

# U.S. Demographics *1990*

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May 1990

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## Demographic Terms

**CAGR (compound annual growth rate).** Calculated using the formula:

$$\text{CAGR} = \left( \frac{\text{Value in year } 1+n}{\text{Value in year } 1} \right)^{\left( \frac{1}{n} \right)} - 1$$

**civilian population.** Resident population of the United States that does not include resident or overseas armed forces, merchant marines, or citizens living outside the United States.

**corporation.** A self-perpetuating body set up as a business entity separate from its owners. This means that ownership is separate from management and incurs limited liability.

**desktop.** Defined in Dataquest's desktop analyses as a potential location for a desktop information device.

**elementary grades.** Elementary grades are classified through the school district. If the district covers kindergarten through eighth grade, then up through eighth grade is considered elementary. If the district covers only through sixth grade, then only through sixth grade is considered elementary.

**enterprise.** An aggregation of establishments that have common ownership. This definition includes a parent company plus all of its subsidiaries and branches, as well as single establishments that have no financial links with other establishments.

**establishment.** A single physical location where business activity is conducted, whether or not there are any financial links to other units. Establishments include independently owned and operated businesses as well as the headquarters, subsidiaries, and branches of larger firms.

**family.** A group of two or more persons residing together who are related by birth, marriage, or adoption.

**household.** A housing unit intended as separate living quarters. A household includes all persons, either related or unrelated, living in the unit.

**householder.** The person in whose name the housing unit is owned or rented. The term is never applied to either husbands or wives in married-couple families, but relates only to persons in families maintained by either men or women without a spouse.

**information worker.** An individual who is or will be a user of an automated desktop information device.

**median income.** Indicates the value that divides the income distribution into two equal parts, one part having values above the median and the other having values below the median.

**nonfamily.** A group of two or more persons residing together who are unrelated.

**occupational tenure.** The cumulative number of years a person works in his or her current occupation, regardless of the number of employers, interruptions in employment, or times spent in other occupations.

**other four-year colleges.** A school that places its primary emphasis on undergraduate education. A four-year college can offer doctorate and professional degrees, but its graduate programs will not be as extensive as those of a university.

**participation rates.** Represents the proportion of the population that is in the labor force.

**partnership.** An association of two or more persons to carry on as co-owners of a business. Partners may be individuals, corporations, estates, trusts, or other partnerships and may be actively or passively involved in business operations.

**secondary grades.** Secondary grades are classified like elementary grades, by district. If the district covers eighth through twelfth grades, then grades eight through twelve are considered secondary. Likewise, if the district covers grades nine through twelve, then only nine through twelve are considered secondary.

**sole proprietorship.** A business that is fully owned and managed by a single individual.

**total population.** Includes all citizens, armed forces personnel, and merchant marines of the United States living at home or abroad.

**two-year colleges.** A school that offers an associate degree, but not a baccalaureate degree. Two-year colleges are also called junior colleges.

**university.** A school that places its primary emphasis on graduate and professional education. Universities offer doctoral studies in numerous fields and support at least two professional programs.

**vocational school.** A school that offers a certification in a specialized profession but does not offer classes applicable toward an associate or baccalaureate degree.

## Education and Government Environments

The evolution of demographic changes in the United States has profoundly affected American society. One significant factor that has caused major shifts in school enrollment is the alteration in the fertility rate of women.

- The continuing effects of the baby boom (1946-1964) have caused enrollment at the elementary and secondary levels to:
  - Increase—1950s and 1960s
  - Decrease—1970s and early 1980s
  - Increase—Mid-1980s to late 1980s
- Higher education (postsecondary) enrollment has also been affected. Enrollment has:
  - Increased—Mid-1960s and 1970s
  - Peaked—Mid-1980s
  - Increased—Late 1980s
- Changes in the enrollment of elementary and secondary schools reflect shifts in school-age population. As women started having more children in the early 1980s, the school-age population began to increase.
- Enrollment in grades kindergarten through 8 will continue to increase well into the 1990s. However, enrollment in grades 9 through 12 is expected to decline through 1990, then begin to increase through 1997.
- Although enrollment in elementary and secondary schools was decreasing in the 1970s, the number of teachers in public elementary and secondary schools increased. Part of the increase can be attributed to a greater number of teachers required to implement special and bilingual education programs and smaller class-size policies. The number of teachers declined in the late 1970s and early 1980s. After 1983, the number of classroom teachers reached an all-time high of 2.3 million in 1987. This number is expected to reach 2.6 million by 1997.
- Although school-age population contributes to the enrollment of higher education institutions, the younger population is no longer the sole source of enrollment.
- The traditional college-age population is between 18 and 24 years old. This group declined from 30.4 million in 1981, to 27.4 million in 1987. This decline is expected to continue throughout most of the 1990s, reaching 24.0 million in 1997.
- There are several factors influencing changes in enrollment. Some of these factors are:
  - Economic conditions
  - Political and administrative decisions
  - Perceived value of a degree
  - Intrinsic value of higher education
  - College costs
- Although the traditional college-age population is declining, higher education enrollment will be supplemented by the increasing entrance of women, part-time, and older students.
- Preparing students for their post-education work experience is critical. As the required skill level to perform basic job tasks escalates, the demand on the education system to provide a solid foundation to meet these requirements is heightened.
- The 1990s will be a time for the education system and the workplace to join together and take action to keep the skill level of the work force in step with the rapid changes in technology and skill requirements.

## **In This Section**

Tables E-1 through E-9 and G-1, and Figure 1 provide a general overview of education and government statistics. Areas covered in this section are number of schools, enrollment, expenditures, and government employment.



Table E-1. Number of U.S. Schools, Student Enrollment, and Instructional Staff

	Schools	Percent	Student Enrollment (Thousands)	Percent	Instructional Staff (Thousands)	Percent
Elementary						
Public	59,311	52.8	28,818	49.1	1,336	38.8
Private	15,303	13.6	4,097	7.0	256	7.4
Secondary						
Public	20,758	18.5	11,505	19.6	1,003	29.1
Private	2,438	2.2	1,175	2.0	96	2.8
K-12						
Public	2,179	NA	NA	NA	NA	NA
Private	4,949	NA	NA	NA	NA	NA
Other						
Public	1,000	NA	NA	NA	NA	NA
Private	2,926	NA	NA	NA	NA	NA
Subtotal	108,864	96.9	45,595	77.7	2,691	78.1
Higher Education						
Public	1,549	1.4	10,188	17.4	534	15.5
Private	1,908	1.7	2,899	4.9	221	6.4
Subtotal	3,457	3.1	13,087	22.3	755	21.9
Total	112,321	100.0	58,682	100.0	3,446	100.0

Note: Instructional staff for elementary and secondary education represents teachers exclusively.

Others includes special schools, vocational schools, and adult education schools.

Columns may not add to totals shown because of rounding.

NA = Not available

Source: Market Data Retrieval

U.S. Department of Education,  
National Center for Education Statistics

Table E-2. Public School Systems and Student Enrollment by Enrollment-Size Class, 1988-1989

Enrollment Size (Students)	Number of Systems	Percent	Enrollment (Thousands)	Percent
0	195	1.3	NA	0
1 to 299	3,984	25.9	526	1.3
300 to 599	2,266	14.7	1,010	2.5
600 to 999	1,813	11.8	1,454	3.6
1,000 to 2,499	3,529	23.0	5,860	14.5
2,500 to 4,999	1,907	12.4	6,748	16.7
5,000 to 9,999	924	6.0	6,546	16.2
10,000 to 24,999	473	3.1	7,112	17.6
25,000 or more	177	1.2	11,233	27.7
Size Not Reported	108	0.7	NA	0
Total	15,376	100.0	40,489	100.0

Note: Enrollments and numbers of schools should be regarded as approximations only.  
 These totals differ from those in other tables because this table represents data reported by  
 school districts rather than by states.  
 Columns may not add to totals shown because of rounding.  
 NA = Not available

Source: U.S. Department of Education,  
 National Center for Education Statistics

Table E-3. Student Enrollment at U.S. Colleges and Universities, 1985-1995

	Total Enrollment	Four-Year Institutions	Two-Year Institutions	Percent Change
<b>Actual</b>				
1985	12,247	7,716	4,531	0
<b>Estimated</b>				
1986	12,397	7,753	4,644	1.2
1987	12,544	7,816	4,728	1.2
<b>Projected</b>				
1988	12,557	7,878	4,679	0.1
1989	12,570	7,857	4,713	0.1
1990	12,585	7,862	4,723	0.1
1991	12,529	7,831	4,698	(0.2)
1992	12,408	7,756	4,652	(1.3)
1993	12,300	7,679	4,621	(2.3)
1994	12,201	7,605	4,596	(2.6)
1995	12,151	7,563	4,588	(2.1)

Source: U.S. Department of Education,  
National Center for Education Statistics

**Table E-4. Student Enrollment in Grades Kindergarten through 8 and 9 through 12 in Public and Private Elementary and Secondary Schools, 1985-1995 (Thousands of Students)**

Year	Total Public and Private			Public			Private		
	K-12	K-8	9-12	K-12	K-8	9-12	K-12	K-8	9-12
<b>Actual</b>									
1987	45,547	32,101	13,446	40,200	27,983	12,217	5,347	4,118	1,229
<b>Projected</b>									
1988	45,522	32,475	13,047	40,280	28,439	11,841	5,242	4,036	1,206
1989	45,609	32,904	12,705	40,337	28,807	11,530	5,272	4,097	1,175
1990	46,092	33,542	12,550	40,752	29,366	11,386	5,340	4,176	1,164
1991	46,718	34,031	12,687	41,306	29,794	11,512	5,412	4,237	1,175
1992	47,366	34,470	12,896	41,879	30,178	11,701	5,487	4,292	1,195
1993	48,000	34,792	13,208	42,444	30,460	11,984	5,556	4,332	1,224
1994	48,635	34,980	13,655	43,014	30,624	12,390	5,621	4,356	1,265
1995	49,112	35,110	14,002	43,442	30,738	12,704	5,670	4,372	1,298

Source: U.S. Department of Education,  
National Center for Education Statistics

Table E-5. Institutions of Higher Education by Control and Student Enrollment, 1987

Student Enrollment	All Institutions		Universities		Other Four-Year Colleges		Two-Year Colleges	
	Number	Enrollment (Thousands)	Number	Enrollment (Thousands)	Number	Enrollment (Thousands)	Number	Enrollment (Thousands)
<b>Public Institutions</b>								
Less than 200	7	1	0	0	1	0	6	1
200 to 499	40	15	0	0	11	4	29	11
500 to 999	131	100	0	0	29	23	102	76
1,000 to 2,499	415	713	0	0	107	189	308	524
2,500 to 4,999	319	1,137	1	5	103	376	215	756
5,000 to 9,999	316	2,208	7	59	134	930	175	1,220
10,000 to 19,999	220	2,998	30	452	91	1,222	99	1,325
20,000 to 29,999	73	1,741	34	832	18	430	21	479
30,000 or More	28	1,063	22	841	2	71	4	150
Subtotal	1,549	9,976	94	2,189	496	3,245	959	4,542
<b>Private Institutions</b>								
Less than 200	400	41	0	0	283	29	117	12
200 to 499	395	133	0	0	235	79	160	54
500 to 999	393	284	0	0	307	224	86	60
1,000 to 2,499	463	716	0	0	423	654	40	62
2,500 to 4,999	148	509	6	25	139	473	3	11
5,000 to 9,999	68	465	24	183	43	275	1	7
10,000 to 19,999	33	424	24	313	7	82	2	29
20,000 to 29,999	5	125	5	125	0	0	0	0
30,000 or More	3	95	3	95	0	0	0	0
Subtotal	1,908	2,792	62	741	1,437	1,816	409	235
<b>Public and Private Institutions</b>								
Less than 200	407	42	0	0	284	29	123	13
200 to 499	435	148	0	0	246	83	189	65
500 to 999	524	384	0	0	336	248	188	137
1,000 to 2,499	878	1,429	0	0	530	843	348	586
2,500 to 4,999	467	1,646	7	30	242	849	218	766
5,000 to 9,999	384	2,673	31	242	177	1,204	176	1,227
10,000 to 19,999	253	3,422	54	764	98	1,304	101	1,354
20,000 to 29,999	78	1,866	39	957	18	430	21	479
30,000 or More	31	1,158	25	937	2	71	4	150
Total	3,457	12,768	156	2,930	1,933	5,061	1,368	4,777

Source: U.S. Department of Education,  
National Center for Education Statistics

Table E-6. Expenditures of U.S. Schools, 1986 (Millions of Dollars)

Type of School	Expenditures	Percent
Public Elementary and Secondary		
Instruction	89,559	61.1
Support Services	51,905	35.4
Noninstruction	5,125	3.5
Total, Elementary and Secondary	146,589	100.0
Higher Education		
Public Institutions		
Instruction	21,881	34.6
Research	5,705	9.0
Public Service	2,516	4.0
Academic Support	4,694	7.4
Student Services	2,922	4.6
Institutional Support	5,667	9.0
Operation and Maintenance	5,177	8.2
Scholarships and Fellowships	1,576	2.5
Others	13,057	20.7
Subtotal	63,195	100.0
Private Institutions		
Instruction	9,151	26.6
Research	2,732	8.0
Public Service	604	1.8
Academic Support	1,974	5.7
Student Services	1,641	4.8
Institutional Support	3,684	10.7
Operation and Maintenance	2,428	7.1
Scholarships and Fellowships	2,584	7.5
Others	9,543	27.8
Subtotal	34,341	100.0
Total, Higher Education	97,536	
Total	244,125	

Source: U.S. Department of Education,  
National Center for Education Statistics

Table E-7. Ratio of Students to Microcomputers in Public Schools

Grade Level	School Year				
	1985-86*	1986-87*	1987-88	1988-89	1989-90
Elementary	55.3	43.7	36.8	32.4	28.0
Junior High	41.6	32.9	27.6	23.8	22.0
Senior High	37.9	31.1	26.3	22.8	20.5
Total	45.5	36.5	30.8	26.9	24.1

Note: Total represents all public schools including K-12, but excluding schools of special education.  
Data are preliminary.

Source: Market Data Retrieval

\*Data collection was limited to those schools with a microcomputer.



**Table E-8. Installed Base of Microcomputers in Public Elementary and Secondary Schools by Manufacturer and School Year**

Manufacturer	School Year				
	1985-86	1986-87	1987-88	1988-89	1989-90
Apple	460,900	632,900	783,400	930,600	1,072,000
Tandy-Radio Shack	139,000	155,800	171,900	178,200	183,000
Commodore	116,300	130,900	140,400	141,600	138,000
IBM	42,100	68,200	108,900	147,700	189,000
Others	84,300	94,100	107,600	124,900	125,000
Total	842,600	1,081,900	1,312,200	1,523,000	1,707,000

Source: Market Data Retrieval

Table E-9. Microcomputers for Student Instruction in Elementary and Secondary Schools, 1986-1988

Year	Number of Schools				Percent with Microcomputers			
	All	Elementary	Junior High	Senior High	All	Elementary	Junior High	Senior High
1986	80.5	50.7	9.7	15.1	95.6	94.9	98.5	98.7
1987	80.6	50.9	9.7	15.0	96.4	96.0	98.6	99.0
1988	80.8	51.0	9.8	15.0	97.1	96.8	98.8	99.1

Source: Market Data Retrieval

Figure 1. Installed Base of Microcomputers in School for School Year, 1989-1990

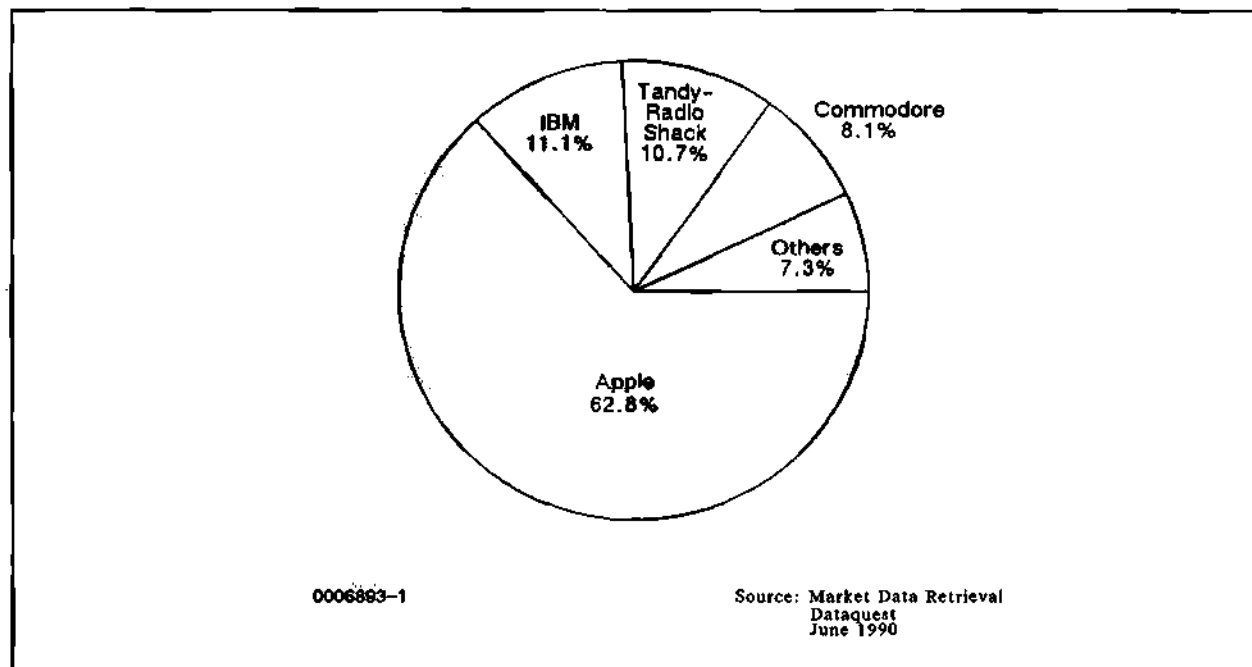


Table G-1. Federal, State, and Local Government Employment by Industry Sector, 1988

SIC Category	Employees
Construction	188,500
Manufacturing	126,039
Transportation and Public Utilities	480,541
Retail Trade	80,655
Services	8,503,458
Hospitals	1,253,829
Social Services	285,018
Amusement and Recreation	138,445
Educational	5,525,277
Elementary and Secondary	5,087,240
Colleges and Universities	1,250,769
Public Administration	6,098,305
U.S. Postal Service	834,673
Total	16,312,171

Source: U.S. Department of Labor,  
Bureau of Labor Statistics

## Households and Population

The phrase "traditional nuclear family" is rapidly becoming a sociological term describing the past in American society. As the new decade begins, the movement away from the two-parent, one-income family with children shall continue. This transition time will give rise to an increase in nonfamily, single-parent households, and dual-income marriages without children.

- The percentage of households composed of a married couple with children in the home is 26 percent, down from 31 percent in 1980.
- The fastest growing household classification is people living with nonrelatives. Although the number of households of this type has increased, it accounts for only 5 percent of total households.
- The overall number of households has grown steadily for decades. In 1910, there were 20.3 million households, increasing in number to 92.8 million in 1989.
- In 1989, 16.5 percent of all family households were maintained by women without a husband present, compared with 9.2 percent in 1950. Two contributing factors to this increase are:
  - A greater number of women participating in the work force
  - A higher incidence of divorce than ever before
- The median age for first marriages is getting older. In the late 1980s, the median age for women getting married for the first time was 23.6 and 26.0 for men. These ages compare with the 1950s, when the median age for first marriages was 20.1 and 22.5 for women and men, respectively. The rise in median age for first marriages will have implications on initial and lifetime fertility rates and marriage dissolution. Those couples who are older at the time of their first marriage have fewer children born and a lower incidence of divorce.
- Almost one-fourth of family households with children are maintained by a single parent.
- Nearly 9 out of 11 children living with a single parent are with their mothers. Unfortunately, many women in this circumstance have lower than average incomes. Subsequently, children raised in poverty are at higher risk of low educational attainment, more frequent crime involvement, and out-of-wedlock childbearing.
- The current social patterns in childbearing point to the continuation of small family units as the norm for the nineties.
- Five states have grown by at least 10 percent since 1985. These increases are significantly higher than the national rate of 4 percent. The five states are:
  - Nevada—18 percent
  - Arizona—12 percent
  - Florida and New Hampshire—11 percent
  - California—10 percent (Overall growth in California—2.7 million—accounted for more than one-fourth of the entire nation's growth since 1985.)
- Rebounding from a slight decline in the early 1980s, the East North Central States (such as Michigan and Ohio) experienced population increases in the second half of the decade.
- West Virginia, Kentucky, Mississippi, and the District of Columbia all experienced either slow growth or population declines in the mid-1980s to late 1980s.

## **In This Section**

Figures 2, 3, and 4, and Tables H-1 through H-4 and P-1 through P-8 provide a detailed overview of the U.S. population and household demographics.

Figure 2. U.S. Census Regions and Divisions





Table H-1. Number of U.S. Households and Average Household Size

Year	1985	1986	1987	1988	1989	1990	Estimated 1995	2000
Households (Millions)	86.8	88.4	89.5	91.1	92.8	94.2	100.3	105.9
CAGR (%)	1.6	1.8	1.2	1.8	1.9	1.7	1.3	1.2
Persons per Household	2.69	2.67	2.66	2.64	2.62	2.60	NA	2.48

NA = Not available

Source: U.S. Department of Commerce,  
Bureau of the Census

Table H-2. Income Distribution of U.S. Households, 1988

Income	Households (Thousands)	Percent
Less than \$5,000	5,737	6.2
\$5,000 to \$9,999	10,006	10.8
\$10,000 to \$14,999	9,516	10.3
\$15,000 to \$19,999	9,126	9.8
\$20,000 to \$24,999	8,184	8.8
\$25,000 to \$29,999	7,891	8.5
\$30,000 to \$34,999	6,984	7.5
\$35,000 to \$39,999	6,414	6.9
\$40,000 to \$49,999	9,638	10.4
\$50,000 to \$74,999	12,455	13.4
\$75,000 or More	6,877	7.4
Total	92,828	100.0
Median Income	\$27,225	
Mean Income	\$34,017	

Source: U.S. Department of Commerce,  
Bureau of the Census

Table H-3. Average U.S. Household Size

Type of Household	1986	Persons per Household		1989
		1987	1988	
All Households	2.67	2.66	2.64	2.62
Family Households <sup>1</sup>	3.28	3.22	3.21	3.16
Married Couple Households	3.32	3.27	3.25	3.23
Male Householder, No Wife	2.94	2.88	2.92	2.75
Female Householder, No Husband	3.11	3.09	3.08	2.95
Nonfamily Households <sup>2</sup>	1.21	1.22	1.22	NA
Male Householder	1.33	1.34	1.33	NA
Female Householder	1.13	1.13	1.13	NA

<sup>1</sup> Family households consist of people related to the householder by birth, marriage, or adoption.

<sup>2</sup> Nonfamily households consist of a person living alone or a householder living with people unrelated by birth, marriage, or adoption.

NA = Not available

Source: U.S. Department of Commerce,  
Bureau of the Census

Table H-4. U.S. Households by Region (Thousands of Households)

Region	1988		1989		CAGR
	Households	Percent	Households	Percent	
Northeast	19,137	21.0	19,158	20.6	0.11
Midwest	22,402	24.6	22,719	24.5	1.42
South	31,048	34.1	31,962	34.4	2.94
West	18,480	20.3	19,078	20.5	3.24
<b>Total</b>	<b>91,067</b>	<b>100.0</b>	<b>92,917</b>	<b>100.0</b>	<b>1.03</b>

Note: Columns may not add to totals shown because of rounding.

Source: U.S. Department of Commerce,  
Bureau of the Census

Table P-1. Population of the United States, 1987-2000 (Thousands of People)

	Actual				Estimated		
	1987	1988	1989	1991	1994	1997	2000
Population	244,425	246,048	248,241	252,502	258,338	263,543	268,266
CAGR (%)	1.39	0.66	0.89	0.85	0.76	0.67	0.59

Source: U.S. Department of Commerce,  
Bureau of the Census  
Dataquest  
June 1990

Table P-2. Distribution of U.S. Population by Age (Percent)

Age	Actual	Estimated			
	1989	1991	1994	1997	2000
Less than 10 Years	14.7	14.6	14.2	13.7	13.0
10-19 Years	14.0	13.7	13.9	14.2	14.3
20-29 Years	16.4	15.7	14.4	13.5	13.2
30-44 Years	23.7	24.6	24.7	24.4	23.6
45-64 Years	18.7	18.7	19.9	21.2	22.9
65 Years and Over	12.5	12.7	12.9	13.0	13.0
	100.0	100.0	100.0	100.0	100.0

Source: U.S. Department of Commerce,  
Bureau of the Census

Figure 3. Actual and Estimated Distribution of U.S. Population by Age

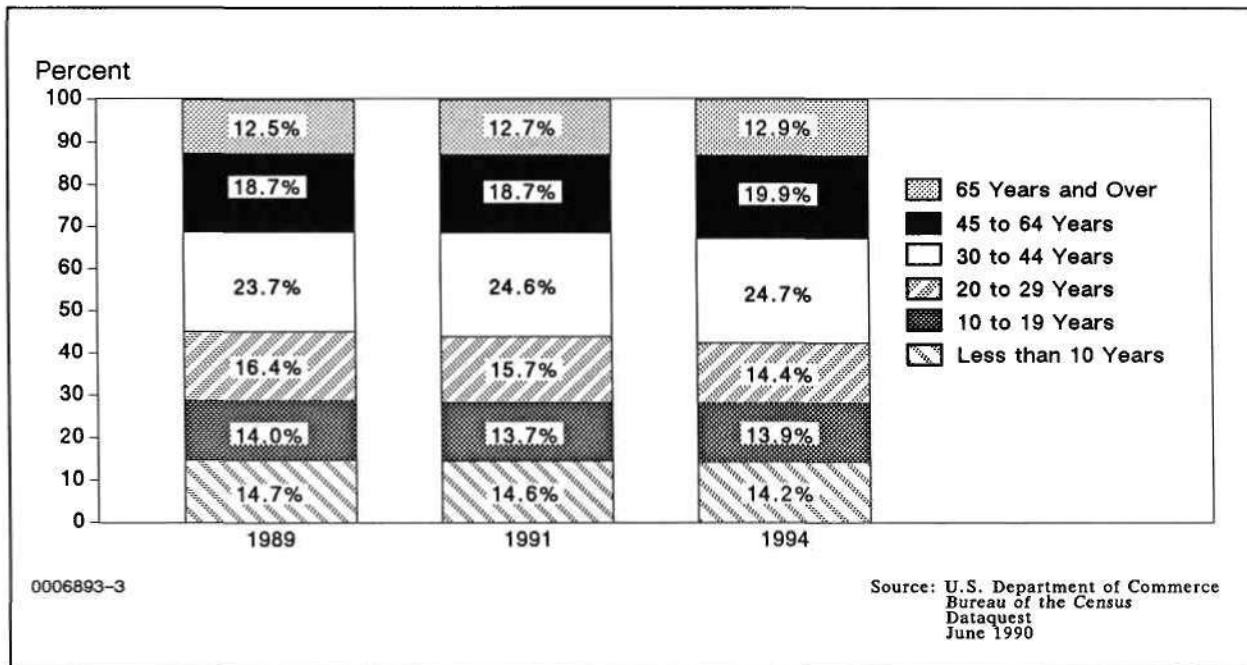




Table P-3. Top 50 Metropolitan Statistical Areas, 1988

Rank	Name	Population (Thousands)
1	New York - Northern New Jersey - Long Island, NY - NJ - CT	18,120,200
2	Los Angeles - Anaheim - Riverside, CA	13,769,700
3	Chicago - Gary - Lake County, IL - IN - WI	8,180,900
4	San Francisco - Oakland - San Jose, CA	6,041,800
5	Philadelphia - Wilmington - Trenton, PA - NJ - DE - MD	5,963,300
6	Detroit - Ann Arbor, MI	4,620,200
7	Boston - Lawrence - Salem, MA - NH	4,109,900
8	Dallas - Fort Worth, TX	3,766,100
9	Washington, DC - MD - VA	3,734,200
10	Houston - Galveston - Brazoria, TX	3,641,500
11	Miami - Fort Lauderdale, FL	3,000,500
12	Cleveland - Akron - Lorain, OH	2,769,000
13	Atlanta, GA	2,736,600
14	St. Louis, Mo - IL	2,466,700
15	Seattle - Tacoma, WA	2,420,800
16	Minneapolis - St. Paul, MN - WI	2,387,500
17	San Diego, CA	2,370,400
18	Baltimore, MD	2,342,500
19	Pittsburgh - Beaver Valley, PA	2,284,100
20	Phoenix, AZ	2,029,500
21	Tampa - St. Petersburg - Clearwater, FL	1,995,100
22	Denver - Boulder, CO	1,858,000
23	Cincinnati - Hamilton, OH - KY - IN	1,728,500
24	Kansas City, MO - KS	1,575,400
25	Milwaukee - Racine, WI	1,571,700
26	Portland - Vancouver, OR - WA	1,414,200
27	Sacramento, CA	1,385,200
28	Norfolk - Virginia Beach - Newport News, VA	1,380,200
29	Columbus, OH	1,344,300
30	San Antonio, TX	1,323,200
31	New Orleans, LA	1,306,900
32	Indianapolis, IN	1,236,600
33	Buffalo - Niagara Falls, NY	1,175,600
34	Providence - Pawtucket - Fall River, RI - MA	1,125,400
35	Charlotte - Gastonia - Rock Hill, NC	1,112,000
36	Hartford - New Britain - Middletown, CT	1,067,600
37	Salt Lake City - Ogden, UT	1,065,000
38	Rochester, NY	980,100
39	Memphis, TN - AR - MS	979,300
40	Nashville, TN	971,800
41	Orlando, FL	971,200
42	Louisville, KY	967,000
43	Oklahoma City, OK	963,800
44	Dayton - Springfield, OH	948,000
45	Greensboro - Winston-Salem - High Point, NC	924,700
46	Birmingham, AL	923,400
47	Jacksonville, FL	898,100
48	Albany - Schenectady - Troy, NY	850,800
49	Richmond - Petersburg, VA	844,300
50	Honolulu, HI	838,500

Source: U.S. Department of Commerce,  
Bureau of the Census

Table P-4. 100 Largest U.S. Cities, 1988

Rank	City	Population (Thousands)
1	New York, NY	7,353
2	Los Angeles, CA	3,353
3	Chicago, IL	2,978
4	Houston, TX	1,698
5	Philadelphia, PA	1,647
6	San Diego, CA	1,070
7	Detroit, MI	1,036
8	Dallas, TX	987
9	San Antonio, TX	941
10	Phoenix, AZ	924
11	Baltimore, MD	751
12	San Jose, CA	738
13	San Francisco, CA	732
14	Indianapolis, IN	727
15	Memphis, TN	645
16	Jacksonville, FL	635
17	Washington, D.C.	617
18	Milwaukee, WI	599
19	Boston, MA	578
20	Columbus, OH	570
21	New Orleans, LA	532
22	Cleveland, OH	521
23	El Paso, TX	511
24	Seattle, WA	502
25	Denver, CO	492
26	Nashville-Davidson, TN	481
27	Austin, TX	465
28	Kansas City, MO	439
29	Oklahoma City, OK	434
30	Fort Worth, TX	427
31	Atlanta, GA	420
32	Portland, OR	418
33	Long Beach, CA	415
34	St. Louis, MO	404
35	Tucson, AZ	386
36	Albuquerque, NM	378
37	Honolulu, HI	376
38	Pittsburgh, PA	375
39	Miami, FL	371
40	Cincinnati, OH	370
41	Tulsa, OK	368
42	Charlotte, NC	368
43	Virginia Beach, VA	365
44	Oakland, CA	357
45	Omaha, NE	353
46	Minneapolis, MN	345
47	Toledo, OH	341
48	Sacramento, CA	338
49	Newark, NJ	314
50	Buffalo, NY	314
51	Fresno, CA	307

(Continued)

Table P-4 (Continued). 100 Largest U.S. Cities, 1988

Rank	City	Population (Thousands)
52	Wichita, KS	295
53	Norfolk, VA	286
54	Colorado Springs, CO	283
55	Louisville, KY	282
56	Tampa, FL	282
57	Mesa, AZ	280
58	Birmingham, AL	277
59	Corpus Christi, TX	261
60	St. Paul, MN	259
61	Arlington, TX	257
62	Anaheim, CA	245
63	Santa Ana, CA	240
64	St. Petersburg, FL	235
65	Baton Rouge, LA	235
66	Rochester, NY	230
67	Lexington-Fayette, KY	226
68	Akron, OH	222
69	Aurora, CO	219
70	Anchorage, AK	218
71	Shreveport, LA	218
72	Jersey City, NJ	218
73	Richmond, VA	213
74	Riverside, CA	211
75	Las Vegas, NV	211
76	Mobile, AL	209
77	Jackson, MS	201
78	Montgomery, AL	194
79	Des Moines, IA	193
80	Stockton, CA	191
81	Lubbock, TX	188
82	Lincoln, NE	188
83	Huntington Beach, CA	187
84	Raleigh, NC	187
85	Grand Rapids, MI	185
86	Yonkers, NY	183
87	Greensboro, NC	182
88	Garland, TX	180
89	Little Rock, AR	180
90	Fort Wayne, IN	180
91	Madison, WI	178
92	Dayton, OH	178
93	Columbus, GA	178
94	Knoxville, TN	172
95	Spokane, WA	171
96	Fremont, CA	166
97	Amarillo, TX	166
98	Tacoma, WA	164
99	Chattanooga, TN	163
100	Hialeah, FL	162

Source: U.S. Department of Commerce,  
Bureau of the Census

Table P-5. Summary of U.S. Civilian Population By Labor Force Status, 1989

	Population (Thousands)
Civilian Noninstitutional Population Under 16 Years	57,038
Civilian Noninstitutional Population 16 Years and Over	
Civilian Labor Force	
Employed	
Nonagricultural Industries	
Wage and Salary Workers	
Private Household Workers	1,112
Government	17,637
Others	87,568
Self-Employed Workers	8,692
Unpaid Family Workers	282
Subtotal	115,291
Agricultural	
Wage and Salary Workers	1,682
Self-Employed Workers	1,417
Unpaid Family Workers	132
Subtotal	3,231
Total	118,523
Unemployed	6,594
Total	125,117
Not in Labor Force	
Keeping House	27,252
Going to School	7,454
Unable to Work	3,487
Other Reasons	24,966
Subtotal	63,158
Total	188,275
Institutionalized Population	2,928
Civilian Population	248,241

Note: Civilian population figure does not include armed forces or institutionalized population under 16 years.  
Noninstitutional population under 16 years as of July 1, 1988.

Source: U.S. Department of Labor,  
Bureau of Labor Statistics

Table P-6. U.S. Census Regions and Divisions

Northeast Region	Midwest Region	South Region	West Region
New England Division	East North Central Division	South Atlantic Division	Mountain Division
Maine	Ohio	Delaware	Montana
New Hampshire	Indiana	Maryland	Idaho
Vermont	Illinois	District of Columbia	Wyoming
Massachusetts	Michigan	Virginia	Colorado
Rhode Island	Wisconsin	West Virginia	New Mexico
Connecticut		North Carolina	Arizona
		Maryland	Utah
		Georgia	Nevada
		Florida	
Middle Atlantic Division	West North Central Division	East South Central Division	Pacific Division
New York	Minnesota	Kentucky	Washington
New Jersey	Iowa	Tennessee	Oregon
Pennsylvania	Missouri	Alabama	California
	North Dakota	Mississippi	Alaska
	South Dakota		Hawaii
	Nebraska	West South Central Division	
	Kansas	Arkansas	
		Louisiana	
		Oklahoma	
		Texas	

Source: U.S. Department of Commerce,  
Bureau of the Census

Figure 4. Distribution of U.S. Population by Census Divisions

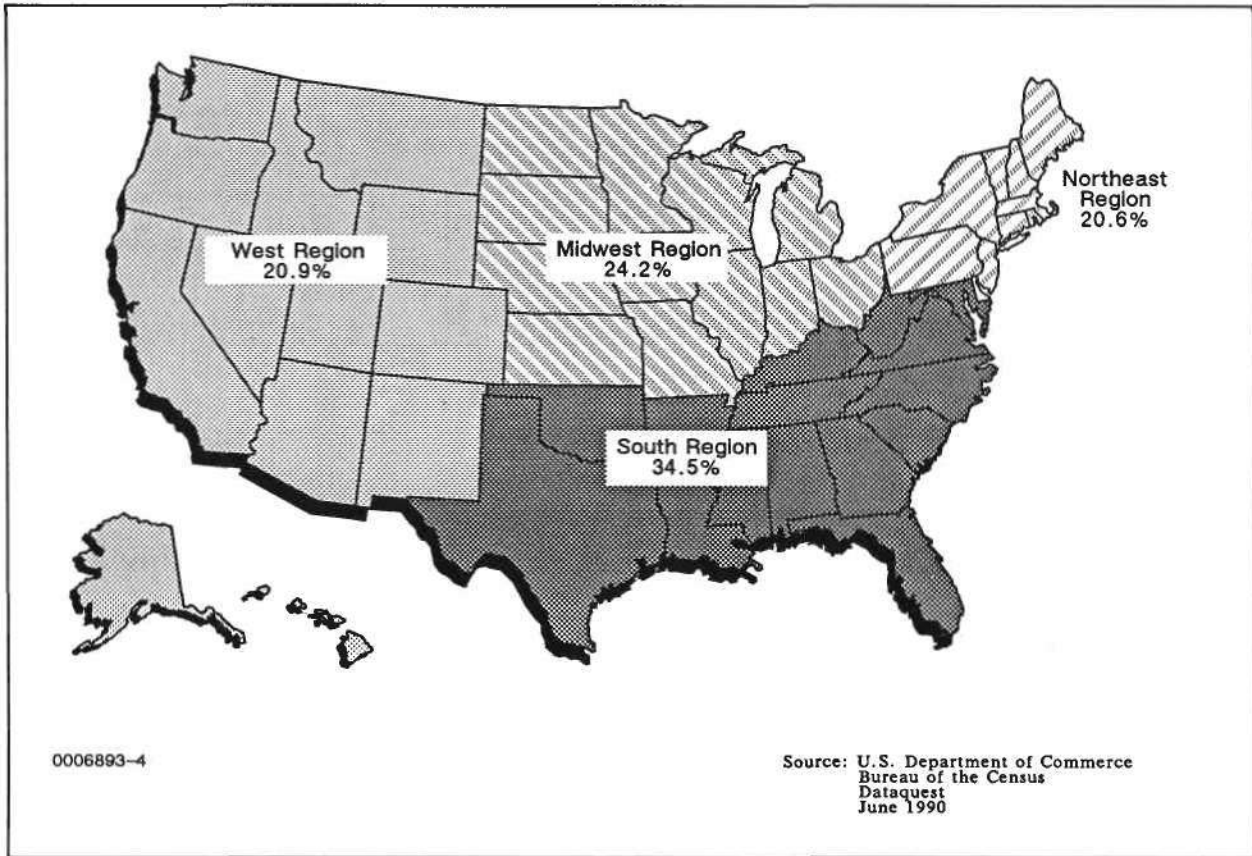


Table P-7. U.S. Population by Region and Division (Thousands)

	1989	Percent	1990	Percent
<b>Northeast Region</b>				
New England Division	13,047	5.3	12,733	5.1
Middle Atlantic Division	37,726	15.2	35,690	14.3
Subtotal	50,773	20.5	48,423	19.4
<b>Midwest Region</b>				
East North Central Division	42,298	17.0	42,372	17.0
West North Central Division	17,851	7.2	17,894	7.2
Subtotal	60,149	24.2	60,266	24.2
<b>South Region</b>				
South Atlantic Division	43,115	17.4	43,144	17.3
East South Central Division	15,406	6.2	16,121	6.5
West South Central Division	27,002	10.9	28,328	11.4
Subtotal	85,523	34.5	87,593	35.1
<b>West Region</b>				
Mountain Division	13,513	5.4	15,404	6.2
Pacific Division	38,283	15.4	37,516	15.1
Subtotal	51,796	20.9	52,920	21.2
<b>Total</b>	<b>248,241</b>	<b>100.0</b>	<b>249,202</b>	<b>100.0</b>

Note: Columns may not add to totals shown because of rounding.

Source: U.S. Department of Commerce,  
Bureau of the Census  
Dataquest  
June 1990

Table P-8. U.S. Population by Census Regions, Divisions, and States

Region	Population (Thousands)	Percent
<b>Northeast Region</b>		
<b>New England Division</b>		
Maine	1,222	0.5
New Hampshire	1,107	0.4
Vermont	567	0.2
Massachusetts	5,913	2.4
Rhode Island	998	0.4
Connecticut	3,239	1.3
Subtotal	13,046	5.3
<b>Middle Atlantic Division</b>		
New York	17,950	7.2
New Jersey	7,736	3.1
Pennsylvania	12,040	4.9
Subtotal	37,726	15.2
<b>Midwest Region</b>		
<b>East North Central Division</b>		
Ohio	10,907	4.4
Indiana	5,593	2.3
Illinois	11,658	4.7
Michigan	9,273	3.7
Wisconsin	4,867	2.0
Subtotal	42,298	17.0
<b>West North Central Division</b>		
Minnesota	4,353	1.8
Iowa	2,840	1.1
Missouri	5,159	2.1
North Dakota	660	0.3
South Dakota	715	0.3
Nebraska	1,611	0.6
Kansas	2,513	1.0
Subtotal	17,851	7.2

(Continued)



Table P-8 (Continued). U.S. Population by Census Regions, Divisions, and States

Region	Population (Thousands)	Percent
<b>South Region</b>		
<b>South Atlantic Division</b>		
Delaware	673	0.3
Maryland	4,694	1.9
District of Columbia	604	0.2
Virginia	6,098	2.5
West Virginia	1,857	0.7
North Carolina	6,571	2.6
South Carolina	3,512	1.4
Georgia	6,436	2.6
Florida	12,671	5.1
Subtotal	43,116	17.4
<b>East South Central Division</b>		
Kentucky	3,727	1.5
Tennessee	4,940	2.0
Alabama	4,118	1.7
Mississippi	2,621	1.1
Subtotal	15,406	6.2
<b>West South Central Division</b>		
Arkansas	2,406	1.0
Louisiana	4,382	1.8
Oklahoma	3,224	1.3
Texas	16,991	6.8
Subtotal	27,003	10.9
<b>West Region</b>		
<b>Mountain Division</b>		
Montana	806	0.3
Idaho	1,014	0.4
Wyoming	475	0.2
Colorado	3,317	1.3
New Mexico	1,528	0.6
Arizona	3,556	1.4
Utah	1,707	0.7
Nevada	1,111	0.4
Subtotal	13,514	5.4

(Continued)

Table P-8 (Continued). U.S. Population by Census Regions, Divisions, and States

Region	Population (Thousands)	Percent
West Region (Continued)		
Pacific Division		
Washington	4,761	1.9
Oregon	2,820	1.1
California	29,063	11.7
Alaska	527	0.2
Hawaii	1,112	0.4
Subtotal	38,283	15.4
Total	248,241	100.0

Note: Includes armed forces residing in each state. Columns may not add to totals shown because of rounding.

Source: U.S. Department of Commerce,  
Bureau of the Census  
Dataquest  
June 1990

## Business

The business sector of the U.S. economy is faced with responding to a multitude of high-impact trends occurring simultaneously in our society. The production orientation of American business is transforming into a service-providing framework. As the structure of business is rebuilt, a new set of challenges await businesses in the nineties.

- Over the next decade, service-producing industries are projected to reach 79.0 percent of all nonfarm wage and salary jobs, compared with 75.9 percent in 1988.
- Employment within the services segment of service-producing industries will account for nearly one-half of all new jobs added over the next 10 years.
- In health and business services alone, employment is expected to reach 18 million by the year 2000. The fastest growing business service industry will be computer services. The business starts of computer-related services have been increasing at an accelerating level.
- The installation of automatic processing equipment in industries such as food production and automotive has raised productivity levels while reducing employment.
- Increased demand for printed material has augmented growth in both employment in this field and the establishment of new small firms. Printing and publishing is one of the few manufacturing sectors where growth has increased to accommodate these new opportunities.
- Strong migration to western states such as Nevada, Arizona, and California has spawned opportunities. The market for opening new businesses in response to this population movement is widening.
- The results of The Dun & Bradstreet Corporation's Dun's 5000 Survey show that 40.9 percent of the companies surveyed expect to increase capital spending in 1990 over their 1989 level. This is a positive economic development in light of rising interest rates.
- Capital equipment expenditures, within the information industry sector, are less dependent on interest rates because of the pace of technological change. The average life-cycle of a computer is shorter than that of a turbine, tractor, or desk.
- There is a strong correlation between the size of the company and plans to increase capital spending. Over half of the companies with greater than 10,000 employees plan to increase capital equipment expenditures. Only 31.7 percent of the companies with less than 20 employees plan to spend more.
- The implementation of technologically advanced equipment in the workplace will foster a continued need for businesses to train and retrain existing employees.

## In This Section

Tables B-1 through B-5 and Figures 5 through 7 provide a detailed overview of the overall composition of U.S. business.

Table B-1. Distribution of U.S. Establishments by Detailed Industry Sector and Employment-Size Class, 1990

Industry Sector	Number of Establishments by Employment-Size Class							Total	Percent of Total
	0-9	10-19	20-49	50-99	100-499	500-999	1,000+		
Agriculture, Forestry, Fisheries									
Agricultural Production	206,669	7,775	4,473	1,154	743	52	19	220,885	2.5
Agricultural Services	85,386	6,648	2,965	704	360	19	5	96,087	1.1
Forestry	3,213	274	159	47	48	10	1	3,752	0
Fishing, Hunting, and Trapping	2,315	174	103	29	6	0	0	2,627	0
Subtotal	297,583	14,871	7,700	1,934	1,157	81	25	323,351	3.7
Percent	92.0	4.6	2.4	0.6	0.4	0	0	100.0	
Mining									
Oil and Gas Extraction	29,653	4,176	2,852	876	587	58	45	38,247	0.4
Other Mining	8,180	1997	1756	579	675	91	47	13,325	0.2
Subtotal	37,833	6,173	4,608	1,455	1,262	149	92	51,572	0.6
Percent	73.4	12.0	8.9	2.8	2.4	0.3	0.2	100.0	
Contract Construction									
General Contractors and Builders	271,208	20,894	11,356	2,900	1,458	58	27	307,901	3.5
Heavy Construction Contractors	30,870	6,306	5,114	1,946	1,197	60	39	45,532	0.5
Special Trade Contractors	432,107	42,268	24,537	6,060	2,563	54	16	507,605	5.8
Subtotal	734,185	69,468	41,007	10,906	5,218	172	82	861,038	9.9
Percent	85.3	8.1	4.8	1.3	0.6	0	0	100.0	
Manufacturing									
Food and Kindred Products	15,565	4,852	5,142	2,888	3,704	488	238	32,877	0.4
Tobacco Manufactures	97	29	28	32	63	10	16	275	0
Textile Mill Products	5,805	1,612	1,894	1,127	1,743	309	112	12,602	0.1
Apparel and Other Textile Products	16,668	4,061	4,438	2,613	3,028	261	52	31,121	0.4
Lumber and Wood Products	30,805	5,713	4,693	1,946	1,527	84	30	44,798	0.5

(Continued)

Table B-1 (Continued). Distribution of U.S. Establishments by Detailed Industry Sector and Employment-Size Class, 1990

Industry Sector	Number of Establishments by Employment-Size Class							Total	Percent of Total
	0-9	10-19	20-49	50-99	100-499	500-999	1,000+		
Manufacturing (Continued)									
Furniture and Fixtures	11,041	2,599	2,353	1,179	1,239	129	41	18,581	0.2
Paper and Allied Products	2,708	1,326	1,958	1,327	1,891	169	112	9,491	0.1
Printing and Publishing	76,496	12,146	8,673	3,463	2,791	260	167	103,996	1.2
Chemicals and Allied Products	10,881	3,780	3,810	1,916	2,086	335	258	23,066	0.3
Petroleum and Coal Products	2,167	621	611	265	343	60	58	4,125	0
Rubber and Miscellaneous Plastics Products	7,861	2,812	3,555	2,238	2,283	160	74	18,983	0.2
Leather and Leather Products	2,336	455	469	278	377	39	12	3,966	0
Stone, Clay, and Glass Products	14,065	3,781	3,411	1,353	1,262	145	54	24,071	0.3
Primary Metal Industries	4,497	1,834	2,158	1,226	1,586	215	137	11,653	0.1
Fabricated Metal Products	24,325	8,292	8,718	4,086	3,361	219	141	49,142	0.6
Machinery, except Electrical	52,140	13,206	10,872	4,311	3,829	466	319	85,143	1.0
Electric and Electronic Equipment	14,118	4,269	4,754	2,647	3,677	612	430	30,507	0.3
Transportation Equipment	10,623	2,461	2,414	1,321	1,976	349	439	19,583	0.2
Instruments and Related Products	10,972	2,943	2,794	1,418	1,683	255	209	20,274	0.2
Miscellaneous Manufacturing Industries	27,242	4,079	3,187	1,276	966	80	29	36,859	0.4
Subtotal	340,412	80,871	75,932	36,910	39,415	4,645	2,928	581,113	6.7
Percent	58.6	13.9	13.1	6.4	6.8	0.8	0.5	100.0	
Transportation, Communications, Utilities									
Railroad Transportation	1,653	409	415	208	364	73	69	3,191	
Local and Interurban Passenger Transportation	13,677	3,902	3,991	1,530	905	72	36	24,113	0.3
Trucking and Warehousing	111,081	17,206	13,570	4,542	2,737	199	89	149,424	1.7
Water Transportation	8,778	1,177	940	300	265	20	12	11,492	0.1
Transportation by Air	10,293	1,864	1,803	808	642	78	88	15,576	0.2
Pipe Lines, except Natural Gas	497	182	163	58	41	3	0	944	0
Transportation Services	39,418	5,854	2,794	741	495	42	20	49,364	0.6

(Continued)

Table B-1 (Continued). Distribution of U.S. Establishments by Detailed Industry Sector and Employment-Size Class, 1990

Industry Sector	Number of Establishments by Employment-Size Class							Total	Percent of Total
	0-9	10-19	20-49	50-99	100-499	500-999	1,000+		
Transportation, Communications, Utilities (Continued)									
Communication									
Telephone	5,644	2,139	1,837	880	951	168	209	11,828	0.1
Telegraph	857	134	57	19	31	1	4	1,103	0
Broadcasting	4,347	3,608	3,049	835	521	16	15	12,391	0.1
Others	6,416	1,416	1,229	425	475	39	18	10,018	0.1
Electric, Gas, and Sanitary Services	19,632	4,557	4,386	2,189	1,799	259	175	32,997	0.4
Subtotal	222,293	42,448	34,234	12,535	9,226	970	735	322,441	3.7
Percent	68.9	13.2	10.6	3.9	2.9	0.3	0.2	100.0	
Wholesale Trade									
Durable Goods	333,253	56,051	31,782	7,364	3,438	169	110	432,167	5.0
Nondurable Goods	188,211	29,225	18,292	5,480	3,282	209	75	244,774	2.8
Subtotal	521,464	85,276	50,074	12,844	6,720	378	185	676,941	7.8
Percent	77.0	12.6	7.4	1.9	1.0	0.1	0	100.0	
Retail Trade									
Building Materials and Garden Supplies	99,721	11,764	5,653	1,440	526	11	4	119,119	1.4
General Merchandise Stores									
Department Stores	3,453	1,644	2,769	3,458	7,784	285	90	19,483	0.2
Others	29,702	3,505	1,813	873	592	41	9	36,535	0.4
Food Stores									
Grocery Stores	136,435	17,557	15,628	9,472	5,823	86	42	185,043	2.1
Others	57,540	6,348	2,603	377	126	9	0	67,003	0.8
Automotive Dealers and Service Stations									
New and Used Car Dealers	13,516	8,129	13,818	6,547	1,711	0	3	43,724	0.5

(Continued)

Table B-1 (Continued). Distribution of U.S. Establishments by Detailed Industry Sector and Employment-Size Class, 1990

Industry Sector	Number of Establishments by Employment-Size Class							Total	Percent of Total
	0-9	10-19	20-49	50-99	100-499	500-999	1,000+		
Retail Trade (Continued)									
Used Car Dealers	31,583	858	204	25	5	0	0	32,675	0.4
Auto and Home Supply	52,347	5,677	1,445	137	68	3	3	59,680	0.7
Gasoline Service Stations	96,454	7,443	1,505	409	207	1	1	106,020	1.2
Others	22,572	2,287	720	103	24	0	0	25,706	0.3
Apparel and Accessory Stores	172,455	15,417	4,406	879	545	42	24	193,768	2.2
Furniture and Home Furnishings Stores									
Household Appliances Stores	20,657	1,484	690	96	38	0	1	22,966	0.3
Radio, TV, and Music Stores	29,380	1,570	522	125	71	7	0	31,675	0.4
Others	124,489	11,150	3,891	582	264	13	6	140,395	1.6
Eating and Drinking Places	260,440	76,014	74,413	22,087	3,798	109	46	436,907	5.0
Miscellaneous Retail									
Drug Stores	36,831	11,931	5,743	652	189	13	8	55,367	0.6
Liquor Stores	38,043	2,040	411	39	7	1	1	40,542	0.5
Used Merchandise Stores	46,388	720	409	77	32	0	1	47,627	0.5
Miscellaneous Shopping Goods	310,257	14,202	4,400	1,006	351	24	17	330,257	3.8
Nonstore Retailers	64,950	3,812	2,170	731	474	41	34	72,212	0.8
Others	180,890	5,172	2,009	365	137	11	2	188,586	2.2
Subtotal	1,828,103	208,724	145,222	49,480	22,772	697	292	2,255,290	25.9
Percent	81.1	9.3	6.4	2.2	1.0	0	0	100.0	
Finance, Insurance, Real Estate									
Banking	45,860	27,441	16,259	4,626	2,831	316	326	97,659	1.1
Credit Agencies, Except Banks	29,997	4,379	2,706	825	655	73	36	38,671	0.4
Securities, Commodities Brokers, and Services	23,305	4,075	3,485	1,229	814	80	90	33,078	0.4
Insurance Carriers	12,423	4,555	5,142	2,280	2,537	411	406	27,754	0.3
Insurance Agents, Brokers and Services	120,529	9,292	5,658	1,668	991	95	35	138,268	1.6

(Continued)

Table B-1 (Continued). Distribution of U.S. Establishments by Detailed Industry Sector and Employment-Size Class, 1990

Industry Sector	Number of Establishments by Employment-Size Class							Total	Percent of Total
	0-9	10-19	20-49	50-99	100-499	500-999	1,000+		
Finance, Insurance, Real Estate (Continued)									
Real Estate	313,425	27,955	16,421	3,814	1,771	72	29	363,487	4.2
Holding and Other Investment Offices	28,915	2,197	1,359	531	381	60	36	33,479	0.4
Subtotal	574,454	79,894	51,030	14,973	9,980	1,107	958	732,396	8.4
Percent	78.4	10.9	7.0	2.0	1.4	0.2	0.1	100.0	
Services									
Hotels and Other Lodging Places	55,361	7,981	7,430	3,729	3,802	306	136	78,745	0.9
Personal Services									
Laundry, Cleaning, Garment Services	70,370	4,942	2,337	824	476	6	2	78,957	0.9
Photographic Studios	18,947	472	139	38	28	5	1	19,630	0.2
Beauty and Barber Shops	152,746	6,405	1,220	102	16	0	0	160,489	1.8
Shoe Repair, Hat Cleaning	8,280	40	6	1	0	0	0	8,327	0.1
Funeral Services	19,532	1,245	315	38	16	0	0	21,146	0.2
Miscellaneous Personal Services	34,981	1,175	542	154	107	9	4	36,972	0.4
Business Services									
Advertising	26,517	3,210	1,634	498	307	30	15	32,211	0.4
Credit Collection and Reporting	5,414	1,361	994	266	130	6	6	8,177	0.1
Mailing, Reproduction, Stenography	15,728	1,682	1,155	363	268	9	1	19,206	0.2
Services to Buildings	40,825	6,710	4,303	1,513	1,529	143	82	55,105	0.6
News Syndicates	586	122	114	35	30	5	0	892	0
Personnel Supply Services	17,721	3,148	1,651	679	939	110	73	24,321	0.3
Computer and Data Processing Services	41,041	6,224	4,405	1,678	1,471	153	114	55,086	0.6
Miscellaneous Business Services	195,790	14,234	8,529	2,873	2,461	210	82	224,179	2.6
Auto Repair, Services, Garages									
Auto Rental, without Drivers	18,372	2,267	1,396	419	227	9	7	22,697	0.3
Auto Parking	2,258	378	319	103	74	4	1	3,137	0

(Continued)



Table B-1 (Continued). Distribution of U.S. Establishments by Detailed Industry Sector and Employment-Size Class, 1990

	Number of Establishments by Employment-Size Class								Percent
Industry Sector	0-9	10-19	20-49	50-99	100-499	500-999	1,000+	Total	of Total
Services (Continued)									
Auto Repair Shops	193,843	8,757	2,181	218	85	6	3	205,093	2.4
Auto Services, except Repair	23,053	1,926	1,055	104	28	2	2	26,170	0.3
Miscellaneous Repair Services	170,398	5,903	2,670	602	311	13	8	179,905	2.1
Motion Pictures	34,961	3,145	1,387	334	219	16	9	40,071	0.5
Amusement and Recreation Services	71,427	10,648	8,263	2,663	1,231	57	63	94,352	1.1
Health Services									
Offices of Physicians	169,628	15,109	6,702	1,329	685	51	41	193,545	2.2
Offices of Dentists	89,783	5,023	943	93	16	0	0	95,858	1.1
Offices of Osteopathic Physicians	5,849	309	87	5	1	1	0	6,252	0.1
Offices of Other Health Practitioners	50,951	1,585	468	107	76	2	0	53,189	0.6
Nursing and Personal Care Facilities	2,649	1,283	3,870	6,416	5,817	97	40	20,172	0.2
Hospitals	1,075	613	1,087	1,555	4,384	1,588	1,899	12,201	0.1
Medical and Dental Laboratories	14,340	1,694	1,024	321	230	17	13	17,639	0.2
Outpatient Care Facilities	3,801	1,728	1,645	627	322	13	18	8,154	0.1
Other Health and Allied Services	4,457	1,831	1,838	844	807	52	17	9,846	0.1
Legal Services	112,716	10,193	6,039	1,722	1,038	91	10	131,809	1.5
Educational Services									
Elementary and Secondary Schools	14,700	12,431	38,378	23,086	9,175	592	296	98,658	1.1
Colleges and Universities	570	346	563	360	1,034	249	335	3,457	0
Libraries and Information Centers	16,467	1,104	914	310	162	18	6	18,981	0.2
Correspondence and Vocational Schools	3,049	791	849	388	238	15	7	5,337	0.1
Other Schools and Educational Services	10,741	1,885	1,757	793	1,030	167	72	16,445	0.2
Social Services	89,954	16,785	10,750	3,333	2,133	115	41	123,111	1.4
Museums, Botanical, Zoological Gardens	3,998	573	550	200	145	9	4	5,479	0.1

(Continued)

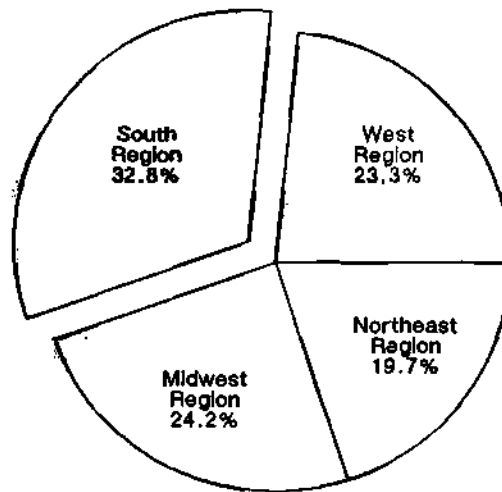
Table B-1 (Continued). Distribution of U.S. Establishments by Detailed Industry Sector and Employment-Size Class, 1990

Industry Sector	Number of Establishments by Employment-Size Class							Total	Percent of Total
	0-9	10-19	20-49	50-99	100-499	500-999	1,000+		
Services (Continued)									
Membership Organizations	186,483	16,667	11,025	3,420	1,720	130	52	219,497	2.5
Miscellaneous Services	212,405	26,299	16,960	5,466	4,375	470	395	266,370	3.1
Subtotal	2,211,767	208,224	157,494	67,609	47,143	4,776	3,855	2,700,868	31.0
Percent	81.9	7.7	5.8	2.5	1.7	0.2	0.1	100.0	
Total	6,768,094	795,949	567,301	208,646	142,893	12,975	9,152	8,505,010	97.6
Percent	79.6	9.4	6.7	2.5	1.7	0.2	0.1	100.0	
Other Government									
Federal								42,047	0.5
Military								13,462	0.2
State								52,656	0.6
Local								99,893	1.1
Subtotal								208,058	2.4
Percent								100.0	
Total								8,713,068	100.0
Percent								100.0	

Note: Columns may not add to totals shown due to rounding.

Source: Dun's Marketing Services  
Dataquest  
June 1990

Figure 5. Percent Distribution of Business Establishments by Industry Sector



0006893-7

Source: Dun's Marketing Services  
Dataquest  
June 1990

Table B-2. Distribution of U.S. Establishments by State and Employment-Size Class

Census Regions and Divisions	Number of Establishments by Employment-Size Class						Total
	0-9	10-19	20-49	50-99	100-499	500-999	1,000+
<b>Northeast Region</b>							
<b>New England Division</b>							
Maine	34,147	4,115	2,835	1,016	637	64	43
New Hampshire	31,334	4,130	2,981	1,031	740	79	36
Vermont	20,046	2,335	1,619	543	299	16	12
Massachusetts	147,121	21,047	15,540	5,834	4,569	482	354
Rhode Island	24,794	3,514	2,431	920	616	79	42
Connecticut	111,443	13,918	9,887	3,336	2,376	233	175
Subtotal	368,885	49,059	35,293	12,680	9,237	953	662
<b>Middle Atlantic Division</b>							
New York	460,645	57,846	40,904	14,966	10,801	1,086	855
New Jersey	192,813	27,712	20,645	7,480	5,795	543	417
Pennsylvania	278,179	35,217	25,121	10,075	7,414	796	469
Subtotal	931,637	120,775	86,670	32,521	24,010	2,425	1,741
<b>Midwest Region</b>							
<b>East North Central Division</b>							
Ohio	238,075	31,741	24,151	9,245	6,662	603	451
Indiana	120,415	15,789	11,526	4,431	3,278	287	197
Illinois	335,450	38,554	29,319	11,037	8,050	770	507
Michigan	208,395	27,432	19,871	7,220	4,882	373	342
Wisconsin	125,275	15,196	11,153	4,198	3,026	272	191
Subtotal	1,027,610	128,712	96,020	36,131	25,898	2,305	1,688
							1,318,363

(Continued)

Table B-2 (Continued). Distribution of U.S. Establishments by State and Employment-Size Class

Census Regions and Divisions	Number of Establishments by Employment-Size Class						Total
	0-9	10-19	20-49	50-99	100-499	500-999	1,000+
<b>West North Central Division</b>							
Minnesota	139,330	14,598	10,223	4,180	2,955	253	175
Iowa	141,791	9,503	6,878	2,463	1,589	140	101
Missouri	130,109	15,178	11,181	4,078	2,917	284	192
North Dakota	25,450	2,363	1,472	527	289	20	13
South Dakota	30,675	2,527	1,739	630	368	18	17
Nebraska	57,557	5,429	3,927	1,388	873	91	45
Kansas	87,412	8,536	5,761	2,054	1,322	110	76
<b>Subtotal</b>	<b>612,324</b>	<b>58,134</b>	<b>41,181</b>	<b>15,320</b>	<b>10,313</b>	<b>916</b>	<b>619</b>
<b>South Region</b>							
<b>South Atlantic Division</b>							
Delaware	15,310	2,161	1,520	568	431	58	44
Maryland	100,460	15,460	10,773	3,996	2,728	243	177
District of Columbia	20,578	3,331	2,541	962	717	108	125
Virginia	147,099	18,422	12,724	4,832	3,486	361	277
West Virginia	39,585	4,444	3,362	1,104	732	81	53
North Carolina	153,380	18,936	13,583	5,318	4,007	411	255
South Carolina	74,752	8,982	6,272	2,522	1,936	232	132
Georgia	143,907	19,688	13,461	5,438	3,800	383	247
Florida	308,145	39,942	26,388	10,067	6,581	530	354
<b>Subtotal</b>	<b>1,003,216</b>	<b>131,366</b>	<b>90,624</b>	<b>34,807</b>	<b>24,418</b>	<b>2,407</b>	<b>1,664</b>
<b>East South Central Division</b>							
Kentucky	84,731	9,245	6,955	2,692	1,702	174	104
Tennessee	108,148	14,103	9,859	3,681	2,738	298	179
Alabama	81,663	10,225	7,559	2,915	2,148	254	128
Mississippi	60,539	6,396	4,445	1,827	1,287	162	61
<b>Subtotal</b>	<b>335,081</b>	<b>39,969</b>	<b>28,818</b>	<b>11,115</b>	<b>7,875</b>	<b>888</b>	<b>472</b>
							<b>424,218</b>

(Continued)

Table B-2 (Continued). Distribution of U.S. Establishments by State and Employment-Size Class

Census Regions and Divisions	Number of Establishments by Employment-Size Class						Total
	0-9	10-19	20-49	50-99	100-499	500-999	1,000+
<b>West South Central Division</b>							
Arkansas	65,053	6,094	4,227	1,625	1,189	125	74
Louisiana	94,255	11,336	8,370	3,023	1,890	178	116
Oklahoma	97,605	9,446	6,585	2,368	1,408	114	78
Texas	652,001	53,912	36,213	13,395	9,214	796	648
Subtotal	908,914	80,788	55,395	20,411	13,701	1,213	916
<b>West Region</b>							
<b>Mountain Division</b>							
Montana	36,726	3,098	2,103	585	319	25	11
Idaho	37,383	3,427	2,261	723	386	52	31
Wyoming	22,284	1,865	1,348	443	250	12	8
Colorado	127,495	12,601	9,018	3,119	1,941	160	138
New Mexico	43,628	4,712	3,241	1,078	660	59	29
Arizona	115,191	12,474	8,473	2,986	1,935	166	108
Utah	42,021	4,890	3,322	1,296	858	69	63
Nevada	29,232	3,624	2,460	834	602	65	86
Subtotal	453,960	46,691	32,226	11,064	6,951	608	474
<b>Pacific Division</b>							
Washington	144,554	15,348	10,572	3,765	2,202	172	143
Oregon	98,859	9,954	7,092	2,328	1,439	140	71
California	877,279	94,360	66,445	24,198	15,722	1,309	1,063
Alaska	15,674	1,566	998	323	253	21	13
Hawaii	22,419	3,225	2,272	813	583	52	33
Subtotal	1,158,785	124,453	87,379	31,427	20,199	1,694	1,323
<b>Total</b>	<b>6,800,419</b>	<b>779,946</b>	<b>553,605</b>	<b>205,475</b>	<b>142,601</b>	<b>13,408</b>	<b>9,557</b>
							<b>8,505,010</b>

Note: Columns may not add to totals shown because of rounding.

Source: Dan's Marketing Services  
Dataquest  
from 1990

Figure 6. Distribution of Business Establishments by Census Divisions

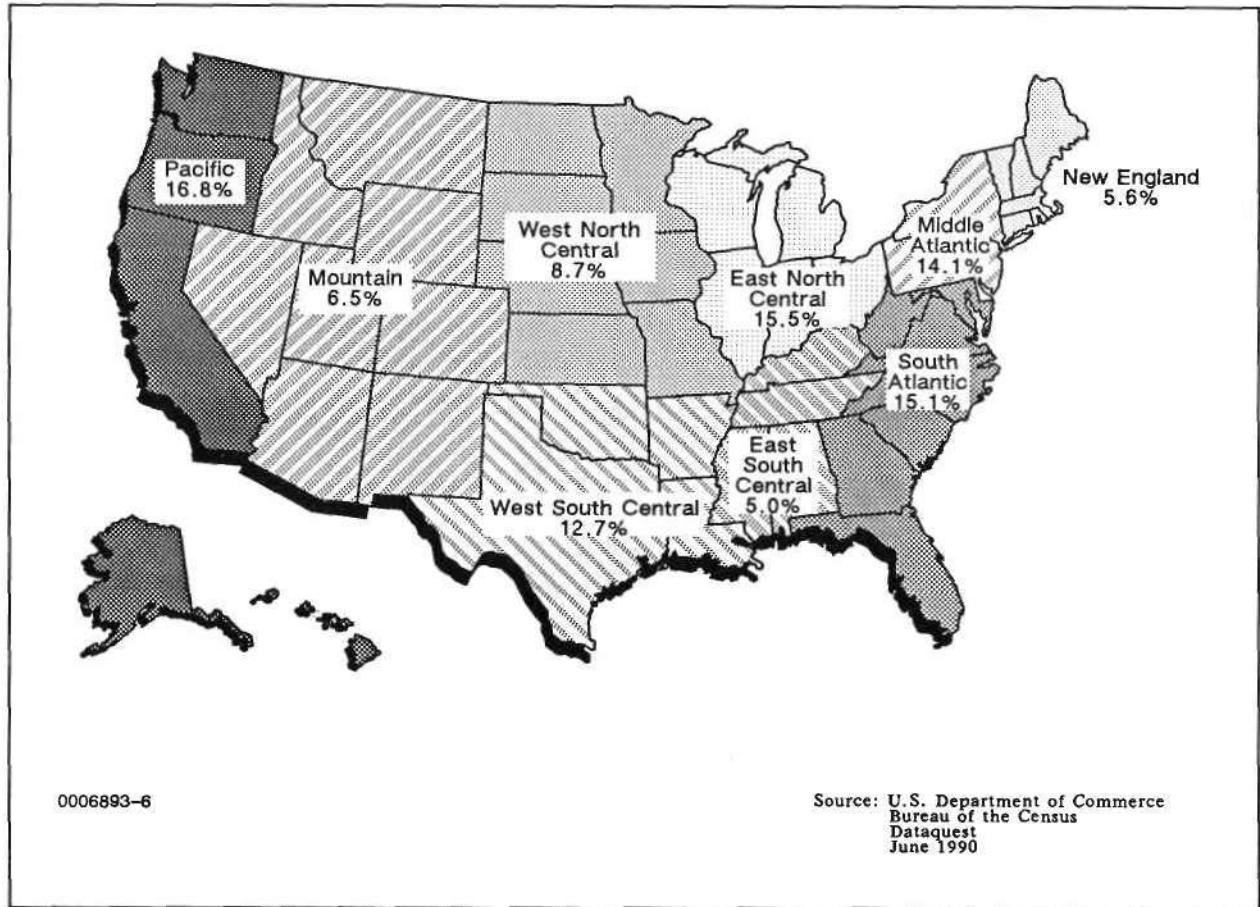


Table B-3. Establishment Data by Census Region, 1990

Census Regions and Divisions	Total	Percent of Total
Northeast Region		
New England Division	476,769	5.6
Middle Atlantic Division	1,199,779	14.1
Midwest Region		
East North Central Division	1,318,363	15.5
West North Central Division	738,807	8.7
South Region		
South Atlantic Division	1,288,502	15.1
East South Central Division	424,218	5.0
West South Central Division	1,081,338	12.7
West Region		
Mountain Division	551,974	6.5
Pacific Division	1,425,260	16.8
Total	8,505,010	100.0

Source: Dun's Marketing Services  
Dataquest  
June 1990



Figure 7. Distribution of Establishments by Census Region

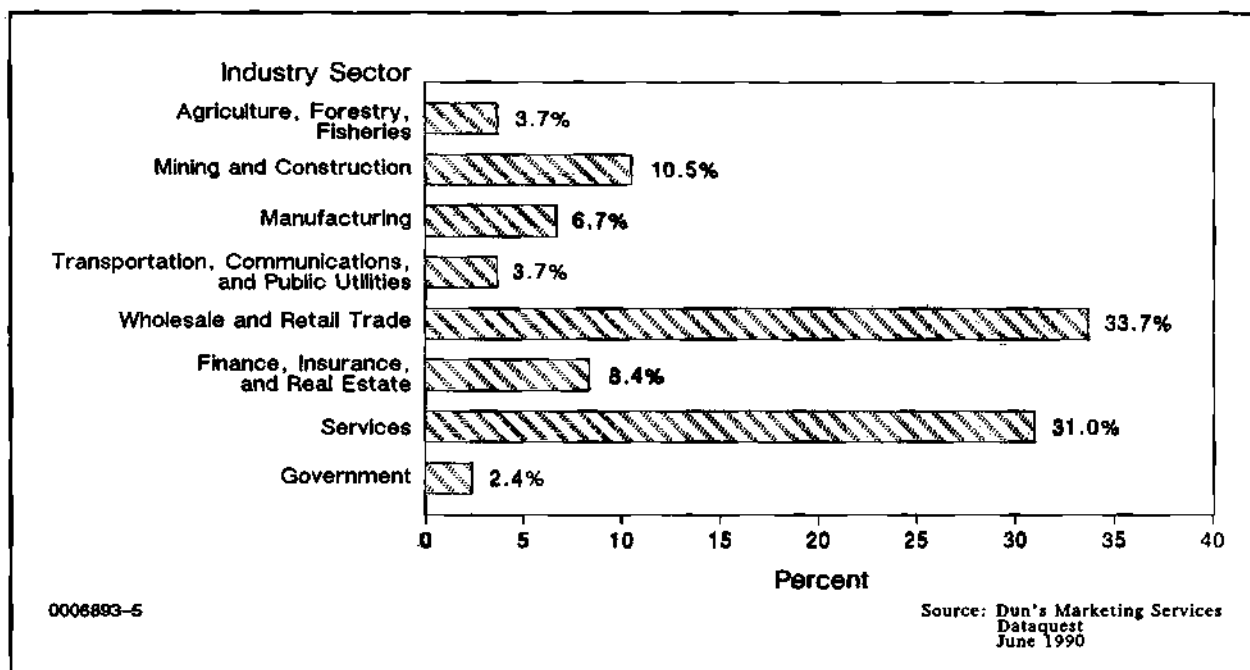


Table B-4. Distribution of Establishments by Sales Volume and Industry Sector

Industry	Number of Establishments by Sales Volume							Total
	0-99.9m	100-499.9m	500-999.9m	1-4.9mm	5-9.9mm	10-49.9mm	50mm+	
Agriculture, Forestry, and Fisheries	90,637	196,803	17,744	13,071	1,382	1,036	184	320,857
Percent of Subtotal	28.2	61.3	5.5	4.1	0.4	0.3	0.1	100.0
Mining	8,099	24,356	7,252	8,039	1,268	1,439	721	51,175
Percent of Subtotal	15.8	47.6	14.2	15.7	2.5	2.8	1.4	100.0
Construction	224,862	416,314	88,551	100,809	13,219	9,247	1,382	854,385
Percent of Subtotal	26.3	48.7	10.4	11.8	1.5	1.1	0.2	100.0
Manufacturing	94,813	225,669	73,437	119,700	26,078	27,327	9,598	576,622
Percent of Subtotal	16.4	39.1	12.7	20.8	4.5	4.7	1.7	100.0
Transportation, Public Utilities, and Communication	67,962	129,025	47,825	55,656	8,818	7,679	2,982	319,947
Percent of Subtotal	21.2	40.3	14.9	17.4	2.8	2.4	0.9	100.0
Wholesale Trade	49,593	280,769	111,150	165,290	32,468	27,291	5,151	671,712
Percent of Subtotal	7.4	41.8	16.5	24.6	4.8	4.1	0.8	100.0
Retail Trade	519,621	1,272,072	221,955	176,104	21,962	22,532	3,620	2,237,865
Percent of Subtotal	23.2	56.8	9.9	7.9	1.0	1.0	0.2	100.0
Banking	4,780	15,596	11,157	36,922	11,435	12,095	4,920	96,904
Percent of Subtotal	4.9	16.1	11.5	38.1	11.8	12.5	5.1	100.0
Finance, Insurance, and Real Estate	139,113	330,992	68,650	63,482	10,711	12,126	4,760	629,833
Percent of Subtotal	22.1	52.6	10.9	10.1	1.7	1.9	0.8	100.0
Services	1,083,624	1,240,714	186,449	187,216	22,137	19,822	5,749	2,745,711
Percent of Subtotal	39.5	45.2	6.8	6.8	0.8	0.7	0.2	100.0
Total	2,283,103	4,132,309	834,170	926,289	149,478	140,593	39,067	8,505,010
Percent of Total	26.8	48.6	9.8	10.9	1.8	1.7	0.5	100.0

Note: Columns may not add to totals shown because of rounding.  
 m = Thousands  
 mm = Millions

Source: Dun's Marketing Services  
 Dataquest  
 June 1990

Table B-5. Primary Mainframe Installation Sites of IBM/PCM\* by Vertical Market

Vertical Market	Total	IBM	Amdahl	Others
Natural Resources/Construction	223	207	14	2
Process Manufacturing	1,073	1,034	15	24
Discrete Manufacturing	1,467	1,404	26	37
Transportation	203	185	9	9
Communications	119	111	7	1
Utilities	223	212	9	2
Wholesale Trade	572	546	11	15
Retail Trade	444	419	7	18
Finance	821	788	21	12
Insurance	727	694	16	17
Real Estate	68	63	1	4
Health Care	407	397	7	3
Hotels and Lodging	18	17	0	1
Business Services	1,339	1,219	68	52
Other Services	484	459	12	13
Education	707	677	11	19
Government	783	677	67	39
Others	61	59	1	1
<b>Total</b>	<b>9,739</b>	<b>9,168</b>	<b>302</b>	<b>269</b>

\*Plug-compatible mainframe

Source: Dataquest  
June 1990

## Work Force

Labor force opportunities in the 1990s will be challenged by industry employment trends, technological change, worker displacement, and education and training needs for workers. Technology and changes in business practices are two factors, in particular, that will play a key role in the ability to achieve and maintain job stability in this new decade.

- Three of the nine major occupational groups are expected to grow more rapidly than the average for total employment over the next 10 years—executive, administrative, and managerial; professional specialty; and technicians and related support. In addition to being the fastest growing groups, these fields also require the highest level of educational attainment to fulfill job requirements.
- An exception to the growth pattern of the top three occupational categories lies in the service workers. Although this category is projected to grow faster than average, it has relatively few workers with college degrees and a rather high incidence of workers with less than a high-school education.
- Occupations within the professional specialty category growing most in this growth segment are:
  - Engineers
  - Computer specialists
  - Lawyers
  - Health-diagnosing and treatment occupations
  - Teachers (except college and university)
- Technological changes and advancements have been key in furthering the demand for several occupations, including engineers and computer specialists.
- The service occupations group will add more than 4 million jobs by the year 2000, an increase of 23 percent. This category will add more new jobs than any other major occupational group.
- Technological innovation and use of office automation will encourage a slowing trend in the growth in the administrative support occupations. However, this technological movement will affect certain occupations positively, such as computer operators.
- Very low employment growth is expected in agriculture, forestry, and fishing. An increase of less than 100,000 jobs is projected through the year 2000.
- A negative result of declining industries is worker displacement. Some of these workers may be reemployed in their same occupation in a growing industry or retrained for a similar position in the declining industry. However, those workers displaced because of technological change, regardless of whether they are in growing or declining industries, will have a more difficult time finding reemployment.

## In This Section

Tables W-1 through W-7 and Figures 8 through 11 highlight the work force by job classification, white-collar segmentation, and employment growth by industry.

