physical Distri-bution /Stock	Level of stock Layout Plant location	B B C	C C B	0.40	C B B	0.53	C B B	0.53	C B B	0.53	C C B	0.40	B B B	0.67	B A A	0.87	C A B	0.67	A A A	1.00
Quality Assu-rance	Inspeciton Standards	A	B		B		B		B		B		A		A		A		A	
	Controlling defect ratio	A	C		B		B		B		B		A		A		A		A	
	Organization in charge of QA	B	B		B		B		B		B		A		A		A		A	
	Lot stra-tification	B	C	0.54	B	0.74	B	0.74	B	0.62	C	0.59	A	0.96	A	1.00	A	1.00	A	1.00
	Controlling measuring equipment	B	C		B		B		B		B	0.605	B		A		A		A	
	Defective rate	B	B		A		A		( )		B		A		A		A		A	
	Assembly non-defective rate	B	B		A		A		( )		C		A		A		( )		A	
	Qualification of industrial *standards*	B	B		B		B		C		B		( )		A		A		( )	
Clean-ness/ Safety	5s(Clean-your-workship activity)	B	C	0.33	A	0.83	B	0.67	C	0.33	B	0.67	A	0.83	B	0.83	A	0.83	A	1.00
	Safety programme	B	C		B		B		C		B		B		A		B		( )	
Work-place Morale	Small group activity	B	C		B		C		C		B		B		B		B		B	
	Suggestion system	B	C	0.33	B	0.67	C	0.44	C	0.44	C	0.56	C	0.56	B	0.67	C	0.56	B	0.67
	Personnel *development*	B	C		B		B		B		B		B		B		B		B	

Note: ( ) indicates results which were not added into the final calculation because of low reliability of data caused by lack of information.

* shows that the evaluation is supplemented with the results of factory visits in the second year survey on office electronic equipment.

Fig. II.2-1 Evaluation of the Technological Level of Assemblers



——— Monitor	One company (Other foreign)
═══ Keyboard	Average of two companies
····· Power Supply	Average of two companies
▬▬▬ Consumer electronics	Average of four Japanese-affiliated companies

II-3. Current Situation of Computer-related Industries

II 3-1. Possibility of Domestic Procurement of Main Parts and Raw Materials

(1) Evaluation of the Possibility of Parts Procurement

When making decisions on new overseas factory sites, manufacturers of personal computers and peripherals put emphasis on factors such as production cost, market access and the technological level which assures production of high quality articles as well as the production environment and infrastructure. Production cost is one of the most important factors in the selection of factory sites because manufacturers are constantly making efforts to improve global competitiveness in the areas of technology and price.

Expenses for raw materials account for the largest part of the total production cost of personal computers and peripherals. In the case of personal computers, they account for about 90 percent of the production cost. The same is true for peripherals as well. It is obvious that the availability of low-priced raw materials will contribute a great deal to the realization of price competitiveness in producing the items covered by this survey. In other words, the availability of low-priced raw materials will be a decisive factor in the selection of overseas factory sites.

With a view to comprehensively evaluating Malaysia's advantages as a production site for personal computers and peripherals, the study team evaluated the possibility of local procurement of parts for these products in Malaysia on the basis of the results of an on-the-spot survey.

The results of the evaluation of the possibility of local procurement of parts are shown in Table II.3-1.

Table II. 3-1 Availability of Parts and Components in Malaysia

Name of Parts	Personal Computers				Motors				Printers				Keyboards			
	At Present Proportion of Malaysian Parts		* In future Proportion of Malaysian Parts		At Present Proportion of Malaysian Parts		* In future Proportion of Malaysian Parts		At Present Proportion of Malaysian Parts		* in Future Proportion of Malaysian Parts		At Present Proportion of Malaysian Parts		In future Proportion of Malaysian Parts	
	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia
Mechanical Parts																
Precision Metal Parts	100 ***	-	100	-	100	-	100	-	20	S,T	50-70	S,T	100	-	100	-
Turning Parts	NU	-	NU	-	NU	-	NU	-	10	T,TH	50-70	T,TH	NU	-	NU	-
Plastic Parts	100	-	100	-	100	-	100	-	100	-	100	-	100	-	100	-
Precision Plastic Parts	NU	-	NU	-	NU	-	NU	-	20	S	100	-	NU	-	NU	-
Fastener	100	-	100	-	100	-	100	-	80	T,S	100	-	100	-	100	-
Spring	NU	-	NU	-	NU	-	NU	-	50	S,TH	100	-	100	-	100	-
Rubber Roller	NU	-	NU	-	NU	-	NU	-	0	TH	50	TH	NU	-	NU	-
Label	100	-	100	-	100	-	100	-	100	-	100	-	100	-	100	-
Others	100	-	100	-	100	-	100	-	100	-	100	-	100	-	100	-
Electronic Parts																
PWB	0	T,S	0	T,S,K	90		100	-	50	T,K	100	-	100	-	100	-
IC/LSI	0	K,T	60	K,T	0		60	K,T	60	-	80	K,T	60	-	80	K,T
Transistor	90	-	90	-	100	-	100	-	100	-	100	-	NU	-	NU	-
Diode	100	-	100	-	100	-	100	-	100	-	100	-	100	-	100	-
LED	100	-	100	-	NU	-	NU	-	100	-	100	-	100	-	100	-
Resistor	95	-	95	-	90	-	90	-	100	-	100	-	100	-	100	-
Capacitor	90	-	90	-	100	-	100	-	100	-	100	-	100	-	100	-
Quartz Oscillator	100	-	100	-	100	-	100	-	100	-	100	-	100	-	100	-

Name of Parts	Personal Computers				Motors				Printers				Keyboards			
	At Present Proportion of Malaysian Parts		* In future Proportion of Malaysian Parts		At Present Proportion of Malaysian Parts		* In future Proportion of Malaysian Parts		At Present Proportion of Malaysian Parts		* in Future Proportion of Malaysian Parts		At Present Proportion of Malaysian Parts		In future Proportion of Malaysian Parts	
	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia	(%)	Sources Except Japan & Malaysia
Switch	30	T	50	T	100	-	100	-	80	T	100	-	20	-	100	-
Connector	50	S	100	-	50	S	100	-	50	S	100	-	50	-	100	-
Plug	70	T	100	-	100	T	100	-	100	-	100	-	100	-	100	-
Motor	NU	-	NU	-	NU	-	NU	-	50	S,TH	50	S,TH	NU	-	NU	-
Power Supply Unit	100	-	100	-	100	-	100	-	100	-	100	-	NU	-	NU	-
Wire	100	-	100	-	100	-	100	-	100	-	100	-	100	-	100	-
Others	100		100		100		100		100		100		100		100	
Special Parts																
FDD/HDD	0	S,T	50	S,T	NU	-	NU	-	NU	-	NU	-	NU	-	NU	-
Keyboard	100	-	100	-	NU	-	NU	-	NU	-	NU	-	NU	-	NU	-
Printer Head	NU	-	NU	-	NU	-	NU	-	0	T	0	T	NU	-	NU	-
Colour CDT	NU	-	NU	-	0	T,K	0	T,K	NU	-	NU	-	NU	-	NU	-
Deflection Yoke/Flyback Transformer	NU	-	NU	-	0	T,K	40	T,K	NU	-	NU	-	NU	-	NU	-
Ribbon Cassette	NU	-	NU	-	NU	-	NU	-	20	T	80-90	T	NU	-	NU	-
Packing Materials																
Paper Box	100	-	100	-	100	-	100	-	100	-	100	-	100	-	100	-
Packing	100	-	100	-	100	-	100	-	100	-	100	-	100	-	100	-
Plastic Bag	100	-	100	-	100	-	100	-	100	-	100	-	100	-	100	-

Note: * This means the expected availability in 3-5 years, ** S: Singapore, T: Taiwan, K: Republic of Korea, TH: Thailand, *** NU: Not Used

(2) Possibility of Procuring Machine Parts

[1] Plastic Parts

Almost all packing cases can be procured. Local firms own machines large enough to mould cases for personal computers and peripherals. But the hands of plastic makers supplying electronic and electric equipment makers are full with the current demand and as a result it is uncertain whether they can stably supply other customers. There is also room for improvement in their quality control.
Malaysian plastic makers do not have the technology to process plastic machine parts for use in printers, making it impossible to purchase the products locally. For manufacturing such parts, the technology to mould engineering plastics is necessary and high precision is required in processing them.

