Table III.3-14 U.S. Casting Production (1979-87)

(Unit: tons)

Material	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Gray cast iron	11,415,062	10,783,290	8,372,286	8,826,266	5,799,483	6,585,700	7,293,376	6,501,020	4,946,562	5,159,248
Ductile cast iron	2,606,125	2,444,207	2,146,739	1,996,986	1,633,207	1,801,804	2,367,867	2,342,813	2,271,533	2,648,117
Cast iron (total)	(14,021,187)	(13,227,497)	(10,519,025)	(10,823,252)	(7,432,690)	(8,387,504)	(9,661,243)	(8,843,833)	(7,218,095)	(7,807,365)
Malleable cast iron	739,740	659,007	418,568	381,899	258,268	264,071	326,619	339,378	469,739	288,490
Steel casting	1,689,552	1,841,894	1,680,518	1,589,722	930,497	662,291	868,338	808,182	876,891	752,976
Copper alloy	257,581	268,722	221,832	213,507	183,591	191,275	283,652	235,003	216,550	216,237
Aluminum	911,356	899,802	697,948	717,495	592,512	680,170	830,301	1,010,808	1,032,224	1,012,501
Magnesium	21,708	14,844	11,091	10,680	6,077	5,372	256,357	11,276	17,973	10,342
Zinc	273,127	234,491	157,001	152,568	117,761	130,761	1,987	231,719	225,117	218,178
Others	15,365	11,492	—	—	—	—	—	—	—	21,364
Total	17,929,616	17,157,749	13,705,983	13,889,123	9,521,396	10,321,444	12,228,497	11,480,199	10,056,589	10,327,453

Source: Annual December issue of Modern Casting

Demand for non-ferrous metals is as follows: automotive, 57%; machinery and equipment, 9%; valves and pipe fittings, 7%; and miscellaneous, 27%.

These figures were taken from a the Materials Process Center of Japan report entitled, "Survey of Materials Industries in Leading Producer Nations." According to this report, the major problems currently facing the U.S. casting industry are as follows: (1) pollution and safety guidelines (OSHA) and the problem of product lifetime are causing a great drain on corporate profitability; (2) the casting industry offers higher wages than the machinery industry despite producing less added value; (3) strong labor unions prevent the rationalization of operations, thereby hindering the improvement of productivity and quality control; (4) young technicians and engineers do not want to work for companies in the casting industry; (5) the labor force is of poor quality; (6) worker expertise, experience, and skills are lost through frequent lay-offs; and (7) firms tend to opt for the easy route of foreign sourcing rather than trying to improve local operations.

Fig. III. 3-8 Breakdown of U.S. Cast Iron Shipments by Use (1987)

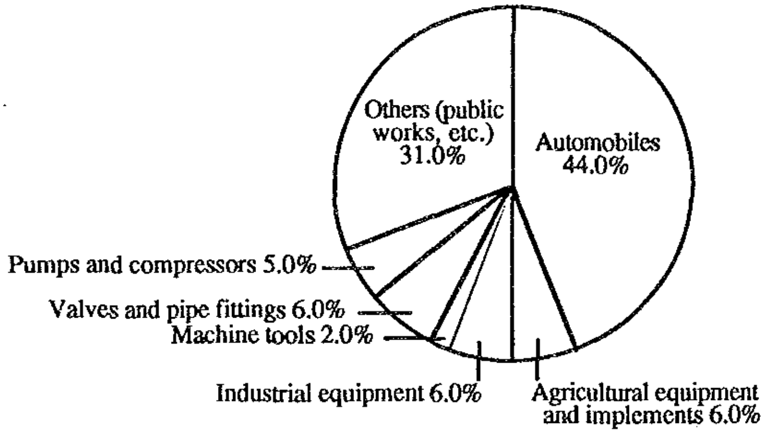


Table III. 3-15 Breakdown of U.S. Cast Iron Shipments by Use (1987)

Use	Share (%)
Automobiles	44%
Agricultural equipment and implements	6%
Mining equipment and implements	1%
Construction equipment and implements	1%
Cooling and heating equipment	1%
Piping facilities	1%
Industrial equipment	6%
Machine tools	2%
Valves and pipe fittings	6%
Pump and compressors	5%
Other (public works, etc.)	27%
Total	100%

Fig. III. 3-9 Breakdown of U.S. Steel Casting Shipments by Use (1987)

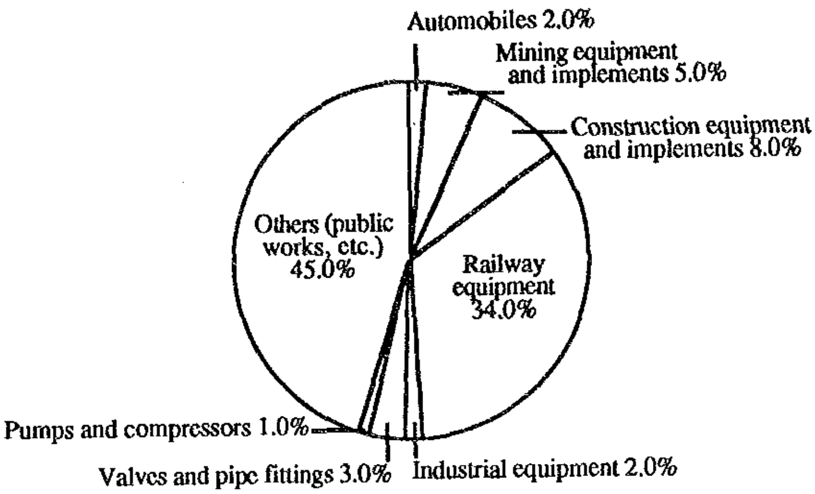


Table III. 3-16 Breakdown of U.S. Steel Casting Shipments by Use (1987)

Use	Share (%)
Automobiles	2%
Mining equipment and implements	5%
Construction equipment and implements	8%
Railway implement	34%
Industrial equipment	2%
Valves and pipe fittings	3%
Pump and compressors	1%
Other (public works, etc.)	45%
Total	100%

Fig. III. 3-10 Breakdown of U.S. Non-ferrous Metal Shipments by Use (1987)

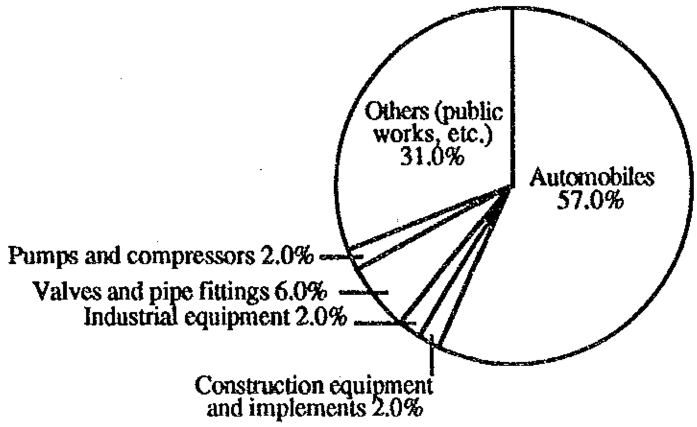


Table III. 3-17 Breakdown of U.S. Non-ferrous Metal Shipments by Use (1987)

Use	Share (%)
Automobiles	57%
Agricultural equipment and implements	1%
Mining equipment and implements	-%
Construction equipment and implements	2%
Cooling and heating equipment	1%
Piping facilities	1%
Industrial equipment	2%
Machine tools	1%
Valves and pipe fittings	6%
Pump and compressors	2%
Miscellaneous (consumer product-related)	27%
Total	100%

(3) West Germany

Table III.3-18 shows West German production of castings for the ten-year period 1978-87. Total 1978 production of 4,345,000 tons rose 6.9% in the following year to 4,646,000 tons but thereafter dropped until reaching 3,757,000 tons (down 13.5% from 1978) in 1983. Production later recovered but again fell to 3,799,000 tons (down 12.6% from 1978) in 1987. When broken down by material, production of gray cast iron rose 6.7% in 1979 to 2,966,000 tons but then embarked on a downward spiral that ended with a decade-low figure of 2,169,000 tons in 1987 (down 26.9% from 1979).

Production of ductile cast iron rose from 636,000 tons in 1978 to 826,400 tons in 1982 (up 29.9%), and after repeated increases and decreases ended up at 742,000 tons (up 16.7% from 1978) in 1987. Malleable cast iron production gradually declined from a figure of 212,000 tons in 1978 to 119,000 tons (down 43.9% from 1978) in 1987. The same pattern held for steel casting production, which fell from 268,000 tons in 1978 to 185,000 tons (down 31.0% from 1978) in 1987. Both of these materials are thought to have been replaced by demand for ductile cast iron. Production of non-ferrous metal castings amounted to 449,000 tons in 1978, and after continued ups and downs experienced a turnaround in 1985, growing to 584,000 tons (up 30.0% from 1978) by 1987.

Table III.3-19 shows a breakdown of production of castings by demand industry. The two leading demand sectors for gray cast iron in 1987 were transportation equipment, at 1,017,500 tons (46.9%), and machinery and equipment, at 712,300 tons (32.8%). Together, the two sectors accounted for 79.7% of total demand. Similar figures were shown for ductile cast iron: transportation equipment, 281,800 tons (37.9%); pressure pipes and fittings, 230,100 tons (31.0%); and machinery and equipment, 179,200 tons (24.2%). For malleable cast iron the leading demand sectors were transportation equipment, at 69,200 tons (58.2%), and "other," at 45,000 tons (37.9%). Demand for steel casting can be broken down as follows: machinery and equipment, 69,200 tons (37.4%); transportation equipment, 17,200 tons (9.3%); railway-related, 3,900 tons (2.1%); and "other," 94,600 tons (51.2%).

Table III.3-18 West German Casting Production by Material

(Unit: 1,000 tons)

		Cast iron				
	Total	Gray cast iron	Ductile cast iron	Malleable cast iron	Steel casting	Non-ferous metals
1978	4,345	2,780	636.0	212	268	449
1979	4,646	2,966	681.9	217	301	480
1980	4,392	2,742	693.2	187	294	476
1981	4,134	2,509	746.5	147	281	451
1982	3,931	2,287	826.4	136	252	429
1983	3,757	2,191	776.4	138	207	446
1984	3,863	2,268	769.0	132	218	476
1985	3,999	2,343	802.0	126	228	494
1986	3,979	2,296	806.0	126	224	587
1987	3,779	2,169	742.0	119	185	584

Source: Die Europaische Giesserei-Industrie im Jahre (CAEF)
Non-ferrous metals Bericht uber das Geschaftsjahre (GDM)

Table III.3-19 West German Casting Production by Use

(Unit: 1,000 tons)

	1986				1987			
	Gray cast iron	Ductile cast iron	Malleable cast iron	Steel casting	Gray cast iron	Ductile cast iron	Malleable cast iron	Steel casting
Pressure tubes and fittings	5.8	266.6	—	—	4.8	230.1	—	—
Water pipes and fittings	12.9	—	—	—	12.8	—	—	—
Construction and household use	98.0	—	—	—	93.5	—	—	—
Ingot molds and stools	67.6	—	—	—	37.9	—	—	—
Rolls	28.6	—	—	—	25.9	—	—	—
Machinery and equipment	788.7	196.4	4.6	74.0	712.3	179.2	4.6	69.2
Transportation equipment	1,012.5	282.0	71.7	20.3	1,017.5	281.8	69.2	17.2
Fittings	—	—	—	—	—	—	—	—
Railroad-related	—	—	—	3.9	—	—	—	3.9
Others	282.0	61.0	49.2	125.7	264.7	50.8	45.0	94.6
Total	2,296.0	806.0	125.5	223.9	2,169.4	741.9	118.8	184.9

Source: Same as Table III.3-18
Note: *Includes ingot molds and roll drainage devices.

Table III.3-20 shows the number of plants and employees together with shipment values for non-ferrous metals. According to Table III.3-20, 70.6% of the plants had fewer than 50 employees, with another 12.1% having 50-99. These two groups thus accounted for 82.7% of the total. However, plants with fewer than 50 employees accounted for only 15.5% of the total work force, while those with 50-99 workers were responsible for 12.0%. Plants with at least 100 workers employed 72.5% of the work force.

Table III.3-21 shows direct exports of castings by West Germany.

Table III.3-20 West German Production of Non-ferrous Castings

(Unit: 1,000 tons)

	Foundries				Employees				Shimpment value			
	Number		Share of total		Number		Share of total		1,000DM		Share of total	
	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986	1985	1986
1-9	153	135	32.3	29.2	752	683	2.3	2.0	7,628	6,935	2.2	1.8
10-19	95	96	20.0	20.7	1,309	1,347	3.9	3.9	14,235	14,528	4.1	3.8
20-49	95	96	20.0	20.7	3,266	3,292	10.0	9.6	36,946	35,628	10.6	9.4
50-99	55	56	11.6	12.1	3,943	4,134	12.0	12.0	38,537	41,392	11.1	10.9
100-199	44	43	9.3	9.3	6,520	6,131	19.9	17.9	75,265	71,071	21.6	18.8
200-499	23	27	4.9	5.8	6,850	7,835	20.9	22.8	73,980	88,226	21.2	23.3
≥500	9	10	1.9	2.2	10,168	10,940	31.0	31.8	101,837	121,194	29.2	32.0
Total	474	463	100.0	100.0	32,808	34,362	100.0	100.0	348,428	378,974	100.0	100.0

Source: Bericht Uber das Geschaflsjhr 1985, '86(GDM)
Note: Figures as of September 1985

Table III.3-21 Direct Exports of Castings by West Germany

(Unit: 1,000 tons)

	1980	1981	1982	1983	1984	1985	1986	1987
Cast iron cast	453.0	495.1	507.1	500.1	541.3	520.7	499.8	472.5
Malleable cast iron	25.6	22.7	21.5	26.7	30.5	31.0	30.9	29.9
Steel casting	44.9	42.4	40.7	32.9	36.4	42.2	39.7	33.2
Total	523.5	560.2	569.3	559.7	608.2	593.9	570.4	535.6
Change over previous year	Δ10.3	7.0	1.6	Δ1.7	8.7	Δ2.4	Δ4.0	Δ6.1

Source: Same as Table III.3-18.

(4) U.K.

Table III.3-22 gives a breakdown of U.K. production of castings by material.

U.K. casting production has fallen by almost 50% during the last ten years. The 1978 figure of 3,081,600 dropped continually and had fallen to 1,363,900 tons (down 55.7% from 1978) by 1987. When broken down by material, production of gray cast iron fell from 2,156,200 tons in 1978 to 1,013,900 tons (down 53.0% from 1978) in 1983 and to 748,000 tons (down 65.3% from 1978) by 1987. Despite significant reductions ductile cast iron production, which amounted to 326,800 tons in 1978, had recovered to 325,000 tons (down 6%) by 1987. Malleable cast iron production fell from 205,800 tons to 33,000 tons during the ten-year period; steel casting, from 210,100 tons to 103,900 tons; and non-ferrous metal casting, from 182,700 tons to 154,000 tons.