Table W-1. Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Managerial and Professional Specialty	29,190	25.39	30,398	25.91	4.1
Executive, Administrative, and Managerial	14,216	12.37	14,848	12.65	4.4
Officials and Administrators, Public Administration	472	0.41	519	0.44	10.0
Financial Managers	502	0.44	472	0.40	(6.0)
Personnel and Labor Relations Managers	130	0.11	128	0.11	(1.5)
Purchasing Managers	99	0.09	110	0.09	11.1
Managers, Marketing, Advertising, and PR	482	0.42	514	0.44	6.6
Administrators, Education and Related Fields	562	0.49	585	0.50	4.1
Managers, Medicine and Health	163	0.14	188	0.16	15.3
Managers, Properties and Real Estate	433	0.38	451	0.38	4.2
Management-Related Occupations	3,772	3.28	3,908	3.33	3.6
Accountants and Auditors	1,329	1.16	1,416	1.21	6.5
Underwriters and Other Financial Officers	741	0.64	103	0.09	(86.1)
Management Analysts	199	0.17	183	0.16	(8.0)
Personnel, Training, Labor Relations	390	0.34	426	0.36	9.2
Buyers, Wholesale and Retail Except Farm Production	233	0.20	214	0.18	(8.2)
Construction Inspectors	60	0.05	61	0.05	1.7
Inspectors and Compliance Officers, Except Construction	194	0.17	196	0.17	1.0
Others (Includes Other Financial Officers)	626	0.54	1309	1.12	109.1
Executive, Administrative, and Managerial NEC	7601	6.61	7973	6.79	4.9
Professional Specialty	14,974	13.02	15,550	13.25	3.8
Architects	143	0.12	157	0.13	9.8
Engineers	1,805	1.57	1,823	1.55	1.0
Aerospace	115	0.10	112	0.10	(2.6)
Chemical	65	0.06	67	0.06	3.1
Civil	218	0.19	249	0.21	14.2
Electrical and Electronic	573	0.50	571	0.49	(0.3)

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Industrial	221	0.19	199	0.17	(10.0)
Mechanical	297	0.26	310	0.26	4.4
Engineers NEC	316	0.27	315	0.27	(0.3)
Mathematical and Computer Scientists	732	0.64	853	0.73	16.5
Computer Systems Analysts and Scientists	479	0.42	566	0.48	18.2
Operations and Systems Researchers and Analyst	210	0.18	239	0.20	13.8
Mathematical and Computer Scientists NEC	43	0.04	48	0.04	11.6
Natural Scientists	395	0.34	413	0.35	4.6
Chemists, except Biochemists	125	0.11	122	0.10	(2.4)
Biological and Life Scientists	75	0.07	77	0.07	2.7
Natural Scientists NEC	195	0.17	214	0.18	9.7
Health Diagnosing Occupations	818	0.71	854	0.73	4.4
Physicians	541	0.47	548	0.47	1.3
Dentists	152	0.13	170	0.14	11.8
Health Diagnosing Occupations NEC	125	0.11	136	0.12	8.8
Health Assessment and Treating Occupations	2,154	1.87	2,242	1.91	4.1
Registered nurses	1,559	1.36	1,599	1.36	2.6
Pharmacists	168	0.15	174	0.15	3.6
Dietitians	74	0.06	83	0.07	12.2
Therapists	298	0.26	324	0.28	8.7
Inhalation	65	0.06	63	0.05	(3.1)
Physical	82	0.07	90	0.08	9.8
Speech	66	0.06	63	0.05	(4.5)
Others	85	0.07	108	0.09	27.1
Health Assessment and Treating Occupations NEC	140	0.12	62	0.05	(55.7)
Teachers, College and University	700	0.61	709	0.60	1.3
Teachers, except College and University	3,773	3.28	3,936	3.35	4.3
Prekindergarten and Kindergarten	393	0.34	431	0.37	9.7

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Elementary School	1,424	1.24	1,489	1.27	4.6
Secondary School	1,187	1.03	1,220	1.04	2.8
Special Education	246	0.21	257	0.22	4.5
Teachers, NEC	524	0.46	539	0.46	2.9
Counselors, Educational and Vocational	206	0.18	214	0.18	3.9
Librarians, Archivists and Curators	219	0.19	212	0.18	(3.2)
Librarians	196	0.17	188	0.16	(4.1)
Librarians, Archivists and Curators NEC	23	0.02	24	0.02	4.3
Social Scientists and Urban Planners	343	0.30	374	0.32	9.0
Economists	116	0.10	122	0.10	5.2
Psychologists	196	0.17	210	0.18	7.1
Social Scientists and Urban Planners NEC	31	0.03	42	0.04	35.5
Social, Recreation, and Religious Workers	1,052	0.92	1,043	0.89	(0.9)
Social Workers	537	0.47	527	0.45	(1.9)
Recreation Workers	92	0.08	101	0.09	9.8
Clergy	348	0.30	336	0.29	(3.4)
Religious Workers NEC	75	0.07	79	0.07	5.3
Lawyers and Judges	757	0.66	774	0.66	2.2
Lawyers	724	0.63	741	0.63	2.3
Lawyers and Judges NEC	33	0.03	33	0.03	0
Writers, Artists, Entertainers, Athletes	1,855	1.61	1,921	1.64	3.6
Authors	82	0.07	82	0.07	0
Technical Writers	58	0.05	65	0.06	12.1
Designers	510	0.44	534	0.46	4.7
Musicians and Composers	151	0.13	170	0.14	12.6
Actors and Directors	100	0.09	96	0.08	(4.0)
Painters, Sculptors, Craft Artists and Artist Printmakers	215	0.19	229	0.20	6.5
Photographers	117	0.10	112	0.10	(4.3)

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Editors and Reporters	260	0.23	253	0.22	(2.7)
Public Relations Specialists	151	0.13	159	0.14	5.3
Announcers	52	0.05	51	0.04	(1.9)
Athletes	73	0.06	74	0.06	1.4
Writers, Artists, Entertainers, Athletes NEC	86	0.07	96	0.08	11.6
Other Professional Specialty	22	0.02	25	0.02	13.6
Technical, Sales, and Administrative Support	35,532	30.91	36,127	30.79	1.7
Technicians and Related Support	3,521	3.06	3,645	3.11	3.5
Health Technologists and Technicians	1,226	1.07	1,276	1.09	4.1
Clinical Laboratory Technologists and Technicians	272	0.24	308	0.26	13.2
Dental Hygienists	78	0.07	80	0.07	2.6
Radiologic Technicians	133	0.12	124	0.11	(6.8)
Licensed Practical Nurses	423	0.37	414	0.35	(2.1)
Health Technicians and Related Support NEC	320	0.28	350	0.30	9.4
Engineering and Related Technologists and Technicians	930	0.81	937	0.80	0.8
Electrical and Electronic Technicians	322	0.28	326	0.28	1.2
Drafting Occupations	290	0.25	296	0.25	2.1
Surveying and Mapping Technicians	78	0.07	70	0.06	(10.3)
Engineering and Related Technologists and Technicians NEC	240	0.21	245	0.21	2.1
Science Technicians	216	0.19	217	0.18	0.5
Biological Technicians	55	0.05	59	0.05	7.3
Chemical Technicians	81	0.07	74	0.06	(8.6)
Science Technicians NEC	80	0.07	84	0.07	5.0
Technicians, except Health, Engineering, and Science	1,149	1.00	1,216	1.04	5.8
Airplane Pilots and Navigators	88	0.08	109	0.09	23.9
Computer Programmers	570	0.50	561	0.48	(1.6)
Legal Assistants	203	0.18	210	0.18	3.4
Technicians, except Health, Engineering, and Science	288	0.25	336	0.29	16.7

(Continued)



Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Sales Occupations	13,747	11.96	14,065	11.99	2.3
Supervisors and Proprietors	3,658	3.18	3,828	3.26	4.6
Sales Representatives, Finance and Business Service	2,410	2.10	2,371	2.02	(1.6)
Insurance Sales	545	0.47	535	0.46	(1.8)
Real Estate Sales	792	0.69	772	0.66	(2.5)
Securities and Financial Services Sales	319	0.28	302	0.26	(5.3)
Advertising and Related Sales	168	0.15	156	0.13	(7.1)
Sales Occupations, Other Business Services	585	0.51	607	0.52	3.8
Sales Representatives, Commodities, except Retail	1,551	1.35	1,612	1.37	3.9
Sales Workers, Retail and Personal Services	6,068	5.28	6,186	5.27	1.9
Sales Workers, Motor Vehicles and Boats	294	0.26	300	0.26	2.0
Sales Workers, Apparel	462	0.40	449	0.38	(2.8)
Sales Workers, Shoes	112	0.10	107	0.09	(4.5)
Sales Workers, Furniture and Home Furnishings	166	0.14	152	0.13	(8.4)
Sales Workers, Radio, Television, Hi-Fi, and Appliances	180	0.16	203	0.17	12.8
Sales Workers, Hardware, and Building Supplies	198	0.17	206	0.18	4.0
Sales Workers, Parts	169	0.15	160	0.14	(5.3)
Sales Workers, Other Commodities	1,537	1.34	1,522	1.30	(1.0)
Sales Counter Clerks	189	0.16	190	0.16	0.5
Cashiers	2,337	2.03	2,473	2.11	5.8
Street and Door-to-Door Sales Workers	318	0.28	323	0.28	1.6
News Vendors	108	0.09	101	0.09	(6.5)
Sales-Related Occupations	59	0.05	68	0.06	15.3
Administrative Support, Including Clerical	18,264	15.89	18,416	15.69	0.8
Supervisors	764	0.66	736	0.63	(3.7)
General Office	458	0.40	446	0.38	(2.6)
Financial Records Processing	91	0.08	82	0.07	(9.9)

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Supervisors, Distributing, Scheduling, and Adjusting	165	0.14	169	0.14	2.4
Supervisors NEC	50	0.04	39	0.03	(22.0)
Computer Equipment Operators	869	0.76	876	0.75	0.8
Computer Operators	865	0.75	870	0.74	0.6
Computer Equipment Operators NEC	4	0	6	0.01	50.0
Secretaries, Stenographers, and Typists	4,876	4.24	4,788	4.08	(1.8)
Secretaries	4,030	3.51	4,010	3.42	(0.5)
Stenographers	48	0.04	47	0.04	(2.1)
Typists	798	0.69	731	0.62	(8.4)
Information Clerks	1,479	1.29	1,451	1.24	(1.9)
Interviewers	163	0.14	183	0.16	12.3
Hotel Clerks	103	0.09	89	0.08	(13.6)
Transportation Ticket and Reservation Agents	114	0.10	112	0.10	(1.8)
Receptionists	848	0.74	815	0.69	(3.9)
Information Clerks NEC	251	0.22	252	0.21	0.4
Records Processing Occupations, Except Financial	827	0.72	851	0.73	2.9
Order Clerks	197	0.17	199	0.17	1.0
Personnel Clerks, except Payroll and Timekeeping	65	0.06	77	0.07	18.5
Library Clerks	143	0.12	144	0.12	0.7
File Clerks	271	0.24	284	0.24	4.8
Records Clerks	132	0.11	116	0.10	(12.1)
Records Processing Occupations, except Financial	19	0.02	31	0.03	63.2
Financial Records Processing	2,414	2.10	2,394	2.04	(0.8)
Bookkeepers, Accounting, and Auditing Clerks	1,970	1.71	1,926	1.64	(2.2)
Payroll and Timekeeping Clerks	173	0.15	177	0.15	2.3
Billing Clerks	157	0.14	159	0.14	1.3
Cost and Rate Clerks	75	0.07	83	0.07	10.7
Financial Records Processing NEC	39	0.03	49	0.04	25.6

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Duplicating, Mail, and Other Office Machine Operators	68	0.06	65	0.06	(4.4)
Communications Equipment Operators	218	0.19	210	0.18	(3.7)
Telephone Operators	210	0.18	201	0.17	(4.3)
Communications Equipment Operators NEC	8	0.01	9	0.01	12.5
Mail and Message Distributing Occupations	936	0.81	952	0.81	1.7
Postal Clerks, except Mail Carriers	313	0.27	313	0.27	0
Mail Carriers, Postal Service	320	0.28	327	0.28	2.2
Mail Clerks, except Postal Service	163	0.14	179	0.15	9.8
Messengers	141	0.12	133	0.11	(5.7)
Material Recording, Scheduling, and Distributing	1,681	1.46	1,745	1.49	3.8
Dispatchers	171	0.15	189	0.16	10.5
Production Coordinators	192	0.17	196	0.17	2.1
Traffic, Shipping and Receiving Clerks	521	0.45	550	0.47	5.6
Stock and Inventory Clerks	559	0.49	561	0.48	0.4
Weighers, Measurers, and Checkers	72	0.06	76	0.06	5.6
Expeditors	95	0.08	96	0.08	1.1
Material Clerks NEC	71	0.06	77	0.07	8.5
Adjusters and Investigators	949	0.83	1,079	0.92	13.7
Insurance Adjusters, Examiners, and Investigators	287	0.25	325	0.28	13.2
Investigators and Adjusters, except Insurance	466	0.41	546	0.47	17.2
Eligibility Clerks, Social Welfare	65	0.06	72	0.06	10.8
Bill and Account Collectors	130	0.11	136	0.12	4.6
Miscellaneous Administrative Support	3,183	2.77	3,269	2.79	2.7
General Office Clerks	833	0.72	810	0.69	(2.8)
Bank Tellers	478	0.42	503	0.43	5.2
Data Entry Keyers	362	0.31	414	0.35	14.4
Statistical Clerks	85	0.07	86	0.07	1.2

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Teachers' Aides	423	0.37	440	0.37	4.0
Miscellaneous Administrative Support NEC	1002	0.87	1,016	0.87	1.4
Service Occupations	15,332	13.34	15,556	13.26	1.5
Private Household	909	0.79	872	0.74	(4.1)
Child Care Workers	378	0.33	358	0.31	(5.3)
Cleaners and Servants	476	0.41	464	0.40	(2.5)
Private Household NEC	55	0.05	50	0.04	(9.1)
Protective Service	1,944	1.69	1,960	1.67	0.8
Supervisors, Protective Services	174	0.15	169	0.14	(2.9)
Supervisors, Police and Detectives	93	0.08	83	0.07	(10.8)
Supervisors, Protective Services NEC	81	0.07	86	0.07	6.2
Firefighting and Fire Prevention	218	0.19	208	0.18	(4.6)
Firefighting Occupations	195	0.17	188	0.16	(3.6)
Firefighting and Fire Prevention NEC	23	0.02	20	0.02	(13.0)
Police and Detectives	755	0.66	803	0.68	6.4
Police and Detectives, Public Service	427	0.37	461	0.39	8.0
Sheriffs, Bailiffs, and Other Law Enforcement Officers	111	0.10	112	0.10	0.9
Correctional Institution Officers	217	0.19	230	0.20	6.0
Guards	796	0.69	781	0.67	(1.9)
Guards and Police, except Public Service	675	0.59	658	0.56	(2.5)
Guards, NEC	121	0.11	123	0.10	1.7
Service Occupations, except Private Household, Protective Service	12,479	10.85	12,724	10.84	2.0
Food Preparation and Service Occupations	5,182	4.51	5,351	4.56	3.3
Supervisors	325	0.28	356	0.30	9.5
Bartenders	324	0.28	322	0.27	(0.6)
Waiters and Waitresses	1,363	1.19	1,389	1.18	1.9
Cooks, except Short Order	1,634	1.42	1,713	1.46	4.8

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Short-Order Cooks	95	0.08	91	0.08	(4.2)
Food Counter, Fountain, and Related Occupations	325	0.28	354	0.30	8.9
Kitchen Workers, Food Preparation	132	0.11	126	0.11	(4.5)
Waiters' and Waitresses' Assistants	339	0.29	352	0.30	3.8
Miscellaneous Food Preparation	645	0.56	648	0.55	0.5
Health Service Occupations	1,977	1.72	2,042	1.74	3.3
Dental Assistants	165	0.14	187	0.16	13.3
Health Aides, except Nursing	407	0.35	416	0.35	2.2
Nursing Aides, Orderlies, and Attendants	1,404	1.22	1,439	1.23	2.5
Cleaning and Building Service Occupations	2,994	2.60	2,997	2.55	0.1
Supervisors	159	0.14	154	0.13	(3.1)
Maids and Housemen	644	0.56	646	0.55	0.3
Janitors and Cleaners	2,133	1.86	2,148	1.83	0.7
Cleaning and Building Service Occupations, NEC	58	0.05	49	0.04	(15.5)
Personal Service Occupations	2,327	2.02	2,333	1.99	0.3
Barbers	94	0.08	81	0.07	(13.8)
Hairdressers and Cosmetologists	769	0.67	736	0.63	(4.3)
Attendants, Amusement and Recreation Facilities	130	0.11	133	0.11	2.3
Public Transportation Attendants	77	0.07	86	0.07	11.7
Welfare Service Aides	92	0.08	95	0.08	3.3
Child Care Workers	853	0.74	861	0.73	0.9
Personal Service Occupations, NEC	312	0.27	341	0.29	9.3
Precision Production, Craft and Repair	13,664	11.88	13,818	11.78	1.1
Mechanics and Repairers	4,454	3.87	4,550	3.88	2.2
Supervisors	256	0.22	285	0.24	11.3
Mechanics and Repairers, except Supervisors	4,198	3.65	4,265	3.63	1.6

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Vehicle and Mobile Equipment Mechanics and Repairers	1,811	1.58	1,793	1.53	(1.0)
Automobile Mechanics	879	0.76	880	0.75	0.1
Bus, Truck, and Stationery Engine Mechanics	325	0.28	320	0.27	(1.5)
Aircraft Engine Mechanics	131	0.11	122	0.10	(6.9)
Small-Engine Repairers	70	0.06	65	0.06	(7.1)
Automobile Body and Related Repairers	194	0.17	191	0.16	(1.5)
Heavy Equipment Mechanics	159	0.14	160	0.14	0.6
Vehicle and Mobile Equipment	53	0.05	55	0.05	3.8
Industrial Machinery Repairers	547	0.48	539	0.46	(1.5)
Electrical and Electronic Equipment Repairers	677	0.59	680	0.58	0.4
Electronic Repairers, Communications and Industrial Equipment	165	0.14	165	0.14	0
Data Processing Equipment Repairers	140	0.12	152	0.13	8.6
Telephone Line Installers and Repairers	61	0.05	54	0.05	(11.5)
Telephone Installers and Repairers	202	0.18	193	0.16	(4.5)
Electronic and Electronic Equipment NEC	109	0.09	116	0.10	6.4
Heating, Air Conditioning, and Refrigeration Mechanics	262	0.23	279	0.24	6.5
Miscellaneous Mechanics and Repairers	874	0.76	948	0.81	8.5
Office Machine Repairers	60	0.05	67	0.06	11.7
Millwrights	96	0.08	101	0.09	5.2
Miscellaneous Mechanics NEC	718	0.62	780	0.66	8.6
Mechanics and Repairers, NEC	27	0.02	26	0.02	(3.7)
Construction Trades	5,098	4.43	5,142	4.38	0.9
Supervisors	617	0.54	662	0.56	7.3
Construction Trades, except Supervisors	4,481	3.90	4,479	3.82	0
Brickmasons and Stonemasons	202	0.18	219	0.19	8.4
Carpet Installers	108	0.09	109	0.09	0.9
Carpenters	1,427	1.24	1,369	1.17	(4.1)

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Drywall Installers	149	0.13	155	0.13	4.0
Electricians	701	0.61	702	0.60	0.1
Electrical Power Installers and Repairers	101	0.09	104	0.09	3.0
Painters, Construction, and Maintenance	525	0.46	543	0.46	3.4
Plumbers, Pipefitters, and Steamfitters	494	0.43	456	0.39	(7.7)
Concrete and Terrazzo Finishers	85	0.07	77	0.07	(9.4)
Insulation Workers	54	0.05	64	0.05	18.5
Roofers	156	0.14	178	0.15	14.1
Structural Metal Workers	48	0.04	63	0.05	31.3
Construction Trade NEC	431	0.37	440	0.37	2.1
Extractive Occupations	144	0.13	138	0.12	(4.2)
Precision Production Occupations	3,968	3.45	3,988	3.40	0.5
Supervisors	1,361	1.18	1,353	1.15	(0.6)
Precision Metalworking	896	0.78	911	0.78	1.7
Tool and Die Makers	145	0.13	148	0.13	2.1
Machinists	497	0.43	479	0.41	(3.6)
Sheet-Metal Workers	126	0.11	141	0.12	11.9
Precision Metalworking, NEC	128	0.11	143	0.12	11.7
Precision Woodworking Occupations	106	0.09	95	0.08	(10.4)
Cabinet Makers and Bench Carpenters	66	0.06	56	0.05	(15.2)
Precision Woodworking, NEC	40	0.03	39	0.03	(2.5)
Precision Textile, Apparel, Furnishings Machine Workers	296	0.26	277	0.24	(6.4)
Dressmakers	126	0.11	117	0.10	(7.1)
Upholsterers	84	0.07	71	0.06	(15.5)
Precision Textile, NEC	86	0.07	89	0.08	3.5
Precision Workers, Assorted Materials	529	0.46	565	0.48	6.8
Optical Goods Workers	60	0.05	80	0.07	33.3

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Dental Laboratory and Medical Appliance Technicians	49	0.04	51	0.04	4.1
Electrical and Electronic Equipment Assemblers	305	0.27	316	0.27	3.6
Precision Workers Assorted NEC	115	0.10	118	0.10	2.6
Precision Food Production Occupations	418	0.36	414	0.35	(1.0)
Butchers and Meat Cutters	258	0.22	266	0.23	3.1
Bakers	126	0.11	113	0.10	(10.3)
Precision Food Production NEC	34	0.03	35	0.03	2.9
Precision Inspectors, Testers, and Related Workers	126	0.11	125	0.11	(0.8)
Inspectors, Testers and Graders	113	0.10	113	0.10	0
Precision Inspectors, NEC	13	0.01	12	0.01	(7.7)
Plant and System Operators	236	0.21	249	0.21	5.5
Stationary Engineers	103	0.09	109	0.09	5.8
Plant and System Operators NEC	133	0.12	140	0.12	5.3
Operators, Fabricators, and Laborers	17,814	15.49	18,022	15.36	1.2
Machine Operators, Assemblers, and Inspectors	8,117	7.06	8,248	7.03	1.6
Machine Operators and Tenders, except Precision	5,362	4.66	5,381	4.59	0.4
Metalworking and Plastic Working Machine Operators	465	0.40	470	0.40	1.1
Lathe and Turning Machine Operators	63	0.05	55	0.05	(12.7)
Punching and Stamping Press Machine Operators	123	0.11	120	0.10	(2.4)
Grinding, Abrading, Buffing, and Polishing Machine Operators	141	0.12	143	0.12	1.4
Metalworking and Plastic Operators NEC	138	0.12	152	0.13	10.1
Metal and Plastic Processing Machine Operators	170	0.15	160	0.14	(5.9)
Molding and Casing Machine Operators	102	0.09	97	0.08	(4.9)
Metal and Plastic Processing, NEC	68	0.06	63	0.05	(7.4)
Woodworking Machine Operators	159	0.14	165	0.14	3.8
Sawing Machine Operators	105	0.09	96	0.08	(8.6)
Other Woodworking, NEC	54	0.05	69	0.06	27.8

(Continued)



Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Printing Machine Operators	505	0.44	474	0.40	(6.1)
Printing Machine Operators	339	0.29	324	0.28	(4.4)
Typesetters and Compositors	67	0.06	66	0.06	(1.5)
Printing Machine Operators, NEC	99	0.09	84	0.07	(15.2)
Textile, Apparel, and Furnishings Machine Operators	1,355	1.18	1,356	1.16	0.1
Winding and Twisting Machine Operators	76	0.07	77	0.07	1.3
Textile Sewing Machine Operators	749	0.65	757	0.65	1.1
Pressing Machine Operators	146	0.13	134	0.11	(8.2)
Laundering and Dry Cleaning Machine Operator	222	0.19	220	0.19	(0.9)
Textile, Apparel, and Furnishings, NEC	162	0.14	168	0.14	3.7
Machine Operators, Assorted Materials	2,680	2.33	2,736	2.33	2.1
Packaging and Filling Machine Operators	414	0.36	442	0.38	6.8
Mixing and Blending Machine Operators	102	0.09	110	0.09	7.8
Separating, Filtering, and Clarifying Machine Operators	56	0.05	62	0.05	10.7
Painting and Paint Spraying Machine Operator	200	0.17	186	0.16	(7.0)
Furnace, Kiln, and Oven Operators, except Food	102	0.09	96	0.08	(5.9)
Slicing and Cutting Machine Operators	215	0.19	219	0.19	1.9
Photographic Process Machine Operators	98	0.09	91	0.08	(7.1)
Machine Operators, Assorted Materials, NEC	1493	1.30	1530	1.30	2.5
Other Machine Operators and Tenders	28	0.02	20	0.02	(28.6)
Fabricators, Assemblers, and Hand-Working Occupations	1,906	1.66	2,011	1.71	5.5
Welders and Cutters	555	0.48	612	0.52	10.3
Assemblers	1,141	0.99	1,177	1.00	3.2
Fabricators, Assemblers, NEC	210	0.18	222	0.19	5.7
Production Inspectors, Testers, Samplers, and Weighers	849	0.74	856	0.73	0.8
Production Inspectors, Checkers, and Examiners	683	0.59	688	0.59	0.7
Production Testers	63	0.05	60	0.05	(4.8)

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Graders and Sorters, except Agricultural	96	0.08	102	0.09	6.3
Production Inspectors, NEC	7	0.01	6	0.01	(14.3)
Transportation and Material-Moving Occupations	4,831	4.20	4,886	4.16	1.1
Motor Vehicle Operators	3,592	3.12	3,602	3.07	0.3
Truck Drivers, Heavy	1,826	1.59	1,850	1.58	1.3
Truck Drivers, Light	782	0.68	766	0.65	(2.0)
Drivers-Sales Workers	201	0.17	192	0.16	(4.5)
Bus Drivers	450	0.39	440	0.37	(2.2)
Taxi-Cab Drivers and Chauffeurs	218	0.19	220	0.19	0.9
Motor Vehicle Operators, NEC	115	0.10	134	0.11	16.5
Transportation Occupations, except Motor Vehicle	195	0.17	177	0.15	(9.2)
Rail Transportation Occupations	137	0.12	129	0.11	(5.8)
Locomotive Operating Occupations	51	0.04	0	0	(100.0)
Rail NEC	86	0.07	129	0.11	50.0
Water Transportation Occupations	58	0.05	0	0	(100.0)
Material Moving Equipment Operators	1,043	0.91	1,107	0.94	6.1
Operating Engineers	210	0.18	220	0.19	4.8
Crane and Tower Operators	88	0.08	99	0.08	12.5
Excavating and Loading Machine Operators	108	0.09	128	0.11	18.5
Grader, Dozer, and Scraper Operators	92	0.08	98	0.08	6.5
Industrial Truck and Tractor Equipment Operators	431	0.37	452	0.39	4.9
Material Moving, NEC	114	0.10	110	0.09	(3.5)
Handlers, Equipment Cleaners, Helpers and Laborers	4,866	4.23	4,888	4.17	0.5
Helpers, Construction and Extractive Occupations	156	0.14	133	0.11	(14.7)
Helpers, Construction Trades	141	0.12	123	0.10	(12.8)
Helpers, NEC	15	0.01	10	0.01	(33.3)
Construction Laborers	799	0.69	755	0.64	(5.5)
Production Helpers	64	0.06	82	0.07	28.1

(Continued)

Table W-1 (Continued). Distribution of U.S. Work Force by Detailed Occupational Category (Thousands of Workers)

Occupational Category	1988		1989		1988-1989 Percent Change
	Number of Workers	Percent of Total	Number of Workers	Percent of Total	
Freight, Stock, and Material Handlers	1,756	1.53	1,743	1.49	(0.7)
Stock Handlers and Baggers	891	0.77	900	0.77	1.0
Machine Feeders and Offbearers	110	0.10	91	0.08	(17.3)
Freight, Stock, Material, NEC	755	0.66	752	0.64	(0.4)
Garage and Service Station Related Occupations	246	0.21	230	0.20	(6.5)
Vehicle Washers and Equipment Cleaners	253	0.22	281	0.24	11.1
Hand Packers and Packagers	298	0.26	327	0.28	9.7
Laborers, except Construction	1,248	1.09	1,288	1.10	3.2
Handlers, Equipment Cleaners, Helpers, and Laborers	46	0.04	49	0.04	6.5
Farming, Forestry, and Fishing	3,437	2.99	3,421	2.92	(0.5)
Farm Operators and Managers	1,286	1.12	1,269	1.08	(1.3)
Farmers	1,154	1.00	1,118	0.95	(3.1)
Farm Managers	133	0.12	150	0.13	12.8
Other Agricultural and Related Occupations	1,978	1.72	1,976	1.68	(0.1)
Farm Occupations, except Managerial	1,020	0.89	964	0.82	(5.5)
Farm Workers	949	0.83	893	0.76	(5.9)
Farm Occupations, NEC	71	0.06	71	0.06	0
Related Agricultural Occupations	958	0.83	1,012	0.86	5.6
Supervisors	76	0.07	73	0.06	(3.9)
Groundskeepers and Gardeners, except Farmers	765	0.67	816	0.70	6.7
Animal Caretakers, except Farmers	101	0.09	104	0.09	3.0
Related Agriculture Occupations, NEC	16	0.01	19	0.02	18.8
Forestry and Logging Occupations	117	0.10	118	0.10	0.9
Timber Cutting and Logging	84	0.07	82	0.07	(2.4)
Forestry and Logging, NEC	33	0.03	36	0.03	9.1
Fishers, Hunters, and Trappers	56	0.05	59	0.05	5.4
Total	114,969	100.00	117,342	100.00	2.1

Note: Columns may not add to totals shown because of rounding.  
NEC = Not elsewhere classified

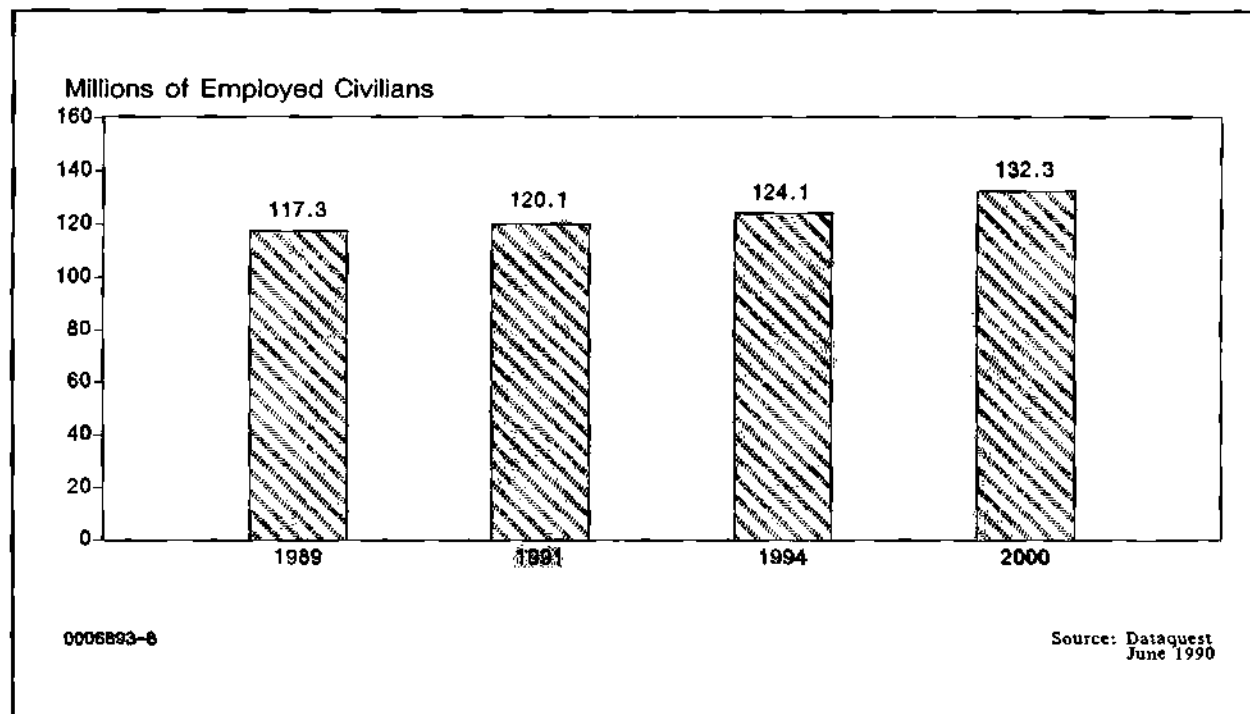
Source: U.S. Department of Labor,  
Bureau of Labor Statistics

Table W-2. Distribution of U.S. Work Force by Major Occupational Category (Thousands of Workers)

Occupational Classification	Actual			Estimated		
	1988	1989	1991	1994	1997	2000
Executive, Administrative, and Managerial	14,216	14,848	15,302	15,982	16,663	17,344
Professional Specialty	14,974	15,550	16,099	16,922	17,745	18,568
Technicians and Related Support	3,521	3,645	3,825	4,094	4,364	4,634
Sales Occupations	13,747	14,065	14,497	15,145	15,793	16,441
Administrative Support, Including Clerical	18,264	18,416	18,780	19,327	19,873	20,419
Private Household	909	872	871	868	866	864
Protective Service	1,944	1,960	2,037	2,152	2,268	2,383
Service, except Private Household and Protective	12,479	12,724	13,192	13,895	14,597	15,299
Precision Production, Craft, and Repair	13,664	13,818	14,036	14,363	14,690	15,017
Operators, Fabricators, and Laborers	17,814	18,022	18,026	18,033	18,039	18,046
Farming, Forestry, and Fishing	3,437	3,422	3,394	3,354	3,313	3,272
Total	114,969	117,342	120,059	124,135	128,211	132,287

Source: U.S. Department of Labor,  
Bureau of Labor Statistics  
Dataquest  
June 1990

Figure 8. Actual and Estimated Number of Employed U.S. Civilian Workers



**Table W-3. Employment Growth by Industry for 1988 and 1989**  
**Annual Estimates through 2000 (Thousands of Workers)**

Industry	Actual		1991	Estimated		2000
	1988	1989		1994	1997	
Agriculture	3,169	3,199	3,195	3,187	3,180	3,173
Mining	753	719	718	717	715	714
Construction	7,603	7,680	7,838	8,075	8,312	8,549
Manufacturing	21,320	21,652	21,626	21,590	21,555	21,523
Transportation and Public Utilities	8,064	8,094	8,203	8,367	8,531	8,695
Wholesale and Retail Trade	23,664	24,229	24,824	25,717	26,611	27,504
Finance	7,921	7,989	8,168	8,436	8,705	8,974
Services	37,043	38,227	39,871	42,334	44,794	47,251
Private Household	1,163	1,108	1,106	1,103	1,100	1,098
Public Administration	5,432	5,553	5,616	5,712	5,808	5,904
<b>Total</b>	<b>114,969</b>	<b>117,342</b>	<b>120,059</b>	<b>124,135</b>	<b>128,211</b>	<b>132,287</b>

Source: U.S. Department of Labor,  
Bureau of Labor Statistics  
Dataquest  
June 1990

Figure 9. Actual and Estimated Employment Growth by Industry, 1989-2000

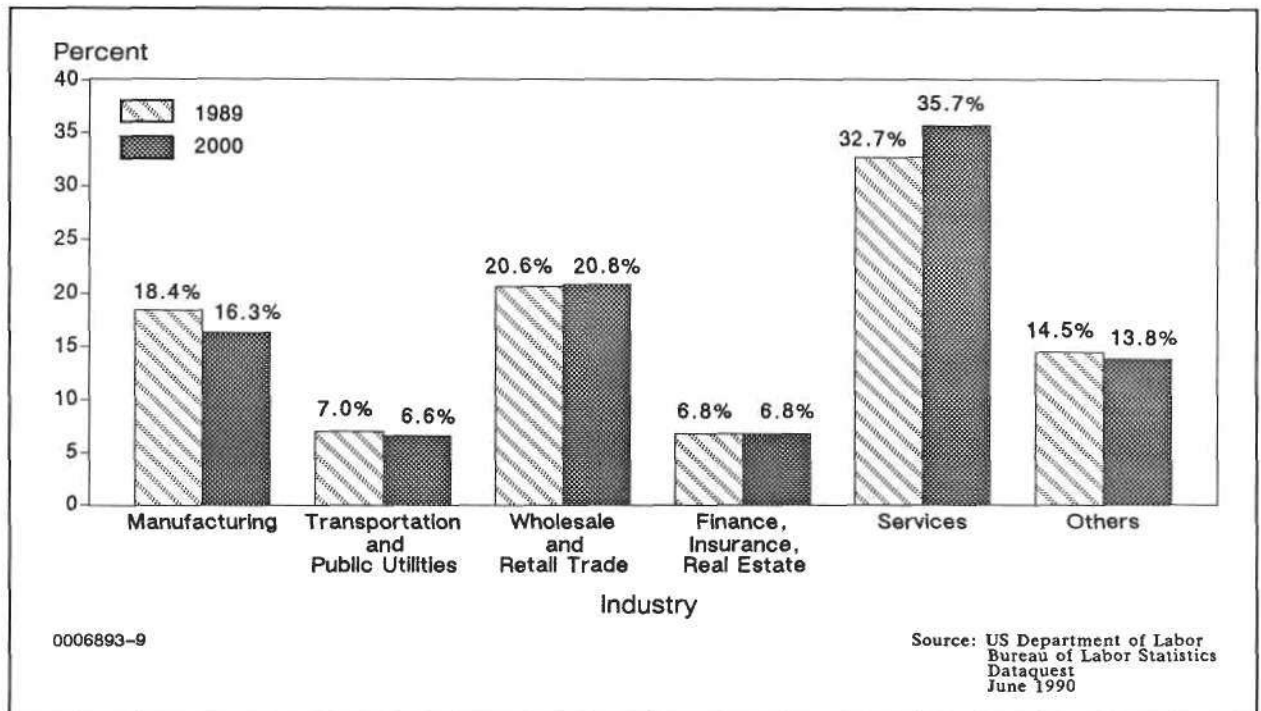
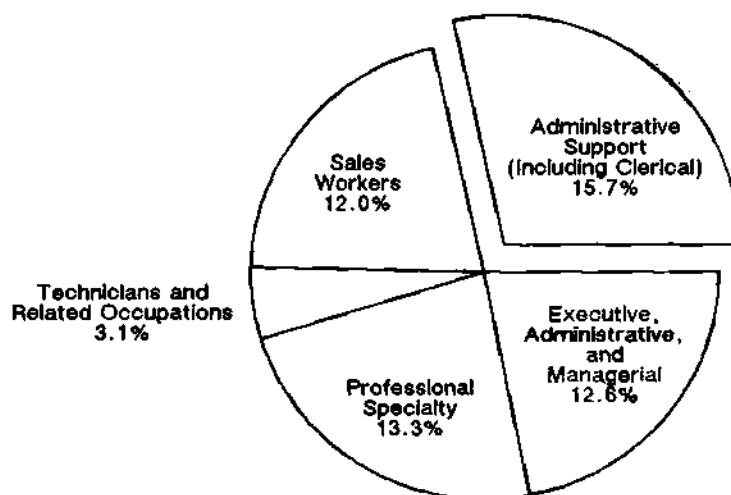


Table W-4. Estimated U.S. White-Collar Workers by Job Classification

Job Function	1988		1989		1994	
	Total White-Collar Workers (Millions)	Percent Total Work Force	Total White-Collar Workers (Millions)	Percent Total Work Force	Total White-Collar Workers (Millions)	Percent Total Work Force
Executive, Administrative, and Managerial	14.2	12.4	14.8	12.6	16.0	12.9
Professional Specialty	15.0	13.0	15.6	13.3	16.9	13.6
Technicians and Related Occupations	3.5	3.0	3.6	3.1	4.1	3.3
Sales Workers	13.7	11.9	14.1	12.0	15.2	12.2
Administrative Support (Including Clerical)	18.3	15.9	18.4	15.7	19.3	15.5
Total White Collar	64.7	56.2	66.5	56.7	71.5	57.5
Total Work Force	114.9	100.0	117.3	100.0	124.2	100.0

Source: U.S. Department of Labor,  
Bureau of Labor Statistics  
Dataquest  
June 1990



**Figure 10. 1989 White-Collar Workers by Job Classification as a Percentage of Total Work Force**

0006893-10

Source: US Department of Labor  
Bureau of Labor Statistics  
Dataquest  
June 1990

Table W-5. Estimated U.S. White-Collar Workers by Industry Sector

Industry Sector	1988		1989		1994	
	Total White-Collar Workers (Millions)	Percent Total White Collar	Total White-Collar Workers (Millions)	Percent Total White Collar	Total White-Collar Workers (Millions)	Percent Total White Collar
Services	24.4	37.7	25.4	38.2	29.3	41.0
Wholesale and Retail Trade	14.8	22.9	15.1	22.7	16.0	22.4
Manufacturing	8.1	12.5	8.3	12.5	7.9	11.0
Finance, Insurance, and Real Estate	7.3	11.3	7.4	11.1	8.0	11.2
Transportation, Communication, and Utilities	4.1	6.3	4.2	6.3	4.2	5.9
Others*	6.0	9.3	6.1	9.2	6.1	8.5
Total White Collar	64.7	100.0	66.5	100.0	71.5	100.0

\*Includes agriculture, mining, construction, and public administration.

Source: U.S. Department of Labor,  
Bureau of Labor Statistics  
Dataquest  
June 1990

Table W-6. Estimated U.S. White-Collar Workers as a Percent of Total Work Force by Industry Sector

Industry Sector	1988		1989		1994	
	Total Work Force (Millions)	Percent White Collar	Total Work Force (Millions)	Percent White Collar	Total Work Force (Millions)	Percent White Collar
Services	37.0	65.6	38.2	66.6	42.3	69.1
Wholesale and Retail Trade	23.7	65.8	24.2	62.2	25.7	62.1
Manufacturing	21.3	38.0	21.6	38.2	21.6	36.6
Finance, Insurance, and Real Estate	7.9	92.9	8.0	93.2	8.4	94.7
Transportation, Communication, and Utilities	8.1	50.8	8.1	51.9	8.4	50.9
Others*	16.9	35.8	17.2	35.0	17.7	33.8
Total Work Force	114.9	56.3	117.3	56.7	124.1	57.6

\*Includes agriculture, mining, construction, and public administration; average of all four industries.

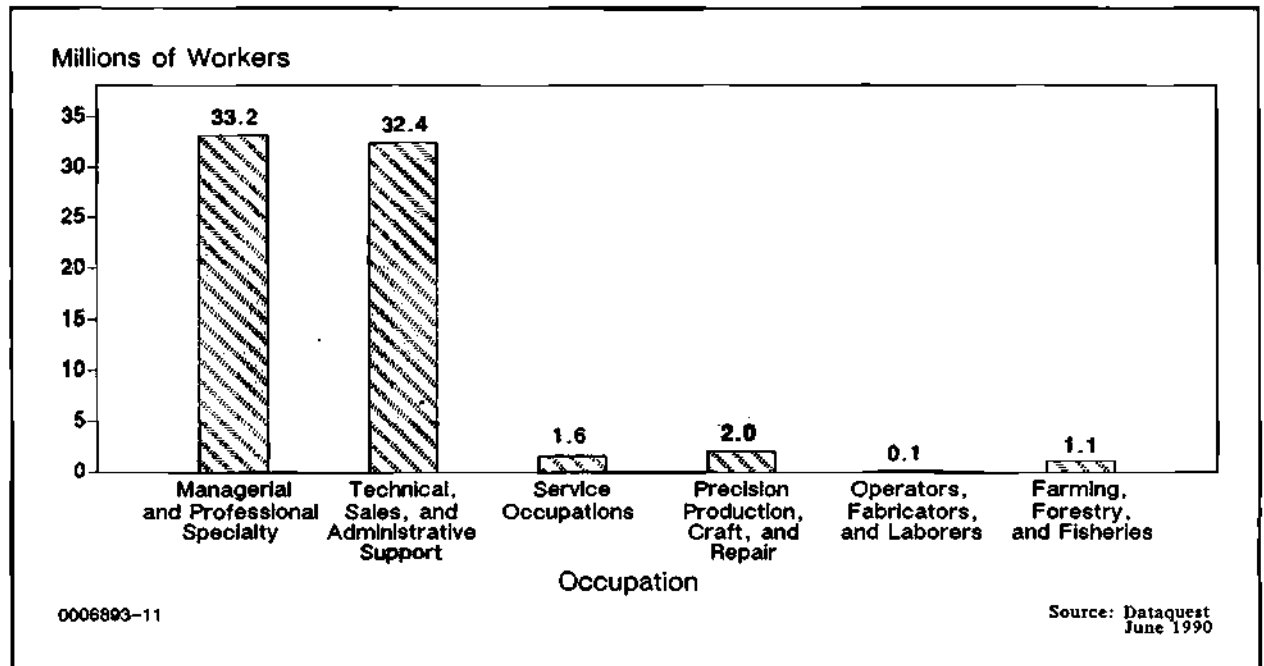
Source: U.S. Department of Labor,  
Bureau of Labor Statistics  
Dataquest  
June 1990

Table W-7. Number of Desktops by Job Classification (Thousands)

Occupational Classification	1989	1990	Estimated		1996
			1992	1994	
Managerial and Professional Specialty	33,179	33,747	34,885	36,022	37,160
Technical, Sales, and Administrative Support	32,394	32,827	33,694	34,561	35,428
Service Occupations	1,620	1,648	1,703	1,758	1,814
Precision Production, Craft, and Repair	2,044	2,058	2,085	2,113	2,141
Operators, Fabricators, and Laborers	114	117	123	130	136
Farming, Forestry, and Fishing	1,092	1,088	1,081	1,074	1,067
<b>Total</b>	<b>70,443</b>	<b>71,485</b>	<b>73,571</b>	<b>75,658</b>	<b>77,746</b>

Source: Dataquest  
June 1990

Figure 11. Number of Desktops by Major Occupational Category, 1989



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# Japanese Semiconductor Application Markets

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## Introduction

The following is a list of the material in the section:

- Introduction To The Service

# **Introduction to the Service**

## **OVERVIEW AND PURPOSE**

The Japanese Semiconductor Application Markets (JSAM) segment is one of the services provided by Dataquest's Components Group (CG).

As the range of semiconductor applications continues to become increasingly complex, so is the task of examining and forecasting semiconductor consumption from an electronic equipment perspective. Dataquest's Semiconductor Application Markets service has developed a methodology and an information base that provide the basis for a thorough analysis and forecast of semiconductor consumption by electronic equipment market. The service provides comprehensive support to decision makers who need to focus on the industry in terms of its current and future application markets. In companies of all sizes, JSAM can facilitate and support decisions regarding the following:

- Strategic planning
- Tactical marketing
- Product planning
- Sales planning

JSAM's position in the group is unique in that it provides a third dimension with which to view the regional and product data that come from adjoining analysts and services. The following Semiconductor Industry Group services work in alignment with JSAM:

- Semiconductor Application Markets (SAM)
- Semiconductor Industry Service (SIS)
- Japanese Semiconductor Industry Service (JSIS)
- European Semiconductor Industry Service (ESIS)
- European Semiconductor Application Markets (ESAM)
- Asian Semiconductor and Electronics Technology Service (ASETS)
- Semiconductor User Information Service (SUIS)
- Semiconductor Equipment and Materials Service (SEMS)

## **ELEMENTS OF THE SERVICE**

The service has the following four basic elements:

- The loose-leaf binder contains the essential data that are at the core of the service's methodology.
- JSAM newsletters report on or analyze electronic equipment, relevant industry topics, conferences, and trends as they pertain to application markets.
- The inquiry privilege allows the JSAM client and a designated alternate access to the JSAM staff for clarification of or further information on the topics covered in the service.

- Clients may also access and use Dataquest's corporate library. The extensive material in the library includes information organized by both subject and company. The semiconductor portion of this information is electronically indexed. The library regularly receives numerous periodicals, including government data, annual reports, and foreign publications.

As a JSAM binder holder, the client and designee also have access to the Components Group's Inquiry Center. The inquiry center provides "quick-turn" support and access to available data. If inquiries extend beyond the need for additional data and there is a need for detailed analyses or opinions on topics that are relevant to the service, we suggest that clients contact the JSAM staff directly, as mentioned above.

Clients are often unaware of what they can seek via the inquiry privilege. The inquiry privilege allows the binder holder access to Dataquest information that is unpublished, or to our analysts' expertise and opinions. It allows clients to personalize the information that they require in order to make decisions that are particular to their (or their company's) needs. We invite clients to make use of the inquiry privilege in order to seek this additional and available information. The inquiry typically is not a means for additional primary research.

The following are topics of typical inquiries frequently made of the JSAM service:

- The dynamics of a particular electronic equipment market, including:
  - A forecast in dollars
  - A forecast in units
  - Major manufacturers
  - Key trends
- Electronic equipment manufacturers' semiconductor procurement data
- The semiconductor content of a particular type of electronic equipment
- Semiconductor manufacturers' estimated sales by application market

The binder containing the comprehensive data that are an integral part of JSAM is given or sent to clients upon subscription. The layout of the binder information that follows this introduction is listed below. (A second binder is provided for convenient filing of JSAM newsletters.)

## **BINDER CONTENTS**

### **Overview**

The "Overview" section is a description of our research procedures and methodology. It also provides an explanation of our market segmentation by the five top-level application markets: data processing, communications, industrial, consumer, and transportation. This section also includes definitions of electronic equipment that is the subject of JSAM forecasts.

### **Company Electronic Equipment Revenue**

The "Company Electronic Equipment Revenue" section consists of a historical look at major electronic equipment revenue by company, year, and application market. The historical information

is preceded by an analysis of semiconductor consumption as it relates to the historical trends in this aggregate electronic equipment revenue.

### **Electronic Equipment Forecast**

In the "Electronic Equipment Forecast" section, we classify and segment more than 60 types of electronic equipment within the five application market categories and project a forecast for each line item.

### **Semiconductor Consumption Analysis**

Total semiconductor consumption analyses are presented by:

- Application market segment (particular equipment type)
- Product by application market segment
- Technology by application market segment

The "Semiconductor Consumption Analysis" is followed by five subtabs, one for each of the five application markets. Behind these tabs are trends and market overviews for the segments, or "bottom-up," detailed analyses for specific equipment within segments.

As staff members report on additional equipment types or trends that are industry- or equipment-specific, the material will be filed behind these tabs.

### **SUPPORT**

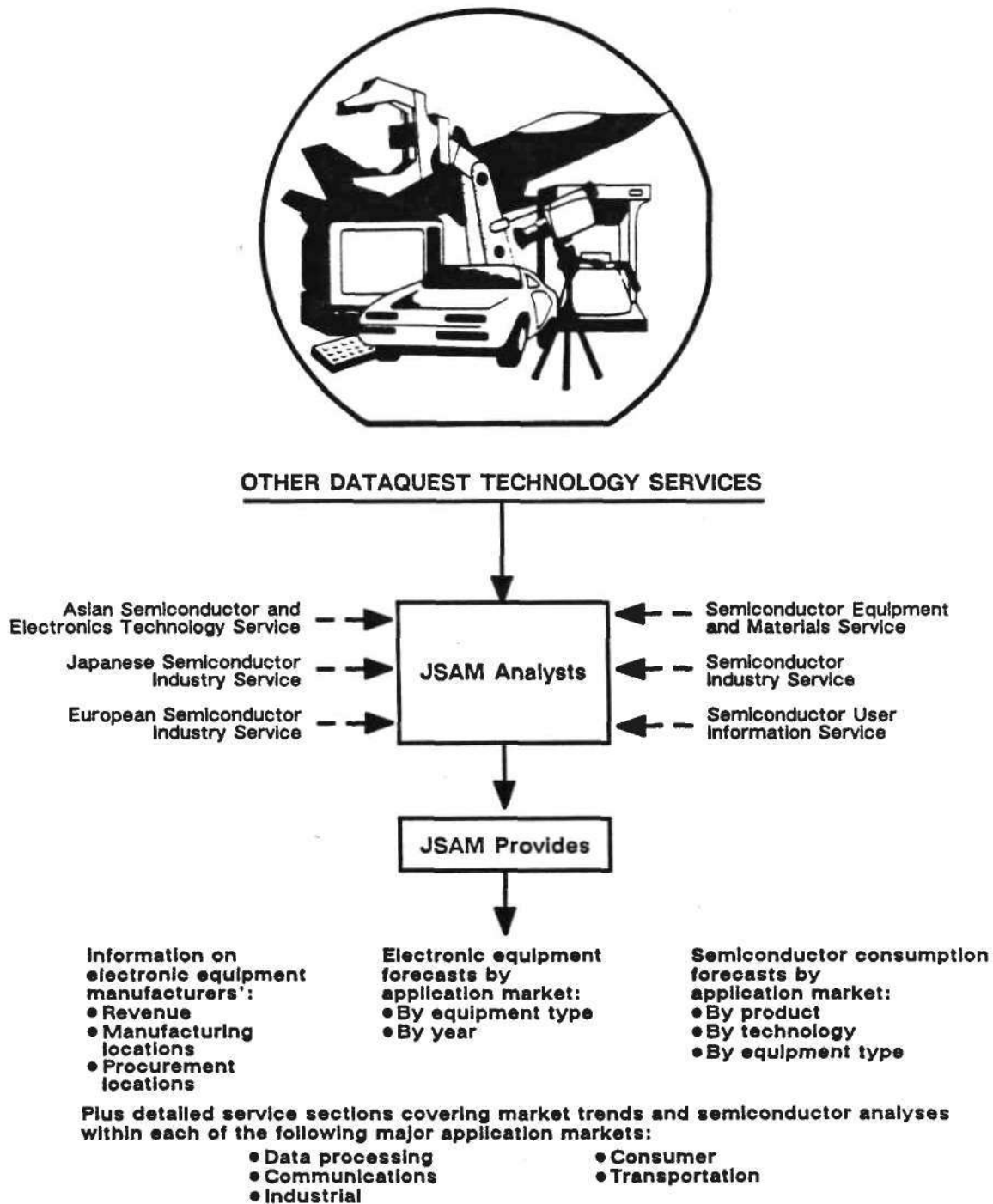
Dataquest's position and strength in providing this product are unprecedented. The service is structured so that the JSAM staff is supported by an integral information base with sources second to none. Our staff has an ongoing dialog with the following sources:

- Semiconductor users (from all industries) who both make and buy devices
- Dataquest's other Semiconductor Industry Group services, providing an ongoing view of the industry from both regional and product viewpoints
- Other Dataquest services that are constantly researching and analyzing fast-paced electronic equipment industries. These Dataquest technology services provide the JSAM staff with key insight into the electronics industry and analyses of specific equipment markets that include the following:
  - Market forecasts in dollars
  - Market forecasts in units
  - Major manufacturers
  - Market trends

JSAM draws upon the expertise of more than 20 electronic equipment services at Dataquest for information. However, detailed market share information and competitive analyses are considered elements of the appropriate industry service's standard subscription; clients may be required to subscribe to that service for an additional fee, if they wish access to this level of information.

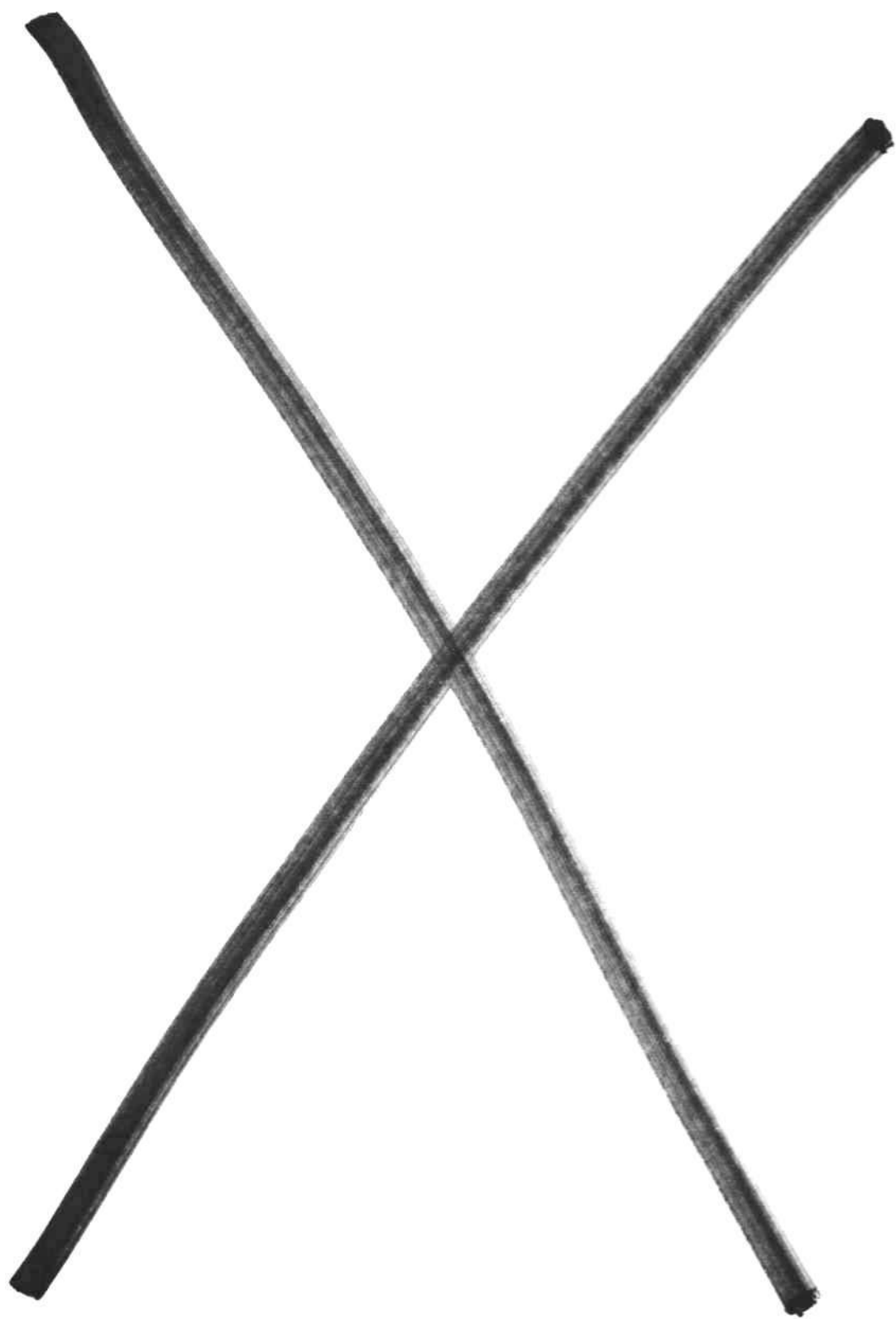
Figure 1 illustrates the Dataquest infrastructure that supports this service.

**Figure 1**  
**Dataquest Infrastructure**



0006430-1

Source: Dataquest  
March 1990



## Overview

The following is a list of the material in this section:

- ➔ • Methodology
- Input/Output Ratios
- ➔ • Definitions

NOTE: The arrow symbol indicates the latest document(s) correct location behind the subject tab.

# **Methodology**

## **INTRODUCTION**

The information behind this "Overview" tab is presented in three parts. The first, "Methodology," describes Dataquest's segmentation of electronic equipment into five application markets and introduces the major databases contained in the binder. The second section entitled "Input/Output Ratios," describes the economic research that establishes the basis for using input/output ratios to generate a forecast of semiconductor consumption by application or end-equipment market. The third section, entitled "Definitions," presents definitions of many of the specific equipment types included in the equipment forecast, which is located behind the tab entitled "Electronic Equipment Production."

## **METHODOLOGY**

### **Electronic Equipment Market Segmentation**

Dataquest segments electronic equipment according to the most widely recognized application areas that form the following five major semiconductor application market segments:

- Data processing
- Communications
- Industrial
- Consumer
- Transportation

Placement of equipment types within each segment is a matter open to a variety of interpretations. Dataquest spent more than a year and a half compiling and defining this segmentation, utilizing the following for input:

- Other Dataquest technology services
- Industry analysts in the semiconductor manufacturing community
- Trade association and government statistics

In this way, our segmentation both complemented and enhanced the way that electronics markets have been analyzed historically. The assumptions by which Dataquest determined its placement of some of the more controversial equipment types in each segment are described in the following paragraphs.

### **Data Processing**

The data processing segment is structured to include any equipment whose primary purpose is information processing. This includes add-on and peripheral devices that are used to reproduce computer data for such things as storage and hard-copy output.



The data processing segment is further subdivided into computer, data storage, data terminals, input/output, and dedicated systems. The last subsegment includes equipment with a more or less specifically defined operation, such as electronic typewriters, word processors, and automated banking/teller machines.

All personal computers (PCs) are placed within the data processing segment rather than in the consumer segment because they are products whose primary function is flexible data processing. The majority of products listed in the consumer segment are electrical or electromechanical equipment designed primarily for home or personal use. Increasingly integrated semiconductor circuitry is being added to these products. Overall, in the cases of appliances and home entertainment systems, the primary function of such consumer equipment is generally not flexible information processing, in spite of the fact that limited dedicated intelligence may be added as a feature.

Furthermore, the objective of reporting PC production, as with all equipment, is to estimate the semiconductor demand engendered by that type of equipment. It is not our objective to report the PC market by application segment such as home, scientific, technical, or business. Such a segmentation would represent a PC market phenomenon that is software based and has little to do with the hardware application of semiconductors. The same can be said for all electronic calculators, since they too are primarily tools for information processing. Electronic games are designed with the primary objective of use in the home and, as such, are counted in the consumer segment.

### Communications

The communications segment is subdivided into customer premises equipment, public telecommunications, radio, broadcast and studio, and other. These equipment designations have been developed to accommodate the equipment segmentation used by the Dataquest Telecommunications Industry Service format and the Standard Industrial Classification (SIC) codes used in the U.S. Department of Commerce Current Industrial Reports.

### Industrial

The industrial segment comprises all manufacturing-related equipment, and it includes some scientific and dedicated systems. The industrial segment is subdivided into the following categories: instrumentation, manufacturing systems, medical, and other. Here, as with all application market segments, when we present data, subtotals and line items have been arranged so that information on particular equipment types can be extracted easily and relocated whenever possible.

### Consumer

The consumer segment has been subdivided to include audio, video, personal electronics, appliances, and other. Personal electronics includes products carried or used by individuals, such as games, cameras, and watches. Overall, because much consumer equipment production stems from Japan, the consumer segment's definition was drafted to complement that region's perspective on the market.

## **Military**

Although the military segment is very important in the North American and European markets, it is insignificant in the Japanese electronic equipment market and has been excluded from our analysis.

## **Transportation**

To date, the transportation segment forecasts the demand for electronic equipment, based on auto and light truck production. However, we have used the title "Transportation" in order to incorporate future analysis and growth of different vehicle electronics, since electronics is impacting many major vehicle markets including motorcycles and off-highway and agricultural equipment. To date, the market is forecast based on the auto and light truck markets and accompanying estimates of increasing electronic equipment content and use per vehicle. We segment the market into equipment types that belong in different vehicle functional areas, such as entertainment, power train, body control, safety and convenience, and driver information. Dataquest reviews technological trends and vehicle market dynamics with auto and semiconductor manufacturers to arrive at its market forecasts.

## **Databases**

The Japanese Semiconductor Applications Markets (JSAM) binder contains three major databases. The first two were created for the purpose of deriving the third—the forecast of semiconductor consumption by application or end-equipment area.

The first database is found behind the tab entitled "Electronic Equipment Companies." This database contains historical information on the electronic equipment revenue (by application market segment) of approximately 25 Japanese manufacturers. The combined revenue of these companies accounts for a large percentage of total Japanese electronic equipment shipments. This electronic equipment revenue by segment is documented for the years 1982 through 1986, establishing trends and common data points with the second database (described below), in order to view the potential future of Japanese equipment production.

A major objective of the first database is to facilitate the development of input/output (I/O) ratios. An I/O ratio represents the relationship between the dollar value of semiconductors in a particular type of electronic equipment and the revenue generated by that equipment. For example, if \$100 worth of semiconductors are used in a piece of equipment that sells for \$1,000, the I/O ratio is 10 percent. This ratio of 10 percent can then be applied to forecasts of future sales of that equipment to estimate the resulting semiconductor demand. I/O ratios are discussed in detail in the next section of this binder.

Dataquest has gathered semiconductor consumption information (merchant procurement plus captive production) for many companies. This consumption information, combined with equipment revenue (both by segment and by individual equipment type), provides the basis for the development of the I/O ratios.

The second database, "Electronic Equipment Forecast," is located behind the tab entitled "Electronic Equipment Forecast" and follows the "Electronic Equipment Companies" section. It comprises an extensive set of tables detailing the shipments of electronic equipment by Japanese manufacturers. These electronic equipment tables are divided into the five application market

segments defined previously. The market forecasts of electronic equipment are used in conjunction with the I/O ratios to forecast semiconductor consumption by each equipment type and overall for each application market segment. This information creates the third database.

The third major set of data is located behind the tab entitled "Semiconductor Consumption Analysis" and is published in aggregate form. Detailed I/O estimates for each of the 66 types of equipment are available to clients via an inquiry to the JSAM staff. We have applied the I/O ratios to the equipment data to provide a forecast of semiconductor consumption by each application market. The semiconductor market is then broken down by semiconductor product category and by semiconductor technology—all by application market.

This section also discusses overall trends in the application market segments and analyzes specific equipment types. Each of the five application market segments is differentiated by subtabs that follow the main semiconductor consumption tables and tab. Information will be added continuously to these sections as individual semiconductor analyses and trend information are explored and developed for specific equipment and markets.

# Input/Output Ratios

As mentioned in the "Methodology" section, the input/output (I/O) ratio rests at the core of Dataquest's research on semiconductor application markets. The following section defines and discusses the I/O ratio historically, with respect to its applicability to research on semiconductor consumption from an electronic equipment perspective.

## THE POWER OF INPUT/OUTPUT RATIOS

I/O ratio analysis offers a number of benefits to the market researcher, including the following:

- It allows one market variable to be simply derived from another.
- Carefully constructed ratios can be relatively independent of time.
- The ratio can provide a means of "top-down" analysis.
- Insight into important trends can sometimes be gained from ratio changes over time.

An example of I/O ratio analysis allowing one market variable to be easily derived from another can be seen by considering the amount of steel used per automobile. If this ratio is known to be relatively constant, steel use by the auto industry can be derived from a forecast of automobile sales, rather than by extrapolating steel use.

Carefully constructed ratios tend to be relatively independent of time. For instance, steel use per auto will not be directly changed by variations in steel or auto prices. However, it might vary slowly, as the size mix of automobiles is changed, since compact vehicles use less steel than full-size cars.

Input/output ratios tend to provide a type of top-down analysis. For instance, steel use per car does not specify the type of steel or the supplier that the auto companies will prefer. It simply gives the total available market for steel in autos. Suppliers and products must compete within this available market. Some might gain share by lowering prices or by improving the performance of their material, but total use will remain unchanged.

Because I/O ratios tend to stay constant over the long run, any ratio changes over time provide important trend information. In the foregoing example, if aluminum and plastic were included with steel as the primary materials used in cars, a decline in steel with time might be explained as being due to substitution of another material.

Similarly, with respect to semiconductors, the I/O ratio reflects the relationship between the dollar value of semiconductors in a type of electronic equipment and the revenue generated by that equipment. The ratio is typically expressed as a percentage.

## Input/Output Ratios

For example, if a piece of electronic equipment (such as a personal computer) sells for \$1,000 and has \$100 worth of semiconductors in it, the I/O ratio is expressed as:

$$\frac{\text{semiconductor value (dollars in)}}{\text{equipment revenue (dollars out)}} = \frac{\$100}{\$1,000} = 0.10 \times 100 \text{ percent} = 10 \text{ percent}$$

On a macro level, understanding a company's equipment revenue and its total semiconductor use allows an I/O ratio to be developed for use on the aggregate. For example, instead of examining an individual PC (as above), we can look at the manufacturer's PC revenue and also its semiconductor consumption (both merchant procurement and captive production, if necessary) for the equipment. Here, a company's PC revenue could be \$1 billion and its semiconductor consumption for these PCs could be \$100 million. Again, we would derive the I/O ratio by dividing dollars in by dollars out and seeing that the aggregate I/O is still 10 percent.

Dataquest derives I/O ratios by using both methods—closely examining the semiconductor content of individual pieces of electronic equipment, and looking at aggregate revenue and total semiconductor consumption of companies involved in particular electronic lines of business.

As described in the "Methodology" section, once an I/O ratio is derived for a given type of equipment, we apply it to the history and forecast of that equipment. In our PC example, if the market in the U.S. in 1984 was \$15.9 billion, the semiconductor consumption for that equipment would be approximately \$1.59 billion.

### ECONOMIC THEORY OF INPUT/OUTPUT RATIOS

Wassily Leontief won the Nobel prize in economic science in 1973 for his pioneering work in input/output analysis. He originally did this work to predict the impact of government policy changes on the economy. For instance, input/output analysis might be used at the end of a war to predict the impact of a decline in tank production on steel consumption if the steel use per tank is known.

The basic assumption of early work with input/output analysis was that ratios tend to be unchanging with time. It turns out that this assumption is quite accurate, and that input/output ratios give significant insight into the workings of the economy. Later work has shown that technology and other factors may tend to cause ratios to change with time, and it takes these changes into account (for example, if integration or substitution of one input for another becomes commonplace within the equipment). In the short term, especially with respect to the price-driven semiconductor industry, year-to-year ratios can change dramatically. For example, I/O ratios in 1984 compared with 1985 were vastly different because, on the average, prices in the semiconductor industry changed

## Input/Output Ratios

much more dramatically than in its electronics equipment counterparts. So, depending on year-to-year dynamics, the ratios may change. However, over the long run, from industry cycle to industry cycle, they tend to remain fairly constant.

In its complete form, the Leontief method of analysis divides the economy into segments or industries. Some studies have used as many as 200 segments. Each industry appears in both a row and a column of a two-dimensional matrix. The number at the intersection of two industry segments represents the output of the industry in that row, utilized by the industry heading the column. The sum of the numbers in the row is then the total output of the industry in the row. The sum of the numbers in a column is the total input to the industry in that column. The input is not necessarily equal to that industry's output, unless other factors such as labor, capital, and profit are included in the analysis.

### **A Semiconductor Example**

The calculator industry was an important consumer of semiconductors in the early 1970s. More importantly, this industry was exposed to extremely rapid technological change during this period: Retail selling prices of comparable calculators fell by a factor of 10 or more in four years. Thus, the calculator industry should serve as a severe test of the stability of input/output ratios in high-technology markets and of the effectiveness of this approach.

Input/output analysis offers much insight into the use of semiconductors in calculators. In addition, the calculator products of the early 1970s are similar to the personal computers of today, so some of the insight is useful today.

Table 1 shows an input/output analysis for two calculators: a printing calculator introduced in 1972 and a small pocket calculator introduced in 1976. It is interesting to note the manner in which the costs of items with no semiconductor content fell in such a way as to keep the ratio of semiconductor use to selling price relatively constant. (This ratio rose from 7.7-percent in the 1972 product to 12.3 percent in the 1976 product.)

For instance, the keyboard cost fell from \$13.00 to \$0.56. This transition was achieved only through a complete change in the technological approach to keyboards. The first keyboard had a separate switch for every key, and each keytop, plunger, and switch had to be assembled from individual components. (In this example, the assembly labor for the keyboard is included in the keyboard price, because the keyboard is purchased as a separate item.)

By contrast, the keyboard for the pocket calculator consists of only four items for all keys: a bottom conductor, a spacer, a top conductor, and a molded single-piece keypad. The bottom conductor is arranged in columns, the top conductor in rows. When a key is depressed, it makes a connection between the row and the column. The LSI chip processes that information to figure out which key has been depressed. All keys are molded of a single piece of plastic in such a way that they can flex individually.

# Input/Output Ratios

**Table 1**  
**Input/Output Ratio Analysis for Two Electronic Calculators**

	<u>Printing Calculator</u>		<u>Pocket Calculator</u>	
	<u>Circa 1972</u>		<u>Circa 1976</u>	
	<u>Dollars</u>	<u>Percent</u>	<u>Dollars</u>	<u>Percent</u>
Selling Price	\$595.00	100.0%	\$19.95	100.0%
Factory Cost	\$195.00	32.8%	\$10.01	49.9%
Printer	\$ 49.00	8.2%	0	0
Display	0	0	\$ 2.40	12.0%
LSI Chip(s)	\$ 35.00	5.9%	\$ 1.50	7.5%
Other Semiconductors	<u>11.00</u>	1.8%	<u>0.96</u>	4.8%
Total Semiconductor	\$ 46.00	7.7%	\$ 2.46	12.3%
Keyboard	\$ 13.00	2.2%	\$ 0.56	2.5%
Case	15.00	2.5%	0.55	2.8%
Power Supply	9.00	1.5%	0	0.0%
PC Board	12.00	2.0%	0.97	4.9%
Other Components	9.00	1.5%	0.21	1.1%
Miscellaneous	<u>3.00</u>	0.5%	<u>0.87</u>	4.4%
Total Other	\$ 61.00	10.3%	\$ 3.16	15.8%
Labor	\$ 39.00	6.6%	\$ 1.99	10.0%

Source: Dataquest  
February 1988

Fundamentally, the low cost of the 1976 keyboard was achieved by reducing the number of parts required. Some of this simplicity was achieved by complicating the LSI chip somewhat. Since more complex chips can be purchased every year for the same price, complicating the chip tends to be "free."

Similar changes occurred in other parts of the calculator design. The pocket calculator uses a low-power LSI chip and display. For this reason, the power supply could be completely eliminated by substitution of a battery. The cost of the battery is not included, because it is supplied by the purchaser as a separate item.

Substitution of a display for a printer to perform the readout function reduces costs from \$49.00 to \$2.40. The display might consist either of LEDs or a liquid crystal.

## Input/Output Ratios

Other components are also less expensive because of the simplicity of the design. The case is less expensive because it is much smaller, and the printed circuit board is less expensive because it holds only 10 or 15 components instead of 600. Most of the additional components are eliminated by including their functions on the LSI chip. Several connectors are also eliminated because the chip, display, and keyboard can all be part of the main printed circuit board, whereas in the printing calculator they are mounted separately.

Although the input/output ratios in Table 1 are relatively stable between the two calculator products, they do change somewhat. Some of this change is due to a change in the channel of distribution rather than a change in technology. Note that factory cost for the printing calculator is 32.8 percent of the selling price; whereas, for the pocket calculator, it is 49.9 percent of the selling price. This difference is due to the fact that the printing calculator has a higher sales expense. It is sold by a direct sales force that calls on customers individually, while the pocket calculator is sold on a wholesale basis through normal consumer channels.

Table 2 recomputes the input/output ratios, using the factory cost as a basis. Note here how stable the ratios become: The output device consumes about one-fourth of the cost, whether it is a display or a printer. The semiconductor content is about one-fourth of the cost in both instances. Labor is constant at 20 percent. Finally, other costs are about 31 percent in both models.

The relative constancy of these ratios tends to justify the use of input/output analysis in high-technology markets, even during periods of rapid technological change.

Dataquest, in its analysis of end markets, prefers to use a ratio of semiconductor content in dollars to the company's sales in dollars. This ratio tends to be relatively constant with time for a given company, especially when the markup appropriate to the channel of distribution is taken into account. As a cross-check, however, we regularly analyze key types of electronic equipment and the semiconductors that they contain. These analyses are typically performed on equipment that sells in high volume or otherwise impacts the semiconductor market. They include the following:

- Personal computers
- Disk drives
- Printers
- Cellular mobile radios



# Input/Output Ratios

**Table 2**  
**Cost Ratio Analysis for Two Electronic Calculators**

	<u>Printing Calculator</u> <u>Circa 1972</u>		<u>Pocket Calculator</u> <u>Circa 1976</u>	
	<u>Dollars</u>	<u>Percent</u>	<u>Dollars</u>	<u>Percent</u>
Factory Cost	\$195.00	100.0%	\$10.01	100.0%
Printer	\$ 49.00	25.1%	0	0
Display	0	0	\$ 2.40	23.9%
LSI Chip(s)	\$ 35.00	17.9%	\$ 1.50	14.9%
Other Semiconductors	<u>11.00</u>	5.6%	<u>0.96</u>	9.6%
Total Semiconductor	\$ 46.00	23.6%	\$ 2.46	24.6%
Keyboard	\$ 13.00	6.7%	\$ 0.56	5.6%
Case	15.00	7.7%	0.55	5.5%
Power Supply	9.00	4.6%	0	0.0%
PC Board	12.00	6.2%	0.97	9.7%
Other Components	9.00	4.6%	0.21	2.1%
Miscellaneous	<u>3.00</u>	1.5%	<u>0.87</u>	8.7%
Total Other	\$ 61.00	31.3%	\$ 3.16	31.6%
Labor	\$ 39.00	20.0%	\$ 1.99	20.0%

Source: Dataquest  
February 1988

## Definitions

The following section provides detailed definitions of equipment types tracked by the Japanese Semiconductor Application Markets (JSAM) segment. The definitions match those used by Japan's Ministry of International Trade and Industry (MITI) in order to follow the standard set by MITI for industry statistics in Japan.

Lists of all electronic equipment types and their forecasts are located behind the tab entitled "Electronic Equipment Forecast."

### DATA PROCESSING

*General-Purpose Computers*—General-purpose computers are digital program accumulation systems. Computers excluded from this classification are computers for control, personal computers, and office computers.

General-purpose computers are split into the following price ranges:

- Large scale: More than ¥250 million
- Medium scale: ¥40 million to ¥250 million
- Small scale: ¥10 million to ¥40 million

Examples of computers in this category include the following:

- Fujitsu M-780 and VP series
- Hitachi M-680
- IBM 3090
- NEC ACOS 750 and SX

*Office Computers*—Office computers are small-scale computers used mainly for clerical work such as issuing vouchers and account processing. Office computers are often equipped with input/output and filing devices, along with on-line processing capabilities.

Office computer prices are segmented as follows:

- Large scale: ¥7.5 million to ¥40.0 million
- Medium scale: ¥3.0 million to ¥7.5 million
- Small scale: Less than ¥3.0 million

Examples of computers in this category include the following:

- Fujitsu K-10
- Hitachi L-30
- IBM System/36 ET Model AO1
- Mitsubishi Melcom 80 System 1
- NEC Office Processor System 8
- Toshiba TOSBAC System 5

**Personal Computers**—Personal computers are microprocessor-based computers used for a variety of applications ranging from business to measuring/control and education. Hand-held computers are excluded from this category. Personal computer prices are usually below ¥3 million.

The following are examples of models included in this category:

- Fujitsu FMR series
- Hitachi 816HX model 386
- NEC PC98000

**Computers for Control**—Computers for control are digital computers with program accumulation systems. These computers are used for a number of applications, including scientific calculation and telecommunications.

The following are examples of computers in this category:

- Fujitsu FACOM S-3000 series
- Hitachi HITAC series
- Nippon Data General Eclipse MV family
- Oki OKITAC System 50V series
- Toshiba TOSBAC G8050

**Rigid Disk Drives**—Rigid disk drives store digital data on platters with magnetically sensitive recording surfaces. The disk media substrates are nonflexible and can be made of aluminum, plastic, glass, or other rigid material.

**Flexible Disk Drives**—Flexible disk drives store digital data on removable flexible magnetic media (floppy diskettes).

**Other Disk Drives**—Other disk drives include magnetic tape drives, optical disk drives, and magnetic drum units.

**Printers**—Printers consist of impact and nonimpact serial, line, and page printers. Computer plotters are excluded from this segment.

**Display Unit**—CRT Terminals

**Miscellaneous**—Other input/output devices include display units, plotters, card readers, and scanners.

**Terminals**—Terminals include display terminals; point-of-sale terminals; and other terminals used in finance, transportation, distribution, and hotels.

**Other Applied Terminals**—Other applied terminals are used for medical imaging, magnetic recording/playing equipment, and industrial displays.

**Copiers**—Copiers include plain-paper copiers ranging from small personal copiers to large-scale, high-volume copiers.

**Word Processors**—Word processors include word processors used for Japanese language.

**Typewriters**—Typewriters are electronic typewriters excluding word processors.

**Cash Registers**—Cash registers include electronic cash registers and exclude point-of-sale terminals.

## COMMUNICATIONS

*Telephones*—The following are common features:

- Standard telephone—Features pushbutton dial, out-pulse dial, redial, on-hook dial, speed dial
- Multifunction—Features answering, auto dial, transferring, hand-free microphone interface
- Cordless—Wireless telephone handsets
- Others—Includes public telephone, highway telephone

*Telephone Applied*—Telephone applied includes attached telephone functions such as telephone-answering devices and interphones.

*Private Branch Exchanges (PBXs)*—PBXs are customer premises telephone-switching systems that, through the dialing of an access code, permit telephones to interface to the public telephone central exchange or office. A PBX includes desktop end-user terminals, attendant consoles, building wire, switching cabinets, and interconnections between switching cabinets.

*Key Telephones*—Key telephones are home and business phones equipped with switching functions that allow access to the public central exchange, without the use of an access code.

*Modems*—Modems are electronic devices that provide modulation and demodulation functions of transmitted data signals over telephone lines. Modems also convert digital data signals to analog signals for transmission over leased lines or the analog, public, switched telephone network.

*Transmission Equipment*—Transmission equipment consists of signal transmission units and broadband terminal equipment.

*Radio Communications Equipment*—Radio communications equipment is divided into fixed-station and mobile equipment. Fixed-station equipment includes receivers, transceivers, and multiplexers. Mobile communications equipment includes automobile, marine, aircraft, and CB radio equipment.

*Radio Applied Equipment*—Radio applied equipment consists of radar, direction finders, and telemeters.

*Broadcasting Equipment*—Broadcasting equipment includes equipment such as amplifiers, preamplifiers, control consoles, and terminal equipment, that is used for radio and television broadcasting.

## INDUSTRIAL

*Metering Units*—Metering units are panel meters, portable meters, relays, and recorders.

*Electronic Measuring Instruments*—Electronic measuring instruments consist of voltmeters, circuit testers, frequency-measuring instruments, oscilloscopes, IC testers, spectrum analyzers, and other measuring instruments.

*Industrial Meters*—Industrial meters are thermometers, pressure gauges, liquid-level gauges, flowmeters, tachometers, and speedometers.

*Numerically Controlled (NC) Machines*—NC machines are numerically controlled lathes, drilling machines, boring machines, milling machines, grinding machines, and other machine tools.

## Definitions

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**Robotics Equipment**—Robotics equipment is segmented into three categories: playback robots, NC robots, and intelligent robots. Playback robots are controlled by a program that is entered by the machine's operator. NC robots perform work in a sequence dictated by numerical instructions entered on paper tape, cards, or by digital switches. Intelligent robots decide to take a necessary action, using recognition techniques such as vision recognition.

**X-Ray Equipment**—X-ray equipment includes X-ray apparatus used for dental and surgical X rays.

**Medical Measuring Systems**—Medical measuring equipment such as electronic thermometer, electronic blood pressure machines, and others.

**Other Medical Electronic Equipment**—Other medical electronic equipment includes biophenomena-measuring apparatus, monitoring equipment, imaging equipment, test-analysis apparatus, therapeutic equipment, prosthetic devices, and medical-care systems.

**Vending Machines**—Vending machines are machines used to dispense various articles, including food, beverages, cigarettes, and tickets.

**Television Equipment**—Industrial-use equipment.

**Miscellaneous**—Other industrial equipment such as electronic beam application equipment, laser application equipment, and others.

## CONSUMER

**Audio Amplifiers**—Audio amplifiers include hi-fi stereo receivers in addition to hi-fi stereo amplifiers.

**Digital Audio Disc Players**—Digital audio disc players include compact disc players. However, optical systems used for computer storage are not included.

**Stereo Sets**—High fidelity stereo equipment including cassette and CD players, amplifiers, and speakers.

**Radios**—Radios include clock radios and other radios. Car radios are excluded from this segment.

**Tape Recorders**—Tape recorders include magnetic audio recording and playback units. Radio cassette recorders, tape decks, and "karaoke" equipment are included in this segment.

**Headphone Stereos**—Headphone stereos include highly portable stereo systems such as the Sony Walkman.

**VCRs**—VCRs are home video tape recorders and portable video tape recorders. VCRs used in broadcasting are excluded.

**Videocameras**—Videocameras include videocamera/recorders and exclude videocameras used in broadcasting.

**Color TVs**—Color television receivers.

**B&W TVs**—Black and white television receivers.

**LCD TVs**—Liquid-crystal display television receivers.

**Cameras**—Electronically controlled/programmable cameras.

*Sewing Machines*—Electronically controlled sewing machines.

*Watches*—Watches are battery-powered watches only. Movement-operated watches are excluded.

*Clocks*—Digital clocks.

*Electronic Musical Instruments*—Electronic musical instruments are electronic organs, synthesizers, and keyboards.

*Electronic Toys*—Digitally controlled toys.

*Air Conditioners*—Air conditioners include home air conditioners. Auto air conditioners are excluded.

*Microwave Ovens*—Programmable microwave ovens.

*Rice Cookers*—Rice cookers are electric appliances used for the sole purpose of preparing steamed rice.

*Fans*—Electronically controlled fans.

*Fan Heaters*—Fan heaters are kerosene heaters with electronic room temperature control and monitoring capabilities. Conventional kerosene heaters are excluded.

*Washing Machines*—Automatic and other electronic washing machines.

*Refrigerators*—Electronically controlled motor and temperature.

## TRANSPORTATION

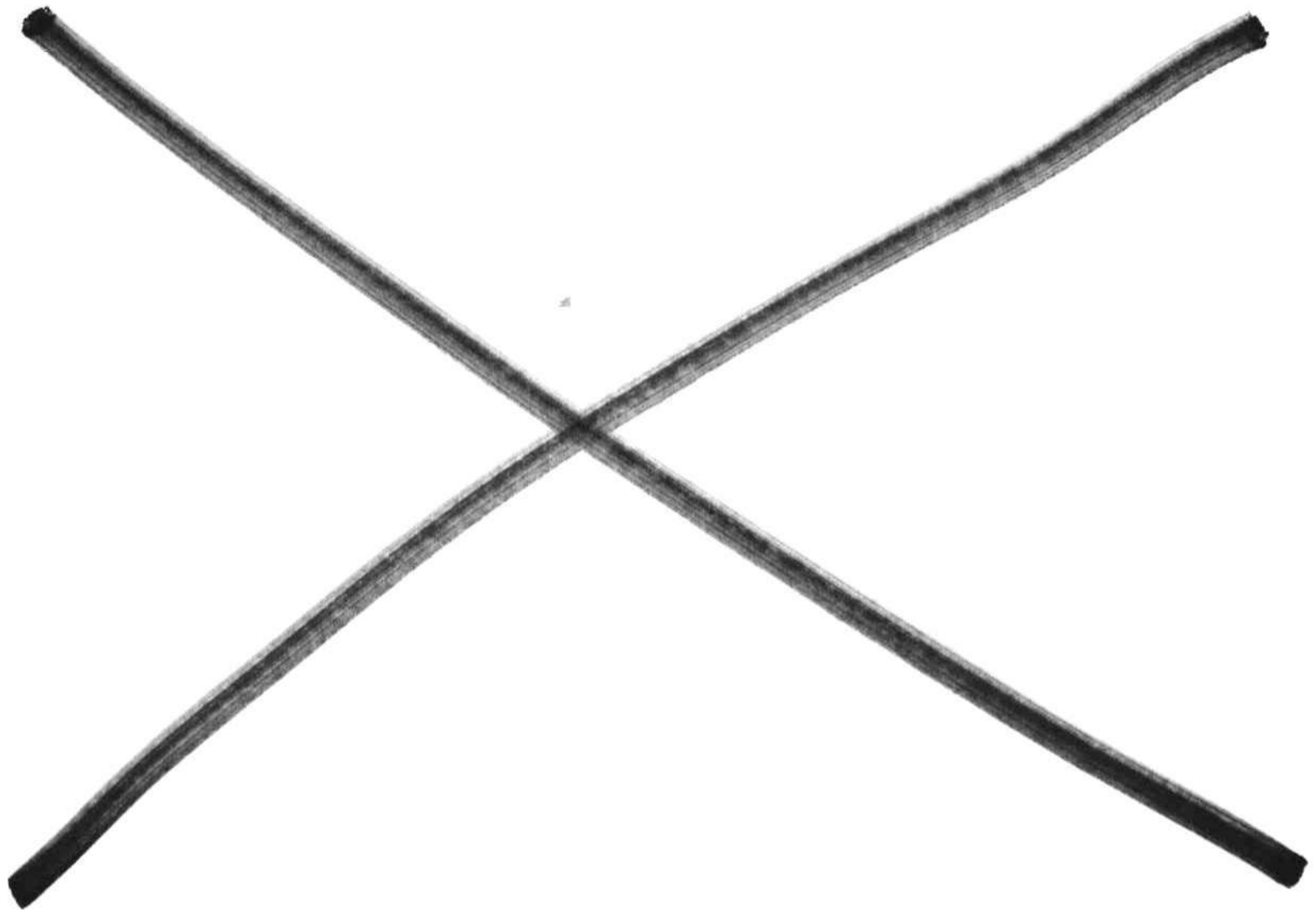
*Entertainment Systems*—Entertainment systems include car stereos and car radios.

*Body Control Systems*—Body control systems include braking systems, steering and suspension systems, speed regulators, and intermittent wipers.

*Safety and Convenience Products*—Safety and convenience products include auto air conditioning.

*Transmission Equipment*—Transmission equipment includes emissions control systems, electronic fuel injection systems, and automatic transmissions.

*Driver Information Equipment*—Driver information equipment includes digital gauges, indicators, and service reminders.



# Electronic Equipment Companies

The following is a list of the material in this section:

- ● Overview
- Application Market Revenue
- Factory Locations Directory

NOTE: The arrow symbol indicates the latest document(s) correct location behind the subject tab.



# Overview

## INTRODUCTION

This section forms the first major data base on which the methodology of this product is based. The other data base, located behind the tab entitled "Electronic Equipment Forecast," provides forecasts of electronic equipment production. The year in common, 1983, forms a transition in which to view history, while simultaneously extrapolating material that is necessary for understanding the future. The purpose of the electronic equipment revenue data base is threefold:

- To provide concrete historical information on specific companies—The section provides a data base of the electronic equipment revenue of 25 Japanese equipment manufacturers. We estimate that this electronics revenue accounts for a significant percentage of Japanese electronic equipment shipments and forms a good base for examining trends in the electronic equipment marketplace. This data base is a tool for analyzing growth by application market segment or by the activities of individual companies.
- To offer a check on other summary data—The information complements a historical view of semiconductor consumption from an equipment viewpoint rather than from the perspective of simply a product-shipment analysis.
- To serve as a basis for developing input/output (I/O) ratios—Tracking the actual semiconductor consumption and the actual electronic equipment revenue of given users allows an analysis of the I/O ratio: the relationship between semiconductor dollar value and the dollar value of the equipment in which the semiconductors are used.

Dataquest has developed I/O ratios by interviewing procurement, contract, and materials managers who are experts in knowing their individual company's merchant and captive use of semiconductors. We have interviewed more than 200 leading electronics manufacturers in North America. They have given us proprietary information on their semiconductor procurement, their captive production, and their relationships to the equipment or division in which the devices are used. The results of this survey, along with similar information provided by Japanese equipment and semiconductor manufacturers, are used to develop top-level I/O ratios.

Dataquest has agreed to use this information only for internal purposes and to report these ratios only on an aggregate basis. The I/O ratios that we develop are applied to the forecasts for electronic equipment. Information in those I/O ratios is available to clients that subscribe to our on-line services and can also be solicited from our analysts by clients via their inquiry privileges. The result is a series of forecasts of semiconductor consumption by application market. These forecasts are presented in the "Semiconductor Consumption Analysis" section.

# Overview

## SUMMARY

The information that follows is the result of a comprehensive data base that allows for tracking and analyzing the electronic equipment revenue of a sample of Japanese manufacturing companies. Major companies' revenue is listed, segmented, and presented in this section in various ways. Accordingly, the data, covering the five years from 1983 through 1987, are presented as follows:

- Annual Japanese yen-to-dollar exchange rates (see Table 1)
- The combined total revenue of all companies in the data base in relation to the combined total electronic equipment revenue of those same companies (see Figure 1 and Tables 2 and 3)
- The combined total electronic equipment revenue broken out by the five standard application markets that consume semiconductors in Japan: data processing, communications, industrial, consumer, and transportation (see Figures 2 and 3 and Tables 4 through 6)
- The individual application markets broken out by year, company, and revenue for that market (see the "Application Market Revenue" section)

Table 1

### Annual Japanese Yen-to-Dollar Exchange Rate

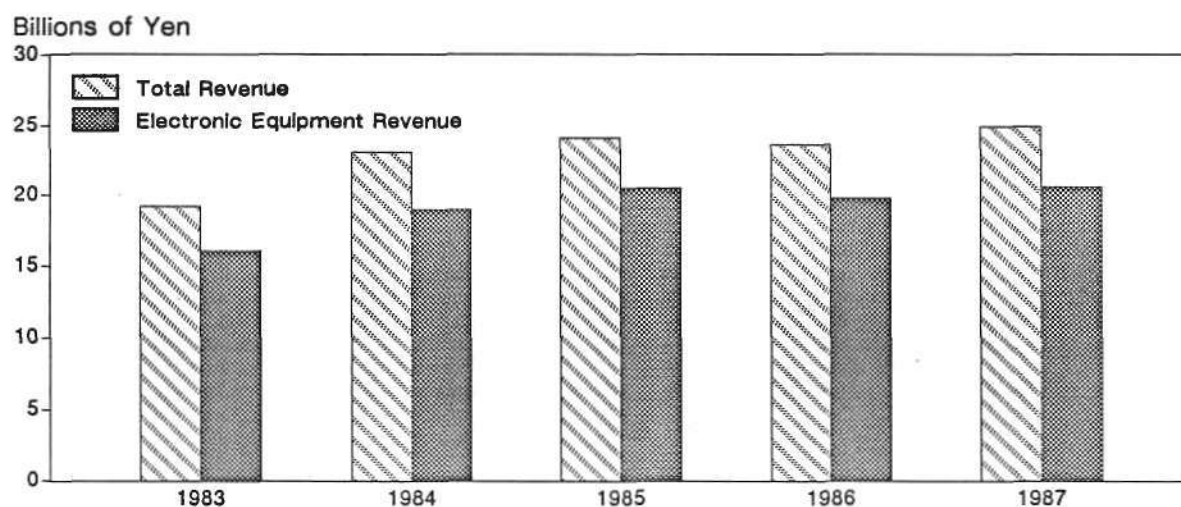
<u>Year</u>	<u>Yen per Dollar</u>
1983	235
1984	237
1985	238
1986	167
1987	144

Source: Dataquest  
March 1989

# Overview

Figure 1

**Total Company Revenue versus  
Total Company Electronic Equipment Revenue**



0003181-1

Source: Dataquest  
March 1989

Table 2

**Total Company Revenue versus  
Total Company Electronic Equipment Revenue  
(Billions of Yen)**

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>CAGR</u> <u>1983-1987</u>
Total Revenue	¥19,200	¥23,093	¥24,131	¥23,553	¥24,913	6.7%
Electronic Equipment Revenue	¥16,100	¥18,957	¥20,513	¥19,804	¥20,561	6.3%
Electronic Equipment Percentage of Total	83.9%	82.1%	85.0%	84.1%	82.5%	

Source: Dataquest  
March 1989

## Overview

Table 3

Total Company Revenue versus  
Total Company Electronic Equipment Revenue  
(Millions of Dollars)

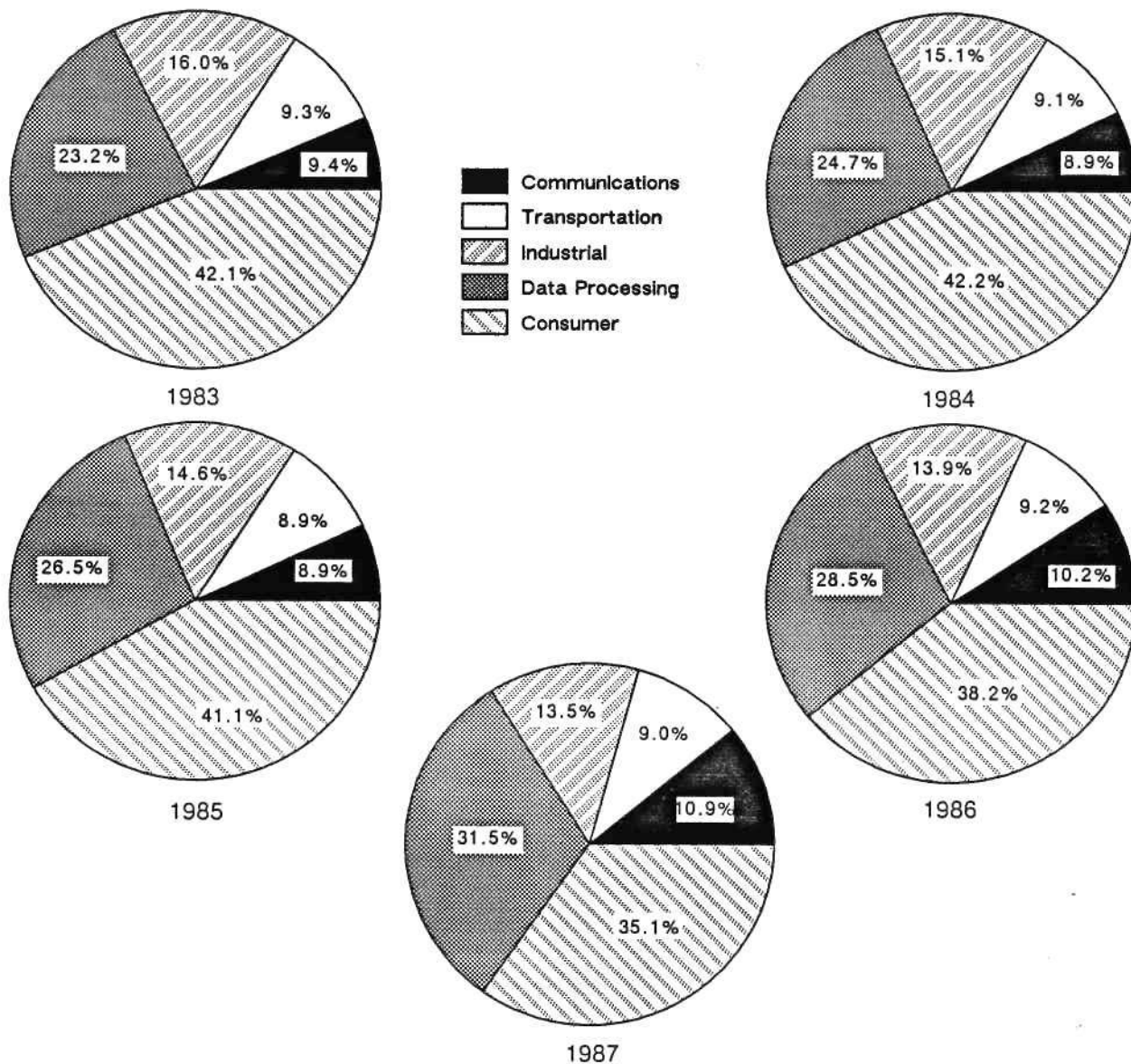
	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	CAGR <u>1983-1987</u>
Total Revenue	\$81,702	\$97,439	\$101,390	\$141,037	\$173,009	20.6%
Electronic Equipment Revenue	\$68,512	\$79,987	\$ 86,190	\$118,585	\$142,785	20.2%
Electronic Equipment Percentage of Total	83.9%	82.1%	85.0%	84.1%	82.5%	

Source: Dataquest  
March 1989

# Overview

Figure 2

Total Company Electronic Equipment  
Revenue by Application Market  
(1983-1987)



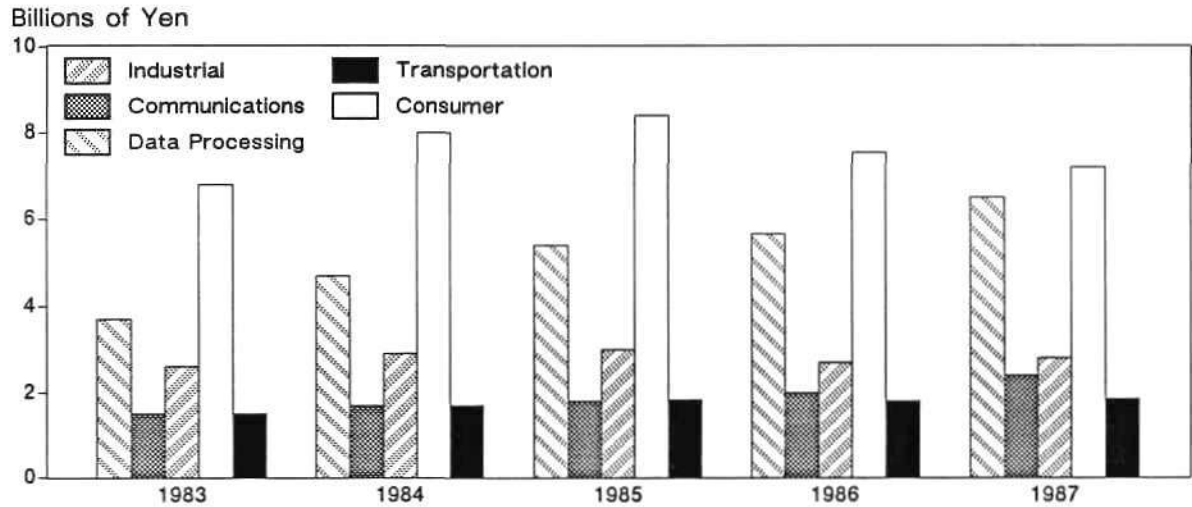
0003181-2

Source: Dataquest  
March 1989

# Overview

Figure 3

Company Electronic Equipment Revenue  
by Application Market



0003181-3

Source: Dataquest  
March 1989

Table 4

Total Company Electronic Equipment Revenue by Application Market  
(Billions of Yen)

Segment	1983	1984	1985	1986	1987	CAGR 1983-1987
Data Processing	¥ 3,732	¥ 4,677	¥ 5,431	¥ 5,661	¥ 6,483	14.8%
Communications	1,517	1,692	1,827	2,019	2,243	10.3%
Industrial	2,576	2,854	2,993	2,748	2,781	1.9%
Consumer	6,784	8,009	8,427	7,559	7,205	1.5%
Transportation	1,491	1,726	1,834	1,816	1,849	5.5%
Total	¥16,100	¥18,957	¥20,513	¥19,804	¥20,561	6.3%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
March 1989

# Overview

Table 5

**Total Company Electronic Equipment Revenue  
by Application Market  
(Millions of Dollars)**

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>CAGR 1983-1987</u>
Data Processing	\$15,880	\$19,733	\$22,820	\$ 33,896	\$ 45,023	29.8%
Communications	6,455	7,138	7,678	12,091	15,575	24.6%
Industrial	10,963	12,042	12,576	16,456	19,315	15.2%
Consumer	28,868	33,794	35,407	45,266	50,031	14.7%
Transportation	<u>6,345</u>	<u>7,281</u>	<u>7,708</u>	<u>10,875</u>	<u>12,842</u>	19.3%
Total	\$68,512	\$79,987	\$86,190	\$118,585	\$142,785	20.2%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
March 1989

Table 6

**Total Company Electronic Equipment Revenue  
by Application Market  
(Percentage)**

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Data Processing	23.2%	24.7%	26.5%	28.5%	31.5%
Communications	9.4	8.9	8.9	10.2	10.9
Industrial	16.0	15.1	14.6	13.9	13.5
Consumer	42.1	42.2	41.1	38.2	35.1
Transportation	<u>9.3</u>	<u>9.1</u>	<u>8.9</u>	<u>9.2</u>	<u>9.0</u>
Total	100.0%	100.0%	100.0%	100.0%	100.0%

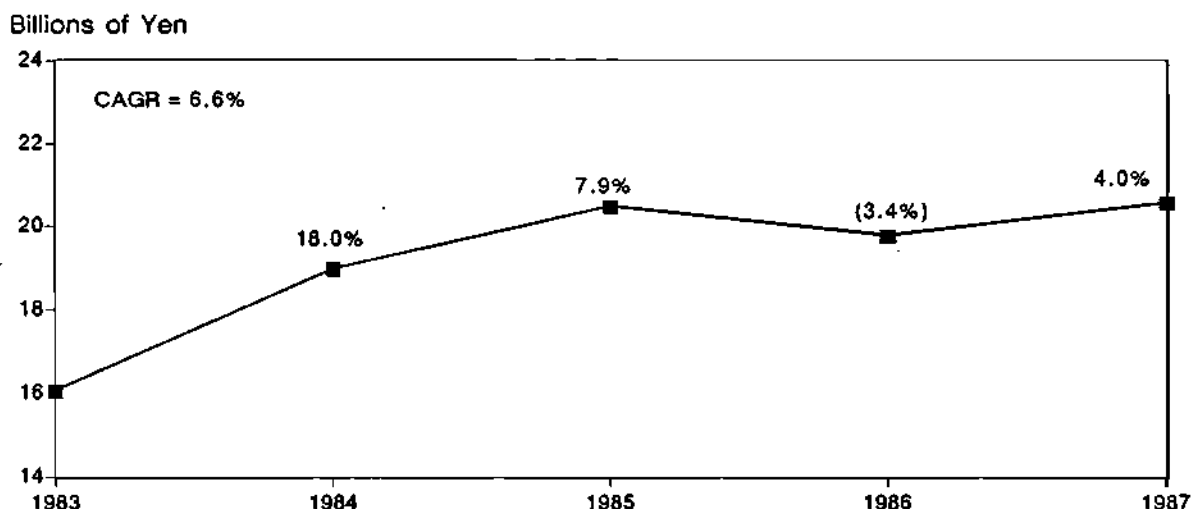
Source: Dataquest  
March 1989

## Overview

Figure 4 illustrates the growth of total company electronic equipment revenue from 1983 through 1987.