[2] Pressed Metal Parts

In light of the current technological level and conditions of the facilities of pressed metal makers in Malaysia, pressed metal parts used for personal computers, monitors and keyboards can be procured locally . But the number of such makers is limited, leaving the supply situation uncertain.
Metal machine parts used in printers cannot be purchased locally because there are no makers able to manufacture parts which satisfy the required precision in dimensional tolerance and bending angle.

[3] Processed Metal Machine Parts

The axis of the moving part used for printers requires processing with automatic and numerically-controlled lathes. Some metal processors have installed such automation facilities but have not attained the level of precision required for the manufacture of printers. It is desirable for them to spend more time and learn the technology and know-how. Even if processed metal parts of high precision could be purchased, their cost would become higher, reducing the cost advantage.

[4] Machine Screw Washers

Common machine screw washers can be purchased but self-tapping screws and restraint washers are dificult to purchase locally.

[5] Springs

Local procurment of coil springs and leaf springs appears to be difficult.

[6] Rubber

Rubber parts for general use are produced but rubber legs and platen rollers are not. Mixing rubber for platen rollers is difficult but there are no problems with the technology of moulding rubber. Local purchases of rubber rollers will become possible in the future.

[7] Labels and Nameplates

The current procurement by electric appliance makers shows that there will be no problems with local purchases of these products by personal computer and peripheral makers.

(3) Possibility of Local Procurement of Electronic Parts

[1] Printed Circuit Boards

Only single-faced and double-faced (without through holes) circuit boards are produced in Malaysia at the moment. Multi-layer circuit boards must be imported. Personal computers require multi-layer circuit boards with four or five layers which cannot be procured locally in the immediate future. Keyboards require only single-faced circuit boards which can be purchased locally. Domestic procurment of the boards for monitors is almost possible. As for printers, double-faced circuit boards with through holes will have to be imported for the time being but, from the long-range viewpoint, full local procurment of circuit boards will become possible in the future.

[2] ICs/LSIs

ASICs for use in personal computers and peripherals are not produced by semiconductor factories in Malaysia and have to be imported from Japan and Singapore. The domestic procurement ratio of ICs/LSIs, therefore, cannot be high.

CPUs, memories, logic ICs and various other standard digital ICs are produced in Malaysia. But the semiconductor factories in the country have no sales staff so the

products are exported to Singapore or Hong Kong and sold to users in Malaysia by sales offices there. Prices are fixed by the parent firms outside of the country and as a result they are kept high.

[3] Transistors, Diodes, Resistors, Capacitors and Crystal Oscillators

For the most part, these items can be procured locally because major Japanese electronic parts manufacturers are producing them in Malaysia. Chip components, however, are not produced with the exception of a few items.

[4] Switches

DIP switches and other items to be loaded on printed circuits should be imported. Key switches to be used in keyboards are not produced locally and must be imported. Power supply switches can be procured locally.

[5] Connectors, Plugs and Wire

These products for personal computers and keyboards must be partially imported. Small-sized connectors and bundled wire are hard to purchase locally at the moment. Cables should meet FCC standards. The products for monitors and printers can all be procured locally.

[6] Motors

Small-sized precision motors for use in printers will have to be imported for the time being but will become available locally in the future.

[7] Power Sources

Power sources can be fully procured locally.

(4) Possibility of Locally Procuring Special Components of Individual Products

[1] FDD/HDD

Only parts of HDD are produced in Malaysia at the moment. But domestic production of FDD/HDD will start in the near future.

[2] Keyboards

Keyboards as fittings for personal computers are produced locally in Malaysia.

[3] Printer Heads

High precision is required to produce printer heads composed of precision machine parts. Domestic purchases of them will be difficult in Malaysia for the time being.

[4] Color CDTs

CDTs are not produced in Malaysia at the moment. Local purchases will become possible in the future because there is a project to manufacture CDTs in the country.

[5] The Possibility of Local Procurement of Packing Materials

Packing materials such as paper cases and plastic bags can all be purchased locally.

II-3-2. The Current Situation of Electronics-related Parts Manufacturing Industries Based on the Results of Questionnaires

Sixty-six parts manufacturers sent replies to our questionnaire survey conducted on 192 electronic industry-related enterprises in Malaysia. The respondents included 29 Japanese, 14 European and American, 13 other foreign and six local firms. Classification of the remaining four firms was uncertain. The current situation of the electronic industry-related parts manufacturers in Malaysia based on the results of the questionnaire is as follows.

(1) Problems with Management

Out of 62 respondents, 33 cited difficulty in hiring skilled people as the first problem with the management of parts manufacturing firms. Purchasing of raw materials, rigid competition and the introduction of new technologies were cited as the next problems by about one-fourth of the respondents.

Replies from many manufacturers of electronic products for industrial and private uses pointed out a lack of ability to develop new products and to improve production processes, a lack of interest in quality control and a lack of long-term perspectives on the part of management as the problems with domestic parts manufacturers.

(2) Parts Purchases

With the exception of seven firms which did not send replies, eight out of the 59 respondent firms said their ratio of domestic procurment of parts was greatly expanding. Twenty-nine others replied that their ratio of domestic procurment was rising. Thirteen out of the 61 respondent firms said they intended to actively increase domestic purchases and 40 others also said they intended to increase domestic purchases but not as actively. Only eight firms were satisfied with the current domestic procurment ratio or did not intend to increase it. The current domestic purchase ratio averages 27.8 percent. In five years, the respondents expect the ratio will average 42.8 percent.

Thirty-eight firms provide assistance to their domestic parts suppliers. They include no Malaysian firms but 19 out of 29 Japanese firms, 10 out of 14 European and American firms and seven out of 13 other foreign firms. Among the measures for assistance, technological assistance for quality improvement is provided by 37 out of the 42 respondent firms, followed by provision of raw materials (ten firms) and training and guidance (seven firms).

The lack of ability to develop new products and to improve production processes, the lack of interest in quality control and the lack of long-term perspectives on the part of management were pointed out as the main problems with parts manufacturers.

As a way to locate parts manufacturers, 35 out of 60 firms cited sales from parts manufacturers themselves and another 35 firms said they utilized directories.

As an effective means to raise the domestic procurment ratio, 44 out of 60 firms called for the provision of guidance on quality control to local parts manufacturers. Thirty-two others cited the provision of incentives for the use of domestic parts and 25 firms recommended attraction of investment from foreign parts manufacturers.

(3) Quality Control

Quality control activities are under way in practically all respondent firms. As for measures to be taken in the future for the improvement of quality control, 35 out of 62 firms called for the provision of QC manuals and 33 firms for seminars on QC methods. Twenty-two firms said they would dispatch their staff to Japan. Of these 22 firms, 16 were Japanese companies. In addition, five firms replied that they would send their staff to Japan.

(4) Securement of Labour

Eight firms replied that a shortage of skilled people had become a serious problem while 41 others answered that it had become a problem to some degree. Seventy-seven percent of the respondent firms said they had trouble in securing skilled people. Seventy-eight percent of the firms which replied that they had trouble in securing skilled people had a particular problem in securing line workers, 71 percent with securing technicians and 53 percent with the hiring of engineers.

(5) Training of Skilled Labour

Fifty-four out of 66 firms are conducting in-house training of skilled labour, with 25 of them considering their current in-house training insufficient. As problems with in-house training, many firms said that supervisors were busy, training systems were imperfect, curriculums were inappropriate, levels of individual trainees vaired widely and manuals had not been prepared.

(6) Raising of Funds

Twenty-nine out of 52 respondent firms said that raising funds was easy, 20 others said it was slightly difficult and three firms said very difficult. The firms which

replied that raising funds was very difficult included Malaysian and other foreign enterprises.

The reasons that make fund-raising difficult include that collateral must be put up, that the interest rate is high, that a guarantee is demanded, that borrowing procedures are complicated and that sums for lending were limited. Two Malaysian firms, which replied that raising funds was difficult, complained that collateral is demanded, the interest rate is high, investigation takes a long time and borrowing procedures are complicated.