Table III.3-22 shows a breakdown of U.K. production of castings by material. As can be seen from the Table III.3-23, 1987 production of gray cast iron can be broken down as follows: transportation equipment, 220,000 tons (29.4%); machinery and equipment, 194,000 tons (25.9%); water pipes and fittings, 70,000 tons (9.4%); construction and household use, 72,000 tons (9.6%); ingot molds and stools, 66,000 tons (8.8%); and miscellaneous, 126,000 tons (16.9%).

Table III.3-24 shows the number of steel casting plants operating in the U.K. during 1980-87, while Table III.3-25 records the number of employees at these plants.

Table III.3-22 U.K. Production of Castings by Material

(Unit: 1,000 ton)

	Total	Gray cast iron	Ductile cast iron	Melleable cast iron	Steel casting	Non-ferrous metals
1978	3,081.6	2,156.2	326.8	205.8	210.1	182.7
1979	3,049.9	2,146.9	338.9	191.3	191.7	181.1
1980	2,227.6	1,456.5	250.0	139.9	180.3	200.9
1981	1,969.4	1,268.8	244.3	131.7	150.0	174.6
1982	1,786.5	1,100.3	290.9	82.7	147.8	164.8
1983	1,774.1	1,013.9	346.3	74.0	114.9	159.2
1984	1,672.9	1,009.1	304.5	62.6	114.3	182.4
1985	1,553.4	903.0	311.0	47.2	118.7	173.5
1986	1,364.0	739.0	303.0	36.0	108.0	142.5
1987	1,363.9	748.0	325.0	33.0	103.9	154.0

Source: Die Europaische Giesserei-Industrie im Jahre(CAFF)
Note: Figures for 1985 are estimates

Table III.3-23 U.K. Production of Castings by Use

(Unit: 1,000 tons)

	1986				1987			
	Gray cast iron	Ductile cast iron	Malleable cast iron	Steel casting	Gray cast iron	Ductile cast iron	Malleable cast iron	Steel casting
Pressure tubes and fittings	—	181.0	—	—	—	200.0	—	—
Water pipes and fittings	81.0	—	—	—	70.0	—	—	—
Construction and household use	73.0	—	—	—	72.0	—	—	—
Ingot molds and stools	61.0	—	—	—	66.0	—	—	—
Rolls	—	—	—	—	—	—	—	—
Machinery and equipment	209.0	29.0	11.0	83.8	194.0	30.0	13.0	55.1
Transportation equipment	199.0	31.0	13.0	4.7	220.0	39.0	14.0	7.5
Fittings	—	—	9.0	—	—	—	5.0	—
Railroad-related	—	—	—	3.9	—	—	—	5.3
Other	116.0	62.0	3.0	15.6	126.0	56.0	1.0	36.0
Total	739.0	303.0	36.0	108.0	748.0	325.0	33.0	103.9

Source: Die Europaische Giesserei-Industrie im Jahre(CAEF)
Note: *Included in other categories(?)

Table III.3-24 Number of Foundries in U.K.

	1980	1981	1982	1983	1984	1985	1986	1987
Cast iron	586	538	500	400	—	345	345	310
Steel casting	69	69	63	61	—	59	62	57

Source: Die Europaische Giesserei-Industrie im Jahre (CAEF)

Table III.3-25 Number of Employees in U.K. Foundries

	1980	1981	1982	1983	1984	1985	1986	1987
Cast iron	64,700	56,700	45,500	40,000	—	34,410	38,300	38,000
Steel casting	14,218	12,624	11,476	8,597	—	8,196	7,059	5,880

Source: Die Europaische Giesserei-Industrie im Jahre (CAEF)

Table III.3-26 Direct Exports of Castings by the U.K.

(Unit: 1,000 tons)

	1979	1980	1981	1982	1983	1984	1985	1986	1987
Cast iron	174.3	134.4	—	—	111.7	120.5	122.8	112.2	117.0
Steel casting	29.5	30.6	30.8	32.9	21.7	19.2	26.8	22.6	22.9
Total	217.1	165.0	—	—	133.4	139.6	149.6	134.8	139.9
Change over previous year	5.7	—24.4	—	—	—	4.6	+7.2	-9.8	-3.8

Source: Die Europaische GieBerei Industrie im Jahre

(5) France

Table III.3-27 shows French production of castings during 1978-87.

1978 production totaled 2,759,700 tons in 1978, but gradual reductions brought this figure to 2,049,800 tons by 1987 (down 25.7%). When broken down by material, gray cast iron production fell from 1,542,800 tons in 1978 to 928,900 tons in 1978 (down 39.8%). Production of ductile cast iron increased slightly from 668,900 tons to 718,600 tons (up 7.4%). Malleable cast iron production dropped from 78,600 tons to 16,700 tons (down 78.8%); steel casting, from 194,400 tons to 118,900 tons (down 38.8%); and non-ferrous metals, from 275,100 tons to 266,700 tons (down 3.1%).

As can be seen from Table III.3-28, 1987 demand for gray cast iron can be broken down as follows: transportation equipment, 414,500 tons (44.6%); machinery and equipment, 217,600 tons (23.4%); pressure pipes and fittings along with construction and household use, 154,500 tons (16.6%); and miscellaneous, 133,900 tons (15.4%).

Table III.3-29 shows the number of foundries operating in France during 1980-87 as well as the number of employees at these plants. Table III.3-30 shows the number of employees at cast iron factories for the same period.

Table III.3-31 shows direct exports of castings by France during 1980-87.

Table III.3-27 French Production of Castings by Material

(Unit: 1,000 tons)

	Total	Gray cast iron	Ductile cast iron	Melleable cast iron	Steel casting	Non-ferrous metals
1978	2,759.7	1,542.8	668.9	78.6	194.4	275.1
1979	2,814.2	1,580.0	676.4	72.6	206.2	278.7
1980	2,732.3	1,468.1	707.0	69.1	218.2	269.9
1981	2,534.1	1,257.1	770.4	58.6	201.6	246.4
1982	2,492.2	1,145.9	852.1	51.9	180.4	261.9
1983	2,266.1	1,084.3	743.2	44.5	142.4	251.7
1984	2,093.0	1,014.3	669.9	35.5	135.9	237.4
1985	2,138.4	957.6	779.3	27.1	138.6	235.8
1986	2,047.6	932.0	715.0	21.6	129.4	249.5
1987	2,049.8	928.9	718.6	16.7	118.9	266.7

Source: Die Europaische Giesserei-Industrie im Jahre(CAEF)

Table III.3-28 French Production of Castings by Use

(Unit: 1,000 tons)

	1986				1987			
	Gray cast iron	Ductile cast iron	Malleable cast iron	Steel casting	Gray cast iron	Ductile cast iron	Malleable cast iron	Steel casting
Pressure tubes and fittings	1.1	413.5	—	—	1.0	394.1	—	—
Water pipes and fittings	51.5	—	—	—	48.4	—	—	—
Construction and household use	109.3	—	—	—	105.1	—	—	—
Ingot molds and stools	9.2	—	—	—	8.4	—	—	—
Rolls								
Machinery and equipment	219.2	24.1	3.7	59.1	217.6	27.1	3.0	48.5
Transportation equipment	391.0	185.3	6.9	13.4	414.5	207.8	4.3	12.2
Fittings	—	—	—	—	—	—	—	—
Railroad-related	—	—	—	16.5	—	—	—	16.9
Other	150.7	92.1	11.0	40.4	133.9	89.6	9.4	41.3
Total	932.0	715.0	21.0	129.4	928.9	718.6	16.7	118.9

Source: Die Europaische Giesserei-Industrie im Jahre(CAEF)

Table III.3-29 Number of Foundries and Employees in France

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Cast iron	346	370	292	280	254	260	230	192	182	186
Malleable cast iron	25	22	20	19	18	17	17	12	9	—
Steel casting	72	70	70	70	72	73	68	57	52	48
Copper alloy	230	230								
Light alloy	327	345	465	460	456	—	—	—	—	—
Other alloys	29	52								
Zinc	120	125								
Total no. of foundries	1,149	1,214	847	829	800	—	—	—	—	—
No. of employees	89,193	87,948	83,799	78,250	76,500	—	—	—	—	—
(No. of employees at cast iron, cast steel, and malleable cast iron foundries)	(69,631)	(68,002)	(64,942)	(58,971)	(57,490)	(56,188)	(50,892)	(39,929)	(37,248)	(35,881)

Source: Syndicat General des Fondeurs de France
Note: Plants with fewer than six employees are not included
The number of pig iron foundries for 1985 includes malleable cast iron plants

Table III.3-30 Number of Employees in French foundries

	1980	1981	1982	1983	1984	1985	1986	1987
Cast iron	—	37,146	36,183	35,126	32,011	25,920	25,239	27,100
Malleable cast iron	—	5,747	5,454	4,472	4,650	3,566	3,119	—
Steel casting	16,287	16,078	15,853	16,590	14,231	10,443	8,890	8,781
Total	—	58,971	57,490	56,187	50,892	39,929	37,248	35,881
Change over previous year	—	—	2.5	2.3	9.4	21.5	6.7	3.7

Source: Die Europaische Giesserei-Industrie im Jahre (CAEF)

Table III.3-31 Direct Exports of Castings by France

(Unit: 1,000 tons)

	1980	1981	1982	1983	1984	1985	1986	1987
Cast iron	455.5	534.1	563.5	495.1	471.3	516.1	422.0	400.1
Malleable cast iron	5.4	5.9	5.3	5.6	7.6	6.1	3.3	3.2
Steel casting	61.6	49.5	45.5	38.6	40.2	44.7	39.3	35.6
Total	522.5	589.5	614.3	539.3	519.1	566.9	464.6	438.9
Change over previous year	0.2	12.8	4.2	12.2	3.7	9.2	18.0	5.5

Source: Die Europaische Giesserei-Industrie im Jahre (CAEF)

(6) Italy

Table III.3-32 shows Italian casting production during the ten-year period 1978-87. Total production of 2,046,700 tons in 1978 had dropped to 1,733,300 tons by 1983 (down 15.3%) but later recovered to 1,909,500 tons in 1987 (down 6.7% from 1978). When broken down by material, production of gray cast iron increased from 1,317,300 tons in 1978 to 1,400,000-1,550,000 tons in 1981 but fell to 1,169,100 tons in 1982 (down 14.7% from 1978). The figure remained in the 1,100,000-1,200,000 ton range through 1987, at which point production amounted to 1,150,000 tons (down 1.6% from 1978).

Production of ductile cast iron grew from 159,900 tons in 1978 to 1,800,300 tons in 1980 (up 12.8%), thereafter dropping somewhat but again experiencing a turnaround in 1985 to show a figure of 165,000 tons (up 3.2% from 1978) by 1987. There were major reductions in production of malleable cast iron and steel casting, although the latter has recovered somewhat in recent years.

As can be seen from Table III.3-33, 1987 demand for gray cast iron can be broken down as follows: transportation equipment, 325,300 tons (28.3%); machinery and equipment, 335,500 tons (29.2%); construction and household use, 364,000 tons

(31.6%); and miscellaneous. Italy is thus characterized by a larger construction and household use market than other countries.

Table III.3-32 Italian Production of Castings by Material

(Unit: 1,000 tons)

	Total	Gray cast iron	Ductile cast iron	Melleable cast iron	Steel casting	Non-ferrous metals
1978	2,046.7	1,317.3	159.9	65.2	129.6	374.4
1979	2,224.9	1,435.6	177.4	65.4	132.9	414.0
1980	2,242.0	1,550.8	180.3	68.7	140.1	431.2
1981	2,125.3	1,404.8	177.4	50.1	115.3	377.7
1982	1,868.0	1,169.1	176.6	41.9	102.7	377.7
1983	1,733.3	1,139.2	114.5	17.2	84.5	377.9
1984	1,818.5	1,164.1	126.6	19.6	86.8	421.4
1985	1,896.5	1,212.3	149.5	18.9	93.8	422.0
1986	1,910.0	1,185.4	155.7	20.8	97.6	450.6
1987	1,909.8	1,150.8	165.0	18.6	92.5	482.9

Source: Die Europaische Giesserei-Industrie im Jahre (CAEF)
Note: Post-1983 figures for ductile cast iron do not include pressure tubes and fittings
Post-1983 figures for malleable cast iron do not include fittings

Table III.3-33 Italian Production of Castings by Use

(Unit: 1,000 tons)

	1986				1987			
	Gray cast iron	Ductile cast iron	Malleable cast iron	Steel casting	Gray cast iron	Ductile cast iron	Malleable cast iron	Steel casting
Pressure tubes and fittings	—	—	—	—	—	—	—	—
Water pipes and fittings	—	—	—	—	—	—	—	—
Construction and household use	364.0	—	—	—	375.8	—	—	—
Ingot molds and stools	24.0	—	—	—	52.0	—	—	—
Rolls	18.3	—	—	—	17.2	—	—	—
Machinery and equipment	335.5	61.2	4.4	47.0	338.8	58.3	5.3	49.5
Transportation equipment	325.3	103.8	14.2	4.9	313.2	97.4	15.5	6.8
Fittings	—	—	—	—	—	—	—	—
Railroad-related	—	—	—	3.6	—	—	—	2.7
Other	83.7	—	—	37.0	88.4	—	—	38.6
Total	1,150.8	165.0	18.6	92.5	1,185.4	155.7	20.8	97.6

Source: Die Europaische Giesserei-Industrie im Jahre(CAEF)
Note: See Footnotes (2) and (3) of Table III.3-32.

Table III.3-34 Number of Foundries in Italy

	1980	1981	1982	1983	1984	1985	1986	1987
Cast iron	551	537	527	497	440	425	416	402
Malleable cast iron	7	6	3	3	2	3	3	3
Steel casting	57	55	64	58	56	53	51	50
Total	615	598	594	558	498	481	470	455

Source: Die Europaische Giesserei-Industrie im Jahre (CAEF)

Table III.3-35 Number of Employees in Italian Fondries

	1980	1981	1982	1983	1984	1985	1986	1987
Cast iron	40,899	40,106	25,844	24,344	21,544	20,789	20,390	19,850
Malleable cast iron								
Steel casting	7,800	7,576	5,841	5,242	5,090	4,671	4,610	4,450
Total	48,699	47,682	31,685	29,586	26,634	25,460	25,000	24,300

Source: Die Europaische Giesserei-Industrie im Jahre (CAEF)
Note: The great drop in post-1982 figures is due to a revision of the source (1985 edition), although the exact reasn is unclear

Table III.3-36 Direct Exports of Castings by Italy

(Unit: 1,000 tons)

	1980	1981	1982	1983	1984	1985	1986	1987
Cast iron	98.8	70.8	62.0	59.9	64.6	74.9	59.8	65.1
Malleable cast iron	5.9	8.7	7.5	1.4	5.8	6.9	5.4	8.3
Steel casting	118.3	113.9	—	36.5	42.1	38.0	36.0	35.8
Total	223.0	193.1	—	97.8	112.8	119.8	101.2	109.2
Change over previous year	14.2	13.4	—	4.1	4.1	6.2	15.5	7.9

Source: Die Europaische Giesserei-Industrie im Jahre (CAEF)

(7) China

Chinese casting production in 1987 was estimated at 6,497,000 tons, placing the country at virtually the same level as Japan.