**Figure 4**

### **Total Company Electronic Equipment Revenue Year-to-Year Growth Rates**



Note: Percentages indicate year-to-year growth rates.

0003181-4

Source: Dataquest  
March 1989

## **METHODOLOGY**

The companies included in the data base represent Dataquest's estimate of the top 25 Japanese electronic equipment manufacturers. Company annual reports provided the main source of information on equipment shipments. Virtually every annual report lists a company's revenue by line of business; each line of business is usually referred to as a segment. A description of each segment is also reported. Dataquest used these reports to determine whether a segment's revenue should be added to the data base.

Given that the information in some annual reports is limited, Dataquest developed the following protocols to provide continuity to the data base:

- The latest annual report was always used. For example, a typical 1987 report might have historical segment data for a two-year period. If only two years were reported, the 1986 report was examined for 1984 information, and the data for 1985 were simply checked against the information in the 1986 report to ensure that a company had not reorganized its reporting structure. Using the latest annual report provided continuity in the segments and in reporting each segment's revenue.



## Overview

- Some companies' segments included nonelectronic equipment. If electronic equipment made up the majority of the segment, or if there was a heavy technical influence in the description, the entire revenue for that segment was added to the data base. Unless specifically detailed or additional information was obtainable, percentages were not applied to segment revenue, based on the proportion or type of electronic equipment in that segment.
- Despite the name that a company gave to a given segment, a description of the equipment in a segment was used to determine in which of the six Dataquest application market segments the revenue belonged. Some of the companies' segments had such a varied product mix that they crossed over the Dataquest segmentation boundaries. In such cases, the major product influence in that segment's description mandated the revenue category.
- In segments where there was little or no clear evidence of electronic equipment, the revenue was not added to the data base. Nonelectronic lines of business also were not included.
- Service, interest, supply, and other additional or product support revenue was eliminated from the data base if it was listed in the report. Most companies in the data base separated such revenue. Software revenue was also eliminated when it was broken out as a separate line item, or if additional information indicated a percentage.

These gray areas applied to only a portion of the companies in the data base. Since Dataquest dealt with them by using the standards just described, we believe that this history of sample companies provides a thorough snapshot of what transpired in the application market segments that affect semiconductor consumption in Japan.

However, when comparing these data to the data located behind our "Electronic Equipment Forecast" tab, it is important to note the following differences in the two data bases:

- The company data in this section are based on the companies' sales revenue in each segment, and the electronic equipment forecast measures factory revenue from equipment production. The sales revenue figure is significantly higher than the factory revenue figure for a given piece of equipment.
- The company data include revenue from products manufactured outside of Japan. The electronic equipment forecast data measure production of equipment manufactured in Japan exclusively.
- The company data reflect the use of top-level segments to develop the total application market numbers, while the electronic equipment forecast tracks specific equipment types to develop the total application market numbers.

## Overview

These differences in the two data bases make the company application market revenue data large, compared with the electronic equipment forecast data. And the disparities distort the relative size of the five application markets tracked by the company data base. As more years are included, we can examine the link between the two data bases more closely and resolve discrepancies as they arise.

### ANALYSIS

Compiling and analyzing the data highlighted many key points. Figure 1 and Table 2 show that the combined total revenue grew at a compound annual growth rate (CAGR) of 6.7 percent in local currency from 1983 to 1987. Combined electronic equipment revenue grew at a slightly slower CAGR of 6.3 percent.

In 1987 the only area to show negative growth was the consumer application markets with a negative 4.6 percent decrease from 1986. In 1983, consumer electronics made up 42.1 percent of the total company electronic equipment revenue. In 1987, the percentage dropped to 35.0. Some of the reasons for this drop are as follows:

- The high yen appreciation severely damaged the Japanese consumer manufacturers in terms of worldwide competition, specifically against the Koreans.
- The export ratio for consumer products from Japan to the United States sharply declined from 58.6 percent in 1986 to 51.4 percent in 1987.
- Japanese manufacturers have been targeting industrial and data processing markets. The data processing portion of total Japanese company electronic equipment revenue grew from 23.2 percent in 1983 to 31.5 percent in 1987.

The fastest growing application segment was data processing, with a positive 15 percent growth rate over 1986. Figures 2 and 3 and Tables 4 through 6 show the changing composition of the Japanese electronics market.

# Application Market Revenue

Table 1

## Estimated Total Company Electronic Equipment Revenue (Billions of Yen)

Company	1983	1984	1985	1986	1987	Year End
1 Matsushita Electric Industrial Co., Ltd.	¥ 2,719	¥ 3,258	¥ 3,424	¥ 3,169	¥ 3,278	Mar. 31
2 Hitachi, Ltd.	2,648	3,026	3,003	2,925	2,920	Mar. 31
3 Toshiba Corporation	2,026	2,526	2,520	2,503	2,683	Mar. 31
4 NEC Corporation	1,460	1,889	1,970	2,124	2,304	Mar. 31
5 Mitsubishi Electric Corporation	1,588	1,858	1,821	1,804	1,954	Mar. 31
6 Fujitsu Limited	992	1,292	1,429	1,482	1,714	Mar. 31
7 IBM Japan, Ltd.	612	769	915	879	1,061	Dec. 31
8 Sony Corporation	770	912	1,071	1,036	1,030	Mar. 31
9 Nippondenso Co., Ltd.	689	789	909	965	994	Mar. 31
10 Sanyo Electric Co., Ltd.	820	992	1,048	839	909	Mar. 31
11 Sharp Corporation	757	910	955	869	873	Mar. 31
12 Matsushita Electric Works Ltd.	530	565	588	603	663	Nov. 30
13 Victor Company of Japan Limited	553	650	588	587	579	Mar. 31
14 Canon Inc.	374	485	575	539	579	Dec. 31
15 Ricoh Company, Ltd.	389	452	490	488	560	Mar. 31
16 Oki Electric Industry Co., Ltd.	304	362	362	361	416	Mar. 31
17 Fuji Electric Co., Ltd.	355	381	386	393	402	Mar. 31
18 Matsushita Communication Industrial Co., Ltd.	251	291	301	317	337	Mar. 31
19 Omron Tateisi Electronics Co.	209	270	246	248	278	Mar. 31
20 Kyocera Corporation	220	283	247	243	271	Mar. 31
21 Pioneer Electronic Corporation	239	247	260	268	266	Sep. 30
22 Daikin Industries, Ltd.	162	190	214	213	225	Nov. 30
23 Casio Computer Co., Ltd.	176	210	236	203	211	Mar. 31
24 Matsushita Kotobuki Electronics Industries Ltd.	226	336	374	285	209	Mar. 31
25 Minolta Camera Co., Ltd.	133	150	199	211	197	Mar. 31
Total	¥19,200	¥23,093	¥24,131	¥23,553	¥24,913	
Exchange Rate (Yen/US\$)	235	237	238	167	144	

Note: Each year shows fiscal year in Japan.

Source: Dataquest  
March 1989

# Application Market Revenue

**Table 2**

## **Estimated Total Company Electronic Equipment Revenue (Millions of Dollars)**

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>Year End</u>
1 Matsushita Electric Industrial Co., Ltd.	\$11,569	\$13,746	\$ 14,387	\$ 18,978	\$ 22,761	Mar. 31
2 Hitachi, Ltd.	11,269	12,767	12,619	17,513	20,275	Mar. 31
3 Toshiba Corporation	8,620	10,658	10,586	14,991	18,630	Mar. 31
4 NEC Corporation	6,212	7,972	8,279	12,716	16,003	Mar. 31
5 Mitsubishi Electric Corporation	6,756	7,841	7,651	10,800	13,571	Mar. 31
6 Fujitsu Limited	4,220	5,450	6,006	8,875	11,906	Mar. 31
7 IBM Japan, Ltd.	2,605	3,243	3,843	5,261	7,366	Dec. 31
8 Sony Corporation	3,277	3,848	4,502	6,205	7,152	Mar. 31
9 Nippondenso Co., Ltd.	2,931	3,330	3,819	5,777	6,903	Mar. 31
10 Sanyo Electric Co., Ltd.	3,488	4,184	4,402	5,023	6,315	Mar. 31
11 Sharp Corporation	3,219	3,838	4,014	5,201	6,060	Mar. 31
12 Matsushita Electric Works Ltd.	2,256	2,385	2,469	3,612	4,602	Nov. 30
13 Victor Company of Japan Limited	2,353	2,743	2,471	3,517	4,020	Mar. 31
14 Canon Inc.	1,592	2,047	2,418	3,230	4,018	Dec. 31
15 Ricoh Company, Ltd.	1,654	1,906	2,059	2,922	3,889	Mar. 31
16 Oki Electric Industry Co., Ltd.	1,292	1,527	1,520	2,162	2,890	Mar. 31
17 Fuji Electric Co., Ltd.	1,510	1,608	1,623	2,353	2,794	Mar. 31
18 Matsushita Communication Industrial Co., Ltd.	1,067	1,227	1,265	1,900	2,341	Mar. 31
19 Omron Tateisi Electronics Co.	889	1,141	1,034	1,483	1,930	Mar. 31
20 Kyocera Corporation	935	1,195	1,036	1,453	1,883	Mar. 31
21 Pioneer Electronic Corporation	1,017	1,043	1,094	1,603	1,848	Sep. 30
22 Daikin Industries, Ltd.	690	800	897	1,275	1,564	Nov. 30
23 Casio Computer Co., Ltd.	751	887	992	1,217	1,466	Mar. 31
24 Matsushita Kotobuki Electronics Industries Ltd.	962	1,417	1,570	1,710	1,454	Mar. 31
25 Minolta Camera Co., Ltd.	567	635	835	1,265	1,368	Mar. 31
<b>Total</b>	<b>\$81,702</b>	<b>\$97,439</b>	<b>\$101,390</b>	<b>\$141,037</b>	<b>\$173,009</b>	
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>	

Note: Each year shows fiscal year in Japan.

Source: Dataquest  
March 1989

# Application Market Revenue

Table 3

## Estimated Revenue for Semiconductor Application Markets (Billions of Yen)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Hitachi, Ltd.	¥ 2,288	¥ 2,486	¥ 2,613	¥ 2,540	¥ 2,510
2 Matsushita Electric Industrial Co., Ltd.	2,104	2,515	2,666	2,386	2,424
3 Toshiba Corporation	1,746	2,091	2,160	2,093	2,213
4 NEC Corporation	1,114	1,382	1,597	1,741	1,871
5 Mitsubishi Electric Corporation	1,448	1,622	1,656	1,628	1,734
6 Fujitsu Limited	819	1,037	1,253	1,315	1,514
7 IBM Japan, Ltd.	612	769	915	879	1,061
8 Nippondenso Co., Ltd.	681	779	896	953	979
9 Sony Corporation	701	812	944	899	858
10 Sanyo Electric Co., Ltd.	747	919	982	778	711
11 Sharp Corporation	643	769	810	724	703
12 Canon Inc.	374	487	571	539	578
13 Victor Company of Japan Limited	527	620	555	541	522
14 Ricoh Company, Ltd.	314	367	407	398	459
15 Matsushita Electric Works Ltd.	314	321	339	352	379
16 Matsushita Communication Industrial Co., Ltd.	251	291	301	317	337
17 Oki Electric Industry Co., Ltd.	237	276	289	286	314
18 Pioneer Electronic Corporation	226	236	251	259	257
19 Casio Computer Co., Ltd.	176	210	236	203	211
20 Matsushita Kotobuki Electronics Industries Ltd.	226	336	374	285	209
21 Minolta Camera Co., Ltd.	133	150	199	211	197
22 Omron Tateisi Electronics Co.	144	188	166	167	179
23 Daikin Industries, Ltd.	109	124	139	143	156
24 Fuji Electric Co., Ltd.	108	110	131	100	110
25 Kyocera Corporation	60	58	64	66	75
Total	¥16,100	¥18,957	¥20,513	¥19,804	¥20,561
Exchange Rate (Yen/US\$)	235	237	238	167	144

Note: Each year shows fiscal year in Japan.

Source: Dataquest  
March 1989

# Application Market Revenue

Table 4

Estimated Revenue for Semiconductor Application Markets  
(Millions of Dollars)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Hitachi, Ltd.	\$ 9,737	\$10,488	\$10,981	\$ 15,207	\$ 17,427
2 Matsushita Electric Industrial Co., Ltd.	8,954	10,613	11,202	14,288	16,836
3 Toshiba Corporation	7,429	8,823	9,074	12,535	15,367
4 NEC Corporation	4,740	5,830	6,710	10,423	12,993
5 Mitsubishi Electric Corporation	6,160	6,845	6,958	9,746	12,043
6 Fujitsu Limited	3,485	4,376	5,265	7,873	10,517
7 IBM Japan, Ltd.	2,605	3,243	3,842	5,260	7,365
8 Nippondenso Co., Ltd.	2,898	3,287	3,764	5,704	6,797
9 Sony Corporation	2,984	3,425	3,965	5,382	5,959
10 Sanyo Electric Co., Ltd.	3,177	3,878	4,124	4,659	4,937
11 Sharp Corporation	2,734	3,243	3,404	4,333	4,880
12 Canon Inc.	1,590	2,057	2,400	3,229	4,017
13 Victor Company of Japan Limited	2,241	2,618	2,332	3,242	3,626
14 Ricoh Company, Ltd.	1,338	1,547	1,711	2,382	3,186
15 Matsushita Electric Works Ltd.	1,335	1,355	1,426	2,110	2,631
16 Matsushita Communication Industrial Co., Ltd.	1,067	1,227	1,265	1,900	2,341
17 Oki Electric Industry Co., Ltd.	1,008	1,166	1,214	1,714	2,179
18 Pioneer Electronic Corporation	962	997	1,055	1,553	1,782
19 Casio Computer Co., Ltd.	751	887	992	1,217	1,466
20 Matsushita Kotobuki Electronics Industries Ltd.	962	1,417	1,570	1,710	1,454
21 Minolta Camera Co., Ltd.	567	635	835	1,265	1,368
22 Omron Tateisi Electronics Co.	613	795	696	998	1,243
23 Daikin Industries, Ltd.	462	525	585	859	1,084
24 Fuji Electric Co., Ltd.	459	465	549	601	765
25 Kyocera Corporation	<u>254</u>	<u>246</u>	<u>270</u>	<u>395</u>	<u>522</u>
Total	\$68,512	\$79,987	\$86,190	\$118,585	\$142,785
Exchange Rate (Yen/US\$)	235	237	238	167	144

Note: Each year shows fiscal year in Japan.

Source: Dataquest  
March 1989

# Application Market Revenue

Table 5

## Estimated Fiscal 1987 Company Electronics Revenue by Semiconductor Application Market (Billions of Yen)

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	¥ 804	¥ 130	¥ 755	¥ 527	¥ 293	¥ 2,510
2 Matsushita Electric Industrial Co., Ltd.	279	130	280	1,735	0	¥ 2,424
3 Toshiba Corporation	382	392	409	758	273	¥ 2,213
4 NEC Corporation	1,037	722	0	112	0	¥ 1,871
5 Mitsubishi Electric Corporation	166	213	745	469	141	¥ 1,734
6 Fujitsu Limited	1,233	282	0	0	0	¥ 1,514
7 IBM Japan, Ltd.	1,061	0	0	0	0	¥ 1,061
8 Nippondenso Co., Ltd.	0	0	0	15	964	¥ 979
9 Sony Corporation	0	0	0	858	0	¥ 858
10 Sanyo Electric Co., Ltd.	55	0	137	519	0	¥ 711
11 Sharp Corporation	151	0	0	551	0	¥ 703
12 Canon Inc.	431	6	20	121	0	¥ 578
13 Victor Company of Japan Limited	0	0	0	522	0	¥ 522
14 Ricoh Company, Ltd.	356	72	0	31	0	¥ 459
15 Matsushita Electric Works Ltd.	0	0	0	379	0	¥ 379
16 Matsushita Communication Industrial Co., Ltd.	90	158	0	0	89	¥ 337
17 Oki Electric Industry Co., Ltd.	190	124	0	0	0	¥ 314
18 Pioneer Electronic Corporation	0	0	0	167	90	¥ 257
19 Casio Computer Co., Ltd.	109	0	0	102	0	¥ 211
20 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	209	0	¥ 209
21 Minolta Camera Co., Ltd.	97	0	0	100	0	¥ 197
22 Omron Tateisi Electronics Co.	10	0	169	0	0	¥ 179
23 Daikin Industries, Ltd.	0	0	156	0	0	¥ 156
24 Fuji Electric Co., Ltd.	0	0	110	0	0	¥ 110
25 Kyocera Corporation	34	14	0	27	0	¥ 75
Total (25 Companies)	¥6,483	¥2,243	¥2,781	¥7,205	¥1,849	¥20,561
Exchange Rate (Yen/US\$): 144.0						

Source: Dataquest  
March 1989

# Application Market Revenue

Table 6

**Estimated Fiscal 1987 Company Electronics Revenue  
by Semiconductor Application Market  
(Millions of Dollars)**

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	\$ 5,583	\$ 903	\$ 5,244	\$ 3,662	\$ 2,036	\$ 17,427
2 Matsushita Electric Industrial Co., Ltd.	1,940	903	1,944	12,048	0	\$ 16,836
3 Toshiba Corporation	2,653	2,719	2,838	5,264	1,892	\$ 15,367
4 NEC Corporation	7,199	5,016	0	778	0	\$ 12,993
5 Mitsubishi Electric Corporation	1,153	1,482	5,171	3,259	979	\$ 12,043
6 Fujitsu Limited	8,561	1,956	0	0	0	\$ 10,517
7 IBM Japan, Ltd.	7,365	0	0	0	0	\$ 7,365
8 Nippondenso Co., Ltd.	0	0	0	105	6,692	\$ 6,797
9 Sony Corporation	0	0	0	5,959	0	\$ 5,959
10 Sanyo Electric Co., Ltd.	379	0	952	3,606	0	\$ 4,937
11 Sharp Corporation	1,051	0	0	3,829	0	\$ 4,880
12 Canon Inc.	2,996	40	141	840	0	\$ 4,017
13 Victor Company of Japan Limited	0	0	0	3,626	0	\$ 3,626
14 Ricoh Company, Ltd.	2,471	500	0	215	0	\$ 3,186
15 Matsushita Electric Works Ltd.	0	0	0	2,631	0	\$ 2,631
16 Matsushita Communication Industrial Co., Ltd.	623	1,097	0	0	621	\$ 2,341
17 Oki Electric Industry Co., Ltd.	1,320	859	0	0	0	\$ 2,179
18 Pioneer Electronic Corporation	0	0	0	1,160	622	\$ 1,782
19 Casio Computer Co., Ltd.	755	0	0	712	0	\$ 1,466
20 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	1,454	0	\$ 1,454
21 Minolta Camera Co., Ltd.	673	0	0	694	0	\$ 1,368
22 Omron Tateisi Electronics Co.	67	0	1,176	0	0	\$ 1,243
23 Daikin Industries, Ltd.	0	0	1,084	0	0	\$ 1,084
24 Fuji Electric Co., Ltd.	0	0	765	0	0	\$ 765
25 Kyocera Corporation	233	100	0	189	0	\$ 522
Total (25 Companies)	\$45,023	\$15,575	\$19,315	\$50,031	\$12,842	\$142,785
Exchange Rate (Yen/US\$): 144.0						

Source: Dataquest  
March 1989



# Application Market Revenue

**Table 7**

**Estimated Fiscal 1986 Company Electronics Revenue  
by Semiconductor Application Market  
(Billions of Yen)**

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	¥ 702	¥ 110	¥ 645	¥ 580	¥ 303	¥ 2,540
2 Matsushita Electric Industrial Co., Ltd.	253	126	253	1,754	0	¥ 2,386
3 Toshiba Corporation	341	339	391	762	260	¥ 2,093
4 NEC Corporation	920	684	0	137	0	¥ 1,741
5 Mitsubishi Electric Corporation	152	189	674	481	132	¥ 1,628
6 Fujitsu Limited	1,077	238	0	0	0	¥ 1,315
7 Nippondenso Co., Ltd.	0	0	0	12	940	¥ 953
8 Sony Corporation	0	0	0	899	0	¥ 899
9 IBM Japan, Ltd.	879	0	0	0	0	¥ 879
10 Sanyo Electric Co., Ltd.	0	0	162	616	0	¥ 778
11 Sharp Corporation	145	0	0	579	0	¥ 724
12 Victor Company of Japan Limited	0	0	0	541	0	¥ 541
13 Canon Inc.	394	6	23	117	0	¥ 539
14 Ricoh Company, Ltd.	315	57	0	26	0	¥ 398
15 Matsushita Electric Works Ltd.	0	0	0	352	0	¥ 352
16 Matsushita Communication Industrial Co., Ltd.	75	97	0	0	91	¥ 317
17 Oki Electric Industry Co., Ltd.	184	102	0	0	0	¥ 286
18 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	285	0	¥ 285
19 Pioneer Electronic Corporation	0	0	0	169	90	¥ 259
20 Minolta Camera Co., Ltd.	85	0	0	126	0	¥ 211
21 Casio Computer Co., Ltd.	106	0	0	97	0	¥ 203
22 Omron Tateisi Electronics Co.	9	0	157	0	0	¥ 167
23 Daikin Industries, Ltd.	0	0	143	0	0	¥ 143
24 Fuji Electric Co., Ltd.	0	0	100	0	0	¥ 100
25 Kyocera Corporation	25	17	0	25	0	¥ 66
Total (25 Companies)	¥5,661	¥2,019	¥2,748	¥7,559	¥1,816	¥19,804
Exchange Rate (Yen/US\$): 167.0						

Source: Dataquest  
March 1989

# Application Market Revenue

**Table 8**

**Estimated Fiscal 1986 Company Electronics Revenue  
by Semiconductor Application Market  
(Millions of Dollars)**

<u>Company</u>	<u>Data</u>					<u>Total</u>
	<u>Processing</u>	<u>Communications</u>	<u>Industrial</u>	<u>Consumer</u>	<u>Transportation</u>	
1 Hitachi, Ltd.	\$ 4,204	\$ 659	\$ 5,061	\$ 3,470	\$ 1,814	\$ 15,207
2 Matsushita Electric Industrial Co., Ltd.	1,514	754	1,515	10,504	0	\$ 14,288
3 Toshiba Corporation	2,042	2,032	2,339	4,565	1,557	\$ 12,535
4 NEC Corporation	5,507	4,097	0	819	0	\$ 10,423
5 Mitsubishi Electric Corporation	910	1,133	4,034	2,881	788	\$ 9,746
6 Fujitsu Limited	6,449	1,423	0	0	0	\$ 7,873
7 Nippondenso Co., Ltd.	0	0	0	73	5,631	\$ 5,704
8 Sony Corporation	0	0	0	5,382	0	\$ 5,382
9 IBM Japan, Ltd.	5,260	0	0	0	0	\$ 5,260
10 Sanyo Electric Co., Ltd.	0	0	969	3,691	0	\$ 4,659
11 Sharp Corporation	866	0	0	3,467	0	\$ 4,333
12 Victor Company of Japan Limited	0	0	0	3,242	0	\$ 3,242
13 Canon Inc.	2,358	37	136	698	0	\$ 3,229
14 Ricoh Company, Ltd.	1,887	339	0	155	0	\$ 2,382
15 Matsushita Electric Works Ltd.	0	0	0	2,110	0	\$ 2,110
16 Matsushita Communication Industrial Co., Ltd.	447	907	0	0	546	\$ 1,900
17 Oki Electric Industry Co., Ltd.	1,104	609	0	0	0	\$ 1,714
18 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	1,710	0	\$ 1,710
19 Pioneer Electronic Corporation	0	0	0	1,012	541	\$ 1,553
20 Minolta Camera Co., Ltd.	508	0	0	757	0	\$ 1,265
21 Casio Computer Co., Ltd.	635	0	0	582	0	\$ 1,217
22 Omron Tateisi Electronics Co.	56	0	943	0	0	\$ 998
23 Daikin Industries, Ltd.	0	0	859	0	0	\$ 859
24 Fuji Electric Co., Ltd.	0	0	601	0	0	\$ 601
25 Kyocera Corporation	149	99	0	147	0	\$ 395
<b>Total (25 Companies)</b>	<b>\$33,896</b>	<b>\$12,091</b>	<b>\$16,456</b>	<b>\$45,266</b>	<b>\$10,875</b>	<b>\$118,585</b>

Exchange Rate  
(Yen/US\$): 167.0

Source: Dataquest  
March 1989

# Application Market Revenue

Table 9

## Estimated Fiscal 1985 Company Electronics Revenue by Semiconductor Application Market (Billions of Yen)

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Matsushita Electric Industrial Co., Ltd.	¥ 263	¥ 131	¥ 263	¥2,009	0	¥ 2,666
2 Hitachi, Ltd.	600	91	901	713	¥ 308	¥ 2,613
3 Toshiba Corporation	293	233	482	830	322	¥ 2,160
4 Mitsubishi Electric Corporation	165	138	717	497	139	¥ 1,656
5 NEC Corporation	771	684	0	142	0	¥ 1,597
6 Fujitsu Limited	1,028	225	0	0	0	¥ 1,253
7 Sanyo Electric Co., Ltd.	0	0	167	815	0	¥ 982
8 Sony Corporation	0	0	0	944	0	¥ 944
9 IBM Japan, Ltd.	915	0	0	0	0	¥ 915
10 Nippondenso Co., Ltd.	0	0	0	13	883	¥ 896
11 Sharp Corporation	166	0	0	644	0	¥ 810
12 Canon Inc.	401	0	35	135	0	¥ 571
13 Victor Company of Japan Limited	0	0	0	555	0	¥ 555
14 Ricoh Company, Ltd.	317	63	0	28	0	¥ 407
15 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	374	0	¥ 374
16 Matsushita Electric Works Ltd.	0	0	0	339	0	¥ 339
17 Matsushita Communication Industrial Co., Ltd.	64	152	0	0	84	¥ 301
18 Oki Electric Industry Co., Ltd.	197	92	0	0	0	¥ 289
19 Pioneer Electronic Corporation	0	0	0	153	98	¥ 251
20 Casio Computer Co., Ltd.	141	0	0	95	0	¥ 236
21 Minolta Camera Co., Ltd.	83	0	0	116	0	¥ 199
22 Omron Tateisi Electronics Co.	8	0	158	0	0	¥ 166
23 Daikin Industries, Ltd.	0	0	139	0	0	¥ 139
24 Fuji Electric Co., Ltd.	0	0	131	0	0	¥ 131
25 Kyocera Corporation	19	19	0	26	0	¥ 64
Total (25 Companies)	¥5,431	¥1,827	¥2,993	¥8,427	¥1,834	¥20,513
Exchange Rate (Yen/US\$): 238.0						

Source: Dataquest  
March 1989

# Application Market Revenue

Table 10

## Estimated Fiscal 1985 Company Electronics Revenue by Semiconductor Application Market (Millions of Dollars)

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Matsushita Electric Industrial Co., Ltd.	\$ 1,103	\$ 550	\$ 1,105	\$ 8,443	0	\$ 11,202
2 Hitachi, Ltd.	2,521	383	3,787	2,997	\$ 1,294	\$ 10,981
3 Toshiba Corporation	1,231	978	2,026	3,486	1,353	\$ 9,074
4 Mitsubishi Electric Corporation	693	581	3,014	2,087	583	\$ 6,958
5 NEC Corporation	3,240	2,873	0	597	0	\$ 6,710
6 Fujitsu Limited	4,320	945	0	0	0	\$ 5,265
7 Sanyo Electric Co., Ltd.	0	0	700	3,425	0	\$ 4,124
8 Sony Corporation	0	0	0	3,965	0	\$ 3,965
9 IBM Japan, Ltd.	3,842	0	0	0	0	\$ 3,842
10 Nippondenso Co., Ltd.	0	0	0	54	3,710	\$ 3,764
11 Sharp Corporation	699	0	0	2,705	0	\$ 3,404
12 Canon Inc.	1,685	0	146	569	0	\$ 2,400
13 Victor Company of Japan Limited	0	0	0	2,332	0	\$ 2,332
14 Ricoh Company, Ltd.	1,330	263	0	118	0	\$ 1,711
15 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	1,570	0	\$ 1,570
16 Matsushita Electric Works Ltd.	0	0	0	1,426	0	\$ 1,426
17 Matsushita Communication Industrial Co., Ltd.	271	640	0	0	354	\$ 1,265
18 Oki Electric Industry Co., Ltd.	829	385	0	0	0	\$ 1,214
19 Pioneer Electronic Corporation	0	0	0	641	414	\$ 1,055
20 Casio Computer Co., Ltd.	594	0	0	398	0	\$ 992
21 Minolta Camera Co., Ltd.	348	0	0	487	0	\$ 835
22 Omron Tateisi Electronics Co.	32	0	665	0	0	\$ 696
23 Daikin Industries, Ltd.	0	0	585	0	0	\$ 585
24 Fuji Electric Co., Ltd.	0	0	549	0	0	\$ 549
25 Kyocera Corporation	81	81	0	108	0	\$ 270
Total (25 Companies)	\$22,820	\$7,678	\$12,576	\$35,407	\$7,708	\$86,190
Exchange Rate (Yen/US\$): 238.0						

Source: Dataquest  
March 1989

# Application Market Revenue

Table 11

## Estimated Fiscal 1984 Company Electronics Revenue by Semiconductor Application Market (Billions of Yen)

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Matsushita Electric Industrial Co., Ltd.	¥ 245	¥ 123	¥ 246	¥1,902	0	¥ 2,515
2 Hitachi, Ltd.	532	97	839	723	¥ 295	¥ 2,486
3 Toshiba Corporation	232	228	536	739	357	¥ 2,091
4 Mitsubishi Electric Corporation	165	150	702	478	127	¥ 1,622
5 NEC Corporation	637	614	0	130	0	¥ 1,382
6 Fujitsu Limited	857	180	0	0	0	¥ 1,037
7 Sanyo Electric Co., Ltd.	0	0	80	839	0	¥ 919
8 Sony Corporation	0	0	0	812	0	¥ 812
9 Nippondenso Co., Ltd.	0	0	0	10	769	¥ 779
10 IBM Japan, Ltd.	769	0	0	0	0	¥ 769
11 Sharp Corporation	169	0	0	599	0	¥ 769
12 Victor Company of Japan Limited	0	0	0	620	0	¥ 620
13 Canon Inc.	300	0	35	152	0	¥ 487
14 Ricoh Company, Ltd.	292	51	0	24	0	¥ 367
15 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	336	0	¥ 336
16 Matsushita Electric Works Ltd.	0	0	0	321	0	¥ 321
17 Matsushita Communication Industrial Co., Ltd.	70	140	0	0	81	¥ 291
18 Oki Electric Industry Co., Ltd.	185	91	0	0	0	¥ 276
19 Pioneer Electronic Corporation	0	0	0	140	96	¥ 236
20 Casio Computer Co., Ltd.	123	0	0	87	0	¥ 210
21 Omron Tateisi Electronics Co.	6	0	182	0	0	¥ 188
22 Minolta Camera Co., Ltd.	80	0	0	70	0	¥ 150
23 Daikin Industries, Ltd.	0	0	124	0	0	¥ 124
24 Fuji Electric Co., Ltd.	0	0	110	0	0	¥ 110
25 Kyocera Corporation	12	19	0	27	0	¥ 58
Total (25 Companies)	¥4,677	¥1,692	¥2,854	¥8,009	¥1,726	¥18,957
Exchange Rate (Yen/US\$):	237.0					

Source: Dataquest  
March 1989

# Application Market Revenue

**Table 12**

**Estimated Fiscal 1984 Company Electronics Revenue  
by Semiconductor Application Market  
(Millions of Dollars)**

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Matsushita Electric Industrial Co., Ltd.	\$ 1,035	\$ 518	\$ 1,036	\$ 8,024	0	\$10,613
2 Hitachi, Ltd.	2,245	408	3,539	3,050	\$1,247	\$10,488
3 Toshiba Corporation	977	961	2,260	3,119	1,506	\$ 8,823
4 Mitsubishi Electric Corporation	696	635	2,961	2,015	538	\$ 6,845
5 NEC Corporation	2,689	2,591	0	550	0	\$ 5,830
6 Fujitsu Limited	3,618	759	0	0	0	\$ 4,376
7 Sanyo Electric Co., Ltd.	0	0	337	3,541	0	\$ 3,878
8 Sony Corporation	0	0	0	3,425	0	\$ 3,425
9 Nippondenso Co., Ltd.	0	0	0	43	3,244	\$ 3,287
10 IBM Japan, Ltd.	3,243	0	0	0	0	\$ 3,243
11 Sharp Corporation	714	0	0	2,528	0	\$ 3,243
12 Victor Company of Japan Limited	0	0	0	2,618	0	\$ 2,618
13 Canon Inc.	1,268	0	150	639	0	\$ 2,057
14 Ricoh Company, Ltd.	1,234	214	0	99	0	\$ 1,547
15 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	1,417	0	\$ 1,417
16 Matsushita Electric Works Ltd.	0	0	0	1,355	0	\$ 1,355
17 Matsushita Communication Industrial Co., Ltd.	295	591	0	0	341	\$ 1,227
18 Oki Electric Industry Co., Ltd.	781	385	0	0	0	\$ 1,166
19 Pioneer Electronic Corporation	0	0	0	592	405	\$ 997
20 Casio Computer Co., Ltd.	521	0	0	366	0	\$ 887
21 Omron Tateisi Electronics Co.	26	0	770	0	0	\$ 795
22 Minolta Camera Co., Ltd.	339	0	0	295	0	\$ 635
23 Daikin Industries, Ltd.	0	0	525	0	0	\$ 525
24 Fuji Electric Co., Ltd.	0	0	465	0	0	\$ 465
25 Kyocera Corporation	52	78	0	116	0	\$ 246
Total (25 Companies)	\$19,733	\$7,138	\$12,042	\$33,794	\$7,281	\$79,987
Exchange Rate (Yen/US\$): 237.0						

Source: Dataquest  
March 1989

# Application Market Revenue

Table 13

## Estimated Fiscal 1983 Company Electronics Revenue by Semiconductor Application Market (Billions of Yen)

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	¥ 443	¥ 99	¥ 869	¥ 605	¥ 272	¥ 2,288
2 Matsushita Electric Industrial Co., Ltd.	189	95	190	1,630	0	¥ 2,104
3 Toshiba Corporation	183	242	412	634	275	¥ 1,746
4 Mitsubishi Electric Corporation	130	129	658	420	111	¥ 1,448
5 NEC Corporation	488	524	0	102	0	¥ 1,114
6 Fujitsu Limited	661	158	0	0	0	¥ 819
7 Sanyo Electric Co., Ltd.	0	0	70	677	0	¥ 747
8 Sony Corporation	0	0	0	701	0	¥ 701
9 Nippondenso Co., Ltd.	0	0	0	8	673	¥ 681
10 Sharp Corporation	153	0	0	490	0	¥ 643
11 IBM Japan, Ltd.	612	0	0	0	0	¥ 612
12 Victor Company of Japan Limited	0	0	0	527	0	¥ 527
13 Canon Inc.	208	0	21	145	0	¥ 374
14 Ricoh Company, Ltd.	261	37	0	16	0	¥ 314
15 Matsushita Electric Works Ltd.	0	0	0	314	0	¥ 314
16 Matsushita Communication Industrial Co., Ltd.	52	128	0	0	70	¥ 251
17 Oki Electric Industry Co., Ltd.	165	72	0	0	0	¥ 237
18 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	226	0	¥ 226
19 Pioneer Electronic Corporation	0	0	0	137	89	¥ 226
20 Casio Computer Co., Ltd.	104	0	0	72	0	¥ 176
21 Omron Tateisi Electronics Co.	3	0	141	0	0	¥ 144
22 Minolta Camera Co., Ltd.	65	0	0	69	0	¥ 133
23 Daikin Industries, Ltd.	0	0	109	0	0	¥ 109
24 Fuji Electric Co., Ltd.	0	0	108	0	0	¥ 108
25 Kyocera Corporation	14	34	0	12	0	¥ 60
Total (25 Companies)	¥3,732	¥1,517	¥2,576	¥6,784	¥1,491	¥16,100
Exchange Rate (Yen/US\$): 235.0						

Source: Dataquest  
March 1989

# Application Market Revenue

Table 14

**Estimated Fiscal 1983 Company Electronics Revenue  
by Semiconductor Application Market  
(Millions of Dollars)**

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	\$ 1,885	\$ 422	\$ 3,697	\$ 2,576	\$1,157	\$ 9,737
2 Matsushita Electric Industrial Co., Ltd.	805	403	809	6,937	0	\$ 8,954
3 Toshiba Corporation	779	1,029	1,752	2,699	1,170	\$ 7,429
4 Mitsubishi Electric Corporation	553	548	2,800	1,786	473	\$ 6,160
5 NEC Corporation	2,077	2,230	0	433	0	\$ 4,740
6 Fujitsu Limited	2,814	671	0	0	0	\$ 3,485
7 Sanyo Electric Co., Ltd.	0	0	297	2,881	0	\$ 3,177
8 Sony Corporation	0	0	0	2,984	0	\$ 2,984
9 Nippondenso Co., Ltd.	0	0	0	33	2,865	\$ 2,898
10 Sharp Corporation	650	0	0	2,084	0	\$ 2,734
11 IBM Japan, Ltd.	2,604	0	0	0	0	\$ 2,604
12 Victor Company of Japan Limited	0	0	0	2,241	0	\$ 2,241
13 Canon Inc.	883	0	90	618	0	\$ 1,590
14 Ricoh Company, Ltd.	1,112	158	0	68	0	\$ 1,338
15 Matsushita Electric Works Ltd.	0	0	0	1,335	0	\$ 1,335
16 Matsushita Communication Industrial Co., Ltd.	223	545	0	0	299	\$ 1,067
17 Oki Electric Industry Co., Ltd.	701	307	0	0	0	\$ 1,008
18 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	962	0	\$ 962
19 Pioneer Electronic Corporation	0	0	0	582	380	\$ 962
20 Casio Computer Co., Ltd.	443	0	0	308	0	\$ 751
21 Omron Tateisi Electronics Co.	14	0	599	0	0	\$ 613
22 Minolta Camera Co., Ltd.	275	0	0	293	0	\$ 567
23 Daikin Industries, Ltd.	0	0	462	0	0	\$ 462
24 Fuji Electric Co., Ltd.	0	0	459	0	0	\$ 459
25 Kyocera Corporation	61	143	0	49	0	\$ 254
Total (25 Companies)	\$15,880	\$6,455	\$10,963	\$28,868	\$6,345	\$68,512
Exchange Rate (Yen/US\$): 235.0						

Source: Dataquest  
March 1989



# Application Market Revenue

Table 15

Estimated Revenue for Data Processing Segment  
(Billions of Yen)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Fujitsu Limited	¥ 661	¥ 874	¥1,028	¥1,077	¥1,233
2 IBM Japan, Ltd.	612	769	915	879	1,061
3 NEC Corporation	488	637	771	920	1,037
4 Hitachi, Ltd.	443	532	600	702	804
5 Canon Inc.	208	300	401	394	431
6 Toshiba Corporation	183	232	293	341	382
7 Ricoh Company, Ltd.	261	292	317	315	356
8 Matsushita Electric Industrial Co., Ltd.	189	245	263	253	279
9 Oki Electric Industry Co., Ltd.	165	185	197	184	190
10 Mitsubishi Electric Corporation	130	165	165	152	166
11 Sharp Corporation	153	169	166	145	151
12 Casio Computer Co., Ltd.	104	123	141	106	109
13 Minolta Camera Co., Ltd.	65	80	83	85	97
14 Matsushita Communication Industrial Co., Ltd.	52	70	64	75	90
15 Sanyo Electric Co., Ltd.	0	0	0	0	55
16 Kyocera Corporation	14	12	19	25	34
17 Omron Tateisi Electronics Co.	3	6	8	9	10
18 Victor Company of Japan Limited	0	0	0	0	0
19 Sony Corporation	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
22 Pioneer Electronic Corporation	0	0	0	0	0
23 Matsushita Electric Works Ltd.	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Nippondenso Co., Ltd.	0	0	0	0	0
<b>Total</b>	<b>¥3,732</b>	<b>¥4,677</b>	<b>¥5,431</b>	<b>¥5,661</b>	<b>¥6,483</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 16

Estimated Revenue for Data Processing Segment  
(Millions of Dollars)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Fujitsu Limited	\$ 2,814	\$ 3,618	\$ 4,320	\$ 6,449	\$ 8,561
2 IBM Japan, Ltd.	2,605	3,243	3,842	5,260	7,365
3 NEC Corporation	2,077	2,689	3,240	5,507	7,199
4 Hitachi, Ltd.	1,885	2,245	2,521	4,204	5,583
5 Canon Inc.	883	1,268	1,685	2,358	2,996
6 Toshiba Corporation	779	977	1,231	2,042	2,653
7 Ricoh Company, Ltd.	1,112	1,234	1,330	1,887	2,471
8 Matsushita Electric Industrial Co., Ltd.	805	1,035	1,103	1,514	1,940
9 Oki Electric Industry Co., Ltd.	701	781	829	1,104	1,320
10 Mitsubishi Electric Corporation	553	696	693	910	1,153
11 Sharp Corporation	650	714	699	866	1,051
12 Minolta Camera Co., Ltd.	275	339	348	508	673
13 Matsushita Communication Industrial Co., Ltd.	223	295	271	447	623
14 Casio Computer Co., Ltd.	443	525	602	451	462
15 Sanyo Electric Co., Ltd.	0	0	0	0	379
16 Kyocera Corporation	61	52	81	149	233
17 Omron Tateisi Elec- tronics Co.	14	26	32	56	67
18 Victor Company of Japan Limited	0	0	0	0	0
19 Sony Corporation	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
22 Pioneer Electronic Corporation	0	0	0	0	0
23 Matsushita Electric Works Ltd.	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Nippondenso Co., Ltd.	0	0	0	0	0
<b>Total</b>	<b>\$15,881</b>	<b>\$19,737</b>	<b>\$22,828</b>	<b>\$33,713</b>	<b>\$44,730</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 17

Estimated Revenue for Communications Segment  
(Billions of Yen)

Company	1983	1984	1985	1986	1987
1 NEC Corporation	¥ 524	¥ 614	¥ 684	¥ 684	¥ 722
2 Toshiba Corporation	242	228	233	339	392
3 Fujitsu Limited	158	180	225	238	282
4 Mitsubishi Electric Corporation	129	150	138	189	213
5 Matsushita Communication Industrial Co., Ltd.	128	140	152	151	158
6 Sharp Corporation	153	169	166	145	151
7 Hitachi, Ltd.	99	97	91	110	130
8 Matsushita Electric Industrial Co., Ltd.	95	123	131	126	130
9 Oki Electric Industry Co., Ltd.	72	91	92	102	124
10 Ricoh Company, Ltd.	37	51	63	57	72
11 Sanyo Electric Co., Ltd.	0	0	0	0	55
12 Kyocera Corporation	34	19	19	17	14
13 Canon Inc.	0	0	0	6	6
14 Daikin Industries, Ltd.	0	0	0	0	0
15 Victor Company of Japan Limited	0	0	0	0	0
16 Matsushita Electric Works Ltd.	0	0	0	0	0
17 Minolta Camera Co., Ltd.	0	0	0	0	0
18 Casio Computer Co., Ltd.	0	0	0	0	0
19 Omron Tateisi Electronics Co.	0	0	0	0	0
20 Nippondenso Co., Ltd.	0	0	0	0	0
21 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
22 Pioneer Electronic Corporation	0	0	0	0	0
23 Sony Corporation	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 IBM Japan, Ltd.	0	0	0	0	0
Total	¥1,670	¥1,861	¥1,994	¥2,164	¥2,449
Exchange Rate (Yen/US\$)	235	237	238	167	144

Source: Dataquest  
March 1989

# Application Market Revenue

Table 18

Estimated Revenue for Communications Segment  
(Millions of Dollars)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 NEC Corporation	\$2,230	\$2,591	\$2,873	\$ 4,097	\$ 5,016
2 Toshiba Corporation	1,029	961	978	2,032	2,719
3 Fujitsu Limited	671	759	945	1,423	1,956
4 Mitsubishi Electric Corporation	548	635	581	1,133	1,482
5 Matsushita Communication Industrial Co., Ltd.	545	596	640	907	1,097
6 Sharp Corporation	650	714	699	866	1,051
7 Hitachi Ltd.	422	408	383	659	903
8 Matsushita Electric Industrial Co., Ltd.	403	518	550	754	903
9 Oki Electric Industry Co., Ltd.	307	385	385	609	859
10 Ricoh Company, Ltd.	158	214	263	339	500
11 Sanyo Electric Co., Ltd.	0	0	0	0	379
12 Kyocera Corporation	143	78	81	99	100
13 Canon Inc.	0	0	0	37	40
14 Daikin Industries, Ltd.	0	0	0	0	0
15 Victor Company of Japan Limited	0	0	0	0	0
16 Matsushita Electric Works Ltd.	0	0	0	0	0
17 Minolta Camera Co., Ltd.	0	0	0	0	0
18 Casio Computer Co., Ltd.	0	0	0	0	0
19 Omron Tateisi Electronics Co.	0	0	0	0	0
20 Nippondenso Co., Ltd.	0	0	0	0	0
21 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
22 Pioneer Electronic Corporation	0	0	0	0	0
23 Sony Corporation	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 IBM Japan, Ltd.	0	0	0	0	0
<b>Total</b>	<b>\$7,105</b>	<b>\$7,857</b>	<b>\$8,378</b>	<b>\$12,957</b>	<b>\$17,004</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 19

Estimated Revenue for Consumers Segment  
(Billions of Yen)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Matsushita Electric Industrial Co., Ltd.	¥1,630	¥1,902	¥2,009	¥1,754	¥1,735
2 Sony Corporation	701	812	944	899	858
3 Toshiba Corporation	634	739	830	762	758
4 Sharp Corporation	490	599	644	579	551
5 Hitachi, Ltd.	605	723	713	580	527
6 Victor Company of Japan Limited	527	620	555	541	522
7 Sanyo Electric Co., Ltd.	677	839	815	616	519
8 Mitsubishi Electric Corporation	420	478	497	481	469
9 Matsushita Electric Works Ltd.	314	321	339	352	379
10 Matsushita Kotobuki Electronics Industries Ltd.	226	336	374	285	209
11 Pioneer Electronic Corporation	137	140	153	169	167
12 Canon Inc.	145	152	135	117	121
13 NEC Corporation	102	130	142	137	112
14 Casio Computer Co., Ltd.	72	87	95	97	102
15 Minolta Camera Co., Ltd.	69	70	116	126	100
16 Ricoh Company, Ltd.	16	24	28	26	31
17 Kyocera Corporation	12	27	26	25	27
18 Nippondenso Co., Ltd.	8	10	13	12	15
19 Matsushita Communication Industrial Co., Ltd.	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Oki Electric Industry Co., Ltd.	0	0	0	0	0
22 Omron Tateisi Electronics Co.	0	0	0	0	0
23 IBM Japan, Ltd.	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Fujitsu Limited	0	0	0	0	0
<b>Total</b>	<b>¥6,784</b>	<b>¥8,009</b>	<b>¥8,427</b>	<b>¥7,559</b>	<b>¥7,205</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

**Table 20**  
**Estimated Revenue for Consumers Segment**  
**(Millions of Dollars)**

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Matsushita Electric Industrial Co., Ltd.	\$ 6,937	\$ 8,024	\$ 8,443	\$10,504	\$12,048
2 Sony Corporation	2,984	3,425	3,965	5,382	5,959
3 Toshiba Corporation	2,699	3,119	3,486	4,565	5,264
4 Sharp Corporation	2,084	2,528	2,705	3,467	3,829
5 Hitachi, Ltd.	2,576	3,050	2,997	3,470	3,662
6 Victor Company of Japan Limited	2,241	2,618	2,332	3,242	3,626
7 Sanyo Electric Co., Ltd.	2,881	3,541	3,425	3,691	3,606
8 Mitsubishi Electric Corporation	1,786	2,015	2,087	2,881	3,259
9 Matsushita Electric Works Ltd.	1,335	1,355	1,426	2,110	2,631
10 Matsushita Kotobuki Electronics Industries Ltd.	962	1,417	1,570	1,710	1,454
11 Pioneer Electronic Corporation	582	592	641	1,012	1,160
12 Canon Inc.	618	639	569	698	840
13 NEC Corporation	433	550	597	819	778
14 Casio Computer Co., Ltd.	308	366	398	582	712
15 Minolta Camera Co., Ltd.	293	295	487	757	694
16 Ricoh Company, Ltd.	68	99	118	155	215
17 Kyocera Corporation	49	116	108	147	189
18 Nippondenso Co., Ltd.	33	43	54	73	105
19 Matsushita Communication Industrial Co., Ltd.	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Oki Electric Industry Co., Ltd.	0	0	0	0	0
22 Omron Tateisi Electronics Co.	0	0	0	0	0
23 IBM Japan, Ltd.	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Fujitsu Limited	0	0	0	0	0
<b>Total</b>	<b>\$28,868</b>	<b>\$33,794</b>	<b>\$35,407</b>	<b>\$45,266</b>	<b>\$50,031</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 21

Estimated Revenue for Industry Segment  
(Billions of Yen)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Hitachi, Ltd.	¥ 869	¥ 839	¥ 901	¥ 845	¥ 755
2 Mitsubishi Electric Corporation	658	702	717	674	745
3 Toshiba Corporation	412	536	482	391	409
4 Matsushita Electric Industrial Co., Ltd.	190	246	263	253	280
5 Omron Tateisi Electronics Co.	141	182	158	157	169
6 Daikin Industries, Ltd.	109	124	139	143	156
7 Sanyo Electric Co., Ltd.	70	80	167	162	137
8 Fuji Electric Co., Ltd.	108	110	131	100	110
9 Canon Inc.	21	35	35	23	20
10 Victor Company of Japan Limited	0	0	0	0	0
11 Pioneer Electronic Corporation	0	0	0	0	0
12 Casio Computer Co., Ltd.	0	0	0	0	0
13 Sony Corporation	0	0	0	0	0
14 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
15 Ricoh Company, Ltd.	0	0	0	0	0
16 Minolta Camera Co., Ltd.	0	0	0	0	0
17 Matsushita Communication Industrial Co., Ltd.	0	0	0	0	0
18 IBM Japan, Ltd.	0	0	0	0	0
19 Sharp Corporation	0	0	0	0	0
20 Fujitsu Limited	0	0	0	0	0
21 Matsushita Electric Works Ltd.	0	0	0	0	0
22 Nippondenso Co., Ltd.	0	0	0	0	0
23 Oki Electric Industry Co., Ltd.	0	0	0	0	0
24 NEC Corporation	0	0	0	0	0
25 Kyocera Corporation	0	0	0	0	0
<b>Total</b>	<b>¥2,576</b>	<b>¥2,854</b>	<b>¥2,993</b>	<b>¥2,748</b>	<b>¥2,781</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 22

Estimated Revenue for Industry Segment  
(Millions of Dollars)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Hitachi, Ltd.	\$ 3,697	\$ 3,539	\$ 3,787	\$ 5,061	\$ 5,244
2 Mitsubishi Electric Corporation	2,800	2,961	3,014	4,034	5,171
3 Toshiba Corporation	1,752	2,260	2,026	2,339	2,838
4 Matsushita Electric Industrial Co., Ltd.	809	1,036	1,105	1,515	1,944
5 Omron Tateisi Electronics Co.	599	770	665	943	1,176
6 Daikin Industries, Ltd.	462	525	585	859	1,084
7 Sanyo Electric Co., Ltd.	297	337	700	969	952
8 Fuji Electric Co., Ltd.	459	465	549	601	765
9 Canon Inc.	90	150	146	136	141
10 Sony Corporation	0	0	0	0	0
11 IBM Japan, Ltd.	0	0	0	0	0
12 Sharp Corporation	0	0	0	0	0
13 Casio Computer Co., Ltd.	0	0	0	0	0
14 Fujitsu Limited	0	0	0	0	0
15 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
16 Matsushita Electric Works Ltd.	0	0	0	0	0
17 Minolta Camera Co., Ltd.	0	0	0	0	0
18 Nippondenso Co., Ltd.	0	0	0	0	0
19 Pioneer Electronic Corporation	0	0	0	0	0
20 Oki Electric Industry Co., Ltd.	0	0	0	0	0
21 Ricoh Company, Ltd.	0	0	0	0	0
22 Victor Company of Japan Limited	0	0	0	0	0
23 Matsushita Communication Industrial Co., Ltd.	0	0	0	0	0
24 NEC Corporation	0	0	0	0	0
25 Kyocera Corporation	0	0	0	0	0
<b>Total</b>	<b>\$10,963</b>	<b>\$12,042</b>	<b>\$12,576</b>	<b>\$16,456</b>	<b>\$19,315</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989



# Application Market Revenue

Table 23

Estimated Revenue for Transportation Segment  
(Billions of Yen)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Nippondenso Co., Ltd.	¥ 673	¥ 769	¥ 883	¥ 940	¥ 964
2 Hitachi, Ltd.	272	295	308	303	293
3 Toshiba Corporation	275	357	322	260	273
4 Mitsubishi Electric Corporation	138	159	173	164	176
5 Pioneer Electronic Corporation	89	96	98	90	90
6 Matsushita Communication Industrial Co., Ltd.	70	81	84	91	89
7 Victor Company of Japan Limited	0	0	0	0	0
8 Oki Electric Industry Co., Ltd.	0	0	0	0	0
9 IBM Japan, Ltd.	0	0	0	0	0
10 Matsushita Electric Industrial Co., Ltd.	0	0	0	0	0
11 Sanyo Electric Co., Ltd.	0	0	0	0	0
12 Casio Computer Co., Ltd.	0	0	0	0	0
13 Canon Inc.	0	0	0	0	0
14 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
15 Ricoh Company, Ltd.	0	0	0	0	0
16 Minolta Camera Co., Ltd.	0	0	0	0	0
17 NEC Corporation	0	0	0	0	0
18 Omron Tateisi Electronics Co.	0	0	0	0	0
19 Sharp Corporation	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Matsushita Electric Works Ltd.	0	0	0	0	0
22 Fujitsu Limited	0	0	0	0	0
23 Sony Corporation	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Kyocera Corporation	0	0	0	0	0
<b>Total</b>	<b>¥1,518</b>	<b>¥1,758</b>	<b>¥1,869</b>	<b>¥1,849</b>	<b>¥1,885</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 24

Estimated Revenue for Transportation Segment  
(Millions of Dollars)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Nippondenso Co., Ltd.	\$2,865	\$3,244	\$3,710	\$ 5,631	\$ 6,692
2 Hitachi, Ltd.	1,157	1,247	1,294	1,814	2,036
3 Toshiba Corporation	1,170	1,506	1,353	1,557	1,892
4 Mitsubishi Electric Corporation	587	673	728	985	1,225
5 Pioneer Electronic Corporation	380	405	414	541	622
6 Matsushita Communication Industrial Co., Ltd.	299	341	354	546	621
7 Victor Company of Japan Limited	0	0	0	0	0
8 Oki Electric Industry Co., Ltd.	0	0	0	0	0
9 IBM Japan, Ltd.	0	0	0	0	0
10 Matsushita Electric Industrial Co., Ltd.	0	0	0	0	0
11 Sanyo Electric Co., Ltd.	0	0	0	0	0
12 Casio Computer Co., Ltd.	0	0	0	0	0
13 Canon Inc.	0	0	0	0	0
14 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
15 Ricoh Company, Ltd.	0	0	0	0	0
16 Minolta Camera Co., Ltd.	0	0	0	0	0
17 NEC Corporation	0	0	0	0	0
18 Omron Tateisi Electronics Co.	0	0	0	0	0
19 Sharp Corporation	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Matsushita Electric Works Ltd.	0	0	0	0	0
22 Fujitsu Limited	0	0	0	0	0
23 Sony Corporation	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Kyocera Corporation	0	0	0	0	0
<b>Total</b>	<b>\$6,459</b>	<b>\$7,416</b>	<b>\$7,852</b>	<b>\$11,072</b>	<b>\$13,088</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Factory Locations Directory

## INTRODUCTION

This section lists more than 300 factory locations of the 50 Japanese companies included in the preceding "Application Market Revenue" section. The directory includes only locations of the companies and their consolidated subsidiaries. Nonconsolidated subsidiaries and locations that do not consume semiconductors have not been included.

The directory is split into two segments: "Japanese Factory Locations" and "Factory Locations Abroad." As Dataquest continues to update this list, we will be able to monitor the movement of Japanese companies away from Japan. Currently, close to 15 percent of the factory locations listed are outside of Japan.

The following list explains the abbreviations used in the directory:

- DP--Data processing
- COMM--Communications
- IND--Industrial
- CON--Consumer
- TRAN--Transportation
- LOB--Line of business

## Japanese Factory Locations

<u>#</u>	<u>Company</u>	<u>Prefecture</u>	<u>City</u>	<u>Main LOB</u>	<u>Product</u>
1	Alps Electric	Fukushima	Soma	CON	Tuners
	Alps Electric	Iwate	Morioka	DP	Printers
	Alps Electric	Kanagawa	Yokohama	DP	Data processing equipment
	Alps Electric	Miyagi	Kakuda	CON	Audio equipment
	Alps Electric	Fukushima	Iwaki	CON	Audio equipment
	Alpine*	Fukushima	Iwaki	TRAN	Car stereos
2	Tohoku Alps*	Miyagi	Furukawa	DP	Flexible disk drives
	Anritsu	Kanagawa	Atsugi	DP	Office equipment
				IND	Measuring instruments
	Brother Industries	Mizuho	Nagoya	DP	Printers
				DP	Typewriters
				DP	Sewing machines
3	Brother Industries	Aichi	Kariya	CON	Home appliances
	Canon	Fukushima	Fukushima	CON	Cameras
				CON	Video equipment
	Canon	Ibaraki	Toride	DP	Copiers
				DP	Laser printers
	Canon	Ibaraki	Ami	DP	Word processors
4				DP	PCs
				COMM	Facsimile machines
				DP	Typewriters
	Canon	Tochigi	Utsunomiya	IND	Semiconductor production equipment
	Canon Electronics*	Saitama	Chichibu	DP	Flexible disk drives
	Copyer*	Tokyo	Tachikawa	DP	Copiers
5	Copyer*	Yamanashi	Higashi Yatsushiro	DP	Copiers
	Ohita Canon*	Oita	Higashi Kunisaki	CON	Cameras
	Casio Computer	Tokyo	Higashi Yamato	CON	Watches
				CON	Musical instruments
	Casio Computer	Yamanashi	Tamao	DP	Electronic cash registers
				DP	Calculators
6	Fuji Denahi*	Shizuoka	Fujimiya	CON	Watches
				CON	Musical instruments
	Yamagata Casio*	Yamagata	Tone	DP	Office equipment
				CON	Watches
				CON	Musical instruments
				CON	Musical instruments

(Continued)

## Japanese Factory Locations (Continued)

## Factory Locations Directory

<u>#</u>	<u>Company</u>	<u>Prefecture</u>	<u>City</u>	<u>Main LOB</u>	<u>Product</u>
6	Clarion	Saitama	Toda	TRAN	Auto electronics
	Clarion	Fukushima	Koriyama	TRAN	Auto electronics
	Clarion	Tochigi	Motegi-cho	TRAN	Auto electronics
	Clarion	Gunma	Yura-cho	TRAN	Auto electronics
7	Daikin Industries	Osaka	Sakai	CON	Air conditioners
	Daikin Industries	Osaka	Osaka	CON	Air conditioners
	Daikin Industries	Shiga	Kusatsu	CON	Air conditioners
8	Fanuc	Yamanashi	Minamitsuru	IND	Robots
	Fanuc	Yamanashi	Minamitsuru	IND	Robots
9	Fuji Electric	Tokyo	Hino	DP	PCs
	Fuji Electric	Saitama	Fukiage-cho	IND	Factory automation equipment
				IND	Robots
				IND	Factory automation equipment
	Fuji Electric	Mie	Yokkaichi	IND	Vending machines
	Fuji Electric	Chiba	Ichihara	IND	Medical imaging equipment
10	Fuji Electric	Hyogo	Kobe	IND	Control systems
	Fujitsu	Tochigi	Koyama	COMM	Switches
	Fujitsu	Tochigi	Odawara	COMM	Terminal equipment
				COMM	Communications equipment
	Fujitsu	Gunma	Tatebayashi	DP	Data processing equipment
	Fujitsu	Saitama	Kumagaya	COMM	Facsimile machines
				DP	Data processing equipment
	Fujitsu	Tokyo	Inagi	DP	Terminals
	Fujitsu	Kanagawa	Kawasaki	DP	Terminals
	Fujitsu	Nagano	Nagano	DP	Terminals
	Fujitsu	Shizuoka	Numazu	DP	Computers
	Fujitsu	Hyogo	Akashi	DP	Data processing equipment
	Fujitsu Denso*	Kanagawa	Kawasaki	COMM	Communications equipment
				COMM	Communications equipment
	Fujitsu Ten*	Hyogo	Akashi	TRAN	Car audio
	Hasegawa Electric*	Yamanashi	Shirane	COMM	Telephones
	Hasegawa Electric	Tochigi	Koyama	COMM	Switches
				COMM	Telephones
	Yamagata Fujitsu*	Yamagata	Tone	COMM	Switches
				DP	Data processing equipment

(Continued)

## Japanese Factory Locations (Continued)

<u>#</u>	<u>Company</u>	<u>Prefecture</u>	<u>City</u>	<u>Main LOB</u>	<u>Product</u>
11	Fujitsu General	Kanagawa	Kawasaki	CON	Color TVs
				CON	VCRs
				CON	Refrigerators
				COMM	Communications equipment
	Fujitsu General	Shizuoka	Hamamatsu	CON	Air conditioners
	Fujitsu General	Yamagata	Shinjo	CON	Color TVs
	Fujitsu General	Iwate	Ichinoseki	DP	PCs
				DP	Word processors
	General Denko*	Osaka	Matsubara	COMM	Communications equipment
				CON	Refrigerators
12	Hitachi	Shizuoka	Shimizu	CON	Air conditioners
	Hitachi	Niigata	Nakajo	DP	Terminals
	Hitachi	Chiba	Narashino	IND	Robots
	Hitachi	Ibaraki	Katsuta	TRAN	Car air conditioners
	Hitachi	Ibaraki	Hitachi	TRAN	Auto electronics
				DP	Word processors
	Hitachi	Tochigi	Oohita-cho	CON	Washing machines
				CON	Air conditioners
	Hitachi	Gifu	Minokamo	CON	Refrigerators
	Hitachi	Ibaraki	Katsuta	CON	Color TVs
	Hitachi	Aichi	Toyokawa	CON	Tape recorders
				CON	VCRs
				CON	Video cameras
				CON	Audio equipment
	Hitachi	Kanagawa	Yokohama	DP	PCs
	Hitachi	Kanagawa	Yokohama	COMM	PBXs
	Hitachi	Kanagawa	Hatano	COMM	Facsimile machines
				DP	Computers
				DP	Disk drives
				DP	Input/output equipment
	Hitachi	Aichi	Asahi	DP	Computers
	Nippon Tsushin*	Fukushima	Koriyama	COMM	Communications equipment
13	Hitachi Koki	Ibaraki	Kazama	DP	Printers
	Hitachi Koki	Yamagata	Yamagata	DP	Printers
	Hitachi Koki Yamagata*	Yamagata	Yamagata	DP	Printers
14	IBM Japan	Kanagawa	Fujisawa	DP	Computers and related products
	IBM Japan	Shiga	Yasu	DP	Flexible disk drives
				DP	Computers

(Continued)

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
15	Japan Radio	Tokyo	Mitaka	COMM	Communications equipment
	Japan Radio	Kanagawa	Yokohama	DP	Data processing equipment
				COMM	Facsimile machines
				IND	Measuring instruments
				IND	Medical electronics
	Aloka	Tokyo	Mitaka	IND	Medical electronics
	JRC Tokki	Kanagawa	Yokohama	TRAN	Transportation electronics
16	Kenwood	Tokyo	Ohta	COMM	Radio communications equipment
	Kenwood	Tokyo	Hachioji	CON	Audio equipment
	Kenwood	Nagano	Komagane	CON	Audio equipment
	Kenwood	Kanagawa	Zama	IND	Measuring instruments
	Komagane Denshi*	Nagano	Komagane	CON	Audio equipment
	Misuzu Denshi*	Yamagata	Tsuruoka	COMM	Radio communications equipment
	Yamagata Kenwood*	Yamagata	Tsuruoka	COMM	Radio communications equipment
				CON	Audio equipment
				CON	Audio equipment
	Yorii Electronics*	Saitama	Oosato-gun	CON	Audio equipment
17	Kokusai Electric	Tokyo	Hamura	DP	Data processing equipment
				COMM	Communications equipment
	Kokusai Electric	Yamanashi	Fuji-Yoshida	DP	Data processing equipment
	Goyo Denshi Kogyo*	Akita	Tenno	IND	Industrial electronics
	Jinmeidai Kogyo*	Tokyo	Mizuho-cho	DP	Data processing equipment
18				IND	Semiconductor production equipment
	Kyocera	Hokkaido	Kitami	COMM	Communications equipment
				CON	Cameras
	Kyocera	Fukushima	Tanagura	COMM	Communications equipment
				CON	Audio equipment
	Kyocera	Mie	Tamaki	DP	Office equipment
				COMM	Communications equipment
19	Kyocera	Mie	Ise	DP	Data processing equipment
	Kyocera	Nagano	Okaya	CON	Cameras
	Kyushu Matsushita Electric	Fukuoka	Fukuoka	DP	Data processing equipment
				CON	Radios
				CON	Color TVs
	Kyushu Matsushita Electric	Saga	Tosu	DP	Office equipment
				CON	Stereos
	Kyushu Matsushita Electric	Kumamoto	Taimai	CON	Color TV assemblies
	Kyushu Matsushita Electric	Oita	Usa	DP	Data processing equipment
	Kyushu Matsushita Electric	Nagasaki	Isahaya	DP	Data processing equipment

(Continued)

## Japanese Factory Locations (Continued)

<u>#</u>	<u>Company</u>	<u>Prefecture</u>	<u>City</u>	<u>Main LOB</u>	<u>Product</u>
20	Matsushita Comm. Ind.	Kanagawa	Yokohama	DP	PCs
				DP	Word processors
				COMM	Communications equipment
				IND	Measuring instruments
	Matsushita Comm. Ind.	Kanagawa	Yokohama	COMM	Telephones
				CON	Video cameras
				TRAN	Car audio equipment
21	Matsushita Comm. Ind.	Nagano	Matsumoto	TRAN	Car audio equipment
	Matsushita Comm. Ind.	Fukushima	Shirakawa	CON	Video cameras
	Matsushita Comm. Ind.	Fukushima	Hanamaki	DP	Flexible disk drives
				DP	Rigid disk drives
				COMM	Telephones
	Matsushita Electric Ind.	Osaka	Kadoma	DP	Office equipment
				CON	Audio cassette recorders
	Matsushita Electric Ind.	Osaka	Moriguchi	CON	VCRs
				CON	Stereos
	Matsushita Electric Ind.	Osaka	Ibaraki	CON	Musical instruments
				CON	Video equipment
	Matsushita Electric Ind.	Osaka	Toyonaka	CON	Color TVs
				CON	Washing machines
	Matsushita Electric Ind.	Osaka	Osaka	CON	Other home appliances
				CON	Rice cookers
	Matsushita Electric Ind.	Miyagi	Natori	CON	Audio cassette recorders
	Matsushita Electric Ind.	Yamagata	Tendo	CON	Video equipment
	Matsushita Electric Ind.	Fukushima	Fukushima	CON	Stereos
	Matsushita Electric Ind.	Tochigi	Utsunomiya	DP	Copiers
				CON	Color TVs
	Matsushita Electric Ind.	Yamanashi	Nakakoma-gun	IND	Factory automation equipment
	Matsushita Electric Ind.	Kanagawa	Fujisawa	DP	CRT displays
				CON	Cable TV equipment
				CON	Video equipment
	Matsushita Electric Ind.	Shizuoka	Fukuroi	CON	Washing machines
	Matsushita Electric Ind.	Ishikawa	Ishikawa	CON	Video equipment
	Matsushita Electric Ind.	Shiga	Yokkaichi	CON	Home appliances
	Matsushita Electric Ind.	Shiga	Kusatsu	CON	Air conditioners
	Matsushita Electric Ind.	Okayama	Okayama	CON	Video equipment
				CON	Video equipment

(Continued)



## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
22	Matsushita Electric Works	Mie	Tsu	IND	Control equipment
				IND	Safety systems
	Matsushita Electric Works	Mie	Watarai-gun	IND	Control equipment
23	Matsushita-Kotobuki	Ehime	Saijo	CON	VCRs
				CON	Color TVs
	Matsushita-Kotobuki	Ehime	Kawauchi-cho	CON	Tape recorders
	Matsushita-Kotobuki	Tokushima	Waki-machi	CON	VCRs
	Matsushita-Kotobuki	Ehime	Ipponmatsu-machi	DP	Video cameras Rigid disk drives
24	Matsushita Refrigeration	Shiga	Kusatsu	IND	Vending machines
				CON	Refrigerators
	Matsushita Refrigeration	Osaka	Higashi-Osaka	CON	Air conditioners
	Matsushita Refrigeration	Kanagawa	Fujisawa	CON	Refrigerators
25	Matsushita Seiko	Osaka	Osaka	CON	Fan heaters
	Matsushita Seiko	Aichi	Kasugai	CON	Home appliances
	Matsushita Seiko	Kanagawa	Fujisawa	CON	Air conditioners
26	Meidensha Electric Mfg.	Shizuoka	Numazu	IND	Control systems
	Meidensha Electric Mfg.	Gunma	Ohta	IND	Control systems
27	Minolta	Aichi	Toyokawa	DP	Data processing equipment
	Minolta	Aichi	Toyokawa	DP	Copiers
	Minolta	Osaka	Sakai	CON	Cameras
	Minolta	Aichi	Toyokawa	CON	Cameras
28	Mitsubishi Electric	Aichi	Aichi	IND	Robots
				IND	NC Machines
	Mitsubishi Electric	Hyogo	Himeji	TRAN	Auto electronics
	Mitsubishi Electric	Gifu	Nakatsugawa	CON	Home appliances
	Mitsubishi Electric	Wakayama	Wakayama	CON	Air conditioners
				CON	Refrigerators
	Mitsubishi Electric	Shizuoka	Shizuoka	CON	Air conditioners
				CON	Refrigerators
	Mitsubishi Electric	Kyoto	Kyoto	CON	VCRs
				CON	Color TVs
	Mitsubishi Electric	Gunma		CON	Microwave ovens
	Mitsubishi Electric	Osaka	Anagasaki	COMM	Facsimile machines
				COMM	Other communications equipment
	SPC Electronics	Tokyo	Fuchu	IND	Industrial electronics

(Continued)

# Japanese Factory Locations (Continued)

<u>#</u>	<u>Company</u>	<u>Prefecture</u>	<u>City</u>	<u>Main LOB</u>	<u>Product</u>
29	NCR Japan	Kanagawa	Ohiso	DP	Data processing equipment
	NCR Japan	Tokyo	Tokyo	DP	Data processing equipment
30	NEC	Tokyo	Minato-ku	DP	Computers
	NEC	Kanagawa	Kawasaki	COMM	Communications equipment
	NEC	Tokyo	Fuchu	COMM	Transmission equipment
	NEC			DP	Computers
	NEC			COMM	Communications equipment
	NEC	Kanagawa	Sagamihara	COMM	PBXs
	NEC	Kanagawa	Yokohama	COMM	Radio communications systems
	NEC	Chiba	Abiko	COMM	PBXs
	Ando Electric*	Shizuoka	Kosai	IND	Measuring instruments
	Ando Electric*	Shizuoka	Hamakita	IND	Measuring instruments
	Anelva*	Yamanashi	Narusawa	IND	Semiconductor production equipment
	NEC Fukushima*	Fukushima	Fukushima	COMM	Communications equipment
	NEC Gumma*	Gumma	Ohta	DP	Computers and related systems
	NEC Home Electronics*	Kanagawa	Kawasaki	CON	Audio equipment
				CON	VCRs
				CON	Video cameras
				CON	Color TVs
	NEC Home Electronics*	Shizuoka	Odawara	CON	VCRs
				CON	Color TVs
	NEC Home Electronics*	Shizuoka	Gotenba	CON	VCRs
	NEC Ibaraki*	Ibaraki	Sikijo-machi	DP	Computers and related systems
	NEC Miyagi*	Miyagi	Daiwa-cho	COMM	Communications equipment
	NEC Nagano*	Nagano	Ina	CON	Color TVs
				CON	Home electronics
	NEC Niigata*	Niigata	Kashiwazaki	DP	Computer terminals
	NEC Saitama*	Saitama	Kamikawa-mura	COMM	Communications equipment
	NEC San-ei Instruments*	Tokyo	Kodaira	IND	Medical equipment
	NEC San-ei Instruments*	Tochigi	Utsunomiya	IND	Medical equipment
	NEC Shizuoka*	Shizuoka	Kakegawa	COMM	Communications equipment
	NEC Tohoku*	Iwate	Ichinoseki	COMM	Communications equipment
	NEC Yonezawa*	Yamagata	Yonezawa	COMM	Communications equipment
31	Nikon	Tokyo	Ohl	CON	Cameras
	Nikon	Kanagawa	Yokohama	IND	Semiconductor production equipment
	Nikon	Saitama	Kumagaya	IND	Semiconductor production equipment
	Mito Nikon*	Ibaraki	Naka-cho	CON	Cameras
	Sendai Nikon*	Miyagi	Natori	CON	Cameras
	Tochigi Nikon*	Tochigi	Odawara	IND	Industrial equipment

(Continued)

# Factory Locations Directory

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
32	Nintendo Nintendo	Kyoto Kyoto	Kyoto Uji	CON CON	Video game machines Video game machines
33	Nippon Columbia Nippon Columbia Tohoku Onkyo	Kanagawa Fukushima Fukushima	Kawasaki Shirakawa Koriyama	CON CON CON	Audio equipment Audio equipment Audio equipment
34	Nippondenso Nippondenso Nippondenso Nippondenso	Aichi Aichi Aichi Mie	Kariya Anjo Nishio Daian	TRAN TRAN TRAN TRAN	Auto electronics Auto electronics Electronic fuel injection systems Car air conditioners Auto electronics
35	Ok! Electric Industry Ok! Electric Industry	Tokyo Saitama	Shinagawa-ku Honjo	COMM COMM COMM COMM	Communications equipment Telephones Facsimile machines Modems
36	Ok! Electric Industry Kuwano Electrical Instruments* Tohoku Ok! Electric* Omron Tateisi Electronics Omron Tateisi Electronics Omron Tateisi Electronics Omron Tateisi Electronics Omron Tateisi Electronics Ichinomiya Tateisi Electronics*	Gumma Kanagawa Fukushima Shiga Shizuoka Kyoto Kyoto Shiga Aichi	Takasaki Kawasaki Fukushima Kusatsu Mishima Kyoto Kyoto Minakuchi Ichinomiya	DP IND COMM DP IND IND IND IND IND	Computers and related equipment Measuring instruments Data communications equipment Control systems Control systems Control systems Control systems Control systems Automatic ticket vending machines
37	Pioneer Electronic Pioneer Electronic Pioneer Electronic Pioneer Electronic Pioneer Seimitsu* Pioneer Video Tohoku Pioneer* Towada Denki*	Tokyo Saitama Saitama Saitama Saitama Yamanashi Yamagata Aomori	Ohta Tokorozawa Fukuroi Kawagoe Iruma Nakakoma-gun Tendo Towada	CON CON CON CON CON TRAN CON CON CON TRAN CON	TVs Cable TV equipment Amplifiers Tape recorders Compact disk players Stereos Car audio equipment Audio equipment Video equipment Video disk players Auto electronics Audio equipment

(Continued)

## Japanese Factory Locations (Continued)

## Factory Locations Directory

<u>#</u>	<u>Company</u>	<u>Prefecture</u>	<u>City</u>	<u>Main LOB</u>	<u>Product</u>
38	Ricoh	Shizuoka	Gotenba	DP	Copiers
	Ricoh	Kanagawa	Atsugi	DP	Copiers
				DP	Printers
	Ricoh	Kanagawa	Hatano	DP	Data processing equipment
	Ricoh Optical Industries*	Iwate	Hanamaki	IND	Photographic equipment
	Tohoku Ricoh*	Miyagi	Shibata	DP	Copiers
				DP	Printers
	Hasama Ricoh*	Miyagi	Tome	DP	Copiers
				COMM	Facsimile machines
	Ricoh Tokki*	Saitama	Yashio	DP	Copiers
				COMM	Facsimile machines
39	Sanden	Gunma	Isazaki	IND	Vending machines
	Sanden	Gunma	Isazaki	TRAN	Car air conditioners
	Sanden	Gunma	Sakai-machi	CON	Fan heaters
40	Sankyo Seiki Mfg.	Nagano	Shimosuwa	DP	Flexible disk drives
				DP	Data systems
	Sankyo Seiki Mfg.	Nagano	Iida	IND	Robots
	Achi Seimitsu*	Nagano	Achi-mura	IND	Control systems
	Tateshina Denshi*	Nagano	Chino	DP	Data systems
41	Sanyo Electric	Osaka	Daito	CON	Video equipment
	Sanyo Electric	Gifu	Anpachi	CON	TVs
	Sanyo Electric	Osaka	Daito	CON	Video equipment
	Sanyo Electric	Osaka	Osaka	CON	Video equipment
	Sanyo Electric	Osaka	Daito	CON	Audio equipment
	Sanyo Electric	Osaka	Osaka	CON	Audio equipment
	Sanyo Electric	Shiga	Kusatsu	CON	Washing machines
				CON	Microwave ovens
	Sanyo Electric	Hyogo	Kasai	DP	Copiers
	Sanyo Electric	Osaka	Moriguchi	CON	Refrigerators
	Sanyo Electric	Gifu	Anpachi	DP	Word processors
	Tottori Sanyo Electric*	Tottori	Tottori	DP	PCs
				CON	Audio equipment
				CON	Home appliances

(Continued)

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
42	Sharp	Tochigi	Yaita	CON	VCRs
				CON	TVs
				CON	Audio equipment
				CON	Home appliances
				DP	PCs
				DP	Copiers
				DP	Calculators
43	Shimazu	Kyoto	Kyoto	DP	Word processors
				IND	Measuring instruments
				IND	Medical equipment
				IND	Aviation systems
				IND	Semiconductor production equipment
				IND	Measuring instruments
				IND	Industrial electronics
44	Sony	Tokyo	Shinagawa-ku	CON	VCRs
				CON	Tape recorders
				CON	Radios
	Sony	Kanagawa	Atsugi	CON	Color TVs
				CON	VCRs
				CON	Audio equipment
				CON	Video equipment
				CON	Cameras
	Sony	Saitama	Sakado	CON	Tape recorders
				CON	Color TVs
				CON	VCRs
	Sony	Aichi	Ichinomiya	CON	Color TVs
				CON	Compact disk players
				CON	VCRs
	Sony	Aichi	Kohda	CON	LCD TVs
				CON	VCRs
				CON	Video equipment
	Sony	Gifu	Minokamo	CON	Headphone stereos
				CON	Audio equipment
				CON	Audio equipment
	Sony	Ibaraki	Shimotsu	CON	Video equipment
				CON	Audio equipment
				CON	Audio equipment
	Taron*	Chiba	Choshi	CON	Video equipment
				CON	Audio equipment
	Toyo Electronics*	Tokyo	Shinagawa-ku	CON	Audio equipment
				CON	Audio equipment

(Continued)

## Japanese Factory Locations (Continued)

## Factory Locations Directory

<u>#</u>	<u>Company</u>	<u>Prefecture</u>	<u>City</u>	<u>Main LOB</u>	<u>Product</u>
45	Tokyo Electric	Shizuoka	Ohito	DP	Flexible disk drives
				DP	Printers
				DP	Point-of-sale systems
				DP	Electronic cash registers
	Tokyo Electric	Shizuoka	Mishima	DP	Printers
				DP	Other data processing equipment
46	Toshiba	Tokyo	Oume	DP	Computers and related equipment
	Toshiba	Tokyo	Hino	COMM	PBXs
				COMM	Facsimile machines
				COMM	Other communications equipment
	Toshiba	Kanagawa	Kawasaki	COMM	Communications equipment
	Toshiba	Tochigi	Odawara	IND	Medical equipment
	Toshiba	Saitama	Fukaya	CON	VCRs
				CON	TVs
				CON	Other video equipment
	Toshiba	Kanagawa	Yokohama	CON	Audio equipment
				DP	Flexible disk drives
	Toshiba	Shizuoka	Fuji	CON	Air conditioners
				CON	Refrigerators
	Toshiba	Osaka	Ibaraki	CON	Copiers
				DP	Other data processing equipment
	Toshiba	Kanagawa	Kawasaki	DP	Other data processing equipment
				IND	Industrial electronics
	Toshiba	Tokyo	Fuchu	DP	Industrial electronics
				DP	PCs
	Toshiba	Aichi	Nagoya	CON	Microwave ovens
				CON	Other appliances
	Toshiba	Aichi	Seto	CON	Washing machines
	Toshiba	Mie	Asahi-cho	IND	Industrial electronics
	Onkyo	Osaka	Neyagawa	CON	Audio equipment
	Onkyo	Osaka	Neyagawa	CON	Audio equipment
	Onkyo	Osaka	Osaka	CON	Audio equipment
	Shibaura Engineering Works*	Kanagawa	Yokohama	IND	Industrial electronics
	Shibaura Engineering Works*	Fukui	Kohama	IND	Industrial electronics
	Toshiba Machine*	Shizuoka	Numazu	IND	Industrial electronics
	Toshiba Machine*	Kanagawa	Sagamihara	IND	Industrial electronics

(Continued)

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
47	Victor of Japan	Kanagawa	Yokohama	CON	VCRs
				CON	Video cameras
	Victor of Japan	Kanagawa	Yamato	CON	Stereos
				CON	Video disk players
	Victor of Japan	Tokyo	Hachioji	CON	Audio equipment
	Victor of Japan	Ibaraki	Iwai	CON	Color TVs
				CON	Other video equipment
	Victor of Japan	Gunma	Maebashi	CON	Cassette recorders
	Victor of Japan	Gunma	Gunma	CON	VCRs
	Victor of Japan	Kanagawa	Yokosuka	CON	VCRs
48	Yamatake Honeywell	Tokyo	Kamata	IND	Industrial meters
	Yamatake Honeywell	Kanagawa	Fujisawa	IND	Control systems
	Yamatake Honeywell	Kanagawa	Isehara	IND	Industrial meters
				IND	Control systems
49	Yaskawa Electric Mfg.	Fukuoka	Kitakyushu	IND	Factory automation equipment
50	Yokogawa Electric	Tokyo	Musashino	IND	Measuring instruments
	Yokogawa Electric	Tokyo	Ohta-ku	IND	Measuring instruments
	Yokogawa Electric	Yamanashi	Rofu	IND	Measuring instruments
	Yokogawa Electric	Tokyo	Ome	IND	Measuring instruments
	Moroyama Denki*	Saitama	Iruma	IND	Measuring instruments

\*Consolidated subsidiaries

Source: Dataquest  
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## Factory Locations Abroad

#	Company	Country	City or State	Main LOB	Product
1	Alps Electric	N/A	N/A	N/A	N/A
2	Anritsu	N/A	N/A	N/A	N/A
3	Brother Industries	Taiwan	Taiwan	DP	Typewriters
	Brother Industries	United Kingdom	Wales	CON DP	Sewing machines Typewriters
4	Canon Bretagne S.A.	France	Liffre	DP	Copiers
	Canon Giessen GmbH	West Germany	Giessen-Roedgen	DP	Typewriters
	Canon Taiwan	Taiwan	Taiwan	DP CON	Copiers Cameras
5	Casio Computer	N/A	N/A	N/A	N/A
6	Clarion France	France	Gervais	TRAN	Auto electronics
	Clarion Mfg. Corp. of America	United States	Delaware	TRAN	Auto electronics
7	Daikin Industries	Belgium		CON	Air conditioners
8	Panuc Europe	Luxembourg	Echternach	IND	NC tape machines
9	Fuji Electric	N/A	N/A	N/A	N/A
10	Fujitsu America	United States	California	COMM	Communications equipment
	Fujitsu Business Communications	United States	California	COMM COMM	PBXs Switches
11	Fujitsu General	N/A	N/A	N/A	N/A
12	Hitachi Consumer Products	United States	California	CON	Color TVs
	Hitachi Consumer Products	Singapore	Singapore	CON CON CON	Audio equipment Color TVs Home appliances
	Fujian-Hitachi Television	Taiwan	Taiwan	CON	TVs
13	Hitachi Koki	N/A	N/A	N/A	N/A
14	IBM Japan	N/A	N/A	N/A	N/A
15	Japan Radio	N/A	N/A	N/A	N/A
16	Trio-Kenwood Singapore	Singapore	Singapore	CON	Audio equipment

(Continued)



# Factory Locations Abroad (Continued)

#	Company	Country	City or State	Main LOB	Product
17	Rokusai Electric	N/A	N/A	N/A	N/A
18	Kyocera				
	Universal Optical Industries	Hong Kong	Hong Kong	IND	Optical equipment
	Yashika de Brazile	Brazil	Sao Paulo	IND	Optical equipment
19	Kyushu Matsushita Electric	N/A	N/A	N/A	N/A
20	Matsushita Comm. Ind.	N/A	N/A	N/A	N/A
21	Matsushita Electric (Malaysia)	Malaysia	Malaysia	CON	Air conditioners
	Matsushita Electric (Taiwan)	Taiwan	Taiwan	CON	Consumer electronics
	Matsushita Electric Corp. of America	United States	New Jersey	CON	Consumer electronics
22	Matsushita Electric Works	N/A	N/A	N/A	N/A
23	Matsushita-Kotobuki	N/A	N/A	N/A	N/A
24	Matsushita Refrigeration	N/A	N/A	N/A	N/A
25	Matsushita Seiko	N/A	N/A	N/A	N/A
26	Meidensha Electric Mfg.	N/A	N/A	N/A	N/A
27	Minolta	N/A	N/A	N/A	N/A
28	Mitsubishi Consumer Electronics	United States	California	CON	Color TV
29	NCR Japan	N/A	N/A	N/A	N/A
30	NEC America	United States	Texas	COMM	Central office switches
				COMM	PBXs
	NEC America	United States	Virginia	COMM	Optical communications systems
	NEC America	United States	Oregon	COMM	Optical communications systems
	NEC America	United States	California	COMM	Mobile telephones
				COMM	Radio pagers
	NEC America	United States	New York	COMM	Key telephone systems
				COMM	PBXs
	NEC Australia	Australia	Victoria	COMM	Communications equipment
	NEC Information Systems	United States	Massachusetts	DP	Computers and related systems

(Continued)

## Factory Locations Abroad (Continued)

#	Company	Country	City or State	Main LOB	Product
31	Nikon	N/A	N/A	N/A	N/A
32	Nintendo of America	United States	Washington	CON	Video games
33	Nippon Columbia	N/A	N/A	N/A	N/A
34	Nippondenso	N/A	N/A	N/A	N/A
35	Oki America	United States	New Jersey	COMM	Communications equipment
36	Omron Tateisi Electronics	N/A	N/A	N/A	N/A
37	Pioneer Brazil Industria	Brazil	Sao Paulo	CON	Audio equipment
	Pioneer Electronic France	France		CON	Audio equipment
	Pioneer Electronic Mfg. N.V.	Belgium		CON	Audio equipment
	Pioneer Electronic Technology	United States	California	CON	Audio equipment
	Pioneer Mfg. Australia	Australia	Victoria	CON	Audio equipment
38	Ricoh	United States	New Jersey	COMM	Facsimile machines
	Ricoh Electronics	United States	California	DP	Copiers
				COMM	Facsimile machines
	Ricoh Industrie France	France	Colmar	DP	Copiers
	Ricoh U.K. Products	United Kingdom	Telford	DP	Copiers
				COMM	Facsimile machines
	Taiwan-Ricoh	Taiwan	Taipei	CON	Photographic equipment
39	Sanden	N/A	N/A	N/A	N/A
40	Sankyo Seiki Mfg.	N/A	N/A	N/A	N/A
41	Sanyo Manufacturing Corp.	United States	Arkansas	CON	Color TVs
				CON	Microwave ovens
42	Sharp Electronics	United States	New Jersey	CON	Consumer electronics
	Sharp Electronics	United States	Tennessee	CON	Consumer electronics
	Sharp Electronics (U.K.)	United Kingdom	Manchester	CON	Consumer electronics
	Sharp Corp. of Australia	Australia	New South Wales	CON	Consumer electronics
43	Shimazu Scientific Instruments	United States	Maryland	IND	Measuring instruments
	Shimazu Europe	West Germany	Dusseldorf	IND	Measuring instruments

(Continued)

Factory Locations Abroad (Continued)

#	Company	Country	City or State	Main LOB	Product
44	Sony Corp. of America Sony (U.K.)	United States United Kingdom	California Wales	CON CON	Color TVs Consumer electronics
45	Tokyo Electric	N/A	N/A	N/A	N/A
46	Toshiba America	United States	New Jersey	CON	Consumer electronics
47	Victor of Japan	N/A	N/A	N/A	N/A
48	Yamatake Honeywell	N/A	N/A	N/A	N/A
49	Yaskawa Electric Mfg.	N/A	N/A	N/A	N/A
50	Yokogawa Corporation of America Yokogawa Electric Singapore	United States Singapore	Georgia Singapore	IND IND	Industrial meters Industrial meters

N/A = Not Applicable

Source: Dataquest  
February 1988

# Electronic Equipment Companies

The following is a list of the material in this section:

- o Overview
- o Application Market Revenue
- o Factory Locations Directory

NOTE: The arrow symbol indicates the latest document(s) correct location behind the subject tab.