(7) Sales

Classification of customers was as follows:

Unit: firm

	Japanese	European & American	Other Foreign	Malaysia	Total
Color TV assemblers	17	1	2	1	21
Audio assemblers	14	3	4	1	22
Air conditioner assemblers	1	-	1	1	3
Other appliance assemblers	5	1	3	-	9
Semiconductor makers	3	-	2	-	5
Other electronic parts makers	5	2	4	1	12
Makers of electronic articles for industrial use	2	1	2	-	5
Others	1	2	-	1	4
Number of respondent firms	21	5	8	2	36

As problems relevant to marketing, 22 out of 42 parts manufacturers cited a shortage of market information. Twelve other makers pointed out that customers required technology and quality of a high level.

Thirty out of 52 parts manufacturers replied that they had never participated in exhibitions before. Eight Japanese and two other foreign firms said they had taken part in domestic exhibitions, while six Japanese, four European or American and two Malaysian firms replied that they had participated in exhibitions abroad. Almost the same was true of their interest in exhibitions. Twenty out of 51 respondents said they were not interested in exhibitions. As to why they were not interested in exhibitions, eight said they did not expect results and seven others replied that they had their hands full in dealing with orders received.

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

(1) Unbalanced Growth of Supporting Industries

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

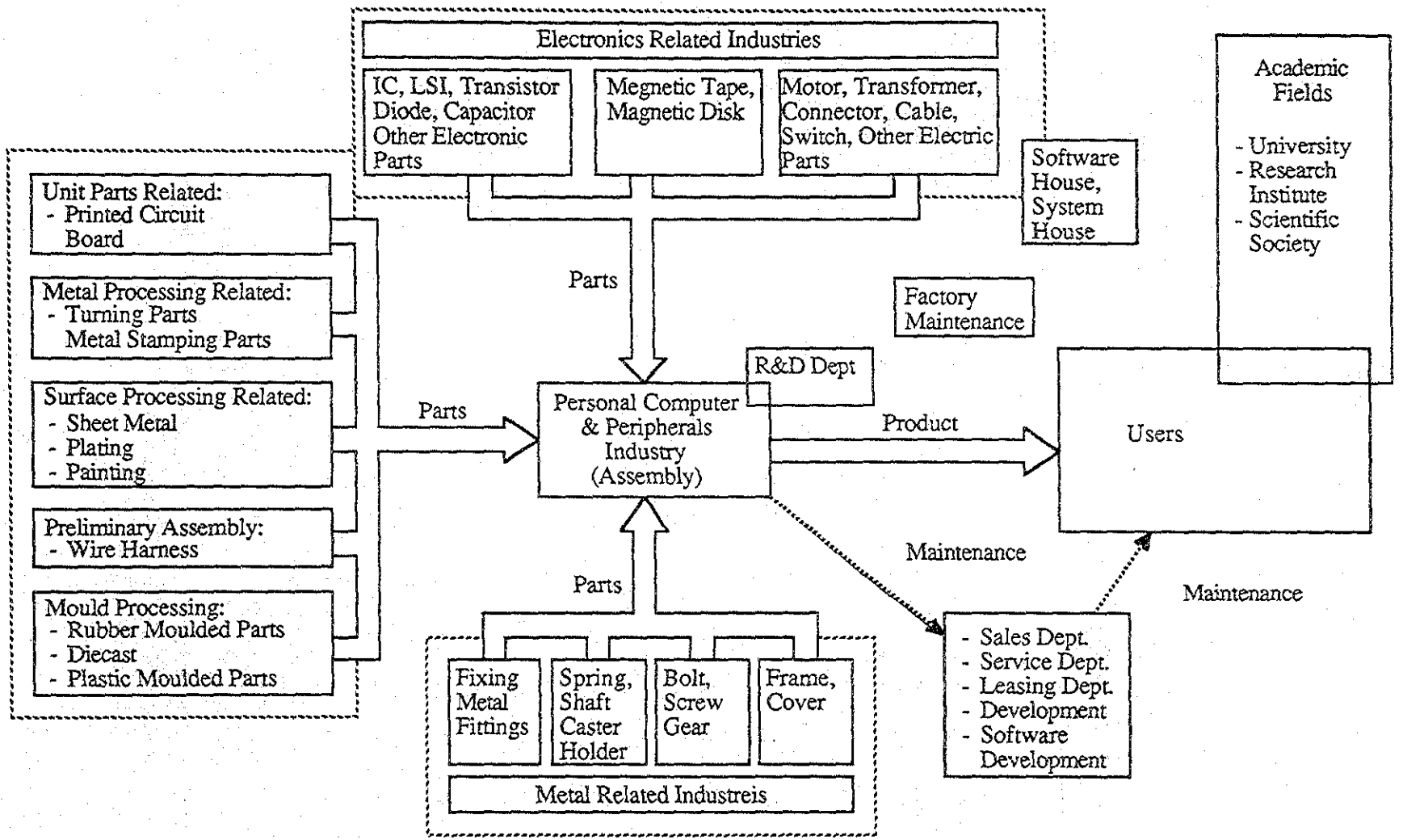
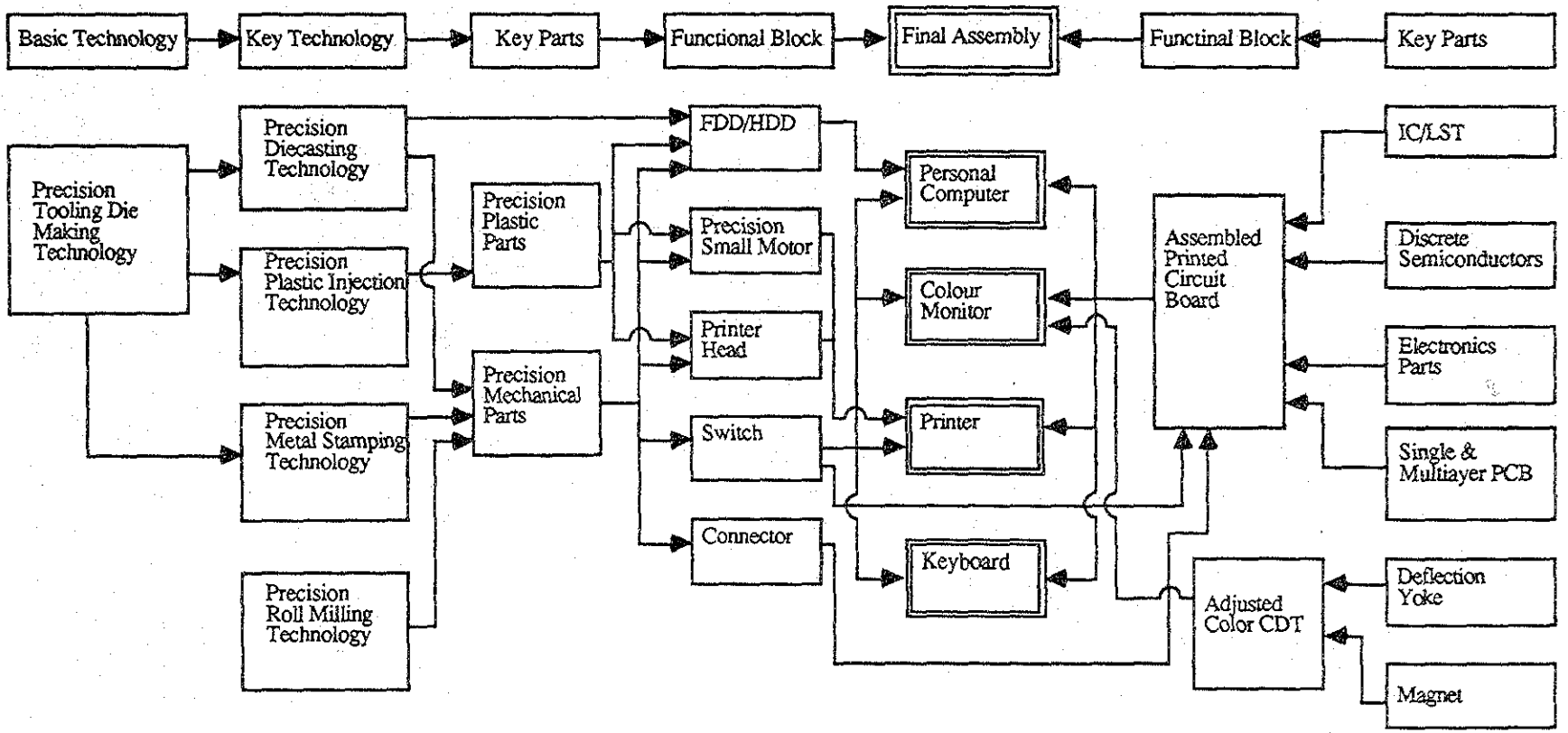


Fig. II.3-2 **Prerequisite Technologies to the Manufacture of Parts and Components and the Assembly of Personal Computers and Peripherals**



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

Table II.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.