Table III.3-37 Chinese Production of Castings by Material

(Unit: 1,000 tons)

	1977	1981	1982	1985	1987
Gray cast iron	3,535,000	3,971,000	4,328,000	3,973,536	4,638,000
Ductile cast iron	350,000	242,000	274,000	390,096	369,000
Malleable cast iron	195,000	263,000	271,000	—	321,000
Steel casting	480,000	683,000	717,000	—	851,000
Copper alloy	—	—	—	—	318,000
Aluminum	—	—	—	87,091	—
Magnesium	—	—	—	—	—
Zic	—	—	—	—	—
Other	300,000	212,000	225,000	—	—
Total	4,860,000	5,371,000	5,815,000	4,450,723	6,497,000

Source: Annual December issue of Modern Casting. However, all of the figures are estimates

Note: "Other" and those figures marked with an asterisk include non-ferrous metals as well

(8) Korea

Table III.3-38 shows Korean casting production for 1977-87, and Table III.3-39 provides a breakdown of cast iron demand. In 1985 automotive applications accounted for 18.2% of cast iron demand; industrial equipment, for 18.0%; and casting moulds and stools, for 14.9%. Post-1985 figures for casting demand have yet to be announced, but as of 1988 the amount of casting destined for the automotive industry is thought to be on the rise.

Table III.3-42 and III.3-43 shows Korean exports and imports of castings.

Table III.3-38 Korean Production of Castings by Material

(Unit: tons)

	Gray cast iron	Cast iron pipe	Ductile cast iron	Malleable cast iron	Steel casting	Non-ferrous metals	Precision -cast metals	Total
1977	322,288	54,249	15,459	28,694	51,366	—	—	471,481
1978	473,372	55,715	17,037	33,964	77,722	10,390	—	667,930
1979	493,391	63,353	16,500	31,295	88,956	22,139	—	715,634
1980	477,526	67,918	24,017	26,843	86,887	23,311	—	706,400
1981	409,332	68,565	25,213	27,140	87,945	22,540	1,070	641,805
1982	412,350	70,540	31,145	29,460	88,650	21,475	1,200	654,820
1983	415,540	73,870	32,255	28,350	89,740	20,175	—	659,930
1984	389,251	144,293	45,281	35,826	91,251	23,905	—	729,807
1985	474,338	126,803	43,395	28,470	97,368	27,070	—	797,444
1986	590,000	110,000	90,000	35,000	109,000	36,000	—	970,000
1987	650,000	120,000	106,000	37,000	115,000	40,000	—	1,068,000

Sources: National Casting Industry Survey Report (August 1984), Korean Casting Industry Survey (November 1987), Korean Casting Industry Association

Note: 1986 figures were taken from the fifth five-year plan for economic development
1987 figurea were taken from the December issue of Modern Casting

Table III.3-39 Korean Production of Cast Iron by Use

(Unit: tons, %)

	1979 1)				1981 1)				1983 1)				1985 2)			
	Gray cast iron		Ductile cast iron		Gray cast iron		Ductile cast iron		Gray cast iron		Ductile cast iron		Gray cast iron		Ductile cast iron	
	Production	Share	Production	Share	Production	Share	Production	Share	Production	Share	Production	Share	Production	Share	Production	Share
Industrial machinery and equipment	136,000	27.6	2,800	16.5	110,270	26.9	3,608	14.3	117,865	28.4	5,160	16.0	87,653	18.5	5,538	12.8
Civil engineering, construction, and minng equipment	9,000	1.8	600	3.5	5,783	1.4	577	2.3	5,325	1.3	500	1.6	25,488	5.4	187	0.4
Metalworking and machining equipment	12,000	2.5	600	3.5	11,286	2.8	488	1.9	13,740	3.3	505	1.6	33,382	7.0	540	1.2
Rolls	23,000	4.7	200	1.2	17,274	4.2	319	1.3	19,450	4.7	540	1.7	5,184	1.1	1,507	3.5
Textile equipment	7,000	1.4	100	0.6	13,239	3.2	945	3.7	10,365	2.5	1,150	3.6	11,171	2.4	233	0.5
Casting molds and stools	75,000	15.2	1,000	5.9	66,302	16.2	975	3.9	68,354	16.4	870	2.7	70,823	14.9	—	—
Agricultural and fishing tools/equipment	10,000	2.0	300	1.8	10,768	2.6	142	0.6	11,470	2.8	130	0.4	34,511	7.3	2,202	5.1
Electrical and communication equipment	17,000	3.5	200	1.2	18,335	4.5	531	2.1	19,505	4.7	850	2.6	16,935	3.6	27	0.1
Automotive	167,000	33.9	9,600	56.7	100,515	24.6	9,400	37.3	100,050	24.1	13,750	42.6	67,650	14.3	26,757	61.7
Industrial vehicles, automobiles, railways	11,000	2.2	400	2.4	—	—	258	1.0	—	—	475	1.5	40	0.01	2,255	5.2
Harbors and ships	11,000	2.2	200	1.2	17,899	4.4	3,471	13.8	16,880	4.1	4,160	12.9	20,248	4.3	238	0.5
Pipe fittings	—	—	—	—	—	—	—	—	—	—	1,050	3.3	755	0.2	3,018	7.0
Valves, cocks, steel piping	—	—	—	—	15,031	3.7	—	—	14,070	3.4	700	2.2	24,470	5.2	408	1.0
Daily goods	9,000	1.8	—	—	9,947	2.4	463	1.8	8,850	2.1	650	2.0	34,457	7.3	—	—
Others	6,000	1.2	1,000	5.9	12,683	3.1	4,036	16.0	9,610	2.3	1,765	5.5	41,571	8.8	485	1.1
Total	493,000	100	17,000	100	409,332	100	25,213	100	415,539	100	32,255	100	474,338	100	43,395	100

Source: 1) National Casting Industry Survey Report (1980, 1982, 1984), Korean Casting Industry Association
2) Industrial Key Technology Survey Report (1986)

Table III.3-40 Number of Korean Foundries by Material

	1980	1981	1982	1983	1984	1985	1986
Gray cast iron	271	270	272	269	237	262	302
Cast iron piping	14	14	14	14	9	11	8
Ductile cast iron	24	24	24	24	33	40	66
Malleable cast iron	15	15	15	15	15	15	18
Steel casting	51	50	50	50	63	71	74
Non-ferrous metals	60	58	58	58	103	113	140
Precision-cast metals	—	2	2	—		—	—
Total	435	433	435	430	460	512	608

Source: 1978-1983 National Casting Industry Survey Report (August 1984), Korean Casting Industry Survey (November 1987), Korean Casting Industry Association
1985 In-Depth Survey on Industrial Key Technologies (November 1986), Korean Industrial Develpment Agency
1984, 1986 Korean Casting Industry Survey (November 1987)

Table III.3-41 Number of Korean Foundries by Scale of Production (1985)

Annual production volume	Cast iron foundries		Steel casting foundries		Non-ferrous metal foundries		Subtotal	
≤50 tons	24	8.8%	4	5.9%	34	25.8%	62	13.1%
51-100	25	9.2%	6	8.8%	15	11.4%	46	9.7%
101-200	40	14.7%	5	7.4%	24	18.2%	69	14.6%
201-300	32	11.7%	5	7.4%	11	8.3%	48	10.1%
301-500	36	13.2%	11	16.2%	19	14.4%	66	14.0%
501-1,000	53	19.4%	12	17.6%	14	10.6%	79	16.8%
1,001-2,000	27	9.9%	10	14.7%	9	6.8%	46	9.7%
2,001-5,000	21	7.6%	12	17.6%	5	3.8%	38	8.0%
5,001-10,000	11	4.0%	3	4.4%	1	0.7%	15	3.2%
≥10,001	4	1.5%	0	0%	0	0%	4	0.8%
Total	273	100.0%	68	100.0%	132	100.0%	473	100.0%

Source: Korean Machinery Research Institute

Table III.3-42 Korean Exports of Castings

(Unit: tons, US$)

	1980		1981		1982		1983		1984	1985	1986
	Volume	Value	Volume	Value	Volume	Value	Volume	Value	Volume (tons)		
Cast iron	43,392	36,450	14,648	9,009	12,804	8,233	96,037	60,023	42,372	48,663	61,958
Malleable cast iron	14,941	17,930	6,895	4,827	3,985	3,698	23,385	25,724	—	—	—
Steel casting	5,537	5,149	46,357	46,357	21,322	24,371	36,752	34,179	40,079	36,531	38,149
Cast iron piping	3,228	2,050	647	398	450	270	3,473	1,587	1,419	4,426	14,486
Non-ferrous metals	2,695	14,826	100	326	98	321	208	680	—	—	—
Total	69,793	76,405	68,647	60,917	38,659	36,893	159,855	122,193	83,870	89,620	114,593
Increase	134	124	131	99	74	60	306	198			

Sources: National Casting Industry Survey Report (August 1984), Korean Casting Industry Survey (November 1987)

Table III.3-43 Korean Imports of Castings

(Unit: tons)

	1980	1981	1982	1983	1984	1985	1986
Cast iron	8,008	11,124	18,506	12,514	15,332	10,981	10,889
Malleable cast iron	—	—	—	—	—	—	—
Steel casting	3,696	3,484	5,672	8,301	9,294	8,140	4,028
Cast iron piping	1,046	46	550	900	628	988	179
Non-ferrous metals	—	—	—	—	—	—	—
Total	12,750	14,657	24,728	21,715	25,254	20,109	15,096

Source: Koran Casting Industry Survey (November 1987)

Table III.3-44 Number of Employees and Productivity in Korean Foundries

(Unit: tons)

	No. of employees			Productivity (1983)
	1981	1982	1983	
Gray cast iron	13,845	14,037	13,697	30.3
Steel piping	903	1,058	2,090	71.7
Ductile cast iron	793	788	786	41.0
Malleable cast iron	1,280	1,210	1,257	22.5
Steel casting	6,270	4,502	6,207	14.5
Non-ferrous metals	3,336	3,599	2,153	9.3
Precision-cast metals	444	499	—	—
Total	26,871	25,693	26,190	25.2

Source: Same as Table III.3-42

(9) Taiwan

Table III.3-45 shows Taiwanese casting production for 1983-88. As can be seen from the Table, production topped the 1-million-ton mark for the first time in 1987 (1,039,000 tons, up 18.3% from the previous year), thereby closing the gap with Korea. Production further increased to 1,247,000 tons in 1988 (up 20.0% over 1987). Although the lack of detailed figures make it difficult to determine which demand sectors are growing, local visits suggested that the automotive and machine tool industries were responsible for the significant growth being recorded.

Table III.3-46 shows changes in the number of foundries and employees in Taiwan during the period 1970-87. Table III.3-47 provides a breakdown of the number of foundries and employees in 1987 according to material. Differences between these Tables are thought to stem from variations in the studies which produced them.

As can be seen from Tables III.3-48 and III.3-49 , 1987 imports and exports totaled 29,034 tons and 66,517 tons, respectively.

Table III.3-45 Taiwanese Production of Castings by Material

(Unit: tons)

	1983	%	1984	%	1985	%	1986	%	1987	%	1988	%
Gray cast iron	408,900	78.0	503,372	79.3	539.090	79.7	640,900	72.7	769,080	73.0	922,896	73.0
Ductile cast iron	25,020	4.8	31,230	4.9	32,740	4.84	60,120	6.8	75,150	7.0	90,180	7.0
Malleable cast iron	33,600	6.4	36,510	5.8	31,110	4.60	27,060	3.0	18,140	1.0	14,000	1.0
Steel casting	24,630	4.7	28,010	4.4	34,720	5.13	50,850	5.8	71,190	6.0	92,500	7.0
Copper alloy	8,800	1.7	9,560	1.5	10,930	1.62	18,920	2.3	22,704	2.0	28,380	2.0
Aluminum alloy*	22,940	4.4	26,290	4.1	27,830	4.11	80,980	9.2	83,230	0.8	87,392	0.7
Total	523,890		634,972		676,420		878,830		1,039,494		1,247,392	

Source: Taiwan Casting Association (1983-1987), Taiwan Economic Research Institute (1988)
Note: *Includes aluminum and zinc as well as other alloy cast products.

Table III.3-46 Number of Foundries and Employees in Taiwan

	No. of foundries	No. of employees	Ave. no. of employees/foundry
1970	383	10,912	28.5
1974	522	16,808	32.2
1979	542	19,282	35.6
1985	375	16,387	43.7
1987	1,260	25,016	19.9

Source: Taiwan Economic Research Institute
Note: The average number of employees per foundry was reduced in 1987 due to the includion of approximately 650 househod operations
Foundry figures for 1970-1985 are registered statistics from the Economic Department

Table III.3-47 Number of Foundries and Employees by Material in Taiwan (1987)

	No. of foundries		No. of employees		
		Share (%)		Share (%)	Ave. no. of employees/foundry
Cast iron					
Gray cast iron	415	34.8	—	—	—
Ductile cast iron	54	4.5	—	—	—
Subtotal	469	39.3	11,464	59.8	24.4
Malleable cast iron	11	0.9	832	4.3	75.6
Steel casting	156	13.1	1,413	7.4	9.1
Non-ferrous metals					
Aluminum	274	23.0	3,015	15.7	11.0
Copper	135	11.3	675	3.5	5.0
Zinc	148	12.4	1,776	9.3	12.0
Subtotal	557	46.7	5,466	28.5	9.8
Total	1,193	100.0	19.175	100 0	16.1

Source: Same as Table III.3-46

Table III.3-48 Taiwanese Castings Imports (1983-87)

(Unit: tons, NT$1,000)

Product / Year	1983 Weight	1983 Value	1984 Weight	1984 Value	1985 Weight	1985 Value	1986 Weight	1986 Value	1987 Weight	1987 Value
Ductile cast iron	180	4,235	177	4,232	201	4,590	280	8,025	671	11,067
Cast iron pipe	235	10,722	4,334	105,380	5,022	118,584	821	25,154	2,170	57,514
Products containing cast iron pipe	30	8,766	232	13,526	16	5,433	14	11,771	339	41,081
Cast iron materials	521	54,980	389	40,669	388	37,364	117	12,874	64	5,799
Cast steel materials	168	11,113	6	1,223	984	1,880	842	34,691	1,030	36,668
Cast iron ingots	203	3,711	-	-	50	831	18	286	36	611
Cast steel ingots	-	-	831	4,733	-	-	11	160	11	810
High-carbon -content steel ingots	11	195	-	-	-	-	-	-	62	1,549
Stanless steel ingots	186	10,006	72	5,312	295	17,500	802	38,701	346	12,074
Other alloy steels	20	1,216	18	312	-	-	46	919	640	16,554
Iron anchors	137	16,573	92	14,985	283	13,036	241	12,905	231	10,183
Steel casting and accessories	6,424	129,109	13,341	276,138	5,993	119,884	13,724	478,076	23,434	374,785
Total	8,115	250,826	19,492	466,510	13,232	319,102	26,916	623,562	29,034	568,695

Source: Monthly Trade Statistics

Table III.3-49 Taiwanese Castings Exports (1983-87)

(Unit: tons, NT$1,000)

Product / Year	1983 Weight	1983 Value	1984 Weight	1984 Value	1985 Weight	1985 Value	1986 Weight	1986 Value	1987 Weight	1987 Value
Cast iron pipe	200	5,430	819	19,887	595	13,652	2,105	24,787	762	20,891
Cast iron pipe accessories	10,815	458,646	12,714	472,354	12,077	528,674	12,362	498,800	15,149	592,053
Cast iron materials	4,776	173,314	6,162	202,852	5,266	188,459	7,701	314,597	6,891	307,233
Cast steel products and materials	577	27,231	984	39,173	489	28,100	597	26,189	907	42,810
Cast steel ingots	1,673	12,876	673	10,121	655	10,542				
Cast iron furnaces and accessories	16,612	659,088	17,396	755,198	20,897	943,627	20,536	990,892	12,135	996,255
Cast iron furnace wall frames	1,838	61,145	782	31,877	431	12,633	325	14,380	651	28,592
Cast iron __for grilling meat	13,713	462,423	15,433	557,986	11,164	393,441	11,089	433,381	12,224	484,413
Cast iron cooking pots	6,823	256,213	6,760	253,447	6,048	218,588	7,827	320,022	5,749	276,246
Iron anchors	3,286	88,116	3,743	92,457	2,758	96,568	1,993	92,838	2,507	103,821
Steel casting and accessories	2,752	37,363	1,432	30,943	351	16,654	603	24,290	542	52,598
Total	63,063	2,241,945	65,466	2,466,295	60,631	1,449,938	15,038	2,749,176	66,517	1,904,912

Source: Monthly Trade Statistics

(10) Singapore

In Singapore as well, the casting industry is an important supporting industry. At present, the industry is engaged in production of general castings in addition to die casting and investment casting. Casting operations are centered in Jurong.