# Overview

## INTRODUCTION

This section forms the first major data base on which the methodology of this product is based. The other data base, located behind the tab entitled "Electronic Equipment Forecast," provides forecasts of electronic equipment production. The year in common, 1983, forms a transition in which to view history, while simultaneously extrapolating material that is necessary for understanding the future. The purpose of the electronic equipment revenue data base is threefold:

- To provide concrete historical information on specific companies—The section provides a data base of the electronic equipment revenue of 25 Japanese equipment manufacturers. We estimate that this electronics revenue accounts for a significant percentage of Japanese electronic equipment shipments and forms a good base for examining trends in the electronic equipment marketplace. This data base is a tool for analyzing growth by application market segment or by the activities of individual companies.
- To offer a check on other summary data—The information complements a historical view of semiconductor consumption from an equipment viewpoint rather than from the perspective of simply a product-shipment analysis.
- To serve as a basis for developing input/output (I/O) ratios—Tracking the actual semiconductor consumption and the actual electronic equipment revenue of given users allows an analysis of the I/O ratio: the relationship between semiconductor dollar value and the dollar value of the equipment in which the semiconductors are used.

Dataquest has developed I/O ratios by interviewing procurement, contract, and materials managers who are experts in knowing their individual company's merchant and captive use of semiconductors. We have interviewed more than 200 leading electronics manufacturers in North America. They have given us proprietary information on their semiconductor procurement, their captive production, and their relationships to the equipment or division in which the devices are used. The results of this survey, along with similar information provided by Japanese equipment and semiconductor manufacturers, are used to develop top-level I/O ratios.

Dataquest has agreed to use this information only for internal purposes and to report these ratios only on an aggregate basis. The I/O ratios that we develop are applied to the forecasts for electronic equipment. Information in those I/O ratios is available to clients that subscribe to our on-line services and can also be solicited from our analysts by clients via their inquiry privileges. The result is a series of forecasts of semiconductor consumption by application market. These forecasts are presented in the "Semiconductor Consumption Analysis" section.

## Overview

### SUMMARY

The information that follows is the result of a comprehensive data base that allows for tracking and analyzing the electronic equipment revenue of a sample of Japanese manufacturing companies. Major companies' revenue is listed, segmented, and presented in this section in various ways. Accordingly, the data, covering the five years from 1983 through 1987, are presented as follows:

- Annual Japanese yen-to-dollar exchange rates (see Table 1)
- The combined total revenue of all companies in the data base in relation to the combined total electronic equipment revenue of those same companies (see Figure 1 and Tables 2 and 3)
- The combined total electronic equipment revenue broken out by the five standard application markets that consume semiconductors in Japan: data processing, communications, industrial, consumer, and transportation (see Figures 2 and 3 and Tables 4 through 6)
- The individual application markets broken out by year, company, and revenue for that market (see the "Application Market Revenue" section)

Table 1

#### Annual Japanese Yen-to-Dollar Exchange Rate

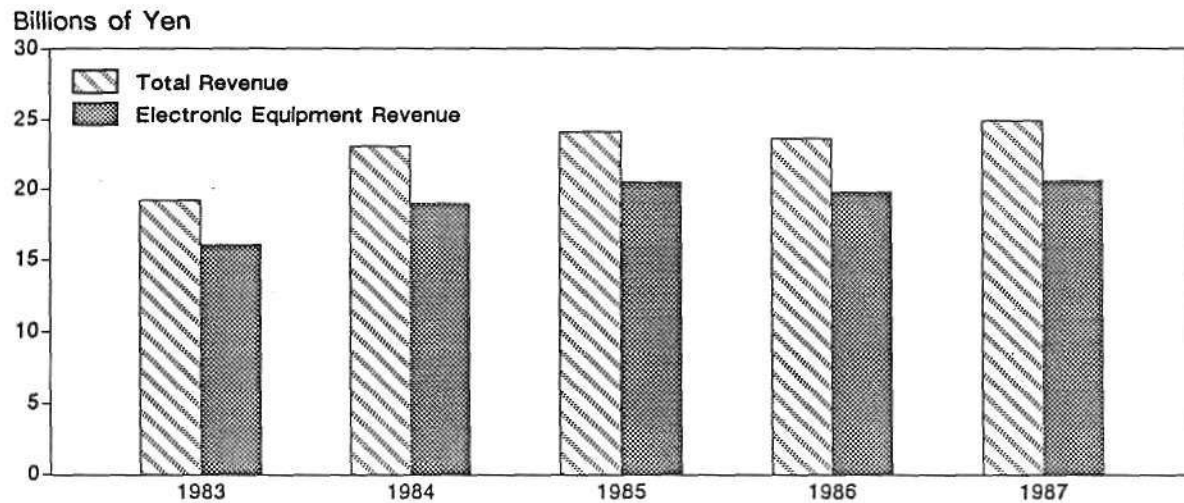
<u>Year</u>	<u>Yen per Dollar</u>
1983	235
1984	237
1985	238
1986	167
1987	144

Source: Dataquest  
March 1989

# Overview

Figure 1

Total Company Revenue versus  
Total Company Electronic Equipment Revenue



0003181-1

Source: Dataquest  
March 1989

Table 2

Total Company Revenue versus  
Total Company Electronic Equipment Revenue  
(Billions of Yen)

	1983	1984	1985	1986	1987	CAGR 1983-1987
Total Revenue	¥19,200	¥23,093	¥24,131	¥23,553	¥24,913	6.7%
Electronic Equipment Revenue	¥16,100	¥18,957	¥20,513	¥19,804	¥20,561	6.3%
Electronic Equipment Percentage of Total	83.9%	82.1%	85.0%	84.1%	82.5%	

Source: Dataquest  
March 1989

## Overview

Table 3

Total Company Revenue versus  
Total Company Electronic Equipment Revenue  
(Millions of Dollars)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>CAGR</u> <u>1983-1987</u>
Total Revenue	\$81,702	\$97,439	\$101,390	\$141,037	\$173,009	20.6%
Electronic Equipment Revenue	\$68,512	\$79,987	\$ 86,190	\$118,585	\$142,785	20.2%
Electronic Equipment Percentage of Total	83.9%	82.1%	85.0%	84.1%	82.5%	

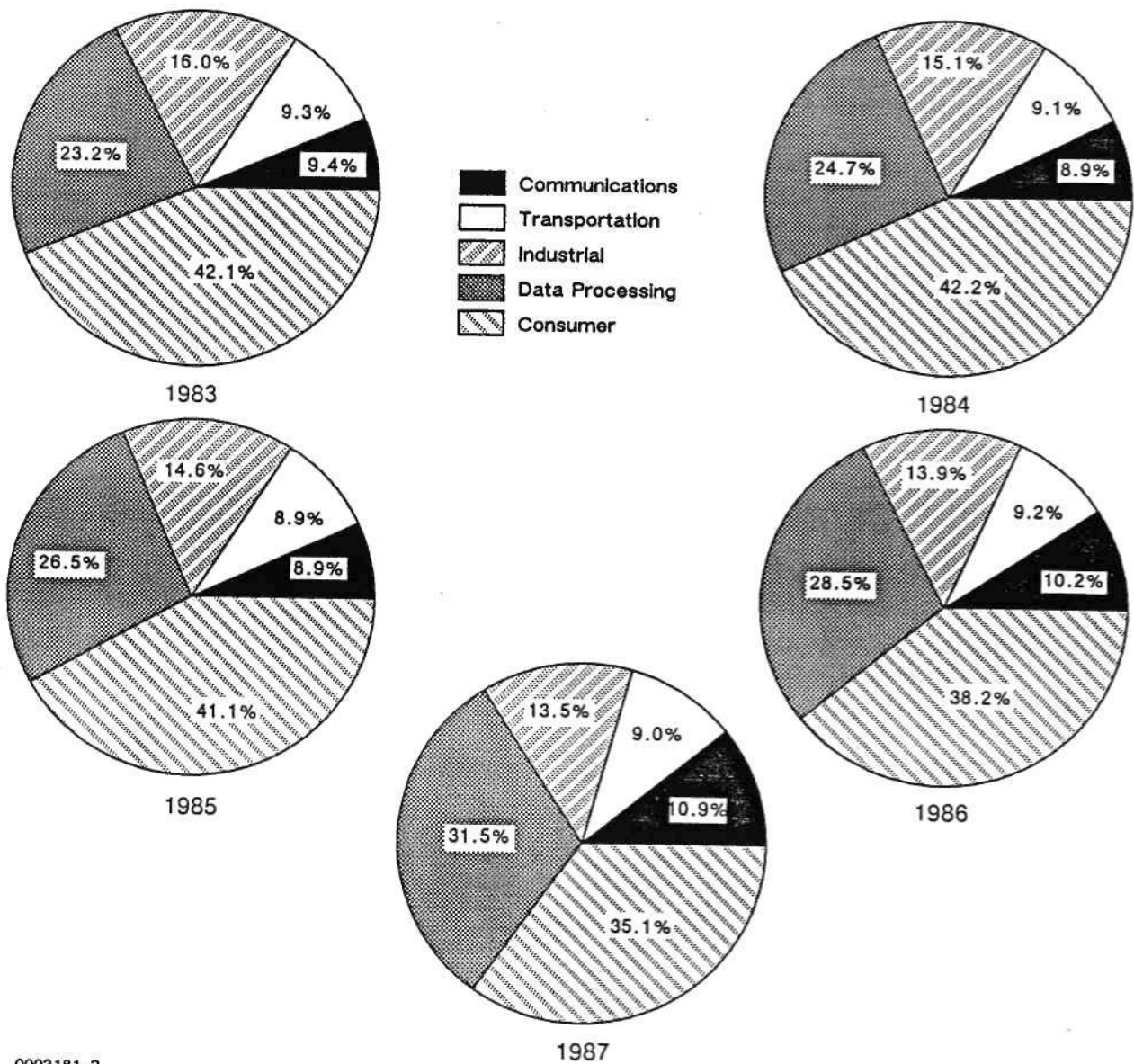
Source: Dataquest  
March 1989



# Overview

Figure 2

Total Company Electronic Equipment  
Revenue by Application Market  
(1983-1987)



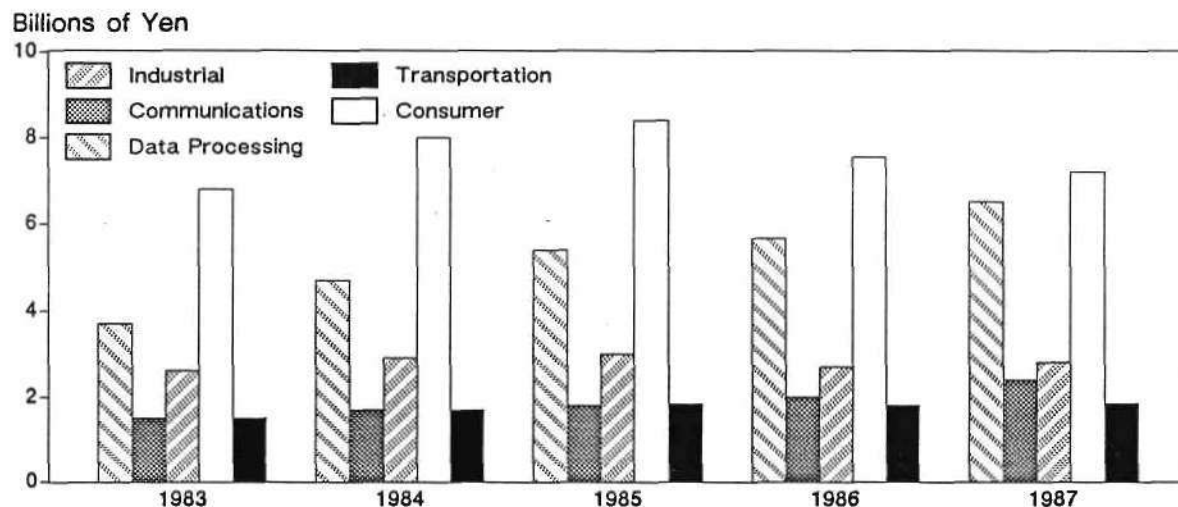
0003181-2

Source: Dataquest  
March 1989

## Overview

Figure 3

**Company Electronic Equipment Revenue  
by Application Market**



0003181-3

Source: Dataquest  
March 1989

Table 4

**Total Company Electronic Equipment Revenue by Application Market  
(Billions of Yen)**

Segment	1983	1984	1985	1986	1987	CAGR 1983-1987
Data Processing	¥ 3,732	¥ 4,677	¥ 5,431	¥ 5,661	¥ 6,483	14.8%
Communications	1,517	1,692	1,827	2,019	2,243	10.3%
Industrial	2,576	2,854	2,993	2,748	2,781	1.9%
Consumer	6,784	8,009	8,427	7,559	7,205	1.5%
Transportation	1,491	1,726	1,834	1,816	1,849	5.5%
Total	¥16,100	¥18,957	¥20,513	¥19,804	¥20,561	6.3%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
March 1989

# Overview

Table 5

## Total Company Electronic Equipment Revenue by Application Market (Millions of Dollars)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>CAGR</u> <u>1983-1987</u>
Data Processing	\$15,880	\$19,733	\$22,820	\$ 33,896	\$ 45,023	29.8%
Communications	6,455	7,138	7,678	12,091	15,575	24.6%
Industrial	10,963	12,042	12,576	16,456	19,315	15.2%
Consumer	28,868	33,794	35,407	45,266	50,031	14.7%
Transportation	<u>6,345</u>	<u>7,281</u>	<u>7,708</u>	<u>10,875</u>	<u>12,842</u>	19.3%
Total	\$68,512	\$79,987	\$86,190	\$118,585	\$142,785	20.2%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
March 1989

Table 6

## Total Company Electronic Equipment Revenue by Application Market (Percentage)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
Data Processing	23.2%	24.7%	26.5%	28.5%	31.5%
Communications	9.4	8.9	8.9	10.2	10.9
Industrial	16.0	15.1	14.6	13.9	13.5
Consumer	42.1	42.2	41.1	38.2	35.1
Transportation	<u>9.3</u>	<u>9.1</u>	<u>8.9</u>	<u>9.2</u>	<u>9.0</u>
Total	100.0%	100.0%	100.0%	100.0%	100.0%

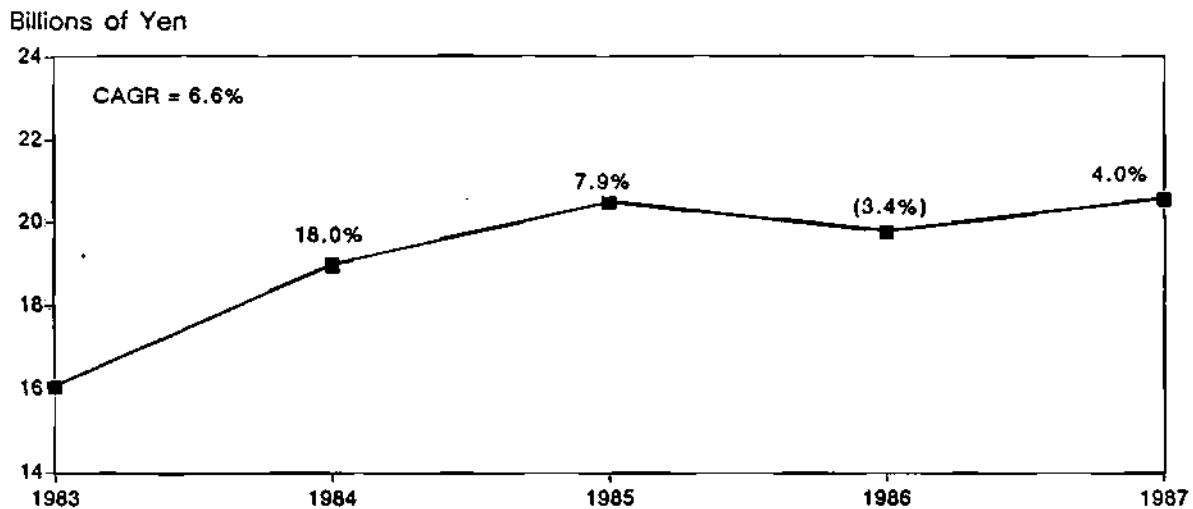
Source: Dataquest  
March 1989

## Overview

Figure 4 illustrates the growth of total company electronic equipment revenue from 1983 through 1987.

Figure 4

### Total Company Electronic Equipment Revenue Year-to-Year Growth Rates



Note: Percentages indicate year-to-year growth rates.  
0003181-4

Source: Dataquest  
March 1989

## METHODOLOGY

The companies included in the data base represent Dataquest's estimate of the top 25 Japanese electronic equipment manufacturers. Company annual reports provided the main source of information on equipment shipments. Virtually every annual report lists a company's revenue by line of business; each line of business is usually referred to as a segment. A description of each segment is also reported. Dataquest used these reports to determine whether a segment's revenue should be added to the data base.

Given that the information in some annual reports is limited, Dataquest developed the following protocols to provide continuity to the data base:

- The latest annual report was always used. For example, a typical 1987 report might have historical segment data for a two-year period. If only two years were reported, the 1986 report was examined for 1984 information, and the data for 1985 were simply checked against the information in the 1986 report to ensure that a company had not reorganized its reporting structure. Using the latest annual report provided continuity in the segments and in reporting each segment's revenue.

## Overview

- Some companies' segments included nonelectronic equipment. If electronic equipment made up the majority of the segment, or if there was a heavy technical influence in the description, the entire revenue for that segment was added to the data base. Unless specifically detailed or additional information was obtainable, percentages were not applied to segment revenue, based on the proportion or type of electronic equipment in that segment.
- Despite the name that a company gave to a given segment, a description of the equipment in a segment was used to determine in which of the six Dataquest application market segments the revenue belonged. Some of the companies' segments had such a varied product mix that they crossed over the Dataquest segmentation boundaries. In such cases, the major product influence in that segment's description mandated the revenue category.
- In segments where there was little or no clear evidence of electronic equipment, the revenue was not added to the data base. Nonelectronic lines of business also were not included.
- Service, interest, supply, and other additional or product support revenue was eliminated from the data base if it was listed in the report. Most companies in the data base separated such revenue. Software revenue was also eliminated when it was broken out as a separate line item, or if additional information indicated a percentage.

These gray areas applied to only a portion of the companies in the data base. Since Dataquest dealt with them by using the standards just described, we believe that this history of sample companies provides a thorough snapshot of what transpired in the application market segments that affect semiconductor consumption in Japan.

However, when comparing these data to the data located behind our "Electronic Equipment Forecast" tab, it is important to note the following differences in the two data bases:

- The company data in this section are based on the companies' sales revenue in each segment, and the electronic equipment forecast measures factory revenue from equipment production. The sales revenue figure is significantly higher than the factory revenue figure for a given piece of equipment.
- The company data include revenue from products manufactured outside of Japan. The electronic equipment forecast data measure production of equipment manufactured in Japan exclusively.
- The company data reflect the use of top-level segments to develop the total application market numbers, while the electronic equipment forecast tracks specific equipment types to develop the total application market numbers.

## Overview

These differences in the two data bases make the company application market revenue data large, compared with the electronic equipment forecast data. And the disparities distort the relative size of the five application markets tracked by the company data base. As more years are included, we can examine the link between the two data bases more closely and resolve discrepancies as they arise.

### ANALYSIS

Compiling and analyzing the data highlighted many key points. Figure 1 and Table 2 show that the combined total revenue grew at a compound annual growth rate (CAGR) of 6.7 percent in local currency from 1983 to 1987. Combined electronic equipment revenue grew at a slightly slower CAGR of 6.3 percent.

In 1987 the only area to show negative growth was the consumer application markets with a negative 4.6 percent decrease from 1986. In 1983, consumer electronics made up 42.1 percent of the total company electronic equipment revenue. In 1987, the percentage dropped to 35.0. Some of the reasons for this drop are as follows:

- The high yen appreciation severely damaged the Japanese consumer manufacturers in terms of worldwide competition, specifically against the Koreans.
- The export ratio for consumer products from Japan to the United States sharply declined from 58.6 percent in 1986 to 51.4 percent in 1987.
- Japanese manufacturers have been targeting industrial and data processing markets. The data processing portion of total Japanese company electronic equipment revenue grew from 23.2 percent in 1983 to 31.5 percent in 1987.

The fastest growing application segment was data processing, with a positive 15 percent growth rate over 1986. Figures 2 and 3 and Tables 4 through 6 show the changing composition of the Japanese electronics market.

# Application Market Revenue

Table 1

## Estimated Total Company Electronic Equipment Revenue (Billions of Yen)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>Year End</u>
1 Matsushita Electric Industrial Co., Ltd.	¥ 2,719	¥ 3,258	¥ 3,424	¥ 3,169	¥ 3,278	Mar. 31
2 Hitachi, Ltd.	2,648	3,026	3,003	2,925	2,920	Mar. 31
3 Toshiba Corporation	2,026	2,526	2,520	2,503	2,683	Mar. 31
4 NEC Corporation	1,460	1,889	1,970	2,124	2,304	Mar. 31
5 Mitsubishi Electric Corporation	1,588	1,858	1,821	1,804	1,954	Mar. 31
6 Fujitsu Limited	992	1,292	1,429	1,482	1,714	Mar. 31
7 IBM Japan, Ltd.	612	769	915	879	1,061	Dec. 31
8 Sony Corporation	770	912	1,071	1,036	1,030	Mar. 31
9 Nippondenso Co., Ltd.	689	789	909	965	994	Mar. 31
10 Sanyo Electric Co., Ltd.	820	992	1,048	839	909	Mar. 31
11 Sharp Corporation	757	910	955	869	873	Mar. 31
12 Matsushita Electric Works Ltd.	530	565	588	603	663	Nov. 30
13 Victor Company of Japan Limited	553	650	588	587	579	Mar. 31
14 Canon Inc.	374	485	575	539	579	Dec. 31
15 Ricoh Company, Ltd.	389	452	490	488	560	Mar. 31
16 Oki Electric Industry Co., Ltd.	304	362	362	361	416	Mar. 31
17 Fuji Electric Co., Ltd.	355	381	386	393	402	Mar. 31
18 Matsushita Communication Industrial Co., Ltd.	251	291	301	317	337	Mar. 31
19 Omron Tateisi Electronics Co.	209	270	246	248	278	Mar. 31
20 Kyocera Corporation	220	283	247	243	271	Mar. 31
21 Pioneer Electronic Corporation	239	247	260	268	266	Sep. 30
22 Daikin Industries, Ltd.	162	190	214	213	225	Nov. 30
23 Casio Computer Co., Ltd.	176	210	236	203	211	Mar. 31
24 Matsushita Kotobuki Electronics Industries Ltd.	226	336	374	285	209	Mar. 31
25 Minolta Camera Co., Ltd.	133	150	199	211	197	Mar. 31
Total	¥19,200	¥23,093	¥24,131	¥23,553	¥24,913	
Exchange Rate (Yen/US\$)	235	237	238	167	144	

Note: Each year shows fiscal year in Japan.

Source: Dataquest  
March 1989

# Application Market Revenue

Table 2

## Estimated Total Company Electronic Equipment Revenue (Millions of Dollars)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>Year End</u>
1 Matsushita Electric Industrial Co., Ltd.	\$11,569	\$13,746	\$ 14,387	\$ 18,978	\$ 22,761	Mar. 31
2 Hitachi, Ltd.	11,269	12,767	12,619	17,513	20,275	Mar. 31
3 Toshiba Corporation	8,620	10,658	10,586	14,991	18,630	Mar. 31
4 NEC Corporation	6,212	7,972	8,279	12,716	16,003	Mar. 31
5 Mitsubishi Electric Corporation	6,756	7,841	7,651	10,800	13,571	Mar. 31
6 Fujitsu Limited	4,220	5,450	6,006	8,875	11,906	Mar. 31
7 IBM Japan, Ltd.	2,605	3,243	3,843	5,261	7,366	Dec. 31
8 Sony Corporation	3,277	3,848	4,502	6,205	7,152	Mar. 31
9 Nippondenso Co., Ltd.	2,931	3,330	3,819	5,777	6,903	Mar. 31
10 Sanyo Electric Co., Ltd.	3,488	4,184	4,402	5,023	6,315	Mar. 31
11 Sharp Corporation	3,219	3,838	4,014	5,201	6,060	Mar. 31
12 Matsushita Electric Works Ltd.	2,256	2,385	2,469	3,612	4,602	Nov. 30
13 Victor Company of Japan Limited	2,353	2,743	2,471	3,517	4,020	Mar. 31
14 Canon Inc.	1,592	2,047	2,418	3,230	4,018	Dec. 31
15 Ricoh Company, Ltd.	1,654	1,906	2,059	2,922	3,889	Mar. 31
16 Oki Electric Industry Co., Ltd.	1,292	1,527	1,520	2,162	2,890	Mar. 31
17 Fuji Electric Co., Ltd.	1,510	1,608	1,623	2,353	2,794	Mar. 31
18 Matsushita Communication Industrial Co., Ltd.	1,067	1,227	1,265	1,900	2,341	Mar. 31
19 Omron Tateisi Electronics Co.	889	1,141	1,034	1,483	1,930	Mar. 31
20 Kyocera Corporation	935	1,195	1,036	1,453	1,883	Mar. 31
21 Pioneer Electronic Corporation	1,017	1,043	1,094	1,603	1,848	Sep. 30
22 Daikin Industries, Ltd.	690	800	897	1,275	1,564	Nov. 30
23 Casio Computer Co., Ltd.	751	887	992	1,217	1,466	Mar. 31
24 Matsushita Kotobuki Electronics Industries Ltd.	962	1,417	1,570	1,710	1,454	Mar. 31
25 Minolta Camera Co., Ltd.	567	635	835	1,265	1,368	Mar. 31
<b>Total</b>	<b>\$81,702</b>	<b>\$97,439</b>	<b>\$101,390</b>	<b>\$141,037</b>	<b>\$173,009</b>	
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>	

Note: Each year shows fiscal year in Japan.

Source: Dataquest  
March 1989



# Application Market Revenue

Table 3

Estimated Revenue for Semiconductor Application Markets  
(Billions of Yen)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Hitachi, Ltd.	¥ 2,288	¥ 2,486	¥ 2,613	¥ 2,540	¥ 2,510
2 Matsushita Electric Industrial Co., Ltd.	2,104	2,515	2,666	2,386	2,424
3 Toshiba Corporation	1,746	2,091	2,160	2,093	2,213
4 NEC Corporation	1,114	1,382	1,597	1,741	1,871
5 Mitsubishi Electric Corporation	1,448	1,622	1,656	1,628	1,734
6 Fujitsu Limited	819	1,037	1,253	1,315	1,514
7 IBM Japan, Ltd.	612	769	915	879	1,061
8 Nippondenso Co., Ltd.	681	779	896	953	979
9 Sony Corporation	701	812	944	899	858
10 Sanyo Electric Co., Ltd.	747	919	982	778	711
11 Sharp Corporation	643	769	810	724	703
12 Canon Inc.	374	487	571	539	578
13 Victor Company of Japan Limited	527	620	555	541	522
14 Ricoh Company, Ltd.	314	367	407	398	459
15 Matsushita Electric Works Ltd.	314	321	339	352	379
16 Matsushita Communication Industrial Co., Ltd.	251	291	301	317	337
17 Oki Electric Industry Co., Ltd.	237	276	289	286	314
18 Pioneer Electronic Corporation	226	236	251	259	257
19 Casio Computer Co., Ltd.	176	210	236	203	211
20 Matsushita Kotobuki Electronics Industries Ltd.	226	336	374	285	209
21 Minolta Camera Co., Ltd.	133	150	199	211	197
22 Omron Tateisi Electronics Co.	144	188	166	167	179
23 Daikin Industries, Ltd.	109	124	139	143	156
24 Fuji Electric Co., Ltd.	108	110	131	100	110
25 Kyocera Corporation	60	58	64	66	75
Total	¥16,100	¥18,957	¥20,513	¥19,804	¥20,561
Exchange Rate (Yen/US\$)	235	237	238	167	144

Note: Each year shows fiscal year in Japan.

Source: Dataquest  
March 1989

# Application Market Revenue

Table 4

Estimated Revenue for Semiconductor Application Markets  
(Millions of Dollars)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Hitachi, Ltd.	\$ 9,737	\$10,488	\$10,981	\$ 15,207	\$ 17,427
2 Matsushita Electric Industrial Co., Ltd.	8,954	10,613	11,202	14,288	16,836
3 Toshiba Corporation	7,429	8,823	9,074	12,535	15,367
4 NEC Corporation	4,740	5,830	6,710	10,423	12,993
5 Mitsubishi Electric Corporation	6,160	6,845	6,958	9,746	12,043
6 Fujitsu Limited	3,485	4,376	5,265	7,873	10,517
7 IBM Japan, Ltd.	2,605	3,243	3,842	5,260	7,365
8 Nippondenso Co., Ltd.	2,898	3,287	3,764	5,704	6,797
9 Sony Corporation	2,984	3,425	3,965	5,382	5,959
10 Sanyo Electric Co., Ltd.	3,177	3,878	4,124	4,659	4,937
11 Sharp Corporation	2,734	3,243	3,404	4,333	4,880
12 Canon Inc.	1,590	2,057	2,400	3,229	4,017
13 Victor Company of Japan Limited	2,241	2,618	2,332	3,242	3,626
14 Ricoh Company, Ltd.	1,338	1,547	1,711	2,382	3,186
15 Matsushita Electric Works Ltd.	1,335	1,355	1,426	2,110	2,631
16 Matsushita Communication Industrial Co., Ltd.	1,067	1,227	1,265	1,900	2,341
17 Oki Electric Industry Co., Ltd.	1,008	1,166	1,214	1,714	2,179
18 Pioneer Electronic Corporation	962	997	1,055	1,553	1,782
19 Casio Computer Co., Ltd.	751	887	992	1,217	1,466
20 Matsushita Kotobuki Electronics Industries Ltd.	962	1,417	1,570	1,710	1,454
21 Minolta Camera Co., Ltd.	567	635	835	1,265	1,368
22 Omron Tateisi Electronics Co.	613	795	696	998	1,243
23 Daikin Industries, Ltd.	462	525	585	859	1,084
24 Fuji Electric Co., Ltd.	459	465	549	601	765
25 Kyocera Corporation	254	246	270	395	522
Total	\$68,512	\$79,987	\$86,190	\$118,585	\$142,785
Exchange Rate (Yen/US\$)	235	237	238	167	144

Note: Each year shows fiscal year in Japan.

Source: Dataquest  
March 1989

# Application Market Revenue

Table 5

Estimated Fiscal 1987 Company Electronics Revenue  
by Semiconductor Application Market  
(Billions of Yen)

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	¥ 804	¥ 130	¥ 755	¥ 527	¥ 293	¥ 2,510
2 Matsushita Electric Industrial Co., Ltd.	279	130	280	1,735	0	¥ 2,424
3 Toshiba Corporation	382	392	409	758	273	¥ 2,213
4 NEC Corporation	1,037	722	0	112	0	¥ 1,871
5 Mitsubishi Electric Corporation	166	213	745	469	141	¥ 1,734
6 Fujitsu Limited	1,233	282	0	0	0	¥ 1,514
7 IBM Japan, Ltd.	1,061	0	0	0	0	¥ 1,061
8 Nippondenso Co., Ltd.	0	0	0	15	964	¥ 979
9 Sony Corporation	0	0	0	858	0	¥ 858
10 Sanyo Electric Co., Ltd.	55	0	137	519	0	¥ 711
11 Sharp Corporation	151	0	0	551	0	¥ 703
12 Canon Inc.	431	6	20	121	0	¥ 578
13 Victor Company of Japan Limited	0	0	0	522	0	¥ 522
14 Ricoh Company, Ltd.	356	72	0	31	0	¥ 459
15 Matsushita Electric Works Ltd.	0	0	0	379	0	¥ 379
16 Matsushita Communication Industrial Co., Ltd.	90	158	0	0	89	¥ 337
17 Oki Electric Industry Co., Ltd.	190	124	0	0	0	¥ 314
18 Pioneer Electronic Corporation	0	0	0	167	90	¥ 257
19 Casio Computer Co., Ltd.	109	0	0	102	0	¥ 211
20 Matsushita Rotobuki Electronics Industries Ltd.	0	0	0	209	0	¥ 209
21 Minolta Camera Co., Ltd.	97	0	0	100	0	¥ 197
22 Omron Tateisi Electronics Co.	10	0	169	0	0	¥ 179
23 Daikin Industries, Ltd.	0	0	156	0	0	¥ 156
24 Fuji Electric Co., Ltd.	0	0	110	0	0	¥ 110
25 Kyocera Corporation	34	14	0	27	0	¥ 75
Total (25 Companies)	¥6,483	¥2,243	¥2,781	¥7,205	¥1,849	¥20,561
Exchange Rate (Yen/US\$): 144.0						

Source: Dataquest  
March 1989

# Application Market Revenue

**Table 6**

**Estimated Fiscal 1987 Company Electronics Revenue  
by Semiconductor Application Market  
(Millions of Dollars)**

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	\$ 5,583	\$ 903	\$ 5,244	\$ 3,662	\$ 2,036	\$ 17,427
2 Matsushita Electric Industrial Co., Ltd.	1,940	903	1,944	12,048	0	\$ 16,836
3 Toshiba Corporation	2,653	2,719	2,838	5,264	1,892	\$ 15,367
4 NEC Corporation	7,199	5,016	0	778	0	\$ 12,993
5 Mitsubishi Electric Corporation	1,153	1,482	5,171	3,259	979	\$ 12,043
6 Fujitsu Limited	8,561	1,956	0	0	0	\$ 10,517
7 IBM Japan, Ltd.	7,365	0	0	0	0	\$ 7,365
8 Nippondenso Co., Ltd.	0	0	0	105	6,692	\$ 6,797
9 Sony Corporation	0	0	0	5,959	0	\$ 5,959
10 Sanyo Electric Co., Ltd.	379	0	952	3,606	0	\$ 4,937
11 Sharp Corporation	1,051	0	0	3,829	0	\$ 4,880
12 Canon Inc.	2,996	40	141	840	0	\$ 4,017
13 Victor Company of Japan Limited	0	0	0	3,626	0	\$ 3,626
14 Ricoh Company, Ltd.	2,471	500	0	215	0	\$ 3,186
15 Matsushita Electric Works Ltd.	0	0	0	2,631	0	\$ 2,631
16 Matsushita Communication Industrial Co., Ltd.	623	1,097	0	0	621	\$ 2,341
17 Oki Electric Industry Co., Ltd.	1,320	859	0	0	0	\$ 2,179
18 Pioneer Electronic Corporation	0	0	0	1,160	622	\$ 1,782
19 Casio Computer Co., Ltd.	755	0	0	712	0	\$ 1,466
20 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	1,454	0	\$ 1,454
21 Minolta Camera Co., Ltd.	673	0	0	694	0	\$ 1,368
22 Omron Tateisi Electronics Co.	67	0	1,176	0	0	\$ 1,243
23 Daikin Industries, Ltd.	0	0	1,084	0	0	\$ 1,084
24 Fuji Electric Co., Ltd.	0	0	765	0	0	\$ 765
25 Kyocera Corporation	233	100	0	189	0	\$ 522
Total (25 Companies)	\$45,023	\$15,575	\$19,315	\$50,031	\$12,842	\$142,785
Exchange Rate (Yen/US\$):	144.0					

Source: Dataquest  
March 1989

# Application Market Revenue

**Table 7**

## **Estimated Fiscal 1986 Company Electronics Revenue by Semiconductor Application Market (Billions of Yen)**

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	¥ 702	¥ 110	¥ 845	¥ 580	¥ 303	¥ 2,540
2 Matsushita Electric Industrial Co., Ltd.	253	126	253	1,754	0	¥ 2,386
3 Toshiba Corporation	341	339	391	762	260	¥ 2,093
4 NEC Corporation	920	684	0	137	0	¥ 1,741
5 Mitsubishi Electric Corporation	152	189	674	481	132	¥ 1,628
6 Fujitsu Limited	1,077	238	0	0	0	¥ 1,315
7 Nippondenso Co., Ltd.	0	0	0	12	940	¥ 953
8 Sony Corporation	0	0	0	899	0	¥ 899
9 IBM Japan, Ltd.	879	0	0	0	0	¥ 879
10 Sanyo Electric Co., Ltd.	0	0	162	616	0	¥ 778
11 Sharp Corporation	145	0	0	579	0	¥ 724
12 Victor Company of Japan Limited	0	0	0	541	0	¥ 541
13 Canon Inc.	394	6	23	117	0	¥ 539
14 Ricoh Company, Ltd.	315	57	0	26	0	¥ 398
15 Matsushita Electric Works Ltd.	0	0	0	352	0	¥ 352
16 Matsushita Communication Industrial Co., Ltd.	75	97	0	0	91	¥ 317
17 Oki Electric Industry Co., Ltd.	184	102	0	0	0	¥ 286
18 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	285	0	¥ 285
19 Pioneer Electronic Corporation	0	0	0	169	90	¥ 259
20 Minolta Camera Co., Ltd.	85	0	0	126	0	¥ 211
21 Casio Computer Co., Ltd.	106	0	0	97	0	¥ 203
22 Omron Tateisi Electronics Co.	9	0	157	0	0	¥ 167
23 Daikin Industries, Ltd.	0	0	143	0	0	¥ 143
24 Fuji Electric Co., Ltd.	0	0	100	0	0	¥ 100
25 Kyocera Corporation	25	17	0	25	0	¥ 66
Total (25 Companies)	¥5,661	¥2,019	¥2,748	¥7,559	¥1,816	¥19,804
Exchange Rate (Yen/US\$): 167.0						

Source: Dataquest  
March 1989

# Application Market Revenue

**Table 8**

**Estimated Fiscal 1986 Company Electronics Revenue  
by Semiconductor Application Market  
(Millions of Dollars)**

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	\$ 4,204	\$ 659	\$ 5,061	\$ 3,470	\$ 1,814	\$ 15,207
2 Matsushita Electric Industrial Co., Ltd.	1,514	754	1,515	10,504	0	\$ 14,288
3 Toshiba Corporation	2,042	2,032	2,339	4,565	1,557	\$ 12,535
4 NEC Corporation	5,507	4,097	0	819	0	\$ 10,423
5 Mitsubishi Electric Corporation	910	1,133	4,034	2,881	788	\$ 9,746
6 Fujitsu Limited	6,449	1,423	0	0	0	\$ 7,873
7 Nippondenso Co., Ltd.	0	0	0	73	5,631	\$ 5,704
8 Sony Corporation	0	0	0	5,382	0	\$ 5,382
9 IBM Japan, Ltd.	5,260	0	0	0	0	\$ 5,260
10 Sanyo Electric Co., Ltd.	0	0	969	3,691	0	\$ 4,659
11 Sharp Corporation	866	0	0	3,467	0	\$ 4,333
12 Victor Company of Japan Limited	0	0	0	3,242	0	\$ 3,242
13 Canon Inc.	2,358	37	136	698	0	\$ 3,229
14 Ricoh Company, Ltd.	1,887	339	0	155	0	\$ 2,382
15 Matsushita Electric Works Ltd.	0	0	0	2,110	0	\$ 2,110
16 Matsushita Communication Industrial Co., Ltd.	447	907	0	0	546	\$ 1,900
17 Oki Electric Industry Co., Ltd.	1,104	609	0	0	0	\$ 1,714
18 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	1,710	0	\$ 1,710
19 Pioneer Electronic Corporation	0	0	0	1,012	541	\$ 1,553
20 Minolta Camera Co., Ltd.	508	0	0	757	0	\$ 1,265
21 Casio Computer Co., Ltd.	635	0	0	582	0	\$ 1,217
22 Omron Tateisi Electronics Co.	56	0	943	0	0	\$ 998
23 Daikin Industries, Ltd.	0	0	859	0	0	\$ 859
24 Fuji Electric Co., Ltd.	0	0	601	0	0	\$ 601
25 Kyocera Corporation	149	99	0	147	0	\$ 395
Total (25 Companies)	\$33,896	\$12,091	\$16,456	\$45,266	\$10,875	\$118,585

Exchange Rate  
(Yen/US\$): 167.0

Source: Dataquest  
March 1989

# Application Market Revenue

Table 9

## Estimated Fiscal 1985 Company Electronics Revenue by Semiconductor Application Market (Billions of Yen)

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Matsushita Electric Industrial Co., Ltd.	¥ 263	¥ 131	¥ 263	¥2,009	0	¥ 2,666
2 Hitachi, Ltd.	600	91	901	713	¥ 308	¥ 2,613
3 Toshiba Corporation	293	233	402	830	322	¥ 2,160
4 Mitsubishi Electric Corporation	165	138	717	497	139	¥ 1,656
5 NEC Corporation	771	684	0	142	0	¥ 1,597
6 Fujitsu Limited	1,028	225	0	0	0	¥ 1,253
7 Sanyo Electric Co., Ltd.	0	0	167	815	0	¥ 982
8 Sony Corporation	0	0	0	944	0	¥ 944
9 IBM Japan, Ltd.	915	0	0	0	0	¥ 915
10 Nippondenso Co., Ltd.	0	0	0	13	883	¥ 896
11 Sharp Corporation	166	0	0	644	0	¥ 810
12 Canon Inc.	401	0	35	135	0	¥ 571
13 Victor Company of Japan Limited	0	0	0	555	0	¥ 555
14 Ricoh Company, Ltd.	317	63	0	28	0	¥ 407
15 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	374	0	¥ 374
16 Matsushita Electric Works Ltd.	0	0	0	339	0	¥ 339
17 Matsushita Communication Industrial Co., Ltd.	64	152	0	0	84	¥ 301
18 Oki Electric Industry Co., Ltd.	197	92	0	0	0	¥ 289
19 Pioneer Electronic Corporation	0	0	0	153	98	¥ 251
20 Casio Computer Co., Ltd.	141	0	0	95	0	¥ 236
21 Minolta Camera Co., Ltd.	83	0	0	116	0	¥ 199
22 Omron Tateisi Electronics Co.	8	0	158	0	0	¥ 166
23 Daikin Industries, Ltd.	0	0	139	0	0	¥ 139
24 Fuji Electric Co., Ltd.	0	0	131	0	0	¥ 131
25 Kyocera Corporation	19	19	0	26	0	¥ 64
Total (25 Companies)	¥5,431	¥1,827	¥2,993	¥8,427	¥1,834	¥20,513
Exchange Rate (Yen/US\$):	238.0					

Source: Dataquest  
March 1989

# Application Market Revenue

Table 10

## Estimated Fiscal 1985 Company Electronics Revenue by Semiconductor Application Market (Millions of Dollars)

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Matsushita Electric Industrial Co., Ltd.	\$ 1,103	\$ 550	\$ 1,105	\$ 8,443	0	\$ 11,202
2 Hitachi, Ltd.	2,521	383	3,787	2,997	\$ 1,294	\$ 10,981
3 Toshiba Corporation	1,231	978	2,026	3,486	1,353	\$ 9,074
4 Mitsubishi Electric Corporation	693	581	3,014	2,087	583	\$ 6,958
5 NEC Corporation	3,240	2,873	0	597	0	\$ 6,710
6 Fujitsu Limited	4,320	945	0	0	0	\$ 5,265
7 Sanyo Electric Co., Ltd.	0	0	700	3,425	0	\$ 4,124
8 Sony Corporation	0	0	0	3,965	0	\$ 3,965
9 IBM Japan, Ltd.	3,842	0	0	0	0	\$ 3,842
10 Nippondenso Co., Ltd.	0	0	0	54	3,710	\$ 3,764
11 Sharp Corporation	699	0	0	2,705	0	\$ 3,404
12 Canon Inc.	1,685	0	146	569	0	\$ 2,400
13 Victor Company of Japan Limited	0	0	0	2,332	0	\$ 2,332
14 Ricoh Company, Ltd.	1,330	263	0	118	0	\$ 1,711
15 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	1,570	0	\$ 1,570
16 Matsushita Electric Works Ltd.	0	0	0	1,426	0	\$ 1,426
17 Matsushita Communication Industrial Co., Ltd.	271	640	0	0	354	\$ 1,265
18 Oki Electric Industry Co., Ltd.	829	385	0	0	0	\$ 1,214
19 Pioneer Electronic Corporation	0	0	0	641	414	\$ 1,055
20 Casio Computer Co., Ltd.	594	0	0	398	0	\$ 992
21 Minolta Camera Co., Ltd.	348	0	0	487	0	\$ 835
22 Omron Tateisi Electronics Co.	32	0	665	0	0	\$ 696
23 Daikin Industries, Ltd.	0	0	585	0	0	\$ 585
24 Fuji Electric Co., Ltd.	0	0	549	0	0	\$ 549
25 Kyocera Corporation	81	81	0	108	0	\$ 270
Total (25 Companies)	\$22,820	\$7,678	\$12,576	\$35,407	\$7,708	\$86,190
Exchange Rate (Yen/US\$):	236.0					

Source: Dataquest  
March 1989



# Application Market Revenue

Table 11

## Estimated Fiscal 1984 Company Electronics Revenue by Semiconductor Application Market (Billions of Yen)

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Matsushita Electric Industrial Co., Ltd.	¥ 245	¥ 123	¥ 246	¥1,902	0	¥ 2,515
2 Hitachi, Ltd.	532	97	839	723	¥ 295	¥ 2,486
3 Toshiba Corporation	232	228	536	739	357	¥ 2,091
4 Mitsubishi Electric Corporation	165	150	702	478	127	¥ 1,622
5 NEC Corporation	637	614	0	130	0	¥ 1,382
6 Fujitsu Limited	857	180	0	0	0	¥ 1,037
7 Sanyo Electric Co., Ltd.	0	0	80	839	0	¥ 919
8 Sony Corporation	0	0	0	812	0	¥ 812
9 Nippondenso Co., Ltd.	0	0	0	10	769	¥ 779
10 IBM Japan, Ltd.	769	0	0	0	0	¥ 769
11 Sharp Corporation	169	0	0	599	0	¥ 769
12 Victor Company of Japan Limited	0	0	0	620	0	¥ 620
13 Canon Inc.	300	0	35	152	0	¥ 487
14 Ricoh Company, Ltd.	292	51	0	24	0	¥ 367
15 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	336	0	¥ 336
16 Matsushita Electric Works Ltd.	0	0	0	321	0	¥ 321
17 Matsushita Communication Industrial Co., Ltd.	70	140	0	0	81	¥ 291
18 Oki Electric Industry Co., Ltd.	185	91	0	0	0	¥ 276
19 Pioneer Electronic Corporation	0	0	0	140	96	¥ 236
20 Casio Computer Co., Ltd.	123	0	0	87	0	¥ 210
21 Omron Tateisi Electronics Co.	6	0	182	0	0	¥ 188
22 Minolta Camera Co., Ltd.	80	0	0	70	0	¥ 150
23 Daikin Industries, Ltd.	0	0	124	0	0	¥ 124
24 Fuji Electric Co., Ltd.	0	0	110	0	0	¥ 110
25 Kyocera Corporation	12	19	0	27	0	¥ 58
Total (25 Companies)	¥4,677	¥1,692	¥2,854	¥8,009	¥1,726	¥18,957
Exchange Rate (Yen/US\$):	237.0					

Source: Dataquest  
March 1989

# Application Market Revenue

**Table 12**

**Estimated Fiscal 1984 Company Electronics Revenue  
by Semiconductor Application Market  
(Millions of Dollars)**

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Matsushita Electric Industrial Co., Ltd.	\$ 1,035	\$ 518	\$ 1,036	\$ 8,024	0	\$10,613
2 Hitachi, Ltd.	2,245	408	3,539	3,050	\$1,247	\$10,488
3 Toshiba Corporation	977	961	2,260	3,119	1,506	\$ 8,823
4 Mitsubishi Electric Corporation	696	635	2,961	2,015	538	\$ 6,845
5 NEC Corporation	2,689	2,591	0	550	0	\$ 5,830
6 Fujitsu Limited	3,618	759	0	0	0	\$ 4,376
7 Sanyo Electric Co., Ltd.	0	0	337	3,541	0	\$ 3,878
8 Sony Corporation	0	0	0	3,425	0	\$ 3,425
9 Nippondenso Co., Ltd.	0	0	0	43	3,244	\$ 3,287
10 IBM Japan, Ltd.	3,243	0	0	0	0	\$ 3,243
11 Sharp Corporation	714	0	0	2,528	0	\$ 3,243
12 Victor Company of Japan Limited	0	0	0	2,618	0	\$ 2,618
13 Canon Inc.	1,268	0	150	639	0	\$ 2,057
14 Ricoh Company, Ltd.	1,234	214	0	99	0	\$ 1,547
15 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	1,417	0	\$ 1,417
16 Matsushita Electric Works Ltd.	0	0	0	1,355	0	\$ 1,355
17 Matsushita Communication Industrial Co., Ltd.	295	591	0	0	341	\$ 1,227
18 Oki Electric Industry Co., Ltd.	781	385	0	0	0	\$ 1,166
19 Pioneer Electronic Corporation	0	0	0	592	405	\$ 997
20 Casio Computer Co., Ltd.	521	0	0	366	0	\$ 887
21 Omron Tateisi Electronics Co.	26	0	770	0	0	\$ 795
22 Minolta Camera Co., Ltd.	339	0	0	295	0	\$ 635
23 Daikin Industries, Ltd.	0	0	525	0	0	\$ 525
24 Fuji Electric Co., Ltd.	0	0	465	0	0	\$ 465
25 Kyocera Corporation	52	78	0	116	0	\$ 246
<b>Total (25 Companies)</b>	<b>\$19,733</b>	<b>\$7,138</b>	<b>\$12,042</b>	<b>\$33,794</b>	<b>\$7,281</b>	<b>\$79,987</b>
Exchange Rate (Yen/US\$): 237.0						

Source: Dataquest  
March 1989

# Application Market Revenue

Table 13

## Estimated Fiscal 1983 Company Electronics Revenue by Semiconductor Application Market (Billions of Yen)

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	¥ 443	¥ 99	¥ 869	¥ 605	¥ 272	¥ 2,288
2 Matsushita Electric Industrial Co., Ltd.	189	95	190	1,630	0	¥ 2,104
3 Toshiba Corporation	183	242	412	634	275	¥ 1,746
4 Mitsubishi Electric Corporation	130	129	658	420	111	¥ 1,448
5 NEC Corporation	488	524	0	102	0	¥ 1,114
6 Fujitsu Limited	661	158	0	0	0	¥ 819
7 Sanyo Electric Co., Ltd.	0	0	70	677	0	¥ 747
8 Sony Corporation	0	0	0	701	0	¥ 701
9 Nippondenso Co., Ltd.	0	0	0	8	673	¥ 681
10 Sharp Corporation	153	0	0	490	0	¥ 643
11 IBM Japan, Ltd.	612	0	0	0	0	¥ 612
12 Victor Company of Japan Limited	0	0	0	527	0	¥ 527
13 Canon Inc.	208	0	21	145	0	¥ 374
14 Ricoh Company, Ltd.	261	37	0	16	0	¥ 314
15 Matsushita Electric Works Ltd.	0	0	0	314	0	¥ 314
16 Matsushita Communication Industrial Co., Ltd.	52	128	0	0	70	¥ 251
17 Oki Electric Industry Co., Ltd.	165	72	0	0	0	¥ 237
18 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	226	0	¥ 226
19 Pioneer Electronic Corporation	0	0	0	137	89	¥ 226
20 Casio Computer Co., Ltd.	104	0	0	72	0	¥ 176
21 Omron Tateisi Electronics Co.	3	0	141	0	0	¥ 144
22 Minolta Camera Co., Ltd.	65	0	0	69	0	¥ 133
23 Daikin Industries, Ltd.	0	0	109	0	0	¥ 109
24 Fuji Electric Co., Ltd.	0	0	108	0	0	¥ 108
25 Kyocera Corporation	14	34	0	12	0	¥ 60
Total (25 Companies)	¥3,732	¥1,517	¥2,576	¥6,784	¥1,491	¥16,100
Exchange Rate (Yen/US\$): 235.0						

Source: Dataquest  
March 1989

# Application Market Revenue

Table 14

**Estimated Fiscal 1983 Company Electronics Revenue  
by Semiconductor Application Market  
(Millions of Dollars)**

Company	Data					Total
	Processing	Communications	Industrial	Consumer	Transportation	
1 Hitachi, Ltd.	\$ 1,885	\$ 422	\$ 3,697	\$ 2,576	\$1,157	\$ 9,737
2 Matsushita Electric Industrial Co., Ltd.	805	403	809	6,937	0	\$ 8,954
3 Toshiba Corporation	779	1,029	1,752	2,699	1,170	\$ 7,429
4 Mitsubishi Electric Corporation	553	548	2,800	1,786	473	\$ 6,160
5 NEC Corporation	2,077	2,230	0	433	0	\$ 4,740
6 Fujitsu Limited	2,814	671	0	0	0	\$ 3,485
7 Sanyo Electric Co., Ltd.	0	0	297	2,881	0	\$ 3,177
8 Sony Corporation	0	0	0	2,984	0	\$ 2,984
9 Nippondenso Co., Ltd.	0	0	0	33	2,865	\$ 2,898
10 Sharp Corporation	650	0	0	2,084	0	\$ 2,734
11 IBM Japan, Ltd.	2,604	0	0	0	0	\$ 2,604
12 Victor Company of Japan Limited	0	0	0	2,241	0	\$ 2,241
13 Canon Inc.	883	0	90	618	0	\$ 1,590
14 Ricoh Company, Ltd.	1,112	158	0	68	0	\$ 1,338
15 Matsushita Electric Works Ltd.	0	0	0	1,335	0	\$ 1,335
16 Matsushita Communication Industrial Co., Ltd.	223	545	0	0	299	\$ 1,067
17 Oki Electric Industry Co., Ltd.	701	307	0	0	0	\$ 1,008
18 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	962	0	\$ 962
19 Pioneer Electronic Corporation	0	0	0	582	380	\$ 962
20 Casio Computer Co., Ltd.	443	0	0	308	0	\$ 751
21 Omron Tateisi Electronics Co.	14	0	599	0	0	\$ 613
22 Minolta Camera Co., Ltd.	275	0	0	293	0	\$ 567
23 Daikin Industries, Ltd.	0	0	462	0	0	\$ 462
24 Fuji Electric Co., Ltd.	0	0	459	0	0	\$ 459
25 Kyocera Corporation	61	143	0	49	0	\$ 254
Total (25 Companies)	\$15,880	\$6,455	\$10,963	\$28,868	\$6,345	\$68,512
Exchange Rate (Yen/US\$): 235.0						

Source: Dataquest  
March 1989

# Application Market Revenue

Table 15

Estimated Revenue for Data Processing Segment  
(Billions of Yen)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Fujitsu Limited	¥ 661	¥ 874	¥1,028	¥1,077	¥1,233
2 IBM Japan, Ltd.	612	769	915	879	1,061
3 NEC Corporation	488	637	771	920	1,037
4 Hitachi, Ltd.	443	532	600	702	804
5 Canon Inc.	208	300	401	394	431
6 Toshiba Corporation	183	232	293	341	382
7 Ricoh Company, Ltd.	261	292	317	315	356
8 Matsushita Electric Industrial Co., Ltd.	189	245	263	253	279
9 Oki Electric Industry Co., Ltd.	165	185	197	184	190
10 Mitsubishi Electric Corporation	130	165	165	152	166
11 Sharp Corporation	153	169	166	145	151
12 Casio Computer Co., Ltd.	104	123	141	106	109
13 Minolta Camera Co., Ltd.	65	80	83	85	97
14 Matsushita Communication Industrial Co., Ltd.	52	70	64	75	90
15 Sanyo Electric Co., Ltd.	0	0	0	0	55
16 Kyocera Corporation	14	12	19	25	34
17 Omron Tateisi Electronics Co.	3	6	8	9	10
18 Victor Company of Japan Limited	0	0	0	0	0
19 Sony Corporation	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
22 Pioneer Electronic Corporation	0	0	0	0	0
23 Matsushita Electric Works Ltd.	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Nippondenso Co., Ltd.	0	0	0	0	0
<b>Total</b>	<b>¥3,732</b>	<b>¥4,677</b>	<b>¥5,431</b>	<b>¥5,661</b>	<b>¥6,483</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 16

Estimated Revenue for Data Processing Segment  
(Millions of Dollars)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Fujitsu Limited	\$ 2,814	\$ 3,618	\$ 4,320	\$ 6,449	\$ 8,561
2 IBM Japan, Ltd.	2,605	3,243	3,842	5,260	7,365
3 NEC Corporation	2,077	2,689	3,240	5,507	7,199
4 Hitachi, Ltd.	1,885	2,245	2,521	4,204	5,583
5 Canon Inc.	883	1,268	1,685	2,358	2,996
6 Toshiba Corporation	779	977	1,231	2,042	2,653
7 Ricoh Company, Ltd.	1,112	1,234	1,330	1,887	2,471
8 Matsushita Electric Industrial Co., Ltd.	805	1,035	1,103	1,514	1,940
9 Oki Electric Industry Co., Ltd.	701	781	829	1,104	1,320
10 Mitsubishi Electric Corporation	553	696	693	910	1,153
11 Sharp Corporation	650	714	699	866	1,051
12 Minolta Camera Co., Ltd.	275	339	348	508	673
13 Matsushita Communication Industrial Co., Ltd.	223	295	271	447	623
14 Casio Computer Co., Ltd.	443	525	602	451	462
15 Sanyo Electric Co., Ltd.	0	0	0	0	379
16 Kyocera Corporation	61	52	81	149	233
17 Omron Tateisi Electronics Co.	14	26	32	56	67
18 Victor Company of Japan Limited	0	0	0	0	0
19 Sony Corporation	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
22 Pioneer Electronic Corporation	0	0	0	0	0
23 Matsushita Electric Works Ltd.	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Nippondenso Co., Ltd.	0	0	0	0	0
<b>Total</b>	<b>\$15,881</b>	<b>\$19,737</b>	<b>\$22,828</b>	<b>\$33,713</b>	<b>\$44,730</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 17

## Estimated Revenue for Communications Segment (Billions of Yen)

	<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1	NEC Corporation	¥ 524	¥ 614	¥ 684	¥ 684	¥ 722
2	Toshiba Corporation	242	228	233	339	392
3	Fujitsu Limited	158	180	225	238	282
4	Mitsubishi Electric Corporation	129	150	138	189	213
5	Matsushita Communication Industrial Co., Ltd.	128	140	152	151	158
6	Sharp Corporation	153	169	166	145	151
7	Hitachi, Ltd.	99	97	91	110	130
8	Matsushita Electric Industrial Co., Ltd.	95	123	131	126	130
9	Oki Electric Industry Co., Ltd.	72	91	92	102	124
10	Ricoh Company, Ltd.	37	51	63	57	72
11	Sanyo Electric Co., Ltd.	0	0	0	0	55
12	Kyocera Corporation	34	19	19	17	14
13	Canon Inc.	0	0	0	6	6
14	Daikin Industries, Ltd.	0	0	0	0	0
15	Victor Company of Japan Limited	0	0	0	0	0
16	Matsushita Electric Works Ltd.	0	0	0	0	0
17	Minolta Camera Co., Ltd.	0	0	0	0	0
18	Casio Computer Co., Ltd.	0	0	0	0	0
19	Omron Tateisi Electronics Co.	0	0	0	0	0
20	Nippondenso Co., Ltd.	0	0	0	0	0
21	Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
22	Pioneer Electronic Corporation	0	0	0	0	0
23	Sony Corporation	0	0	0	0	0
24	Fuji Electric Co., Ltd.	0	0	0	0	0
25	IBM Japan, Ltd.	0	0	0	0	0
	<b>Total</b>	<b>¥1,670</b>	<b>¥1,861</b>	<b>¥1,994</b>	<b>¥2,164</b>	<b>¥2,449</b>
	<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 18

## Estimated Revenue for Communications Segment (Millions of Dollars)

	<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1	NEC Corporation	\$2,230	\$2,591	\$2,873	\$ 4,097	\$ 5,016
2	Toshiba Corporation	1,029	961	978	2,032	2,719
3	Fujitsu Limited	671	759	945	1,423	1,956
4	Mitsubishi Electric Corporation	548	635	581	1,133	1,482
5	Matsushita Communication Industrial Co., Ltd.	545	596	640	907	1,097
6	Sharp Corporation	650	714	699	866	1,051
7	Hitachi Ltd.	422	408	383	659	903
8	Matsushita Electric Industrial Co., Ltd.	403	518	550	754	903
9	Oki Electric Industry Co., Ltd.	307	385	385	609	859
10	Ricoh Company, Ltd.	158	214	263	339	500
11	Sanyo Electric Co., Ltd.	0	0	0	0	379
12	Kyocera Corporation	143	78	81	99	100
13	Canon Inc.	0	0	0	37	40
14	Daikin Industries, Ltd.	0	0	0	0	0
15	Victor Company of Japan Limited	0	0	0	0	0
16	Matsushita Electric Works Ltd.	0	0	0	0	0
17	Minolta Camera Co., Ltd.	0	0	0	0	0
18	Casio Computer Co., Ltd.	0	0	0	0	0
19	Omron Tateisi Electronics Co.	0	0	0	0	0
20	Nippondenso Co., Ltd.	0	0	0	0	0
21	Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
22	Pioneer Electronic Corporation	0	0	0	0	0
23	Sony Corporation	0	0	0	0	0
24	Fuji Electric Co., Ltd.	0	0	0	0	0
25	IBM Japan, Ltd.	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
	<b>Total</b>	<b>\$7,105</b>	<b>\$7,857</b>	<b>\$8,378</b>	<b>\$12,957</b>	<b>\$17,004</b>
	<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989



# Application Market Revenue

Table 19

Estimated Revenue for Consumers Segment  
(Billions of Yen)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Matsushita Electric Industrial Co., Ltd.	¥1,630	¥1,902	¥2,009	¥1,754	¥1,735
2 Sony Corporation	701	812	944	899	858
3 Toshiba Corporation	634	739	830	762	758
4 Sharp Corporation	490	599	644	579	551
5 Hitachi, Ltd.	605	723	713	580	527
6 Victor Company of Japan Limited	527	620	555	541	522
7 Sanyo Electric Co., Ltd.	677	839	815	616	519
8 Mitsubishi Electric Corporation	420	478	497	481	469
9 Matsushita Electric Works Ltd.	314	321	339	352	379
10 Matsushita Kotobuki Electronics Industries Ltd.	226	336	374	285	209
11 Pioneer Electronic Corporation	137	140	153	169	167
12 Canon Inc.	145	152	135	117	121
13 NEC Corporation	102	130	142	137	112
14 Casio Computer Co., Ltd.	72	87	95	97	102
15 Minolta Camera Co., Ltd.	69	70	116	126	100
16 Ricoh Company, Ltd.	16	24	28	26	31
17 Kyocera Corporation	12	27	26	25	27
18 Nippondenso Co., Ltd.	8	10	13	12	15
19 Matsushita Communication Industrial Co., Ltd.	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Oki Electric Industry Co., Ltd.	0	0	0	0	0
22 Omron Tateisi Electronics Co., Ltd.	0	0	0	0	0
23 IBM Japan, Ltd.	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Fujitsu Limited	0	0	0	0	0
<b>Total</b>	<b>¥6,784</b>	<b>¥8,009</b>	<b>¥8,427</b>	<b>¥7,559</b>	<b>¥7,205</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 20

Estimated Revenue for Consumers Segment  
(Millions of Dollars)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Matsushita Electric Industrial Co., Ltd.	\$ 6,937	\$ 8,024	\$ 8,443	\$10,504	\$12,048
2 Sony Corporation	2,984	3,425	3,965	5,382	5,959
3 Toshiba Corporation	2,699	3,119	3,486	4,565	5,264
4 Sharp Corporation	2,084	2,528	2,705	3,467	3,829
5 Hitachi, Ltd.	2,576	3,050	2,997	3,470	3,662
6 Victor Company of Japan Limited	2,241	2,618	2,332	3,242	3,626
7 Sanyo Electric Co., Ltd.	2,881	3,541	3,425	3,691	3,606
8 Mitsubishi Electric Corporation	1,786	2,015	2,087	2,881	3,259
9 Matsushita Electric Works Ltd.	1,335	1,355	1,426	2,110	2,631
10 Matsushita Kotobuki Electronics Industries Ltd.	962	1,417	1,570	1,710	1,454
11 Pioneer Electronic Corporation	582	592	641	1,012	1,160
12 Canon Inc.	618	639	569	698	840
13 NEC Corporation	433	550	597	819	778
14 Casio Computer Co., Ltd.	308	366	398	582	712
15 Minolta Camera Co., Ltd.	293	295	487	757	694
16 Ricoh Company, Ltd.	68	99	118	155	215
17 Kyocera Corporation	49	116	108	147	189
18 Nippondenso Co., Ltd.	33	43	54	73	105
19 Matsushita Communication Industrial Co., Ltd.	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Oki Electric Industry Co., Ltd.	0	0	0	0	0
22 Omron Tateisi Electronics Co.	0	0	0	0	0
23 IBM Japan, Ltd.	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Fujitsu Limited	0	0	0	0	0
<b>Total</b>	<b>\$28,868</b>	<b>\$33,794</b>	<b>\$35,407</b>	<b>\$45,266</b>	<b>\$50,031</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 21

Estimated Revenue for Industry Segment  
(Billions of Yen)

	<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1	Hitachi, Ltd.	¥ 869	¥ 839	¥ 901	¥ 845	¥ 755
2	Mitsubishi Electric Corporation	658	702	717	674	745
3	Toshiba Corporation	412	536	482	391	409
4	Matsushita Electric Industrial Co., Ltd.	190	246	263	253	280
5	Omron Tateisi Electronics Co.	141	182	158	157	169
6	Daikin Industries, Ltd.	109	124	139	143	156
7	Sanyo Electric Co., Ltd.	70	80	167	162	137
8	Fuji Electric Co., Ltd.	108	110	131	100	110
9	Canon Inc.	21	35	35	23	20
10	Victor Company of Japan Limited	0	0	0	0	0
11	Pioneer Electronic Corporation	0	0	0	0	0
12	Casio Computer Co., Ltd.	0	0	0	0	0
13	Sony Corporation	0	0	0	0	0
14	Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
15	Ricoh Company, Ltd.	0	0	0	0	0
16	Minolta Camera Co., Ltd.	0	0	0	0	0
17	Matsushita Communication Industrial Co., Ltd.	0	0	0	0	0
18	IBM Japan, Ltd.	0	0	0	0	0
19	Sharp Corporation	0	0	0	0	0
20	Fujitsu Limited	0	0	0	0	0
21	Matsushita Electric Works Ltd.	0	0	0	0	0
22	Nippondenso Co., Ltd.	0	0	0	0	0
23	Oki Electric Industry Co., Ltd.	0	0	0	0	0
24	NEC Corporation	0	0	0	0	0
25	Kyocera Corporation	0	0	0	0	0
	<b>Total</b>	<b>¥2,576</b>	<b>¥2,854</b>	<b>¥2,993</b>	<b>¥2,748</b>	<b>¥2,781</b>
	<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 22

Estimated Revenue for Industry Segment  
(Millions of Dollars)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Hitachi, Ltd.	\$ 3,697	\$ 3,539	\$ 3,787	\$ 5,061	\$ 5,244
2 Mitsubishi Electric Corporation	2,800	2,961	3,014	4,034	5,171
3 Toshiba Corporation	1,752	2,260	2,026	2,339	2,838
4 Matsushita Electric Industrial Co., Ltd.	809	1,036	1,105	1,515	1,944
5 Omron Tateisi Electronics Co.	599	770	665	943	1,176
6 Daikin Industries, Ltd.	462	525	585	859	1,084
7 Sanyo Electric Co., Ltd.	297	337	700	969	952
8 Fuji Electric Co., Ltd.	459	465	549	601	765
9 Canon Inc.	90	150	146	136	141
10 Sony Corporation	0	0	0	0	0
11 IBM Japan, Ltd.	0	0	0	0	0
12 Sharp Corporation	0	0	0	0	0
13 Casio Computer Co., Ltd.	0	0	0	0	0
14 Fujitsu Limited	0	0	0	0	0
15 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
16 Matsushita Electric Works Ltd.	0	0	0	0	0
17 Minolta Camera Co., Ltd.	0	0	0	0	0
18 Nippondenso Co., Ltd.	0	0	0	0	0
19 Pioneer Electronic Corporation	0	0	0	0	0
20 Oki Electric Industry Co., Ltd.	0	0	0	0	0
21 Ricoh Company, Ltd.	0	0	0	0	0
22 Victor Company of Japan Limited	0	0	0	0	0
23 Matsushita Communication Industrial Co., Ltd.	0	0	0	0	0
24 NEC Corporation	0	0	0	0	0
25 Kyocera Corporation	0	0	0	0	0
Total	\$10,963	\$12,042	\$12,576	\$16,456	\$19,315
Exchange Rate (Yen/US\$)	235	237	238	167	144

Source: Dataquest  
March 1989

# Application Market Revenue

Table 23

Estimated Revenue for Transportation Segment  
(Billions of Yen)

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Nippondenso Co., Ltd.	¥ 673	¥ 769	¥ 883	¥ 940	¥ 964
2 Hitachi, Ltd.	272	295	308	303	293
3 Toshiba Corporation	275	357	322	260	273
4 Mitsubishi Electric Corporation	138	159	173	164	176
5 Pioneer Electronic Corporation	89	96	98	90	90
6 Matsushita Communication Industrial Co., Ltd.	70	81	84	91	89
7 Victor Company of Japan Limited	0	0	0	0	0
8 Oki Electric Industry Co., Ltd.	0	0	0	0	0
9 IBM Japan, Ltd.	0	0	0	0	0
10 Matsushita Electric Industrial Co., Ltd.	0	0	0	0	0
11 Sanyo Electric Co., Ltd.	0	0	0	0	0
12 Casio Computer Co., Ltd.	0	0	0	0	0
13 Canon Inc.	0	0	0	0	0
14 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
15 Ricoh Company, Ltd.	0	0	0	0	0
16 Minolta Camera Co., Ltd.	0	0	0	0	0
17 NEC Corporation	0	0	0	0	0
18 Omron Tateisi Electronics Co.	0	0	0	0	0
19 Sharp Corporation	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Matsushita Electric Works Ltd.	0	0	0	0	0
22 Fujitsu Limited	0	0	0	0	0
23 Sony Corporation	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Kyocera Corporation	0	0	0	0	0
<b>Total</b>	<b>¥1,518</b>	<b>¥1,758</b>	<b>¥1,869</b>	<b>¥1,849</b>	<b>¥1,885</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Application Market Revenue

Table 24

**Estimated Revenue for Transportation Segment  
(Millions of Dollars)**

<u>Company</u>	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>
1 Nippondenso Co., Ltd.	\$2,865	\$3,244	\$3,710	\$ 5,631	\$ 6,692
2 Hitachi, Ltd.	1,157	1,247	1,294	1,814	2,036
3 Toshiba Corporation	1,170	1,506	1,353	1,557	1,892
4 Mitsubishi Electric Corporation	587	673	728	985	1,225
5 Pioneer Electronic Corporation	380	405	414	541	622
6 Matsushita Communication Industrial Co., Ltd.	299	341	354	546	621
7 Victor Company of Japan Limited	0	0	0	0	0
8 Oki Electric Industry Co., Ltd.	0	0	0	0	0
9 IBM Japan, Ltd.	0	0	0	0	0
10 Matsushita Electric Industrial Co., Ltd.	0	0	0	0	0
11 Sanyo Electric Co., Ltd.	0	0	0	0	0
12 Casio Computer Co., Ltd.	0	0	0	0	0
13 Canon Inc.	0	0	0	0	0
14 Matsushita Kotobuki Electronics Industries Ltd.	0	0	0	0	0
15 Ricoh Company, Ltd.	0	0	0	0	0
16 Minolta Camera Co., Ltd.	0	0	0	0	0
17 NEC Corporation	0	0	0	0	0
18 Omron Tateisi Electronics Co.	0	0	0	0	0
19 Sharp Corporation	0	0	0	0	0
20 Daikin Industries, Ltd.	0	0	0	0	0
21 Matsushita Electric Works Ltd.	0	0	0	0	0
22 Fujitsu Limited	0	0	0	0	0
23 Sony Corporation	0	0	0	0	0
24 Fuji Electric Co., Ltd.	0	0	0	0	0
25 Kyocera Corporation	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
<b>Total</b>	<b>\$6,459</b>	<b>\$7,416</b>	<b>\$7,852</b>	<b>\$11,072</b>	<b>\$13,088</b>
<b>Exchange Rate (Yen/US\$)</b>	<b>235</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>

Source: Dataquest  
March 1989

# Factory Locations Directory

## INTRODUCTION

This section lists more than 300 factory locations of the 50 Japanese companies included in the preceding "Application Market Revenue" section. The directory includes only locations of the companies and their consolidated subsidiaries. Nonconsolidated subsidiaries and locations that do not consume semiconductors have not been included.

The directory is split into two segments: "Japanese Factory Locations" and "Factory Locations Abroad." As Dataquest continues to update this list, we will be able to monitor the movement of Japanese companies away from Japan. Currently, close to 15 percent of the factory locations listed are outside of Japan.