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 II.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 II.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.

II-4. Feasibility Analysis of Investment

II-4-1. Methodology of Feasibility Analysis

It is a precondition for the promotion of the personal computer and peripherals industries in Malaysia and the promotion of investment in this sector that personal computers and peripherals manufactured in Malaysia would have price competitiveness in the world market.

In this section, in order to evaluate the possibility of Malaysia as an industry site of personal computers and peripherals and to identify the necessary conditions for the promotion of the industry, a quite rough analysis of investment feasibility was conducted on the assumption that personal computers and peripherals plants are to be newly constructed in Malaysia.

The feasibility analysis was conducted on the following assumptions.

i) Feasibility analysis of four different factories for four products; personal computers, monitors, printers and keyboards.

ii) Investment by a Japanese firm

iii) Factories would engage only in production and production-related operation and would not have sales and R&D functions.

iv) Take-over of the production of products for the European and the U.S. markets

v) Products are directed to exports.

Major factors in the assumption were set as follows:

Assumption for the Feasibility Analysis

Project Period:	10 years
Construction Period:	1 year
Price:	Fixed price as of 1989
Investment Incentive:	-Ten year exemption from corporate tax based on Pioneer Status -Exemption from import tax for equipment and materials
Exchange Rates:	1US$= 143.52, 1US$=2.7027M$ (Period average of November, 1989)

II-4-2 Product Item and Production Capacity

(1) Product Item

The following items were selected as subject product items of the analysis assumed to be produced in Malaysia.

1) Personal Computer

Assumed product models: IBM compatible personal computers (IBM-AT compatible)

The specifications of products are as follows:

	Model 1 (Medium Grade)	Model 2 (Lower Grade)
CPU (Clock Speed)	i80286 (12MHz)	
Main RAM	1MB	
Disk Drives	5 inch 1.2M FDD x 1 40M HDD x 1	5 inch 1.2M FDD x 1
Bus Type	PC/AT - Bus	
Monitor Type	VGA (Video Graphics Array) (A monitor is not attached.)	
Keyboard	A 101-key keyboard is attached.	

The reasons for choosing the above models are as follows:

[1] The trends in the world market press an assumed plant to adopt a product strategy of producing IBM-compatibles both in exporting and in selling in Malaysia.

As for the usage of personal computers, the proportion of software cost among the cost which users bear becomes large compared to the hardware cost because the unit price of a personal computer is relatively low. Users of personal computers use application software sold on the market instead of developing original software, which is usually expensive. Users tend to buy a personal computer for which a larger amount of application software has been developed. Therefore it is one of the characteristics of the market structure that a personal computer which has a larger market share gets a higher and tighter market share.

Mass-produced personal computers in the world market adopt IBM-architecture, Apple-architecture, or NEC-architecture. Above all, IBM and IBM-compatibles hold an overwhelming share in the world market.

IBM took an open architecture policy and designed their personal computers with components made by other manufacturers instead of their original components. Therefore it is easy to procure components for IBM-compatibles. IBM's BIOS is protected by copyright, but there are many software houses which legally offer BIOS compatible with IBM's.

The personal computer to be produced in Malaysia would be an IBM compatible in order to aim at the largest market, i.e., the U.S. and European market.

[2] It is estimated that computers using the Intel 80286 microprocessor chip as a CPU will be the predominant type of personal computer on the market for the coming several years. Although computers with the Intel 80386 chip CPU are estimated to become popular in the near future, its market share is presently not so large. In addition, it is considered easy to shift from the production of a 286 computer to a 386 computer.

[3] The demand for personal computers equipped with a hard disk drive is increasingly expanding. Therefore, it is considered necessary to produce both models; a model with HDD and a model without HDD.

[4] For a display controlling unit, VGA is regarded as the standard for 286 computers because 286 computer users require a higher resolution level.

2) Monitor

Assumed product model: Monitor for IBM personal computers and compatibles

The specifications of the model are as follows:

	Colour Display
Size	14 inches
Resolution	640 by 480 (VGA)
Dot Pitch	0.31 mm
Frequency	35 kilohertz

The reasons for choosing the above model are as follows:

[1] Specifications of monitor differ according to the architecture of personal computers. For example, an Apple computer or an NEC computer can not use monitors designed for IBM computers. Production of monitors for IBM computers and IBM compatibles, which have the largest market share in the markets in the U.S., Europe, and South East Asia, seems to be the most marketable.

[2] There are quite a few different standards, in terms of resolution (frequency and dot pitch) and colours, of monitors available for use with IBM computers and IBM compatibles. Although low-resolution monochrome displays are popularly used in South East Asia, a high-resolution colour display (VGA) has become popular in the U.S.

[3] In the low-priced low-resolution display market, Taiwan and Korean makers hold an unchallenged position.

It can be concluded that production of the high-resolution colour display (VGA) is desirable in Malaysia for the above mentioned reasons.

The procurement of a CDT is the most important factor in the production of monitors. The nonexistence of display production in Malaysia in spite of the active production of TVs is due to the difficulty in procuring industrial-use CDTs. Production of VGA displays needs a high resolution CDT of the 0.31mm dot pitch level. In this analysis, it is assumed that the procurement of CRTs necessary for a VGA display in Malaysia or from the neighbouring countries would be possible at the start of production.

3) Printer

Assumed product model: Printer for IBM computer and IBM compatibles

The specifications of the model are as follows:

Printing Method	Serial Impact Dot Matrix Method
Printing Head	24 pins
Printing Speed	120 characters per second

The reasons for choosing the above model are as follows:

[1] Dot matrix impact-method printers are the most popular printers for personal computers because the running cost is relatively small. Non-impact printers (such as ink jet printers) and page printers, characterised by high speed and high quality, are at present not popular due to the high price although they will be even more popular as they become cheaper.

[2] Considering the trend in the U.S. and Europe markets, relatively high quality and high speed printers of around the 24 pins and 120 cps level have a high marketability and are recommended to be produced in Malaysia.

4) Keyboard

Assumed product model: Keyboard for IBM personal computer and IBM compatibles

The reasons for choosing the above model are as follows:

- The highest demand for keyboards in the world market is that for IBM compatibles. There exists a distribution market of keyboards for IBM compatibles. So it is comparatively easy to find buyers for keyboards for IBM convertibles.

(2) Sales Plan and Production Capacity

1) Sales Plan

All the products would be exported to the U.S. and European markets. The plants would take over the production presently carried out in Japan, the U.S. or Europe which sales in Malaysia is possible, it may be safe to take no account of that possibility because the possible size of such sales in Malaysia is very small.

Sales would be wholly made on an L/C basis.

2) Production Capacity

[1] Personal computer factory

i) Maximum assembly production scale

Although the annual world demand for personal computers is 21 million units in 1989, there are a limited number of personal computer makers producing more than 20 thousand AT-type personal computers in the world.

Accordingly, even if a large personal computer maker with a large market share in the world set up a plant in Malaysia, the production scale would be 20 thousand units at most.

ii) Minimum economic scale of production

Surface mounting of PCB assembly can realise high reliability of the finished product and make the size of the finished product very small to a level which conventional mounting techniques can not achieve. It, however, costs much in equipment and materials for the moment. When production in Malaysia is considered, the assembly processes combining manual processes and automated process would have advantages in production cost against the fully automated PCB mounting process using chip parts and parts for surface mounting.

The optimum production scale of a final assembly line is 500 - 700 units a day when a conventional production process is adopted,

iii) Assumed production capacity

Considering the sales plan and minimum economic scale of production mentioned above, the production capacity of a personal computer plant to be established is assumed to be 12 thousand units a month (600 units/day x 20 days).