1) Cast iron

Together, the 12 manufacturers of pig iron are responsible for monthly production of 2,990 tons (35,880 tons/year). Three of the twelve firms are large-scale operations with annual production of at least 4,000 tons, and these three alone account for 92% of total production. Four of the remaining nine companies have 18-24 employees and are engaged primarily in the production of pipe fittings. The remaining five manufacturers are extremely small operations employing two to twelve workers and producing only 25-400 tons annually.

2) Steel casting

There are three manufacturers of steel castings, and they produce 3,960 tons annually. The two larger companies account for 91% of total production.

3) Die casting

There are eight firms with die casting operations. Five of these have at least 110 employees and are joint ventures with companies from Hong Kong, the U.K., the U.S., and Taiwan. All are characterized by a dependence on exports to Malaysia, Japan, Australia, Europe, and the U.S.

4) Precision casting

There are four firms engaged in precision casting. Three of these are joint ventures with companies from Japan and the U.K.

The following Table provides a brief summary of the leading casting firms in Singapore.

Table III. 3-50 Summary of Leading Singaporean Casting Manufacturers

	Number of employees	Production/ sales volume	Remarks
Cast iron			
Hitachi Metal Singapore Pte Ltd.	130	400 tons/month	Sells to machinery manufacturers in Japan and Singapore
Matsushita Refrigeration Industries (S) Ptd Ltd.	200	2,000 tons/month	Components for compressors.
Pacific Precision Casting Pte Ltd.	110	350 tons/month	60% of production (machine tool components) is sold to the Japanese market.
Steel casting			
Swanmet Engineering Pte Ltd.	100	200 tons/month	Export ratio of 70%
Kvaerner Singapore		100 tons/month	Norwegian subsidiary engaged in manufacture of components for pumps and ship repair services. Plans to increase monthly production by 150tons.
Die casting			
Pioneer Die Casting	220	S$18 million (1989 sales)	Joint venture with Scott and English
Advance Die Casting	400	S$7 million (1989 sales)	Export ratio of 20%. Main markets are Malaysia and Europe.
Precision casting			
NGL (S) Pte Ltd.	95	S$6 million (1989 sales)	Singapore's first investment casting plant; established by the U.K. firm Normalair-Garrett.
Chatered Precision Foundry Pte Ltd.	50	S$3 million	A subsidiary of Singapore Technology engaged mainly in production of components for machinery and ships. Singapore Technologies broke into the automotive and aerospace sectors in a joint venture with Hayashi Lostwax.

Source: Third-country survey

(11) Thailand

Thailand is estimated to have 340 casting plants. 79 manufacturers of cast iron and steel casting products were surveyed, and the geographical distribution obtained from this survey was as follows.

Table III. 3-51 Geographical Distribution of Cast Iron Foundries

Region	Gray cast iron		Steel casting		Total	
	No. of plants	Share	No. of plants	Share	No. of plants	Share
North	9	11.4	-	-	9	11.4
Northeast	20	25.3	1	1.3	21	26.6
South	12	15.2	-	-	12	15.2
Bangkok and surrounding areas	29	36.7	8	10.1	37	46.8
Total	70	88.6	9	11.4	79	100.0

Source: Third-country survey

In the gray cast iron sector, firms located in the provinces tended to produce such products as corn heads, parts for agricultural implements, pulleys, and water pump cylinders, while those situated in central areas were likely to manufacture drain covers, drain pipe joints, water pumps, gas cookers, tractor components, and automobile components (disc brakes, stub axle, cylinders, crankcases, clutch flanges, and differential gears).

Steel casting manufacturers were concentrated in central areas and were engaged mainly in the production of automobile components, compressor grinding balls, tractor drakes, and hub.

III-4. Cost Analysis

The following studies were carried out in order to determine the international price competitiveness of the Malaysian casting industry.

[1] An international comparison of selling prices for casting

[2] A feasibility study for a precision casting plant using lost-wax method

First, the selling prices of general castings currently being produced in Malaysia were compared with those of products being produced in other nations to determine their cost competitiveness, and selling costs were then broken down to determine the reasons behind the difference in selling prices.

Since there are as yet no foundries in Malaysia producing precision castings by investment casting, a model plant was posed and its financial viability was investigated.

III-4-1. Cost Analysis for Castings

(1) Selling price

Table III.4-1 provides a comparison of the average unit sales prices of various kinds of cast metal products in Malaysia and in Japan.

Table III.4-1 Comparison of Selling Prices in Malaysia and Japan

	Malaysia	Japan	No. of Malaysian factories surveyed
Cast iron(FC)	M$/kg 2.3	M$/kg 3.4	68
Malleable cast iron	4.3	6.7	1
Steel casting	3.6	—	9
Copper casting	12.2	16.4	20
Aluminium alloy casting	9.6	14.7	17
Aluminium diecast	8.4	12.1	8

Sources: Questionnaires and *Materials Process Industries Yearbook*, 1989
Note: Calculated at an exchange rate of M$1 = ¥53.

As can be seen from Table III.4-1, the selling prices of Malaysian products in all categories are lower than those of their Japanese counterparts. The Malaysian prices were based on information gained during the field interview survey in Malaysia, while the figures for Japan were obtained from official statistics by dividing total production value by total production volume for each material. The Malaysian figures are the average unit sales prices taken from the number of companies shown in the Table. The two sets of figures, however, should provide a reasonable basis for comparison.

Table III.4-2 shows selling prices for various Malaysian castings.

Table III.4-2 Selling Prices for Malaysian Castings

Selling price (M$/Kg)	Details			
	Product	Unit weight	Material	Buyer
Cast iron				
1.8~2.4	Manhole conver	180~90 kg	FC	Domestic
2.6~3.0	Dust collector cone	73~57	FC	Domestic
1.4~2.0	Iron weight	1.3~0.75	FC	Domestic
2.6~3.1	Gas burner	0.8~0.75	FC	Domestic
2.2~2.8	Gravel pump	1110~90	FC	Domestic
Steel casting				
4.0	Palm oil worm screw	200	1.5%Mn	Domestic
2.6~3.5	Counter weight	480~140	SC46	Foreign
2.8	Ship bollard & pollar	70~60	SC46	Foreign

Source: Interviews

Table III.4-3 provides a comparison of Malaysian prices with prices in other nations.

Table III.4-3 International Comparison of Selling Prices

	Malaysia (1989.11)	Korea (1989.11)	Taiwan (1989.11)	Thailand (1989.11)
Cast iron				
FC	2.3	2.2~2.8	1.7~2.1	
FC15 ~ 20				1.5
FC25				1.9~2.6
FC30		3.4		
Steel casting				
SC	3.6		2.5	

Source: Table III.4-1, *Report of Private Casting Technology Consultant in Tokyo*
Unit: M$/kg
Note: Calculations were made at the following exchange rates: M$1 = ¥53; ¥1 = 4.6 won; NT$1 = ¥4.4; 1 baht = ¥5.5.

The unit prices for export products indicated in Table III.4-2 are lower than the corresponding unit prices for local sales products. Many Malaysian companies consider that present export price levels are very severe. By one large company, the typical unit price was indicated as M$2.0/kg for cast iron and by another firm M$2.4-2.6/kg for cast iron and M$3.0-3.3/kg for ductile cast iron. As a result, many factories were giving serious consideration to productivity improvement measures such as the mechanization of sand processing and transport in an attempt to reduce production costs.

(2) **Cost breakdown**

A breakdown of Malaysian costs was drawn up for each material and compared with Japanese figures in Table III.4-4.

Table III.4-4 Cost Breakdown for Casting in Malaysia and Japan

Breakdown	Malaysia				Japan
	Cast iron	Steel casting	Light alloys	Average	
Raw materials	48%	35%	55%	48%	33%
Labour and subcontracting fees	28	25	24	27	42
Power	5	13	5	6	8
Depreciation	7	9	7	7	5
Miscellaneous	12	18	9	12	12
Total	100%	100%	100%	100%	100%

Sources: Questionnaires and *Small Business Price Indices* (Small and Medium Enterprise Agency), 1988 figures

Note: Data for Malaysia was obtained from 61 firms, with 11 manufacturers of steel casting and 24 light alloy producers.

In Malaysia, power costs for steel casting production and raw material costs for light alloys are higher than those for cast iron. This is thought to stem from differences in melting techniques and raw materials. In addition, labour and subcontracting fees account for a lower percentage of costs in Malaysia than in Japan.

Next, a breakdown of the costs involved in cast iron production in Malaysia and Japan were compared together with productivity figures. The results of this comparison are shown in Tales III.4-5 and III.4-6.

Table III.4-5 Cost Breakdown for Cast Iron in Malaysia and Japan

Breakdown	Malaysia (1)	Japan (2)	(1)/(2)
Raw materials	M$/kg 1.104	M$/kg 1.122	0.98
Labour and subcontracting fees	0.644	1.428	0.45
Power	0.115	0.272	0.42
Depreciation	0.161	0.170	0.94
Miscellaneous	0.276	0.408	0.67
Total	M$/kg 2.3	M$/kg 3.4	0.67

Sources: Tables III.4-1 and III.4-4

Raw materials, which constitute the largest single element in the cost breakdown, were virtually unchanged at 0.98 in Malaysia against an index of 1 for Japan. As products become more advanced, the gap in raw material costs between the two nations is expected to shrink even further. Labour and subcontracting fees and power costs constitute approximately twice the portion of total cost in Japan as in Malaysia.

The ratio of labour costs to subcontracting fees in Japan is 55:45. Since the productivity in Japan indicated in the Table is limited to in-house production, the publicly announced figure was halved. The same ratio for Malaysia is 93:7.

The difference in power consumption shown in Table III.4-5 is thought to stem from differing levels of mechanization. This gap in mechanization and automation is also thought to be responsible in part for the low productivity of Malaysian factories. In addition, the lack of quality-related facilities for annealing and surface treatment is also a factor in the low power consumption of Malaysian factories.

In summary, greater international competitiveness for Malaysian cast metal products will require the improvement of productivity accompanied by suitable improvements in product quality.

Next, Table III.4-6 shows a comparison of productivity for cast iron production.

Table III.4-6 Productivity in the Manufacture of Cast Iron

Country	Productivity	Productivity index	Remarks
Malaysia	17 ton/man/year	1	Average figure for 70 cast iron manufacturers
Japan	60 ton/man/year	3.5 times	Publicly announced figure = 120.6 ton/man/year

Source: Questionnaires and *Raw Material Yearbook*, 1989

(3) Unit cost

1) Raw material costs

Raw materials are responsible for about half of all casting costs. Imports are relied upon for the main raw materials -- pig iron, coke, and alloy steel and light alloy ingots -- which means that the prices of these materials are directly affected by exchange rate fluctuations and foreign market conditions. Available cast iron scrap and steel scrap consist mainly of locally-produced materials which have been recovered. Scrap prices are easily affected by changes in the business climate, with prices tending to increase during times of prosperity.

Malaysia boasts large deposits of silica sand, one of the materials critical to casting, and this ensures a steady supply. The supply of cement is also secured by its abundant deposit of linestore in Malaysia.

Raw material prices vary greatly depending on the grade of the material in question, in addition to the supply and demand conditions. In the case of coke, for example, prices vary as much as 100% depending on the country of origin, that is, the quality of the material. While Japanese coke sells for about M$1,000/ton, Chinese coke is valued at only M$500/ton. Even prices for local silica sand range from the M$10/ton of natural sand to M$100/ton for high-quality Johor sand. These grade-induced price differentials can be seen in the case of scrap as well. Foundries must constantly work to achieve a balance of cost and quality when selecting raw materials.

Table III.4-7 provides a summary of price levels for the main raw materials current as of November 1989. The figures in the Table are the averages of various grades of materials being used at the surveyed foundries.

Table III.4-7 Price Levels for Main Raw Materials

Material	Price (M$/T) 1988	1989	89/88	Comparable foreign prices (M$/T) Japan	Korea	Thailand	Taiwan
1. Pig iron	607	702	116%	590	600	590	
2. Iron scrap	435	559	129	570	510	470	
3. Steel scrap	352	449	127	530	560	440	
4. Cu ingot	9615	12210	127	8650			
5. Cu scrap	4776	5244	110	5660			
6. Al ingot	6300	6077	96	6280			
7. Al scrap	4171	4022	96	4670			
8. Zn ingot	5500	5450	96	3950			
9. Fe-Si	3089	3012	96	3250	3280	2590	
10. Fe-Mn	2018	2249	111	1570	1840	1970	
11. Coke	662	782	118	1170		830	760
12. Silica sand	75	83	110	220	140		
13. Bentonite	513	605	118	670	820	880	
14. Sodium silicate	473	526	111			830	
15. Cement	182	185	101	230			

Sources: Questionnaires (averages taken from valid responses); *Materials Process Industries Yearbook*, figures for December 1988, Japan Casting Industry Association, based on standard prices; *Report of Private Casting Technology Consultant in Tokyo,* figures for June and November 1989

Note: Calculations were made at the following exchange rates: M$1 = ¥53; ¥1=4.6won; NT$1 = ¥4.4; 1 baht = ¥5.5.