The following list explains the abbreviations used in the directory:

- DP--Data processing
- COMM--Communications
- IND--Industrial
- CON--Consumer
- TRAN--Transportation
- LOB--Line of business

## Japanese Factory Locations

<u>#</u>	<u>Company</u>	<u>Prefecture</u>	<u>City</u>	<u>Main LOB</u>	<u>Product</u>
1	Alps Electric	Fukushima	Soma	CON	Tuners
	Alps Electric	Iwate	Morioka	DP	Printers
	Alps Electric	Kanagawa	Yokohama	DP	Data processing equipment
	Alps Electric	Miyagi	Kakuda	CON	Audio equipment
	Alpine*	Fukushima	Iwaki	CON	Audio equipment
				TRAN	Car stereos
				DP	Flexible disk drives
2	Anritsu	Kanagawa	Atsugi	DP	Office equipment
				IND	Measuring instruments
3	Brother Industries	Mizuho	Nagoya	DP	Printers
				DP	Typewriters
				DP	Sewing machines
	Brother Industries	Aichi	Kariya	CON	Home appliances
4	Canon	Fukushima	Fukushima	CON	Cameras
				CON	Video equipment
	Canon	Ibaraki	Toride	DP	Copiers
				DP	Laser printers
	Canon	Ibaraki	Ami	DP	Word processors
				DP	PCs
				COMM	Facsimile machines
				DP	Typewriters
	Canon	Tochigi	Utsunomiya	IND	Semiconductor production equipment
	Canon Electronics*	Saitama	Chichibu	DP	Flexible disk drives
	Copyer*	Tokyo	Tachikawa	DP	Copiers
	Copyer*	Yamanashi	Higashi Yatsushiro	DP	Copiers
5	Ohita Canon*	Oita	Higashi Kunisaki	CON	Cameras
	Casio Computer	Tokyo	Higashi Yamato	CON	Watches
				CON	Musical instruments
	Casio Computer	Yamanashi	Tamao	DP	Electronic cash registers
				DP	Calculators
	Fuji Denshi*	Shizuoka	Fujimiya	CON	Watches
				CON	Musical instruments
	Yamagata Casio*	Yamagata	Tone	DP	Office equipment
				CON	Watches
				CON	Musical instruments

(Continued)



## Japanese Factory Locations (Continued)

## Factory Locations Directory

#	Company	Prefecture	City	Main LOB	Product
6	Clarion	Saitama	Toda	TRAN	Auto electronics
	Clarion	Fukushima	Koriyama	TRAN	Auto electronics
	Clarion	Tochigi	Motegi-cho	TRAN	Auto electronics
	Clarion	Gumma	Yura-cho	TRAN	Auto electronics
7	Daikin Industries	Osaka	Sakai	CON	Air conditioners
	Daikin Industries	Osaka	Osaka	CON	Air conditioners
	Daikin Industries	Shiga	Kusatsu	CON	Air conditioners
8	Fanuc	Yamanashi	Minamitsuru	IND	Robots
	Fanuc	Yamanashi	Minamitsuru	IND	Robots
9	Fuji Electric	Tokyo	Hino	DP	PCs
				IND	Factory automation equipment
	Fuji Electric	Saitama	Fukiage-cho	IND	Robots
				IND	Factory automation equipment
	Fuji Electric	Mie	Yokkaichi	IND	Vending machines
	Fuji Electric	Chiba	Ichihara	IND	Medical imaging equipment
	Fuji Electric	Hyogo	Kobe	IND	Control systems
10	Fujitsu	Tochigi	Koyama	COMM	Switches
				COMM	Terminal equipment
	Fujitsu	Tochigi	Odawara	COMM	Communications equipment
	Fujitsu	Gumma	Tatebayashi	DP	Data processing equipment
				COMM	Facsimile machines
	Fujitsu	Saitama	Kumagaya	DP	Data processing equipment
	Fujitsu	Tokyo	Inagi	DP	Terminals
	Fujitsu	Kanagawa	Kawasaki	DP	Terminals
	Fujitsu	Nagano	Nagano	DP	Terminals
	Fujitsu	Shizuoka	Numazu	DP	Computers
	Fujitsu	Hyogo	Akashi	DP	Data processing equipment
				COMM	Communications equipment
	Fujitsu Denso*	Kanagawa	Kawasaki	COMM	Communications equipment
	Fujitsu Ten*	Hyogo	Akashi	TRAN	Car audio
	Hasegawa Electric*	Yamanashi	Shirane	COMM	Telephones
				COMM	Switches
	Hasegawa Electric	Tochigi	Koyama	COMM	Telephones
				COMM	Switches
	Yamagata Fujitsu*	Yamagata	Tone	DP	Data processing equipment

(Continued)

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
11	Fujitsu General	Kanagawa	Kawasaki	CON	Color TVs
				CON	VCRs
				CON	Refrigerators
				COMM	Communications equipment
	Fujitsu General	Shizuoka	Hamamatsu	CON	Air conditioners
	Fujitsu General	Yamagata	Shinjo	CON	Color TVs
	Fujitsu General	Iwate	Ichinoseki	DP	PCs
				DP	Word processors
				COMM	Communications equipment
	General Denko*	Osaka	Matsubara	CON	Refrigerators
12	Hitachi	Shizuoka	Shimizu	CON	Air conditioners
	Hitachi	Niigata	Nakajo	DP	Terminals
	Hitachi	Chiba	Narashino	IND	Robots
	Hitachi	Ibaraki	Katsuta	TRAN	Car air conditioners
	Hitachi	Ibaraki	Hitachi	TRAN	Auto electronics
				DP	Word processors
				CON	Washing machines
	Hitachi	Tochigi	Oohita-cho	CON	Air conditioners
				CON	Refrigerators
				CON	Color TVs
	Hitachi	Gifu	Minokamo	CON	Tape recorders
				CON	VCRs
				CON	Video cameras
	Hitachi	Aichi	Toyokawa	CON	Audio equipment
	Hitachi	Kanagawa	Yokohama	DP	PCs
	Hitachi	Kanagawa	Yokohama	COMM	PBXs
	Hitachi	Kanagawa	Hatano	COMM	Facsimile machines
				DP	Computers
				DP	Disk drives
	Hitachi	Aichi	Asahi	DP	Input/output equipment
				DP	Computers
				COMM	Communications equipment
13	Hitachi Koki	Ibaraki	Kazama	DP	Printers
	Hitachi Koki	Yamagata	Yamagata	DP	Printers
	Hitachi Koki Yamagata*	Yamagata	Yamagata	DP	Printers
14	IBM Japan	Kanagawa	Fujisawa	DP	Computers and related products
	IBM Japan	Shiga	Yasu	DP	Flexible disk drives
	IBM Japan			DP	Computers

(Continued)

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
15	Japan Radio Japan Radio	Tokyo Kanagawa	Mitaka Yokohama	COMM	Communications equipment
				DP	Data processing equipment
				COMM	Facsimile machines
				IND	Measuring instruments
				IND	Medical electronics
16	Aloka JRC Tokki	Tokyo Kanagawa	Mitaka Yokohama	TRAN	Transportation electronics
				COMM	Radio communications equipment
				CON	Audio equipment
				CON	Audio equipment
				IND	Measuring instruments
17	Kenwood Kenwood Kenwood Kenwood Komagane Denshi* Misuzu Denshi* Yamagata Kenwood*	Tokyo Tokyo Nagano Kanagawa Nagano Yamagata Yamagata	Ohta Hachioji Komagane Zama Komagane Tsuruoka Tsuruoka	CON	Audio equipment
				CON	Audio equipment
				IND	Measuring instruments
				CON	Audio equipment
				COMM	Radio communications equipment
18	Yorii Electronics*	Saitama	Oosato-gun	COMM	Radio communications equipment
				CON	Audio equipment
				CON	Audio equipment
				CON	Audio equipment
				CON	Audio equipment
19	Kokusai Electric Kokusai Electric Goyo Denshi Kogyo* Jinmeidai Kogyo*	Tokyo Yamanashi Akita Tokyo	Hamura Fuji-Yoshida Tenno Mizuho-cho	DP	Data processing equipment
				COMM	Communications equipment
				DP	Data processing equipment
				IND	Industrial electronics
				DP	Data processing equipment
20	Semiconductor production equipment	IND			
21	Kyocera Kyocera Kyocera Kyocera Kyocera	Hokkaido Fukushima Mie Mie Nagano	Kitami Tanagura Tamaki Ise Okaya	COMM	Communications equipment
				CON	Cameras
				COMM	Communications equipment
				CON	Audio equipment
				DP	Office equipment
22	Kyocera Kyocera	Mie Nagano	Ise Okaya	COMM	Communications equipment
				DP	Data processing equipment
				CON	Cameras
				CON	Cameras
				CON	Cameras
23	Kyushu Matsushita Electric Kyushu Matsushita Electric Kyushu Matsushita Electric Kyushu Matsushita Electric Kyushu Matsushita Electric	Fukuoka Fukuoka Saga Kumamoto Oita Nagasaki	Fukuoka Fukuoka Tosu Taimai Usa Isahaya	DP	Data processing equipment
				CON	Radios
				CON	Color TVs
				DP	Office equipment
				CON	Stereos
24	Kyushu Matsushita Electric Kyushu Matsushita Electric Kyushu Matsushita Electric Kyushu Matsushita Electric Kyushu Matsushita Electric	Kumamoto Oita Nagasaki	Taimai Usa Isahaya	CON	Color TV assemblies
				DP	Data processing equipment
				DP	Data processing equipment
				DP	Data processing equipment
				DP	Data processing equipment

(Continued)

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
20	Matsushita Comm. Ind.	Kanagawa	Yokohama	DP	PCs
				DP	Word processors
				COMM	Communications equipment
				IND	Measuring instruments
	Matsushita Comm. Ind.	Kanagawa	Yokohama	COMM	Telephones
				CON	Video cameras
	Matsushita Comm. Ind.	Nagano	Matsumoto	TRAN	Car audio equipment
				TRAN	Car audio equipment
	Matsushita Comm. Ind.	Fukushima	Shirakawa	CON	Video cameras
	Matsushita Comm. Ind.	Fukushima	Hanamaki	DP	Flexible disk drives
21	Matsushita Electric Ind.	Osaka	Kadoma	DP	Office equipment
				CON	Audio cassette recorders
				CON	VCRs
				CON	Stereos
	Matsushita Electric Ind.	Osaka	Moriguchi	CON	Musical instruments
				CON	Video equipment
	Matsushita Electric Ind.	Osaka	Ibaraki	CON	Color TVs
				CON	Washing machines
	Matsushita Electric Ind.	Osaka	Toyonaka	CON	Other home appliances
				CON	Rice cookers
	Matsushita Electric Ind.	Osaka	Osaka	CON	Audio cassette recorders
	Matsushita Electric Ind.	Miyagi	Natori	CON	Video equipment
	Matsushita Electric Ind.	Yamagata	Tendo	CON	Stereos
	Matsushita Electric Ind.	Fukushima	Fukushima	CON	Copiers
	Matsushita Electric Ind.	Tochigi	Utsunomiya	DP	Color TVs
	Matsushita Electric Ind.	Yamanashi	Nakakoma-gun	CON	Factory automation equipment
				IND	CRT displays
	Matsushita Electric Ind.	Kanagawa	Fujisawa	DP	Cable TV equipment
				CON	Video equipment
	Matsushita Electric Ind.	Shizuoka	Fukuroi	CON	Washing machines
	Matsushita Electric Ind.	Ishikawa	Ishikawa	CON	Video equipment
	Matsushita Electric Ind.	Shiga	Yokkaichi	CON	Home appliances
	Matsushita Electric Ind.	Shiga	Kusatsu	CON	Air conditioners
	Matsushita Electric Ind.	Okayama	Okayama	CON	Video equipment

(Continued)

# Japanese Factory Locations (Continued)

<u>#</u>	<u>Company</u>	<u>Prefecture</u>	<u>City</u>	<u>Main LOB</u>	<u>Product</u>
22	Matsushita Electric Works	Mie	Tsu	IND	Control equipment
				IND	Safety systems
	Matsushita Electric Works	Mie	Watarai-gun	IND	Control equipment
23	Matsushita-Kotobuki	Ehime	Saijo	CON	VCRs
				CON	Color TVs
	Matsushita-Kotobuki	Ehime	Kawauchi-cho	CON	Tape recorders
	Matsushita-Kotobuki	Tokushima	Waki-machi	CON	VCRs
				CON	Video cameras
24	Matsushita-Kotobuki	Ehime	Ipponmatsu-machi	DP	Rigid disk drives
	Matsushita Refrigeration	Shiga	Kusatsu	IND	Vending machines
				CON	Refrigerators
	Matsushita Refrigeration	Osaka	Higashi-Osaka	CON	Air conditioners
	Matsushita Refrigeration	Kanagawa	Fujisawa	CON	Refrigerators
25	Matsushita Seiko	Osaka	Osaka	CON	Fan heaters
	Matsushita Seiko	Aichi	Kanugai	CON	Home appliances
	Matsushita Seiko	Kanagawa	Fujisawa	CON	Air conditioners
26	Meidensha Electric Mfg.	Shizuoka	Numazu	IND	Control systems
	Meidensha Electric Mfg.	Gumma	Ohta	IND	Control systems
27	Minolta	Aichi	Toyokawa	DP	Data processing equipment
	Minolta	Aichi	Toyokawa	DP	Copiers
	Minolta	Osaka	Sakai	CON	Cameras
	Minolta	Aichi	Toyokawa	CON	Cameras
28	Mitsubishi Electric	Aichi	Aichi	IND	Robots
				IND	NC Machines
	Mitsubishi Electric	Hyogo	Himeji	TRAN	Auto electronics
	Mitsubishi Electric	Gifu	Nakatsugawa	CON	Home appliances
	Mitsubishi Electric	Wakayama	Wakayama	CON	Air conditioners
				CON	Refrigerators
	Mitsubishi Electric	Shizuoka	Shizuoka	CON	Air conditioners
				CON	Refrigerators
	Mitsubishi Electric	Kyoto	Kyoto	CON	VCRs
				CON	Color TVs
	Mitsubishi Electric	Gumma		CON	Microwave ovens
7	Mitsubishi Electric	Osaka	Amagasaki	COMM	Facsimile machines
				COMM	Other communications equipment
	SPC Electronics	Tokyo	Fuchu	IND	Industrial electronics

(Continued)

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
29	NCR Japan	Kanagawa	Ohiso	DP	Data processing equipment
	NCR Japan	Tokyo	Tokyo	DP	Data processing equipment
30	NEC	Tokyo	Minato-ku	DP	Computers
	NEC	Kanagawa	Kawasaki	COMM	Communications equipment
	NEC	Tokyo	Fuchu	COMM	Transmission equipment
	NEC			DP	Computers
	NEC			COMM	Communications equipment
	NEC	Kanagawa	Sagamihara	COMM	PBXs
	NEC	Kanagawa	Yokohama	COMM	Radio communications systems
	NEC	Chiba	Abiko	COMM	PBXs
	Ando Electric*	Shizuoka	Kosai	IND	Measuring instruments
	Ando Electric*	Shizuoka	Hamakita	IND	Measuring instruments
	Anelva*	Yamanashi	Narusawa	IND	Semiconductor production equipment
	NEC Fukushima*	Fukushima	Fukushima	COMM	Communications equipment
	NEC Gumma*	Gumma	Ohta	DP	Computers and related systems
	NEC Home Electronics*	Kanagawa	Kawasaki	CON	Audio equipment
				CON	VCRs
				CON	Video cameras
				CON	Color TVs
	NEC Home Electronics*	Shizuoka	Odawara	CON	VCRs
				CON	Color TVs
	NEC Home Electronics*	Shizuoka	Gotenba	CON	VCRs
	NEC Ibaraki*	Ibaraki	Sikijo-machi	DP	Computers and related systems
	NEC Miyagi*	Miyagi	Daiwa-cho	COMM	Communications equipment
	NEC Nagano*	Nagano	Ina	CON	Color TVs
				CON	Home electronics
	NEC Niigata*	Niigata	Kashiwazaki	DP	Computer terminals
	NEC Saitama*	Saitama	Kamikawa-mura	COMM	Communications equipment
	NEC San-ei Instruments*	Tokyo	Kodaira	IND	Medical equipment
	NEC San-ei Instruments*	Tochigi	Utsunomiya	IND	Medical equipment
	NEC Shizuoka*	Shizuoka	Kakegawa	COMM	Communications equipment
	NEC Tohoku*	Iwate	Ichinoseki	COMM	Communications equipment
	NEC Yonezawa*	Yamagata	Yonezawa	COMM	Communications equipment
31	Nikon	Tokyo	Ohi	CON	Cameras
	Nikon	Kanagawa	Yokohama	IND	Semiconductor production equipment
	Nikon	Saitama	Kumagaya	IND	Semiconductor production equipment
	Mito Nikon*	Ibaraki	Naka-cho	CON	Cameras
	Sendai Nikon*	Miyagi	Natori	CON	Cameras
	Tochigi Nikon*	Tochigi	Odawara	IND	Industrial equipment

(Continued)

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
32	Nintendo	Kyoto	Kyoto	CON	Video game machines
	Nintendo	Kyoto	Uji	CON	Video game machines
33	Nippon Columbia	Kanagawa	Kawasaki	CON	Audio equipment
	Nippon Columbia	Fukushima	Shirakawa	CON	Audio equipment
	Tohoku Onkyo	Fukushima	Koriyama	CON	Audio equipment
34	Nippondenso	Aichi	Kariya	TRAN	Auto electronics
	Nippondenso	Aichi	Anjo	TRAN	Auto electronics
	Nippondenso	Aichi	Nishio	TRAN	Electronic fuel injection systems
				TRAN	Car air conditioners
	Nippondenso	Mie	Daian	TRAN	Auto electronics
35	Oki Electric Industry	Tokyo	Shinagawa-ku	COMM	Communications equipment
	Oki Electric Industry	Saitama	Honjo	COMM	Telephones
				COMM	Facsimile machines
				COMM	Modems
	Oki Electric Industry	Gunma	Takasaki	DP	Computers and related equipment
	Kuwano Electrical Instruments*	Kanagawa	Kawasaki	IND	Measuring instruments
	Tohoku Oki Electric*	Fukushima	Fukushima	COMM	Data communications equipment
36	Omron Tateisi Electronics	Shiga	Kusatsu	DP	Control systems
	Omron Tateisi Electronics	Shizuoka	Mishima	IND	Control systems
	Omron Tateisi Electronics	Kyoto	Kyoto	IND	Control systems
	Omron Tateisi Electronics	Kyoto	Kyoto	IND	Control systems
	Omron Tateisi Electronics	Shiga	Minakuchi	IND	Control systems
	Ichinomiya Tateisi Electronics*	Aichi	Ichinomiya	IND	Automatic ticket vending machines
37	Pioneer Electronic	Tokyo	Ohta	CON	TVs
				CON	Cable TV equipment
				CON	Amplifiers
	Pioneer Electronic	Saitama	Tokorozawa	CON	Tape recorders
				CON	Compact disk players
	Pioneer Electronic	Saitama	Fukuroi	CON	Stereos
	Pioneer Electronic	Saitama	Kawagoe	TRAN	Car audio equipment
	Pioneer Seimitsu*	Saitama	Iruma	CON	Audio equipment
				CON	Video equipment
	Pioneer Video	Yamanashi	Nakakoma-gun	CON	Video disk players
	Tohoku Pioneer*	Yamagata	Tendo	TRAN	Auto electronics
	Towada Denki*	Aomori	Towada	CON	Audio equipment

(Continued)

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
38	Ricoh	Shizuoka	Gotenba	DP	Copiers
	Ricoh	Kanagawa	Atsugi	DP	Copiers
				DP	Printers
	Ricoh	Kanagawa	Hatano	DP	Data processing equipment
	Ricoh Optical Industries*	Iwate	Hanamaki	IND	Photographic equipment
	Tohoku Ricoh*	Miyagi	Shibata	DP	Copiers
				DP	Printers
	Hasama Ricoh*	Miyagi	Tome	DP	Copiers
				COMM	Facsimile machines
	Ricoh Tokki*	Saitama	Yashio	DP	Copiers
				COMM	Facsimile machines
39	Sanden	Gumma	Isazaki	IND	Vending machines
	Sanden	Gumma	Isazaki	TRAN	Car air conditioners
	Sanden	Gumma	Sakai-machi	CON	Fan heaters
40	Sankyo Seiki Mfg.	Nagano	Shimosuwa	DP	Flexible disk drives
				DP	Data systems
	Sankyo Seiki Mfg.	Nagano	Iida	IND	Robots
	Achi Seimitsu*	Nagano	Achi-mura	IND	Control systems
	Tateshina Denshi*	Nagano	Chino	DP	Data systems
41	Sanyo Electric	Osaka	Daito	CON	Video equipment
	Sanyo Electric	Gifu	Anpachi	CON	TVs
	Sanyo Electric	Osaka	Daito	CON	Video equipment
	Sanyo Electric	Osaka	Osaka	CON	Video equipment
	Sanyo Electric	Osaka	Daito	CON	Audio equipment
	Sanyo Electric	Osaka	Osaka	CON	Audio equipment
	Sanyo Electric	Shiga	Kusatsu	CON	Washing machines
				CON	Microwave ovens
	Sanyo Electric	Hyogo	Kasai	DP	Copiers
	Sanyo Electric	Osaka	Moriguchi	CON	Refrigerators
	Sanyo Electric	Gifu	Anpachi	DP	Word processors
	Tottori Sanyo Electric*	Tottori	Tottori	DP	PCs
				CON	Audio equipment
				CON	Home appliances

(Continued)



## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
42	Sharp	Tochigi	Yaita	CON	VCRs
				CON	TVs
				CON	Audio equipment
				CON	Home appliances
				DP	PCs
				DP	Copiers
				DP	Calculators
43	Shimazu	Kyoto	Kyoto	DP	Word processors
				IND	Measuring instruments
				IND	Medical equipment
				IND	Aviation systems
				IND	Semiconductor production equipment
				IND	Measuring instruments
				IND	Industrial electronics
44	Sony	Tokyo	Shinagawa-ku	CON	VCRs
				CON	Tape recorders
	Sony	Kanagawa	Atsugi	CON	Radios
				CON	Color TVs
				CON	VCRs
				CON	Audio equipment
				CON	Video equipment
	Sony Audio*	Shizuoka	Kosai	CON	Cameras
				CON	Tape recorders
				CON	Color TVs
	Sony Bonson*	Saitama	Sakado	CON	VCRs
				CON	Color TVs
	Sony Denshi*	Kanagawa	Fujisawa	CON	Color TVs
				CON	VCRs
	Sony Ichinomiya*	Aichi	Ichinomiya	CON	Color TVs
				CON	Compact disk players
	Sony Kisarazu*	Chiba	Kisarazu	CON	VCRs
				CON	LCD TVs
				CON	VCRs
	Sony Kohda*	Aichi	Kohda	CON	Video equipment
				CON	Headphone stereos
	Sony Minokamo*	Gifu	Minokamo	CON	Audio equipment
				CON	Audio equipment
	Sony Tsukuba*	Ibaraki	Shimotsuma	CON	Video equipment
				CON	Audio equipment
	Taron*	Chiba	Choshi	CON	Video equipment
				CON	Audio equipment
	Toyo Electronics*	Tokyo	Shinagawa-ku	CON	Video equipment
				CON	Audio equipment

(Continued)

# Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
45	Tokyo Electric	Shizuoka	Ohito	DP	Flexible disk drives
				DP	Printers
				DP	Point-of-sale systems
				DP	Electronic cash registers
	Tokyo Electric	Shizuoka	Mishima	DP	Printers
				DP	Other data processing equipment
46	Toshiba	Tokyo	Oume	DP	Computers and related equipment
	Toshiba	Tokyo	Hino	COMM	PBXs
				COMM	Facsimile machines
				COMM	Other communications equipment
	Toshiba	Kanagawa	Kawasaki	COMM	Communications equipment
	Toshiba	Tochigi	Odawara	IND	Medical equipment
	Toshiba	Saitama	Fukaya	CON	VCRs
				CON	TVs
				CON	Other video equipment
	Toshiba	Kanagawa	Yokohama	CON	Audio equipment
	Toshiba	Shizuoka	Fuji	DP	Flexible disk drives
				CON	Air conditioners
	Toshiba	Osaka	Ibaraki	CON	Refrigerators
	Toshiba	Kanagawa	Kawasaki	DP	Copiers
				DP	Other data processing equipment
	Toshiba	Tokyo	Fuchu	IND	Industrial electronics
	Toshiba	Aichi	Nagoya	DP	PCs
				CON	Microwave ovens
				CON	Other appliances
	Toshiba	Aichi	Seto	CON	Washing machines
	Toshiba	Mie	Asahi-cho	IND	Industrial electronics
	Onkyo	Osaka	Neyagawa	CON	Audio equipment
	Onkyo	Osaka	Neyagawa	CON	Audio equipment
	Onkyo	Osaka	Osaka	CON	Audio equipment
	Shibaura Engineering Works*	Kanagawa	Yokohama	IND	Industrial electronics
	Shibaura Engineering Works*	Fukui	Kohama	IND	Industrial electronics
	Toshiba Machine*	Shizuoka	Numazu	IND	Industrial electronics
	Toshiba Machine*	Kanagawa	Sagamihara	IND	Industrial electronics

(Continued)

## Japanese Factory Locations (Continued)

#	Company	Prefecture	City	Main LOB	Product
47	Victor of Japan	Kanagawa	Yokohama	CON	VCRs
				CON	Video cameras
	Victor of Japan	Kanagawa	Yamato	CON	Stereos
				CON	Video disk players
	Victor of Japan	Tokyo	Hachioji	CON	Audio equipment
	Victor of Japan	Ibaraki	Iwai	CON	Color TVs
				CON	Other video equipment
48	Victor of Japan	Gunma	Maebashi	CON	Cassette recorders
	Victor of Japan	Gunma	Gunma	CON	VCRs
	Victor of Japan	Kanagawa	Yokosuka	CON	VCRs
	Yamatake Honeywell	Tokyo	Kanata	IND	Industrial meters
	Yamatake Honeywell	Kanagawa	Fujisawa	IND	Control systems
	Yamatake Honeywell	Kanagawa	Isehara	IND	Industrial meters
				IND	Control systems
49	Yaskawa Electric Mfg.	Fukuoka	Kitakyushu	IND	Factory automation equipment
50	Yokogawa Electric	Tokyo	Musashino	IND	Measuring instruments
	Yokogawa Electric	Tokyo	Ohta-ku	IND	Measuring instruments
	Yokogawa Electric	Yamanashi	Kofu	IND	Measuring instruments
	Yokogawa Electric	Tokyo	Ome	IND	Measuring instruments
	Moroyama Denki*	Saitama	Iruma	IND	Measuring instruments

\*Consolidated subsidiaries

Source: Dataquest  
February 1988

## Factory Locations Abroad

#	Company	Country	City or State	Main LOB	Product
1	Alps Electric	N/A	N/A	N/A	N/A
2	Anritsu	N/A	N/A	N/A	N/A
3	Brother Industries	Taiwan	Taiwan	DP	Typewriters
	Brother Industries	United Kingdom	Wales	CON DP	Sewing machines Typewriters
4	Canon Bretagne S.A.	France	Liffre	DP	Copiers
	Canon Giessen GmbH	West Germany	Giessen-Roedgen	DP	Typewriters
	Canon Taiwan	Taiwan	Taiwan	DP CON	Copiers Cameras
5	Casio Computer	N/A	N/A	N/A	N/A
6	Clarion France	France	Gervais	TRAN	Auto electronics
	Clarion Mfg. Corp. of America	United States	Delaware	TRAN	Auto electronics
7	Daikin Industries	Belgium		CON	Air conditioners
8	Fanuc Europe	Luxembourg	Echternach	IND	NC tape machines
9	Fuji Electric	N/A	N/A	N/A	N/A
10	Fujitsu America	United States	California	COMM	Communications equipment
	Fujitsu Business Communications	United States	California	COMM COMM COMM	PBXs Switches
11	Fujitsu General	N/A	N/A	N/A	N/A
12	Hitachi Consumer Products	United States	California	CON	Color TVs
	Hitachi Consumer Products	Singapore	Singapore	CON CON CON CON	Audio equipment Color TVs Home appliances TVs
	Fujian-Hitachi Television	Taiwan	Taiwan	CON	TVs
13	Hitachi Koki	N/A	N/A	N/A	N/A
14	IBM Japan	N/A	N/A	N/A	N/A
15	Japan Radio	N/A	N/A	N/A	N/A
16	Trio-Kenwood Singapore	Singapore	Singapore	CON	Audio equipment

(Continued)

# Factory Locations Abroad (Continued)

#	Company	Country	City or State	Main LOB	Product
17	Kokusai Electric	N/A	N/A	N/A	N/A
18	Kyocera				
	Universal Optical Industries	Hong Kong	Hong Kong	IND	Optical equipment
	Yashika de Brazile	Brazil	Sao Paulo	IND	Optical equipment
19	Kyushu Matsushita Electric	N/A	N/A	N/A	N/A
20	Matsushita Comm. Ind.	N/A	N/A	N/A	N/A
21	Matsushita Electric (Malaysia)	Malaysia	Malaysia	CON	Air conditioners
	Matsushita Electric (Taiwan)	Taiwan	Taiwan	CON	Consumer electronics
	Matsushita Electric Corp. of America	United States	New Jersey	CON	Consumer electronics
22	Matsushita Electric Works	N/A	N/A	N/A	N/A
23	Matsushita-Kotobuki	N/A	N/A	N/A	N/A
24	Matsushita Refrigeration	N/A	N/A	N/A	N/A
25	Matsushita Seiko	N/A	N/A	N/A	N/A
26	Meidensha Electric Mfg.	N/A	N/A	N/A	N/A
27	Minolta	N/A	N/A	N/A	N/A
28	Mitsubishi Consumer Electronics	United States	California	CON	Color TV's
29	NCR Japan	N/A	N/A	N/A	N/A
30	NEC America	United States	Texas	COMM	Central office switches
				COMM	PBXs
	NEC America	United States	Virginia	COMM	Optical communications systems
	NEC America	United States	Oregon	COMM	Optical communications systems
	NEC America	United States	California	COMM	Mobile telephones
				COMM	Radio pagers
	NEC America	United States	New York	COMM	Key telephone systems
				COMM	PBXs
	NEC Australia	Australia	Victoria	COMM	Communications equipment
	NEC Information Systems	United States	Massachusetts	DP	Computers and related systems

(Continued)

## Factory Locations Abroad (Continued)

<u>#</u>	<u>Company</u>	<u>Country</u>	<u>City or State</u>	<u>Main LOB</u>	<u>Product</u>
31	Nikon	N/A	N/A	N/A	N/A
32	Nintendo of America	United States	Washington	CON	Video games
33	Nippon Columbia	N/A	N/A	N/A	N/A
34	Nippondenso	N/A	N/A	N/A	N/A
35	Oki America	United States	New Jersey	COMM	Communications equipment
36	Omron Tateisi Electronics	N/A	N/A	N/A	N/A
37	Pioneer Brazil Industria	Brazil	Sao Paulo	CON	Audio equipment
	Pioneer Electronic France	France		CON	Audio equipment
	Pioneer Electronic Mfg. N.V.	Belgium		CON	Audio equipment
	Pioneer Electronic Technology	United States	California	CON	Audio equipment
	Pioneer Mfg. Australia	Australia	Victoria	CON	Audio equipment
38	Ricoh	United States	New Jersey	COMM	Facsimile machines
	Ricoh Electronics	United States	California	DP	Copiers
				COMM	Facsimile machines
	Ricoh Industrie France	France	Colmar	DP	Copiers
	Ricoh U.K. Products	United Kingdom	Telford	DP	Copiers
				COMM	Facsimile machines
	Taiwan-Ricoh	Taiwan	Taipei	CON	Photographic equipment
39	Sanden	N/A	N/A	N/A	N/A
40	Sankyo Seiki Mfg.	N/A	N/A	N/A	N/A
41	Sanyo Manufacturing Corp.	United States	Arkansas	CON	Color TVs
				CON	Microwave ovens
42	Sharp Electronics	United States	New Jersey	CON	Consumer electronics
	Sharp Electronics	United States	Tennessee	CON	Consumer electronics
	Sharp Electronics (U.K.)	United Kingdom	Manchester	CON	Consumer electronics
	Sharp Corp. of Australia	Australia	New South Wales	CON	Consumer electronics
43	Shimazu Scientific Instruments	United States	Maryland	IND	Measuring instruments
	Shimazu Europe	West Germany	Dusseldorf	IND	Measuring instruments

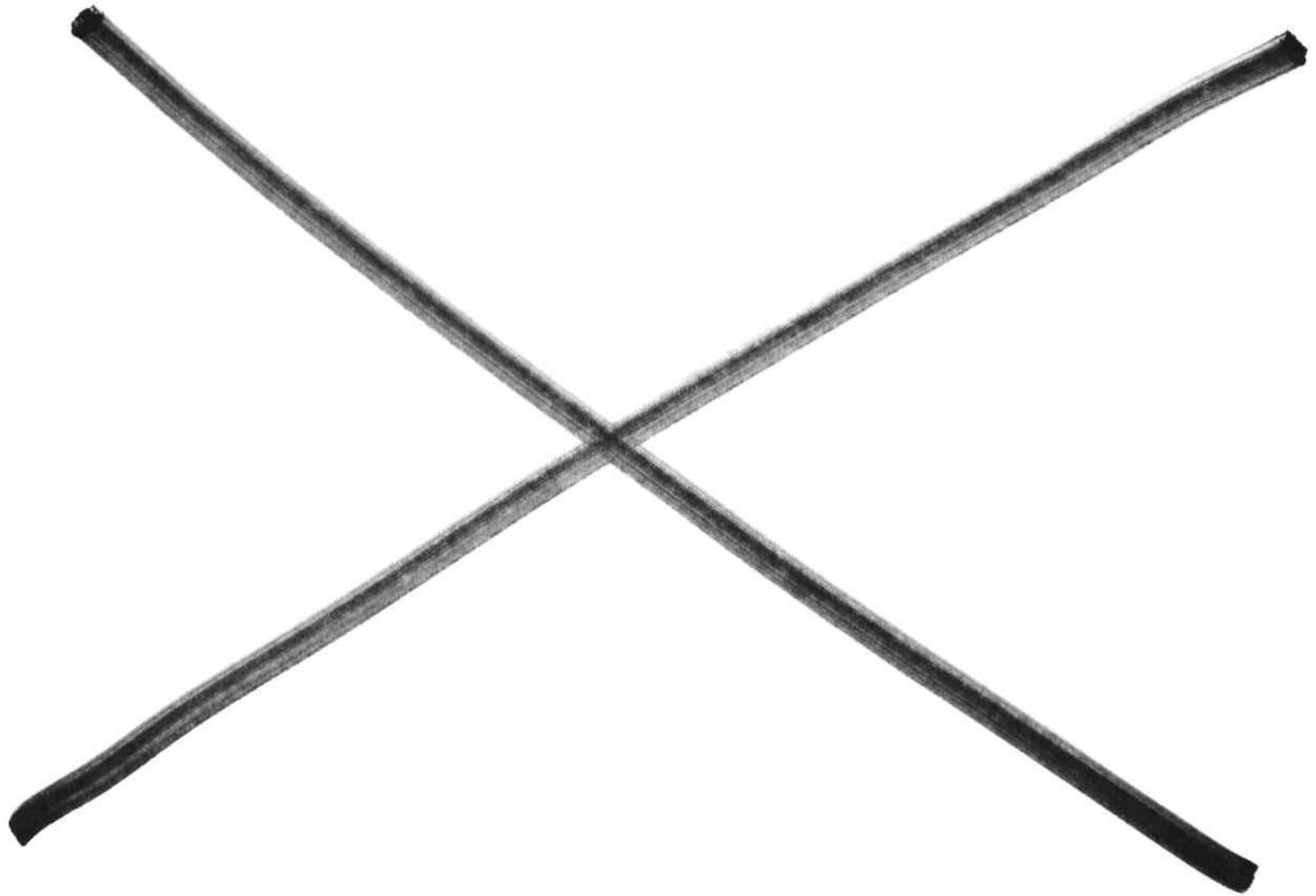
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## Factory Locations Abroad (Continued)

<u>#</u>	<u>Company</u>	<u>Country</u>	<u>City or State</u>	<u>Main LOB</u>	<u>Product</u>
44	Sony Corp. of America	United States	California	CON	Color TVs
	Sony (U.K.)	United Kingdom	Wales	CON	Consumer electronics
45	Tokyo Electric	N/A	N/A	N/A	N/A
46	Toshiba America	United States	New Jersey	CON	Consumer electronics
47	Victor of Japan	N/A	N/A	N/A	N/A
48	Yamatake Honeywell	N/A	N/A	N/A	N/A
49	Yaskawa Electric Mfg.	N/A	N/A	N/A	N/A
50	Yokogawa Corporation of America	United States	Georgia	IND	Industrial meters
	Yokogawa Electric Singapore	Singapore	Singapore	IND	Industrial meters

N/A = Not Applicable

Source: Dataquest  
February 1988





## Electronic Equipment Forecast

The following is a list of the material in this section:

- • Electronic Equipment Overview and Forecast
- Monthly Electronic Equipment Production

NOTE: The arrow symbol indicated the latest document(s) correct location behind the subject tab.

# **Electronic Equipment Overview and Forecast**

## **OVERVIEW**

This section presents the methodology used in structuring the forecast data on Japanese electronic equipment production, describes the organization of the tables, and provides the complete equipment database.

### **Methodology**

The "Electronic Equipment Forecast" section provides detailed information on the estimated production of electronic equipment in Japan for the years 1984 through 1994. This set of tables is the second of two major databases upon which the forecast of semiconductor consumption by application market is based.

The equipment shipment data presented here are used in conjunction with input/output ratios to generate semiconductor consumption estimates by application market. (For a more in-depth discussion on this subject, see the "Input/Output Ratios" section behind the tab entitled "Overview.")

The first database, located behind the tab entitled "Company Electronic Equipment Revenue," presents the electronic equipment revenue of various electronic equipment manufacturers. These data provide historical trend information on Japanese equipment manufacturers and serve as input for developing the I/O ratios that we use in our analysis.

Within the Japanese Semiconductor Application Markets service (JSAM), Dataquest uses the term "Japanese shipments" to refer to equipment produced in Japan. In this context, "shipments" does not refer to all products consumed within the Japanese market.

Data reflecting production in Japan are used in this database on the assumption that Japanese regional semiconductor consumption is more accurately forecast based on the current production of Japanese electronic equipment and the forecast growth rates of individual equipment types. Much of the currently available data on semiconductor consumption by application market was obtained through surveys of semiconductor manufacturers, and this tends to give a view that is one step removed from the geographic markets.

Japanese shipment statistics are gathered from the Japanese Ministry of International Trade and Industry (MITI). In the case of the forecast, input from a variety of sources is considered, including Dataquest's other industry sources, economic data, and industry associations.

The data published in the "Electronic Equipment Forecast" are based on the production value of the equipment. Production value is equal to the manufacturers' contract prices or the manufacturers' selling prices, excluding margin, warehouse, freight, insurance, and any other related costs. However, it does include tax and packaging.

### **Organization of the Electronic Equipment Forecast Tables**

The equipment forecast section contains a series of tables presenting the current and forecast shipments of electronic equipment produced in Japan, by application market segment, and by individual type of equipment. This information is presented both in terms of Japanese yen and U.S.

dollars. The first table in this series is an application market segment overview. The overview table presents a condensed version of each of the five segments: data processing, communications, industrial, consumer, and transportation. For each segment, the major equipment subcategories are shown. For example, communications has four subsegments: Customer Premises, Public Telecommunications, radio, and broadcast and studio.

The segment overview is followed by detailed tables for each of the five segments. For example, the communications segment has its own table, with the subsegments broken down into detailed equipment types and accompanied by their respective forecasts. To provide flexibility, all equipment types are presented as line items. Where possible, as in the case of medical electronic equipment in the industrial segment, we have supplied subtotals that make it easy to extract and relocate particular equipment types. Line item values and subtotals are provided for the convenience of binder users who may require more than five segments, or who need to reconfigure any of the segments to meet individual market segmentation requirements.

The percentage of growth in equipment in 1989 and the compound annual growth rate (CAGR) from 1989 through 1994 are calculated in the detailed tables. The years 1984 through 1988 are the common data points between the electronic equipment forecast and the information behind the preceding tab entitled "Company Electronic Equipment Revenue." The years 1990 through 1994 are more representative of a current four-year market forecast.

A discussion of the overall assumptions made in developing Dataquest's entire analysis of semiconductor consumption by application market, including segmentation and definitions of specific equipment types, is located behind the "Overview" tab of this binder.

Table 1 displays the exchange rates used for the yen-to-dollar conversion.

**Table 1**

**Yen-to-Dollar Exchange Rates**

<b>Year</b>	<b>Yen to Dollar</b>
1983	235
1984	237
1985	238
1986	167
1987	144
1988	130
1989	138

Source: Dataquest  
February 1990

**FORECAST**

Tables 2 through 13 present Dataquest's forecast for shipments of electronic equipment produced in Japan.

Table 2

Segment Overview Japanese Electronic Equipment Forecast  
(Billions of Yen)

Segment	Estimates						Forecast					CAGR	CAGR
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1988-1989	1989-1994
<b>Data Processing</b>													
Computers	1,106	1,367	1,551	1,781	2,167	2,663	3,001	3,240	3,577	4,002	4,230	22.9%	9.7%
Data Storage	634	787	956	1,023	1,115	1,221	1,294	1,360	1,472	1,606	1,663	9.5%	6.4%
Terminals	513	521	598	717	760	753	772	888	941	981	1,010	(1.0%)	6.1%
Input/Output	575	599	688	772	913	948	986	1,054	1,177	1,260	1,350	3.8%	7.3%
Dedicated Systems	1,059	1,146	964	861	904	1,023	1,027	1,047	1,133	1,220	1,202	13.2%	3.3%
Subtotal	3,888	4,421	4,757	5,152	5,860	6,608	7,080	7,588	8,299	9,069	9,455	12.8%	7.4%
<b>Communications</b>													
Customer Premises	622	907	901	959	1,139	1,268	1,385	1,479	1,569	1,667	1,787	11.3%	7.1%
Public Telecomm.	457	467	482	648	713	630	651	678	701	733	771	(11.6%)	4.1%
Radio	536	565	596	678	757	786	826	885	971	1,088	1,189	3.9%	8.6%
Broadcast and Studio	63	74	67	61	70	68	72	75	79	82	85	(3.0%)	4.7%
Subtotal	1,679	2,012	2,046	2,346	2,679	2,752	2,934	3,116	3,321	3,570	3,832	2.7%	6.8%
<b>Instrumentation</b>													
Manufacturing Systems	555	622	520	519	631	703	717	768	830	880	898	11.3%	5.0%
Medical	719	847	735	597	785	1,037	1,180	1,212	1,357	1,452	1,463	32.1%	7.1%
Others	390	441	489	528	557	582	599	640	709	753	773	4.5%	5.8%
Subtotal	411	459	470	478	621	676	709	752	887	934	976	8.8%	7.6%
Subtotal	2,075	2,370	2,214	2,122	2,594	2,998	3,205	3,373	3,783	4,018	4,111	15.6%	6.5%

(Continued)

Table 2 (Continued)

Segment Overview Japanese Electronic Equipment Forecast  
(Billions of Yen)

Segment	Estimates						Forecast					CAGR	CAGR
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1988-1989	1989-1994
Consumer													
Audio	1,038	1,004	898	751	805	787	732	677	665	640	593	(2.1%)	(5.5%)
Video	3,069	3,209	2,887	2,559	2,770	2,774	2,863	2,890	3,079	3,112	3,143	0.1%	2.5%
Personal Electronic	922	1,059	1,052	966	1,109	1,182	1,117	1,142	1,245	1,294	1,292	6.6%	1.8%
Appliances	1,687	1,902	1,849	1,841	2,013	1,999	1,915	2,024	2,168	2,166	2,240	(0.7%)	2.3%
Subtotal	6,716	7,174	6,686	6,117	6,696	6,742	6,627	6,733	7,157	7,211	7,269	0.7%	1.5%
Transportation	1,290	1,433	1,550	1,586	1,860	2,123	2,178	2,323	2,578	2,727	2,851	14.2%	6.1%
Total	15,648	17,410	17,252	17,323	19,689	21,223	22,024	23,133	25,138	26,596	27,517	7.8%	5.3%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
February 1990

Table 3

Segment Overview  
Japanese Electronic Equipment Forecast  
(Millions of Dollars)

Equipment Type	Estimates						Forecast					CAGR	CAGR
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1988-1989	1989-1994
Computers	4,668	5,743	9,287	12,365	16,672	19,158	20,983	22,656	25,014	27,987	29,578	14.9%	9.1%
Data Storage	2,675	3,309	5,723	7,101	8,576	8,782	9,050	9,509	10,292	11,230	11,628	2.4%	5.8%
Terminals	2,163	2,189	3,583	4,979	5,850	5,416	5,399	6,210	6,580	6,857	7,063	(7.4%)	5.5%
Input/Output	2,428	2,517	4,117	5,359	7,027	6,821	6,895	7,368	8,230	8,815	9,442	(2.9%)	6.7%
Dedicated Systems	4,469	4,817	5,772	5,978	6,952	7,363	7,183	7,320	7,920	8,533	8,405	5.9%	2.7%
Subtotal	16,403	18,575	28,482	35,781	45,077	47,541	49,510	53,062	58,037	63,422	66,116	5.5%	6.8%
Communications													
Customer Premises	2,626	3,809	5,396	6,659	8,763	9,120	9,686	10,340	10,973	11,660	12,497	4.1%	6.5%
Public Telecomm.	1,930	1,962	2,886	4,500	5,483	4,533	4,554	4,741	4,905	5,124	5,393	(17.3%)	3.5%
Radio	2,264	2,374	3,568	4,709	5,821	5,657	5,776	6,188	6,794	7,610	8,313	(2.8%)	8.0%
Broadcast and Studio	264	310	400	421	537	487	503	523	551	571	595	(9.3%)	4.1%
Subtotal	7,083	8,455	12,250	16,289	20,604	19,797	20,520	21,793	23,223	24,965	26,798	(3.9%)	6.2%
Industrial													
Instrumentation	2,343	2,613	3,115	3,604	4,854	5,054	5,015	5,370	5,806	6,151	6,281	4.1%	4.4%
Manufacturing Systems	3,033	3,560	4,402	4,146	6,038	7,462	8,250	8,478	9,492	10,155	10,232	23.6%	6.5%
Medical	1,646	1,852	2,927	3,667	4,285	4,187	4,189	4,477	4,957	5,263	5,407	(2.3%)	5.3%
Others	1,736	1,930	2,814	3,319	4,777	4,862	4,957	5,262	6,200	6,531	6,826	1.8%	7.0%
Subtotal	8,756	9,956	13,258	14,736	19,954	21,565	22,412	23,586	26,454	28,100	28,747	8.1%	5.9%

(Continued)

Table 3 (Continued)

**Segment Overview**  
**Japanese Electronic Equipment Forecast**  
(Millions of Dollars)

Equipment Type	1984	1985	Estimates		1988	1989	Forecast				1994	CAGR	CAGR
			1986	1987			1990	1991	1992	1993		1988-1989	1989-1994
Consumer													
Audio	4,379	4,218	5,376	5,215	6,190	5,665	5,118	4,733	4,648	4,475	4,148	(8.5%)	(6.0%)
Video	12,950	13,484	17,285	17,774	21,306	19,956	20,023	20,208	21,531	21,759	21,982	(6.3%)	2.0%
Personal													
Electronics	3,892	4,451	6,298	6,705	8,530	8,503	7,809	7,988	8,708	9,049	9,038	(0.3%)	1.2%
Appliances	7,117	7,992	11,074	12,785	15,485	14,381	13,391	14,153	15,164	15,144	15,663	(7.1%)	1.7%
Subtotal	28,338	30,145	40,033	42,479	51,510	48,504	46,341	47,082	50,050	50,428	50,831	(5.8%)	0.9%
Transportation	5,443	6,023	9,282	11,014	14,308	15,275	15,233	16,245	18,026	19,072	19,935	6.8%	5.5%
Total	66,023	73,153	103,306	120,299	151,453	152,682	154,015	161,768	175,790	185,986	192,427	0.8%	4.7%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
February 1990

Table 4

Segment Detail  
Japanese Data Processing Equipment Forecast  
(Billions of Yen)

Equipment Type	1984	1985	Estimates		1988	1989	Forecast					1994	CAGR 1988-1989	CAGR 1989-1994
<b>Computers</b>														
General-Purpose	663	834	985	1,166	1,354	1,421	1,488	1,551	1,605	1,650	1,686		5.0%	3.5%
Office	127	142	149	176	226	340	418	493	592	682	738		50.0%	16.8%
Personal	268	339	364	383	488	781	961	1,047	1,192	1,453	1,576		60.0%	15.1%
Control Purpose	49	53	52	56	99	121	134	149	188	217	230		22.0%	13.7%
Subtotal	1,106	1,367	1,551	1,781	2,167	2,663	3,001	3,240	3,577	4,002	4,230		22.9%	9.7%
<b>Data Storage</b>														
Rigid Disk Drives	331	517	615	655	721	851	910	944	1,020	1,135	1,174		18.0%	6.7%
Floppy Disk Drives	213	142	185	199	181	123	117	120	126	116	106		(32.0%)	(3.1%)
Others	90	129	156	169	213	247	267	296	326	355	383		16.0%	9.2%
Subtotal	634	787	956	1,023	1,115	1,221	1,294	1,360	1,472	1,606	1,663		9.5%	6.4%
<b>Terminal Equipment</b>	513	521	598	717	760	753	772	888	941	981	1,010		(1.0%)	6.1%
Subtotal	513	521	598	717	760	753	772	888	941	981	1,010		(1.0%)	6.1%
<b>Input/Output Unit</b>														
Printer	406	403	483	554	660	698	733	788	874	945	1,025		5.7%	8.0%
Display Unit	132	160	170	183	195	202	206	219	234	243	250		3.6%	4.3%
Miscellaneous	37	36	35	35	58	48	47	47	69	72	75		(17.2%)	9.3%
Subtotal	575	599	688	772	913	948	986	1,054	1,177	1,260	1,350		3.8%	7.3%

(Continued)



Table 4 (Continued)

**Segment Detail**  
**Japanese Data Processing Equipment Forecast**  
**(Billions of Yen)**

Equipment Type	1984	1985	Estimates		1988	1989	Forecast					CAGR 1988-1989	CAGR 1989-1994
			1986	1987			1990	1991	1992	1993	1994		
Dedicated Systems													
Copying Machines	552	601	484	434	442	457	434	443	456	474	455	3.5%	(0.1%)
Calculators	173	167	97	74	96	123	142	146	156	178	168	28.0%	6.4%
Word Processors	85	138	174	191	215	273	308	323	379	424	439	27.1%	9.9%
Typewriters	147	131	109	65	56	46	39	35	33	29	27	(17.0%)	(10.0%)
Cash Registers	103	109	100	96	95	123	104	100	108	114	112	30.0%	(1.8%)
Subtotal	1,059	1,146	964	861	904	1,023	1,027	1,047	1,133	1,220	1,202	13.2%	3.3%
Total Data Processing	3,888	4,421	4,757	5,152	5,860	6,608	7,080	7,588	8,299	9,069	9,455	12.8%	7.4%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
February 1990

Table 5

Segment Detail  
Japanese Data Processing Equipment Forecast  
(Millions of Dollars)

Equipment Type	Estimates						Forecast					CAGR	CAGR
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1988-1989	1989-1994
<b>Computers</b>													
General-Purpose	2,797	3,503	5,900	8,094	10,412	10,225	10,406	10,843	11,223	11,537	11,791	(1.8%)	2.9%
Office	536	595	895	1,222	1,741	2,443	2,923	3,449	4,138	4,771	5,158	40.3%	16.1%
Personal	1,131	1,423	2,180	2,659	3,756	5,620	6,720	7,322	8,336	10,162	11,021	49.6%	14.4%
Control	205	222	312	389	763	870	934	1,042	1,316	1,517	1,607	14.1%	13.0%
Subtotal	4,668	5,743	9,287	12,365	16,672	19,158	20,983	22,656	25,014	27,987	29,578	14.9%	9.1%
<b>Data Storage</b>													
Rigid Disk Drives	1,397	2,170	3,685	4,547	5,544	6,119	6,364	6,599	7,134	7,937	8,210	10.4%	6.1%
Floppy Disk Drives	899	597	1,107	1,379	1,394	887	819	839	881	811	738	(36.4%)	(3.6%)
Other	380	542	932	1,175	1,637	1,776	1,867	2,070	2,277	2,482	2,680	8.5%	8.6%
Subtotal	2,675	3,309	5,723	7,101	8,576	8,782	9,050	9,509	10,292	11,230	11,628	2.4%	(100.0%)
<b>Terminals</b>													
Terminals	2,163	2,189	3,583	4,979	5,850	5,416	5,399	6,210	6,580	6,857	7,063	(7.4%)	5.5%
Subtotal	2,163	2,189	3,583	4,979	5,850	5,416	5,399	6,210	6,580	6,857	7,063	(7.4%)	(100.0%)
<b>Input/Output</b>													
Printers	1,715	1,694	2,890	3,845	5,080	5,022	5,126	5,508	6,114	6,609	7,171	(1.1%)	7.4%
Other	156	151	210	243	446	345	351	351	512	538	559	(22.6%)	10.1%
Subtotal	1,871	1,845	3,099	4,088	5,527	5,368	5,477	5,859	6,626	7,147	7,730	(2.9%)	7.6%

(Continued)

Table 5 (Continued)

**Segment Detail**  
**Japanese Data Processing Equipment Forecast**  
(Millions of Dollars)

Equipment Type	1984	1985	Estimates				1990	Forecast				CAGR 1988-1989	CAGR 1989-1994
			1986	1987	1988	1989		1991	1992	1993	1994		
<b>Dedicated Systems</b>													
Copying Machines	2,329	2,525	2,898	3,014	3,400	3,291	3,035	3,098	3,189	3,316	3,184	(3.2%)	(0.7%)
Calculators	729	703	580	516	742	888	994	1,019	1,094	1,248	1,177	19.7%	5.8%
Word Processors	359	579	1,042	1,330	1,654	1,966	2,154	2,259	2,652	2,963	3,069	18.9%	9.3%
Typewriters	619	552	651	450	429	333	273	245	231	205	191	(22.4%)	(10.5%)
Cash Registers	433	457	600	668	728	885	727	699	755	801	785	21.6%	(2.4%)
Subtotal	4,469	4,817	5,772	5,978	6,952	7,363	7,183	7,320	7,920	8,533	8,405	5.9%	2.7%
<b>Total Data Processing</b>	15,846	17,902	27,464	34,510	43,577	46,087	48,092	51,553	56,432	43,667	45,713	5.8%	(100.0%)

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
February 1990

Table 6

Segment Detail  
Japanese Communications Equipment Forecast  
(Billions of Yen)

Equipment Type	Estimates						Forecast					CAGR	CAGR
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1988-1989	1989-1994
<b>Customer Premises</b>													
Telephones	73	101	102	111	156	201	243	265	279	292	308	29.1%	8.9%
Standard Telephone	N/A	51	38	32	27	21	18	15	12	10	9	(22.0%)	(16.4%)
Multifunction	N/A	24	29	39	53	63	73	79	85	89	96	18.3%	9.0%
Cordless	N/A	N/A	N/A	N/A	35	65	99	115	125	135	144	87.0%	17.0%
Others	N/A	26	35	40	41	52	53	55	57	58	60	27.1%	2.7%
Applied Telephones	71	61	67	61	45	49	51	51	51	52	50	8.0%	0.4%
Facsimiles	248	313	303	365	466	503	527	563	610	667	753	8.0%	8.4%
PBX Telephone Systems	N/A	82	102	104	111	112	119	128	136	143	154	0.6%	6.6%
Key Telephone Systems	231	205	182	138	123	129	126	129	133	139	142	5.0%	2.0%
Modems	N/A	44	43	69	83	73	76	79	81	82	72	(12.0%)	(0.2%)
Subtotal	622	907	901	959	1,139	1,268	1,385	1,479	1,569	1,667	1,787	11.3%	7.1%
<b>Public Telecomm.</b>													
Carrier Transmission	240	292	301	407	427	376	379	387	392	407	420	(12.0%)	2.3%
Central Office Switch	217	175	181	241	286	255	272	291	309	326	351	(11.0%)	6.7%
Subtotal	457	467	482	648	713	630	651	678	701	733	771	(11.6%)	4.1%
<b>Radio</b>													
Radio Communication	355	375	386	445	500	539	567	605	667	780	871	7.8%	10.1%
Applied Radio Equip.	181	190	210	233	256	247	259	280	304	308	317	(3.7%)	5.2%
Subtotal	536	565	596	678	757	786	826	885	971	1,088	1,189	3.9%	8.6%
<b>Broadcast and Studio</b>													
Broadcasting	63	74	67	61	70	68	72	75	79	82	85	(3.0%)	4.7%
Subtotal	63	74	67	61	70	68	72	75	79	82	85	(3.0%)	4.7%
<b>Total Communications</b>	<b>1,679</b>	<b>2,012</b>	<b>2,046</b>	<b>2,346</b>	<b>2,679</b>	<b>2,752</b>	<b>2,934</b>	<b>3,116</b>	<b>3,321</b>	<b>3,570</b>	<b>3,832</b>	<b>2.7%</b>	<b>6.8%</b>

Note: Columns may not add to totals shown because of rounding.  
N/A = Not Available

Source: Dataquest  
February 1990

Table 7

**Segment Detail**  
**Japanese Communications Equipment Forecast**  
(Millions of Dollars)

Equipment Type	Estimates						Forecast					CAGR	CAGR
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1988-1989	1989-1994
Telephones	306	424	611	771	1,200	1,448	1,698	1,853	1,950	2,043	2,155	20.7%	8.3%
Standard Telephone	N/A	214	228	222	208	152	125	105	87	71	60	(27.1%)	(16.8%)
Multifunction	N/A	101	174	271	408	451	508	555	592	623	675	10.6%	8.4%
Cordless	N/A	N/A	N/A	N/A	269	471	691	806	875	944	1,004	74.9%	16.3%
Others	N/A	109	210	278	315	375	374	387	396	405	416	18.9%	2.1%
Telephones Applied	300	256	401	424	346	350	355	353	355	361	346	1.0%	(0.2%)
Facsimiles	1,046	1,316	1,814	2,534	3,584	3,620	3,687	3,935	4,267	4,666	5,268	1.0%	7.8%
PBXs	N/A	345	611	722	854	803	836	893	949	1,000	1,075	(5.9%)	6.0%
Key Telephones	975	860	1,091	960	945	928	879	899	933	975	994	(1.8%)	1.4%
Modems	N/A	184	257	478	635	522	531	555	569	572	503	(17.7%)	(0.7%)
Subtotal	2,626	3,809	5,396	6,659	8,763	9,120	9,686	10,340	10,973	11,660	12,497	4.1%	6.5%
Public Telecomm.													
Transmission	1,014	1,227	1,802	2,826	3,283	2,702	2,650	2,705	2,743	2,845	2,936	(17.7%)	1.7%
Switching	916	735	1,084	1,674	2,200	1,831	1,905	2,036	2,162	2,279	2,457	(16.8%)	6.1%
Subtotal	1,930	1,962	2,886	4,500	5,483	4,533	4,554	4,741	4,905	5,124	5,393	(17.3%)	3.5%
Radio													
Communications	1,498	1,576	2,309	3,088	3,849	3,881	3,965	4,232	4,668	5,457	6,093	0.8%	9.4%
Applied	765	798	1,259	1,621	1,972	1,776	1,811	1,956	2,126	2,154	2,220	(9.9%)	4.6%
Subtotal	2,264	2,374	3,568	4,709	5,821	5,657	5,776	6,188	6,794	7,610	8,313	(2.8%)	8.0%
Broadcast and Studio													
Broadcasting	264	310	400	421	537	487	503	523	551	571	595	(9.3%)	4.1%
Subtotal	264	310	400	421	537	487	503	523	551	571	595	(9.3%)	(100.0%)
Total													
Communications	7,083	8,455	12,250	16,289	20,604	19,797	20,520	21,793	23,223	24,394	26,203	(3.9%)	5.8%

Note: Columns may not add to totals shown because of rounding.  
N/A = Not Available

Source: Dataquest  
February 1990

Table 8

Segment Detail  
Japanese Industrial Equipment Forecast  
(Billions of Yen)

Equipment Type	1984	1985	Estimates		1988	1989	Forecast				1994	CAGR	CAGR
			1986	1987			1990	1991	1992	1993		1988-1989	1989-1994
<b>Instruments</b>													
Meter Units	41	40	38	39	45	42	39	38	37	40	39	(6.2%)	(1.4%)
Measuring Instruments	289	339	243	243	302	339	347	384	426	457	468	12.3%	6.7%
Industrial Meters	225	243	239	237	284	321	331	345	367	383	391	13.1%	4.0%
Subtotal	555	622	520	519	631	703	717	768	830	880	898	11.3%	5.0%
<b>Manufacturing Systems</b>													
NC Machines	590	704	611	487	621	824	956	975	1,073	1,141	1,143	32.7%	6.8%
Robotics	129	144	124	110	164	213	224	237	285	311	320	30.0%	8.5%
Subtotal	719	847	735	597	785	1,037	1,180	1,212	1,357	1,452	1,463	32.1%	7.1%
<b>Medical</b>													
X-Ray Systems	119	132	139	147	161	171	180	193	211	220	227	6.5%	5.8%
Measuring Systems	49	52	48	52	53	51	49	51	54	56	55	(3.8%)	1.5%
Others	222	257	302	329	343	359	370	396	444	476	491	4.8%	6.4%
Subtotal	390	441	489	528	557	582	599	640	709	753	773	4.5%	5.8%
<b>Others</b>													
Vending Machines	164	160	168	210	268	255	260	278	320	304	307	(4.9%)	3.8%
Flight Simulators	6	9	4	5	9	2	6	9	9	10	11	(80.0%)	43.6%
Television Equip.	30	35	82	79	110	121	123	136	157	171	183	10.0%	8.6%
Electron Microscope	26	33	32	28	30	39	45	48	59	64	67	30.0%	11.5%
Miscellaneous	185	222	184	156	204	259	275	282	341	385	408	27.0%	9.5%
Subtotal	411	459	470	478	621	676	709	752	887	934	976	8.8%	7.6%
<b>Total Industrial</b>	<b>2,075</b>	<b>2,370</b>	<b>2,214</b>	<b>2,122</b>	<b>2,594</b>	<b>2,998</b>	<b>3,205</b>	<b>3,373</b>	<b>3,783</b>	<b>4,018</b>	<b>4,111</b>	<b>15.6%</b>	<b>6.5%</b>

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
February 1990

Table 9

**Segment Detail**  
**Japanese Industrial Equipment Forecast**  
(Millions of Dollars)

Equipment Type	Estimates						Forecast					CAGR	CAGR
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1988-1989	1989-1994
Meter Units	172	168	228	271	346	304	271	268	259	282	275	(12.3%)	(2.0%)
Measuring Instruments	1,221	1,423	1,455	1,688	2,323	2,440	2,429	2,686	2,979	3,193	3,273	5.0%	6.1%
Industrial Meters	950	1,022	1,431	1,646	2,185	2,311	2,316	2,415	2,568	2,675	2,733	5.8%	3.4%
Subtotal	2,343	2,613	3,115	3,604	4,854	5,054	5,015	5,370	5,806	6,151	6,281	4.1%	4.4%
Manufacturing Systems													
NC Machines	2,489	2,957	3,660	3,382	4,777	5,929	6,685	6,818	7,500	7,980	7,996	24.1%	6.2%
Robotics	543	603	743	764	1,262	1,534	1,565	1,659	1,991	2,175	2,237	21.6%	7.8%
Subtotal	3,033	3,560	4,402	4,146	6,038	7,462	8,250	8,478	9,492	10,155	10,232	23.6%	6.5%
Medical													
X-Ray Systems	502	554	831	1,021	1,238	1,234	1,257	1,350	1,476	1,541	1,587	(0.4%)	5.2%
Measuring Systems	207	218	287	361	408	367	343	357	378	391	385	(10.0%)	0.9%
Other	937	1,080	1,808	2,285	2,638	2,586	2,589	2,770	3,103	3,331	3,436	(2.0%)	5.8%
Subtotal	1,646	1,852	2,927	3,667	4,285	4,187	4,189	4,477	4,957	5,263	5,407	(2.3%)	5.3%
Other													
Vending Machines	693	674	1,006	1,458	2,062	1,835	1,818	1,945	2,237	2,125	2,150	(11.0%)	3.2%
Flight Simulators	25	38	24	35	69	13	42	63	63	70	77	(81.3%)	42.8%
Television Equip.	127	147	491	549	846	871	863	949	1,101	1,196	1,279	2.9%	8.0%
Electron Microscope	110	139	192	194	231	281	313	334	415	448	469	21.6%	10.8%
Miscellaneous	781	933	1,102	1,083	1,569	1,863	1,922	1,970	2,384	2,692	2,850	18.7%	8.9%
Subtotal	1,736	1,930	2,814	3,319	4,777	4,862	4,957	5,262	6,200	6,531	6,826	1.8%	7.0%
Total Industrial	8,756	9,956	13,258	14,736	19,954	21,565	22,412	23,586	26,454	28,100	28,747	8.1%	5.9%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
February 1990

Table 10

Segment Detail  
Japanese Consumer Equipment Forecast  
(Billions of Yen)

Equipment Type	1984	1985	Estimates		1988	1989	Forecast					1988-1989	CAGR 1989-1994
			1986	1987			1990	1991	1992	1993	1994		
<b>Audio</b>													
Audio Amplifiers	155	140	110	111	104	98	92	90	90	87	81	(5.5%)	(3.7%)
DAD Players	46	151	200	155	176	146	129	112	103	98	91	(17.0%)	(9.1%)
Radios	38	34	32	25	25	24	22	20	18	16	14	(4.0%)	(9.9%)
Stereo Sets	58	86	133	130	141	166	166	149	157	159	143	18.0%	(2.9%)
Tape Recorders	655	506	326	249	281	264	238	223	210	200	188	(6.0%)	(6.6%)
Headphone Stereos	86	87	98	81	78	89	85	82	87	81	75	14.0%	(3.2%)
Subtotal	1,038	1,004	898	751	805	787	732	677	665	640	593	(2.1%)	(5.5%)
<b>Video</b>													
VCRs	2,090	1,889	1,659	1,243	1,212	1,218	1,261	1,235	1,277	1,229	1,194	0.5%	(0.4%)
Video Cameras	155	354	417	483	645	613	643	708	814	854	871	(5.0%)	7.3%
Video Disc Players	48	54	50	48	79	102	117	120	134	144	154	30.0%	8.5%
Color TVs	756	897	724	765	814	818	817	801	825	851	887	0.5%	1.6%
B&W TVs	21	14	11	4	1	1	0	0	0	0	0	(26.7%)	(100.0%)
LCD TVs	N/A	0	25	16	19	22	24	26	28	33	37	15.0%	10.9%
Subtotal	3,069	3,209	2,887	2,559	2,770	2,774	2,863	2,890	3,079	3,112	3,143	0.1%	2.5%
<b>Personal Electronics</b>													
Cameras	350	368	375	336	319	332	332	339	354	370	375	4.0%	2.5%
Sewing Machines	53	43	37	37	34	30	26	24	21	20	19	(12.2%)	(8.8%)
Watches	305	329	280	239	270	267	241	236	247	254	242	(1.0%)	(1.9%)
Clocks	103	99	99	90	95	93	92	88	90	88	86	(1.9%)	(1.5%)
Musical Instruments	111	113	109	132	162	150	147	138	147	130	125	(7.0%)	(3.5%)
Electric Toys	N/A	107	152	131	229	309	278	318	387	433	444	35.0%	7.5%
Subtotal	922	1,059	1,052	966	1,109	1,182	1,117	1,142	1,245	1,294	1,292	6.6%	1.8%

(Continued)



Table 10 (Continued)

**Segment Detail**  
**Japanese Consumer Equipment Forecast**  
**(Billions of Yen)**

Equipment Type	1984	1985	Estimates		1988	1989	Forecast					CAGR 1988-1989	CAGR 1989-1994
			1986	1987			1990	1991	1992	1993	1994		
<b>Appliances</b>													
Air Conditioners	755	915	898	915	1,109	1,130	1,107	1,241	1,365	1,351	1,443	1.9%	5.0%
Microwave Ovens	262	278	271	241	198	166	133	113	102	97	94	(16.1%)	(10.7%)
Rice Cookers	59	68	76	65	68	76	76	80	84	87	85	12.0%	2.3%
Fans	36	45	42	32	30	19	16	12	10	9	7	(35.1%)	(18.5%)
Fan Heaters	19	22	31	26	30	38	42	40	44	48	51	28.3%	5.8%
Washing Machines	140	139	134	138	153	161	157	157	165	171	168	5.0%	0.9%
Refrigerators	415	435	397	424	425	408	384	380	399	404	391	(4.0%)	(0.8%)
Subtotal	1,687	1,902	1,849	1,841	2,013	1,999	1,915	2,024	2,168	2,166	2,240	(0.7%)	2.3%
Total Consumer	6,716	7,174	6,686	6,117	6,696	6,742	6,627	6,733	7,157	7,211	7,269	0.7%	1.5%

Note: Columns may not add to totals shown because of rounding.  
N/A = Not Available

Source: Dataquest  
February 1990

Table 11

Segment Detail  
Japanese Consumer Equipment Forecast  
(Millions of Dollars)

Equipment Type	Estimates						Forecast					CAGR	CAGR
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1988-1989	1989-1994
<b>Audio</b>													
Audio Amplifiers	655	587	657	771	800	707	643	630	630	605	568	(11.6%)	(4.3%)
DAD Players	192	634	1,195	1,076	1,354	1,051	899	782	720	683	635	(22.4%)	(9.6%)
Radios	159	143	190	174	192	173	156	140	124	112	100	(10.2%)	(10.4%)
Stereo Sets	246	359	794	903	1,082	1,194	1,161	1,045	1,097	1,109	1,003	10.4%	(3.4%)
Tape Recorders	2,764	2,128	1,953	1,729	2,162	1,900	1,662	1,563	1,469	1,399	1,315	(12.1%)	(7.1%)
Headphone Stereos	N/A	366	587	563	600	640	597	573	609	567	527	6.6%	(3.8%)
Subtotal	4,016	4,218	5,376	5,215	6,190	5,665	5,118	4,733	4,648	4,475	4,148	(8.5%)	(6.0%)
<b>Video</b>													
VCRs	8,819	7,938	9,934	8,632	9,323	8,763	8,816	8,640	8,933	8,593	8,352	(6.0%)	(1.0%)
Video Cameras	654	1,489	2,498	3,354	4,962	4,408	4,499	4,949	5,692	5,974	6,090	(11.2%)	6.7%
Video Disc Players	201	228	302	335	604	734	821	837	938	1,009	1,075	21.6%	7.9%
Color TVs	3,189	3,769	4,334	5,313	6,262	5,885	5,715	5,601	5,769	5,952	6,204	(6.0%)	1.1%
B&W TVs	87	60	68	28	6	4	3	3	2	0	0	(31.5%)	(100.0%)
LCD TVs	N/A	0	149	112	149	161	169	179	197	231	262	7.6%	10.3%
Subtotal	12,950	13,484	17,285	17,774	21,306	19,956	20,023	20,208	21,531	21,759	21,982	(6.3%)	2.0%
<b>Personal Electronics</b>													
Cameras	1,476	1,545	2,247	2,335	2,457	2,389	2,323	2,373	2,472	2,584	2,623	(2.7%)	1.9%
Sewing Machines	224	181	222	257	262	215	184	165	145	139	132	(17.9%)	(9.3%)
Watches	1,286	1,382	1,674	1,660	2,077	1,923	1,682	1,649	1,727	1,778	1,695	(7.4%)	(2.5%)
Clocks	436	415	593	625	731	670	645	613	631	615	605	(8.3%)	(2.0%)
Musical Instruments	470	476	651	918	1,243	0	0	0	0	908	878	(100.0%)	N/A
Electric Toys	N/A	452	911	911	1,761	2,224	0	0	0	3,027	3,107	26.3%	6.9%
Subtotal	3,892	3,999	5,387	5,794	6,769	5,198	4,834	4,800	4,976	6,022	5,932	(23.2%)	2.7%

(Continued)

Table 11 (Continued)

**Segment Detail**  
**Japanese Consumer Equipment Forecast**  
(Millions of Dollars)

Equipment Type	1984	1985	Estimates		1988	1989	Forecast					CAGR 1988-1989	CAGR 1989-1994
			1986	1987			1990	1991	1992	1993	1994		
<b>Appliances</b>													
Air Conditioners	3,187	3,843	5,377	6,354	8,531	8,130	7,745	8,678	9,546	9,445	10,094	(4.7%)	4.4%
Microwave Ovens	1,107	1,168	1,625	1,674	1,523	1,195	929	790	711	681	660	(21.5%)	(11.2%)
Rice Cookers	251	285	454	451	523	548	533	559	587	606	596	4.7%	1.7%
Fans	152	190	253	222	231	140	109	87	70	63	49	(39.3%)	(19.0%)
Fan Heaters	79	94	184	181	231	277	293	282	306	332	357	20.0%	5.2%
Washing Machines	589	582	802	958	1,177	1,156	1,101	1,101	1,156	1,193	1,173	(1.8%)	0.3%
Refrigerators	1,752	1,828	2,378	2,944	3,269	2,935	2,682	2,655	2,788	2,823	2,734	(10.2%)	(1.4%)
Subtotal	7,117	7,992	11,074	12,785	15,485	14,381	13,391	14,153	15,164	15,144	15,663	(7.1%)	1.7%
Total Consumer	27,975	29,693	39,122	41,568	49,749	45,200	43,366	43,894	46,319	47,401	47,725	(9.1%)	1.1%

Note: Columns may not add to totals shown because of rounding.  
N/A = Not Available

Source: Dataquest  
February 1990

Table 12

**Segment Detail**  
**Japanese Transportation Equipment Forecast**  
 (Billions of Yen)

Equipment Type	1984	1985	Estimates		1988	1989	Forecast					CAGR 1988-1989	CAGR 1989-1994
			1986	1987			1990	1991	1992	1993	1994		
Entertainment	255	265	262	278	284	285	279	287	296	304	302	0.2%	1.2%
Body Control	252	281	348	260	276	288	292	301	315	322	329	4.5%	2.7%
Power Train	226	260	302	408	592	804	836	920	1,104	1,197	1,273	35.8%	9.6%
Safety and Convenience	427	487	495	500	565	594	614	652	690	724	759	5.2%	5.0%
Driver Information	130	140	143	140	143	152	157	163	174	181	188	6.2%	4.3%
Total Transportation	1,290	1,433	1,550	1,586	1,860	2,123	2,178	2,323	2,578	2,727	2,851	14.2%	6.1%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
February 1990

Table 13

**Segment Detail**  
**Japanese Transportation Equipment Forecast**  
(Millions of Dollars)

Equipment Type	Estimates						Forecast					CAGR	CAGR
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1988-1989	1989-1994
Entertainment	1,075	1,115	1,569	1,931	2,185	2,047	2,009	2,062	2,128	2,187	2,172	(6.3%)	1.2%
Body Control	1,063	1,181	2,084	1,806	2,123	2,075	2,102	2,167	2,265	2,317	2,367	(2.3%)	2.7%
Power Train	954	1,092	1,808	2,833	4,554	5,784	6,016	6,617	7,941	8,611	9,159	27.0%	9.6%
Safety and Convenience	1,802	2,046	2,964	3,472	4,346	4,276	4,417	4,691	4,964	5,206	5,459	(1.6%)	5.0%
Driver Information	549	588	856	972	1,100	1,093	1,127	1,175	1,248	1,300	1,351	(0.7%)	4.3%
<b>Total Transportation</b>	<b>5,443</b>	<b>6,023</b>	<b>9,282</b>	<b>11,014</b>	<b>14,308</b>	<b>15,275</b>	<b>15,671</b>	<b>16,712</b>	<b>18,545</b>	<b>19,621</b>	<b>20,508</b>	<b>6.8%</b>	<b>6.1%</b>

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
February 1990

# Monthly Electronic Equipment Production

## SUMMARY

This section presents monthly production, inventory, and shipment statistics for the following 12 categories of electronic equipment in Japan:

- Calculators
- Computer storage equipment
- Copiers
- Digital audio disk players
- Facsimile equipment
- Microwave ovens
- Personal computers
- Robots (industrial)
- Telephones
- Televisions (color)
- Word processors
- VCRs

## DEFINITIONS AND DATA SOURCES

The source of all data in this section is the Japanese Ministry of International Trade and Industry's (MITI) monthly machinery statistics. Where available, tables and figures include:

- **Production**—All products manufactured in Japan, as reported to MITI by manufacturers
- **Inventory**—All finished goods in manufacturers' inventories, at month end, as reported to MITI by manufacturers
- **Shipments**—Production, plus or minus monthly change in inventory, as calculated by Dataquest from MITI data

# Monthly Electronic Equipment Production

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# Monthly Electronic Equipment Production

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# Monthly Electronic Equipment Production

Table 1

## Japanese Calculator Production (Thousands of Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1983	JAN	4,627	10,479	3,133	N/A
	FEB	5,116	11,205	3,294	4,955
	MAR	5,264	11,763	2,482	6,076
	APR	5,161	11,241	2,900	4,743
	MAY	5,116	10,556	3,008	5,008
	JUN	5,640	11,348	2,902	5,746
	JUL	5,849	11,640	3,058	5,693
	AUG	5,426	11,586	2,892	5,592
	SEP	5,883	12,946	2,411	6,364
	OCT	5,815	12,659	2,808	5,418
	NOV	6,038	13,275	3,020	5,826
	DEC	<u>6,612</u>	<u>14,074</u>	3,462	<u>6,170</u>
Total		66,547	142,772	3,462	N/A
1984	JAN	5,592	12,666	3,322	5,732
	FEB	6,396	14,198	3,263	6,455
	MAR	6,379	14,160	2,790	6,852
	APR	6,833	14,437	3,342	6,281
	MAY	6,633	13,838	3,726	6,249
	JUN	7,590	15,171	3,983	7,333
	JUL	7,527	14,859	4,199	7,311
	AUG	7,240	14,290	4,369	7,070
	SEP	7,369	14,512	4,358	7,380
	OCT	7,270	14,780	4,360	7,268
	NOV	7,549	14,948	4,440	7,469
	DEC	<u>7,453</u>	<u>14,797</u>	4,477	<u>7,416</u>
Total		83,831	172,656	4,477	82,816

N/A = Not Available

(Continued)

# Monthly Electronic Equipment Production

Table 1 (Continued)

Japanese Calculator Production  
(Thousands of Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1985	JAN	6,561	13,597	3,950	7,088
	FEB	8,035	16,866	4,268	7,717
	MAR	7,696	16,559	4,544	7,420
	APR	7,754	16,430	4,395	7,903
	MAY	7,181	15,631	4,376	7,200
	JUN	7,621	16,342	4,828	7,169
	JUL	8,310	15,571	5,160	7,978
	AUG	6,756	11,782	4,817	7,099
	SEP	7,312	12,141	3,781	8,348
	OCT	5,884	9,541	3,514	6,151
	NOV	6,753	11,457	4,125	6,142
	DEC	<u>6,632</u>	<u>11,532</u>	4,216	<u>6,541</u>
Total		86,495	167,449	4,216	86,756
1986	JAN	6,609	11,016	4,794	6,031
	FEB	6,959	11,413	5,407	6,346
	MAR	5,882	10,105	4,476	6,813
	APR	5,261	8,484	4,344	5,393
	MAY	5,312	8,467	4,603	5,053
	JUN	5,516	7,425	4,650	5,469
	JUL	4,958	6,970	4,607	5,001
	AUG	4,703	6,740	4,485	4,825
	SEP	5,534	7,192	3,303	6,716
	OCT	4,193	5,644	3,441	4,055
	NOV	4,543	6,348	3,461	4,523
	DEC	<u>4,740</u>	<u>7,060</u>	3,300	<u>4,901</u>
Total		64,210	96,864	3,300	65,126

(Continued)

# Monthly Electronic Equipment Production

Table 1 (Continued)

## Japanese Calculator Production (Thousands of Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1987	JAN	3,623	5,993	3,391	3,532
	FEB	4,829	7,142	3,514	4,706
	MAR	4,583	7,272	2,674	5,423
	APR	4,446	5,755	2,913	4,207
	MAY	4,087	5,550	3,085	3,915
	JUN	3,955	5,674	3,017	4,023
	JUL	4,312	5,645	2,647	4,682
	AUG	<u>4,510</u>	<u>5,375</u>	2,617	<u>4,540</u>
YTD Total		34,345	48,772	2,617	35,028

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 2

## Japanese Computer Storage Equipment Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>
1983	JAN	68,982
	FEB	79,351
	MAR	101,773
	APR	119,647
	MAY	128,209
	JUN	176,000
	JUL	226,464
	AUG	239,369
	SEP	251,523
	OCT	298,124
	NOV	327,979
	DEC	<u>393,113</u>
Total		2,410,534
1984	JAN	422,618
	FEB	454,462
	MAR	593,994
	APR	531,963
	MAY	459,221
	JUN	510,017
	JUL	524,805
	AUG	399,307
	SEP	440,119
	OCT	408,917
	NOV	399,496
	DEC	<u>385,132</u>
Total		5,530,051

(Continued)

# Monthly Electronic Equipment Production

Table 2 (Continued)

## Japanese Computer Storage Equipment Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>
1985	JAN	550,273
	FEB	538,797
	MAR	588,306
	APR	505,084
	MAY	484,170
	JUN	516,086
	JUL	579,671
	AUG	576,659
	SEP	617,952
	OCT	593,337
	NOV	611,056
	DEC	<u>709,574</u>
Total		6,870,965
1986	JAN	762,258
	FEB	1,010,806
	MAR	1,113,514
	APR	1,136,004
	MAY	1,162,269
	JUN	1,491,263
	JUL	1,520,149
	AUG	1,306,140
	SEP	1,524,553
	OCT	1,392,832
	NOV	1,236,135
	DEC	<u>1,525,916</u>
Total		15,181,839

(Continued)

# Monthly Electronic Equipment Production

Table 2 (Continued)

## Japanese Computer Storage Equipment Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>
1987	JAN	1,395,566
	FEB	1,676,966
	MAR	1,777,644
	APR	1,623,436
	MAY	1,687,284
	JUN	2,082,141
	JUL	2,031,376
	AUG	<u>1,702,507</u>
YTD Total		13,976,920

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 3

## Japanese Copier Production\* (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1983	JAN	123,908	37,033	118,504	N/A
	FEB	139,898	35,523	114,396	144,006
	MAR	156,837	38,334	106,731	164,502
	APR	153,848	38,086	112,465	148,114
	MAY	152,234	37,154	120,405	144,294
	JUN	170,054	42,536	119,033	171,426
	JUL	179,771	43,898	130,339	168,465
	AUG	165,609	40,216	133,720	162,228
	SEP	185,026	47,680	139,680	179,066
	OCT	162,839	42,107	137,561	164,958
	NOV	169,180	45,386	145,387	161,354
	DEC	<u>164,875</u>	<u>43,920</u>	157,977	<u>152,285</u>
Total		1,924,079	491,873	157,977	N/A
1984	JAN	159,177	39,703	158,456	158,698
	FEB	183,594	45,851	169,891	172,159
	MAR	189,915	46,123	153,477	206,329
	APR	194,608	45,963	160,966	187,119
	MAY	183,809	43,112	168,127	176,648
	JUN	214,020	50,425	189,274	192,873
	JUL	209,866	48,306	182,089	217,051
	AUG	193,428	43,511	197,195	178,322
	SEP	210,847	53,844	192,887	215,155
	OCT	202,711	48,411	200,381	195,217
	NOV	192,352	48,201	202,189	190,544
	DEC	<u>205,511</u>	<u>48,704</u>	205,485	<u>202,215</u>
Total		2,339,838	562,154	205,485	2,292,330

\*In 1986 and 1987, includes electrostatic indirect copiers only. Prior to 1986, includes direct copiers as well.

N/A = Not Available

(Continued)

# Monthly Electronic Equipment Production

Table 3 (Continued)

## Japanese Copier Production\* (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1985	JAN	181,175	42,879	207,552	179,108
	FEB	214,010	50,909	217,828	203,734
	MAR	222,031	50,897	203,926	235,933
	APR	226,517	52,525	181,213	249,230
	MAY	211,693	50,376	190,475	202,431
	JUN	233,261	55,057	202,978	220,758
	JUL	250,857	58,202	230,460	223,375
	AUG	199,518	45,560	235,125	194,853
	SEP	230,914	55,328	199,266	266,773
	OCT	260,357	58,657	211,395	248,228
	NOV	233,098	50,729	210,536	233,957
	DEC	<u>237,334</u>	<u>50,901</u>	221,683	<u>226,187</u>
Total		2,700,765	622,020	221,683	2,684,567
1986	JAN	183,337	40,775	216,811	188,209
	FEB	203,506	46,942	227,990	192,327
	MAR	218,533	49,061	218,828	227,695
	APR	179,177	41,126	211,381	186,624
	MAY	176,654	38,969	227,600	160,435
	JUN	190,774	41,473	222,460	195,914
	JUL	213,533	40,509	224,874	211,119
	AUG	187,588	33,231	229,437	183,025
	SEP	230,098	41,385	246,235	213,300
	OCT	211,330	38,385	263,769	193,796
	NOV	191,885	35,754	268,641	187,013
	DEC	<u>206,374</u>	<u>36,719</u>	283,706	<u>191,309</u>
Total		2,392,789	484,329	283,706	2,330,766

\*In 1986 and 1987, includes electrostatic indirect copiers only. Prior to 1986, includes direct copiers as well.

(Continued)



# Monthly Electronic Equipment Production

Table 3 (Continued)

Japanese Copier Production\*  
(Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1987	JAN	161,108	32,261	277,528	167,286
	FEB	190,877	37,915	277,671	190,734
	MAR	181,507	39,456	270,108	189,070
	APR	160,353	31,484	269,463	160,998
	MAY	158,701	31,192	248,397	179,767
	JUN	186,399	37,970	251,987	182,809
	JUL	196,779	38,912	249,621	199,145
	AUG	<u>166,967</u>	<u>33,011</u>	226,362	<u>190,226</u>
YTD Total		1,402,691	282,201	226,362	1,460,035

\*In 1986 and 1987, includes electrostatic indirect copiers only. Prior to 1986, includes direct copiers as well.

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 4

## Japanese Production of Digital Audio Disk Players (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1984	JAN	38,548	2,338	55,513	N/A
	FEB	43,400	2,908	63,374	35,539
	MAR	47,056	3,071	61,897	48,533
	APR	40,275	2,470	55,908	46,264
	MAY	43,974	2,791	57,729	42,153
	JUN	56,090	3,448	58,621	55,198
	JUL	57,705	3,953	62,028	54,298
	AUG	59,526	3,920	70,081	51,473
	SEP	73,566	4,417	83,513	60,134
	OCT	91,746	4,989	81,026	94,233
	NOV	103,080	5,409	76,134	107,972
	DEC	<u>113,587</u>	<u>5,872</u>	72,136	<u>117,585</u>
Total		768,553	45,586	72,136	N/A
1985	JAN	102,975	5,298	89,806	85,305
	FEB	141,964	6,853	98,113	133,657
	MAR	202,893	9,614	105,048	195,958
	APR	225,879	9,606	122,284	208,643
	MAY	261,271	10,331	143,739	239,816
	JUN	301,624	11,482	172,465	272,898
	JUL	334,704	12,408	174,502	332,667
	AUG	335,041	11,872	179,422	330,121
	SEP	475,036	15,915	180,193	474,265
	OCT	528,629	17,134	211,367	497,455
	NOV	601,655	19,498	288,014	525,008
	DEC	<u>621,333</u>	<u>20,861</u>	326,889	<u>582,458</u>
Total		4,133,004	150,872	326,889	3,878,251

N/A = Not Available

(Continued)

# Monthly Electronic Equipment Production

Table 4 (Continued)

## Japanese Production of Digital Audio Disk Players (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1986	JAN	536,413	16,930	379,572	483,730
	FEB	670,971	20,143	470,124	580,419
	MAR	737,616	19,785	443,569	764,171
	APR	680,139	18,312	514,163	609,545
	MAY	660,861	16,622	609,457	565,567
	JUN	710,617	18,098	665,180	654,894
	JUL	682,516	17,237	666,218	681,478
	AUG	610,676	13,829	614,637	662,257
	SEP	639,780	16,033	579,275	675,142
	OCT	514,506	14,906	603,183	490,598
	NOV	460,168	13,698	603,398	459,953
	DEC	<u>442,793</u>	<u>13,997</u>	530,678	<u>515,513</u>
Total		7,347,056	199,590	530,678	7,143,267
1987	JAN	341,594	9,980	545,700	326,572
	FEB	376,919	9,849	518,343	404,276
	MAR	515,439	12,893	529,842	503,940
	APR	508,158	11,466	615,698	422,302
	MAY	559,692	12,416	555,698	619,692
	JUN	673,652	14,112	892,357	336,993
	JUL	704,548	14,586	824,429	772,476
	AUG	<u>588,380</u>	<u>11,278</u>	666,776	<u>746,033</u>
YTD Total		4,268,381	96,580	666,776	4,123,283

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 5

## Japanese Facsimile Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Units</u>	<u>Production (Yen)</u>
1982	JAN	14,512	9,499
	FEB	15,640	10,512
	MAR	19,083	14,481
	APR	18,515	12,868
	MAY	17,247	10,412
	JUN	19,806	10,462
	JUL	19,804	11,116
	AUG	20,668	11,528
	SEP	23,820	14,801
	OCT	20,526	11,441
	NOV	20,764	13,594
	DEC	<u>18,816</u>	<u>12,278</u>
Total		229,201	142,992
1983	JAN	18,237	10,339
	FEB	21,392	11,687
	MAR	23,043	13,688
	APR	20,282	11,064
	MAY	21,632	12,553
	JUN	22,312	12,273
	JUL	26,014	13,776
	AUG	23,354	12,445
	SEP	34,518	19,271
	OCT	29,635	15,825
	NOV	32,470	18,905
	DEC	<u>31,455</u>	<u>17,047</u>
Total		304,344	168,873

(Continued)

# Monthly Electronic Equipment Production

Table 5 (Continued)

## Japanese Facsimile Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Units</u>	<u>Production (Yen)</u>
1984	JAN	31,935	16,550
	FEB	36,625	19,046
	MAR	43,895	23,590
	APR	39,424	19,761
	MAY	39,733	19,503
	JUN	42,012	20,073
	JUL	41,777	20,211
	AUG	39,856	19,698
	SEP	48,484	23,822
	OCT	46,000	20,764
	NOV	46,692	21,761
	DEC	<u>54,582</u>	<u>23,012</u>
Total		511,015	247,791
1985	JAN	51,430	20,621
	FEB	58,589	22,910
	MAR	76,304	31,599
	APR	72,688	26,453
	MAY	74,858	27,041
	JUN	78,840	26,044
	JUL	76,627	27,833
	AUG	71,513	25,562
	SEP	77,649	28,493
	OCT	78,347	26,655
	NOV	72,279	26,623
	DEC	<u>76,455</u>	<u>23,328</u>
Total		865,579	313,162

(Continued)

# Monthly Electronic Equipment Production

Table 5 (Continued)

## Japanese Facsimile Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Units</u>	<u>Production (Yen)</u>
1986	JAN	70,010	20,411
	FEB	75,664	22,695
	MAR	91,958	27,274
	APR	91,065	24,249
	MAY	92,724	24,911
	JUN	97,760	24,805
	JUL	104,935	26,501
	AUG	104,134	23,750
	SEP	140,619	31,197
	OCT	121,647	26,453
	NOV	122,928	25,911
	DEC	<u>121,557</u>	<u>25,016</u>
Total		1,234,228	302,958
1987	JAN	107,358	21,111
	FEB	130,528	25,721
	MAR	165,405	32,344
	APR	148,962	24,655
	MAY	168,986	27,585
	JUN	215,132	33,809
	JUL	225,252	34,114
	AUG	<u>218,208</u>	<u>32,243</u>
YTD Total		1,379,831	231,582

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 6

## Japanese Microwave Oven Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1983	JAN	216,535	11,534	133,888	N/A
	FEB	246,101	13,207	127,652	252,337
	MAR	286,177	14,743	126,475	287,354
	APR	281,134	14,369	145,781	261,828
	MAY	266,709	12,649	133,063	279,427
	JUN	310,553	15,373	139,576	304,040
	JUL	356,955	17,013	146,136	350,395
	AUG	295,924	14,435	165,233	276,827
	SEP	387,915	19,680	161,216	391,932
	OCT	376,436	19,749	172,686	364,966
	NOV	356,434	17,831	167,219	361,901
	DEC	<u>404,541</u>	<u>19,254</u>	165,560	<u>406,200</u>
Total		3,785,414	189,837	165,560	N/A
1984	JAN	318,469	15,409	174,771	309,258
	FEB	413,903	19,814	186,498	402,176
	MAR	414,628	18,928	188,555	412,571
	APR	457,407	20,432	213,455	432,507
	MAY	367,648	15,658	188,389	392,714
	JUN	565,339	22,037	195,577	558,151
	JUL	603,954	23,717	254,344	545,187
	AUG	502,887	19,800	262,640	494,591
	SEP	687,321	27,683	236,866	713,095
	OCT	638,844	26,345	229,722	645,988
	NOV	648,428	26,549	297,159	580,991
	DEC	<u>607,100</u>	<u>26,070</u>	288,744	<u>615,515</u>
Total		6,225,928	262,442	288,744	6,102,744

N/A = Not Available

(Continued)

# Monthly Electronic Equipment Production

Table 6 (Continued)

## Japanese Microwave Oven Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1985	JAN	463,728	19,197	276,537	475,935
	FEB	575,683	23,847	298,102	554,118
	MAR	591,603	22,941	278,610	611,095
	APR	574,469	21,110	325,940	527,139
	MAY	534,201	18,276	322,607	537,534
	JUN	600,156	19,087	341,327	581,436
	JUL	741,991	23,283	364,374	718,944
	AUG	702,685	22,675	353,003	714,056
	SEP	838,736	28,359	251,683	940,056
	OCT	779,847	26,888	274,970	756,560
	NOV	749,327	26,778	348,894	675,403
	DEC	<u>756,775</u>	<u>25,636</u>	267,033	<u>838,636</u>
Total		7,909,201	278,077	267,033	7,930,912
1986	JAN	616,318	19,658	267,327	616,024
	FEB	759,297	24,812	274,751	751,873
	MAR	764,378	24,677	228,831	810,298
	APR	697,853	23,145	288,071	638,613
	MAY	656,347	19,729	373,680	570,738
	JUN	750,967	22,238	366,966	757,681
	JUL	722,804	22,155	486,840	602,930
	AUG	632,835	19,022	477,507	642,168
	SEP	775,465	24,776	291,760	961,212
	OCT	715,748	23,477	333,022	674,486
	NOV	643,271	23,379	353,879	622,414
	DEC	<u>706,123</u>	<u>24,317</u>	335,681	<u>724,321</u>
Total		8,441,406	271,385	335,681	8,372,758

(Continued)



# Monthly Electronic Equipment Production

Table 6 (Continued)

## Japanese Microwave Oven Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1987	JAN	568,234	17,984	367,609	536,306
	FEB	673,743	21,542	433,530	607,822
	MAR	782,985	24,104	339,317	877,198
	APR	593,843	18,721	355,970	577,190
	MAY	550,556	15,110	342,447	564,079
	JUN	656,252	17,851	394,939	603,760
	JUL	725,940	18,740	479,131	641,748
	AUG	<u>496,358</u>	<u>15,872</u>	382,490	<u>592,999</u>
YTD Total		5,047,911	149,924	382,490	5,001,102

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 7

## Japanese Personal Computer Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Units</u>	<u>Value (Yen)</u>
1984	JAN	88,262	14,465
	FEB	83,022	17,425
	MAR	117,070	20,732
	APR	99,753	16,457
	MAY	112,173	19,064
	JUN	138,431	23,506
	JUL	123,875	21,006
	AUG	120,224	20,434
	SEP	170,148	24,392
	OCT	146,757	22,486
	NOV	158,203	24,107
	DEC	<u>142,892</u>	<u>24,270</u>
Total		1,500,810	248,344
1985	JAN	139,773	24,270
	FEB	159,996	24,731
	MAR	219,018	35,073
	APR	149,705	24,817
	MAY	139,499	24,640
	JUN	159,751	27,717
	JUL	162,012	31,009
	AUG	159,024	28,019
	SEP	164,625	29,688
	OCT	130,790	26,693
	NOV	165,009	29,675
	DEC	<u>171,198</u>	<u>30,443</u>
Total		1,920,400	336,775

(Continued)

# Monthly Electronic Equipment Production

Table 7 (Continued)

## Japanese Personal Computer Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Units</u>	<u>Value (Yen)</u>
1986	JAN	147,917	27,559
	FEB	160,808	30,173
	MAR	224,338	38,240
	APR	164,035	29,325
	MAY	126,618	26,594
	JUN	144,115	28,715
	JUL	146,312	31,538
	AUG	132,130	27,527
	SEP	180,683	32,596
	OCT	170,493	26,667
	NOV	206,489	31,892
	DEC	<u>189,179</u>	<u>33,212</u>
Total		1,993,117	364,038
1987	JAN	129,558	28,475
	FEB	151,322	33,006
	MAR	209,450	42,107
	APR	161,449	31,772
	MAY	143,782	26,401
	JUN	164,044	31,938
	JUL	162,631	30,380
	AUG	<u>144,792</u>	<u>29,660</u>
YTD Total		1,267,028	253,739

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 8

## Japanese Industrial Robot Production (Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production</u>
1983	JAN	2,827
	FEB	4,133
	MAR	5,738
	APR	4,199
	MAY	4,321
	JUN	4,827
	JUL	4,572
	AUG	4,080
	SEP	4,096
	OCT	4,937
	NOV	4,772
	DEC	<u>5,262</u>
Total		53,764
1984	JAN	7,958
	FEB	10,202
	MAR	11,582
	APR	11,483
	MAY	8,894
	JUN	10,498
	JUL	11,252
	AUG	11,762
	SEP	11,481
	OCT	10,308
	NOV	10,819
	DEC	<u>11,624</u>
Total		127,863

(Continued)

# Monthly Electronic Equipment Production

Table 8 (Continued)

Japanese Industrial Robot Production  
(Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production</u>
1985	JAN	10,869
	FEB	12,790
	MAR	14,196
	APR	13,118
	MAY	12,201
	JUN	12,726
	JUL	11,542
	AUG	10,504
	SEP	13,025
	OCT	10,899
	NOV	12,537
	DEC	<u>9,770</u>
Total		144,177
1986	JAN	8,586
	FEB	10,573
	MAR	11,388
	APR	9,396
	MAY	10,914
	JUN	11,459
	JUL	10,803
	AUG	10,607
	SEP	13,373
	OCT	9,305
	NOV	8,788
	DEC	<u>8,301</u>
Total		123,493

(Continued)

# Monthly Electronic Equipment Production

Table 8 (Continued)

## Japanese Industrial Robot Production (Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production</u>
1987	JAN	7,163
	FEB	8,373
	MAR	10,039
	APR	8,801
	MAY	8,350
	JUN	8,471
	JUL	9,570
	AUG	<u>8,780</u>
YTD Total		25,575

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 9

## Japanese Telephone Production (Thousands of Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1983	JAN	293	3,650	421	N/A
	FEB	316	4,226	464	273
	MAR	388	5,341	518	334
	APR	419	4,822	471	466
	MAY	384	4,168	477	378
	JUN	435	5,032	532	380
	JUL	408	4,456	512	428
	AUG	352	4,284	470	394
	SEP	363	4,762	499	334
	OCT	460	5,336	573	386
	NOV	462	5,561	578	457
	DEC	<u>428</u>	<u>4,771</u>	594	<u>412</u>
Total		4,708	56,409	594	N/A
1984	JAN	455	5,589	627	422
	FEB	470	5,413	689	408
	MAR	565	6,078	711	543
	APR	541	6,345	689	563
	MAY	510	6,891	644	555
	JUN	511	6,642	620	535
	JUL	517	6,546	638	499
	AUG	499	6,517	682	455
	SEP	453	6,899	763	372
	OCT	397	5,652	861	299
	NOV	349	4,877	924	286
	DEC	<u>331</u>	<u>5,094</u>	879	<u>376</u>
Total		5,598	72,543	879	5,313

N/A = Not Available

(Continued)

# Monthly Electronic Equipment Production

Table 9 (Continued)

Japanese Telephone Production  
(Thousands of Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1985	JAN	450	6,263	941	388
	FEB	471	6,858	940	472
	MAR	701	8,304	824	817
	APR	588	7,406	709	703
	MAY	722	8,485	753	678
	JUN	882	10,230	846	789
	JUL	850	10,087	1,002	694
	AUG	769	9,045	1,067	704
	SEP	875	8,872	1,171	771
	OCT	701	9,039	1,330	542
	NOV	643	7,238	1,389	584
	DEC	<u>673</u>	<u>8,475</u>	1,331	<u>731</u>
Total		8,325	100,302	1,331	7,873
1986	JAN	579	7,278	1,340	570
	FEB	693	8,971	1,482	551
	MAR	708	11,000	1,269	921
	APR	588	9,174	1,278	579
	MAY	626	10,471	1,312	592
	JUN	695	10,132	1,353	654
	JUL	675	9,338	1,325	703
	AUG	560	6,471	1,175	710
	SEP	630	7,593	1,048	757
	OCT	678	8,365	1,108	618
	NOV	542	6,093	1,093	557
	DEC	<u>703</u>	<u>7,320</u>	1,143	<u>653</u>
Total		7,677	102,206	1,143	7,865

(Continued)



# Monthly Electronic Equipment Production

Table 9 (Continued)

## Japanese Telephone Production (Thousands of Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1987	JAN	555	6,010	1,142	556
	FEB	621	8,738	1,110	653
	MAR	744	12,034	1,026	828
	APR	781	10,076	1,047	760
	MAY	815	9,872	1,111	751
	JUN	736	9,563	1,168	679
	JUL	849	10,065	1,215	802
	AUG	<u>691</u>	<u>8,817</u>	1,145	<u>761</u>
YTD Total		5,792	75,175	1,145	5,790

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 10

Japanese Production of Color Televisions\*  
(Thousands of Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1983	JAN	793	45,864	989	N/A
	FEB	911	49,681	1,018	882
	MAR	1,041	55,259	959	1,100
	APR	1,070	57,963	926	1,103
	MAY	1,015	53,721	933	1,008
	JUN	1,012	54,369	1,005	940
	JUL	1,014	55,362	977	1,042
	AUG	857	45,110	949	885
	SEP	1,083	58,024	875	1,157
	OCT	1,109	59,938	839	1,145
	NOV	1,243	66,892	779	1,303
	DEC	<u>1,224</u>	<u>66,041</u>	661	<u>1,342</u>
Total		12,372	668,224	661	N/A
1984	JAN	922	47,063	755	828
	FEB	1,103	56,510	834	1,024
	MAR	1,147	58,999	786	1,195
	APR	1,331	67,408	850	1,267
	MAY	1,095	56,256	898	1,047
	JUN	1,234	62,091	982	1,150
	JUL	1,215	60,618	1,012	1,185
	AUG	998	49,459	1,018	992
	SEP	1,207	62,052	1,001	1,224
	OCT	1,335	70,105	1,038	1,298
	NOV	1,441	76,678	1,021	1,458
	DEC	<u>1,450</u>	<u>75,594</u>	917	<u>1,554</u>
Total		14,478	742,833	917	14,222

\*Prior to 1986, data include color television sets only; from 1986, data include color television sets and kits.