[2] Monitor plant

i) Minimum economic scale of production

The adjusting process takes the most time in assembling monitors. This process to minimise picture distortion is a value adding process, but it requires much time. The production scale suitable to this process is 550 units/day or 11,000 units/month per assembly line.

ii) Assumed production capacity

The monitor plant is assumed to have two assembly lines and total production capacity of 22,000 units/month, taking the optimum production capacity into consideration.

Production Volume	Monitors of own brand	12,000 units/month
	Monitors of OEM	10,000 units/month

[3] Printer plant

i) Maximum assembly production scale

The world's annual demand of printers was 12.8 million units in 1987. The production volume of printer factories of Japanese makers, major suppliers in the world market, is 80 to 200 thousand a month.

Considering such factors as the necessity of narrowing down product items, the possibility of parts procurement in Malaysia, production of parts in Malaysia, plant maintenance ability, and infrastructure, the maximum assembly production scale is assumed to be 20 thousand units/month.

ii) Minimum economic scale of production

The minimum economic scale of production is 10 thousand units/month, taking necessary overhead cost into consideration.

iii) Assembly production capacity

Production capacity of the printer plant is assumed to be 15 thousand units/month based upon the maximum assembly production scale and the minimum economic scale of production mentioned above.

[4] Keyboard plant

i) Assumed production capacity

The keyboard plant is assumed to have a production capacity of 20 thousand units a month considering the production capacity of a printing machine, that of moulding machine, and the optimum production scale of an assembly line.

II-4-3. Production and Sales Programmes

(1) Production Programme

Based on the assumed production capacity and operation ratio at the start, annual production volume of each plant is assumed as follows.

Table II.4-1 Production Programme of Personal Computer Factory

Unit: 1,000 units

	1st Year	2nd Year	3rd Year	4th Year	After 5th Year
Production Capacity	144.0	144.0	144.0	144.0	144.0
Model 1	72.0	72.0	72.0	72.0	72.0
Model 2	72.0	72.0	72.0	72.0	72.0
Annual Production	100.8	115.2	136.8	144.0	144.0
Volume					
Model 1	50.4	57.6	68.4	72.0	72.0
Model 2	50.4	57.6	68.4	72.0	72.0
Operating Ratio(%)	70	80	95	100	100

Table II.4-2 Production Programme of Monitor Factory

Unit: 1,000 units

	1st Year	2nd Year	3rd Year	4th Year	After 5th Year
Production Capacity	264.0	264.0	264.0	264.0	264.0
Annual Production Volume	184.8	211.0	251.0	264.0	264.0
Operating Ratio(%)	70	80	95	100	100

Table II.4-3 Production Programme of Printer Factory

Unit: 1,000 units

	1st Year	2nd Year	3rd Year	4th Year	After 5th Year
Production Capacity	180.0	180.0	180.0	180.0	180.0
Annual Production Volume	126.0	144.0	171.0	180.0	180.0
Operating Ratio(%)	70	80	95	100	100

Table II.4-4 Production Programme of Keyboard Factory

Unit: 1,000 units

	1st Year	2nd Year	3rd Year	4th Year	After 5th Year
Production Capacity	240.0	240.0	240.0	240.0	240.0
Annual Production Volume	168.0	168.0	168.0	168.0	168.0
Operating Ratio(%)	70	80	95	100	100

(2) Unit Sales Prices

The following unit sales prices, i.e., ex-factory prices, for the products of each factory were set taking into consideration ex-factory prices of the same type products produced at Japanese factories, and present transaction prices in the international market.

Table II.4-5 Unit Sales Prices

	Ex-factory Price (M$)	Domestic Distribution Cost (M$)	FOB Price (M$)
Personal Computer			
Model 1	2,102.94	42.06	2,145.00
Model 2	1,514.71	30.29	1,545.00
Monitor	518.69	10.37	529.07
Printer	436.27	8.73	445.00
Keyboard	96.10	1.90	97.00

Domestic distribution cost is estimated at 2% of ex-factory cost.

(3) CIF Prices at Overseas Markets

The CIF prices at major overseas markets of the products of each factory were calculated as follows.

Table II.4-6 Freight and Insurance Fee

Unit: M$

	Personal Computer Model 1	Personal Computer Model 2	Monitor	Printer	Keyboard
Freight:					
To U.S.A.	24.26	24.26	25.15	24.26	1.01
To Europe	24.63	24.63	25.66	24.63	1.03
Insurance:					
To U.S.A.	6.53	4.72	1.67	1.41	0.29
To Europe	6.53	4.72	1.67	1.41	0.29

Table II.4-7 CIF Prices at Overseas Markets

Unit: M$

	Personal Computer Model 1	Personal Computer Model 2	Monitor	Printer	Keyboard
FOB Price, Malaysia	2,145.00	1,545.00	529.07	445.00	97.00
CIF Price, USA	2,175.79	1,574.32	555.89	470.67	98.30
CIF Price, Europe	2,179.16	1,574.35	556.40	471.04	98.32

(4) Sales Programmes

Annual sales of each factory were projected as follows based on the above assumed production volume and unit sales price.

Table II.4-8 Sales Programme of Personal Computer Factories

Unit: 1,000 units

	1st Year	2nd Year	3rd Year	4th Year	After 5th Year
Personal Computer	182.33	208.38	247.45	260.47	260.47
Model 1	105.99	121.13	143.84	151.41	151.41
Model 2	76.34	87.25	103.61	109.06	109.06
Monitor	95.85	109.55	130.09	136.93	136.93
Printer	54.97	62.82	74.60	78.53	78.53
Keyboard	15.98	18.26	21.68	22.82	22.82

II-4-4. Location

(1) Location Selection

The following site conditions are required for the assumed personal computer and peripherals plants.

- Location convenient for transportation of final products and materials

- Existence of parts suppliers near the assumed plants

- Abundant labour force and easy employment of engineers and technicians

Major possible sites are the Kuala Lumpur area and the Penang area which have an advantage in port facilities handling exporting products and imported parts and materials.

It is impossible to decide on a specific site for the plants because a detailed site selection survey was not conducted in this survey. The feasibility analysis is carried out with the Bangi industrial estate being assumed as the condidate plant site for the sake of cost calculation.

(2) Land Cost

The land acquisition cost at the Bangi industrial estate is as follows.

Outline of Land Purchase Conditions

Purchase Method:		99 years lease
Land Price	:	M$80.73/m2

A plant site is assumed at twice the building floor space, the coverage ratio being 50%.

Land costs of the assumed personal computer and peripheral factories are as follows.

Table II.4-9 Land Costs

	Land Area(m2)	Land Cost(M$ Thousand)
Personal Computer Factory	8,000	645.83
Monitor Factory	8,800	710.42
Printer Factory	4,675	377.41
Keyboard Factory	4,675	377.41

II-4-5. Construction Costs

(1) Plant Construction Conditions

The conditions of plant construction were set as follows.

- Walls, ceilings, and floor are made up of formwork concrete.
- Pillarless structure is adopted for working area.
- Load capacity of floor is over 500kg/m2.
- Illuminance is 500 lux.
- Asbestos or asbestos-composites is not used inside the factory.
- Floor surface is finished with plastic tiles.
- Ceiling height is 5.5m.

Air-conditioning conditions were set as follows.

- Temperature: 25-25°C
- Humidity: 55-45°C
- The cleanness of air-conditioned room: Class 100 thousand at the time of operation
- Measures are taken to avoid dew concentration on goods in carried from the airconditioned room to the warehouse and from the warehouse to outside of the factory.
- The wind velocity: 0.5m/sec or less
- Intake of fresh air: 30 m3/hour*man
- Carbon dioxide concentration: 1,000ppm or less

- Ceiling height: 3.5m
- Load conditions were set as follows.

	Personal Computer Factory	Monitor Factory	Printer Factory	Keyboard Factory
Floor Space	50mx80m 4,000m2	55mx80m 4,400m2	40mx80m 3,200m2	40mx80m 2,275m2
Ventilation	500m3/h			
Power Load	1,000KWH			

(2) Factory Construction Costs

The factory construction costs are assumed as follows.