The overseas prices indicated in the Table are for specific grades and hence differ somewhat from the Malaysian figures, but should serve as reference.

Overall, Malaysian raw material prices are not particularly high in comparison with those in other nations. In particular, Malaysia has an advantage in the inexpensive supply of silica.

From the results of the questionaire survey, it was observed that prices for pig iron, scrap, and coke rose significantly from 1988 to 1989. By the field interviews, this point was confirmed and past trends were investigated. The results are shown in Table III.4-8.

Table III.4-8 Price Fluctuations for Steel Scrap

Period	Price	Index
1981~1984	M$/T 180~250	113~156
1985~1986	160~170	100~106
1987~1988	180~200	113~125
Nov. 1988	380~450	238~281

Source: Interviews
Note: The price index was set to M$160 = 100.

Table III.4-9 shows prices for the main raw materials imported from other countries/regions.

Table III.4-9 Prices of Imported Raw Materials

Supplier	Pig iron	Coke	No. of responses for pig iron	No. of responses for coke
Japan	M$/T —	M$/T 900	—	18
China	700	530	20	6
Taiwan	690	790	1	7
Australia	680	650	1	3
Brazil	720	—	2	—

Source: Questionnaires

In the case of pig iron, there is little difference among supplier nations, with Chinese products being the most commonly used. There was a major differential, however, for coke. A considerable number of factories were found to be using the expensive but high-quality Japanese coke.

Recently, however, the overall trend has been towards use of cheaper grades of coke due to rising prices. Some of the foundries visited had already switched over to less-expensive varieties, but they also indicated that the rate of defective pieces incapable of providing high melting temperatures had increased. This points out the importance of comprehensive cost reduction measures that take into account not only raw material selection but facilities and technical aspects as well.

2) Labour costs

Table III.4-10 shows that the average annual wage at a foundry in Malaysia is approximately M$8,400.

Table III.4-10 Average Wages

	Annual wage (M$/1988)	No. of responses
Staff	11,697	60
Skilled workers	9,710	86
Unskilled workers	5,777	73
Weighted mean	8,334	—

Source: Questionnaires

At foundries located around Kuala Lumpur there is a shortage of skilled labourers, and as a result wages at these facilities are on the rise. Some suggested the case that a maximum daily wage of M$40 was offered due to this labour condition. Assuming 290 working days per year, this would represent an annual wage of M$11,600.

From a worldwide standpoint, current wage standards in Malaysia are competitive. In order to take advantage of this, the upgreeding of efficiency in operations would be desired as well as the improvement product quality and the increase of the training oppotunities in technologies and skills.

3) Other costs

(a) Electrical power

Electrical power fees in Malaysia are divided` into basic fees and usage-based fees. Manufacturers in Malaysia are eligible for a 20% deduction of power fees. The basic fee is M$12 for the maximum load power during daytime hours. Users are exempted from this fee at night. The usage-based fee is 16 cents/kwh during the daytime and drops to 8 cents/kwh at night.

As a result of this fee structure, some of the steel casting manufacturers with numerous electric induction furnaces have set up their operating schedules to allow melting to be carried out at night. As a result of such scheduling and other factors, average power costs vary significantly from plant to plant. The average cost per kilowatt-hour at the companies visited ranged from 12 cents to 21 cents.

(b) Wooden pattern cost

When wooden moulds are ordered from a wooden mould manufacturer, the cost depends on the time required for production, with the standard fee being M$10/hour. In cases of volume orders, etc., a discount is often provided.

4) Cost reduction

Rising raw material costs is the largest problem to which Malaysian casting industry is facing in order to reduce production costs. This and other problems as determined from a questionnaire survey are summarized in Table III.4-11.

Table III.4-11 Problem Areas in Cost-related Factors

Problem	No. of firms facing to the problem (%)	
Rising raw material costs	70	(68.0)
Rising fuel costs	15	(14.6)
High electrical power costs	13	(12.6)
Insufficient production	11	(10.7)

Source: Questionnaires (103 respondents; multiple answers permitted.)

Cost reduction efforts aimed at dealing with the problems outlined in Table III.4-11 are naturally centered on the area of raw materials. One of the results of this is the aforementioned shift to less expensive raw materials. Table III.4-12 shows some of the cost reduction measures being implemented at Malaysian companies.

Table III.4-12 Cost Reduction Measures

Measure	No. of firms taking measures (%)	
1. Procurement of low-cost raw materials	61	(59.2)
2. Improvement of production technologies	45	(43.7)
3. Improvement of productivity (energy conservation)	41	(39.8)
4. Streamlining of raw material purchasing routes	24	(23.3)

Source: Questionnaires (103 respondents; multiple answers permitted.)

Malaysian foundries are trying to respond to the above-mentioned problems with very fundamental technical improvement measures. One of the most common is the use of technological improvements to reduce defect rates, improve yield, and eliminate a variety of losses. During the factory visits members of the study team were often asked about methods for reducing defect rates, and some facilities were visited again in order to work out possible solutions. At one factory where problems were pointed out in mould coating methods, improvement measures were immediately implemented.

Most of the Malaysian casting factories recognize the need for improved productivity, and the efforts for this are already being started in many factories. Some of the visited plants engaged in the fabrication of castings had already adopted productivity improvement as a clearly-stated corporate objective. This is indication that the environment surrounding these firms is forcing them to improve their productivity. These productivity-boosting measures are expected to lead to the further promotion of facility modernization and automation in the future.

Measures were also being taken to improve the distribution of raw materials. A new material supply company has been established by the support of industry association members in order to resolve the problem of price fluctuations caused by the lack of companies dealing in raw materials. As numerous firms are expected to move their operations to the industrial parks and to modernize their operations in the near future, further improvements, including the problem of raw material procurement, will also be needed.

III-4-2. 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	:	5,000m2
Total Building Area	:	2,400m2
Total Initial Investment Costs	:	Approx. M$6.5 million
Number of Employee	:	38
Production Items	:	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) Excemption 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 III-4-13.

Table III.4-13 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 III.4-14, 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 III.4-14 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

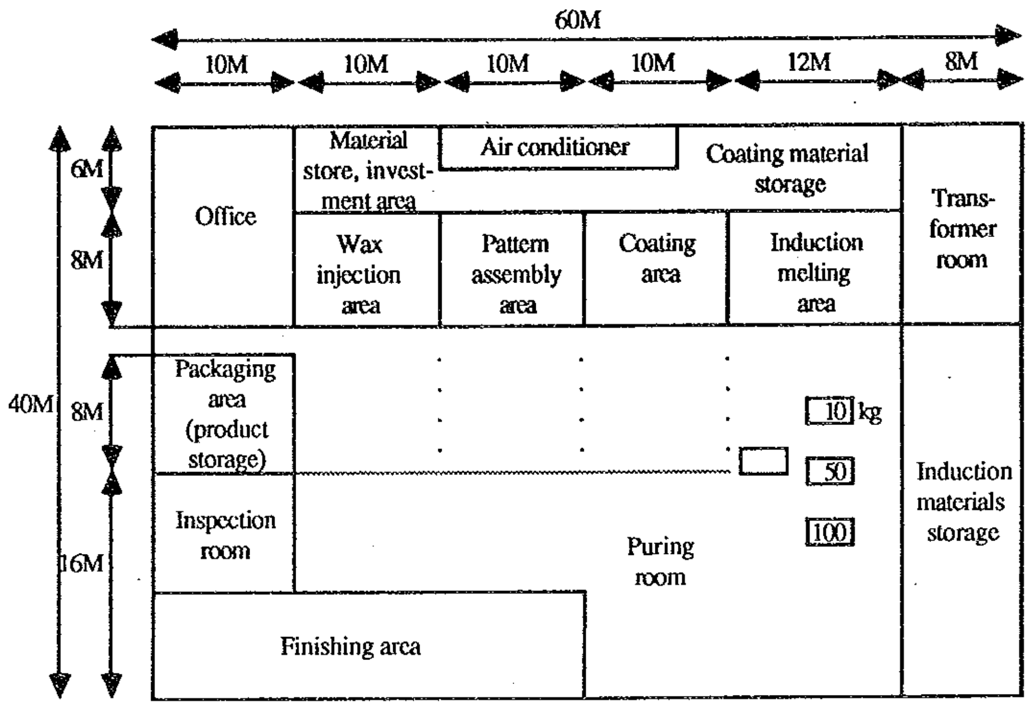
<u>Depreciating Costs</u>

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. III.4-1. 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. III.4-1 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 III.4-15. 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 III.4-15 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/cm2		
	2) Boiler	kg/cm2		
	3) Steam tank	1,800 little		
	4) Water softener	0.75m2/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 III-4-16. 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 III.4-17. 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 III.4-16 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 III.4-17 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 III.4-18.

Table III.4-18 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 III.4-19 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 III.4-20.

(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 III.4-20 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 III.4-21.

Further, the long-term cash flow projection is shown in Table III.4-22. 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 III.4-22 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 III.4-22.

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	:	2,800m2	2,400m2
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 III.4-21 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 III.4-22. 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 III.4-23 Investment Casting Plant Cash-Flow for FIRR Calculation

(Unit: M$1,000)

	Cash Outflow		Cash Inflow		Net
	Physical Investment	Working Capital	Operating Revenue	Deprecia-tion	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%.

III-5. Future Directions

III-5-1. Factors in Development of the Casting Industry

The casting industry in Malaysia has long served as a kind of supporting industry for the traditional local industries such as tin, rubber, palm oil, and timber. In recent years, Malaysia's industrialization has proceeded with an emphasis on foreign-capital export-oriented assembly firms rather than import replacement, and development of casting as a supporting industry for the modern industries has fallen behind.

Recently, however, the following changes in the external environment have come to require the modernization and development of the Malaysian casting industry.

(1) Changes in the Domestic Market

In the past, traditional local industries formed the main source of demand for cast metal products in Malaysia, with manufacturers of automobiles and industrial equipment turning to imports instead. Recent years, however, have seen considerable growth in the automobile and machinery industries, both of which are critical to the development of casting. In the electronics and electrical appliance industries, demand for air conditioners, refrigerators, and other products requiring large quantities of castings has been expanding, and casting demand from non-traditional modern industries in Malaysia is growing at a rapid pace. These industries currently rely mainly upon foreign-capital firms or new corporations that have brought in technology from foreign firms, but some are turning to existing small and medium-size foundries which previously dealt mainly in products for the traditional industries.

(2) Changes in International Markets

Due to high labor costs, the casting of the U.S., Japan, and other industrialized nations have lost their cost competitiveness on the global market. Even the NIES, which in recent years have taken over as the main exporters of castings, are finding themselves beset by rapidly increasing labor costs. This phenomenon is serving to increase the local content ratio of casting of export-oriented assemblers in Malaysia on one hand and to promote investment in Malaysia by Taiwanese and Japanese casting firms on the other.

(3) Changes in the Domestic Production Infrastructure

In the past virtually all of Malaysia's foundries were small-scale facilities concentrated in TOL (Temporary Occupied Land), and this was a major factor hindering the expansion of production and the modernization of plants and facilities. The recent concretization of plans to construct foundry and engineering industrial parks is helping to improve the chances for modernization of the local casting industry.

(4) Expansion of the ASEAN market

One of the leading factors inhibiting the development of the Malaysian casting industry has been the limited total domestic market size and the lack of demand in sizeable quantities for each specific product. Recently, however, a trend is visible among manufacturers of automobiles and home electrical appliances to expand their search for parts from the country of assembly to the ASEAN region as a whole. The possibilities for expanded casting production with an eye on exports to other ASEAN nations are increasing.

III-5-2. Directions for Development

Malaysia is currently engaged in promoting the machinery industry together with numerous other demand sectors, making it difficult to make any accurate predictions concerning future growth. The following section will try to probe future directions for the industry from the standpoint of demand sectors and products.

(1) Economic Scale and Casting Production

Malaysia boasts the largest per-capita GNP among the four ASEAN nations, and as can be seen from the following Table per-capita cast metal production was also the largest in the region. In comparison with Asian NIEs, however, Korea had a per-capita GNP 1.6 times greater than that of Malaysia, while Taiwan's GNP was 2.9 times greater. An even larger gap could be seen in terms of cast metal production, where the respective multiples were 7.7 and 16.1. Table III.5-1 shows that Malaysia's casting industry have great potential for future development.

Table III.5-1 GNP and Casting Production in the Asian NIEs and ASEAN Nations (1987)

	Casting production (tons)	GNP (US$ billions)	Per-capita GNP (US$)	Population (millions)	Per-capita casting production (kg)	Per-capita GNP index (in relation to Malaysia)	Per-capita casting Production index (in relation to Malaysia)
Korea	1,068,000	118.6	2,826	42	25.4	1.6	7.7
Taiwan	1,059,594	97.5	4,989	20	53.0	2.9	16.1
Hong Kong	80,00	46.5	8,230	5.6	14.3	4.8	4.3
Singapore	40,00	20.5	7,464	2.6	15.4	4.3	4.7
Subtotal	2,247,594	282.8	4,028	70	-	-	-
Thailand	120,000	45.4	857	53	2.4	0.5	0.7
Malaysia	55,884	28.6	1,729	17	3.3	1.0	1.0
Indonesia	60,000	71.6	421	170	0.4	0.2	0.1
Philippines	120,000	34.3	421	57	2.1	0.3	0.6
Subtotal	355,884	179.9	606	297	-	-	-

Note: GNP figures for Hong Kong represent GDP.
Source: Statistical Research Division, Asian Economic Research Institute (economic scale)

(2) Demand Industries

Directions for development of the casting industry in Malaysia will be heavily dependent on the future growth patterns of local demand industries. A breakdown of the major purchasers of cast iron in several leading nations is provided in the following Table for use as reference in predicting the same for Malaysia.

Table III.5-2 Breakdown of Demand for Cast Iron (1987)

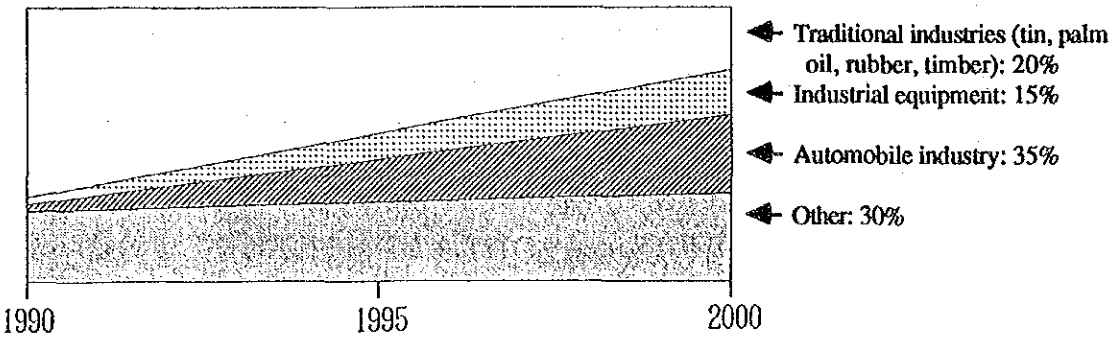
(Unit: %)

	France	Italy	U.S.A.	Korea	Japan
Transportation equipment	37.8	32.8	44.0	18.2	53.7
Industrial equipment	14.9	30.1	6.6	18.0	16.9
Other	47.3	37.1	49.4	63.8	29.4
Total	100.0	100.0	100.0	100.0	100.0

Source: Reports compiled by Materials Process Technology Center of Japan

As of 1987, four traditional industries — tin, palm oil, rubber, and timber — accounted for fully 65% of all cast iron demand in Malaysia. Fig. III.5-1 below provides a fairly subjective estimate of the breakdown of demand for castings in Malaysia in the year 2000 based on the current level of industrialization and expected future direction of industrial development. As can be seen from the Fig.III.5-1, the production of high-quality castings for supply to modern industries such as the industrial equipment and automobile sectors will be critical to the future development of Malaysia's casting industry.