N/A = Not Available

(Continued)

# Monthly Electronic Equipment Production

Table 10 (Continued)

Japanese Production of Color Televisions\*  
(Thousands of Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1985	JAN	1,120	56,873	932	1,105
	FEB	1,370	69,504	1,086	1,216
	MAR	1,359	71,000	1,013	1,432
	APR	1,571	78,478	1,024	1,560
	MAY	1,386	70,280	1,193	1,217
	JUN	1,588	79,614	1,350	1,431
	JUL	1,546	77,073	1,379	1,517
	AUG	1,239	62,820	1,291	1,327
	SEP	1,437	74,804	1,201	1,527
	OCT	1,473	78,221	1,226	1,448
	NOV	1,422	78,761	1,164	1,484
	DEC	<u>1,369</u>	<u>74,815</u>	997	<u>1,536</u>
Total		16,880	872,243	997	16,800
1986	JAN	915	49,091	1,102	810
	FEB	1,134	59,615	1,199	1,037
	MAR	1,172	61,541	1,123	1,248
	APR	1,232	63,863	1,218	1,137
	MAY	1,035	52,921	1,207	1,046
	JUN	1,101	55,933	1,235	1,073
	JUL	1,122	55,932	1,238	1,119
	AUG	895	45,361	1,213	920
	SEP	1,229	63,873	1,172	1,270
	OCT	1,236	66,112	1,273	1,135
	NOV	1,327	74,097	1,199	1,401
	DEC	<u>1,411</u>	<u>75,433</u>	1,051	<u>1,559</u>
Total		13,809	723,772	1,051	13,755

\*Prior to 1986, data include color television sets only; from 1986, data include color television sets and kits.

(Continued)

# Monthly Electronic Equipment Production

Table 10 (Continued)

## Japanese Production of Color Televisions\* (Thousands of Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1987	JAN	898	46,424	1,096	853
	FEB	1,199	57,398	1,181	1,114
	MAR	1,217	63,400	1,017	1,381
	APR	1,238	63,272	1,052	1,203
	MAY	1,131	57,861	957	1,226
	JUN	1,187	62,773	995	1,149
	JUL	1,194	64,592	1,079	1,110
	AUG	<u>977</u>	<u>48,393</u>	1,077	<u>979</u>
YTD Total		9,041	464,113	1,077	9,015

\*Prior to 1986, data include color television sets only; from 1986, data include color television sets and kits.

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 11

## Japanese Word Processor Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1983	JAN	4,826	3,967	4,401	N/A
	FEB	5,708	4,866	4,477	5,632
	MAR	7,072	5,651	3,755	7,794
	APR	8,560	6,065	5,310	7,005
	MAY	8,504	5,579	8,660	5,154
	JUN	9,551	7,068	9,996	8,215
	JUL	8,375	6,863	9,493	8,878
	AUG	8,488	6,529	10,588	7,393
	SEP	11,046	7,541	11,895	9,739
	OCT	8,583	5,962	13,695	6,783
	NOV	8,132	5,493	14,328	7,499
	DEC	<u>7,514</u>	<u>5,419</u>	13,963	<u>7,879</u>
Total		96,359	71,003	13,963	N/A
1984	JAN	7,836	4,794	14,845	6,954
	FEB	10,921	6,872	14,420	11,346
	MAR	13,074	7,173	9,098	18,396
	APR	9,905	4,988	8,429	10,574
	MAY	11,461	5,675	8,374	11,516
	JUN	14,162	7,063	9,074	13,462
	JUL	21,728	9,490	10,194	20,608
	AUG	20,822	8,033	7,888	23,128
	SEP	22,757	7,882	9,275	21,370
	OCT	24,362	6,992	13,101	20,536
	NOV	25,673	8,635	15,823	22,951
	DEC	<u>27,919</u>	<u>7,607</u>	20,427	<u>23,315</u>
Total		210,620	85,204	20,427	204,156

N/A = Not Available

(Continued)

# Monthly Electronic Equipment Production

Table 11 (Continued)

## Japanese Word Processor Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1985	JAN	39,642	8,384	31,756	28,313
	FEB	39,712	8,914	43,321	28,147
	MAR	30,283	7,368	30,940	42,664
	APR	33,106	8,175	29,302	34,744
	MAY	43,356	8,898	31,707	40,951
	JUN	65,243	10,429	42,055	54,895
	JUL	95,227	11,796	54,374	82,908
	AUG	87,022	11,855	76,989	64,407
	SEP	104,986	13,602	77,369	104,606
	OCT	135,775	13,816	94,457	118,687
	NOV	208,772	16,676	124,530	178,699
	DEC	<u>195,651</u>	<u>14,897</u>	165,515	<u>154,666</u>
Total		1,078,775	134,810	165,515	933,687
1986	JAN	94,495	7,862	162,277	97,733
	FEB	92,491	9,591	135,567	119,201
	MAR	172,590	14,796	114,341	193,816
	APR	153,348	13,379	107,574	160,115
	MAY	207,180	16,896	144,063	170,691
	JUN	203,830	17,285	163,598	184,295
	JUL	206,626	18,334	192,205	178,019
	AUG	161,464	14,194	212,437	141,232
	SEP	153,593	13,874	186,881	179,149
	OCT	149,769	13,108	201,352	135,298
	NOV	205,938	16,016	192,880	214,410
	DEC	<u>245,746</u>	<u>18,607</u>	196,444	<u>242,182</u>
Total		2,047,070	173,942	196,444	2,016,141

(Continued)

# Monthly Electronic Equipment Production

Table 11 (Continued)

Japanese Word Processor Production  
(Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1987	JAN	133,941	10,588	218,870	111,515
	FEB	135,966	11,809	207,225	147,611
	MAR	177,849	14,931	148,692	236,382
	APR	129,749	13,607	133,378	145,063
	MAY	149,776	14,493	122,225	160,929
	JUN	218,416	20,192	118,490	222,151
	JUL	181,676	17,258	141,974	158,192
	AUG	<u>131,941</u>	<u>13,897</u>	157,582	<u>116,333</u>
YTD Total		1,259,314	116,775	157,582	1,298,176

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Table 12

## Japanese VCR Production (Units, Millions of Yen)

Year	Month	Production (Units)	Production (Yen)	Inventory (Units)	Shipments (Units)
1983	JAN	970,141	88,052	691,996	N/A
	FEB	1,123,885	99,918	674,209	1,141,672
	MAR	1,257,490	109,653	659,858	1,271,841
	APR	1,445,918	121,048	716,304	1,389,472
	MAY	1,341,733	112,301	736,837	1,321,200
	JUN	1,530,443	127,761	799,660	1,467,620
	JUL	1,665,841	136,230	811,712	1,653,789
	AUG	1,476,613	118,478	768,175	1,520,150
	SEP	1,795,101	145,093	761,331	1,801,945
	OCT	1,787,398	143,611	701,622	1,847,107
	NOV	1,865,750	153,857	658,648	1,908,724
	DEC	<u>1,956,253</u>	<u>157,989</u>	638,184	<u>1,976,717</u>
Total		18,216,566	1,513,991	638,184	N/A
1984	JAN	1,509,883	120,695	737,736	1,410,331
	FEB	1,936,156	155,820	926,897	1,746,995
	MAR	1,941,339	151,344	954,152	1,914,084
	APR	2,283,315	173,844	1,101,119	2,136,348
	MAY	1,869,589	139,486	994,547	1,976,161
	JUN	2,407,047	173,609	1,185,712	2,215,882
	JUL	2,518,055	186,449	1,399,921	2,303,846
	AUG	2,075,398	150,492	1,372,334	2,102,985
	SEP	2,712,108	193,508	1,486,474	2,597,968
	OCT	2,595,312	186,505	1,437,336	2,644,450
	NOV	2,813,265	206,481	1,381,296	2,869,305
	DEC	<u>2,462,120</u>	<u>181,686</u>	1,419,648	<u>2,423,768</u>
Total		27,123,587	2,019,919	1,419,648	26,342,123

N/A = Not Available

(Continued)



# Monthly Electronic Equipment Production

Table 12 (Continued)

## Japanese VCR Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1985	JAN	1,941,039	129,653	1,335,659	2,025,028
	FEB	2,358,339	159,198	1,501,902	2,192,096
	MAR	2,168,686	143,507	1,408,740	2,261,848
	APR	2,469,808	159,421	1,534,057	2,344,491
	MAY	2,260,496	148,642	1,672,807	2,121,746
	JUN	2,616,556	169,165	1,824,721	2,464,642
	JUL	2,626,883	168,167	1,931,635	2,519,969
	AUG	2,203,312	135,906	1,928,734	2,206,213
	SEP	2,490,788	153,688	1,531,541	2,887,981
	OCT	2,429,833	150,007	1,432,464	2,528,910
	NOV	2,436,352	143,055	1,410,027	2,458,789
	DEC	<u>2,392,822</u>	<u>141,197</u>	1,453,785	<u>2,349,064</u>
Total		28,394,914	1,801,606	1,453,785	28,360,777
1986	JAN	1,883,428	104,123	1,073,670	2,263,543
	FEB	2,438,214	133,497	1,163,748	2,348,136
	MAR	2,603,731	139,053	1,028,392	2,739,087
	APR	2,832,169	145,568	1,327,678	2,532,883
	MAY	2,729,889	138,038	1,457,525	2,600,042
	JUN	3,109,708	151,926	1,647,772	2,919,461
	JUL	3,033,007	143,929	1,738,352	2,942,427
	AUG	2,415,795	117,924	1,573,485	2,580,662
	SEP	2,805,777	135,309	1,204,850	3,174,412
	OCT	2,631,070	125,112	1,059,918	2,776,002
	NOV	2,472,261	127,035	1,114,414	2,417,765
	DEC	<u>2,328,826</u>	<u>117,807</u>	1,083,022	<u>2,360,218</u>
Total		31,283,875	1,579,321	1,083,022	31,654,638

(Continued)

# Monthly Electronic Equipment Production

Table 12 (Continued)

## Japanese VCR Production (Units, Millions of Yen)

<u>Year</u>	<u>Month</u>	<u>Production (Units)</u>	<u>Production (Yen)</u>	<u>Inventory (Units)</u>	<u>Shipments (Units)</u>
1987	JAN	1,717,426	80,633	1,082,788	1,717,660
	FEB	2,183,558	97,005	1,280,286	1,986,060
	MAR	2,512,310	106,001	1,192,179	2,600,417
	APR	2,259,006	92,567	1,501,318	1,949,867
	MAY	2,099,589	88,063	1,470,638	2,130,269
	JUN	2,448,561	104,774	1,533,108	2,386,091
	JUL	2,496,457	109,387	1,718,038	2,311,527
	AUG	<u>2,065,245</u>	<u>85,616</u>	1,531,796	<u>2,251,487</u>
YTD Total		17,782,152	764,046	153,796	17,333,662

Source: MITI  
Dataquest  
February 1988

# Monthly Electronic Equipment Production

Figure 1

## Japanese Calculator Production and Inventory

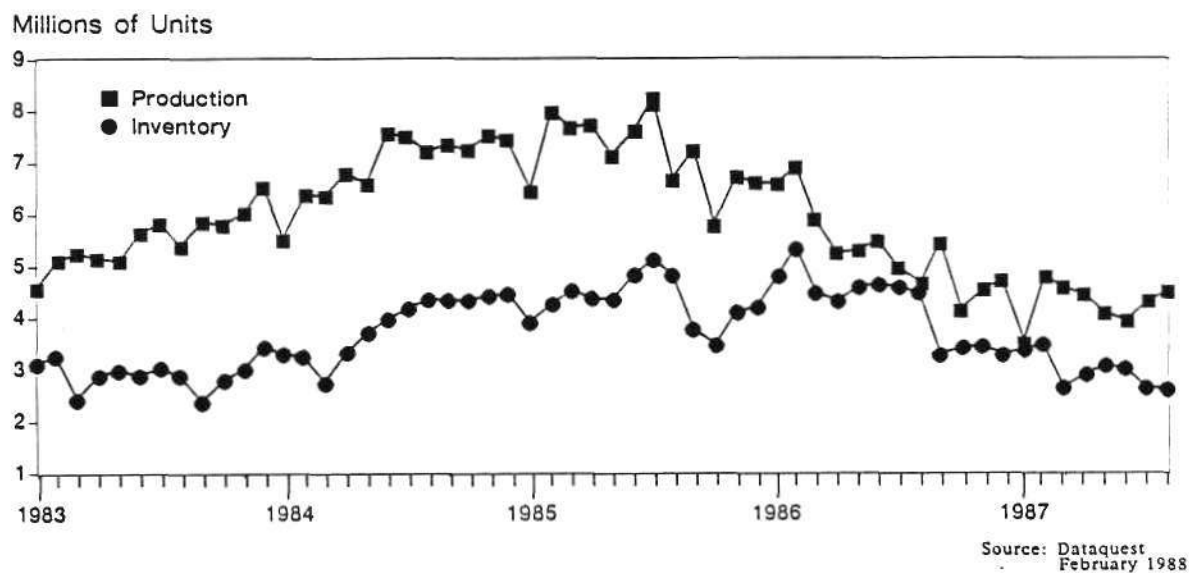
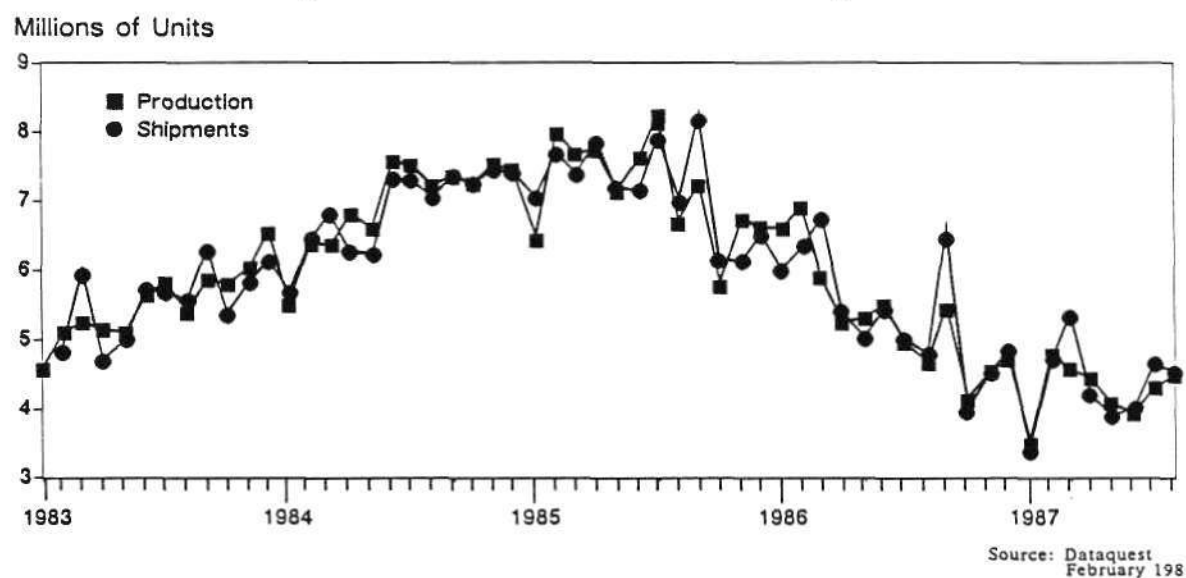


Figure 2

## Japanese Calculator Production and Shipments



# Monthly Electronic Equipment Production

Figure 3

## Japanese Calculator Production Value

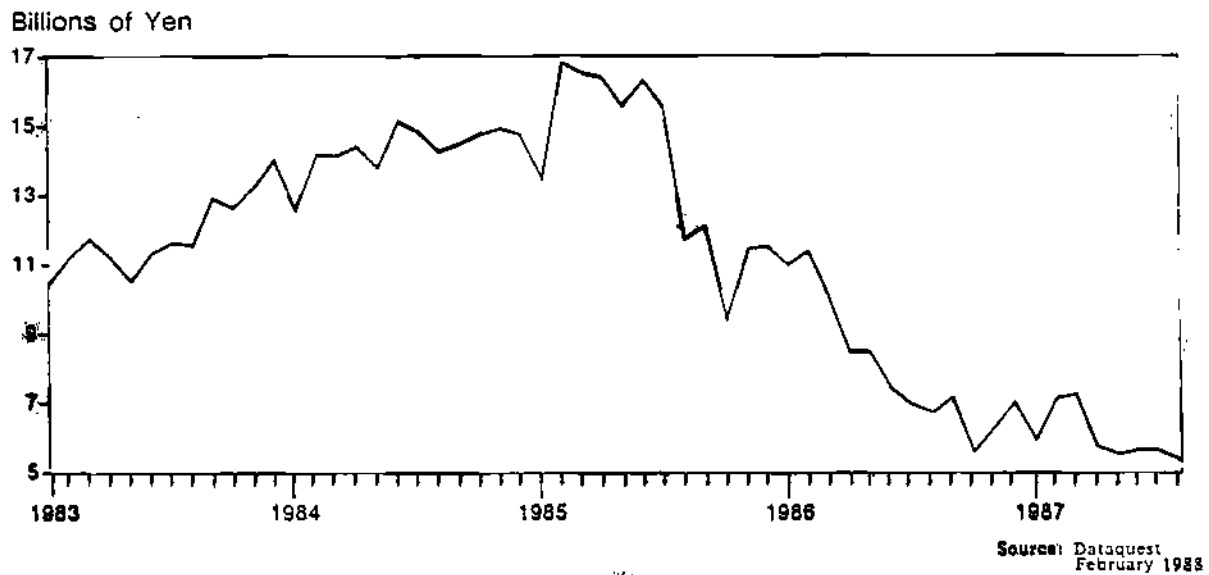
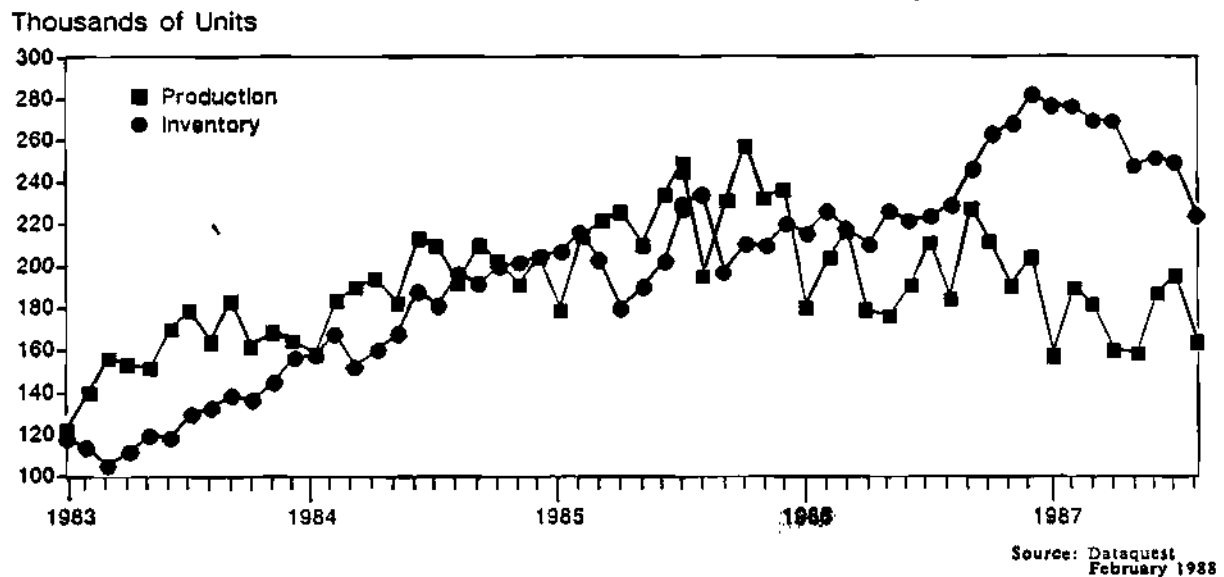


Figure 4

## Japanese Copier Production and Inventory



# Monthly Electronic Equipment Production

Figure 5

Japanese Copier Production and Shipments

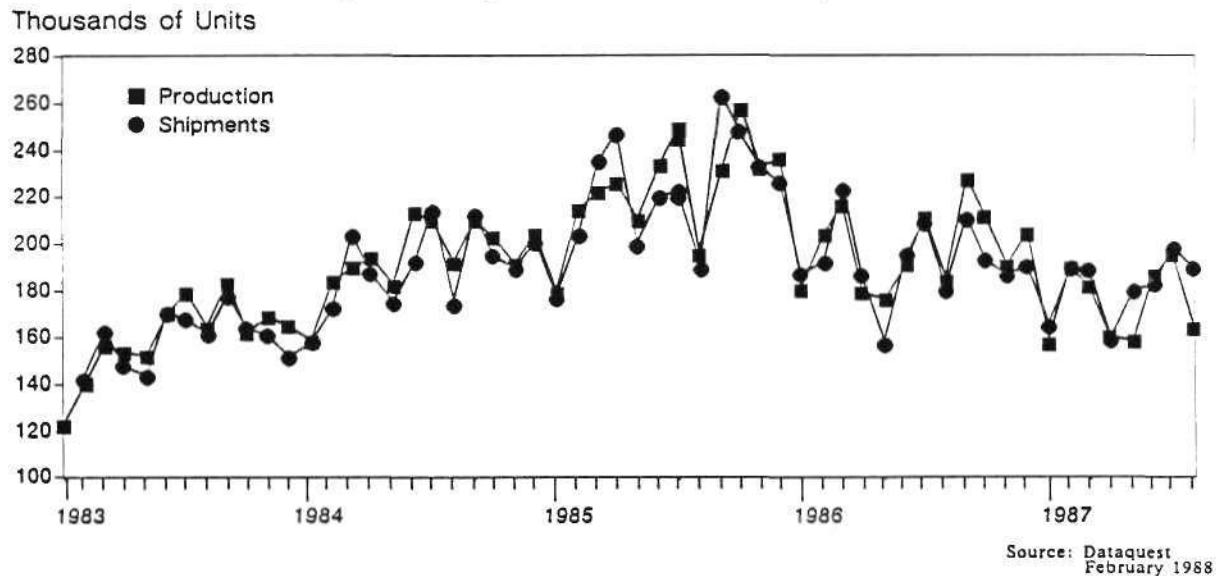
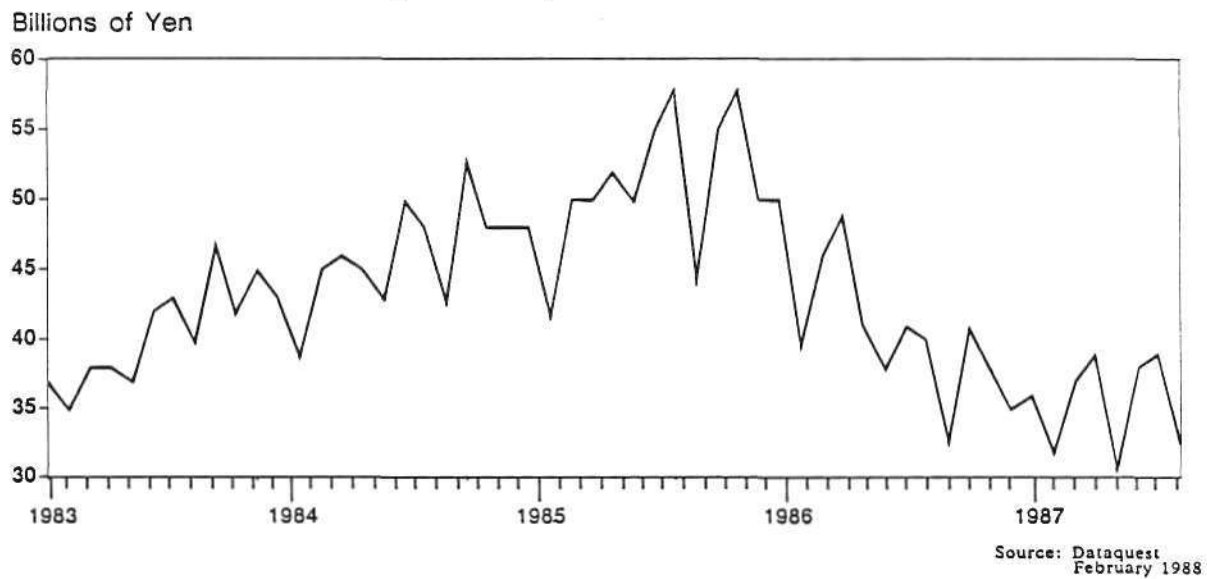


Figure 6

Japanese Copier Production Value

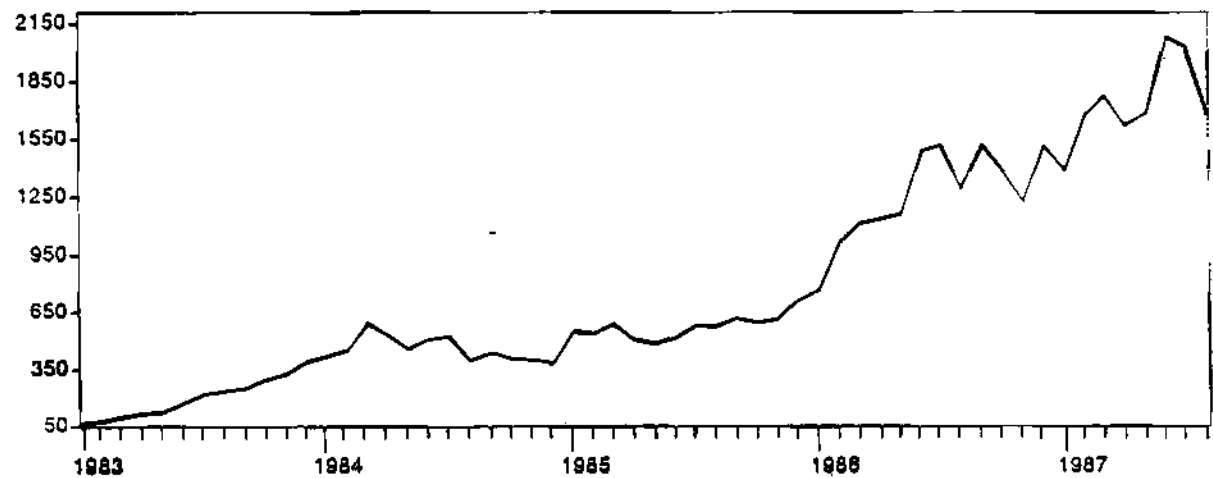


# Monthly Electronic Equipment Production

Figure 7

## Japanese Computer Storage Equipment Unit Production

Billions of Yen

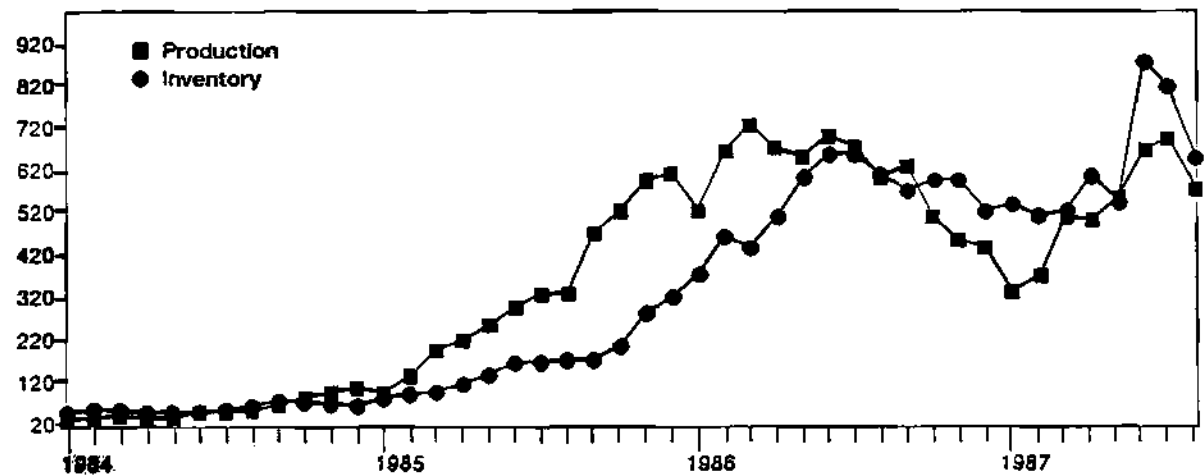


Source: Dataquest  
February 1988

Figure 8

## Japanese Digital Audio Disk Player Production and Inventory

Thousands of Units



Source: Dataquest  
February 1988

# Monthly Electronic Equipment Production

Figure 9

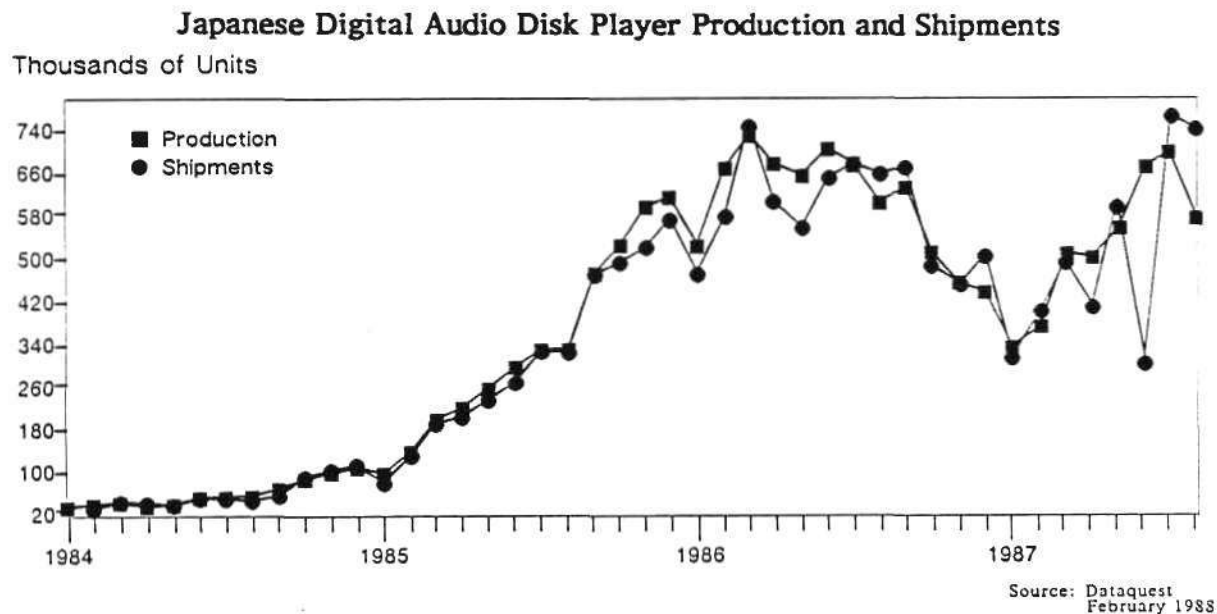
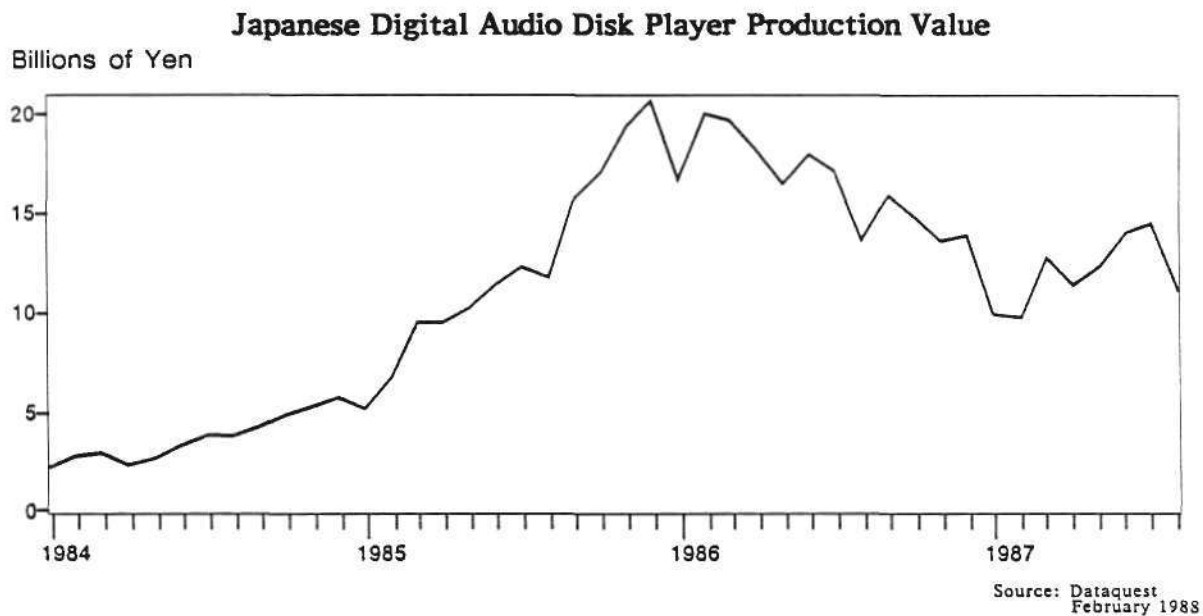


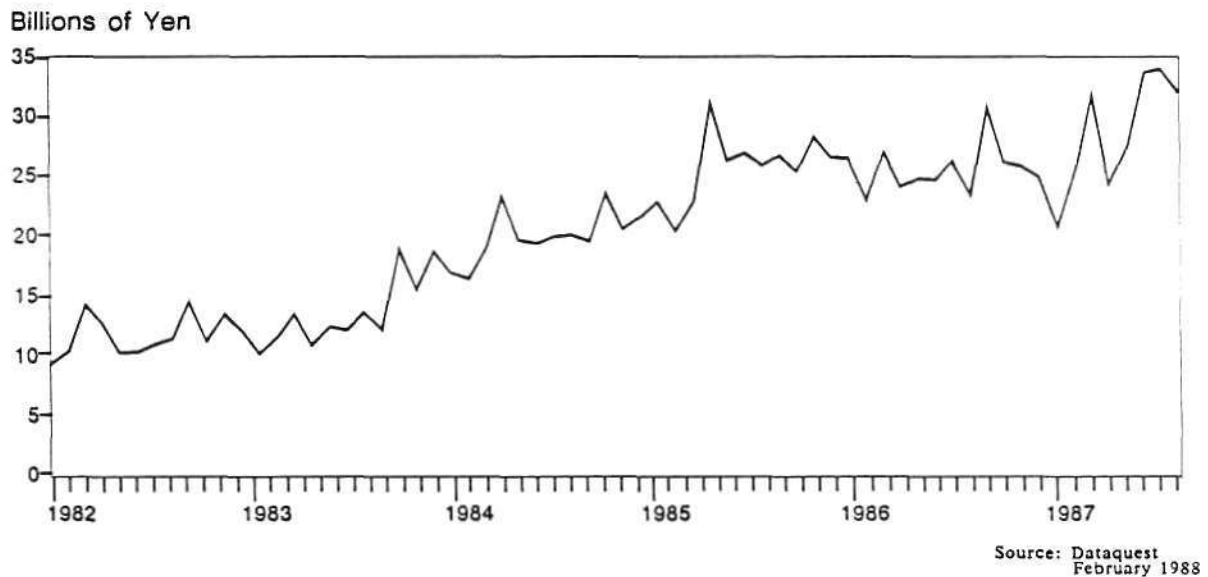
Figure 10



# Monthly Electronic Equipment Production

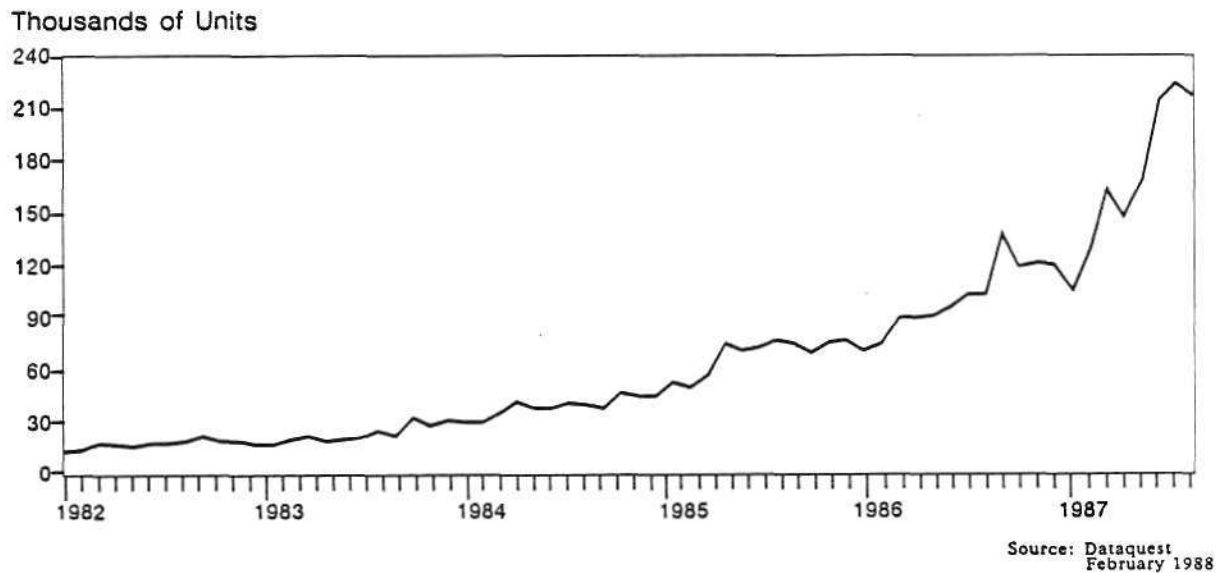
**Figure 11**

## **Japanese Facsimile Machine Production Value**



**Figure 12**

## **Japanese Facsimile Machine Unit Production**



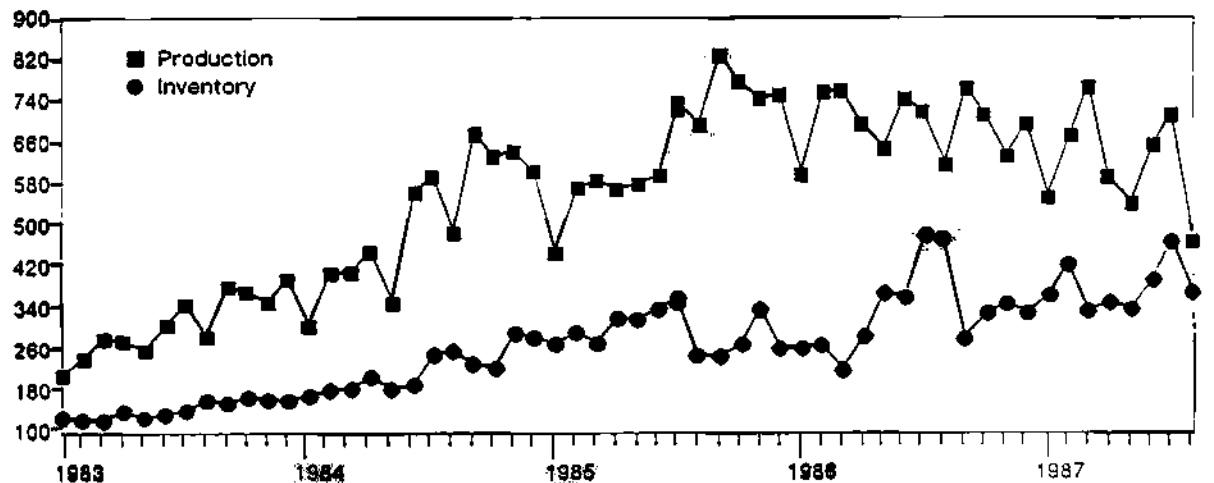


# Monthly Electronic Equipment Production

Figure 13

## Japanese Microwave Oven Production and Inventory

Thousands of Units

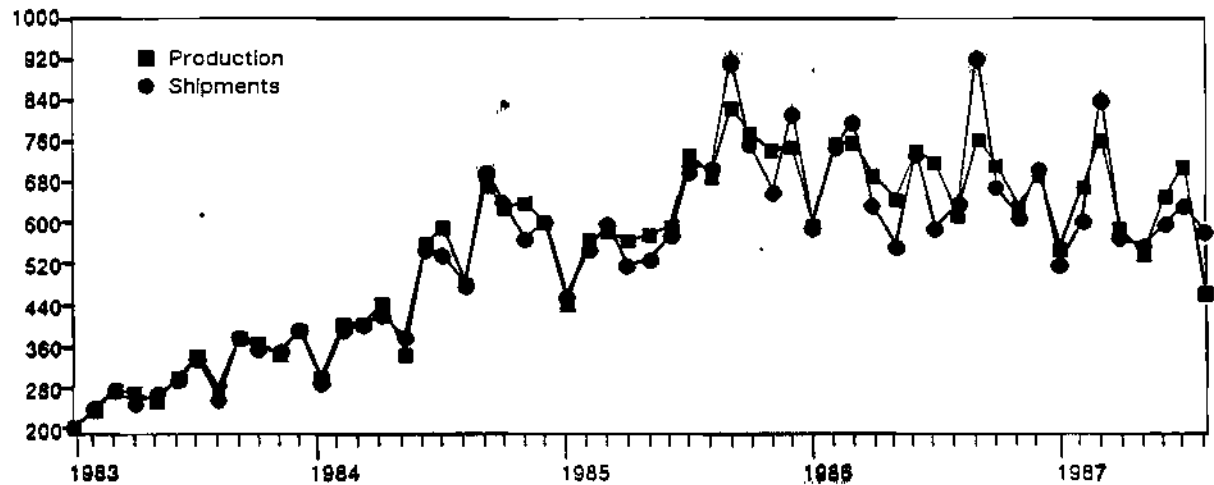


Source: Dataquest  
February 1988

Figure 14

## Japanese Microwave Oven Production and Shipments

Millions of Units



Source: Dataquest  
February 1988

# Monthly Electronic Equipment Production

Figure 15

## Japanese Microwave Oven Production Value

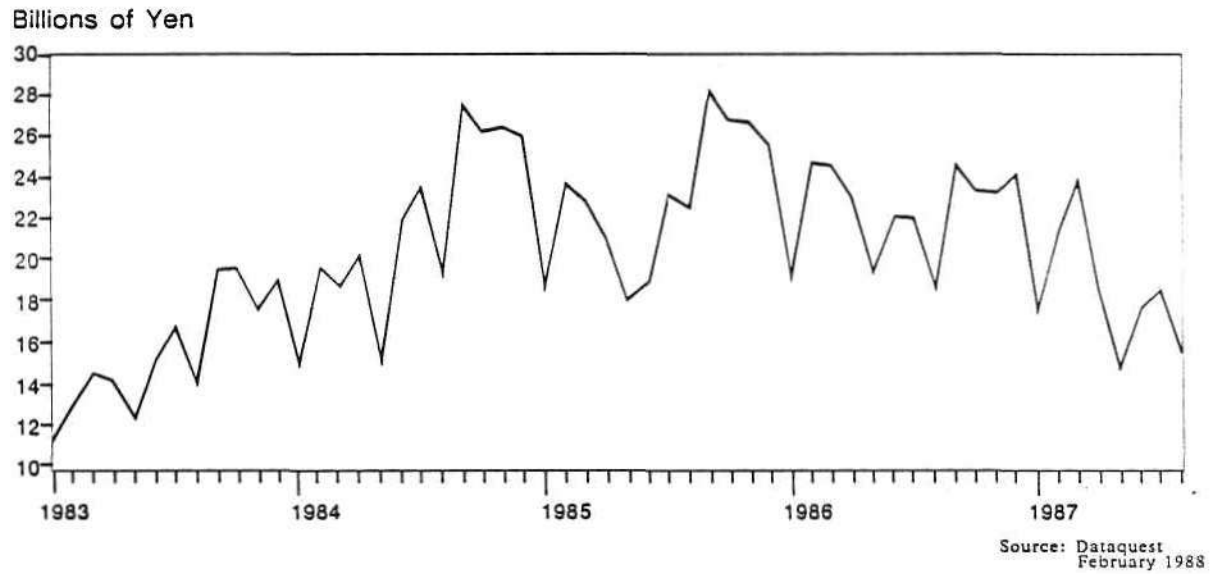
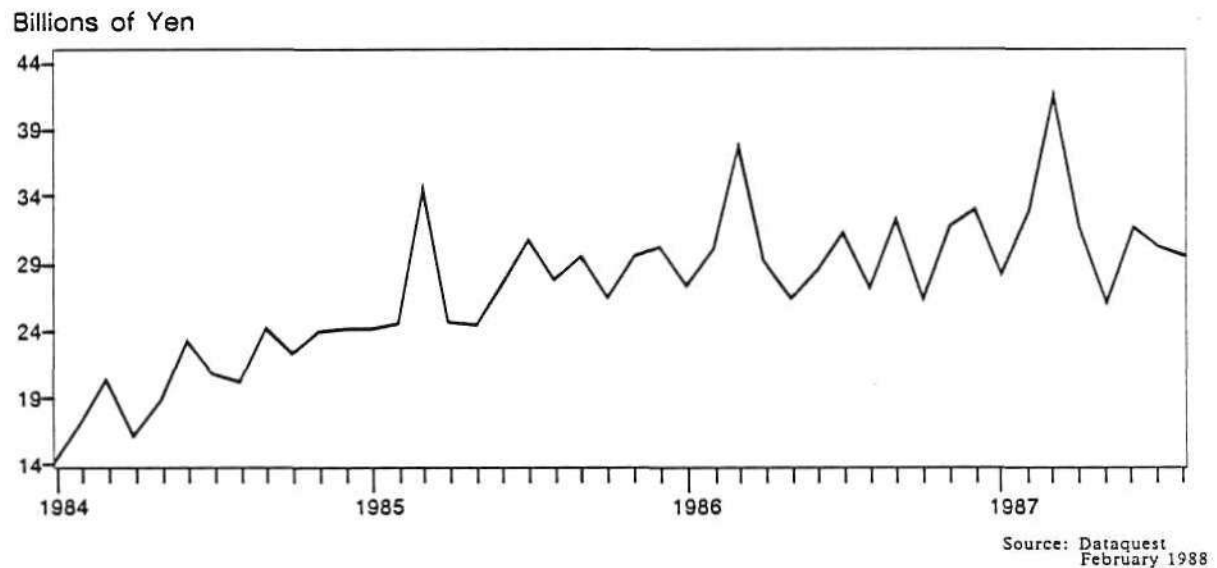


Figure 16

## Japanese Personal Computer Production Value

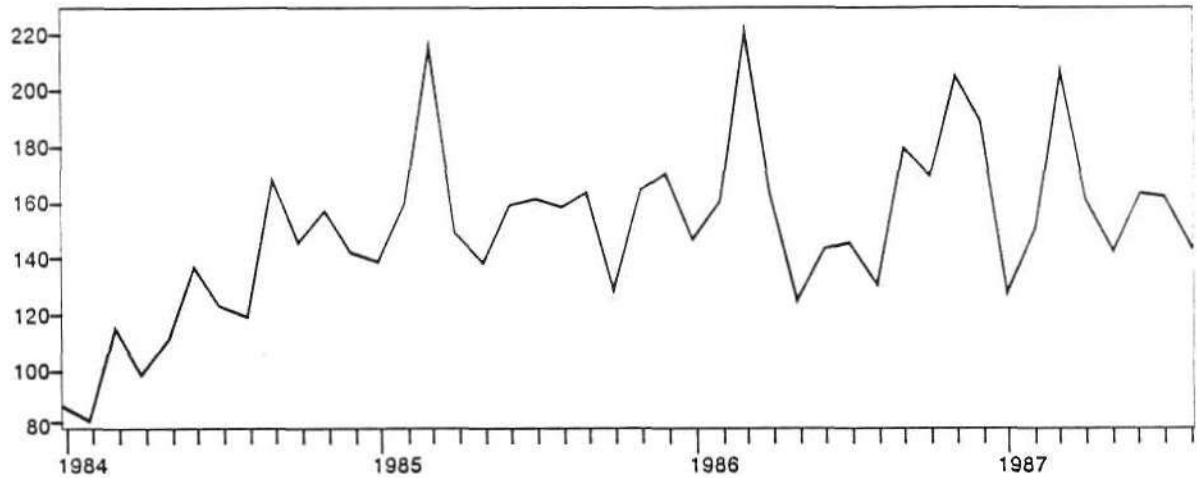


# Monthly Electronic Equipment Production

Figure 17

## Japanese Personal Computer Unit Production

Thousands of Units

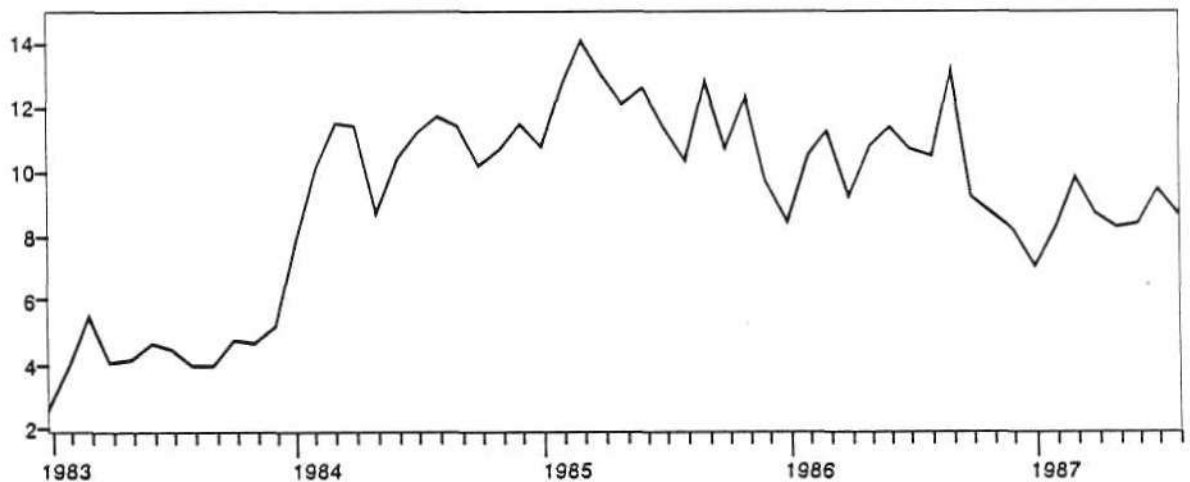


Source: Dataquest  
February 1988

Figure 18

## Japanese Industrial Robot Production Value

Billions of Yen



Source: Dataquest  
February 1988

# Monthly Electronic Equipment Production

Figure 19

Japanese Telephone Production and Inventory

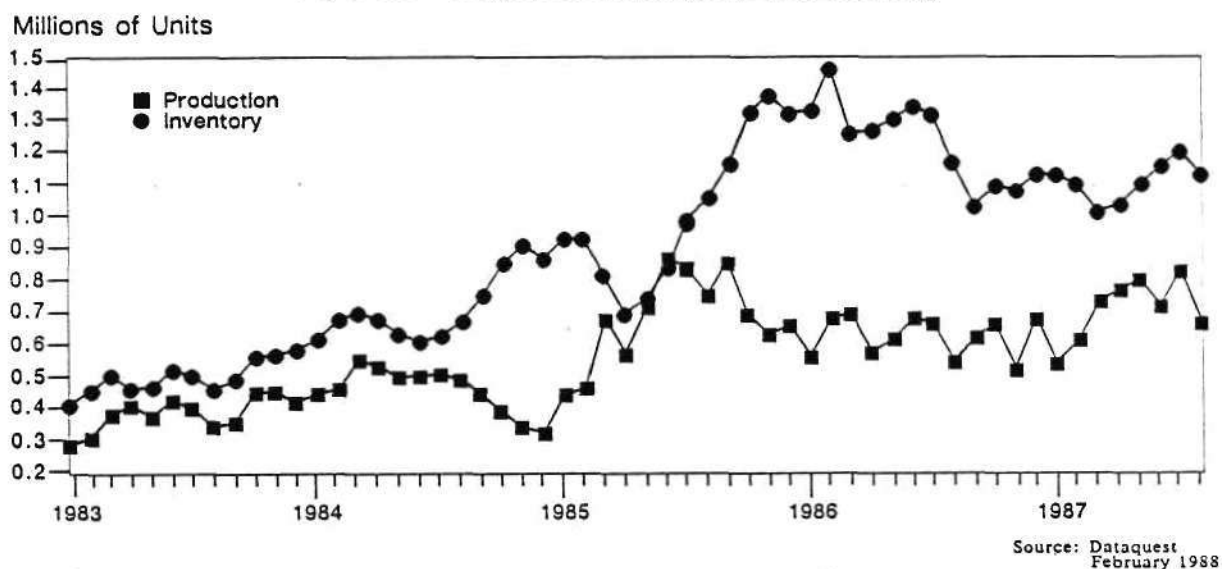
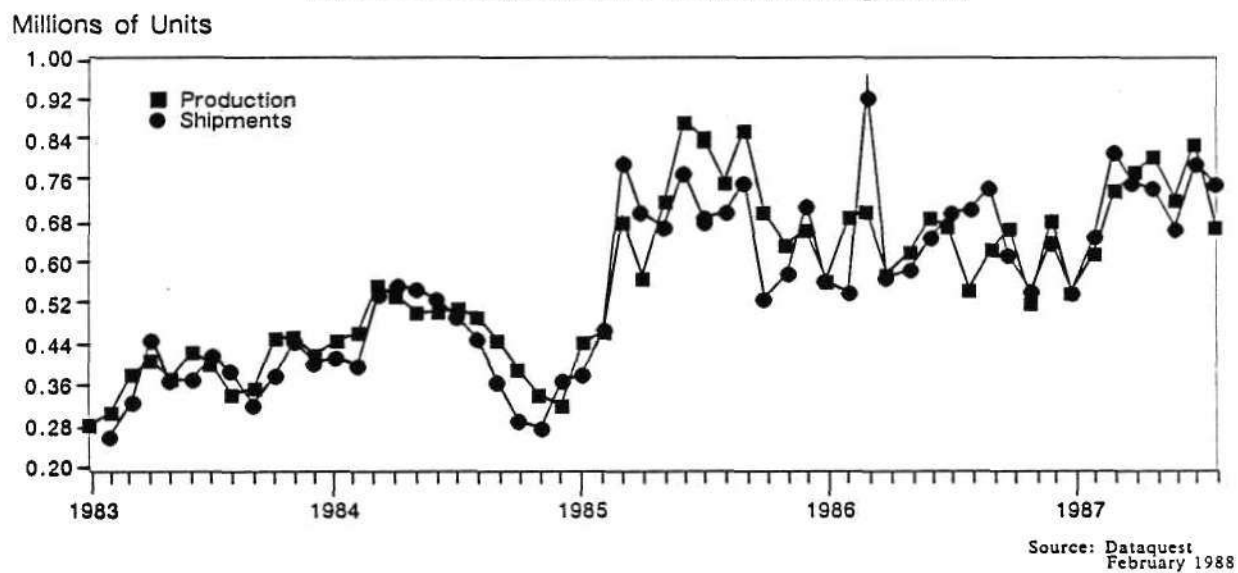


Figure 20

Japanese Telephone Production and Shipments



# Monthly Electronic Equipment Production

Figure 21

## Japanese Telephone Production Value

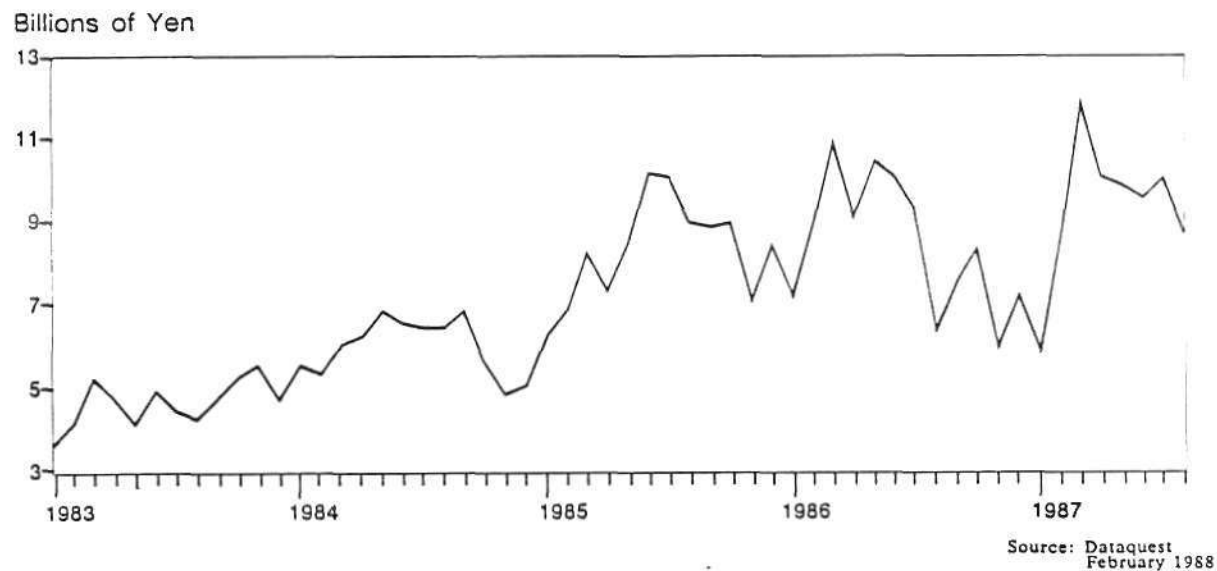
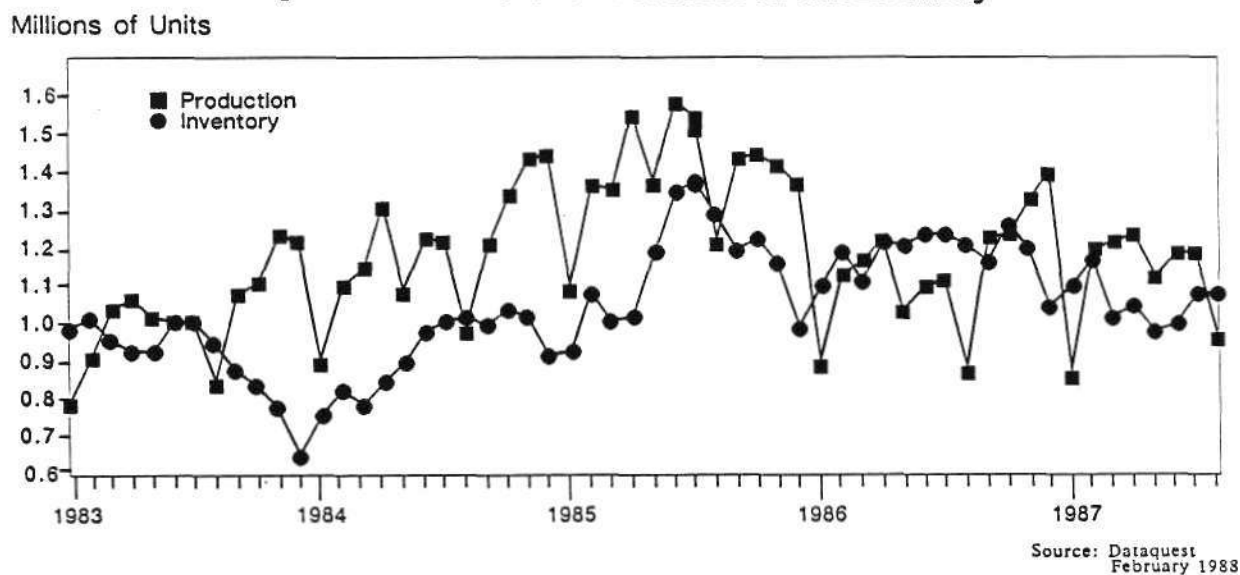


Figure 22

## Japanese Color Television Production and Inventory



# Monthly Electronic Equipment Production

Figure 23

Japanese Color Television Production and Shipments

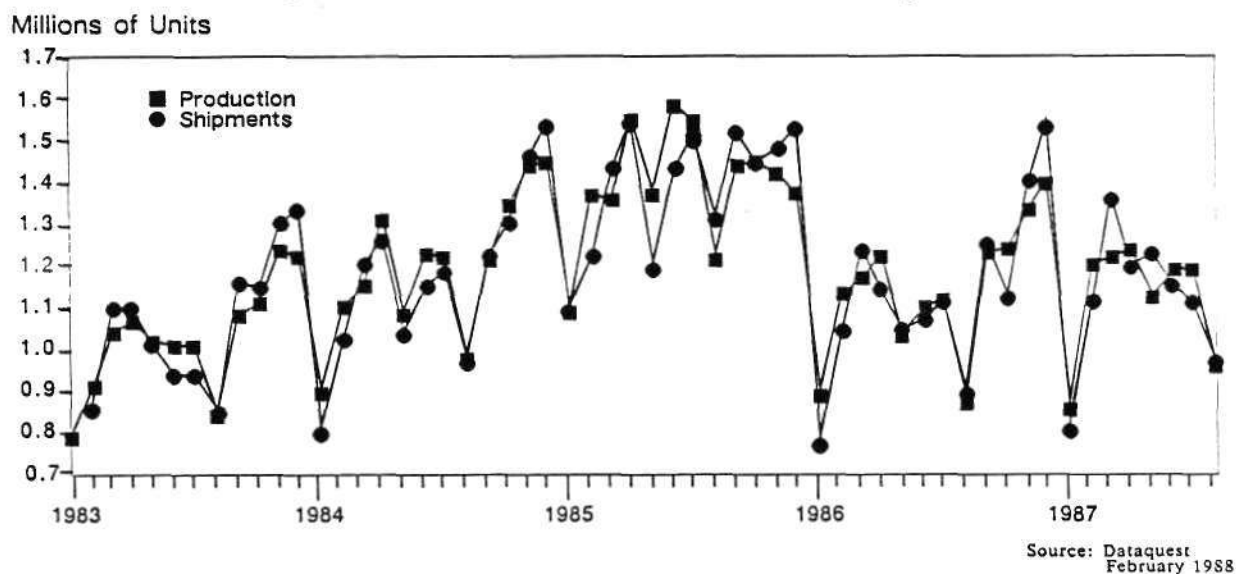
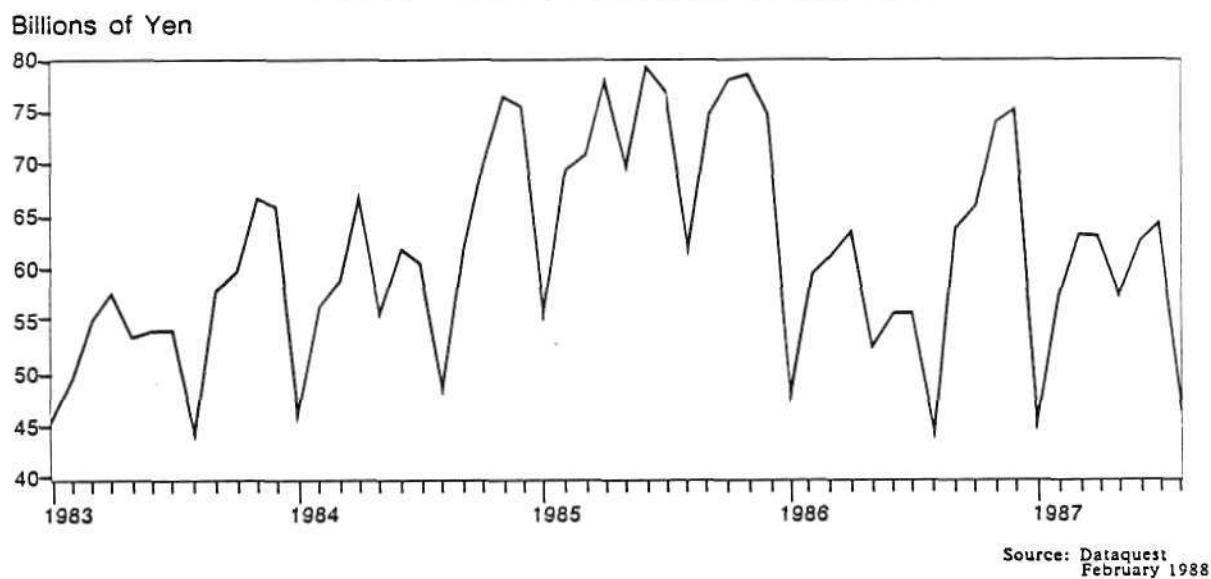


Figure 24

Japanese Color Television Production Value



# Monthly Electronic Equipment Production

Figure 25

## Japanese Word Processor Production and Inventory

Thousands of Units

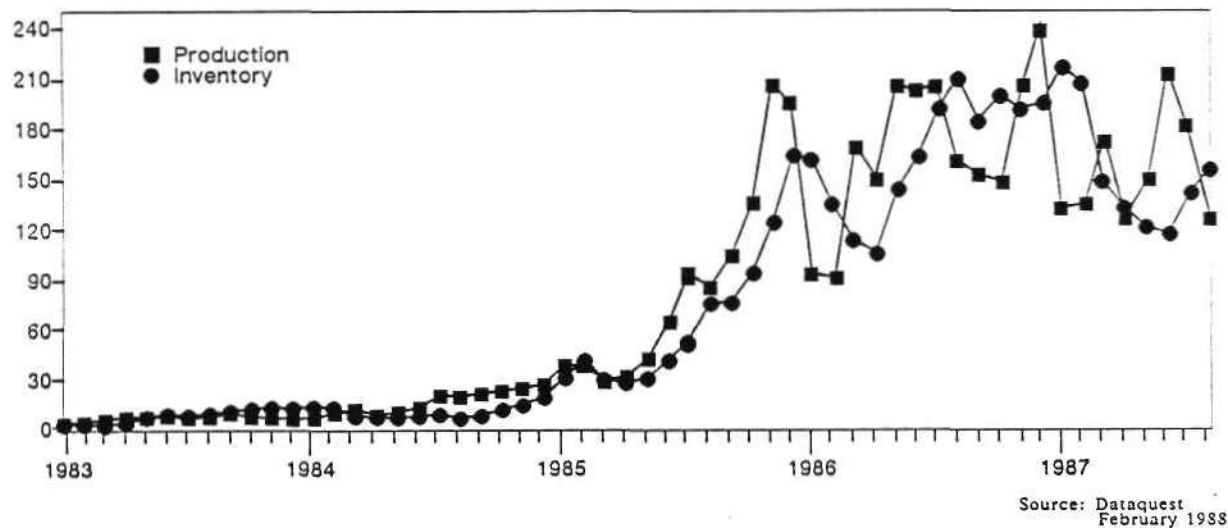
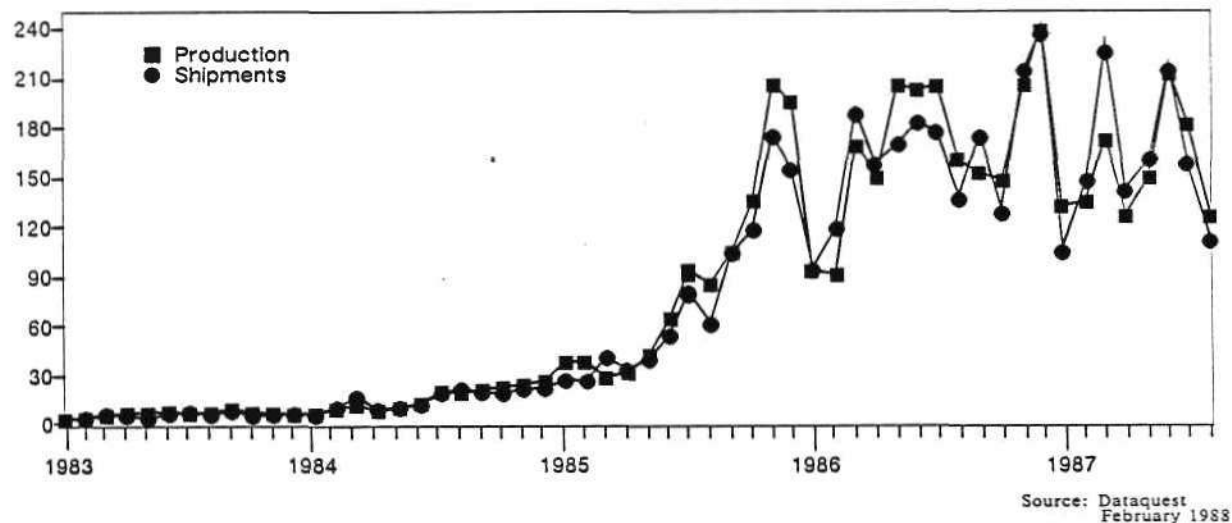


Figure 26

## Japanese Word Processor Production and Shipments

Thousands of Units

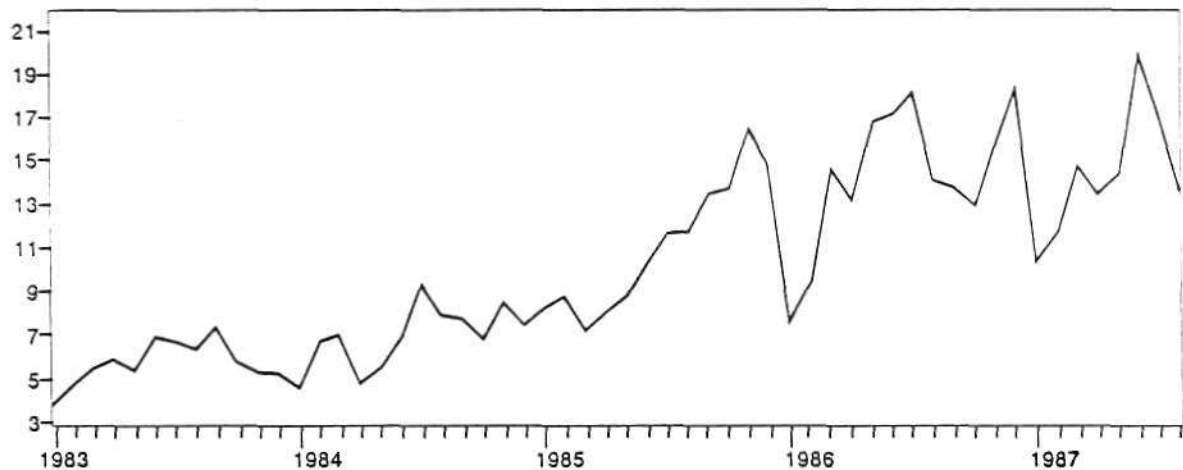


# Monthly Electronic Equipment Production

Figure 27

## Japanese Word Processor Production Value

Billions of Yen

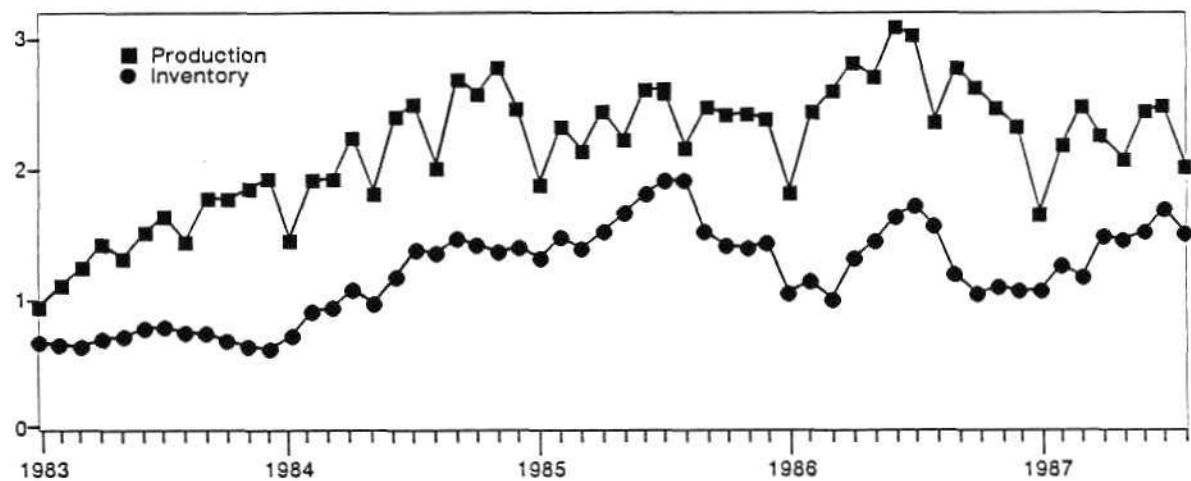


Source: Dataquest  
February 1988

Figure 28

## Japanese VCR Production and Inventory

Millions of Units



Source: Dataquest  
February 1988

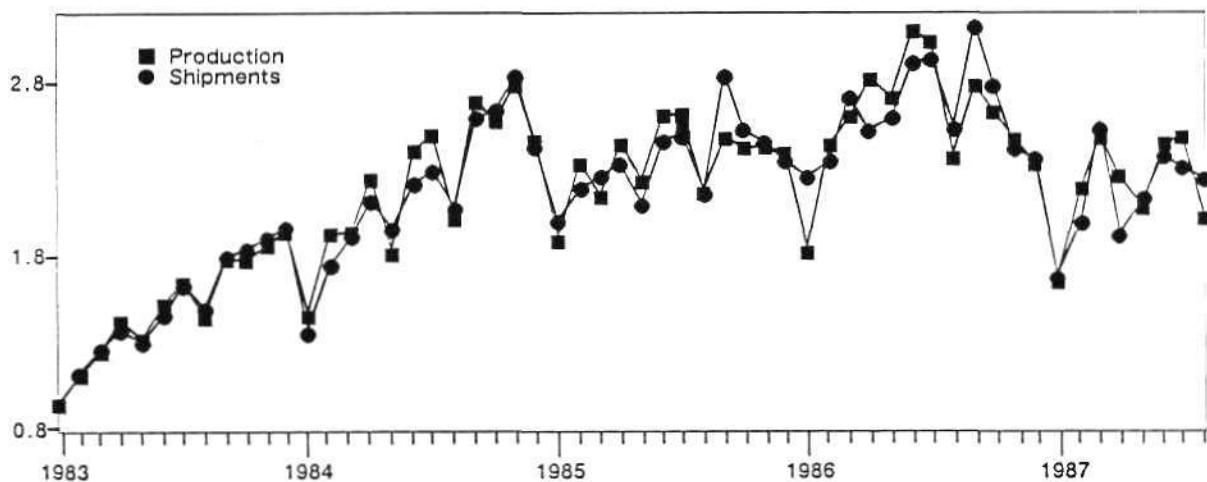


# Monthly Electronic Equipment Production

Figure 29

## Japanese VCR Production and Shipments

Millions of Units

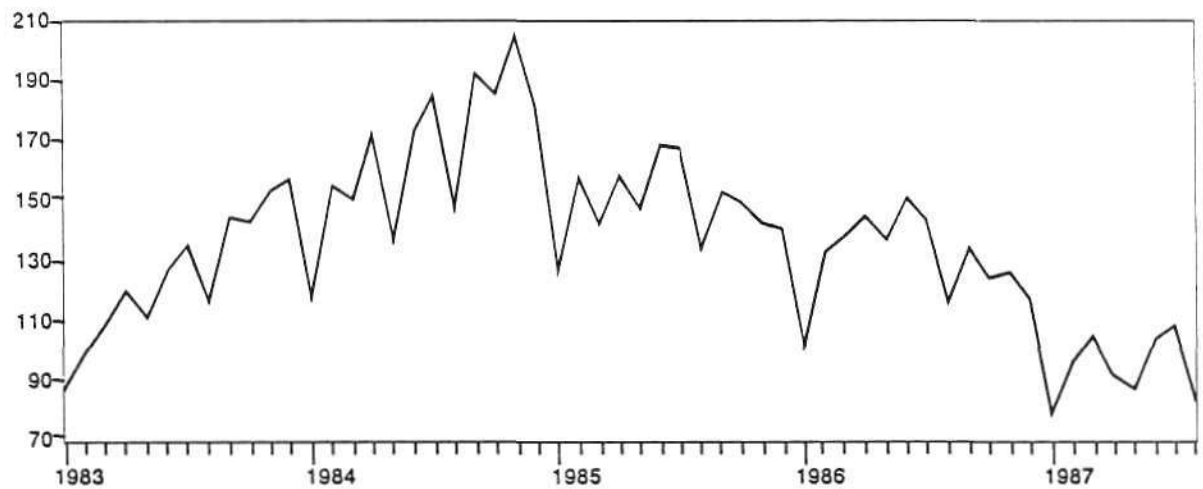


Source: Dataquest  
February 1988

Figure 30

## Japanese VCR Production Value

Billions of Yen



Source: Dataquest  
February 1988



# **Database Analysis**

## **INTRODUCTION**

As mentioned throughout this binder, semiconductor consumption by application market is estimated by applying input/output ratios to the equipment forecast. A summary of this model is presented in the following tables:

- Yen-to-Dollar Exchange Rates (Table 1)
- Japanese Electronic Equipment Forecast (Table 2 and Table 3)
- Estimated Input/Output Ratio by Application Market (Table 4)
- Japanese Semiconductor Consumption (Table 5 and Table 6)
- Estimated Japanese Semiconductor Consumption by Application Market (Table 7)

In the JSAM database, input/output ratios are estimated by each of the detailed equipment types—more than 60 are tracked. These detailed input/output ratios are available to our clients on an inquiry basis.

**Table 1**

### **Yen-to-Dollar Exchange Rates**

<b>Year</b>	<b>Yen per US\$1</b>
1988	130
1989	138
1990	149 (preliminary)

Source: Dataquest (June 1990)

Table 2  
Japanese Electronic Equipment Production Forecast  
(Billions of Yen)

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1988-1989	CAGR 1989-1994
Data Processing									
Computers	2,167	2,663	3,001	3,240	3,577	4,002	4,230	22.9%	9.7%
Data Storage	1,115	1,221	1,294	1,360	1,472	1,606	1,663	9.5%	6.4%
Terminals	760	753	772	888	941	981	1,010	(1.0%)	6.1%
Input/Output	913	948	986	1,054	1,177	1,260	1,350	3.8%	7.3%
Dedicated Systems	904	1,023	1,027	1,047	1,133	1,220	1,202	13.2%	3.3%
Subtotal	5,860	6,608	7,080	7,588	8,299	9,069	9,455	12.8%	7.4%
Communications									
Customer Premises	1,139	1,268	1,385	1,479	1,569	1,667	1,787	11.3%	7.1%
Public Telecom	713	630	651	678	701	733	771	(11.6%)	4.1%
Radio	757	786	826	885	971	1,088	1,189	3.9%	8.6%
Broadcast and Studio	70	68	72	75	79	82	85	(3.0%)	4.7%
Subtotal	2,679	2,752	2,934	3,116	3,321	3,570	3,832	2.7%	6.8%
Industrial									
Instrumentation	631	703	717	768	830	880	898	11.3%	5.0%
Manufacturing Systems	785	1,037	1,180	1,212	1,357	1,452	1,463	32.1%	7.1%
Medical	557	582	599	640	709	753	773	4.5%	5.8%
Others	621	676	709	752	887	934	976	8.8%	7.6%
Subtotal	2,594	2,998	3,205	3,373	3,783	4,018	4,111	15.6%	6.5%
Consumer									
Audio	805	787	732	677	665	640	593	(2.1%)	(5.5%)
Video	2,770	2,774	2,863	2,890	3,079	3,112	3,143	0.1%	2.5%
Personal Electronics	1,109	1,182	1,117	1,142	1,245	1,294	1,292	6.6%	1.8%
Appliances	2,013	1,999	1,915	2,024	2,168	2,166	2,240	(0.7%)	2.3%
Subtotal	6,696	6,742	6,627	6,733	7,157	7,211	7,269	0.7%	1.5%
Transportation	1,860	2,123	2,178	2,323	2,578	2,727	2,851	14.2%	6.1%
Total	19,689	21,223	22,024	23,133	25,138	26,596	27,517	7.8%	5.3%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 3

**Japanese Electronic Equipment Production Forecast**  
(Millions of Dollars)

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1988-1989	CAGR 1989-1994
<b>Data Processing</b>									
Computers	16,672	19,297	20,138	21,743	24,006	26,860	28,387	15.7%	8.0%
Data Storage	8,576	8,846	8,686	9,126	9,878	10,778	11,160	3.1%	4.8%
Terminals	5,850	5,455	5,181	5,960	6,315	6,581	6,779	(6.7%)	4.4%
Input/Output	7,027	6,871	6,618	7,071	7,899	8,460	9,062	(2.2%)	5.7%
Dedicated Systems	6,952	7,416	6,894	7,025	7,601	8,189	8,067	6.7%	1.7%
Subtotal	45,077	47,885	47,516	50,925	55,700	60,868	63,454	6.2%	5.8%
<b>Communications</b>									
Customer Premises	8,763	9,186	9,296	9,924	10,531	11,191	11,994	4.8%	5.5%
Public Telecom	5,483	4,566	4,371	4,550	4,708	4,917	5,176	(16.7%)	2.5%
Radio	5,821	5,698	5,544	5,939	6,520	7,304	7,978	(2.1%)	7.0%
Broadcast and Studio	537	491	483	502	529	548	571	(8.6%)	3.1%
Subtotal	20,604	19,940	19,693	20,915	22,288	23,960	25,719	(3.2%)	5.2%
<b>Industrial</b>									
Instrumentation	4,854	5,091	4,813	5,153	5,572	5,903	6,028	4.9%	3.4%
Manufacturing Systems	6,038	7,516	7,918	8,136	9,109	9,746	9,820	24.5%	5.5%
Medical	4,285	4,217	4,020	4,296	4,757	5,051	5,190	(1.6%)	4.2%
Others	4,777	4,897	4,758	5,050	5,951	6,268	6,551	2.5%	6.0%
Subtotal	19,954	21,721	21,509	22,636	25,389	26,968	27,589	8.9%	4.9%
<b>Consumer</b>									
Audio	6,190	5,706	4,912	4,542	4,460	4,295	3,981	(7.8%)	(6.9%)
Video	21,306	20,100	19,217	19,395	20,664	20,883	21,097	(5.7%)	1.0%
Personal Electronics	8,530	8,564	7,495	7,666	8,357	8,685	8,674	0.4%	0.3%
Appliances	15,485	14,485	12,852	13,583	14,553	14,534	15,032	(6.5%)	0.7%
Subtotal	51,510	48,856	44,475	45,186	48,035	48,397	48,785	(5.2%)	0
Transportation	14,308	15,386	14,619	15,591	17,300	18,304	19,132	7.5%	4.5%
Total	151,453	153,788	147,813	155,254	168,712	178,497	184,679	1.5%	3.7%

E = Estimates

P = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

**Table 4**  
**Estimated Input/Output Ratio by Application Market**  
**(Percentage)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994
<b>Data Processing</b>							
Computers	26.3%	27.2%	24.8%	26.8%	30.5%	35.2%	36.9%
Data Storage	14.6%	14.7%	14.5%	16.3%	18.8%	21.9%	23.9%
Terminals	24.7%	27.4%	28.4%	28.6%	32.0%	34.5%	36.0%
Input/Output	17.4%	19.5%	20.3%	23.0%	25.2%	30.9%	32.5%
Dedicated Systems	13.7%	13.7%	14.6%	17.5%	19.7%	23.6%	27.0%
Subtotal	20.5%	21.7%	21.2%	23.3%	26.4%	30.6%	32.7%
<b>Communications</b>							
Customer Premises	14.0%	14.4%	13.9%	15.1%	17.5%	20.8%	21.2%
Public Telecom	12.2%	16.5%	16.6%	18.0%	20.4%	23.5%	23.6%
Radio	17.3%	18.6%	19.4%	21.2%	23.6%	26.2%	26.8%
Broadcast and Studio	10.0%	11.8%	13.9%	14.7%	21.6%	28.2%	29.4%
Subtotal	14.4%	16.0%	16.0%	17.5%	20.0%	23.2%	23.6%
<b>Industrial</b>							
Instrumentation	19.8%	21.5%	21.9%	24.1%	27.0%	31.6%	33.8%
Manufacturing Systems	6.1%	5.9%	5.6%	6.7%	7.3%	9.2%	9.9%
Medical	6.6%	8.1%	8.8%	10.2%	11.4%	14.2%	16.0%
Others	3.5%	4.1%	4.4%	5.3%	5.6%	6.6%	7.6%
Subtotal	8.9%	9.6%	9.6%	11.0%	12.0%	14.4%	15.7%
<b>Consumer</b>							
Audio	18.9%	19.9%	21.9%	24.8%	28.6%	29.4%	30.5%
Video	16.7%	17.3%	17.5%	19.4%	21.4%	25.1%	26.2%
Personal Electronics	7.4%	7.4%	8.8%	9.6%	9.9%	12.0%	12.8%
Appliances	3.3%	3.3%	3.7%	4.0%	4.3%	5.2%	5.4%
Subtotal	11.4%	11.7%	12.5%	13.7%	14.9%	17.2%	17.8%
<b>Transportation</b>							
	6.2%	6.3%	6.7%	7.2%	7.8%	9.1%	9.4%
<b>Total</b>	<b>13.7%</b>	<b>14.5%</b>	<b>14.8%</b>	<b>16.3%</b>	<b>18.2%</b>	<b>21.3%</b>	<b>22.5%</b>

Source: Dataquest (June 1990)  
E = Estimates F = Forecast

Table 5

**Estimated Japanese Semiconductor Consumption by Application Market**  
(Billions of Yen)

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1988-1989	CAGR 1989-1994
<b>Data Processing</b>									
Computers	570	724	743	868	1,092	1,408	1,561	27.0%	16.6%
Data Storage	163	179	188	221	277	352	398	9.8%	17.3%
Terminals	188	206	219	254	301	338	364	9.6%	12.1%
Input/Output	159	185	200	242	297	390	439	16.4%	18.9%
Dedicated Systems	124	140	150	183	223	288	325	12.9%	18.3%
Subtotal	1,204	1,434	1,500	1,768	2,190	2,776	3,087	19.1%	16.6%
<b>Communications</b>									
Customer Premises	160	182	192	223	275	347	379	13.8%	15.8%
Public Telecom	87	104	108	122	143	172	182	19.5%	11.8%
Radio	131	146	160	188	229	285	319	11.5%	16.9%
Broadcast and Studio	7	8	10	11	17	23	25	14.3%	25.6%
Subtotal	385	440	470	544	664	827	905	14.3%	15.5%
<b>Industrial</b>									
Instrumentation	125	151	157	185	224	278	304	20.8%	15.0%
Manufacturing Systems	48	61	66	81	99	133	145	27.1%	18.9%
Medical	37	47	53	65	81	107	124	27.0%	21.4%
Others	22	28	31	40	50	62	74	27.3%	21.5%
Subtotal	232	287	307	371	454	580	647	23.7%	17.7%
<b>Consumer</b>									
Audio	152	157	160	168	190	188	181	3.3%	2.9%
Video	463	479	501	561	658	782	825	3.5%	11.5%
Personal Electronics	82	88	98	110	123	155	166	7.3%	13.5%
Appliances	67	66	70	81	94	112	121	(1.5%)	12.9%
Subtotal	764	790	829	920	1,065	1,237	1,293	3.4%	10.4%
Transportation	116	134	145	167	202	247	269	15.5%	15.0%
Total	2,701	3,085	3,251	3,770	4,575	5,667	6,201	14.2%	15.0%

E = Estimates  
F = Forecast  
Source: Dataquest (June 1990)

**Table 6**  
**Estimated Japanese Semiconductor Consumption by Application Market**  
**(Millions of Dollars)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1988-1989	CAGR 1989-1994
<b>Data Processing</b>									
Computers	4,385	5,246	4,987	5,826	7,329	9,450	10,477	19.7%	14.8%
Data Storage	1,254	1,297	1,262	1,483	1,859	2,362	2,671	3.4%	15.5%
Terminals	1,446	1,493	1,470	1,705	2,020	2,268	2,443	3.2%	10.4%
Input/Output	1,223	1,341	1,342	1,624	1,993	2,617	2,946	9.6%	17.1%
Dedicated Systems	954	1,014	1,007	1,228	1,497	1,933	2,181	6.4%	16.5%
Subtotal	9,262	10,391	10,067	11,866	14,698	18,631	20,718	12.2%	14.8%
<b>Communications</b>									
Customer Premises	1,231	1,319	1,289	1,497	1,846	2,329	2,544	7.2%	14.0%
Public Telecom	669	754	725	819	960	1,154	1,221	12.6%	10.1%
Radio	1,008	1,058	1,074	1,262	1,537	1,913	2,141	5.0%	15.1%
Broadcast and Studio	54	58	67	74	114	154	168	7.7%	23.7%
Subtotal	2,962	3,188	3,154	3,651	4,456	5,550	6,074	7.7%	13.8%
<b>Industrial</b>									
Instrumentation	962	1,094	1,054	1,242	1,503	1,866	2,040	13.8%	13.3%
Manufacturing Systems	369	442	443	544	664	893	973	19.7%	17.1%
Medical	285	341	356	436	544	718	832	19.7%	19.6%
Others	169	203	208	268	336	416	497	19.9%	19.6%
Subtotal	1,785	2,080	2,060	2,490	3,047	3,893	4,342	16.5%	15.9%
<b>Consumer</b>									
Audio	1,169	1,138	1,074	1,128	1,275	1,262	1,215	(2.7%)	1.3%
Video	3,562	3,471	3,362	3,765	4,416	5,248	5,537	(2.5%)	9.8%
Personal Electronics	631	638	658	738	826	1,040	1,114	1.1%	11.8%
Appliances	515	478	470	544	631	752	812	(7.2%)	11.2%
Subtotal	5,877	5,725	5,564	6,174	7,148	8,302	8,678	(2.6%)	8.7%
Transportation	892	971	973	1,121	1,356	1,658	1,805	8.8%	13.2%
Total	20,777	22,355	21,819	25,302	30,705	38,034	41,617	7.6%	13.2%

E = Estimates  
F = Forecast

Note: Columns may not add to totals shown because of rounding.  
Source: Dataquest (June 1990)



Table 7

**Estimated Japanese Semiconductor Consumption by Application Market  
(Percentage of Total Yen)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994
<b>Data Processing</b>							
Computers	21.1%	23.5%	22.9%	23.0%	23.9%	24.8%	25.2%
Data Storage	6.0	5.8	5.8	5.9	6.1	6.2	6.4
Terminals	6.9	6.7	6.7	6.7	6.6	6.0	5.9
Input/Output	5.9	6.0	6.2	6.4	6.5	6.9	7.1
Dedicated Systems	4.6	4.5	4.6	4.9	4.9	5.1	5.2
Subtotal	44.6%	46.5%	46.1%	46.9%	47.9%	49.0%	49.8%
<b>Communications</b>							
Customer Premises	5.9%	5.9%	5.9%	5.9%	6.0%	6.1%	6.1%
Public Telecom	3.2	3.4	3.3	3.2	3.1	3.0	2.9
Radio	4.9	4.7	4.9	5.0	5.0	5.0	5.1
Broadcast and Studio	0.3	0.3	0.3	0.3	0.4	0.4	0.4
Subtotal	14.3%	14.3%	14.5%	14.4%	14.5%	14.6%	14.6%
<b>Industrial</b>							
Instrumentation	4.6%	4.9%	4.8%	4.9%	4.9%	4.9%	4.9%
Manufacturing Systems	1.8	2.0	2.0	2.1	2.2	2.3	2.3
Medical	1.4	1.5	1.6	1.7	1.8	1.9	2.0
Others	0.8	0.9	1.0	1.1	1.1	1.1	1.2
Subtotal	8.6%	9.3%	9.4%	9.8%	9.9%	10.2%	10.4%
<b>Consumer</b>							
Audio	5.6%	5.1%	4.9%	4.5%	4.1%	3.3%	2.9%
Video	17.1	15.5	15.4	14.9	14.4	13.8	13.3
Personal Electronics	3.1	2.9	3.0	2.9	2.7	2.7	2.7
Appliances	2.5	2.1	2.2	2.1	2.0	2.0	2.0
Subtotal	28.3%	25.6%	25.5%	24.4%	23.3%	21.8%	20.9%
<b>Transportation</b>	4.3%	4.3%	4.5%	4.4%	4.4%	4.4%	4.3%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

## ANALYSIS

Analyzing Japanese electronic equipment production in conjunction with Japanese semiconductor consumption highlights many key trends in the Japanese electronics market.