Table II.4-10 Plant Construction Costs

Unit : M$1,000

		Personal Computer Factory	Monitor Factory	Printer Factory	Keyboard Factory
(1)	Site works, roads, turfing, and landscaping	432.43	475.68	252.70	252.70
(2)	Building Cost	2,729.73	3,002.70	1,552.53	1,552.53
(3)	Air-conditioning service	1,500.00	1,500.00	1,500.00	1,500.00
(4)	Electrical services	1,300.00	1,300.00	1,300.00	1,300.00
(5)	Fire fighting	100.00	100.00	100.00	100.00
(6)	Sanitary, plumbing, and water supply	200.00	200.00	200.00	200.00
	Total	6,262.16	6,578.38	5,282.65	4,905.24

(3) Machinery and Equipment

The procurement cost of production facilities for each factory is assumed as follows.

Table II.4-11 Procurement Cost of Production Facilities

Unit : M$1,000

	Personal Computer Factory	Monitor Factory	Printer Factory	Keyboard Factory
FOB Price, Japan	4,199.43	3,788.90	17,329.26	4,506.69
Transportation, Insurance, and Installation Cost (FOB Price x 10%)	419.94	378.89	1,732.93	405.67
Spares & Consumables (FOB Price x 10%)	419.94	378.89	1,732.93	405.67
Expense on Experts (FOB Price x 3%)	125.98	113.67	519.80	121.70
Total	5,165.30	4,660.35	21,314.98	4,989.72

As the production of printers is quite a new type of manufacture in Malaysia, the printer factory in study is assumed to procure up-to-date equipment and the equipment cost of the printer factory becomes far larger than those of the other factories.

(4) Moulds and Jigs

Investment for renewal of moulds and jigs would be made every 2 years.

Table II.4-12 Moulds and Jigs Costs

Unit : M$1,000

	Personal Computer Factory	Monitor Factory	Printer Factory	Keyboard Factory
Investment in Moulds and Jigs Every 2 Years	725.01	611.08	10,357.34	1,575.14

(5) Office Equipment, Vehicles, and Others

The cost of equipment besides production equipment such as office equipment, vehicles, etc., is estimated as follows.

Table II.4-13 Office Equipment, Vehicles, and Others Costs

Unit : M$1,000

	Personal Computer Factory	Monitor Factory	Printer Factory	Keyboard Factory
Office Equipment, Vehicles, and Others	400.0	400.0	400.0	400.0

(6) Depreciation

The following depreciation methods are adopted for the calculation of depreciation expenses.

Depreciation Method

Building	35 Years Straight Line Depreciation
Auxiliary Facilities	15 Years Straight Line Depreciation
Production Facilities	10 Years Straight Line Depreciation
Moulds and Jigs	2 Years Straight Line Depreciation
Office Equipment and Vehicles	5 Years Straight Line Depreciation

The annual depreciation expenses can be calculated as follows based on the above mentioned depreciation methods.

Table II.4-14 Depreciation Expenses for the First Year

Unit : M$1,000

	Personal Computer Factory	Monitor Factory	Printer Factory	Keyboard Factory
Building	77.99	85.79	44.36	44.36
Auxiliary Facilities	206.67	206.67	206.67	206.67
Production Facilities	516.53	516.53	516.53	516.53
Moulds and Jigs	362.51	305.54	5,178.67	787.57
Office Equipment and Vehicles	80.00	80.00	80.00	80.00
Total	1,243.70	1,144.03	7,561.19	1,617.57

II-4-6. Materials Purchase Programme

According to the results of the survey on the availability of parts in Malaysia, parts and materials procurement programme by source of suppliers: Malaysia; neighbouring Asian countries/areas such as Taiwan and Singapore; and Japan was made for each factory. These material purchase programmes are based on the assumption that investment by foreign parts suppliers in Malaysia and its neighbouring countries and the development of supporting industries in this area would continue to advance steadily in the future.

Material costs per unit are estimated as follows.

Table II.4-15 Unit Material Cost

Unit: M$

	1st Year		10th Year	
Personal Computer Model 1				
Model 1	2,065.92	(100.0%)	1,892.07	(100.0%)
Materials/Malaysia	256.38	(12.4%)	1,046.24	(55.3%)
Materials/Other Asia	1,239.83	(60.0%)	682.07	(36.0%)
Materials/Japan	569.71	(27.6%)	163.76	(8.7%)
Model 2	1,481.82	(100.0%)	1,324.19	(100.0%)
Materials/Malaysia	256.38	(17.3%)	770.41	(58.2%)
Materials/Other Asia	655.73	(44.3%)	390.02	(29.5%)
Materials/Japan	569.71	(38.4%)	163.76	(12.4%)
Monitor	490.72	(100.0%)	458.38	(100.0%)
Materials/Malaysia	101.35	(20.7%)	273.08	(59.6%)
Materials/Other Asia	196.76	(40.1%)	170.57	(37.2%)
Materials/Japan	192.61	(39.3%)	14.73	(3.2%)
Printer	363.42	(100.0%)	458.38	(100.0%)
Materials/Malaysia	70.75	(19.5%)	108.19	(32.3%)
Materials/Other Asia	57.27	(15.8%)	99.54	(29.8%)
Materials/Japan	235.40	(64.8%)	126.80	(37.9%)
Keyboard	72.22	(100.0%)	66.40	(100.0%)
Materials/Malaysia	39.75	(55.0%)	63.15	(95.1%)
Materials/Other Asia	0.00	(0.0%)	0.00	(0.0%)
Materials/Japan	32.47	(45.0%)	3.24	(4.9%)

Annual material costs are calculated as follows according to the unit material costs and the production programmes.

Table II.4-16 Material Costs Estimates

Unit : M$1,000

	Personal Computer Factory	Monitor Factory	Printer Factory	Keyboard Factory
1st Year	178,806	90,685	45,791	12,133
2nd Year	202,228	102,881	51,870	13,742
3rd Year	237,627	121,269	61,047	16,171
4th Year	247,482	126,703	63,682	16,867
5th Year	244,830	125,755	63,104	16,711
6th Year	242,178	124,806	62,526	16,556
7th Year	239,526	123,857	61,948	16,401
8th Year	236,875	122,909	61,371	16,246
9th Year	234,223	121,960	60,793	16,090
10th Year	231,571	121,011	60,215	15,935

II-4-7. Expenses for Indirect Material, Utilities, Other Indirect Expenses, and Administration Expense

(1) Indirect Material Expense

Considering the examples of factories in Japan and the price level of Malaysia, expenses for indirect materials are estimated as follows.

Personal Computer Factory	0.60% of production cost
Monitor Factory	0.60% of production cost
Printer Factory	0.55% of production cost
Keyboard Factory	0.56% of production cost

(2) Other indirect expenses

Personal Computer Factory	2.5% of production cost
Monitor Factory	2.5% of production cost
Printer Factory	2.5% of production cost
Keyboard Factory	3.3% of production cost

(3) Administration expense

Considering the examples of factories in Japan and the price level of Malaysia, administration expenses are estimated as follows.

Personal Computer Factory	0.53% of sales
Monitor Factory	1.01% of sales
Printer Factory	1.63% of sales
Keyboard Factory	4.50% of sales

II-4-8. Personnel Programme

(1) Assumptions of personnel planning

The following assumptions of factory operation were set in order to estimate the number of personnel necessary for the operation of the assumed plants.

Assumptions of Factory Operation

Yearly Working Days	250 days/year
Working Hours	8 hours/day
Interval	60 minutes/day
Work Attendance Ratio	95%
Work Shift	3 shifts for automated work and aging process 1 shift for other work

(2) Personnel and Personnel Expense

The number of personnel necessary for the operation of each assumed factory was surveyed by type of work. Personnel unit costs including fringe benefits and bonus were estimated based on statistical data and the results of field interviews in Malaysia.

Personnel unit costs were assumed to increase by 8% every 2 years.

The number of necessary personnel, personnel unit cost, and annual personnel expense calculated according to the above data are shown in Table II.4-17 to Table II.4-20.

The annual personnel expenses shown above were calculated on the assumption that the factory operating ratios would be 100%. However, direct labour costs for the first 3 years were downwardly adjusted to assumed operating ratios of 70% in the first year, 80% in the second year and 95% in the third year of operation. And those downwardly adjusted direct labour costs are reflected in the calculation of factory feasibility.