Fig. III.5-1 Future Directions for the Development of the Malaysian Casting Industry



Figures in parentheses indicate predicted share in 2000.
Source: JICA Study Team

(3) Directions in Product Development

It is difficult to predict with any degree of accuracy the types of products which will be in demand in the future. This list would also have to include products — such as the precision industrial casting produced by investment casting — for which there is no accumulation of technology within Malaysia and which will require the introduction of technology from abroad. The following is a list of products thought to offer realistic possibilities for development by the small and medium-sized foundries currently operating in Malaysia.

1. Pulleys (flat, V-groove), bearings, gear materials (FC), manholes, etc.
2. Valves
3. Small compressor (1-10 hp) components, small blowers (1-10 hp), small pumps
4. Small gasoline and diesel engine blocks (1-10 hp)
5. Small pressed components (mechanical, friction, hydraulic)
6. Machine tool components (drills, races, shearings)
7. Transmission components
8. Roller conveyors, bucket elevator components
9. Motor components
10. Liners, brake drums, and brake shoe components for automobiles
11. Components for tractors

Selection of the products listed above was based mainly on the following three criteria: (1) the ability of local small and medium-sized foundries to "catch up" in terms of production technology; (2) the presence of demand in sizeable quantities; and (3) the ability to start production without large-scale capital investment.

(4) Directions for Technological Development

Technological development in Malaysia should be investigated with the following main points in mind. First of all, it is important that all concerned recognize the necessity of standards for functions and quality in the products and components demanded from the modern industrial sectors. This should be realized as soon as possible and the close cooperation system among industry, academia, and government be maintained.

Next is a mastery of basic casting know-how and technology. The only available option here is to be given assistance from experienced engineers and technicians. These people are needed to provide long-term education and job training.

It is necessary that the technological development in Malaysia through the above-described measures be promoted in accordance with the nation's basic industrial policies.

Specifically, the technological development in casting industry should be undertaken in accordance with the development of the following industries: automobiles, construction equipment, and agricultural equipment (all of which are mass-produced and have small engines) and their related parts; and machine tools and press machines (which are not mass-produced).

The domestic demand for investment-cast products, which offer dimensional precision and high quality, and similar products will remain limited for the time being, and it is therefore necessary to start R&D activities in the field. More practical, however, it could be recommended that the government put more focus on the development and promotion of the existing casting industries.

III-5-3. Strategies for Development of the Casting Industry

(1) Industrial Policy Framework for Promotion of the Casting Industry

As Malaysia's industrialization proceeds, demand for castings and the quality required of these products will increase, and products will become more diverse. This new demand can be met in two ways. The first is the construction of new plants aided by the introduction of foreign capital and technology. The second is the expansion of production capacity at existing foundries. If either of these two options is depended too heavily upon, there will be a polarization into two groups, one dependent entirely on the traditional industries and the other on the modern industries, thereby delaying development of the industry as a whole. Thus it is important that any industrial promotion policies take fully into account the management and technological capabilities of existing casting companies and the potentials thereof.

(2) Promotion of Existing Casting Factories

It is necessary to transform the existing local casting factories, which in the past have relied mainly upon orders from the traditional Malaysian industries, into companies capable of producing castings for supply to such modern industry as machinery or automobile industry. However, product standards in these modern industries are far higher — in terms of quality, delivery time, and price — than in the traditional industries. In order to be able to satisfy these standards, the casting industry will have to (1) improve current production technology; (2) refurbish and expand machinery and other elements of the production infrastructure; and (3) promote modernization of corporate management itself.

(3) Attraction and Promotion of New Casting Factories

Many Taiwanese and Japanese casting firms have become enthusiastic about moving operations abroad. In order to promote Malaysian industrialization, there is a great need for attraction and promotion of such firms, particularly in fields in which the Malaysian industry lacks technology and experience.

III-5-4. Measures for Promotion of the Casting Industry

(1) General

Various measures for promotion of the Malaysian casting industry are outlined in Fig. III.5-2 and Fig. III.5-3. These can be broadly divided into measures dealing with (1) enlargement of the industrial infrastructure and (2) internationalization.

(2) Measures for Enlargement of the Industrial Infrastructure

There are four main measures for enlargement of the industrial infrastructure: (1) improvement of technological standards; (2) modernization of management; (3) enlargement of the production infrastructure; and (4) market expansion.

(a) Improvement of technological standards

In order to improve technological standards at existing Malaysian casting factories, it will be necessary to introduce scientific plant management methods and transform the current manufacturing process, which relies on operator experience and intuition, into one based on rationally designed management manuals under the guidance of managers and engineers. This will require the training of managers and engineers. The manufacture of high-quality products will also require the training of skilled laborers. Furthermore, quality control efforts must be strengthened by the preparation of national standards and the promotion of in-house standardization.

(b) Modernization of management

With few exceptions, Malaysia's casting factories are small outfits managed by individuals or families. It is seldom that these factories have the management initiative to move into new demand sectors. First of all, the training of small business managers is needed. One effective means for achieving modernization of the industry as a whole would be the strengthening of exchanges of knowledge, experience, and know-how among Malaysian factories. In addition, the use of traveling seminars to provide factories with advice on new demand markets would be helpful.

(c) Enlargement of the production infrastructure

Virtually all Malaysian casting factories are located on Temporary Occupied Land (TOL) or in city suburbs where there is no room for further plant expansion. As a result, plans to build foundry and engineering parks should be promoted in order to assist factory expansion and modernization. In addition, credit programmes for the modernization of plants and facilities should be expanded. Finally, inter-corporate cooperation should be promoted in the following areas: shared use of modern manufacturing facilities and product inspection facilities; joint purchasing of raw materials; and joint receipt of orders for production.

(d) Market expansion

The limited scale of the market for castings in Malaysia has inhibited development of the casting industry. One method of solving this impasse would be to collect information regarding overseas markets and attempt to break into these markets. Another would be to attract firms in industries having high demand for castings, such as the machinery sector. Finally, it is important to establish linkages between local buyers and casting companies.

(3) Measures for Internationalization

Measures for the promotion of internationalization include (1) greater efforts to attract investment; and (2) promotion of capital and technological tie-ups with foreign manufacturers.

(a) Greater efforts to attract investment

An increasing number of overseas casting factories are considering moving their production bases abroad. Consequently, it is hoped that investment attraction efforts by MIDA will be strengthened with a focus on these corporations.

(b) Promotion of capital and technological tie-ups

The promotion of capital and technological tie-ups between foreign casting factories and Malaysian firms will require strengthening of programmes such as MIDA's RICOM and MEXPO's Trade Inquiry Service. In addition, Malaysian industry efforts should be increased to promote cooperation not only between factories but between industry groups as well.

Fig. III.5-2 Framework for Promotion of the Casting Industry

Industry Outline

- Malaysian production of castings is very limited, with estimated production in 1988 totaling only 55,884 tons. A breakdown of production by material follows:

1988 casting production in Malaysia

Cast iron	33,421 tons
Steel casting	13,802 tons
Malleable iron casting	3,960 tons
Other	4,701 tons
Total	55,884 tons

- Traditional industries form the main source of demand for castings. The tin industry accounts for 24% of all demand for pig iron; palm oil, 14% rubber and lumber, 13% each; and other industries, 36%.
- 85% of the 163 foundries in Malaysia are concentrated in Kuala Lumpur, Selangor, Perak, and Pengang.

Programmes and Policies

- The casting industry was designated as a key industry in the 1985 IMP, and since then specially-established task forces have been responsible for carrying out trend surveys and studying the creation of industrial parks for the casting industry.
- In addition, prodution of cast metal components for automobiles is scheduled to start in October 1990 as part of the efforts to modernize the casting industry.
- The casting industry has been singled out for promotion by the government.

Significant new demand

Overseas Market Demand

- The world can be broken down into three main markets — the U.S., Europe and Asia (excluding China) — each with a share of about 22%.
- Taiwan and Korea have annual production exceeding 1 million tons, and production is increasing on an annual basis.
- Labour and power account for a large portion of the manufacturing cost for cast metal products, and this has weakened the competitiveness of products from the U.S., Japan, and other industrialized nations. The NIEs have also suffered from rising labour costs, and as a result investment in Malaysia by casting firms from Taiwan and other countries is increasing.
- Recent trends include the procurement of parts for automobiles and home electric appliances from throughout the ASEAN region and not just the country of assembly, indicating the possibility of increasing production for supply to other ASEAN nations.

Current Problems

- Production at most foundries still relies on operator experience and intuition. Adoption of plant management systems and the latest production technologies has been delayed.
- Most foundries are small operations managed by families or individuals. As result, managers are not enthusiastic about breaking into new fields, and modernizatio has been delayed.
- Virtually all foundries are located on temporary occupied land (TOL) or in crowded city suburbs, making further expanbsion impossible.
- There have been no moves by foundries towards the joint use of modern production and product inspection facilities, the joint purchasing of raw materials, or the joint taking of orders.
- Malaysia's limited market for castings has hindered development of the industry. Basic market strategies, such as the gathering of information o local and overseas markets, the promotion and attraction of companies in the machinery industry, and the establishment of linkages with demand sectors, remain insufficient.

General Directions

Expansion of industrial foundation	Promotion of internationalization

Specific Measures (Expansion of industrial foundation)

Improvement of technical standards
- Nurturing of engineers and technicians
- Training of skilled workers
- Tightened quality control

Modernization of management
- Greater training of management
- Promotion of industry cooperation
- Greater guidance in management know-how

Enlargement of production infrastructure
- Promotion of plans to build industrial parks
- Enlargement of financing programs for industrial modernization
- Promotion of inter-company cooperation

Market expansion
- Export promotion
- Attraction and promotion of key industries
- Establishment of linkages with assembly firms

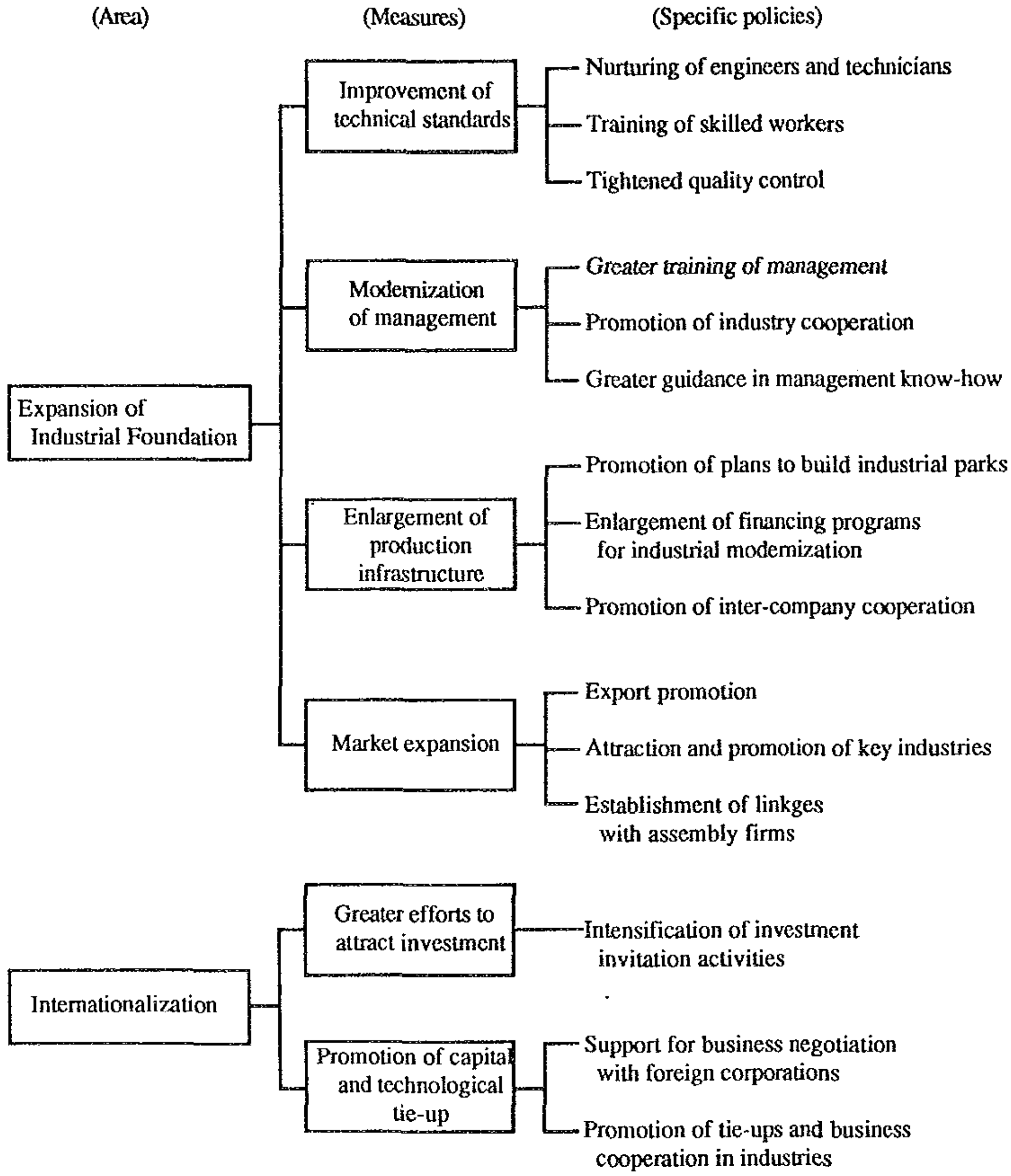
Specific Measures (Promotion of internationalization)

Greater efforts to attract investment
- Intensification of investment invitation activities

Promotion of capital and technological tie-up
- Support for business negotiation with foreign corporations
- Promotion of tie-ups and business cooperation in industries

Promotion of the casting industry

Fig. III.5-3 Policies for Promotion of the Casting Industry



IV. Computers and Computer Peripherals

IV. Computers and Computer Peripherals

IV-1. Overview of the Industry

IV-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.