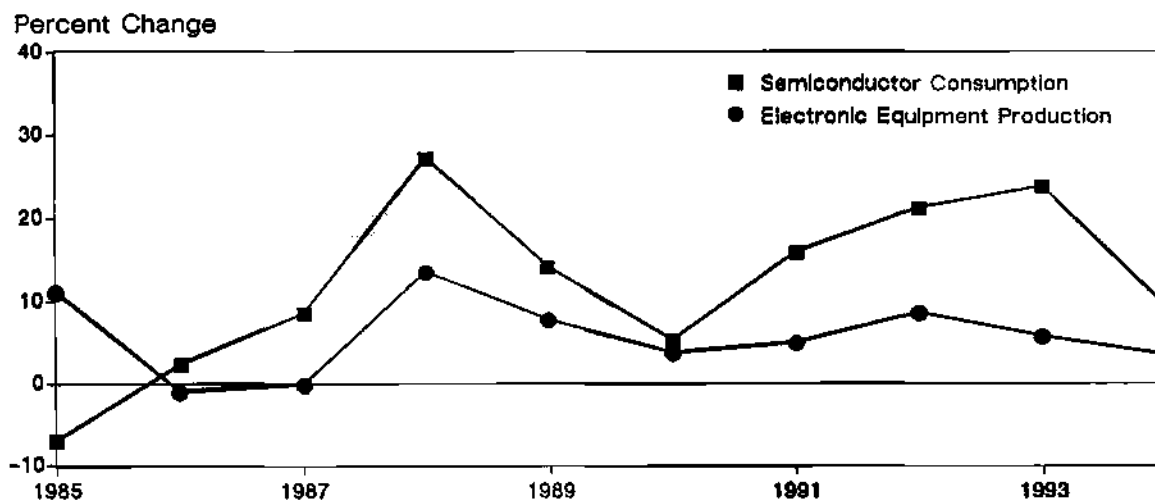
Historically, the Japanese semiconductor market has closely followed Japanese electronic equipment production. Dataquest believes that this relationship will hold true throughout the forecast period from 1990 through 1994 (see Figure 1). However, changes in semiconductor consumption growth rates from year to year tend to outpace those of equipment production for the following reasons:

- Pervasiveness of semiconductors in equipment
- Inventory buildup and reduction
- Semiconductor price increases/decreases due to dramatic changes in supply and demand

A prime example of these factors coming into play to make semiconductor consumption dramatically outpace equipment production occurred in 1984. Growth in the 1984 computer market caused manufacturers to hoard semiconductors (microprocessors and memories) that were in short supply, pushing semiconductor prices up throughout the world. In 1985, growth did not meet equipment manufacturers' expectations. This situation forced equipment manufacturers to produce equipment, using the excess semiconductor inventories built up in 1984. Consequently, semiconductor consumption was pushed below 1984 levels.

Figure 1

Comparison of Japanese Semiconductor  
Consumption and Electronic Equipment Production



Source: Dataquest (June 1990)

Looking toward the future, Dataquest believes that 1990 will be a moderate year for Japanese equipment manufacturers and semiconductor vendors. Electronic equipment is expected to grow 3.8 percent, and semiconductor consumption is forecast to grow 5.4 percent. Dataquest expects the following factors to foster this growth:

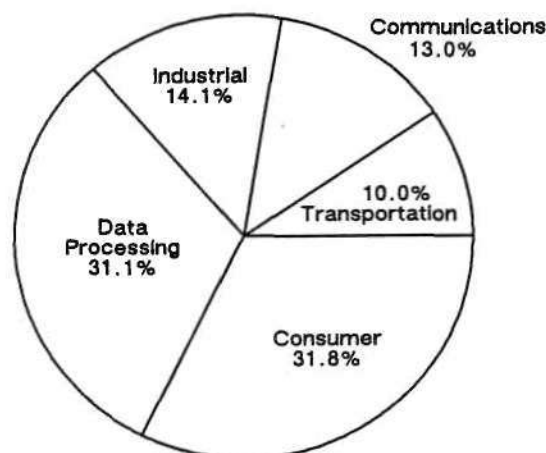
- Japanese equipment manufacturers will continue to develop demand for their products in Japan.
- Japanese equipment manufacturers will continue to move into higher-growth nonconsumer product areas.

The composition of Japanese electronic equipment production continues to change dramatically. Japanese equipment manufacturers have been moving away from the low-end consumer electronics markets and moving toward information processing-related industries: computers, printers, computer storage, and communications.

Dataquest believes that this trend of moving away from low-end consumer electronics markets will continue through the 1990s, as manufacturers move consumer electronics production offshore and focus on developing the Japanese demand for information-processing products. Figure 1 shows a comparison of the Japanese semiconductor consumption and electronic equipment production from 1985 through 1994. Figures 2 and 3 show electronic equipment production by application market in 1989 and 1994, respectively, and Figures 4 and 5 show semiconductor consumption by application market for the same years.

**Figure 2**

**1989 Japanese Electronic Equipment Production**

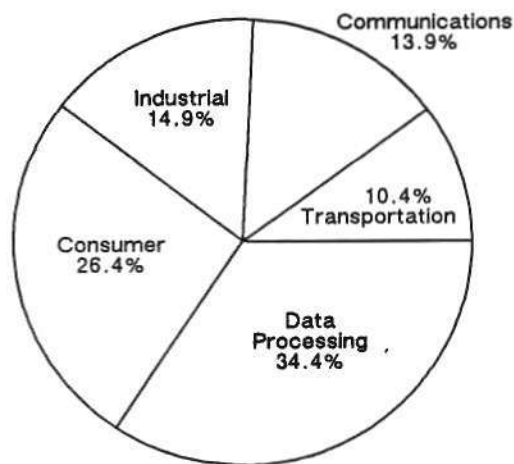


Source: Dataquest (June 1990)

Source: Dataquest (June 1990)

Figure 3

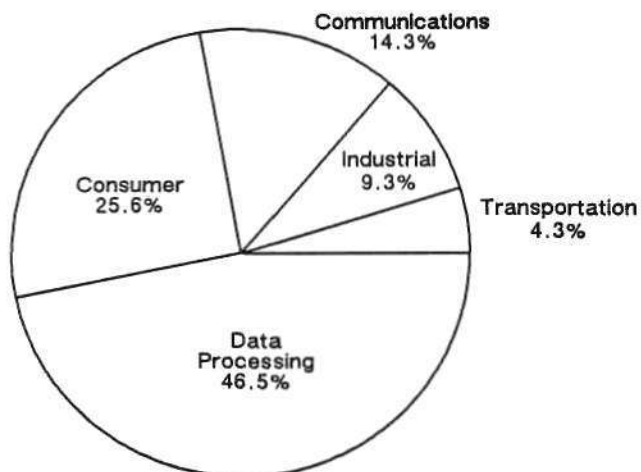
1994 Japanese Electronic Equipment Production Forecast



Source: Dataquest (June 1990)

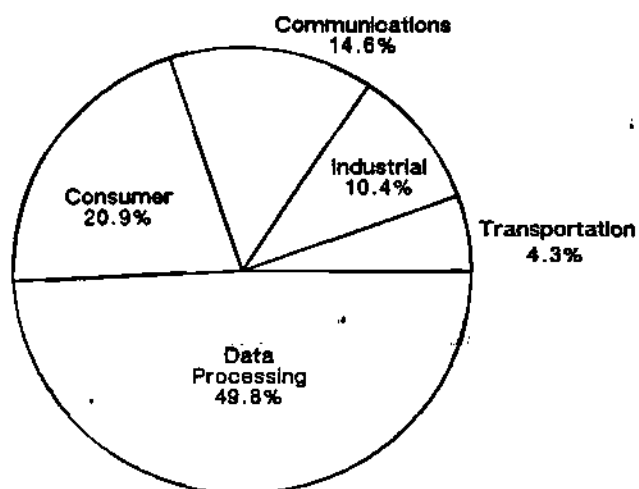
Figure 4

1989 Japanese Semiconductor Consumption by Application Market



Source: Dataquest (June 1990)

Figure 5

**Forecast of 1994 Japanese Semiconductor Consumption  
by Application Market**

Source: Dataquest (June 1990)

Tables 8 through 34 present the estimated Japanese consumption figures by application markets. The first two columns (1988 and 1989) are estimates, whereas the last six columns are projected figures and compound annual growth rates (CAGRs) from 1989 through 1994.

Table 8

**Estimated Japanese IC Consumption by Application Market  
(Billions of Yen)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	533	677	690	805	1,016	1,323	1,469	16.8%
Data Storage	129	142	146	169	212	278	317	17.5%
Terminals	138	151	161	188	229	257	279	13.0%
Input/Output	110	132	141	171	212	291	330	20.1%
Dedicated Systems	90	104	110	135	166	223	253	19.5%
Subtotal	1,000	1,206	1,248	1,468	1,835	2,372	2,648	17.0%
<b>Communications</b>								
Customer Premises	121	139	145	169	211	273	299	16.5%
Public Telecom	57	71	73	83	98	122	128	12.5%
Radio	94	105	114	134	164	210	236	17.5%
Broadcast and Studio	5	7	8	8	12	16	19	23.5%
Subtotal	277	322	340	394	485	621	682	16.2%
<b>Industrial</b>								
Instrumentation	91	111	113	134	161	207	227	15.4%
Manufacturing Systems	38	48	51	62	76	107	116	19.2%
Medical	27	35	39	49	62	85	98	22.9%
Others	16	20	22	29	37	47	56	23.5%
Subtotal	172	214	225	274	335	446	497	18.4%
<b>Consumer</b>								
Audio	108	113	113	119	135	134	130	2.9%
Video	356	365	383	433	516	624	656	12.5%
Personal Electronics	65	70	78	88	97	126	133	13.6%
Appliances	38	36	38	45	54	69	74	15.6%
Subtotal	566	584	612	685	801	953	993	11.2%
<b>Transportation</b>	80	94	101	116	140	181	198	16.0%
<b>Total</b>	<b>2,096</b>	<b>2,419</b>	<b>2,526</b>	<b>2,937</b>	<b>3,596</b>	<b>4,573</b>	<b>5,018</b>	<b>15.7%</b>

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 9

**Estimated Japanese IC Consumption by Application Market**  
(Millions of Dollars)

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	4,097	4,903	4,631	5,403	6,819	8,879	9,859	15.0%
Data Storage	993	1,027	980	1,134	1,423	1,866	2,128	15.7%
Terminals	1,059	1,097	1,081	1,262	1,537	1,725	1,872	11.3%
Input/Output	849	959	946	1,148	1,424	1,953	2,215	18.2%
Dedicated Systems	696	754	738	906	1,115	1,497	1,698	17.6%
Subtotal	7,694	8,739	8,376	9,852	12,317	15,919	17,772	15.3%
<b>Communications</b>								
Customer Premises	933	1,009	973	1,134	1,416	1,832	2,007	14.7%
Public Telecom	436	514	490	557	658	819	859	10.8%
Radio	721	764	765	899	1,101	1,409	1,584	15.7%
Broadcast and Studio	42	48	54	54	77	107	128	21.7%
Subtotal	2,132	2,334	2,282	2,644	3,252	4,168	4,577	14.4%
<b>Industrial</b>								
Instrumentation	699	804	758	899	1,081	1,389	1,523	13.6%
Manufacturing Systems	295	349	342	416	507	718	779	17.4%
Medical	208	254	262	329	418	570	658	21.0%
Others	125	141	148	195	245	315	376	21.6%
Subtotal	1,327	1,548	1,510	1,839	2,250	2,993	3,336	16.6%
<b>Consumer</b>								
Audio	831	817	758	799	903	899	872	1.3%
Video	2,735	2,642	2,570	2,906	3,461	4,188	4,403	10.8%
Personal Electronics	497	510	523	591	649	846	893	11.8%
Appliances	292	260	255	302	361	463	497	13.8%
Subtotal	4,354	4,229	4,107	4,597	5,374	6,396	6,664	9.5%
<b>Transportation</b>	617	682	678	779	942	1,215	1,329	14.3%
<b>Total</b>	16,124	17,532	16,953	19,711	24,135	30,691	33,678	13.9%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 10

**Estimated Japanese IC Consumption by Application Market  
(Percentage of Total)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994
<b>Data Processing</b>							
Computers	25.4%	28.0%	27.3%	27.4%	28.3%	28.9%	29.3%
Data Storage	6.2	5.9	5.8	5.8	5.9	6.1	6.3
Terminals	6.6	6.3	6.4	6.4	6.4	5.6	5.6
Input/Output	5.3	5.5	5.6	5.8	5.9	6.4	6.6
Dedicated Systems	4.3	4.3	4.4	4.6	4.6	4.9	5.0
Subtotal	47.7%	49.8%	49.4%	50.0%	51.0%	51.9%	52.8%
<b>Communications</b>							
Customer Premises	5.8%	5.8%	5.7%	5.8%	5.9%	6.0%	6.0%
Public Telecom	2.7	2.9	2.9	2.8	2.7	2.7	2.6
Radio	4.5	4.4	4.5	4.6	4.6	4.6	4.7
Broadcast and Studio	0.3	0.3	0.3	0.3	0.3	0.3	0.4
Subtotal	13.2%	13.3%	13.5%	13.4%	13.5%	13.6%	13.6%
<b>Industrial</b>							
Instrumentation	4.3%	4.6%	4.5%	4.6%	4.5%	4.5%	4.5%
Manufacturing Systems	1.8	2.0	2.0	2.1	2.1	2.3	2.3
Medical	1.3	1.4	1.5	1.7	1.7	1.9	2.0
Others	0.8	0.8	0.9	1.0	1.0	1.0	1.1
Subtotal	8.2%	8.8%	8.9%	9.3%	9.3%	9.8%	9.9%
<b>Consumer</b>							
Audio	5.2%	4.7%	4.5%	4.1%	3.7%	2.9%	2.6%
Video	17.0	15.1	15.2	14.7	14.3	13.6	13.1
Personal Electronics	3.1	2.9	3.1	3.0	2.7	2.8	2.7
Appliances	1.8	1.5	1.5	1.5	1.5	1.5	1.5
Subtotal	27.0%	24.1%	24.2%	23.3%	22.3%	20.8%	19.8%
<b>Transportation</b>	3.8%	3.9%	4.0%	3.9%	3.9%	4.0%	3.9%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)



Table 11

**Estimated Japanese Bipolar Logic Consumption by Application Market  
(Billions of Yen)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	77	83	74	77	86	87	85	0.5%
Data Storage	22	24	21	22	23	24	23	(0.8%)
Terminals	13	14	12	12	13	13	13	(1.5%)
Input/Output	15	16	14	15	15	16	14	(2.6%)
Dedicated Systems	8	9	8	9	8	8	8	(2.3%)
Subtotal	135	146	129	135	145	148	143	(0.4%)
<b>Communications</b>								
Customer Premises	10	12	11	12	12	13	11	(1.7%)
Public Telecom	5	5	4	4	5	5	5	(0.8%)
Radio	13	15	14	15	17	18	17	2.5%
Broadcast and Studio	1	0	0	0	0	0	0	(100.0%)
Subtotal	28	33	29	31	34	36	33	0.2%
<b>Industrial</b>								
Instrumentation	13	16	13	14	14	15	15	(1.3%)
Manufacturing Systems	5	6	5	5	6	6	7	3.1%
Medical	3	4	4	5	4	5	6	8.4%
Others	1	1	1	2	2	2	2	14.9%
Subtotal	22	27	23	26	25	28	30	2.1%
<b>Consumer</b>								
Audio	0	0	0	0	0	0	0	(100.0%)
Video	2	3	2	2	2	3	2	(7.8%)
Personal Electronics	2	2	2	2	2	2	1	(12.9%)
Appliances	3	3	2	2	2	2	1	(19.7%)
Subtotal	7	8	6	6	5	7	4	(13.6%)
<b>Transportation</b>	10	12	11	12	10	11	10	0.5%
<b>Total</b>	203	226	198	210	220	230	220	2.0%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 12

**Estimated Japanese Bipolar Logic Consumption by Application Market**  
(Millions of Dollars)

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	590	601	497	517	577	584	570	(1.1%)
Data Storage	172	174	141	148	154	161	154	(2.4%)
Terminals	103	101	81	81	87	87	87	(3.0%)
Input/Output	112	116	94	101	101	107	94	(4.1%)
Dedicated Systems	63	65	54	60	51	54	54	(3.8%)
Subtotal	1,040	1,058	866	906	972	993	960	(1.9%)
<b>Communications</b>								
Customer Premises	75	87	74	81	81	87	74	(3.2%)
Public Telecom	41	38	27	27	34	34	34	(2.3%)
Radio	98	109	94	101	114	121	114	1.0%
Broadcast and Studio	4	3	0	0	0	0	0	(100.0%)
Subtotal	217	236	195	208	228	242	221	(1.3%)
<b>Industrial</b>								
Instrumentation	99	116	87	94	94	101	101	(2.8%)
Manufacturing Systems	37	43	34	34	37	40	47	1.6%
Medical	24	29	27	34	29	34	40	6.8%
Others	10	7	7	13	10	13	13	13.1%
Subtotal	169	196	154	174	170	188	201	0.6%
<b>Consumer</b>								
Audio	3	2	0	0	1	0	0	(100.0%)
Video	18	22	13	13	11	20	13	(9.2%)
Personal Electronics	16	14	13	13	11	13	7	(14.3%)
Appliances	19	22	13	13	12	13	7	(20.9%)
Subtotal	57	60	40	40	36	47	27	(14.9%)
<b>Transportation</b>	78	87	74	81	70	74	67	(5.0%)
<b>Total</b>	<b>1,561</b>	<b>1,637</b>	<b>1,329</b>	<b>1,409</b>	<b>1,475</b>	<b>1,544</b>	<b>1,477</b>	<b>(2.0%)</b>

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 13

**Estimated Japanese Bipolar Logic Consumption by Application Market  
(Percentage of Total)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994
<b>Data Processing</b>							
Computers	37.8%	36.7%	37.4%	36.7%	39.1%	37.8%	38.6%
Data Storage	11.0	10.6	10.6	10.5	10.5	10.4	10.5
Terminals	6.6	6.2	6.1	5.7	5.9	5.7	5.9
Input/Output	7.2	7.1	7.1	7.1	6.9	7.0	6.4
Dedicated Systems	4.0	4.0	4.0	4.3	3.5	3.5	3.6
Subtotal	66.6%	64.6%	65.2%	64.3%	65.9%	64.3%	65.0%
<b>Communications</b>							
Customer Premises	4.8%	5.3%	5.6%	5.7%	5.5%	5.7%	5.0%
Public Telecom	2.6	2.3	2.0	1.9	2.3	2.2	2.3
Radio	6.3	6.6	7.1	7.1	7.7	7.8	7.7
Broadcast and Studio	0.2	0.2	0	0	0	0	0
Subtotal	13.9%	14.4%	14.6%	14.8%	15.5%	15.7%	15.0%
<b>Industrial</b>							
Instrumentation	6.3%	7.1%	6.6%	6.7%	6.4%	6.5%	6.8%
Manufacturing Systems	2.4	2.7	2.5	2.4	2.5	2.6	3.2
Medical	1.5	1.8	2.0	2.4	2.0	2.2	2.7
Others	0.6	0.4	0.5	1.0	0.7	0.9	0.9
Subtotal	10.8%	12.0%	11.6%	12.4%	11.5%	12.2%	13.6%
<b>Consumer</b>							
Audio	0.2%	0.1%	0	0	0.1%	0	0
Video	1.2	1.3	1.0%	1.0%	0.8	1.3%	0.9%
Personal Electronics	1.1	0.9	1.0	1.0	0.8	0.9	0.5
Appliances	1.2	1.3	1.0	1.0	0.8	0.9	0.5
Subtotal	3.7%	3.7%	3.0%	2.9%	2.4%	3.0%	1.8%
<b>Transportation</b>	5.0%	5.3%	5.6%	5.7%	4.7%	4.8%	4.5%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

E = Estimates  
F = Forecast  
Source: Dataquest (June 1990)

Table 14

**Estimated Japanese Bipolar Memory Consumption by Application Market  
(Billions of Yen)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	45	28	23	21	18	16	14	(20.6%)
Data Storage	0	0	0	0	0	0	0	0
Terminals	0	0	0	0	0	0	0	0
Input/Output	0	0	0	0	0	0	0	0
Dedicated Systems	0	0	0	0	0	0	0	0
Subtotal	45	28	23	21	18	16	14	(20.6%)
<b>Communications</b>								
Customer Premises	0	0	0	0	0	0	0	0
Public Telecom	0	0	0	0	0	0	0	0
Radio	0	0	0	0	0	0	0	0
Broadcast and Studio	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Industrial</b>								
Instrumentation	0	0	0	0	0	0	0	0
Manufacturing Systems	0	0	0	0	0	0	0	0
Medical	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Consumer</b>								
Audio	0	0	0	0	0	0	0	0
Video	0	0	0	0	0	0	0	0
Personal Electronics	0	0	0	0	0	0	0	0
Appliances	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Transportation</b>	0	0	0	0	0	0	0	0
<b>Total</b>	45	28	23	21	18	16	14	(16.8%)

E = Estimates

F = Forecast

Source: Dataquest (June 1990)

Table 15

**Estimated Japanese Bipolar Memory Consumption by Application Market  
(Millions of Dollars)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	348	203	154	141	121	107	94	(14.3%)
Data Storage	0	0	0	0	0	0	0	0
Terminals	0	0	0	0	0	0	0	0
Input/Output	0	0	0	0	0	0	0	0
Dedicated Systems	0	0	0	0	0	0	0	0
Subtotal	348	203	154	141	121	107	94	(14.3%)
<b>Communications</b>								
Customer Premises	0	0	0	0	0	0	0	0
Public Telecom	0	0	0	0	0	0	0	0
Radio	0	0	0	0	0	0	0	0
Broadcast and Studio	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Industrial</b>								
Instrumentation	0	0	0	0	0	0	0	0
Manufacturing Systems	0	0	0	0	0	0	0	0
Medical	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Consumer</b>								
Audio	0	0	0	0	0	0	0	0
Video	0	0	0	0	0	0	0	0
Personal Electronics	0	0	0	0	0	0	0	0
Appliances	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Transportation</b>	0	0	0	0	0	0	0	0
<b>Total</b>	348	203	154	141	121	107	94	(14.3%)

E = Estimates

F = Forecast

Source: Dataquest (June 1990)

Table 16

**Estimated Japanese Bipolar Memory Consumption by Application Market  
(Percentage of Total)**

<b>Segment</b>	<b>E 1988</b>	<b>E 1989</b>	<b>F 1990</b>	<b>F 1991</b>	<b>F 1992</b>	<b>F 1993</b>	<b>F 1994</b>
<b>Data Processing</b>							
Computers	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Data Storage	0	0	0	0	0	0	0
Terminals	0	0	0	0	0	0	0
Input/Output	0	0	0	0	0	0	0
Dedicated Systems	0	0	0	0	0	0	0
Subtotal	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
<b>Communications</b>							
Customer Premises	0	0	0	0	0	0	0
Public Telecom	0	0	0	0	0	0	0
Radio	0	0	0	0	0	0	0
Broadcast and Studio	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0
<b>Industrial</b>							
Instrumentation	0	0	0	0	0	0	0
Manufacturing Systems	0	0	0	0	0	0	0
Medical	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0
<b>Consumer</b>							
Audio	0	0	0	0	0	0	0
Video	0	0	0	0	0	0	0
Personal Electronics	0	0	0	0	0	0	0
Appliances	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0
<b>Transportation</b>	0	0	0	0	0	0	0
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

E = Estimates

F = Forecast

Source: Dataquest (June 1990)

Table 17

**Estimated Japanese MOS Logic Consumption by Application Market  
(Billions of Yen)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	56	66	80	99	135	170	179	22.2%
Data Storage	24	26	31	39	57	74	77	24.5%
Terminals	33	38	44	54	70	80	84	17.5%
Input/Output	27	30	36	46	59	79	82	22.0%
Dedicated Systems	37	41	48	60	78	105	113	22.7%
Subtotal	177	200	239	298	399	508	535	21.8%
<b>Communications</b>								
Customer Premises	32	34	38	47	61	81	85	20.0%
Public Telecom	14	15	17	21	25	32	33	16.6%
Radio	19	20	23	29	37	50	55	21.9%
Broadcast and Studio	1	1	1	1	2	3	3	20.1%
Subtotal	66	71	79	98	125	166	176	19.9%
<b>Industrial</b>								
Instrumentation	21	23	25	31	40	52	54	18.7%
Manufacturing Systems	8	9	11	14	19	27	27	24.2%
Medical	5	7	8	11	15	20	23	28.6%
Others	4	5	6	7	12	15	16	28.3%
Subtotal	38	43	50	63	86	114	120	22.7%
<b>Consumer</b>								
Audio	28	29	29	31	32	33	32	1.8%
Video	102	106	114	127	144	179	183	11.5%
Personal Electronics	24	26	30	34	37	45	47	12.3%
Appliances	8	8	8	9	11	14	14	12.7%
Subtotal	162	170	181	201	224	271	276	10.2%
<b>Transportation</b>	12	15	17	20	25	32	33	17.1%
<b>Total</b>	456	499	566	680	859	1,091	1,140	18.0%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 18

**Estimated Japanese MOS Logic Consumption by Application Market  
(Millions of Dollars)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
Data Processing								
Computers	434	475	537	664	906	1,141	1,201	20.4%
Data Storage	183	186	208	262	383	497	517	22.6%
Terminals	254	272	295	362	470	537	564	15.7%
Input/Output	211	220	242	309	396	530	550	20.2%
Dedicated Systems	282	295	322	403	523	705	758	20.8%
Subtotal	1,364	1,447	1,604	2,000	2,678	3,409	3,591	19.9%
Communications								
Customer Premises	243	248	255	315	409	544	570	18.1%
Public Telecom	105	111	114	141	168	215	221	14.8%
Radio	149	148	154	195	248	336	369	20.1%
Broadcast and Studio	9	9	7	7	10	20	20	18.3%
Subtotal	505	515	530	658	836	1,114	1,181	18.1%
Industrial								
Instrumentation	160	166	168	208	268	349	362	16.9%
Manufacturing Systems	64	66	74	94	128	181	181	22.4%
Medical	40	47	54	74	101	134	154	26.6%
Others	32	33	40	47	81	101	107	26.4%
Subtotal	296	313	336	423	577	765	805	20.8%
Consumer								
Audio	212	212	195	208	215	220	215	0.2%
Video	788	770	765	852	966	1,201	1,228	9.8%
Personal Electronics	183	191	201	228	248	302	315	10.6%
Appliances	65	56	54	60	74	94	94	11.0%
Subtotal	1,247	1,229	1,215	1,349	1,503	1,817	1,852	8.6%
Transportation	94	109	114	134	168	215	221	15.3%
Total	3,505	3,613	3,799	4,564	5,762	7,321	7,651	16.2%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)



Table 19

**Estimated Japanese MOS Logic Consumption by Application Market  
(Percentage of Total)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994
<b>Data Processing</b>							
Computers	12.4%	13.2%	14.1%	14.6%	15.7%	15.6%	15.7%
Data Storage	5.2	5.2	5.5	5.7	6.6	6.8	6.8
Terminals	7.2	7.5	7.8	7.9	8.2	7.3	7.4
Input/Output	6.0	6.1	6.4	6.8	6.9	7.2	7.2
Dedicated Systems	8.0	8.2	8.5	8.8	9.1	9.6	9.9
Subtotal	38.9%	40.1%	42.2%	43.8%	46.5%	46.6%	46.9%
<b>Communications</b>							
Customer Premises	6.9%	6.9%	6.7%	6.9%	7.1%	7.4%	7.5%
Public Telecom	3.0	3.1	3.0	3.1	2.9	2.9	2.9
Radio	4.2	4.1	4.1	4.3	4.3	4.6	4.8
Broadcast and Studio	0.2	0.2	0.2	0.1	0.2	0.3	0.3
Subtotal	14.4%	14.3%	14.0%	14.4%	14.5%	15.2%	15.4%
<b>Industrial</b>							
Instrumentation	4.6%	4.6%	4.4%	4.6%	4.7%	4.8%	4.7%
Manufacturing Systems	1.8	1.8	1.9	2.1	2.2	2.5	2.4
Medical	1.1	1.3	1.4	1.6	1.7	1.8	2.0
Others	0.9	0.9	1.1	1.0	1.4	1.4	1.4
Subtotal	8.4%	8.7%	8.8%	9.3%	10.0%	10.5%	10.5%
<b>Consumer</b>							
Audio	6.0%	5.9%	5.1%	4.6%	3.7%	3.0%	2.8%
Video	22.5	21.3	20.1	18.7	16.8	16.4	16.1
Personal Electronics	5.2	5.3	5.3	5.0	4.3	4.1	4.1
Appliances	1.8	1.5	1.4	1.3	1.3	1.3	1.2
Subtotal	35.6%	34.0%	32.0%	29.6%	26.1%	24.8%	24.2%
<b>Transportation</b>	2.7%	3.0%	3.0%	2.9%	2.9%	2.9%	2.9%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 20

**Estimated Japanese MOS Microcomponent Consumption by Application Market  
(Billions of Yen)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	94	127	140	157	187	259	288	17.8%
Data Storage	24	27	29	33	39	55	61	17.7%
Terminals	24	28	31	35	41	48	53	13.6%
Input/Output	14	18	20	23	27	37	41	17.9%
Dedicated Systems	12	16	17	19	22	30	33	15.6%
Subtotal	168	216	237	267	316	429	476	17.1%
<b>Communications</b>								
Customer Premises	22	26	29	33	39	48	53	15.3%
Public Telecom	10	12	13	14	16	22	23	13.5%
Radio	13	15	17	20	23	28	31	15.6%
Broadcast and Studio	1	1	2	2	3	4	5	44.3%
Subtotal	46	54	61	69	81	102	112	15.7%
<b>Industrial</b>								
Instrumentation	13	17	19	21	25	32	37	16.8%
Manufacturing Systems	5	7	8	9	11	16	18	20.8%
Medical	5	6	7	8	9	13	15	19.9%
Others	2	3	3	4	4	5	6	14.9%
Subtotal	24	33	37	42	49	66	76	18.1%
<b>Consumer</b>								
Audio	14	15	15	16	17	17	16	1.3%
Video	44	47	50	55	63	76	79	10.9%
Personal Electronics	8	9	10	11	12	16	18	14.6%
Appliances	8	9	9	10	11	15	16	13.2%
Subtotal	75	80	84	92	103	124	129	10.1%
<b>Transportation</b>	21	25	27	31	36	46	50	14.9%
<b>Total</b>	<b>334</b>	<b>408</b>	<b>446</b>	<b>501</b>	<b>585</b>	<b>767</b>	<b>843</b>	<b>15.6%</b>

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 21

**Estimated Japanese MOS Microcomponent Consumption by Application Market  
(Millions of Dollars)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	723	920	940	1,054	1,255	1,738	1,933	16.0%
Data Storage	181	196	195	221	262	369	409	15.9%
Terminals	185	203	208	235	275	322	356	11.9%
Input/Output	105	130	134	154	181	248	275	16.1%
Dedicated Systems	96	116	114	128	150	201	221	13.8%
Subtotal	1,291	1,565	1,591	1,792	2,123	2,879	3,195	15.3%
<b>Communications</b>								
Customer Premises	168	188	195	221	262	322	356	13.6%
Public Telecom	77	88	87	94	107	148	154	11.8%
Radio	103	109	114	134	154	188	208	13.9%
Broadcast and Studio	6	6	13	13	20	27	34	42.1%
Subtotal	354	391	409	463	544	685	752	13.9%
<b>Industrial</b>								
Instrumentation	99	123	128	141	168	215	248	15.1%
Manufacturing Systems	37	51	54	60	74	107	121	19.0%
Medical	37	44	47	54	60	87	101	18.1%
Others	14	22	20	27	27	34	40	13.1%
Subtotal	187	239	248	282	329	443	510	16.3%
<b>Consumer</b>								
Audio	107	109	101	107	114	114	107	(0.2%)
Video	339	341	336	369	423	510	530	9.3%
Personal Electronics	65	66	67	74	81	107	121	12.9%
Appliances	65	62	60	67	74	101	107	11.5%
Subtotal	576	578	564	617	691	832	866	8.4%
<b>Transportation</b>	163	181	181	208	242	309	336	13.1%
<b>Total</b>	2,572	2,955	2,993	3,362	3,928	5,148	5,658	13.9%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 22

**Estimated Japanese MOS Microcomponent Consumption by Application Market  
(Percentage of Total)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994
<b>Data Processing</b>							
Computers	28.1%	31.1%	31.4%	31.3%	31.9%	33.8%	34.2%
Data Storage	7.0	6.6	6.5	6.6	6.7	7.2	7.2
Terminals	7.2	6.9	7.0	7.0	7.0	6.3	6.3
Input/Output	4.1	4.4	4.5	4.6	4.6	4.8	4.9
Dedicated Systems	3.7	3.9	3.8	3.8	3.8	3.9	3.9
Subtotal	50.2%	53.0%	53.1%	53.3%	54.1%	55.9%	56.5%
<b>Communications</b>							
Customer Premises	6.5%	6.4%	6.5%	6.6%	6.7%	6.3%	6.3%
Public Telecom	3.0	3.0	2.9	2.8	2.7	2.9	2.7
Radio	4.0	3.7	3.8	4.0	3.9	3.7	3.7
Broadcast and Studio	0.2	0.2	0.4	0.4	0.5	0.5	0.6
Subtotal	13.8%	13.2%	13.7%	13.8%	13.8%	13.3%	13.3%
<b>Industrial</b>							
Instrumentation	3.8%	4.2%	4.3%	4.2%	4.3%	4.2%	4.4%
Manufacturing Systems	1.4	1.7	1.8	1.8	1.9	2.1	2.1
Medical	1.5	1.5	1.6	1.6	1.5	1.7	1.8
Others	0.6	0.7	0.7	0.8	0.7	0.7	0.7
Subtotal	7.3%	8.1%	8.3%	8.4%	8.4%	8.6%	9.0%
<b>Consumer</b>							
Audio	4.2%	3.7%	3.4%	3.2%	2.9%	2.2%	1.9%
Video	13.2	11.5	11.2	11.0	10.8	9.9	9.4
Personal Electronics	2.5	2.2	2.2	2.2	2.1	2.1	2.1
Appliances	2.5	2.1	2.0	2.0	1.9	2.0	1.9
Subtotal	22.4%	19.5%	18.8%	18.4%	17.6%	16.2%	15.3%
<b>Transportation</b>	6.3%	6.1%	6.1%	6.2%	6.2%	6.0%	5.9%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 23

**Estimated Japanese MOS Memory Consumption by Application Market  
(Billions of Yen)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	251	362	359	432	564	758	864	19.0%
Data Storage	44	49	48	53	66	90	114	18.4%
Terminals	49	52	52	62	72	77	85	10.3%
Input/Output	45	57	58	70	89	130	158	22.6%
Dedicated Systems	25	30	28	34	42	60	74	19.8%
Subtotal	414	550	545	651	833	1,115	1,295	18.7%
<b>Communications</b>								
Customer Premises	38	44	42	48	60	82	96	16.9%
Public Telecom	18	27	26	29	34	40	42	9.5%
Radio	20	25	26	29	35	44	50	14.9%
Broadcast and Studio	2	3	3	3	4	5	6	14.9%
Subtotal	78	99	97	109	133	171	194	14.5%
<b>Industrial</b>								
Instrumentation	25	33	32	38	45	62	67	15.2%
Manufacturing Systems	12	17	17	20	23	35	38	17.5%
Medical	7	10	11	13	17	22	25	20.1%
Others	3	4	4	5	6	7	8	13.8%
Subtotal	47	64	64	76	91	126	138	16.5%
<b>Consumer</b>								
Audio	2	3	2	2	3	4	3	2.1%
Video	11	13	14	16	23	32	41	25.8%
Personal Electronics	9	12	13	15	17	24	28	18.5%
Appliances	1	2	2	3	4	4	5	27.2%
Subtotal	24	29	31	36	47	64	77	21.4%
<b>Transportation</b>	11	14	14	15	20	30	35	15.5%
<b>Total</b>	574	756	751	887	1,124	1,506	1,739	18.3%

E = Estimates

F = Forecast

Source: Dataquest (June 1990)

Table 24

**Estimated Japanese MOS Memory Consumption by Application Market  
(Millions of Dollars)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	1,931	2,623	2,409	2,899	3,785	5,087	5,799	17.2%
Data Storage	339	355	322	356	443	604	765	16.6%
Terminals	376	377	349	416	483	517	570	8.6%
Input/Output	348	413	389	470	597	872	1,060	20.8%
Dedicated Systems	192	217	188	228	282	403	497	18.0%
Subtotal	3,185	3,986	3,658	4,369	5,590	7,483	8,691	16.9%
<b>Communications</b>								
Customer Premises	294	319	282	322	403	550	644	15.1%
Public Telecom	139	193	174	195	228	268	282	7.8%
Radio	156	181	174	195	235	295	336	13.1%
Broadcast and Studio	15	22	20	20	27	34	40	13.1%
Subtotal	604	715	651	732	893	1,148	1,302	12.7%
<b>Industrial</b>								
Instrumentation	192	239	215	255	302	416	450	13.5%
Manufacturing Systems	92	123	114	134	154	235	255	15.7%
Medical	54	72	74	87	114	148	168	18.3%
Others	22	30	27	34	40	47	54	12.0%
Subtotal	360	465	430	510	611	846	926	14.8%
<b>Consumer</b>								
Audio	16	20	13	13	23	27	20	0.6%
Video	88	94	94	107	154	215	275	23.9%
Personal Electronics	69	87	87	101	114	161	188	16.7%
Appliances	10	11	13	20	27	27	34	25.3%
Subtotal	183	212	208	242	318	430	517	19.6%
<b>Transportation</b>	86	101	94	101	134	201	235	18.3%
<b>Total</b>	4,418	5,479	5,040	5,953	7,546	10,107	11,671	16.3%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 25

**Estimated Japanese MOS Memory Consumption by Application Market  
(Percentage of Total)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994
<b>Data Processing</b>							
Computers	43.7%	47.9%	47.8%	48.7%	50.2%	50.3%	49.7%
Data Storage	7.7	6.5	6.4	6.0	5.9	6.0	6.6
Terminals	8.5	6.9	6.9	7.0	6.4	5.1	4.9
Input/Output	7.9	7.5	7.7	7.9	7.9	8.6	9.1
Dedicated Systems	4.3	4.0	3.7	3.8	3.7	4.0	4.3
Subtotal	72.1%	72.7%	72.6%	73.4%	74.1%	74.0%	74.5%
<b>Communications</b>							
Customer Premises	6.6%	5.8%	5.6%	5.4%	5.3%	5.4%	5.5%
Public Telecom	3.1	3.5	3.5	3.3	3.0	2.7	2.4
Radio	3.5	3.3	3.5	3.3	3.1	2.9	2.9
Broadcast and Studio	0.3	0.4	0.4	0.3	0.4	0.3	0.3
Subtotal	13.7%	13.1%	12.9%	12.3%	11.8%	11.4%	11.2%
<b>Industrial</b>							
Instrumentation	4.3%	4.4%	4.3%	4.3%	4.0%	4.1%	3.9%
Manufacturing Systems	2.1	2.2	2.3	2.3	2.0	2.3	2.2
Medical	1.2	1.3	1.5	1.5	1.5	1.5	1.4
Others	0.5	0.6	0.5	0.6	0.5	0.5	0.5
Subtotal	8.1%	8.5%	8.5%	8.6%	8.1%	8.4%	7.9%
<b>Consumer</b>							
Audio	0.4%	0.4%	0.3%	0.2%	0.3%	0.3%	0.2%
Video	2.0	1.7	1.9	1.8	2.0	2.1	2.4
Personal Electronics	1.6	1.6	1.7	1.7	1.5	1.6	1.6
Appliances	0.2	0.2	0.3	0.3	0.4	0.3	0.3
Subtotal	4.1%	3.9%	4.1%	4.1%	4.2%	4.2%	4.4%
<b>Transportation</b>	2.0%	1.9%	1.9%	1.7%	1.8%	2.0%	2.0%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 26

**Estimated Japanese Linear IC Consumption by Application Market  
(Billions of Yen)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	9	11	14	19	26	33	39	29.5%
Data Storage	15	16	17	22	27	35	42	15.2%
Terminals	18	20	22	25	33	39	44	15.9%
Input/Output	10	11	13	17	22	29	35	23.2%
Dedicated Systems	8	8	9	13	16	20	25	18.1%
Subtotal	61	66	75	96	124	156	185	19.6%
<b>Communications</b>								
Customer Premises	20	23	25	29	39	49	56	18.2%
Public Telecom	10	12	13	15	18	23	25	16.7%
Radio	28	30	34	41	52	70	83	16.9%
Broadcast and Studio	1	1	2	2	3	4	5	28.5%
Subtotal	59	66	74	87	112	146	169	17.5%
<b>Industrial</b>								
Instrumentation	20	22	24	30	37	46	54	17.4%
Manufacturing Systems	8	9	10	14	17	23	26	19.2%
Medical	7	8	9	12	17	25	29	25.3%
Others	6	7	8	11	13	18	24	20.3%
Subtotal	41	46	51	67	84	112	133	19.6%
<b>Consumer</b>								
Audio	64	65	67	70	82	80	84	6.3%
Video	195	195	203	233	284	334	357	9.8%
Personal Electronics	21	21	23	26	29	39	47	8.1%
Appliances	17	15	17	21	26	34	38	10.9%
Subtotal	298	297	310	350	421	487	526	9.0%
<b>Transportation</b>	25	28	32	38	49	62	70	17.9%
<b>Total</b>	<b>484</b>	<b>503</b>	<b>542</b>	<b>638</b>	<b>790</b>	<b>963</b>	<b>1,083</b>	<b>13.1%</b>

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)



Table 27

**Estimated Japanese Linear IC Consumption by Application Market**  
(Millions of Dollars)

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	71	80	94	128	174	221	262	26.8%
Data Storage	118	116	114	148	181	235	282	19.4%
Terminals	141	144	148	168	221	262	295	15.4%
Input/Output	73	80	87	114	148	195	235	24.1%
Dedicated Systems	63	60	60	87	107	134	168	22.7%
Subtotal	467	480	503	644	832	1,047	1,242	20.9%
<b>Communications</b>								
Customer Premises	154	167	168	195	262	329	376	17.7%
Public Telecom	75	83	87	101	121	154	168	15.0%
Radio	214	217	228	275	349	470	557	20.7%
Broadcast and Studio	8	9	13	13	20	27	34	31.0%
Subtotal	452	476	497	584	752	980	1,134	19.0%
<b>Industrial</b>								
Instrumentation	150	159	161	201	248	309	362	17.9%
Manufacturing Systems	65	66	67	94	114	154	174	21.5%
Medical	53	61	60	81	114	168	195	26.2%
Others	48	49	54	74	87	121	161	27.1%
Subtotal	315	335	342	450	564	752	893	21.7%
<b>Consumer</b>								
Audio	493	474	450	470	550	537	564	3.5%
Video	1,502	1,415	1,362	1,564	1,906	2,242	2,396	11.1%
Personal Electronics	163	152	154	174	195	262	315	15.7%
Appliances	132	109	114	141	174	228	255	18.4%
Subtotal	2,291	2,151	2,081	2,349	2,826	3,268	3,530	10.4%
<b>Transportation</b>	195	204	215	255	329	416	470	18.2%
<b>Total</b>	<b>3,720</b>	<b>3,645</b>	<b>3,638</b>	<b>4,282</b>	<b>5,302</b>	<b>6,463</b>	<b>7,268</b>	<b>14.8%</b>

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 28

**Estimated Japanese Linear IC Consumption by Application Market  
(Percentage of Total)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994
<b>Data Processing</b>							
Computers	1.9%	2.2%	2.6%	3.0%	3.3%	3.4%	3.6%
Data Storage	3.2	3.2	3.1	3.4	3.4	3.6	3.9
Terminals	3.8	4.0	4.1	3.9	4.2	4.0	4.1
Input/Output	2.0	2.2	2.4	2.7	2.8	3.0	3.2
Dedicated Systems	1.7	1.7	1.7	2.0	2.0	2.1	2.3
Subtotal	12.5%	13.2%	13.8%	15.0%	15.7%	16.2%	17.1%
<b>Communications</b>							
Customer Premises	4.1%	4.6%	4.6%	4.5%	4.9%	5.1%	5.2%
Public Telecom	2.0	2.3	2.4	2.4	2.3	2.4	2.3
Radio	5.8	6.0	6.3	6.4	6.6	7.3	7.7
Broadcast and Studio	0.2	0.2	0.4	0.3	0.4	0.4	0.5
Subtotal	12.1%	13.1%	13.7%	13.6%	14.2%	15.2%	15.6%
<b>Industrial</b>							
Instrumentation	4.0%	4.4%	4.4%	4.7%	4.7%	4.8%	5.0%
Manufacturing Systems	1.7	1.8	1.8	2.2	2.2	2.4	2.4
Medical	1.4	1.7	1.7	1.9	2.2	2.6	2.7
Others	1.3	1.3	1.5	1.7	1.6	1.9	2.2
Subtotal	8.5%	9.2%	9.4%	10.5%	10.6%	11.6%	12.3%
<b>Consumer</b>							
Audio	13.3%	13.0%	12.4%	11.0%	10.4%	8.3%	7.8%
Video	40.4	38.8	37.5	36.5	35.9	34.7	33.0
Personal Electronics	4.4	4.2	4.2	4.1	3.7	4.0	4.3
Appliances	3.6	3.0	3.1	3.3	3.3	3.5	3.5
Subtotal	61.6%	59.0%	57.2%	54.9%	53.3%	50.6%	48.6%
<b>Transportation</b>	5.3%	5.6%	5.9%	6.0%	6.2%	6.4%	6.5%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 29

**Estimated Japanese Discrete Consumption by Application Market  
(Billions of Yen)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	36	44	49	58	69	76	81	17.9%
Data Storage	32	34	37	44	52	58	62	13.4%
Terminals	46	49	53	60	65	71	73	9.1%
Input/Output	40	42	46	54	64	73	77	12.6%
Dedicated Systems	21	23	25	30	35	40	43	13.3%
Subtotal	174	192	210	246	285	318	336	13.1%
<b>Communications</b>								
Customer Premises	24	26	28	32	38	43	44	12.5%
Public Telecom	15	16	17	19	22	24	25	10.5%
Radio	30	33	37	43	52	59	63	14.4%
Broadcast and Studio	1	1	1	2	3	4	3	25.7%
Subtotal	70	77	83	96	115	130	135	13.2%
<b>Industrial</b>								
Instrumentation	23	26	28	33	41	45	47	15.2%
Manufacturing Systems	8	10	11	13	15	17	18	17.8%
Medical	6	7	8	9	11	13	16	16.3%
Others	3	4	4	5	6	7	9	16.3%
Subtotal	40	47	51	60	73	82	90	16.0%
<b>Consumer</b>								
Audio	19	18	19	20	21	19	17	2.9%
Video	70	70	72	75	81	88	92	3.7%
Personal Electronics	7	7	8	9	12	13	14	13.0%
Appliances	20	20	21	24	27	28	30	8.2%
Subtotal	116	114	120	128	141	148	153	5.0%
<b>Transportation</b>	26	28	31	35	42	43	44	12.5%
<b>Total</b>	427	458	495	565	656	721	758	11.3%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 30

**Estimated Japanese Discrete Consumption by Application Market  
(Millions of Dollars)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	275	319	329	389	463	510	544	11.3%
Data Storage	242	246	248	295	349	389	416	11.1%
Terminals	353	357	356	403	436	477	490	6.6%
Input/Output	306	304	309	362	430	490	517	11.2%
Dedicated Systems	163	167	168	201	235	268	289	11.6%
Subtotal	1,340	1,393	1,409	1,651	1,913	2,134	2,255	10.1%
<b>Communications</b>								
Customer Premises	182	188	188	215	255	289	295	9.4%
Public Telecom	113	118	114	128	148	161	168	7.3%
Radio	234	239	248	289	349	396	423	12.1%
Broadcast and Studio	9	9	7	13	20	27	20	18.3%
Subtotal	539	554	557	644	772	872	906	10.3%
<b>Industrial</b>								
Instrumentation	179	188	188	221	275	302	315	10.9%
Manufacturing Systems	60	72	74	87	101	114	121	10.8%
Medical	46	49	54	60	74	87	107	16.9%
Others	25	29	27	34	40	47	60	15.8%
Subtotal	310	339	342	403	490	550	604	12.2%
<b>Consumer</b>								
Audio	144	127	128	134	141	128	114	(2.1%)
Video	540	507	483	503	544	591	617	4.0%
Personal Electronics	57	48	54	60	81	87	94	14.5%
Appliances	151	144	141	161	180	188	201	6.9%
Subtotal	891	826	805	859	945	993	1,027	4.4%
<b>Transportation</b>	202	203	208	235	282	289	295	7.8%
<b>Total</b>	<b>3,282</b>	<b>3,315</b>	<b>3,322</b>	<b>3,792</b>	<b>4,401</b>	<b>4,839</b>	<b>5,087</b>	<b>8.9%</b>

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 31

**Estimated Japanese Discrete Consumption by Application Market  
(Percentage of Total)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994
<b>Data Processing</b>							
Computers	8.4%	9.6%	9.9%	10.3%	10.5%	10.5%	10.7%
Data Storage	7.4	7.4	7.5	7.8	7.9	8.0	8.2
Terminals	10.8	10.8	10.7	10.6	9.9	9.8	9.6
Input/Output	9.3	9.2	9.3	9.6	9.8	10.1	10.2
Dedicated Systems	5.0	5.0	5.1	5.3	5.3	5.5	5.7
Subtotal	40.8%	42.0%	42.4%	43.5%	43.5%	44.1%	44.3%
<b>Communications</b>							
Customer Premises	5.6%	5.7%	5.7%	5.7%	5.8%	6.0%	5.8%
Public Telecom	3.5	3.6	3.4	3.4	3.4	3.3	3.3
Radio	7.1	7.2	7.5	7.6	7.9	8.2	8.3
Broadcast and Studio	0.3	0.3	0.2	0.4	0.5	0.6	0.4
Subtotal	16.4%	16.7%	16.8%	17.0%	17.5%	18.0%	17.8%
<b>Industrial</b>							
Instrumentation	5.4%	5.7%	5.7%	5.8%	6.3%	6.2%	6.2%
Manufacturing Systems	1.8	2.2	2.2	2.3	2.3	2.4	2.4
Medical	1.4	1.5	1.6	1.6	1.7	1.8	2.1
Others	0.8	0.9	0.8	0.9	0.9	1.0	1.2
Subtotal	9.5%	10.2%	10.3%	10.6%	11.1%	11.4%	11.9%
<b>Consumer</b>							
Audio	4.4%	3.8%	3.8%	3.5%	3.2%	2.6%	2.2%
Video	16.4	15.3	14.5	13.3	12.4	12.2	12.1
Personal Electronics	1.7	1.4	1.6	1.6	1.8	1.8	1.8
Appliances	4.6	4.3	4.2	4.2	4.1	3.9	4.0
Subtotal	27.1%	24.9%	24.2%	22.7%	21.5%	20.5%	20.2%
<b>Transportation</b>	6.1%	6.1%	6.3%	6.2%	6.4%	6.0%	5.8%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 32

**Estimated Japanese Optoelectronics Consumption by Application Market  
(Billions of Yen)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	2	3	4	5	7	9	11	40.0%
Data Storage	2	3	5	8	13	16	19	60.3%
Terminals	4	5	5	6	7	10	12	15.2%
Input/Output	9	11	13	17	21	26	32	23.4%
Dedicated Systems	12	13	15	18	22	25	29	16.3%
Subtotal	29	35	42	54	70	86	103	24.8%
<b>Communications</b>								
Customer Premises	15	17	19	22	26	31	36	15.0%
Public Telecom	15	17	18	20	23	26	29	11.0%
Radio	7	8	9	11	13	16	20	15.6%
Broadcast and Studio	0	0	1	1	2	3	3	62.1%
Subtotal	38	42	47	54	64	76	88	14.2%
<b>Industrial</b>								
Instrumentation	11	14	16	18	22	26	30	19.7%
Manufacturing Systems	2	3	4	6	8	9	11	43.4%
Medical	4	5	6	7	8	9	10	20.5%
Others	3	4	5	6	7	8	9	28.9%
Subtotal	19	26	31	37	45	52	60	24.1%
<b>Consumer</b>								
Audio	25	27	28	29	34	35	34	7.6%
Video	37	44	46	53	61	70	77	13.3%
Personal Electronics	10	11	12	13	14	16	19	7.6%
Appliances	9	10	11	12	13	15	17	8.2%
Subtotal	82	92	97	107	122	136	147	10.3%
<b>Transportation</b>	10	12	13	16	20	23	27	20.5%
<b>Total</b>	<b>177</b>	<b>207</b>	<b>230</b>	<b>268</b>	<b>321</b>	<b>373</b>	<b>425</b>	<b>16.0%</b>

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 33

**Estimated Japanese Optoelectronic Consumption by Application Market  
(Millions of Dollars)**

Segment	E 1988	E 1989	F 1990	F 1991	F 1992	F 1993	F 1994	CAGR 1989-1994
<b>Data Processing</b>								
Computers	14	22	27	34	47	60	74	27.7%
Data Storage	15	22	34	54	87	107	128	42.5%
Terminals	31	36	34	40	47	67	81	17.3%
Input/Output	70	80	87	114	141	174	215	21.9%
Dedicated Systems	92	94	101	121	148	168	195	15.6%
Subtotal	222	254	282	362	470	577	691	22.2%
<b>Communications</b>								
Customer Premises	115	123	128	148	174	208	242	14.4%
Public Telecom	116	120	121	134	154	174	195	10.2%
Radio	56	58	60	74	87	107	134	18.3%
Broadcast and Studio	2	2	7	7	13	20	20	58.2%
Subtotal	289	303	315	362	430	510	591	14.3%
<b>Industrial</b>								
Instrumentation	83	101	107	121	148	174	201	14.7%
Manufacturing Systems	15	22	27	40	54	60	74	27.7%
Medical	29	36	40	47	54	60	67	13.1%
Others	20	29	34	40	47	54	60	15.8%
Subtotal	146	188	208	248	302	349	403	16.4%
<b>Consumer</b>								
Audio	195	196	188	195	228	235	228	3.1%
Video	285	319	309	356	409	470	517	10.1%
Personal Electronics	80	79	81	87	94	107	128	10.1%
Appliances	73	72	74	81	87	101	114	9.5%
Subtotal	633	666	651	718	819	913	987	8.2%
<b>Transportation</b>	73	87	87	107	134	154	181	15.8%
<b>Total</b>	1,363	1,498	1,544	1,799	2,154	2,503	2,852	13.8%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)

Table 34

**Estimated Japanese Optoelectronics Consumption by Application Market  
(Percentage of Total)**

Segment	F 1988	F 1989	F 1990	F 1991	F 1992	F 1993	F 1994
<b>Data Processing</b>							
Computers	1.0%	1.5%	1.7%	1.9%	2.2%	2.4%	2.6%
Data Storage	1.1	1.5	2.2	3.0	4.0	4.3	4.5
Terminals	2.2	2.4	2.2	2.2	2.2	2.7	2.8
Input/Output	5.1	5.3	5.7	6.3	6.5	7.0	7.5
Dedicated Systems	6.8	6.3	6.5	6.7	6.9	6.7	6.8
Subtotal	16.3%	16.9%	18.3%	20.1%	21.8%	23.1%	24.2%
<b>Communications</b>							
Customer Premises	8.4%	8.2%	8.3%	8.2%	8.1%	8.3%	8.5%
Public Telecom	8.5	8.0	7.8	7.5	7.2	7.0	6.8
Radio	4.1	3.9	3.9	4.1	4.0	4.3	4.7
Broadcast and Studio	0.2	0.1	0.4	0.4	0.6	0.8	0.7
Subtotal	21.2%	20.2%	20.4%	20.1%	19.9%	20.4%	20.7%
<b>Industrial</b>							
Instrumentation	6.1%	6.8%	7.0%	6.7%	6.9%	7.0%	7.1%
Manufacturing Systems	1.1	1.5	1.7	2.2	2.5	2.4	2.6
Medical	2.1	2.4	2.6	2.6	2.5	2.4	2.4
Others	1.4	1.9	2.2	2.2	2.2	2.1	2.1
Subtotal	10.7%	12.6%	13.5%	13.8%	14.0%	13.9%	14.1%
<b>Consumer</b>							
Audio	14.3%	13.1%	12.2%	10.8%	10.6%	9.4%	8.0%
Video	20.9	21.3	20.0	19.8	19.0	18.8	18.1
Personal Electronics	5.9	5.3	5.2	4.9	4.4	4.3	4.5
Appliances	5.4	4.8	4.8	4.5	4.0	4.0	4.0
Subtotal	46.4%	44.5%	42.2%	39.9%	38.0%	36.5%	34.6%
<b>Transportation</b>	5.4%	5.8%	5.7%	6.0%	6.2%	6.2%	6.4%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

E = Estimates

F = Forecast

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (June 1990)



# Historical Data Base

## INTRODUCTION

This section, covering the years from 1984 through 1988, is provided for reference only and will not be updated. Please retain this material in the JSAM binder. The following tables are included in this section:

- Yen-to-Dollar Exchange Rates (Table 1)
- Japanese Electronic Equipment Production—Historical (Tables 2 and 3)
- Estimated Input/Output Ratio by Application Market (Table 4)
- Japanese Semiconductor Consumption (Tables 5 and 6)
- Estimated Japanese Semiconductor Consumption by Application Market (Table 7)

**Table 1**

### **Yen-to-Dollar Exchange Rates**

<b>Year</b>	<b>Yen per US\$1</b>
1984	237
1985	238
1986	167
1987	144
1988	130
1989	138

Source: Dataquest (June 1990)

Japanese IC consumption by application markets is examined further in the following tables:

- Estimated Japanese IC Consumption by Application Market (Tables 8A, 8B, and 8C)
- Estimated Japanese Bipolar Logic Consumption by Application Market (Tables 9A, 9B, and 9C)
- Estimated Japanese Bipolar Memory Consumption by Application Market (Tables 10A, 10B, and 10C)
- Estimated Japanese MOS Logic Consumption by Application Market (Tables 11A, 11B, and 11C)
- Estimated Japanese MOS Microcomponent Consumption by Application Market (Tables 12A, 12B, and 12C)
- Estimated Japanese MOS Memory Consumption by Application Market (Tables 13A, 13B, and 13C)
- Estimated Japanese Linear IC Consumption by Application Market (Tables 14A, 14B, and 14C)
- Estimated Japanese Discrete Consumption by Application Market (Tables 15A, 15B, and 15C)
- Estimated Japanese Optoelectronics Consumption by Application Market (Tables 16A, 16B, and 16C)

Table 2

**Japanese Electronic Equipment Production—Historical  
(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	1,106	1,367	1,551	1,781	2,167
Data Storage	634	787	956	1,023	1,115
Terminals	513	521	598	717	760
Input/Output	575	599	688	772	913
Dedicated Systems	1,059	1,146	964	861	904
Subtotal	3,888	4,421	4,757	5,152	5,860
Communications					
Customer Premises	622	907	901	959	1,139
Public Telecom	457	467	482	648	713
Radio	536	565	596	678	757
Broadcast and Studio	63	74	67	61	70
Subtotal	1,679	2,012	2,046	2,346	2,679
Industrial					
Instrumentation	555	622	520	519	631
Manufacturing Systems	719	847	735	597	785
Medical	390	441	489	528	557
Others	411	459	470	478	621
Subtotal	2,075	2,370	2,214	2,122	2,594
Consumer					
Audio	1,038	1,004	898	751	805
Video	3,069	3,209	2,887	2,559	2,770
Personal Electronics	922	1,059	1,052	966	1,109
Appliances	1,687	1,902	1,849	1,841	2,013
Subtotal	6,716	7,174	6,686	6,117	6,696
Transportation	1,290	1,433	1,550	1,586	1,860
Total	15,648	17,410	17,252	17,323	19,689

Source: Dataquest (June 1990)

Table 3

## Japanese Electronic Equipment Production—Historical (Millions of Dollars)

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	4,668	5,743	9,287	12,365	16,672
Data Storage	2,675	3,309	5,723	7,101	8,576
Terminals	2,163	2,189	3,583	4,979	5,850
Input/Output	2,428	2,517	4,117	5,359	7,027
Dedicated Systems	4,469	4,817	5,772	5,978	6,952
Subtotal	16,403	18,575	28,482	35,781	45,077
Communications					
Customer Premises	2,626	3,809	5,396	6,659	8,763
Public Telecom	1,930	1,962	2,886	4,500	5,483
Radio	2,264	2,374	3,568	4,709	5,821
Broadcast and Studio	264	310	400	421	537
Subtotal	7,083	8,455	12,250	16,289	20,604
Industrial					
Instrumentation	2,343	2,613	3,115	3,604	4,854
Manufacturing Systems	3,033	3,560	4,402	4,146	6,038
Medical	1,646	1,852	2,927	3,667	4,285
Others	1,736	1,930	2,814	3,319	4,777
Subtotal	8,756	9,956	13,258	14,736	19,954
Consumer					
Audio	4,379	4,218	5,376	5,215	6,190
Video	12,950	13,484	17,285	17,774	21,306
Personal Electronics	3,892	4,451	6,298	6,705	8,530
Appliances	7,117	7,992	11,074	12,785	15,485
Subtotal	28,338	30,145	40,033	42,479	51,510
Transportation	5,443	6,023	9,282	11,014	14,308
Total	66,023	73,153	103,306	120,299	151,453
Exchange Rate (¥/US\$1)	237	238	167	144	130

Source: Dataquest (June 1990)

**Table 4**  
**Estimated Input/Output Ratio**  
**by Application Market**  
**(Percentage)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	27.5%	20.9%	21.5%	22.6%	26.3%
Data Storage	14.2	11.7	11.4	12.6	14.6
Terminals	24.6	20.9	20.2	20.2	24.7
Input/Output	16.9	15.0	14.3	15.2	17.4
Dedicated Systems	11.7	9.9	10.4	10.8	13.7
Subtotal	19.1%	15.6%	16.0%	17.2%	20.5%
<b>Communications</b>					
Customer Premises	15.6%	11.5%	12.0%	13.1%	14.0%
Public Telecom	10.7	9.2	8.9	9.1	12.2
Radio	16.0	13.3	13.8	14.6	17.3
Broadcast and Studio	11.2	9.5	9.0	9.9	10.0
Subtotal	14.2%	11.4%	11.7%	12.4%	14.4%
<b>Industrial</b>					
Instrumentation	19.6%	16.1%	17.1%	18.1%	19.8%
Manufacturing Systems	6.5	4.8	4.9	5.9	6.1
Medical	6.2	5.0	4.9	5.7	6.6
Others	3.9	3.0	3.0	3.1	3.5
Subtotal	9.4%	7.5%	7.4%	8.2%	8.9%
<b>Consumer</b>					
Audio	16.0%	15.2%	16.6%	17.0%	18.9%
Video	16.3	13.9	14.5	15.6	16.7
Personal Electronics	6.8	6.4	6.8	7.2	7.4
Appliances	3.3	2.8	3.0	3.5	3.3
Subtotal	11.7%	10.0%	10.4%	10.8%	11.4%
<b>Transportation</b>	6.7%	6.3%	6.1%	6.7%	6.2%
<b>Total</b>	13.1%	11.0%	11.3%	12.2%	13.7%

Source: Dataquest (June 1990)

**Table 5**  
**Estimated Japanese Semiconductor Consumption**  
**by Application Market**  
**(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	304	285	333	403	570
Data Storage	90	92	109	129	163
Terminals	126	109	121	145	188
Input/Output	97	90	98	117	159
Dedicated Systems	124	114	100	93	124
Subtotal	741	690	761	887	1,204
Communications					
Customer Premises	97	104	108	126	160
Public Telecom	49	43	43	59	87
Radio	86	75	82	99	131
Broadcast and Studio	7	7	6	6	7
Subtotal	239	229	239	290	385
Industrial					
Instrumentation	109	100	89	94	125
Manufacturing Systems	47	41	36	35	48
Medical	24	22	24	30	37
Others	16	14	14	15	22
Subtotal	196	177	163	174	232
Consumer					
Audio	166	153	149	128	152
Video	499	446	419	400	463
Personal Electronics	63	68	71	70	82
Appliances	55	53	55	64	67
Subtotal	783	720	694	662	764
Transportation	87	91	95	107	116
Total	2,046	1,907	1,952	2,120	2,701

Source: Dataquest (June 1990)

**Table 6**  
**Estimated Japanese Semiconductor Consumption**  
**by Application Market**  
**(Millions of Dollars)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	1,283	1,197	1,994	2,799	4,385
Data Storage	380	387	653	896	1,254
Terminals	532	458	725	1,007	1,446
Input/Output	409	378	587	813	1,223
Dedicated Systems	523	479	599	646	954
Subtotal	3,127	2,899	4,557	6,160	9,262
<b>Communications</b>					
Customer Premises	409	437	647	875	1,231
Public Telecom	207	181	257	410	669
Radio	363	315	491	688	1,008
Broadcast and Studio	30	29	36	42	54
Subtotal	1,008	962	1,431	2,014	2,962
<b>Industrial</b>					
Instrumentation	460	420	533	653	962
Manufacturing Systems	198	172	216	243	369
Medical	101	92	144	208	285
Others	68	59	84	104	169
Subtotal	827	744	976	1,208	1,785
<b>Consumer</b>					
Audio	700	643	892	889	1,169
Video	2,105	1,874	2,509	2,778	3,562
Personal Electronics	266	286	425	486	631
Appliances	232	223	329	444	515
Subtotal	3,304	3,025	4,156	4,597	5,877
<b>Transportation</b>	367	382	569	743	892
<b>Total</b>	<b>8,633</b>	<b>8,013</b>	<b>11,689</b>	<b>14,722</b>	<b>20,777</b>
<b>Exchange Rate (¥/US\$1)</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>	<b>130</b>

Source: Dataquest (June 1990)

Table 7

**Estimated Japanese Semiconductor Consumption  
by Application Market  
(Percentage of Total Yen)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	14.9%	14.9%	17.1%	19.0%	21.1%
Data Storage	4.4	4.8	5.6	6.1	6.0
Terminals	6.1	5.7	6.2	6.8	6.9
Input/Output	4.7	4.7	5.0	5.5	5.9
Dedicated Systems	6.1	6.0	5.1	4.4	4.6
Subtotal	36.2%	36.2%	39.0%	41.9%	44.6%
<b>Communications</b>					
Customer Premises	4.7%	5.5%	5.6%	6.0%	5.9%
Public Telecom	2.4	2.3	2.2	2.8	3.2
Radio	4.2	3.9	4.2	4.7	4.9
Broadcast and Studio	0.3	0.4	0.3	0.3	0.3
Subtotal	11.7%	12.0%	12.3%	13.7%	14.3%
<b>Industrial</b>					
Instrumentation	5.4%	5.3%	4.5%	4.4%	4.6%
Manufacturing Systems	2.3	2.1	1.8	1.6	1.8
Medical	1.2	1.1	1.3	1.4	1.4
Others	0.8	0.7	0.7	0.7	0.8
Subtotal	9.6%	9.3%	8.3%	8.2%	8.6%
<b>Consumer</b>					
Audio	8.1%	8.0%	7.6%	6.0%	5.6%
Video	24.4	23.4	21.5	18.9	17.1
Personal Electronics	3.1	3.6	3.6	3.3	3.1
Appliances	2.7	2.8	2.8	3.0	2.5
Subtotal	38.3%	37.8%	35.6%	31.3%	28.3%
<b>Transportation</b>	4.2%	4.8%	4.9%	5.0%	4.3%
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

Source: Dataquest (June 1990)

**Table 8A**  
**Estimated Japanese IC Consumption**  
**by Application Market**  
**(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	283	263	309	371	533
Data Storage	72	74	86	104	129
Terminals	97	78	81	100	138
Input/Output	71	62	67	80	110
Dedicated Systems	99	89	74	68	90
Subtotal	622	566	617	723	1,000
<b>Communications</b>					
Customer Premises	76	74	77	91	121
Public Telecom	36	27	27	37	57
Radio	61	50	56	68	94
Broadcast and Studio	5	5	5	5	5
Subtotal	178	157	164	200	277
<b>Industrial</b>					
Instrumentation	75	72	62	67	91
Manufacturing Systems	36	30	26	27	38
Medical	17	15	16	22	27
Others	12	10	10	11	16
Subtotal	140	127	114	127	172
<b>Consumer</b>					
Audio	115	103	100	90	108
Video	346	330	316	307	356
Personal Electronics	50	54	56	55	65
Appliances	29	29	30	38	38
Subtotal	540	515	502	490	566
<b>Transportation</b>	57	54	67	74	80
<b>Total</b>	<b>1,537</b>	<b>1,419</b>	<b>1,463</b>	<b>1,614</b>	<b>2,096</b>

Source: Dataquest (June 1990)



**Table 8B**  
**Estimated Japanese IC Consumption**  
**by Application Market**  
**(Millions of Dollars)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	1,193	1,105	1,851	2,573	4,097
Data Storage	305	309	515	721	993
Terminals	410	326	483	696	1,059
Input/Output	300	262	401	557	849
Dedicated Systems	417	374	443	473	696
Subtotal	2,625	2,377	3,693	5,021	7,694
Communications					
Customer Premises	321	310	460	629	933
Public Telecom	151	115	161	260	436
Radio	259	212	334	470	721
Broadcast and Studio	23	22	27	32	42
Subtotal	753	659	982	1,391	2,132
Industrial					
Instrumentation	315	301	370	463	699
Manufacturing Systems	151	127	155	189	295
Medical	73	64	97	150	208
Others	51	43	59	78	125
Subtotal	590	536	680	880	1,327
Consumer					
Audio	486	432	599	627	831
Video	1,459	1,385	1,895	2,133	2,735
Personal Electronics	211	225	333	379	497
Appliances	121	121	179	264	292
Subtotal	2,276	2,163	3,006	3,403	4,354
Transportation	239	227	399	517	617
Total	6,484	5,962	8,760	11,211	16,124
Exchange Rate (¥/US\$1)	237	238	167	144	130

Source: Dataquest (June 1990)

Table 8C

**Estimated Japanese IC Consumption  
by Application Market  
(Percentage of Total)**

<b>Segment</b>	<b>1984</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>
<b>Data Processing</b>					
Computers	18.4%	18.5%	21.1%	23.0%	25.4%
Data Storage	4.7	5.2	5.9	6.4	6.2
Terminals	6.3	5.5	5.5	6.2	6.6
Input/Output	4.6	4.4	4.6	5.0	5.3
Dedicated Systems	6.4	6.3	5.1	4.2	4.3
Subtotal	40.5%	39.9%	42.2%	44.8%	47.7%
<b>Communications</b>					
Customer Premises	4.9%	5.2%	5.3%	5.6%	5.8%
Public Telecom	2.3	1.9	1.8	2.3	2.7
Radio	4.0	3.6	3.8	4.2	4.5
Broadcast and Studio	0.3	0.4	0.3	0.3	0.3
Subtotal	11.6%	11.1%	11.2%	12.4%	13.2%
<b>Industrial</b>					
Instrumentation	4.9%	5.0%	4.2%	4.1%	4.3%
Manufacturing Systems	2.3	2.1	1.8	1.7	1.8
Medical	1.1	1.1	1.1	1.3	1.3
Others	0.8	0.7	0.7	0.7	0.8
Subtotal	9.1%	9.0%	7.8%	7.8%	8.2%
<b>Consumer</b>					
Audio	7.5%	7.3%	6.8%	5.6%	5.2%
Video	22.5	23.2	21.6	19.0	17.0
Personal Electronics	3.3	3.8	3.8	3.4	3.1
Appliances	1.9	2.0	2.0	2.4	1.8
Subtotal	35.1%	36.3%	34.3%	30.4%	27.0%
<b>Transportation</b>	3.7%	3.8%	4.6%	4.6%	3.8%
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

Source: Dataquest (June 1990)

Table 9A

**Estimated Japanese Bipolar Logic Consumption  
by Application Market  
(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	46	52	66	74	77
Data Storage	15	15	21	21	22
Terminals	18	15	12	11	13
Input/Output	12	11	13	12	15
Dedicated Systems	13	13	10	9	8
Subtotal	105	105	122	126	135
<b>Communications</b>					
Customer Premises	10	9	10	10	10
Public Telecom	6	4	3	4	5
Radio	13	9	13	11	13
Broadcast and Studio	1	1	1	1	1
Subtotal	30	22	27	26	28
<b>Industrial</b>					
Instrumentation	12	12	10	10	13
Manufacturing Systems	6	3	3	4	5
Medical	3	2	2	3	3
Others	2	1	1	1	1
Subtotal	23	18	17	17	22
<b>Consumer</b>					
Audio	1	0	1	0	0
Video	8	4	3	3	2
Personal Electronics	5	3	3	2	2
Appliances	4	3	3	2	3
Subtotal	18	10	10	7	7
<b>Transportation</b>	12	8	11	11	10
<b>Total</b>	<b>187</b>	<b>163</b>	<b>187</b>	<b>186</b>	<b>203</b>

Source: Dataquest (June 1990)

Table 9B

**Estimated Japanese Bipolar Logic Consumption  
by Application Market  
(Millions of Dollars)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	195	218	395	510	590
Data Storage	62	62	124	145	172
Terminals	78	61	69	78	103
Input/Output	52	45	80	81	112
Dedicated Systems	55	55	62	61	63
Subtotal	441	440	730	875	1,040
Communications					
Customer Premises	42	39	63	69	75
Public Telecom	24	15	21	31	41
Radio	56	37	75	75	98
Broadcast and Studio	4	3	3	3	4
Subtotal	126	94	162	178	217
Industrial					
Instrumentation	52	48	61	70	99
Manufacturing Systems	27	14	20	24	37
Medical	11	7	13	17	24
Others	7	5	5	7	10
Subtotal	96	75	99	118	169
Consumer					
Audio	6	1	3	2	3
Video	32	18	20	18	18
Personal Electronics	20	12	20	13	16
Appliances	19	12	18	15	19
Subtotal	77	43	61	48	57
Transportation	49	34	66	76	78
Total	790	686	1,118	1,295	1,561
Exchange Rate (¥/US\$1)	237	238	167	144	130

Source: Dataquest (June 1990)

Table 9C

**Estimated Japanese Bipolar Logic Consumption  
by Application Market  
(Percentage of Total)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	24.7%	31.7%	35.3%	39.4%	37.8%
Data Storage	7.8	9.1	11.1	11.2	11.0
Terminals	9.8	8.9	6.2	6.0	6.6
Input/Output	6.6	6.5	7.1	6.2	7.2
Dedicated Systems	6.9	8.0	5.6	4.7	4.0
Subtotal	55.9%	64.1%	65.3%	67.6%	66.6%
<b>Communications</b>					
Customer Premises	5.3%	5.7%	5.6%	5.3%	4.8%
Public Telecom	3.0	2.2	1.9	2.4	2.6
Radio	7.1	5.4	6.7	5.8	6.3
Broadcast and Studio	0.5	0.5	0.3	0.3	0.2
Subtotal	15.9%	13.8%	14.5%	13.7%	13.9%
<b>Industrial</b>					
Instrumentation	6.6%	7.0%	5.5%	5.4%	6.3%
Manufacturing Systems	3.4	2.1	1.8	1.9	2.4
Medical	1.4	1.1	1.2	1.3	1.5
Others	0.9	0.7	0.5	0.5	0.6
Subtotal	12.2%	10.9%	8.8%	9.1%	10.8%
<b>Consumer</b>					
Audio	0.7%	0.2%	0.3%	0.2%	0.2%
Video	4.1	2.6	1.8	1.4	1.2
Personal Electronics	2.6	1.8	1.8	1.0	1.1
Appliances	2.4	1.7	1.6	1.2	1.2
Subtotal	9.7%	6.3%	5.5%	3.7%	3.7%
<b>Transportation</b>	6.3%	4.9%	5.9%	5.9%	5.0%
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

Source: Dataquest (June 1990)

Table 10A

**Estimated Japanese Bipolar Memory Consumption  
by Application Market  
(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	39	32	28	33	45
Data Storage	0	0	0	0	0
Terminals	0	0	0	0	0
Input/Output	0	0	0	0	0
Dedicated Systems	0	0	0	0	0
Subtotal	39	32	28	33	45
Communications					
Customer Premises	0	0	0	0	0
Public Telecom	0	0	0	0	0
Radio	0	0	0	0	0
Broadcast and Studio	0	0	0	0	0
Subtotal	0	0	0	0	0
Industrial					
Instrumentation	0	0	0	0	0
Manufacturing Systems	0	0	0	0	0
Medical	0	0	0	0	0
Others	0	0	0	0	0
Subtotal	0	0	0	0	0
Consumer					
Audio	0	0	0	0	0
Video	0	0	0	0	0
Personal Electronics	0	0	0	0	0
Appliances	0	0	0	0	0
Subtotal	0	0	0	0	0
Transportation	0	0	0	0	0
Total	39	32	28	33	45

Source: Dataquest (June 1990)

Table 10B

**Estimated Japanese Bipolar Memory Consumption  
by Application Market  
(Millions of Dollars)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	162	136	169	227	348
Data Storage	0	0	0	0	0
Terminals	0	0	0	0	0
Input/Output	0	0	0	0	0
Dedicated Systems	0	0	0	0	0
Subtotal	162	136	169	227	348
<b>Communications</b>					
Customer Premises	0	0	0	0	0
Public Telecom	0	0	0	0	0
Radio	0	0	0	0	0
Broadcast and Studio	0	0	0	0	0
Subtotal	0	0	0	0	0
<b>Industrial</b>					
Instrumentation	0	0	0	0	0
Manufacturing Systems	0	0	0	0	0
Medical	0	0	0	0	0
Others	0	0	0	0	0
Subtotal	0	0	0	0	0
<b>Consumer</b>					
Audio	0	0	0	0	0
Video	0	0	0	0	0
Personal Electronics	0	0	0	0	0
Appliances	0	0	0	0	0
Subtotal	0	0	0	0	0
<b>Transportation</b>	0	0	0	0	0
<b>Total</b>	<b>162</b>	<b>136</b>	<b>169</b>	<b>227</b>	<b>348</b>
<b>Exchange Rate (¥/US\$1)</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>	<b>130</b>

Source: Dataquest (June 1990)

Table 10C

**Estimated Japanese Bipolar Memory Consumption  
by Application Market  
(Percentage of Total)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	100.0%	100.0%	100.0%	100.0%	100.0%
Data Storage	0	0	0	0	0
Terminals	0	0	0	0	0
Input/Output	0	0	0	0	0
Dedicated Systems	0	0	0	0	0
Subtotal	100.0%	100.0%	100.0%	100.0%	100.0%
Communications					
Customer Premises	0	0	0	0	0
Public Telecom	0	0	0	0	0
Radio	0	0	0	0	0
Broadcast and Studio	0	0	0	0	0
Subtotal	0	0	0	0	0
Industrial					
Instrumentation	0	0	0	0	0
Manufacturing Systems	0	0	0	0	0
Medical	0	0	0	0	0
Others	0	0	0	0	0
Subtotal	0	0	0	0	0
Consumer					
Audio	0	0	0	0	0
Video	0	0	0	0	0
Personal Electronics	0	0	0	0	0
Appliances	0	0	0	0	0
Subtotal	0	0	0	0	0
Transportation	0	0	0	0	0
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest (June 1990)



**Table 11A**  
**Estimated Japanese MOS Logic Consumption**  
**by Application Market**  
**(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	10	21	26	38	56
Data Storage	8	12	11	17	24
Terminals	10	17	16	25	33
Input/Output	12	14	14	20	27
Dedicated Systems	28	27	24	27	37
Subtotal	67	91	91	127	177
Communications					
Customer Premises	13	18	19	23	32
Public Telecom	7	5	5	9	14
Radio	9	9	9	13	19
Broadcast and Studio	1	1	1	1	1
Subtotal	29	34	34	45	66
Industrial					
Instrumentation	9	16	13	13	21
Manufacturing Systems	6	6	5	5	8
Medical	2	3	2	4	5
Others	2	2	2	2	4
Subtotal	20	27	22	25	38
Consumer					
Audio	23	19	19	17	28
Video	81	73	76	74	102
Personal Electronics	21	20	19	17	24
Appliances	4	5	6	7	8
Subtotal	129	117	120	115	162
Transportation	6	7	8	11	12
Total	251	275	275	322	456

Source: Dataquest (June 1990)

Table 11B

**Estimated Japanese MOS Logic Consumption  
by Application Market  
(Millions of Dollars)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	43	90	156	261	434
Data Storage	34	51	67	116	183
Terminals	41	69	96	176	254
Input/Output	50	57	81	142	211
Dedicated Systems	116	113	143	184	282
Subtotal	284	380	544	879	1,364
Communications					
Customer Premises	53	78	114	159	243
Public Telecom	29	22	30	62	105
Radio	37	37	53	88	149
Broadcast and Studio	4	5	5	6	9
Subtotal	123	142	202	315	505
Industrial					
Instrumentation	38	65	78	93	160
Manufacturing Systems	25	26	28	36	64
Medical	10	13	13	26	40
Others	10	10	14	16	32
Subtotal	84	114	134	171	296
Consumer					
Audio	97	80	112	118	212
Video	342	308	455	514	788
Personal Electronics	87	83	116	121	183
Appliances	17	20	38	46	65
Subtotal	543	490	720	798	1,247
Transportation	26	31	50	74	94
Total	1,058	1,157	1,650	2,237	3,505
Exchange Rate (¥/US\$1)	237	238	167	144	130

Source: Dataquest (June 1990)

Table 11C

**Estimated Japanese MOS Logic Consumption  
by Application Market  
(Percentage of Total)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	4.0%	7.8%	9.4%	11.7%	12.4%
Data Storage	3.2	4.4	4.1	5.2	5.2
Terminals	3.8	6.0	5.8	7.9	7.2
Input/Output	4.7	4.9	4.9	6.3	6.0
Dedicated Systems	11.0	9.8	8.7	8.2	8.0
Subtotal	26.8%	32.9%	33.0%	39.3%	38.9%
<b>Communications</b>					
Customer Premises	5.0%	6.7%	6.9%	7.1%	6.9%
Public Telecom	2.8	1.9	1.8	2.8	3.0
Radio	3.5	3.2	3.2	3.9	4.2
Broadcast and Studio	0.4	0.4	0.3	0.3	0.2
Subtotal	11.6%	12.2%	12.3%	14.1%	14.4%
<b>Industrial</b>					
Instrumentation	3.6%	5.6%	4.7%	4.2%	4.6%
Manufacturing Systems	2.4	2.2	1.7	1.6	1.8
Medical	1.0	1.1	0.8	1.1	1.1
Others	0.9	0.9	0.9	0.7	0.9
Subtotal	7.9%	9.9%	8.1%	7.6%	8.4%
<b>Consumer</b>					
Audio	9.1%	6.9%	6.8%	5.3%	6.0%
Video	32.3	26.6	27.6	23.0	22.5
Personal Electronics	8.3	7.2	7.0	5.4	5.2
Appliances	1.6	1.7	2.3	2.0	1.8
Subtotal	51.3%	42.4%	43.6%	35.7%	35.6%
<b>Transportation</b>	2.4%	2.7%	3.0%	3.3%	2.7%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest (June 1990)