Table II.4-17 Annual Personnel Cost of Personal Computer Factory*

Section & Type of Personnel	Number	Unit Monthly Cost(1st Year) (M$/Year)	Annual Cost for 1st Year (M$ Thousand)	Annual Cost for 10th Year (M$ Thousand)
Direct Production				
Un-skilled Worker	54	3,990	215.5	293.1
Skilled Worker	26	4,550	118.3	160.9
Supervisor	5	10,400	52.0	70.7
Japanese Engineer	1	180,000	180.0	244.9
Sub-total	86	—	565.8	769.7
Production Support (Technology, Production Management, Quality Control, Purchase, etc.)				
Clerk	9	4,940	44.5	60.5
Staff Worker	9	5,850	52.7	71.6
Technician	6	7,540	45.2	61.5
Supervisor	2	10,400	20.8	28.3
Engineer	4	15,600	62.4	84.9
Japanese Engineer	1	180,000	180.0	244.9
Sub-total	31	—	405.6	551.7
Administration				
Clerk	6	4,940	29.6	40.3
Staff Worker	5	5,850	29.3	39.8
Manager	1	32,500	32.5	44.2
Japanese Manager	1	225,000	225.0	306.1
Sub-total	13	—	316.4	430.4
Total	130	—	1,287.7	1,751.9

* The factory operating ratio is assumed to be 100%.

Table II.4-18 Annual Personnel Cost of Monitor Factory*

Section & Type of Personnel	Number	Unit Monthly Cost(1st Year) (M$/Year)	Annual Cost for 1st Year (M$ Thousand)	Annual Cost for 10th Year (M$ Thousand)
Direct Production				
Un-skilled Worker	98	3,990	391.02	531.98
Skilled Worker	49	4,550	222.95	303.32
Supervisor	8	10,400	82.20	113.19
Japanese Engineer	1	180,000	180.00	244.89
Sub-total	156	—	877.17	1,193.38
Production Support (Technology, Production Management, Quality Control, Purchase, etc.)				
Clerk	9	4,940	44.46	60.49
Staff Worker	9	5,850	52.65	71.63
Technician	6	7,540	45.24	61.55
Supervisor	2	10,400	20.80	28.30
Engineer	4	15,600	62.40	84.89
Japanese Engineer	1	180,000	180.00	244.89
Sub-total	31	—	405.55	551.75
Administration				
Clerk	6	4,940	29.64	40.32
Staff Worker	5	5,850	29.25	39.79
Manager	1	32,500	32.50	44.22
Japanese Manager	1	225,000	225.00	306.11
Sub-total	13	—		
Total	200	—	1,599.11	2,175.57

* The factory operating ratio is assumed to be 100%.

Table II.4-19 Annual Personnel Cost of Printer Factory*

Section & Type of Personnel	Number	Unit Monthly Cost(1st Year) (M$/Year)	Annual Cost for 1st Year (M$ Thousand)	Annual Cost for 10th Year (M$ Thousand)
Direct Production				
Un-skilled Worker	70	3,990	279.30	379.98
Skilled Worker	35	4,550	159.25	216.66
Sub-total	105	—	438.55	596.64
Production Support (Technology, Production Management, Quality Control, Purchase, etc.)				
Clerk	4	4,940	19.76	26.88
Staff Worker	3	5,850	17.55	23.88
Technician	3	7,540	22.62	30.77
Supervisor	8	10,400	83.20	113.19
Engineer	4	15,600	62.40	84.89
Manager	1	32,500	32.50	44.22
Japanese Engineer	1	180,000	180.00	244.89
Sub-total	24	—		
Administration				
Clerk	6	4,940	29.64	40.32
Staff Worker	1	5,850	5.85	7.96
Supervisor	2	15,600	31.20	42.89
Japanese Stuff	1	180,000	180.00	244.89
Japanese Manager	1	225,000	225.00	306.11
Sub-total	11	—	471.69	641.73
Total	140	—	1,328.27	1,807.10

* The factory operating ratio is assumed to be 100%.

Table II.4-20 Annual Personnel Cost of Keyboard Factory*

Section & Type of Personnel	Number	Unit Monthly Cost(1st Year) (M$/Year)	Annual Cost for 1st Year (M$ Thousand)	Annual Cost for 10th Year (M$ Thousand)
Direct Production				
Un-skilled Worker	123	3,900	479.70	652.63
Skilled Worker	23	4,550	104.65	142.38
Sub-total	146	—	584.35	795.00
Production Support (Technology, Production Management, Quality Control, Purchase, etc.)				
Clerk	5	4,940	24.70	33.60
Staff Worker	6	5,850	35.10	47.75
Technician	4	10,400	30.16	41.03
Supervisor	4	15,600	41.60	56.60
Manager	1	32,500	32.50	44.22
Japanese Engineer	1	180,000	180.00	244.89
Japanese Staff	1	180,000	180.00	244.89
Sub-total	22	—	524.06	712.98
Administration				
Clerk	2	4,940	9.88	13.44
Staff Worker	1	5,850	5.85	7.96
Supervisor	1	15,600	15.60	21.22
Manager	1	32,500	32.50	44.22
Japanese Manager	1	225,000	225.00	306.11
Sub-total	6	—	288.83	392.95
Total	174	—	1,397.24	1,900.93

* The factory operating ratio is assumed to be 100%.

II-4-9. Calculation of Investment

(1) Initial Investment

1) Initial Fixed Investment

Based on the necessary investment costs mentioned, initial fixed investment for each factory is assumed to be as follows.

Table II.4-21 Initial Fixed Investment Costs

Unit : M$ 1,000

	Personal Computer Factory	Monitor Factory	Printer Factory	Keyboard Factory
Land	645.8	710.4	377.4	377.4
Factory Construction	6,262.2	6,578.4	4,905.2	4,905.2
Machinery and Equipment	5,165.3	4,660.4	21,315.0	4,989.7
Moulds and Jigs	725.0	611.1	10,375.3	1,575.1
Office equipment, vehicles, etc.	400.0	400.0	400.00	400.00
Total	13,198.3	12,960.2	37,355.0	12,247.5

2) Organization Expenses

Organization expenses occurring as regards the foundation are estimated at 3% of initial fixed investment.

3) Contingency Cost

The amount of 5% of initial fixed investment is assumed as contingency cost.

(2) Working Capital

Working capital is assumed to be two thirds of monthly sales.

II-4-10. Financing Programme

Approximately one third of the initial investment and working capital for the first operation year is assumed to be procured from paid-up capital and the remaining two thirds from long-term borrowing.

Necessary funds after the start of operation are to be financed by short-term borrowing from financial institutions.

Interest rates of both long-term and short-term borrowings are assumed to be 9% per annum.

Initial Investment Financing Programme

	Amount(M$ Thousand)	Conditions
Personal Computer Factory		
Paid-up Capital	8,200	
Long-term Borrowing	16,200	10 years average repayment Interest rate 9%
Monitor Factory		
Paid-up Capital	6,500	
Long-term Borrowing	12,900	10 years average repayment Interest rate 9%
Printer Factory		
Paid-up Capital	14,500	
Long-term Borrowing	28,900	10 years average repayment Interest rate 9%
Keyboard Factory		
Paid-up Capital	4,900	
Long-term Borrowing	9,700	10 years average repayment Interest rate 9%

II-4-11. Results of Financial Analysis

Projection of long-term profit and loss for each plant based on the estimated sales and costs was calculated. The profit and loss projection are shown in Table II.4-22 to Table II.4-25.

The results of financial analysis can be summarised as follows.