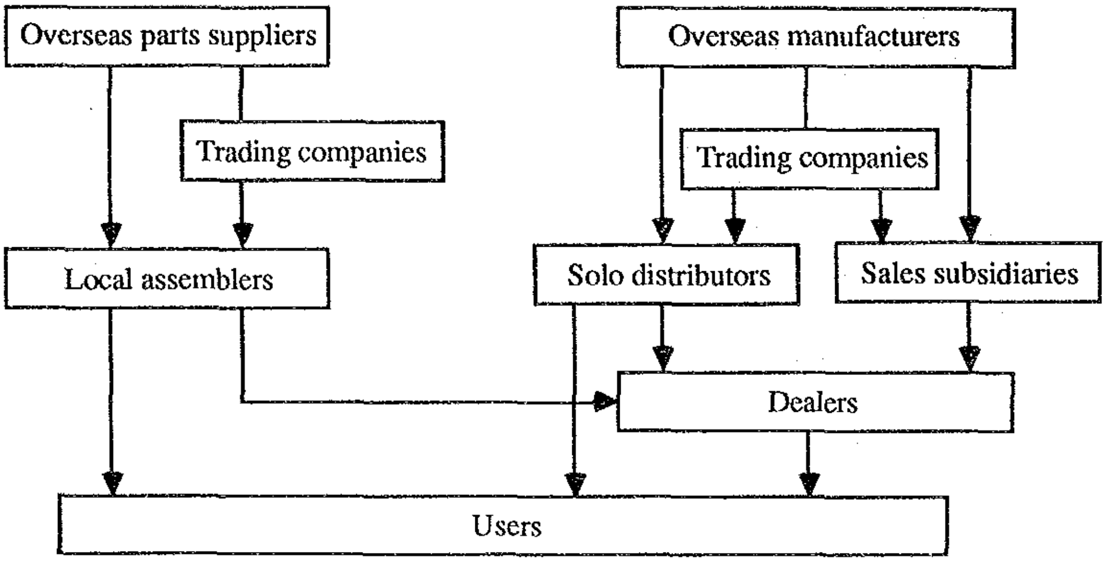
(4) keyboard Market

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. IV.1-1.

Fig. IV.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.

IV-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 IV.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 IV.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

IV-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 IV.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 IV.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.

IV-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.

Table IV.1-3 shows a summary of current and predicted computer-related production in Malaysia. Disk drives and power supplies maintain a large share in the cost breakdown of intermediate components for personal computers, and there is a trend towards greater local production of power supplies, hard disk drives, and floppy disk drives.

(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.

Table IV. 1-3 Present Status of and Outlook for Production of Computer-related Products in Malaysia

Completed products	Parts	Firms which have started operation	Firms which plan to start production	Remarks
P/C		• Accent Technology • Microcomputer Systems • Compex Systems • Meranti Computer • Techtrans Computer • Micro Base Electronics • Computer Resources	• Acer (from the latter half of 1990)	• There are no domestic manufacturers with a production scale of 1,000 units per month. Acer will be the first mass producer. • Astec used to assemble motherboards for supply to Apple but production stopped in 1986. The firm has the facilities, experience, and ability as well as enthusiasm for OEM production.
	Power supply	• Astec (M) • Innopower • Lambang Hidup (for special-purpose) • PK Electronics	• Micro Base Electronics • Stanford Industries	• Local sourcing is possible from Astec. • There is a chance for local manufacturers to enter the market because power supplies represent an area which is technically easy to enter and because Taiwan, a large supplier, is losing its competitive edge.
	HDD		• Conner Peripherals (from 1990)	• Increasing production is possible as a result of a shift from Singapore.
	HDD components	• Conner Peripherals • Maxtor • Imprimis Technology • Kobe Precision • Hitachi Metal Electronics • Control Data Components • Chew Chuan Seng	• Eng Technologi (from 1990)	• Production of components has been showing a considerable increase • There will be a ripple effects on related industries because high precision components are required.
	FDD		• Sony Mechatronic (from 1990) • Mitsumi (from 1990)	
	FDD components		• Yano Electronics	

Completed products	Parts	Firms which have started operation	Firms which plan to start production	Remarks
	Readhead	• Lemetronics		
Keyboard		• Fujitsu • Mitsumi	• Micro Base Electronics • SMK • Acer (from 1990) • San Teh Industries • Siltek Co.	• Production is tending to increase. There is a possibility that production will shift from Taiwan. In that case, Thailand may be regarded as a competitor. • Technically, production is possible
Monitor		• Sharp-Roxy Electronics • Wearnes	• Mitsubishi Electronics MFG (from 1990) • Sonica Technology • Acer	• Production is tending to increase. It is possible that existing TV manufacturers will start production of monitors in an attempt to diversify and the shift of production by foreign affiliated manufacturers. • Technically, production is possible.
Printer	Head Unknown		• Brother Industries • Epson	• Technically, it is the most difficult field because most of the components are fine precision mechanical ones.

Note: HDD = Hard Disk Drive, FDD = Floppy Disk Drive

(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 IV.1-4 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 IV.1-4 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.

IV-2. State of Production

IV-2-1. Production Processes

(1) Outline of Production Processes of Personal Computer and Peripherals

1) Purchase of Parts

Purchase of parts can be divided into two types: purchase of standard parts and purchase of custom-made parts.

General-purpose electronic parts such as capacitors, diodes, and semiconductors are standardized parts of which specifications are fixed by suppliers. Personal computer and peripherals makers choose adequate ones for their products among assortments of standard parts.

For metal stamping parts and plastic injection moulding parts, personal computers and peripherals makers decide on the specifications of parts and often order them from subcontracting specialized manufacturers. Custom ICs are procured in the same way.

Makers procure parts from outside suppliers because personal computers and peripherals are comprised of a large number of parts and components and it is not economical to manufacture all the parts and components by themselves.

2) Manufacture of parts

Personal computer and peripherals makers internally manufacture such parts as key parts which require higher levels of technologies and the parts of which the outside sources are limited to expensive imports because there exist no domestic suppliers.

3) Sub-assembly (Assembly of Units)

Units are formed by the combination of a number of parts and components and perform one or more functions in the final product. Units are roughly divided into mechanical units, electrical units, and mechanical-electrical units.

Mechanical units are assemblies of metal stamping parts, plastic injection moulding parts, and other mechanical parts which are assembled by such measures as welding, fusion, adhesion, caulking, pressure fitting, screwing and other methods.

Functions which these units primarily fulfill are to support the overall structure as the frame and to transmit power as a lever or actuator.

Most electrical units are assembled by fixing electronic parts into printed circuit boards with solder. Its functions are to supply power and to process electrical signals for the control of movements of the product.

Mechanical-electric units are assembled by combining such mechanical parts as metal stamping parts, plastic injection moulding parts, etc., and electrical parts by the same kind of method as adopted for the assembly of mechanical units. These units function to convert electrical signals to mechanical operations and vice versa.

4) Final Assembly

The final products are assembled by combining a number of units and components in this stage. This stage, in general, consists of assembling, inspection, adjustment, aging inspection, forwarding inspection, packing, and shipment.

5) Production Process Chart

Production processes of personal computers and its peripherals are illustrated in Fig. IV.2-1 to IV.2-4.

Fig. IV.2-1 Production Process Flow of Personal Computers

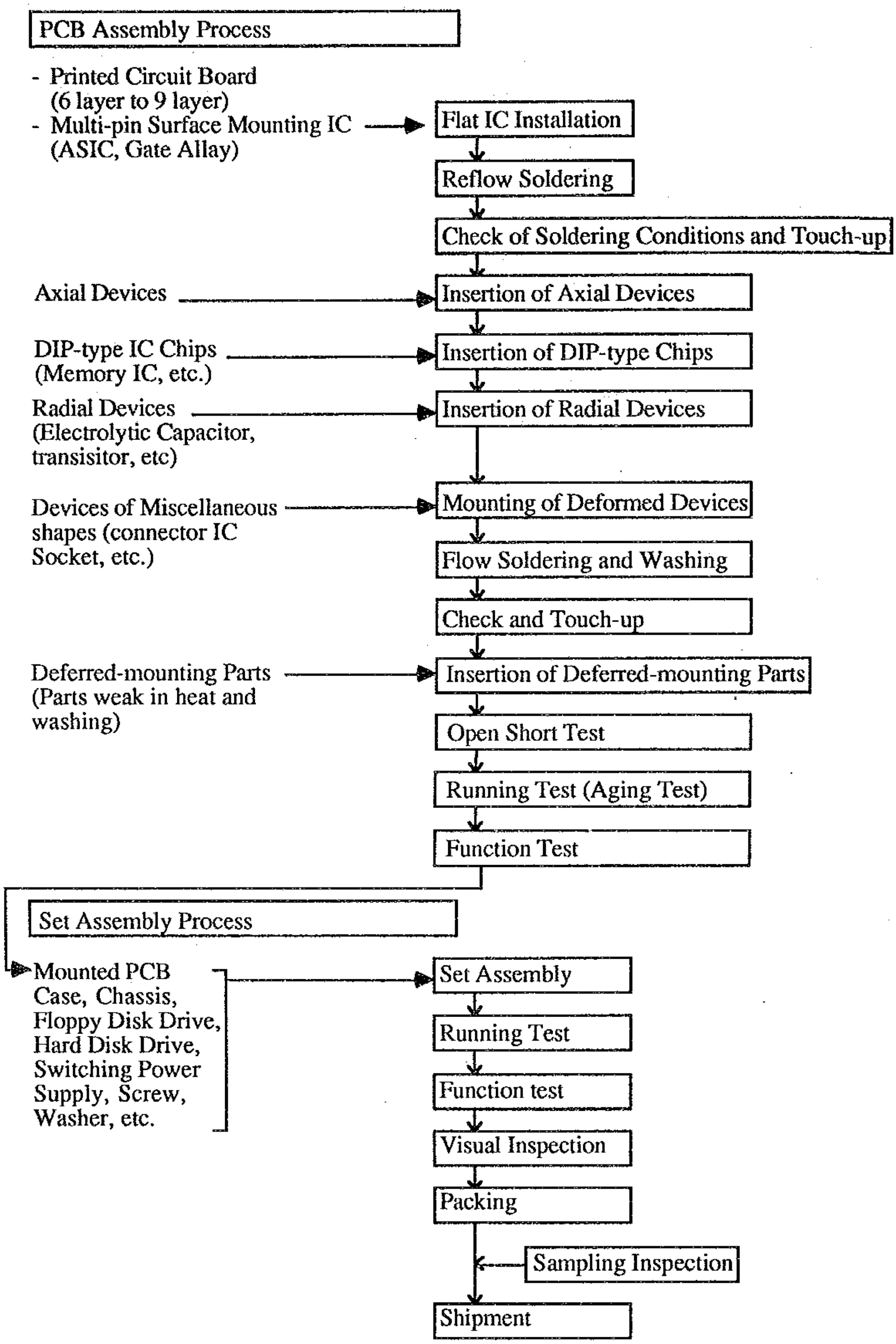


Fig. IV.2-2 Production Process Flow of Monitors

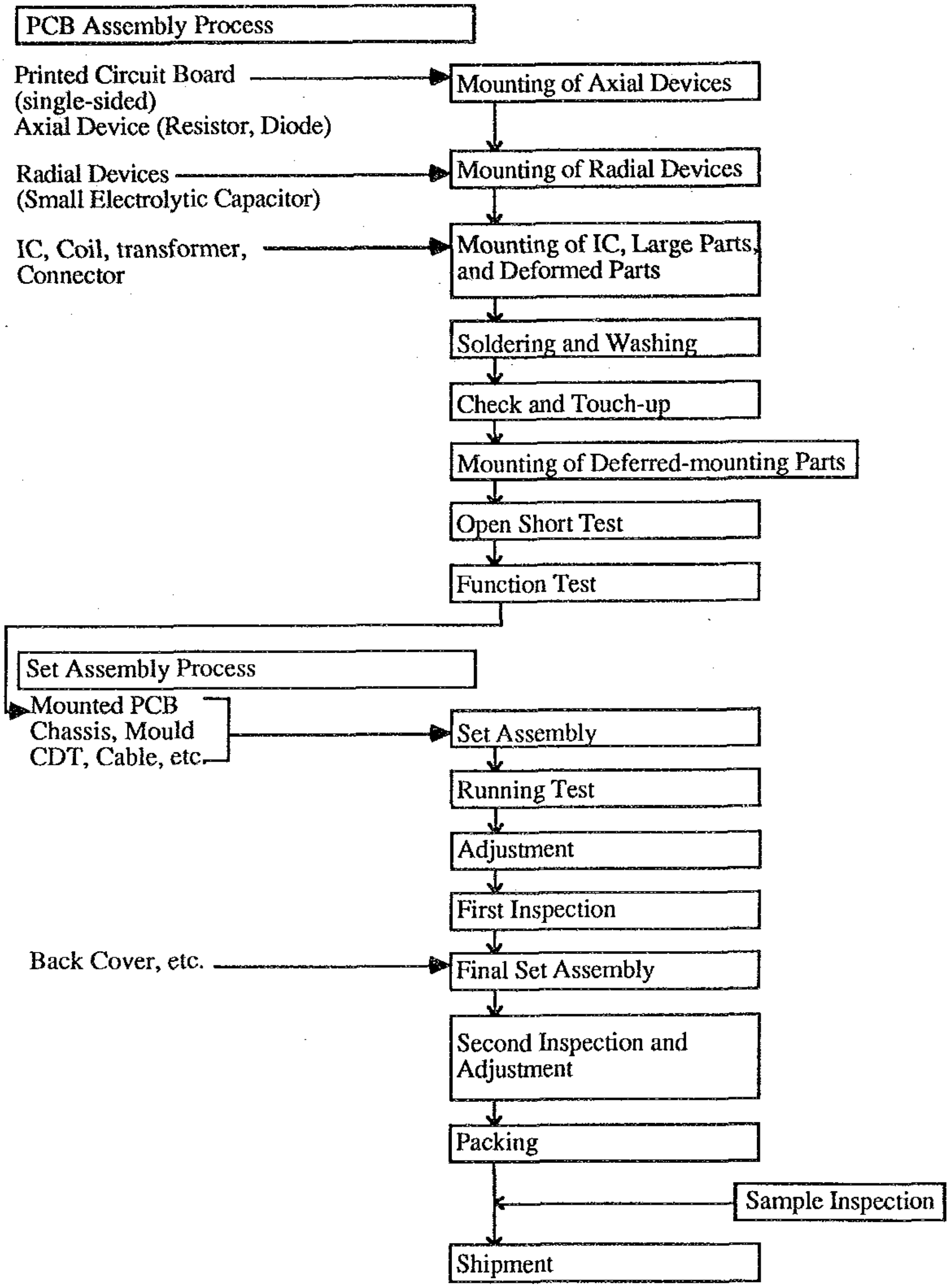


Fig. IV.2-3 Production Process Flow of Printers

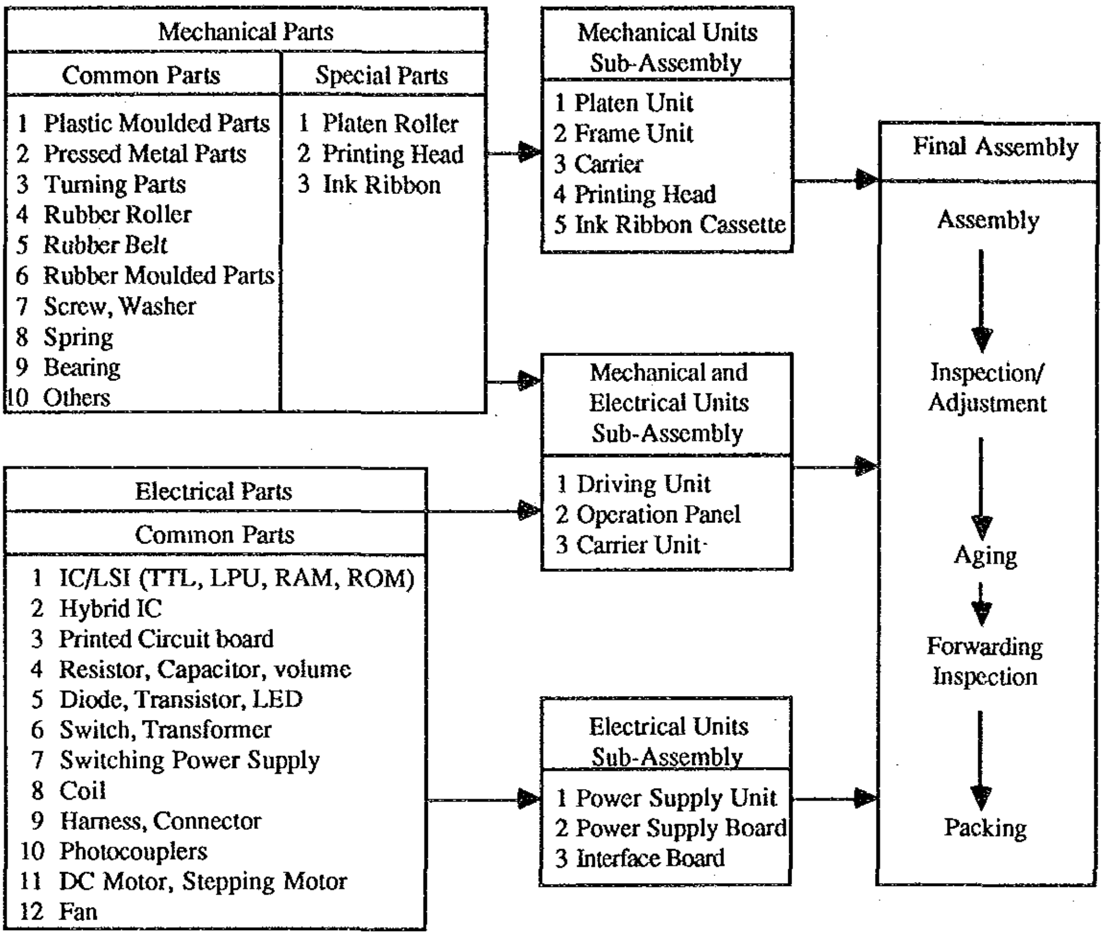
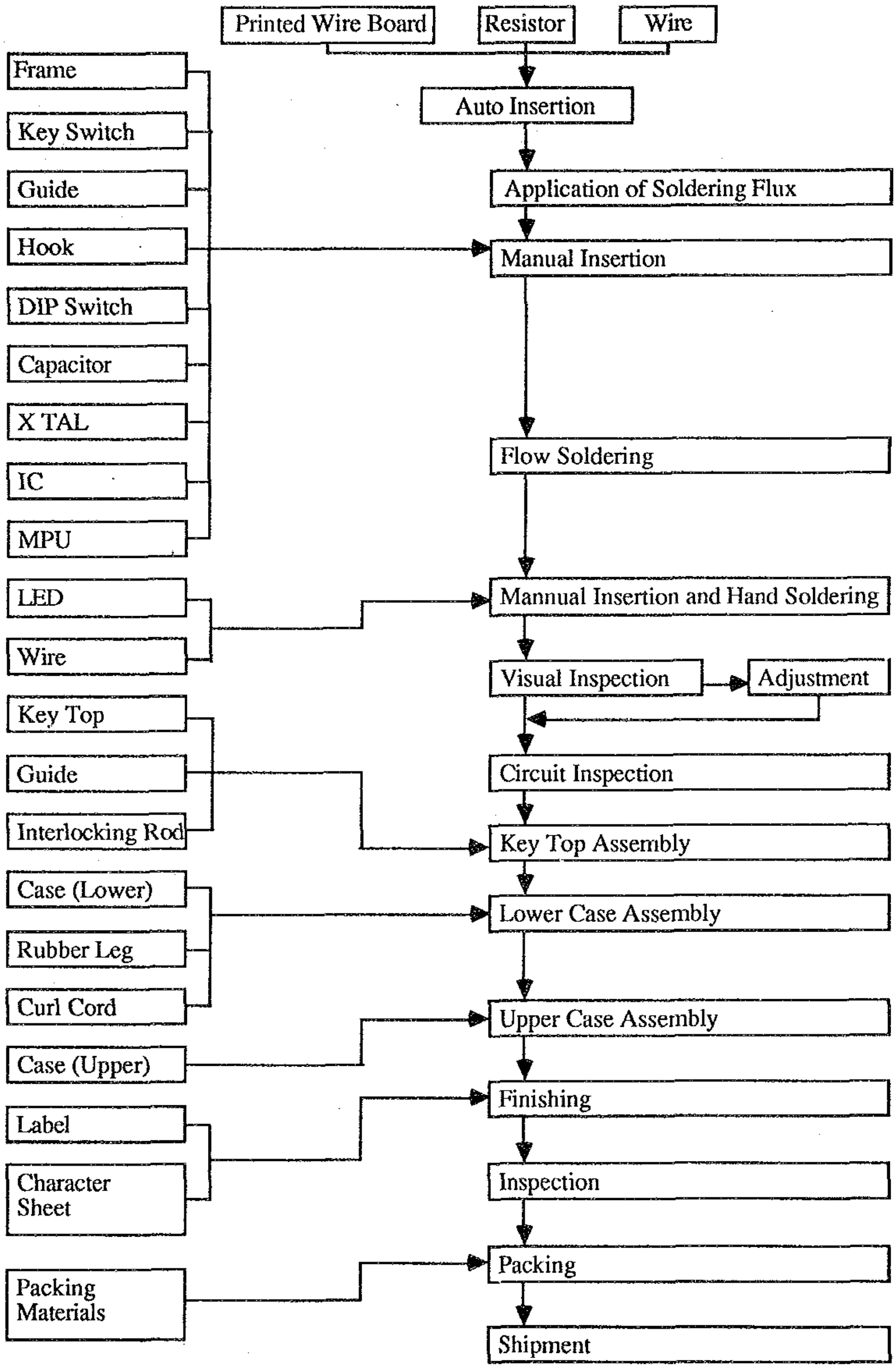


Fig. IV.2-4 Production Process Flow of Keyboards



IV-2-2. The Development Process of Personal Computers

(1) Process of Development

In the process of developing personal computers, product concept is decided first, followed by the system specifications. Based on the specifications, both hardware and software are devolped. In hardware development, circuits are designed based on the hardware design specifications. Preparation of product designs are based on the design of the hardware circuits. As a next step, prototypes are fabricated to confirm the operability of the basic parts of the hardware. In the process of software development, the system structure is designed for each layer, based on software design specifications, and then the program structure for each module is designed. Based on the module designs for the programs, flow charts are drawn for each section, and coding is done. Next, the programme is edited and assembled. In the final stage, debugging tests are conducted using machines with software and then running test are conducted to inspect quality and performance.

Usually, synerscopes, logic analyzers, logistic testers, testers, test boards and other devices are used as tools for the development of hardware. Tools for the development of software include source editors, development languages, software debuggers, insert kit emulators, PROM programmers and other devices.

(2) Basic Circuit Design

1) Design of Custom LSIs

In the design of personal computers, the most sophisticated techniques are required at the stage of designing basic circuits and adapting them to LSI. If general-purpose electonics components are used, the size of the circuits will be too large to realize the functions of personal computers. Therefore, it is imperative that key portions of circuits be integrated into several custom-LSIs.

To develop custom-LSIs for use in personal computers, a large group of highly-skilled engineers must spend 1.5-2.0 years - even if they use dedicated machines and equipment.

To offset the costs of developing custom-LSIs, the firm must have five-digit monthly sales figures for the product. In this sense, only large manufacturers are capable of producing such mass-production-type general-purpose personal computers.

2) Chip Set Purchase

Semiconductor design manufacturers have solved the problem of the great deal of time and money involved in developing custom chips. U.S. firms like Chips & Technologies and Intel have developed and marketed "chip sets" capable of providing all the functions of an IBM PC machine with only five or six chips.

Through the purchase of such chip sets, even smaller personal computer manufacturers can produce products which are compatible with IBM PCs. In turn, the manufacturers of chip sets are able to recover development costs through the sale of these sets to numerous companies.

Virtually all of the PC manufacturers in Taiwan and Singapore use chip sets.

Since the expensive chip sets account for a significant portion of manufacturing costs, it is difficult to produce competitive products using purchased chip sets.

3) Gate Array Design

Gate arrays are semi-custom chips containing the logic gates which form the basis for logic circuits on the printed circuit board and wired to user specifications. Although they have a low degree of integration, gate arrays require little time and money to develop and allow easy design modification.

When gate arrays are used, manufacturers are forced to use a greater number of components than in the case of the more expensive full-custom chips.

Some of the Taiwanese PC manufacturers have forgone the use of chip sets in place of in-house design of PC gate arrays.

(3) Basic Software Development

During full-scale in-house development of a personal computer, development of basic software (i.e., the operating system) requires the greatest technological resources. The operating system, or "OS," is the basic software which controls the operations of the computer hardware. Development of an operating system requires a great deal of time and money, but standard operating system software which can be run on different PCs is available from Microsoft and other companies. Consequently, it is common for personal computer manufacturers to obtain licenses for the use of this software from these software houses.

In order to run an OS on a given hardware system, a basic input/output system (BIOS) is required to connect the operating system and the hardware. Development of a BIOS usually requires a year's effort on the part of five or six software engineers trained in machine language. The resulting BIOS is then etched onto ROM chips which are mounted on the motherboard.

When developing a personal computer in-house, the development of a BIOS is extremely important, since the BIOS has a large impact on personal computer performance.

A computer with a BIOS having exactly the same functions as the BIOS of another computer will be compatible with the latter. Development of a BIOS having an identical interface to the IBM PC BIOS brings in the problem of copyrights. If the IBM BIOS has been optimized, it is very difficult to produce a high-performance BIOS without infringing upon the IBM copyright. Even after development there is always the risk of copyright infringement lawsuits from IBM.

There are some companies in the U.S. and Taiwan which specialize in the development and manufacture of BIOSs. These firms are engaged in the development, licensing, and sales of IBM PC-compatible BIOSs.

Even the larger manufacturers of personal computers in Europe, the U.S., and Japan often resort to obtaining licenses from these firms in order to avoid the possibility of litigation with IBM.

IV-2-3. 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 IV.2-1, Fig.IV.2-5.

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 IV. 2-1 Technology Level Evaluation of Assemblers in Malaysia

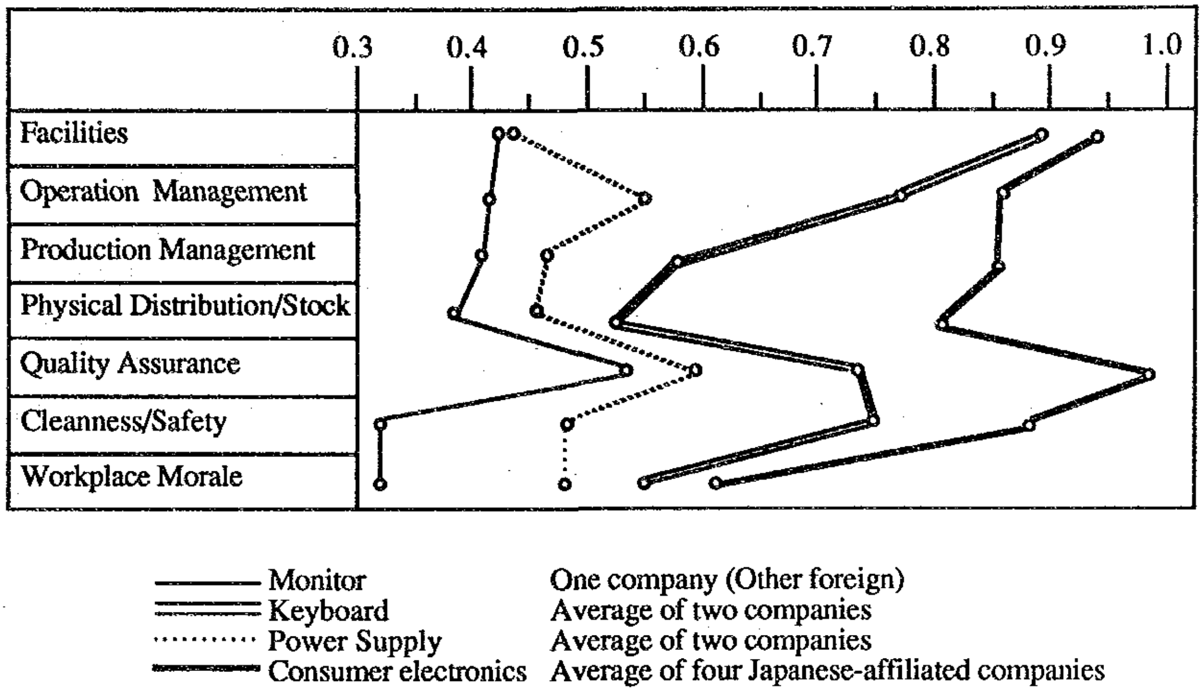
Evaluation Items		Importance Grade	Computer Peripherals						Components for Peripherals				Consumer Electronics Assembly							
			Monitor		Keyboard				Power Supply				TV		Audio				VTR	
			Other Foreign		Japanese		Japanese		Malyasian		Malaysian		Japanese		Japanese*		Japanese*		Japanese	
Facilities	Use 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	B	C		C		C		C		C		B		B		C		A	
	Layout	B	C	0.40	B	0.53	B	0.53	B	0.53	C	0.40	B	0.67	A	0.87	A	0.67	A	1.00
	Plant location	C	B		B		B		B		B		B		A		B		A	
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. IV.2-5 Evaluation of the Technological Level of Assemblers



IV-3. Current Situation of Computer-related Industries

IV-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 IV.3-1.

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

Name of Parts	Personal Computers: At Present Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Personal Computers: * In future Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Motors: At Present Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Motors: * In future Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Printers: At Present Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Printers: * in Future Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Keyboards: At Present Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Keyboards: In future Proportion of Malaysian Parts (%)	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: At Present Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Personal Computers: * In future Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Motors: At Present Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Motors: * In future Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Printers: At Present Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Printers: * in Future Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Keyboards: At Present Proportion of Malaysian Parts (%)	Sources Except Japan & Malaysia	Keyboards: In future Proportion of Malaysian Parts (%)	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.

IV-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.