Table II.4-26 Outline of Results of Financial Analysis

	Personal Computer Factory	Monitor Factory	Printer Factory	Keyboard Factory
Total initial investment (M$ thousand)	14,254	13,997	40,343	13,227
Annual sales (10th Year) (M$ thousand)	260,471	136,935	78,529	22,824
Annual sales/ total initial investment (10th Year) (Times)	18.3	9.8	1.9	1.7
Net operating profit	From 4th year of operation	From 3rd year of operation	From 3rd year of operation	From 2nd year of operation
Operating profit ratio (10th Year) (%)	6.4	5.2	6.9	7.0
Year when accumulated losses are wiped out	8th year	5th year	7th year	5th year

Table II. 4-22 Long-Term Flow of Profit and Loss Projection of Assumed Personal Computer Factory

(Unit: M$ Thousand)

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
Sales	182,329	208,376	247,447	260,471	260,471	260,471	260,471	260,471	260,471	260,471
Direct Material Cost	178,806	202,228	237,627	247,482	244,830	242,178	239,526	236,875	234,223	231,571
Indirect Material Cost	1,119	1,264	1,485	1,546	1,530	1,514	1,499	1,482	1,466	1,450
Direct Labour Cost	396	453	580	611	660	660	713	713	770	770
Indirect Labour Cost	406	406	438	438	473	473	511	511	552	552
Expenses Depreciation Expense	1,117	1,117	1,117	1,117	1,117	1,268	1,268	1,268	1,268	1,268
Others	4,663	5,268	6,186	6,441	6,375	6,375	6,375	6,375	6,375	6,375
Manufacturing Cost	186,506	210,736	247,433	257,635	254,985	252,468	249,891	247,223	244,653	241,985
Gross Margin	-4,177	-2,360	14	2,836	5,486	8,002	10,579	13,248	15,817	18,486
Labour Cost	316	316	342	342	369	369	399	399	430	430
Expenses Depreciation Expense	126	126	126	126	126	126	126	126	126	126
Others	966	1,104	1,311	1,380	1,380	1,380	1,380	1,380	1,380	1,380
Administration Expenses	1,409	1,547	1,779	1,848	1,876	1,876	1,905	1,905	1,937	1,937
Operating Profit	-5,586	-3,907	-1,765	987	3,610	6,127	8,674	11,342	13,880	16,548
Non-Operating Expenses	1,385	1,307	1,517	1,740	1,639	1,331	785	219	0	0
Net Profit	-6,971	-5,214	-3,282	-752	1,971	4,796	7,889	11,124	13,880	16,548

Table II. 4-23 Long-Term Flow of Profit and Loss Projection of Assumed Monitor Factory

(Unit: M$ Thousand)

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
Sales	95,854	109,548	130,088	136,935	136,935	136,935	136,935	136,935	136,935	136,935
Direct Material Cost	90,685	102,881	121,269	126,703	125,755	124,806	123,857	122,909	121,960	121,011
Indirect Material Cost	574	650	766	800	794	789	783	778	772	767
Direct Labour Cost	614	702	900	947	1,023	1,023	1,105	1,105	1,193	1,193
Indirect Labour Cost	406	406	438	438	473	473	511	511	552	552
Expenses Depreciation Expense	1,044	1,044	1,044	1,044	1,044	1,044	1,044	1,044	1,044	1,044
Others	2,393	2,710	3,190	3,332	3,310	3,310	3,310	3,310	3,310	3,310
Manufacturing Cost	95,715	108,392	127,607	133,264	132,399	131,445	130,611	129,656	128,832	127,877
Gross Margin	139	1,156	2,481	3,671	4,536	5,490	6,324	7,279	8,103	9,058
Labour Cost	316	316	342	342	369	369	399	399	430	430
Expenses Depreciation Expense	100	100	100	100	100	100	100	100	100	100
Others	970	1,109	1,317	1,386	1,386	1,386	1,386	1,386	1,386	1,386
Administration Expenses	1,387	1,525	1,759	1,828	1,855	1,855	1,885	1,885	1,917	1,917
Operating Profit	-1,248	-369	722	1,843	2,680	3,635	4,440	5,394	6,187	7,141
Non-Operating Expenses	1,103	987	871	406	0	0	0	0	0	0
Net Profit	-2,351	-1,356	-148	1,437	2,680	3,635	4,440	5,394	6,187	7,141

Table II. 4-24 Long-Term Flow of Profit and Loss Projection of Assumed Printer Factory

(Unit: M$ Thousand)

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
Sales	54,971	62,824	74,603	78,529	78,529	78,529	78,529	78,529	78,529	78,529
Direct Material Cost	45,791	51,870	61,047	63,682	63,104	62,526	61,948	61,371	60,793	60,215
Indirect Material Cost	307	341	394	409	406	403	400	397	394	391
Direct Labour Cost	307	351	450	474	512	512	552	552	597	597
Indirect Labour Cost	418	418	451	451	488	488	527	527	569	569
Expenses Depreciation Expense	7,523	7,523	7,523	7,523	7,523	7,523	7,523	7,523	7,523	7,523
Others	1,393	1,551	1,791	1,860	1,847	1,832	1,819	1,804	1,792	1,777
Manufacturing Cost	55,739	62,054	71,656	74,399	73,879	73,283	72,770	72,173	71,666	71,070
Gross Margin	-768	769	2,946	4,131	4,650	5,246	5,760	6,356	6,863	7,459
Labour Cost	472	472	509	509	550	550	594	594	642	642
Expenses Depreciation Expense	119	119	119	119	119	119	119	119	119	119
Others	896	1,024	1,216	1,280	1,280	1,280	1,280	1,280	1,280	1,280
Administration Expenses	1,486	1,614	1,844	,1908	1,949	1,949	1,993	1,993	2,040	2,040
Operating Profit	-2,254	-845	1,102	2,222	2,701	3,297	3,767	4,363	4,823	5,419
Non-Operating Expenses	2,471	2,211	1,951	910	0	0	0	0	0	0
Net Profit	-4,725	-3,056	-848	1,312	2,701	3,297	3,767	4,363	4,823	5,419

Table II. 4-25 Long-Term Flow of Profit and Loss Projection of Assumed Keyboard Factory

(Unit: M$ Thousand)

	1st Year	2nd Year	3rd Year	4th Year	5th Year	6th Year	7th Year	8th Year	9th Year	10th Year
Sales	15,977	18,259	21,683	22,824	22,824	22,824	22,824	22,824	22,824	22,824
Direct Material Cost	12,133	13,742	16,171	16,867	16,711	16,556	16,401	16,246	16,090	15,935
Indirect Material Cost	85	98	116	122	122	122	122	122	122	122
Direct Labour Cost	409	467	600	631	682	682	736	736	795	795
Indirect Labour Cost	524	524	566	566	611	611	660	660	713	713
Expenses Depreciation Expense	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443	1,443
Others	502	593	679	705	704	700	699	695	694	690
Manufacturing Cost	15,096	16,867	19,575	20,334	20,273	20,114	20,061	19,902	19,858	19,698
Gross Margin	880	1,392	2,108	2,490	2,551	2,710	2,763	2,922	2,966	3,125
Labour Cost	289	289	312	312	337	337	364	364	393	393
Expenses Depreciation Expense	110	110	110	110	110	110	110	110	110	110
Others	719	822	976	1,027	1,027	1,027	1,027	1,027	1,027	1,027
Administration Expenses	1,118	1,220	1,397	1,449	1,474	1,474	1,501	1,501	1,530	1,530
Operating Profit	-237	172	710	1,041	1,077	1,236	1,262	1,421	1,436	1,596
Non-Operating Expenses	829	742	655	306	0	0	0	0	0	0
Net Profit	-1,067	-570	50	736	1,077	1,236	1,262	1,421	1,436	1,596

The financial internal rates of return (FIRR) in the case of a 10-year-project period were calculated. The FIRR for each factory is as follows.

	FIRR
Personal Computer Factory	11.83%
Monitor Factory	10.58%
Printer Factory	6.57%
Keyboard Factory	7.22%

When the internal rates of return are compared for the four assumed factories, the investment in the personal computer factory is the most favourable, followed by the monitor factory, the keyboard factory, and the printer factory.

The ratios of annual sales (10th year) to total initial investment of the personal computer factory and the monitor factory are comparatIlely high, 18.3 times and 9.8 times respectively, against 1.9 times for the printer factory and 1.7 times for the keyboard factory. The difference in these ratios has an influence on the results of financial analysis of the assumed factories.

For indices concerning annual operating profits, the profitability of the personal computer factory is low compared to the printer factory and the keyboard factory, however, the personal computer factory has the highest internal rate of return among the four factories. The second highest rate of return is shown by the monitor factory in spite of the fact that its operating profit, just like that of the personal computer factory, was unfavourable compared to the printer factory and the keyboard factory. The keyboard factory shows the most favourable results for indices related to annual operating profits, but it marked the third best rate of return. The internal rate of return of the printer factory is the worst among the four, which is considered to be attributable to the necessary initial investment which is relatIlely large against the size of sales.

These FIRRs are not necessarily high enough to invite foreign investment. But it can be said that they, at least, reach the minimum level of the project being viable.