Table 12A

**Estimated Japanese MOS Microcomponent Consumption  
by Application Market  
(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	54	44	59	72	94
Data Storage	12	11	15	20	24
Terminals	17	10	13	18	24
Input/Output	11	8	9	14	14
Dedicated Systems	18	13	11	11	12
Subtotal	112	85	108	135	168
<b>Communications</b>					
Customer Premises	13	12	14	18	22
Public Telecom	5	4	5	6	10
Radio	6	5	7	10	13
Broadcast and Studio	1	1	1	1	1
Subtotal	24	22	27	35	46
<b>Industrial</b>					
Instrumentation	11	10	10	10	13
Manufacturing Systems	4	4	3	4	5
Medical	3	2	3	5	5
Others	1	1	1	2	2
Subtotal	18	17	17	21	24
<b>Consumer</b>					
Audio	10	12	12	11	14
Video	42	47	36	37	44
Personal Electronics	5	6	8	8	8
Appliances	7	7	6	8	8
Subtotal	63	72	62	64	75
<b>Transportation</b>	15	15	16	20	21
<b>Total</b>	<b>232</b>	<b>210</b>	<b>228</b>	<b>274</b>	<b>334</b>

Source: Dataquest (June 1990)

Table 12B

**Estimated Japanese MOS Microcomponent Consumption  
by Application Market  
(Millions of Dollars)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	230	183	353	499	723
Data Storage	49	45	90	142	181
Terminals	70	42	80	126	185
Input/Output	47	33	55	98	105
Dedicated Systems	76	53	66	74	96
Subtotal	471	356	644	939	1,291
<b>Communications</b>					
Customer Premises	53	51	82	124	168
Public Telecom	21	18	29	43	77
Radio	24	20	44	67	103
Broadcast and Studio	3	3	4	5	6
Subtotal	102	92	159	240	354
<b>Industrial</b>					
Instrumentation	44	43	57	72	99
Manufacturing Systems	16	15	19	28	37
Medical	12	10	19	33	37
Others	4	3	5	11	14
Subtotal	77	72	100	144	187
<b>Consumer</b>					
Audio	42	51	74	79	107
Video	176	197	216	256	339
Personal Electronics	20	25	46	53	65
Appliances	29	28	35	53	65
Subtotal	267	302	371	441	576
<b>Transportation</b>	62	62	93	135	163
<b>Total</b>	<b>978</b>	<b>884</b>	<b>1,367</b>	<b>1,899</b>	<b>2,572</b>
<b>Exchange Rate (¥/US\$1)</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>	<b>130</b>

Source: Dataquest (June 1990)

Table 12C

**Estimated Japanese MOS Microcomponent Consumption  
by Application Market  
(Percentage of Total)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	23.5%	20.7%	25.8%	26.3%	28.1%
Data Storage	5.0	5.0	6.6	7.5	7.0
Terminals	7.1	4.8	5.9	6.6	7.2
Input/Output	4.8	3.7	4.0	5.2	4.1
Dedicated Systems	7.8	6.0	4.8	3.9	3.7
Subtotal	48.2%	40.3%	47.1%	49.4%	50.2%
<b>Communications</b>					
Customer Premises	5.4%	5.7%	6.0%	6.5%	6.5%
Public Telecom	2.2	2.0	2.1	2.3	3.0
Radio	2.5	2.3	3.2	3.5	4.0
Broadcast and Studio	0.3	0.4	0.3	0.3	0.2
Subtotal	10.4%	10.4%	11.6%	12.6%	13.8%
<b>Industrial</b>					
Instrumentation	4.5%	4.9%	4.2%	3.8%	3.8%
Manufacturing Systems	1.6	1.7	1.4	1.5	1.4
Medical	1.3	1.2	1.4	1.7	1.5
Others	0.4	0.4	0.4	0.6	0.6
Subtotal	7.8%	8.1%	7.3%	7.6%	7.3%
<b>Consumer</b>					
Audio	4.3%	5.8%	5.4%	4.1%	4.2%
Video	18.0	22.3	15.8	13.5	13.2
Personal Electronics	2.1	2.9	3.4	2.8	2.5
Appliances	3.0	3.2	2.6	2.8	2.5
Subtotal	27.4%	34.2%	27.2%	23.2%	22.4%
<b>Transportation</b>	6.3%	7.0%	6.8%	7.1%	6.3%
<b>Total</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>	<b>100.0%</b>

Source: Dataquest (June 1990)

Table 13A

**Estimated Japanese MOS Memory Consumption  
by Application Market  
(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	131	105	123	146	251
Data Storage	32	25	25	29	44
Terminals	44	23	24	28	49
Input/Output	31	23	23	25	45
Dedicated Systems	34	27	21	15	25
Subtotal	271	203	216	242	414
<b>Communications</b>					
Customer Premises	22	18	17	19	38
Public Telecom	11	7	6	7	18
Radio	14	10	8	10	20
Broadcast and Studio	2	2	1	1	2
Subtotal	48	36	32	38	78
<b>Industrial</b>					
Instrumentation	20	13	11	13	25
Manufacturing Systems	9	8	8	7	12
Medical	5	3	4	4	7
Others	1	1	1	1	3
Subtotal	35	25	23	25	47
<b>Consumer</b>					
Audio	1	1	1	1	2
Video	8	6	4	4	11
Personal Electronics	2	4	5	6	9
Appliances	0	1	1	1	1
Subtotal	11	11	11	12	24
<b>Transportation</b>	10	7	9	7	11
<b>Total</b>	<b>374</b>	<b>282</b>	<b>290</b>	<b>325</b>	<b>574</b>

Source: Dataquest (June 1990)

Table 13B

**Estimated Japanese MOS Memory Consumption  
by Application Market  
(Millions of Dollars)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	551	441	737	1,014	1,931
Data Storage	134	104	150	202	339
Terminals	186	98	141	193	376
Input/Output	130	96	136	174	348
Dedicated Systems	141	112	126	101	192
Subtotal	1,142	851	1,291	1,684	3,185
<b>Communications</b>					
Customer Premises	91	75	101	133	294
Public Telecom	44	30	35	51	139
Radio	61	40	49	68	156
Broadcast and Studio	7	6	8	10	15
Subtotal	203	151	194	263	604
<b>Industrial</b>					
Instrumentation	83	56	67	89	192
Manufacturing Systems	40	34	47	49	92
Medical	19	13	21	31	54
Others	6	3	4	6	22
Subtotal	148	106	138	175	360
<b>Consumer</b>					
Audio	4	4	7	8	16
Video	33	24	22	31	88
Personal Electronics	6	17	30	42	69
Appliances	1	2	5	5	10
Subtotal	45	47	63	85	183
<b>Transportation</b>	42	29	52	51	86
<b>Total</b>	<b>1,579</b>	<b>1,184</b>	<b>1,739</b>	<b>2,258</b>	<b>4,418</b>
<b>Exchange Rate (¥/US\$1)</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>	<b>130</b>

Source: Dataquest (June 1990)



Table 13C

**Estimated Japanese MOS Memory Consumption  
by Application Market  
(Percentage of Total)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	34.9%	37.3%	42.4%	44.9%	43.7%
Data Storage	8.5	8.8	8.6	8.9	7.7
Terminals	11.8	8.3	8.1	8.5	8.5
Input/Output	8.2	8.1	7.8	7.7	7.9
Dedicated Systems	9.0	9.5	7.3	4.5	4.3
Subtotal	72.3%	71.9%	74.2%	74.6%	72.1%
<b>Communications</b>					
Customer Premises	5.8%	6.3%	5.8%	5.9%	6.6%
Public Telecom	2.8	2.5	2.0	2.3	3.1
Radio	3.8	3.4	2.8	3.0	3.5
Broadcast and Studio	0.4	0.5	0.5	0.4	0.3
Subtotal	12.8%	12.7%	11.2%	11.6%	13.7%
<b>Industrial</b>					
Instrumentation	5.2%	4.7%	3.8%	3.9%	4.3%
Manufacturing Systems	2.5	2.9	2.7	2.2	2.1
Medical	1.2	1.1	1.2	1.4	1.2
Others	0.4	0.2	0.2	0.3	0.5
Subtotal	9.4%	8.9%	8.0%	7.7%	8.1%
<b>Consumer</b>					
Audio	0.3%	0.4%	0.4%	0.3%	0.4%
Video	2.1	2.0	1.2	1.4	2.0
Personal Electronics	0.4	1.4	1.7	1.8	1.6
Appliances	0.1	0.2	0.3	0.2	0.2
Subtotal	2.8%	4.0%	3.6%	3.8%	4.1%
<b>Transportation</b>	2.6%	2.5%	3.0%	2.3%	2.0%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest (June 1990)

**Table 14A**  
**Estimated Japanese Linear IC Consumption**  
**by Application Market**  
**(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	3	9	7	9	9
Data Storage	6	11	14	17	15
Terminals	9	13	16	18	18
Input/Output	5	8	8	9	10
Dedicated Systems	7	10	8	8	8
Subtotal	30	51	53	60	61
<b>Communications</b>					
Customer Premises	19	16	17	21	20
Public Telecom	8	7	8	10	10
Radio	19	18	19	25	28
Broadcast and Studio	1	1	1	1	1
Subtotal	47	43	44	57	59
<b>Industrial</b>					
Instrumentation	23	21	18	20	20
Manufacturing Systems	10	9	7	7	8
Medical	5	5	5	6	7
Others	6	5	5	6	6
Subtotal	44	40	35	39	41
<b>Consumer</b>					
Audio	80	71	67	61	64
Video	208	199	198	189	195
Personal Electronics	18	21	20	22	21
Appliances	13	14	14	21	17
Subtotal	319	305	299	292	298
<b>Transportation</b>	14	17	23	26	25
<b>Total</b>	<b>454</b>	<b>456</b>	<b>454</b>	<b>474</b>	<b>484</b>

Source: Dataquest (June 1990)

**Table 14B**  
**Estimated Japanese Linear IC Consumption**  
**by Application Market**  
**(Millions of Dollars)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	12	38	42	61	71
Data Storage	27	47	84	117	118
Terminals	36	55	96	123	141
Input/Output	21	32	48	63	73
Dedicated Systems	29	41	46	53	63
Subtotal	125	214	316	417	467
Communications					
Customer Premises	82	68	100	144	154
Public Telecom	32	31	46	73	75
Radio	81	77	113	172	214
Broadcast and Studio	4	5	6	7	8
Subtotal	200	180	264	396	452
Industrial					
Instrumentation	98	88	107	139	150
Manufacturing Systems	43	37	41	51	65
Medical	20	21	31	44	53
Others	25	22	30	38	48
Subtotal	186	169	208	272	315
Consumer					
Audio	337	296	404	421	493
Video	877	837	1,183	1,315	1,502
Personal Electronics	77	88	122	151	163
Appliances	55	59	83	143	132
Subtotal	1,346	1,280	1,791	2,031	2,291
Transportation	61	71	139	179	195
Total	1,916	1,915	2,718	3,294	3,720
Exchange Rate (¥/US\$1)	237	238	167	144	130

Source: Dataquest (June 1990)

Table 14C

**Estimated Japanese Linear IC Consumption  
by Application Market  
(Percentage of Total)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	0.6%	2.0%	1.5%	1.9%	1.9%
Data Storage	1.4	2.5	3.1	3.5	3.2
Terminals	1.9	2.9	3.5	3.7	3.8
Input/Output	1.1	1.7	1.8	1.9	2.0
Dedicated Systems	1.5	2.2	1.7	1.6	1.7
Subtotal	6.5%	11.2%	11.6%	12.6%	12.5%
Communications					
Customer Premises	4.3%	3.5%	3.7%	4.4%	4.1%
Public Telecom	1.7	1.6	1.7	2.2	2.0
Radio	4.2	4.0	4.2	5.2	5.8
Broadcast and Studio	0.2	0.2	0.2	0.2	0.2
Subtotal	10.4%	9.4%	9.7%	12.0%	12.1%
Industrial					
Instrumentation	5.1%	4.6%	3.9%	4.2%	4.0%
Manufacturing Systems	2.2	1.9	1.5	1.6	1.7
Medical	1.1	1.1	1.1	1.3	1.4
Others	1.3	1.2	1.1	1.2	1.3
Subtotal	9.7%	8.8%	7.7%	8.3%	8.5%
Consumer					
Audio	17.6%	15.5%	14.8%	12.8%	13.3%
Video	45.8	43.7	43.5	39.9	40.4
Personal Electronics	4.0	4.6	4.5	4.6	4.4
Appliances	2.9	3.1	3.0	4.4	3.6
Subtotal	70.2%	66.9%	65.9%	61.6%	61.6%
Transportation	3.2%	3.7%	5.1%	5.4%	5.3%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest (June 1990)

**Table 15A**  
**Estimated Japanese Discrete Consumption**  
**by Application Market**  
**(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	21	20	22	30	36
Data Storage	16	16	22	23	32
Terminals	26	29	37	41	46
Input/Output	20	20	23	29	40
Dedicated Systems	17	18	16	15	21
Subtotal	99	103	120	139	174
<b>Communications</b>					
Customer Premises	13	21	22	25	24
Public Telecom	8	10	9	12	15
Radio	21	22	23	27	30
Broadcast and Studio	1	1	1	1	1
Subtotal	43	54	55	64	70
<b>Industrial</b>					
Instrumentation	27	20	19	19	23
Manufacturing Systems	10	9	9	6	8
Medical	5	4	6	6	6
Others	2	2	3	2	3
Subtotal	44	36	36	33	40
<b>Consumer</b>					
Audio	28	26	24	17	19
Video	127	90	76	63	70
Personal Electronics	6	7	6	6	7
Appliances	20	18	17	18	20
Subtotal	181	140	122	105	116
<b>Transportation</b>	24	28	19	22	26
<b>Total</b>	<b>390</b>	<b>361</b>	<b>352</b>	<b>364</b>	<b>427</b>

Source: Dataquest (June 1990)

Table 15B

**Estimated Japanese Discrete Consumption  
by Application Market  
(Millions of Dollars)**

Segment	1984	1985	1986	1987	1988
<b>Data Processing</b>					
Computers	87	84	131	209	275
Data Storage	65	66	129	163	242
Terminals	109	121	224	286	353
Input/Output	84	85	140	203	306
Dedicated Systems	70	77	96	105	163
Subtotal	416	433	718	965	1,340
<b>Communications</b>					
Customer Premises	56	89	130	171	182
Public Telecom	33	40	56	84	113
Radio	87	91	140	185	234
Broadcast and Studio	5	5	6	8	9
Subtotal	181	225	332	447	539
<b>Industrial</b>					
Instrumentation	115	86	114	135	179
Manufacturing Systems	43	37	51	44	60
Medical	19	17	34	38	46
Others	9	9	15	15	25
Subtotal	186	150	214	232	310
<b>Consumer</b>					
Audio	119	108	145	120	144
Video	536	377	453	440	540
Personal Electronics	24	29	34	44	57
Appliances	85	75	99	124	151
Subtotal	764	589	732	729	891
<b>Transportation</b>	101	119	113	153	202
<b>Total</b>	<b>1,648</b>	<b>1,516</b>	<b>2,109</b>	<b>2,526</b>	<b>3,282</b>
<b>Exchange Rate (¥/US\$1)</b>	<b>237</b>	<b>238</b>	<b>167</b>	<b>144</b>	<b>130</b>

Source: Dataquest (June 1990)

**Table 15C**  
**Estimated Japanese Discrete Consumption**  
**by Application Market**  
**(Percentage of Total)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	5.3%	5.6%	6.2%	8.3%	8.4%
Data Storage	4.0	4.3	6.1	6.4	7.4
Terminals	6.6	8.0	10.6	11.3	10.8
Input/Output	5.1	5.6	6.6	8.0	9.3
Dedicated Systems	4.3	5.1	4.6	4.2	5.0
Subtotal	25.3%	28.6%	34.1%	38.2%	40.8%
Communications					
Customer Premises	3.4%	5.9%	6.2%	6.7%	5.6%
Public Telecom	2.0	2.7	2.6	3.3	3.5
Radio	5.3	6.0	6.6	7.3	7.1
Broadcast and Studio	0.3	0.3	0.3	0.3	0.3
Subtotal	11.0%	14.9%	15.7%	17.7%	16.4%
Industrial					
Instrumentation	7.0%	5.7%	5.4%	5.3%	5.4%
Manufacturing Systems	2.6	2.5	2.4	1.7	1.8
Medical	1.2	1.2	1.6	1.5	1.4
Others	0.6	0.6	0.7	0.6	0.8
Subtotal	11.3%	9.9%	10.1%	9.2%	9.5%
Consumer					
Audio	7.2%	7.1%	6.9%	4.8%	4.4%
Video	32.5	24.9	21.5	17.4	16.4
Personal Electronics	1.5	1.9	1.6	1.8	1.7
Appliances	5.1	5.0	4.7	4.9	4.6
Subtotal	46.4%	38.8%	34.7%	28.9%	27.1%
Transportation	6.1%	7.8%	5.4%	6.0%	6.1%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest (June 1990)

Table 16A

**Estimated Japanese Optoelectronics Consumption  
by Application Market  
(Billions of Yen)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	1	2	2	2	2
Data Storage	2	2	2	2	2
Terminals	3	3	3	3	4
Input/Output	6	7	7	8	9
Dedicated Systems	8	7	10	10	12
Subtotal	19	20	23	25	29
Communications					
Customer Premises	7	9	10	11	15
Public Telecom	6	6	6	9	15
Radio	4	3	3	5	7
Broadcast and Studio	0	0	0	0	0
Subtotal	17	19	20	25	38
Industrial					
Instrumentation	8	8	8	8	11
Manufacturing Systems	1	2	1	1	2
Medical	2	2	3	2	4
Others	1	1	1	1	3
Subtotal	12	13	13	13	19
Consumer					
Audio	23	24	25	20	25
Video	26	27	27	29	37
Personal Electronics	7	8	10	9	10
Appliances	6	6	8	9	9
Subtotal	62	66	70	67	82
Transportation	6	9	9	10	10
Total	116	127	135	139	177

Source: Dataquest (June 1990)



Table 16B

**Estimated Japanese Optoelectronic Consumption  
by Application Market  
(Millions of Dollars)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	3	7	12	15	14
Data Storage	7	9	10	11	15
Terminals	11	12	16	23	31
Input/Output	25	30	44	54	70
Dedicated Systems	34	28	57	70	92
Subtotal	80	86	138	173	222
Communications					
Customer Premises	31	38	58	75	115
Public Telecom	24	26	38	65	116
Radio	16	13	20	32	56
Broadcast and Studio	1	2	2	2	2
Subtotal	72	79	118	174	289
Industrial					
Instrumentation	32	35	47	55	83
Manufacturing Systems	6	7	8	7	15
Medical	7	9	16	17	29
Others	5	6	7	9	20
Subtotal	50	56	77	87	146
Consumer					
Audio	96	103	147	139	195
Video	109	112	162	202	285
Personal Electronics	31	34	59	63	80
Appliances	26	27	50	59	73
Subtotal	261	275	417	463	633
Transportation	25	37	56	71	73
Total	489	533	807	968	1,363
Exchange Rate (¥/US\$1)	237	238	167	144	130

Source: Dataquest (June 1990)

Table 16C

**Estimated Japanese Optoelectronics Consumption  
by Application Market  
(Percentage of Total)**

Segment	1984	1985	1986	1987	1988
Data Processing					
Computers	0.5%	1.3%	1.5%	1.5%	1.0%
Data Storage	1.5	1.7	1.3	1.2	1.1
Terminals	2.2	2.2	1.9	2.4	2.2
Input/Output	5.1	5.7	5.4	5.6	5.1
Dedicated Systems	7.0	5.2	7.0	7.3	6.8
Subtotal	16.3%	16.1%	17.1%	17.9%	16.3%
Communications					
Customer Premises	6.4%	7.2%	7.2%	7.8%	8.4%
Public Telecom	4.9	4.8	4.7	6.7	8.5
Radio	3.3	2.4	2.4	3.3	4.1
Broadcast and Studio	0.2	0.3	0.3	0.2	0.2
Subtotal	14.8%	14.7%	14.6%	18.0%	21.2%
Industrial					
Instrumentation	6.5%	6.6%	5.8%	5.6%	6.1%
Manufacturing Systems	1.2	1.2	1.0	0.7	1.1
Medical	1.5	1.6	1.9	1.7	2.1
Others	1.1	1.1	0.9	0.9	1.4
Subtotal	10.2%	10.6%	9.6%	9.0%	10.7%
Consumer					
Audio	19.6%	19.2%	18.2%	14.4%	14.3%
Video	22.3	21.1	20.0	20.9	20.9
Personal Electronics	6.4	6.3	7.3	6.5	5.9
Appliances	5.2	5.1	6.2	6.1	5.4
Subtotal	53.5%	51.7%	51.7%	47.9%	46.4%
Transportation	5.2%	6.9%	7.0%	7.3%	5.4%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Dataquest (June 1990)

# Consumption by Application Market

Table 1a

## Estimated Japanese IC Consumption by Application Market (Billions of Yen)

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
<b>Data Processing</b>								
Computers	¥ 282.8	¥ 266.1	¥ 313.5	¥ 376.7	¥ 540.6	¥ 683.7	¥ 887.8	13.2%
Data Storage	72.3	73.6	86.1	103.8	129.1	140.3	199.8	11.5%
Terminals	97.1	77.7	80.7	100.3	137.6	174.2	241.8	15.1%
Input/Output	71.1	62.3	66.9	80.2	110.4	134.5	185.0	13.8%
Dedicated Systems	98.9	89.0	74.0	68.1	90.5	116.9	163.9	16.0%
Subtotal	¥ 622.1	¥ 568.7	¥ 621.1	¥ 729.2	¥1,008.2	¥1,249.6	¥1,678.3	13.6%
<b>Communications</b>								
Customer Premises	¥ 76.0	¥ 73.7	¥ 76.8	¥ 90.6	¥ 121.2	¥ 139.9	¥ 196.4	12.8%
Public Telecom.	35.8	27.4	26.9	37.4	56.7	70.2	104.1	16.4%
Radio	61.3	50.4	55.7	67.7	93.7	102.3	143.6	11.3%
Broadcast and Studio	5.3	5.3	4.5	4.6	5.5	7.4	8.3	10.8%
Subtotal	¥ 178.5	¥ 156.9	¥ 164.0	¥ 200.3	¥ 277.1	¥ 319.8	¥ 452.3	13.0%
<b>Industrial</b>								
Instrumentation	¥ 74.6	¥ 71.6	¥ 61.7	¥ 66.7	¥ 90.9	¥ 109.0	¥ 135.0	10.4%
Manufacturing Systems	35.8	30.1	25.8	27.2	38.3	47.7	68.2	15.5%
Medical	17.3	15.3	16.2	21.6	27.0	35.0	43.3	12.5%
Others	12.2	10.3	9.8	11.2	16.3	18.3	28.5	15.0%
Subtotal	¥ 139.9	¥ 127.5	¥ 113.5	¥ 126.7	¥ 172.5	¥ 210.0	¥ 275.0	12.4%
<b>Consumer</b>								
Audio	¥ 115.1	¥ 102.9	¥ 100.1	¥ 90.3	¥ 108.0	¥ 111.3	¥ 106.1	(0.5%)
Video	345.8	329.6	316.4	307.2	355.5	365.8	459.1	6.6%
Personal Electronics	50.1	50.7	51.4	49.5	57.0	59.9	79.2	8.6%
Appliances	28.6	28.7	29.9	37.9	37.9	34.8	61.8	13.0%
Subtotal	¥ 539.5	¥ 511.9	¥ 497.8	¥ 485.0	¥ 558.5	¥ 571.8	¥ 706.2	6.0%
<b>Transportation</b>	¥ 56.7	¥ 54.1	¥ 66.7	¥ 74.4	¥ 80.3	¥ 91.8	¥ 153.7	17.6%
<b>Total</b>	¥1,536.7	¥1,419.1	¥1,463.1	¥1,615.5	¥2,096.6	¥2,443.0	¥3,265.4	11.7%
Exchange Rate (Yen/US\$1)	¥ 237.0	¥ 238.0	¥ 167.0	¥ 144.0	¥ 130.0	¥ 136.0		

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 1b

## Estimated Japanese IC Consumption by Application Market (Millions of Dollars)

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
<b>Data Processing</b>								
Computers	\$1,193.2	\$1,118.1	\$1,877.2	\$ 2,616.1	\$ 4,158.4	\$ 5,102.3	\$ 6,625.1	12.3%
Data Storage	305.1	309.2	515.3	720.8	993.2	1,047.0	1,491.2	10.7%
Terminals	409.7	326.5	482.9	696.4	1,058.7	1,300.0	1,804.3	14.3%
Input/Output	299.8	261.8	400.8	557.2	849.5	1,003.4	1,380.3	12.9%
Dedicated Systems	417.2	374.0	443.1	473.1	695.9	872.7	1,223.4	15.1%
Subtotal	\$2,625.0	\$2,389.6	\$3,719.3	\$ 5,063.6	\$ 7,755.6	\$ 9,325.4	\$12,524.3	12.7%
<b>Communications</b>								
Customer Premises	\$ 320.7	\$ 309.9	\$ 460.1	\$ 629.1	\$ 932.6	\$ 1,044.0	\$ 1,465.4	12.0%
Public Telecom.	151.2	115.3	161.1	259.7	436.5	523.9	777.0	15.5%
Radio	258.7	211.7	333.8	469.9	720.5	763.4	1,071.6	10.4%
Broadcast and Studio	22.6	22.3	27.0	32.0	42.2	55.2	61.6	10.0%
Subtotal	\$ 753.1	\$ 659.2	\$ 982.0	\$ 1,390.7	\$ 2,131.8	\$ 2,386.6	\$ 3,375.6	12.2%
<b>Industrial</b>								
Instrumentation	\$ 314.8	\$ 301.0	\$ 369.6	\$ 462.8	\$ 699.4	\$ 813.4	\$ 1,007.5	9.6%
Manufacturing Systems	151.1	126.7	154.7	189.2	294.5	355.6	509.0	14.7%
Medical	73.1	64.4	97.0	150.0	207.6	261.4	323.1	11.7%
Others	51.4	43.4	58.5	77.9	125.3	136.6	212.7	14.1%
Subtotal	\$ 590.4	\$ 535.5	\$ 679.8	\$ 879.9	\$ 1,326.8	\$ 1,567.0	\$ 2,052.3	11.5%
<b>Consumer</b>								
Audio	\$ 485.7	\$ 432.4	\$ 599.5	\$ 627.3	\$ 830.7	\$ 830.6	\$ 791.4	(1.2%)
Video	1,458.9	1,385.0	1,894.7	2,133.3	2,734.8	2,729.9	3,425.8	5.8%
Personal Electronics	211.2	212.9	307.8	343.7	438.8	447.0	591.2	7.7%
Appliances	120.6	120.7	178.9	263.5	291.5	259.7	461.6	12.2%
Subtotal	\$2,276.4	\$2,151.0	\$2,980.8	\$ 3,367.9	\$ 4,295.8	\$ 4,267.2	\$ 5,270.0	5.2%
<b>Transportation</b>	\$ 239.2	\$ 227.5	\$ 399.5	\$ 516.7	\$ 617.3	\$ 685.1	\$ 1,146.9	16.7%
<b>Total</b>	\$6,484.1	\$5,962.8	\$8,761.4	\$11,218.8	\$16,127.4	\$18,231.2	\$24,369.0	10.9%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 1c

Estimated Japanese IC Consumption by Application Market  
(Percentage of Total)

Segment	1984	1985	1986	1987	1988	1989	1992
Data Processing							
Computers	18.4%	18.8%	21.4%	23.3%	25.8%	28.0%	27.2%
Data Storage	4.7	5.2	5.9	6.4	6.2	5.7	6.1
Terminals	6.3	5.5	5.5	6.2	6.6	7.1	7.4
Input/Output	4.6	4.4	4.6	5.0	5.3	5.5	5.7
Dedicated Systems	<u>6.4</u>	<u>6.3</u>	<u>5.1</u>	<u>4.2</u>	<u>4.3</u>	<u>4.8</u>	<u>5.0</u>
Subtotal	40.5%	40.1%	42.5%	45.1%	48.1%	51.2%	51.4%
Communications							
Customer Premises	4.9%	5.2%	5.3%	5.6%	5.8%	5.7%	6.0%
Public Telecom.	2.3	1.9	1.8	2.3	2.7	2.9	3.2
Radio	4.0	3.6	3.8	4.2	4.5	4.2	4.4
Broadcast and Studio	<u>0.3</u>	<u>0.4</u>	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>
Subtotal	11.6%	11.1%	11.2%	12.4%	13.2%	13.1%	13.9%
Industrial							
Instrumentation	4.9%	5.0%	4.2%	4.1%	4.3%	4.5%	4.1%
Manufacturing Sys.	2.3	2.1	1.8	1.7	1.8	2.0	2.1
Medical	1.1	1.1	1.1	1.3	1.3	1.4	1.3
Others	<u>0.8</u>	<u>0.7</u>	<u>0.7</u>	<u>0.7</u>	<u>0.8</u>	<u>0.7</u>	<u>0.9</u>
Subtotal	9.1%	9.0%	7.8%	7.8%	8.2%	8.6%	8.4%
Consumer							
Audio	7.5%	7.3%	6.8%	5.6%	5.2%	4.6%	3.2%
Video	22.5	23.2	21.6	19.0	17.0	15.0	14.1
Personal Electronics	3.3	3.6	3.5	3.1	2.7	2.5	2.4
Appliances	<u>1.9</u>	<u>2.0</u>	<u>2.0</u>	<u>2.3</u>	<u>1.8</u>	<u>1.4</u>	<u>1.9</u>
Subtotal	35.1%	36.1%	34.0%	30.0%	26.6%	23.4%	21.6%
Transportation	<u>3.7%</u>	<u>3.8%</u>	<u>4.6%</u>	<u>4.6%</u>	<u>3.8%</u>	<u>3.8%</u>	<u>4.7%</u>
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

**Table 2a**

## **Estimated Japanese Bipolar Logic Consumption by Application Market (Billions of Yen)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>	<u>CAGR 1988-1992</u>
<b>Data Processing</b>								
Computers	¥ 46.3	¥ 51.8	¥ 65.9	¥ 73.5	¥ 76.6	¥ 70.2	¥ 88.1	3.5%
Data Storage	14.6	14.8	20.7	20.8	22.4	19.3	19.3	(3.7%)
Terminals	18.4	14.5	11.6	11.3	13.4	12.5	15.0	2.9%
Input/Output	12.3	10.6	13.3	11.6	14.6	12.7	15.1	0.9%
Dedicated Systems	13.0	13.0	10.4	8.8	8.1	7.2	7.7	(1.4%)
Subtotal	¥104.6	¥104.7	¥121.9	¥126.0	¥135.2	¥121.8	¥145.2	1.8%
<b>Communications</b>								
Customer Premises	¥ 9.9	¥ 9.3	¥ 10.5	¥ 9.9	¥ 9.7	¥ 8.1	¥ 10.3	1.5%
Public Telecom.	5.7	3.6	3.5	4.4	5.3	5.2	6.8	6.2%
Radio	13.3	8.9	12.5	10.8	12.7	11.1	12.4	(0.7%)
Broadcast and Studio	0.9	0.7	0.6	0.5	0.5	0.4	0.6	2.9%
Subtotal	¥ 29.8	¥ 22.5	¥ 27.1	¥ 25.6	¥ 28.3	¥ 24.8	¥ 30.1	1.5%
<b>Industrial</b>								
Instrumentation	¥ 12.3	¥ 11.5	¥ 10.2	¥ 10.1	¥ 12.8	¥ 11.6	¥ 12.8	(0.1%)
Manufacturing Systems	6.4	3.4	3.3	3.5	4.8	4.3	5.5	3.6%
Medical	2.6	1.8	2.2	2.5	3.1	3.1	4.3	8.9%
Others	1.6	1.1	0.9	1.0	1.2	1.0	1.5	4.8%
Subtotal	¥ 22.8	¥ 17.8	¥ 16.5	¥ 17.0	¥ 21.9	¥ 20.0	¥ 24.1	2.4%
<b>Consumer</b>								
Audio	¥ 1.4	¥ 0.3	¥ 0.5	¥ 0.3	¥ 0.4	¥ 0.3	¥ 0.2	(14.9%)
Video	7.6	4.3	3.4	2.6	2.4	1.9	1.7	(8.2%)
Personal Electronics	4.8	2.9	3.3	1.8	2.1	2.0	1.7	(6.3%)
Appliances	4.4	2.8	3.0	2.2	2.5	2.3	1.8	(8.0%)
Subtotal	¥ 18.2	¥ 10.3	¥ 10.2	¥ 6.9	¥ 7.4	¥ 6.5	¥ 5.4	(7.9%)
<b>Transportation</b>	¥ 11.7	¥ 8.0	¥ 11.0	¥ 11.0	¥ 10.2	¥ 9.2	¥ 10.4	0.5%
<b>Total</b>	¥187.2	¥163.3	¥186.7	¥186.5	¥203.0	¥182.3	¥215.1	1.5%
<b>Exchange Rate (Yen/US\$1)</b>	¥237.0	¥238.0	¥167.0	¥144.0	¥130.0	¥134.0		

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 2b

## Estimated Japanese Bipolar Logic Consumption by Application Market (Millions of Dollars)

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
Data Processing								
Computers	\$ 195.4	\$ 217.6	\$ 394.6	\$ 510.4	\$ 589.5	\$ 523.5	\$ 657.5	(2.8%)
Data Storage	61.6	62.2	124.0	144.5	172.5	144.0	144.1	(4.4%)
Terminals	77.6	60.9	69.5	78.2	103.2	93.3	112.2	2.1%
Input/Output	51.9	44.5	79.6	80.8	112.1	94.9	112.8	0.2%
Dedicated Systems	54.9	54.7	62.0	61.0	62.5	53.4	57.2	(2.2%)
Subtotal	\$ 441.4	\$ 440.0	\$ 729.7	\$ 875.0	\$1,039.8	\$ 909.1	\$1,083.9	1.0%
Communications								
Customer Premises	\$ 41.8	\$ 39.1	\$ 62.9	\$ 68.8	\$ 74.6	\$ 60.4	\$ 76.9	0.7%
Public Telecom.	24.1	15.0	20.8	30.6	41.1	38.8	50.7	5.4%
Radio	56.1	37.2	75.0	75.0	97.9	82.8	92.5	(1.4%)
Broadcast and Studio	3.9	3.1	3.4	3.5	3.8	3.0	4.2	2.1%
Subtotal	\$ 125.9	\$ 94.5	\$ 162.1	\$ 177.8	\$ 217.4	\$ 185.1	\$ 224.3	0.8%
Industrial								
Instrumentation	\$ 51.8	\$ 48.3	\$ 61.1	\$ 69.8	\$ 98.7	\$ 86.6	\$ 95.5	(0.8%)
Manufacturing Systems	27.0	14.3	19.8	24.3	36.8	31.7	41.0	2.8%
Medical	10.8	7.4	12.9	17.4	23.5	23.1	32.1	8.1%
Others	6.7	4.6	5.1	6.6	9.6	7.5	11.2	4.0%
Subtotal	\$ 96.3	\$ 74.6	\$ 98.9	\$ 118.1	\$ 168.6	\$ 148.9	\$ 179.9	1.6%
Consumer								
Audio	\$ 5.9	\$ 1.3	\$ 3.0	\$ 2.1	\$ 2.9	\$ 2.2	\$ 1.5	(15.5%)
Video	32.1	18.1	20.4	18.1	18.4	14.2	12.7	(8.9%)
Personal Electronics	20.3	12.2	19.8	12.5	16.5	14.9	12.3	(7.0%)
Appliances	18.6	11.8	18.0	15.3	19.3	17.2	13.4	(8.7%)
Subtotal	\$ 76.8	\$ 43.3	\$ 61.1	\$ 47.9	\$ 57.1	\$ 48.5	\$ 39.9	(8.6%)
Transportation	\$ 49.4	\$ 33.6	\$ 66.0	\$ 76.4	\$ 78.5	\$ 68.7	\$ 77.6	(0.3%)
Total	\$ 789.7	\$ 686.0	\$1,117.7	\$1,295.1	\$1,561.4	\$1,360.2	\$1,605.6	0.7%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 2c

Estimated Japanese Bipolar Logic Consumption by Application Market  
(Percentage of Total)

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>
Data Processing							
Computers	24.7%	31.7%	35.3%	39.4%	37.8%	38.5%	40.9%
Data Storage	7.8	9.1	11.1	11.2	11.0	10.6	9.0
Terminals	9.8	8.9	6.2	6.0	6.6	6.9	7.0
Input/Output	6.6	6.5	7.1	6.2	7.2	7.0	7.0
Dedicated Systems	<u>6.9</u>	<u>8.0</u>	<u>5.6</u>	<u>4.7</u>	<u>4.0</u>	<u>3.9</u>	<u>3.6</u>
Subtotal	55.9%	64.1%	65.3%	67.6%	66.6%	66.8%	67.5%
Communications							
Customer Premises	5.3%	5.7%	5.6%	5.3%	4.8%	4.4%	4.8%
Public Telecom.	3.0	2.2	1.9	2.4	2.6	2.9	3.2
Radio	7.1	5.4	6.7	5.8	6.3	6.1	5.8
Broadcast and Studio	<u>0.5</u>	<u>0.5</u>	<u>0.3</u>	<u>0.3</u>	<u>0.2</u>	<u>0.2</u>	<u>0.3</u>
Subtotal	15.9%	13.8%	14.5%	13.7%	13.9%	13.6%	14.0%
Industrial							
Instrumentation	6.6%	7.0%	5.5%	5.4%	6.3%	6.4%	5.9%
Manufacturing Sys.	3.4	2.1	1.8	1.9	2.4	2.3	2.6
Medical	1.4	1.1	1.2	1.3	1.5	1.7	2.0
Others	<u>0.9</u>	<u>0.7</u>	<u>0.5</u>	<u>0.5</u>	<u>0.6</u>	<u>0.5</u>	<u>0.7</u>
Subtotal	12.2%	10.9%	8.8%	9.1%	10.8%	10.9%	11.2%
Consumer							
Audio	0.7%	0.2%	0.3%	0.2%	0.2%	0.2%	0.1%
Video	4.1	2.6	1.8	1.4	1.2	1.0	0.8
Personal Electronics	2.6	1.8	1.8	1.0	1.1	1.1	0.8
Appliances	<u>2.4</u>	<u>1.7</u>	<u>1.6</u>	<u>1.2</u>	<u>1.2</u>	<u>1.3</u>	<u>0.8</u>
Subtotal	9.7%	6.3%	5.5%	3.7%	3.7%	3.6%	2.5%
Transportation	<u>6.3%</u>	<u>4.9%</u>	<u>5.9%</u>	<u>5.9%</u>	<u>5.0%</u>	<u>5.0%</u>	<u>4.8%</u>
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989



# Consumption by Application Market

Table 3a

## Estimated Japanese Bipolar Memory Consumption by Application Market (Billions of Yen)

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
<b>Data Processing</b>								
Computers	¥ 38.5	¥ 32.3	¥ 28.3	¥ 32.7	¥ 45.2	¥ 28.5	¥ 33.4	(7.3%)
Data Storage	0	0	0	0	0	0	0	0
Terminals	0	0	0	0	0	0	0	0
Input/Output	0	0	0	0	0	0	0	0
Dedicated Systems	0	0	0	0	0	0	0	0
Subtotal	¥ 38.5	¥ 32.3	¥ 28.3	¥ 32.7	¥ 45.2	¥ 28.5	¥ 33.4	(7.3%)
<b>Communications</b>								
Customer Premises	0	0	0	0	0	0	0	0
Public Telecom.	0	0	0	0	0	0	0	0
Radio	0	0	0	0	0	0	0	0
Broadcast and Studio	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Industrial</b>								
Instrumentation	0	0	0	0	0	0	0	0
Manufacturing Systems	0	0	0	0	0	0	0	0
Medical	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Consumer</b>								
Audio	0	0	0	0	0	0	0	0
Video	0	0	0	0	0	0	0	0
Personal Electronics	0	0	0	0	0	0	0	0
Appliances	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Transportation</b>	0	0	0	0	0	0	0	0
<b>Total</b>	¥ 38.5	¥ 32.3	¥ 28.3	¥ 32.7	¥ 45.2	¥ 28.5	¥ 33.4	(5.9%)
Exchange Rate (Yen/US\$1)	¥237.0	¥238.0	¥167.0	¥144.0	¥130.0	¥134.0		

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

**Table 3b**

## **Estimated Japanese Bipolar Memory Consumption by Application Market (Millions of Dollars)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>	<u>CAGR 1986-1992</u>
<b>Data Processing</b>								
Computers	\$162.4	\$135.7	\$169.5	\$227.1	\$347.7	\$212.7	\$249.3	(8.0%)
Data Storage	0	0	0	0	0	0	0	0
Terminals	0	0	0	0	0	0	0	0
Input/Output	0	0	0	0	0	0	0	0
Dedicated Systems	0	0	0	0	0	0	0	0
Subtotal	\$162.4	\$135.7	\$169.5	\$227.1	\$347.7	\$212.7	\$249.3	(8.0%)
<b>Communications</b>								
Customer Premises	0	0	0	0	0	0	0	0
Public Telecom.	0	0	0	0	0	0	0	0
Radio	0	0	0	0	0	0	0	0
Broadcast and Studio	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Industrial</b>								
Instrumentation	0	0	0	0	0	0	0	0
Manufacturing Systems	0	0	0	0	0	0	0	0
Medical	0	0	0	0	0	0	0	0
Others	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Consumer</b>								
Audio	0	0	0	0	0	0	0	0
Video	0	0	0	0	0	0	0	0
Personal Electronics	0	0	0	0	0	0	0	0
Appliances	0	0	0	0	0	0	0	0
Subtotal	0	0	0	0	0	0	0	0
<b>Transportation</b>	0	0	0	0	0	0	0	0
<b>Total</b>	\$162.4	\$135.7	\$169.5	\$227.1	\$347.7	\$212.7	\$249.3	(8.0%)

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 3c

**Estimated Japanese Bipolar Memory Consumption by Application Market  
(Percentage of Total)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>
<b>Data Processing</b>							
Computers	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Data Storage	0	0	0	0	0	0	0
Terminals	0	0	0	0	0	0	0
Input/Output	0	0	0	0	0	0	0
Dedicated Systems	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Subtotal	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
<b>Communications</b>							
Customer Premises	0	0	0	0	0	0	0
Public Telecom.	0	0	0	0	0	0	0
Radio	0	0	0	0	0	0	0
Broadcast and Studio	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Subtotal	0	0	0	0	0	0	0
<b>Industrial</b>							
Instrumentation	0	0	0	0	0	0	0
Manufacturing Sys.	0	0	0	0	0	0	0
Medical	0	0	0	0	0	0	0
Others	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Subtotal	0	0	0	0	0	0	0
<b>Consumer</b>							
Audio	0	0	0	0	0	0	0
Video	0	0	0	0	0	0	0
Personal Electronics	0	0	0	0	0	0	0
Appliances	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
Subtotal	0	0	0	0	0	0	0
<b>Transportation</b>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 4a

## Estimated Japanese MOS Logic Consumption by Application Market (Billions of Yen)

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
<b>Data Processing</b>								
Computers	¥ 10.1	¥ 21.4	¥ 26.0	¥ 37.6	¥ 56.5	¥ 65.6	¥135.8	24.5%
Data Storage	8.0	12.2	11.2	16.7	23.8	25.7	41.7	15.1%
Terminals	9.6	16.5	16.1	25.4	33.0	37.5	55.4	13.8%
Input/Output	11.9	13.5	13.6	20.4	27.4	30.3	45.0	13.2%
Dedicated Systems	27.6	26.9	23.9	26.5	36.7	40.7	62.8	14.4%
Subtotal	¥ 67.2	¥ 90.5	¥ 90.8	¥126.6	¥177.3	¥199.7	¥340.7	17.7%
<b>Communications</b>								
Customer Premises	¥ 12.5	¥ 18.5	¥ 19.0	¥ 22.9	¥ 31.5	¥ 34.2	¥ 55.2	15.0%
Public Telecom.	6.9	5.2	5.0	8.9	13.6	15.3	25.7	17.2%
Radio	8.7	8.9	8.9	12.7	19.3	20.4	27.9	9.6%
Broadcast and Studio	1.0	1.2	0.9	0.9	1.1	1.2	1.5	7.6%
Subtotal	¥ 29.1	¥ 33.7	¥ 33.8	¥ 45.4	¥ 65.6	¥ 71.1	¥110.2	13.8%
<b>Industrial</b>								
Instrumentation	¥ 9.0	¥ 15.6	¥ 13.0	¥ 13.4	¥ 20.8	¥ 22.9	¥ 32.9	12.2%
Manufacturing Systems	6.0	6.1	4.7	5.1	8.3	9.1	14.7	15.2%
Medical	2.4	3.1	2.2	3.7	5.2	6.5	8.0	11.5%
Others	2.4	2.4	2.4	2.3	4.2	4.6	6.5	11.9%
Subtotal	¥ 19.8	¥ 27.2	¥ 22.3	¥ 24.6	¥ 38.5	¥ 43.2	¥ 62.1	12.7%
<b>Consumer</b>								
Audio	¥ 22.9	¥ 19.0	¥ 18.7	¥ 16.9	¥ 27.5	¥ 29.3	¥ 32.8	4.5%
Video	81.0	73.3	75.9	74.0	102.4	106.3	130.8	6.3%
Personal Electronics	20.7	19.7	19.3	17.4	23.7	26.3	30.8	6.7%
Appliances	4.0	4.7	6.3	6.6	8.4	7.7	13.0	11.5%
Subtotal	¥128.6	¥116.7	¥120.2	¥114.9	¥162.1	¥169.6	¥207.4	6.4%
<b>Transportation</b>	¥ 6.1	¥ 7.3	¥ 8.3	¥ 10.7	¥ 12.2	¥ 15.0	¥ 28.0	23.0%
<b>Total</b>	¥250.8	¥275.4	¥275.5	¥322.2	¥455.7	¥498.6	¥748.4	13.2%
Exchange Rate (Yen/US\$1)	¥237.0	¥238.0	¥167.0	¥144.0	¥130.0	¥134.0		

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 4b

## Estimated Japanese MOS Logic Consumption by Application Market (Millions of Dollars)

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
<b>Data Processing</b>								
Computers	\$ 42.6	\$ 89.9	\$ 155.6	\$ 261.1	\$ 434.3	\$ 489.3	\$1,013.4	23.6%
Data Storage	33.8	51.3	67.2	115.8	182.9	191.8	311.2	14.2%
Terminals	40.5	69.3	96.1	176.4	253.7	279.9	413.2	13.0%
Input/Output	50.2	56.7	81.4	141.9	210.8	226.1	335.8	12.3%
Dedicated Systems	116.5	113.0	143.3	184.0	281.9	303.5	468.7	13.5%
Subtotal	\$ 283.6	\$ 380.3	\$ 543.7	\$ 879.2	\$1,363.7	\$1,490.6	\$2,542.3	16.8%
<b>Communications</b>								
Customer Premises	\$ 52.7	\$ 77.7	\$ 113.8	\$ 159.0	\$ 242.6	\$ 255.2	\$ 411.7	14.1%
Public Telecom.	29.1	21.7	30.1	61.8	104.9	114.2	191.8	16.3%
Radio	36.7	37.4	53.1	87.8	148.6	152.2	207.9	8.8%
Broadcast and Studio	4.2	4.8	5.3	6.3	8.6	9.0	11.2	6.8%
Subtotal	\$ 122.8	\$ 141.6	\$ 202.3	\$ 314.9	\$ 504.8	\$ 530.6	\$ 822.6	13.0%
<b>Industrial</b>								
Instrumentation	\$ 38.0	\$ 65.4	\$ 77.8	\$ 93.3	\$ 159.8	\$ 170.9	\$ 245.5	11.3%
Manufacturing Systems	25.3	25.7	28.3	35.7	64.1	68.1	109.6	14.3%
Medical	10.3	12.9	13.4	25.7	40.0	48.8	59.9	10.6%
Others	10.0	10.1	14.3	16.1	32.0	34.3	48.8	11.1%
Subtotal	\$ 83.6	\$ 114.1	\$ 133.8	\$ 170.8	\$ 295.8	\$ 322.1	\$ 463.8	11.9%
<b>Consumer</b>								
Audio	\$ 96.6	\$ 79.8	\$ 112.0	\$ 117.6	\$ 211.7	\$ 218.7	\$ 244.8	3.7%
Video	341.8	308.2	454.6	513.9	787.9	793.3	976.1	5.5%
Personal Electronics	87.3	82.8	115.6	120.8	182.6	196.3	229.9	5.9%
Appliances	17.0	19.7	37.7	45.8	64.6	57.5	97.0	10.7%
Subtotal	\$ 542.7	\$ 490.5	\$ 719.9	\$ 798.1	\$1,246.8	\$1,265.7	\$1,547.8	5.6%
<b>Transportation</b>	\$ 25.7	\$ 30.8	\$ 50.0	\$ 74.3	\$ 93.9	\$ 111.9	\$ 208.6	22.1%
<b>Total</b>	\$1,058.4	\$1,157.3	\$1,649.6	\$2,237.3	\$3,505.0	\$3,720.9	\$5,585.0	12.4%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 4c

**Estimated Japanese MOS Logic Consumption by Application Market  
(Percentage of Total)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>
<b>Data Processing</b>							
Computers	4.0%	7.8%	9.4%	11.7%	12.4%	13.2%	18.1%
Data Storage	3.2	4.4	4.1	5.2	5.2	5.2	5.6
Terminals	3.8	6.0	5.8	7.9	7.2	7.5	7.4
Input/Output	4.7	4.9	4.9	6.3	6.0	6.1	6.0
Dedicated Systems	<u>11.0</u>	<u>9.8</u>	<u>8.7</u>	<u>8.2</u>	<u>8.0</u>	<u>8.2</u>	<u>8.4</u>
Subtotal	26.8%	32.9%	33.0%	39.3%	38.9%	40.1%	45.5%
<b>Communications</b>							
Customer Premises	5.0%	6.7%	6.9%	7.1%	6.9%	6.9%	7.4%
Public Telecom.	2.8	1.9	1.8	2.8	3.0	3.1	3.4
Radio	3.5	3.2	3.2	3.9	4.2%	4.1%	3.7
Broadcast and Studio	<u>0.4</u>	<u>0.4</u>	<u>0.3</u>	<u>0.3</u>	<u>0.2%</u>	<u>0.2%</u>	<u>0.2</u>
Subtotal	11.6%	12.2%	12.3%	14.1%	14.4%	14.3%	14.7%
<b>Industrial</b>							
Instrumentation	3.6%	5.6%	4.7%	4.2%	4.6%	4.6%	4.4%
Manufacturing Sys.	2.4	2.2	1.7	1.6	1.8	1.8	2.0
Medical	1.0	1.1	0.8	1.1	1.1	1.3	1.1
Others	<u>0.9</u>	<u>0.9</u>	<u>0.9</u>	<u>0.7</u>	<u>0.9</u>	<u>0.9</u>	<u>0.9</u>
Subtotal	7.9%	9.9%	8.1%	7.6%	8.4%	8.7%	8.3%
<b>Consumer</b>							
Audio	9.1%	6.9%	6.8%	5.3%	6.0%	5.9%	4.4%
Video	32.3	26.6	27.6	23.0	22.5	21.3	17.5
Personal Electronics	8.3	7.2	7.0	5.4	5.2	5.3	4.1
Appliances	<u>1.6</u>	<u>1.7</u>	<u>2.3</u>	<u>2.0</u>	<u>1.8</u>	<u>1.5</u>	<u>1.7</u>
Subtotal	51.3%	42.4%	43.6%	35.7%	35.6%	34.0%	27.7%
<b>Transportation</b>	<u>2.4%</u>	<u>2.7%</u>	<u>3.0%</u>	<u>3.3%</u>	<u>2.7%</u>	<u>3.0%</u>	3.7%
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

**Table 5a**

## **Estimated Japanese MOS Microcomponent Consumption by Application Market (Billions of Yen)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>	<u>CAGR 1988-1992</u>
<b>Data Processing</b>								
Computers	¥ 54.4	¥ 43.6	¥ 38.9	¥ 71.9	¥ 94.0	¥100.1	¥153.7	13.1%
Data Storage	11.6	10.6	15.0	20.4	23.6	23.5	39.7	13.9%
Terminals	16.5	10.1	13.4	18.2	24.1	26.2	44.6	16.6%
Input/Output	11.1	7.8	9.2	14.1	13.7	14.3	23.6	14.5%
Dedicated Systems	18.0	12.6	11.0	10.6	12.5	12.8	22.4	15.8%
Subtotal	¥111.6	¥ 84.7	¥107.5	¥135.2	¥167.8	¥176.9	¥284.0	14.1%
<b>Communications</b>								
Customer Premises	¥ 12.6	¥ 12.1	¥ 13.7	¥ 17.9	¥ 21.8	¥ 23.5	¥ 41.0	17.1%
Public Telecom.	5.1	4.3	4.9	6.2	10.0	11.5	19.1	17.4%
Radio	5.8	4.8	7.3	9.6	13.4	13.7	19.0	9.0%
Broadcast and Studio	0.8	0.8	0.7	0.8	0.8	0.8	1.4	14.6%
Subtotal	¥ 24.2	¥ 22.0	¥ 26.5	¥ 34.5	¥ 46.1	¥ 49.5	¥ 80.4	14.9%
<b>Industrial</b>								
Instrumentation	¥ 10.5	¥ 10.2	¥ 9.5	¥ 10.4	¥ 12.8	¥ 13.2	¥ 20.7	12.7%
Manufacturing Systems	3.8	3.6	3.2	4.1	4.8	5.0	9.0	17.1%
Medical	2.9	2.4	3.2	4.7	4.9	5.8	6.8	8.7%
Others	0.9	0.8	0.8	1.6	1.8	1.8	3.2	14.8%
Subtotal	¥ 18.1	¥ 17.0	¥ 16.7	¥ 20.8	¥ 24.3	¥ 25.8	¥ 39.7	13.0%
<b>Consumer</b>								
Audio	¥ 10.0	¥ 12.1	¥ 12.4	¥ 11.4	¥ 13.9	¥ 13.6	¥ 16.9	5.1%
Video	41.6	47.0	36.0	36.8	44.0	42.2	76.4	14.8%
Personal Electronics	4.8	6.1	7.7	7.7	8.5	8.6	10.6	5.8%
Appliances	6.9	6.7	5.9	7.7	8.5	8.2	12.5	10.1%
Subtotal	¥ 63.2	¥ 71.9	¥ 62.0	¥ 63.5	¥ 74.9	¥ 72.6	¥116.5	11.7%
<b>Transportation</b>	¥ 14.6	¥ 14.8	¥ 15.5	¥ 19.5	¥ 21.2	¥ 22.4	¥ 36.7	14.7%
<b>Total</b>	¥231.7	¥210.4	¥228.3	¥273.5	¥334.3	¥347.2	¥557.3	13.6%
<b>Exchange Rate (Yen/US\$1)</b>	¥237.0	¥238.0	¥167.0	¥144.0	¥130.0	¥134.0		

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

**Table 5b**

## **Estimated Japanese MOS Microcomponent Consumption by Application Market (Millions of Dollars)**

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
<b>Data Processing</b>								
Computers	\$229.5	\$183.2	\$ 352.7	\$ 499.4	\$ 723.2	\$ 747.1	\$1,147.0	12.2%
Data Storage	48.9	44.5	89.8	141.9	181.2	175.4	296.3	13.1%
Terminals	69.6	42.4	80.2	126.0	185.3	195.5	332.8	15.8%
Input/Output	46.8	32.8	55.1	97.8	105.5	106.7	176.0	13.7%
Dedicated Systems	<u>75.9</u>	<u>52.9</u>	<u>65.9</u>	<u>73.7</u>	<u>96.0</u>	<u>93.5</u>	<u>167.2</u>	14.9%
Subtotal	\$470.9	\$355.9	\$ 643.7	\$ 938.9	\$1,291.1	\$1,320.2	\$2,119.3	13.2%
<b>Communications</b>								
Customer Premises	\$ 53.2	\$ 50.8	\$ 81.9	\$ 124.3	\$ 167.8	\$ 175.4	\$ 306.0	16.2%
Public Telecom.	21.4	17.9	29.3	43.3	77.2	85.8	142.4	16.5%
Radio	24.3	20.4	43.7	66.6	103.3	102.2	141.4	8.2%
Broadcast and Studio	<u>3.2</u>	<u>3.3</u>	<u>4.0</u>	<u>5.4</u>	<u>6.2</u>	<u>6.0</u>	<u>10.3</u>	13.7%
Subtotal	\$102.1	\$ 92.3	\$ 159.0	\$ 239.7	\$ 354.5	\$ 369.4	\$ 600.1	14.1%
<b>Industrial</b>								
Instrumentation	\$ 44.3	\$ 42.9	\$ 56.9	\$ 72.2	\$ 98.8	\$ 98.5	\$ 154.5	11.8%
Manufacturing Systems	16.0	14.9	19.2	28.5	36.7	37.3	67.0	16.3%
Medical	12.3	10.2	19.2	32.6	37.3	42.9	50.6	7.9%
Others	<u>3.9</u>	<u>3.5</u>	<u>5.0</u>	<u>11.1</u>	<u>14.2</u>	<u>13.4</u>	<u>24.0</u>	14.0%
Subtotal	\$ 76.5	\$ 71.5	\$ 100.2	\$ 144.4	\$ 187.0	\$ 192.2	\$ 296.0	12.2%
<b>Consumer</b>								
Audio	\$ 42.2	\$ 50.8	\$ 74.3	\$ 78.8	\$ 106.8	\$ 101.5	\$ 126.3	4.3%
Video	175.5	197.5	215.6	255.6	338.8	314.9	570.4	13.9%
Personal Electronics	20.0	25.5	46.1	53.1	65.2	64.2	79.3	5.0%
Appliances	<u>29.0</u>	<u>28.2</u>	<u>35.3</u>	<u>53.5</u>	<u>65.3</u>	<u>61.2</u>	<u>93.3</u>	9.3%
Subtotal	\$266.7	\$302.0	\$ 371.3	\$ 441.0	\$ 576.1	\$ 541.8	\$ 869.4	10.8%
<b>Transportation</b>	<u>\$ 61.6</u>	<u>\$ 62.2</u>	<u>\$ 92.8</u>	<u>\$ 135.4</u>	<u>\$ 163.2</u>	<u>\$ 167.2</u>	<u>\$ 273.7</u>	13.8%
<b>Total</b>	<b>\$977.8</b>	<b>\$883.9</b>	<b>\$1,367.0</b>	<b>\$1,899.4</b>	<b>\$2,571.9</b>	<b>\$2,590.7</b>	<b>\$4,158.6</b>	<b>12.8%</b>

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989



# Consumption by Application Market

Table 5c

**Estimated Japanese MOS Microcomponent Consumption by Application Market  
(Percentage of Total)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>
<b>Data Processing</b>							
Computers	23.5%	20.7%	25.8%	26.3%	28.1%	28.8%	27.6%
Data Storage	5.0	5.0	6.6	7.5	7.0	6.8	7.1
Terminals	7.1	4.8	5.9	6.6	7.2	7.5	8.0
Input/Output	4.8	3.7	4.0	5.2	4.1	4.1	4.2
Dedicated Systems	<u>7.8</u>	<u>6.0</u>	<u>4.8</u>	<u>3.9</u>	<u>3.7</u>	<u>3.7</u>	<u>4.0</u>
Subtotal	48.2%	40.3%	47.1%	49.4%	50.2%	51.0%	51.0%
<b>Communications</b>							
Customer Premises	5.4%	5.7%	6.0%	6.5%	6.5%	6.8%	7.4%
Public Telecom.	2.2	2.0	2.1	2.3	3.0	3.3	3.4
Radio	2.5	2.3	3.2	3.5	4.0	3.9	3.4
Broadcast and Studio	<u>0.3</u>	<u>0.4</u>	<u>0.3</u>	<u>0.3</u>	<u>0.2</u>	<u>0.2</u>	<u>0.2</u>
Subtotal	10.4%	10.4%	11.6%	12.6%	13.8%	14.3%	14.4%
<b>Industrial</b>							
Instrumentation	4.5%	4.9%	4.2%	3.8%	3.8%	3.8%	3.7%
Manufacturing Sys.	1.6	1.7	1.4	1.5	1.4	1.4	1.6
Medical	1.3	1.2	1.4	1.7	1.5	1.7	1.2
Others	<u>0.4</u>	<u>0.4</u>	<u>0.4</u>	<u>0.6</u>	<u>0.6</u>	<u>0.5</u>	<u>0.6</u>
Subtotal	7.8%	8.1%	7.3%	7.6%	7.3%	7.4%	7.1%
<b>Consumer</b>							
Audio	4.3%	5.8%	5.4%	4.1%	4.2%	3.9%	3.0%
Video	18.0	22.3	15.8	13.5	13.2	12.2	13.7
Personal Electronics	2.1	2.9	3.4	2.8	2.5	2.5	1.9
Appliances	<u>3.0</u>	<u>3.2</u>	<u>2.6</u>	<u>2.8</u>	<u>2.5</u>	<u>2.4</u>	<u>2.2</u>
Subtotal	27.3%	34.2%	27.2%	23.2%	22.4%	20.9%	20.9%
<b>Transportation</b>	<u>6.3%</u>	<u>7.0%</u>	<u>6.8%</u>	<u>7.1%</u>	<u>6.3%</u>	<u>6.5%</u>	<u>6.6%</u>
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 6a

## Estimated Japanese MOS Memory Consumption by Application Market (Billions of Yen)

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
<b>Data Processing</b>								
Computers	¥130.6	¥108.0	¥127.4	¥152.2	¥259.0	¥409.7	¥ 460.6	15.5%
Data Storage	31.7	24.7	25.1	29.1	44.0	56.6	66.0	10.7%
Terminals	44.0	23.4	23.6	27.8	48.8	78.1	88.6	16.1%
Input/Output	30.8	22.8	22.8	25.1	45.2	67.3	77.1	14.3%
Dedicated Systems	33.5	26.7	21.1	14.5	25.0	48.0	55.9	22.3%
Subtotal	¥270.7	¥205.6	¥220.0	¥248.7	¥422.1	¥659.7	¥ 748.3	15.4%
<b>Communications</b>								
Customer Premises	¥ 21.6	¥ 17.8	¥ 17.0	¥ 19.2	¥ 38.2	¥ 52.5	¥ 50.1	7.0%
Public Telecom.	10.5	7.1	5.9	7.4	18.0	26.7	31.9	15.4%
Radio	14.4	9.5	8.2	9.8	20.3	28.7	30.5	10.7%
Broadcast and Studio	1.6	1.5	1.4	1.4	2.0	3.8	2.4	4.6%
Subtotal	¥ 48.1	¥ 35.9	¥ 32.5	¥ 37.8	¥ 78.5	¥111.7	¥ 114.8	10.0%
<b>Industrial</b>								
Instrumentation	¥ 19.7	¥ 13.3	¥ 11.1	¥ 12.8	¥ 25.0	¥ 40.3	¥ 44.2	15.3%
Manufacturing Systems	9.4	8.2	7.8	7.1	12.0	20.2	24.1	19.0%
Medical	4.6	3.0	3.5	4.4	7.0	11.2	13.9	18.9%
Others	1.5	0.7	0.7	0.9	2.8	4.2	6.1	20.8%
Subtotal	¥ 35.1	¥ 25.2	¥ 23.1	¥ 25.2	¥ 46.8	¥ 75.9	¥ 88.3	17.2%
<b>Consumer</b>								
Audio	¥ 1.0	¥ 1.0	¥ 1.1	¥ 1.1	¥ 2.1	¥ 2.7	¥ 3.4	13.5%
Video	7.8	5.7	3.6	4.4	11.4	20.1	28.1	25.3%
Personal Electronics	1.5	1.1	0.8	1.0	1.5	2.0	3.1	20.5%
Appliances	0.3	0.5	0.9	0.8	1.3	1.5	2.6	18.4%
Subtotal	¥ 10.6	¥ 8.3	¥ 6.4	¥ 7.2	¥ 16.3	¥ 26.3	¥ 37.2	23.0%
<b>Transportation</b>	¥ 9.9	¥ 7.0	¥ 8.7	¥ 7.4	¥ 11.2	¥ 17.1	¥ 22.0	18.3%
<b>Total</b>	¥374.3	¥282.0	¥290.5	¥326.3	¥574.8	¥890.7	¥1,010.6	15.1%
Exchange Rate (Yen/US\$1)	¥237.0	¥238.0	¥167.0	¥144.0	¥130.0	¥134.0		

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 6b

## Estimated Japanese MOS Memory Consumption by Application Market (Millions of Dollars)

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>	<u>CAGR</u> <u>1988-1992</u>
<b>Data Processing</b>								
Computers	\$ 551.1	\$ 453.8	\$ 762.9	\$1,056.9	\$1,992.5	\$3,057.2	\$3,437.3	14.6%
Data Storage	133.8	103.8	150.3	201.9	338.5	422.4	492.4	9.8%
Terminals	185.7	98.3	141.3	192.9	375.7	582.8	661.4	15.2%
Input/Output	130.1	95.8	136.3	174.2	347.7	502.5	575.6	13.4%
Dedicated Systems	141.4	112.2	126.3	100.9	192.2	358.2	417.5	21.4%
Subtotal	\$1,142.0	\$ 863.9	\$1,317.1	\$1,726.9	\$3,246.6	\$4,923.1	\$5,584.3	14.5%
<b>Communications</b>								
Customer Premises	\$ 91.1	\$ 74.6	\$ 101.5	\$ 133.3	\$ 293.8	\$ 391.8	\$ 373.5	6.2%
Public Telecom.	44.3	29.7	35.3	51.4	138.5	199.3	238.0	14.5%
Radio	60.6	40.1	49.1	68.1	156.2	214.2	227.7	9.9%
Broadcast and Studio	6.8	6.4	8.4	9.7	15.1	28.4	17.5	3.9%
Subtotal	\$ 202.8	\$ 150.8	\$ 194.3	\$ 262.6	\$ 603.6	\$ 833.6	\$ 856.8	9.2%
<b>Industrial</b>								
Instrumentation	\$ 82.9	\$ 55.9	\$ 66.6	\$ 88.9	\$ 192.2	\$ 300.7	\$ 329.9	14.5%
Manufacturing Systems	39.7	34.4	46.7	49.3	92.3	150.6	179.5	18.1%
Medical	19.4	12.6	21.0	30.6	53.7	83.9	104.0	18.0%
Others	6.2	2.9	4.2	6.0	21.8	31.3	45.1	19.9%
Subtotal	\$ 148.2	\$ 105.8	\$ 138.5	\$ 174.7	\$ 360.0	\$ 566.6	\$ 658.6	16.3%
<b>Consumer</b>								
Audio	\$ 4.2	\$ 4.2	\$ 6.6	\$ 7.6	\$ 15.8	\$ 20.1	\$ 25.5	12.7%
Video	32.8	23.9	21.6	30.6	87.8	150.0	209.7	24.3%
Personal Electronics	6.3	4.7	4.8	6.6	11.3	14.9	23.1	19.6%
Appliances	1.3	2.1	5.1	5.5	10.1	11.2	19.3	17.5%
Subtotal	\$ 44.6	\$ 35.0	\$ 38.0	\$ 50.3	\$ 125.1	\$ 196.3	\$ 277.7	22.1%
<b>Transportation</b>	\$ 41.7	\$ 29.4	\$ 51.8	\$ 51.4	\$ 86.4	\$ 127.6	\$ 164.2	17.4%
<b>Total</b>	\$1,579.3	\$1,184.8	\$1,739.8	\$2,265.9	\$4,421.6	\$6,647.2	\$7,541.5	14.3%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 6c

**Estimated Japanese MOS Memory Consumption by Application Market  
(Percentage of Total)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>
<b>Data Processing</b>							
Computers	34.9%	38.3%	43.8%	46.6%	45.1%	46.0%	45.6%
Data Storage	8.5	8.8	8.6	8.9	7.7	6.4	6.5
Terminals	11.8	8.3	8.1	8.5	8.5	8.8	8.8
Input/Output	8.2	8.1	7.8	7.7	7.9	7.6	7.6
Dedicated Systems	<u>9.0</u>	<u>9.5</u>	<u>7.3</u>	<u>4.5</u>	<u>4.3</u>	<u>5.4</u>	<u>5.5</u>
Subtotal	72.3%	72.9%	75.7%	76.2%	73.4%	74.1%	74.0%
<b>Communications</b>							
Customer Premises	5.8%	6.3%	5.8%	5.9%	6.6%	5.9%	5.0%
Public Telecom.	2.8	2.5	2.0	2.3	3.1	3.0	3.2
Radio	3.8	3.4	2.8	3.0	3.5	3.2	3.0
Broadcast and Studio	<u>0.4</u>	<u>0.5</u>	<u>0.5</u>	<u>0.4</u>	<u>0.3</u>	<u>0.4</u>	<u>0.2</u>
Subtotal	12.8%	12.7%	11.2%	11.6%	13.7%	12.5%	11.4%
<b>Industrial</b>							
Instrumentation	5.2%	4.7%	3.8%	3.9%	4.3%	4.5%	4.4%
Manufacturing Sys.	2.5	2.9	2.7	2.2	2.1	2.3	2.4
Medical	1.2	1.1	1.2	1.3	1.2	1.3	1.4
Others	<u>0.4</u>	<u>0.2</u>	<u>0.2</u>	<u>0.3</u>	<u>0.5</u>	<u>0.5</u>	<u>0.6</u>
Subtotal	9.4%	8.9%	8.0%	7.7%	8.1%	8.5%	8.7%
<b>Consumer</b>							
Audio	0.3%	0.4%	0.4%	0.3%	0.4%	0.3%	0.3%
Video	2.1	2.0	1.2	1.3	2.0	2.3	2.8
Personal Electronics	0.4	0.4	0.3	0.3	0.3	0.2	0.3
Appliances	<u>0.1</u>	<u>0.2</u>	<u>0.3</u>	<u>0.2</u>	<u>0.2</u>	<u>0.2</u>	<u>0.3</u>
Subtotal	2.8%	3.0%	2.2%	2.2%	2.8%	3.0%	3.7%
<b>Transportation</b>	<u>2.6%</u>	<u>2.5%</u>	<u>3.0%</u>	<u>2.3%</u>	<u>2.0%</u>	<u>1.9%</u>	<u>2.2%</u>
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

**Table 7a**

## **Estimated Japanese Linear IC Consumption by Application Market (Billions of Yen)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>	<u>CAGR 1988-1992</u>
<b>Data Processing</b>								
Computers	¥ 2.9	¥ 9.0	¥ 7.0	¥ 8.8	¥ 9.3	¥ 9.7	¥ 16.2	15.0%
Data Storage	6.4	11.3	14.0	16.8	15.4	15.2	33.1	21.2%
Terminals	8.6	13.2	16.0	17.7	18.3	19.9	38.2	20.2%
Input/Output	4.9	7.6	8.1	9.0	9.5	9.8	24.1	26.1%
Dedicated Systems	6.8	9.8	7.6	7.7	8.2	8.3	15.1	16.4%
<b>Subtotal</b>	<b>¥ 29.6</b>	<b>¥ 50.9</b>	<b>¥ 52.7</b>	<b>¥ 60.0</b>	<b>¥ 60.7</b>	<b>¥ 62.9</b>	<b>¥ 126.7</b>	<b>20.2%</b>
<b>Communications</b>								
Customer Premises	¥ 19.4	¥ 16.1	¥ 16.7	¥ 20.7	¥ 20.0	¥ 21.6	¥ 39.8	18.8%
Public Telecom.	7.7	7.4	7.6	10.5	9.7	11.5	20.6	20.7%
Radio	19.2	18.2	18.8	24.8	27.9	28.4	53.9	17.9%
Broadcast and Studio	1.1	1.1	1.0	1.0	1.1	1.2	2.5	22.4%
<b>Subtotal</b>	<b>¥ 47.3</b>	<b>¥ 42.8</b>	<b>¥ 44.1</b>	<b>¥ 57.0</b>	<b>¥ 58.7</b>	<b>¥ 62.7</b>	<b>¥ 116.8</b>	<b>18.8%</b>
<b>Industrial</b>								
Instrumentation	¥ 23.2	¥ 21.1	¥ 17.9	¥ 20.0	¥ 19.5	¥ 21.0	¥ 24.4	5.8%
Manufacturing Systems	10.2	8.9	6.8	7.4	8.4	9.1	15.0	15.6%
Medical	4.8	5.1	5.1	6.3	6.9	8.4	10.2	10.4%
Others	5.8	5.3	5.0	5.5	6.2	6.7	11.2	15.9%
<b>Subtotal</b>	<b>¥ 44.0</b>	<b>¥ 40.3</b>	<b>¥ 34.8</b>	<b>¥ 39.2</b>	<b>¥ 41.0</b>	<b>¥ 45.2</b>	<b>¥ 60.8</b>	<b>10.4%</b>
<b>Consumer</b>								
Audio	¥ 79.8	¥ 70.5	¥ 67.4	¥ 60.7	¥ 64.1	¥ 65.4	¥ 52.7	(4.8%)
Video	207.8	199.3	197.5	189.4	195.3	195.3	222.0	3.3%
Personal Electronics	18.3	20.9	20.3	21.7	21.2	21.0	33.0	11.7%
Appliances	13.0	14.0	13.8	20.7	17.2	15.1	32.0	16.8%
<b>Subtotal</b>	<b>¥ 318.9</b>	<b>¥ 304.7</b>	<b>¥ 299.0</b>	<b>¥ 292.4</b>	<b>¥ 297.8</b>	<b>¥ 296.8</b>	<b>¥ 339.7</b>	<b>3.3%</b>
<b>Transportation</b>	<b>¥ 14.4</b>	<b>¥ 17.0</b>	<b>¥ 23.2</b>	<b>¥ 25.8</b>	<b>¥ 25.4</b>	<b>¥ 28.1</b>	<b>¥ 56.7</b>	<b>22.2%</b>
<b>Total</b>	<b>¥ 454.2</b>	<b>¥ 455.8</b>	<b>¥ 453.9</b>	<b>¥ 474.3</b>	<b>¥ 483.6</b>	<b>¥ 495.7</b>	<b>¥ 700.7</b>	<b>9.7%</b>
<b>Exchange Rate (Yen/US\$1)</b>	<b>¥ 237.0</b>	<b>¥ 238.0</b>	<b>¥ 167.0</b>	<b>¥ 144.0</b>	<b>¥ 130.0</b>	<b>¥ 134.0</b>		

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

**Table 7b**

## **Estimated Japanese Linear IC Consumption by Application Market (Millions of Dollars)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>	<u>CAGR 1988-1992</u>
<b>Data Processing</b>								
Computers	\$ 12.2	\$ 37.8	\$ 41.9	\$ 61.1	\$ 71.2	\$ 72.5	\$ 120.7	14.1%
Data Storage	27.0	47.5	84.0	116.7	118.1	113.4	247.2	20.3%
Terminals	36.2	55.5	95.8	122.9	140.8	148.5	284.7	19.3%
Input/Output	20.8	31.9	48.4	62.5	73.4	73.1	179.9	25.1%
Dedicated Systems	28.6	41.2	45.5	53.5	63.3	62.2	112.8	15.5%
Subtotal	\$ 124.7	\$ 213.9	\$ 315.6	\$ 416.7	\$ 466.7	\$ 469.7	\$ 945.3	19.3%
<b>Communications</b>								
Customer Premises	\$ 81.9	\$ 67.7	\$ 100.0	\$ 143.7	\$ 153.8	\$ 161.2	\$ 297.3	17.9%
Public Telecom.	32.3	31.0	45.5	72.6	74.7	85.8	154.0	19.8%
Radio	81.0	76.7	112.8	172.3	214.5	211.9	402.0	17.0%
Broadcast and Studio	4.5	4.6	6.0	7.2	8.5	9.0	18.4	21.4%
Subtotal	\$ 199.7	\$ 180.0	\$ 264.3	\$ 395.7	\$ 451.5	\$ 467.9	\$ 871.8	17.9%
<b>Industrial</b>								
Instrumentation	\$ 97.9	\$ 88.5	\$ 107.2	\$ 138.6	\$ 150.0	\$ 156.7	\$ 182.1	5.0%
Manufacturing Systems	43.0	37.3	40.7	51.4	64.7	67.9	111.9	14.7%
Medical	20.2	21.3	30.6	43.8	53.1	62.7	76.4	9.5%
Others	24.6	22.4	29.9	38.2	47.7	50.0	83.6	15.1%
Subtotal	\$ 185.7	\$ 169.5	\$ 208.4	\$ 271.9	\$ 315.5	\$ 337.3	\$ 454.1	9.5%
<b>Consumer</b>								
Audio	\$ 336.7	\$ 296.2	\$ 403.6	\$ 421.2	\$ 493.3	\$ 488.1	\$ 393.3	(5.5%)
Video	876.8	837.4	1,182.6	1,315.3	1,501.9	1,457.5	1,656.9	2.5%
Personal Electronics	77.2	87.8	121.6	150.6	163.2	156.7	246.6	10.9%
Appliances	54.9	58.9	82.8	143.4	132.1	112.7	238.5	15.9%
Subtotal	\$1,345.6	\$1,280.3	\$1,790.6	\$2,030.5	\$2,290.6	\$2,214.9	\$2,535.2	2.6%
<b>Transportation</b>	\$ 60.8	\$ 71.4	\$ 138.9	\$ 179.2	\$ 195.4	\$ 209.7	\$ 422.8	21.3%
<b>Total</b>	\$1,916.5	\$1,915.1	\$2,717.8	\$3,294.0	\$3,719.7	\$3,699.6	\$5,229.1	8.9%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 7c

Estimated Japanese Linear IC Consumption by Application Market  
(Percentage of Total)

Segment	1984	1985	1986	1987	1988	1989	1992
Data Processing							
Computers	0.6%	2.0%	1.5%	1.9%	1.9%	2.0%	2.3%
Data Storage	1.4	2.5	3.1	3.5	3.2	3.1	4.7
Terminals	1.9	2.9	3.5	3.7	3.8	4.0	5.4
Input/Output	1.1	1.7	1.8	1.9	2.0	2.0	3.4
Dedicated Systems	<u>1.5</u>	<u>2.2</u>	<u>1.7</u>	<u>1.6</u>	<u>1.7</u>	<u>1.7</u>	<u>2.2</u>
Subtotal	6.5%	11.2%	11.6%	12.6%	12.5%	12.7%	18.1%
Communications							
Customer Premises	4.3%	3.5%	3.7%	4.4%	4.1%	4.4%	5.7%
Public Telecom.	1.7	1.6	1.7	2.2	2.0	2.3	2.9
Radio	4.2	4.0	4.2	5.2	5.8	5.7	7.7
Broadcast and Studio	<u>0.2</u>	<u>0.2</u>	<u>0.2</u>	<u>0.2</u>	<u>0.2</u>	<u>0.2</u>	<u>0.4</u>
Subtotal	10.4%	9.4%	9.7%	12.0%	12.1%	12.6%	16.7%
Industrial							
Instrumentation	5.1%	4.6%	3.9%	4.2%	4.0%	4.2%	3.5%
Manufacturing Sys.	2.2	1.9	1.5	1.6	1.7	1.8	2.1
Medical	1.1	1.1	1.1	1.3	1.4	1.7	1.5
Others	<u>1.3</u>	<u>1.2</u>	<u>1.1</u>	<u>1.2</u>	<u>1.3</u>	<u>1.4</u>	<u>1.6</u>
Subtotal	9.7%	8.8%	7.7%	8.3%	8.5%	9.1%	8.7%
Consumer							
Audio	17.6%	15.5%	14.8%	12.8%	13.3%	13.2%	7.5%
Video	45.8	43.7	43.5	39.9	40.4	39.4	31.7
Personal Electronics	4.0	4.6	4.5	4.6	4.4	4.2	4.7
Appliances	<u>2.9</u>	<u>3.1</u>	<u>3.0</u>	<u>4.4</u>	<u>3.6</u>	<u>3.0</u>	<u>4.6</u>
Subtotal	70.2%	66.9%	65.9%	61.6%	61.6%	59.9%	48.5%
Transportation	<u>3.2%</u>	<u>3.7%</u>	<u>5.1%</u>	<u>5.4%</u>	<u>5.3%</u>	<u>5.7%</u>	<u>8.1%</u>
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

**Table 8a**

## **Estimated Japanese Discrete Consumption by Application Market (Billions of Yen)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>	<u>CAGR 1988-1992</u>
<b>Data Processing</b>								
Computers	¥ 20.6	¥ 20.1	¥ 21.8	¥ 30.0	¥ 35.7	¥ 37.4	¥ 42.8	4.6%
Data Storage	15.5	15.7	21.5	23.4	31.5	30.8	33.4	1.5%
Terminals	25.9	28.9	37.3	41.2	45.9	49.2	63.5	8.4%
Input/Output	20.0	20.2	23.3	29.2	39.8	41.0	51.5	6.6%
Dedicated Systems	<u>16.7</u>	<u>18.3</u>	<u>16.0</u>	<u>15.2</u>	<u>21.2</u>	<u>21.4</u>	<u>29.2</u>	8.3%
Subtotal	¥ 98.7	¥103.2	¥120.0	¥139.0	¥174.2	¥179.8	¥220.4	6.1%
<b>Communications</b>								
Customer Premises	¥ 13.2	¥ 21.3	¥ 21.8	¥ 24.6	¥ 23.7	¥ 23.7	¥ 28.8	5.0%
Public Telecom.	7.8	9.6	9.3	12.1	14.7	16.3	20.6	8.8%
Radio	20.7	21.7	23.4	26.6	30.4	29.3	41.1	7.8%
Broadcast and Studio	<u>1.2</u>	<u>1.1</u>	<u>0.9</u>	<u>1.1</u>	<u>1.2</u>	<u>1.2</u>	<u>1.6</u>	6.8%
Subtotal	¥ 42.9	¥ 53.7	¥ 55.4	¥ 64.4	¥ 70.0	¥ 70.5	¥ 92.1	7.1%
<b>Industrial</b>								
Instrumentation	¥ 27.2	¥ 20.4	¥ 19.0	¥ 19.4	¥ 23.3	¥ 23.5	¥ 34.5	10.4%
Manufacturing Systems	10.1	8.9	8.5	6.3	7.8	7.8	12.6	12.8%
Medical	4.5	4.2	5.6	5.5	6.0	6.8	9.8	13.0%
Others	<u>2.2</u>	<u>2.2</u>	<u>2.6</u>	<u>2.2</u>	<u>3.3</u>	<u>3.3</u>	<u>5.3</u>	12.7%
Subtotal	¥ 44.0	¥ 35.7	¥ 35.7	¥ 33.4	¥ 40.3	¥ 41.4	¥ 62.2	11.4%
<b>Consumer</b>								
Audio	¥ 28.1	¥ 25.7	¥ 24.2	¥ 17.3	¥ 18.7	¥ 17.5	¥ 15.2	(5.1%)
Video	127.0	89.7	75.7	63.4	70.2	66.2	76.0	2.0%
Personal Electronics	5.8	6.8	5.7	6.4	7.4	6.6	10.0	8.0%
Appliances	<u>20.1</u>	<u>17.9</u>	<u>16.6</u>	<u>17.9</u>	<u>19.6</u>	<u>19.9</u>	<u>26.8</u>	8.2%
Subtotal	¥181.0	¥140.1	¥122.2	¥105.0	¥115.8	¥110.2	¥128.0	2.5%
<b>Transportation</b>	<u>¥ 23.9</u>	<u>¥ 28.3</u>	<u>¥ 18.9</u>	<u>¥ 22.0</u>	<u>¥ 26.2</u>	<u>¥ 27.3</u>	<u>¥ 39.5</u>	10.8%
<b>Total</b>	¥390.5	¥360.9	¥352.1	¥363.8	¥426.6	¥429.2	¥542.2	6.2%
Exchange Rate (Yen/US\$1)	¥237.0	¥238.0	¥167.0	¥144.0	¥130.0	¥134.0		

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989



# Consumption by Application Market

Table 8b

## Estimated Japanese Discrete Consumption by Application Market (Millions of Dollars)

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
<b>Data Processing</b>								
Computers	\$ 86.8	\$ 84.3	\$ 130.5	\$ 208.5	\$ 274.9	\$ 278.7	\$ 319.6	3.8%
Data Storage	65.4	66.0	128.7	162.6	242.3	229.9	249.1	0.7%
Terminals	109.3	121.4	223.6	285.8	353.3	367.2	473.7	7.6%
Input/Output	84.4	84.9	139.5	202.8	306.3	306.1	384.3	5.8%
Dedicated Systems	70.5	76.9	96.0	105.4	163.2	160.0	218.0	7.5%
Subtotal	\$ 416.3	\$ 433.5	\$ 718.5	\$ 965.1	\$1,340.0	\$1,341.9	\$1,644.7	5.3%
<b>Communications</b>								
Customer Premises	\$ 55.9	\$ 89.5	\$ 130.5	\$ 170.5	\$ 182.3	\$ 176.9	\$ 215.0	4.2%
Public Telecom.	32.9	40.3	55.7	84.0	113.3	121.6	153.9	8.0%
Radio	87.3	91.0	140.1	184.7	233.9	218.7	306.5	7.0%
Broadcast and Studio	4.9	4.7	5.6	7.9	9.2	9.0	11.6	6.0%
Subtotal	\$ 181.0	\$ 225.5	\$ 331.9	\$ 447.2	\$ 538.8	\$ 526.1	\$ 687.0	6.3%
<b>Industrial</b>								
Instrumentation	\$ 114.8	\$ 85.9	\$ 113.8	\$ 134.7	\$ 178.8	\$ 175.4	\$ 257.5	9.5%
Manufacturing Systems	42.6	37.3	50.9	43.8	59.9	58.2	94.0	11.9%
Medical	19.1	17.4	33.5	38.2	46.2	50.7	73.1	12.1%
Others	9.3	9.4	15.4	15.4	25.2	24.6	39.5	11.8%
Subtotal	\$ 185.8	\$ 149.9	\$ 213.6	\$ 232.1	\$ 310.2	\$ 309.0	\$ 464.1	10.6%
<b>Consumer</b>								
Audio	\$ 118.7	\$ 108.0	\$ 144.9	\$ 120.1	\$ 144.0	\$ 130.6	\$ 113.4	(5.8%)
Video	535.9	376.9	453.3	440.3	539.8	494.0	567.2	1.2%
Personal Electronics	24.3	28.6	33.9	44.4	56.6	49.3	74.6	7.2%
Appliances	84.8	75.3	99.4	124.3	150.7	148.5	200.0	7.3%
Subtotal	\$ 763.7	\$ 588.7	\$ 731.5	\$ 729.2	\$ 891.0	\$ 822.4	\$ 955.2	1.8%
<b>Transportation</b>	\$ 100.8	\$ 118.9	\$ 113.2	\$ 152.8	\$ 201.8	\$ 203.7	\$ 294.9	10.0%
<b>Total</b>	\$1,647.6	\$1,516.5	\$2,108.6	\$2,526.3	\$3,281.8	\$3,203.1	\$4,046.0	5.4%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 8c

**Estimated Japanese Discrete Consumption by Application Market  
(Percentage of Total)**

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>
<b>Data Processing</b>							
Computers	5.3%	5.6%	6.2%	8.3%	8.4%	8.7%	7.9%
Data Storage	4.0	4.3	6.1	6.4	7.4	7.2	6.2
Terminals	6.6	8.0	10.6	11.3	10.8	11.5	11.7
Input/Output	5.1	5.6	6.6	8.0	9.3	9.6	9.5
Dedicated Systems	<u>4.3</u>	<u>5.1</u>	<u>4.6</u>	<u>4.2</u>	<u>5.0</u>	<u>5.0</u>	<u>5.4</u>
Subtotal	25.3%	28.6%	34.1%	38.2%	40.8%	41.9%	40.7%
<b>Communications</b>							
Customer Premises	3.4%	5.9%	6.2%	6.7%	5.6%	5.5%	5.3%
Public Telecom.	2.0	2.7	2.6	3.3	3.5	3.8	3.8
Radio	5.3	6.0	6.6	7.3	7.1	6.8	7.6
Broadcast and Studio	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>
Subtotal	11.0%	14.9%	15.7%	17.7%	16.4%	16.4%	17.0%
<b>Industrial</b>							
Instrumentation	7.0%	5.7%	5.4%	5.3%	5.4%	5.5%	6.4%
Manufacturing Sys.	2.6	2.5	2.4	1.7	1.8	1.8	2.3
Medical	1.2	1.2	1.6	1.5	1.4	1.6	1.8
Others	<u>0.6</u>	<u>0.6</u>	<u>0.7</u>	<u>0.6</u>	<u>0.8</u>	<u>0.8</u>	<u>1.0</u>
Subtotal	11.3%	9.9%	10.1%	9.2%	9.5%	9.6%	11.5%
<b>Consumer</b>							
Audio	7.2%	7.1%	6.9%	4.8%	4.4%	4.1%	2.8%
Video	32.5	24.9	21.5	17.4	16.4	15.4	14.0
Personal Electronics	1.5	1.9	1.6	1.8	1.7	1.5	1.8
Appliances	<u>5.1</u>	<u>5.0</u>	<u>4.7</u>	<u>4.9</u>	<u>4.6</u>	<u>4.6</u>	<u>4.9</u>
Subtotal	46.4%	38.8%	34.7%	28.9%	27.1%	25.7%	23.6%
<b>Transportation</b>	<u>6.1%</u>	<u>7.8%</u>	<u>5.4%</u>	<u>6.0%</u>	<u>6.1%</u>	<u>6.4%</u>	<u>7.3%</u>
<b>Total</b>	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 9a

## Estimated Japanese Optoelectronic Consumption by Application Market (Billions of Yen)

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
<b>Data Processing</b>								
Computers	¥ 0.6	¥ 1.6	¥ 2.0	¥ 2.1	¥ 1.8	¥ 1.8	¥ 2.8	11.0%
Data Storage	1.7	2.2	1.7	1.6	2.0	1.9	5.7	30.4%
Terminals	2.6	2.8	2.6	3.3	4.0	4.4	9.3	23.7%
Input/Output	5.9	7.2	7.3	7.8	9.1	9.0	17.3	17.5%
Dedicated Systems	<u>8.1</u>	<u>6.6</u>	<u>9.5</u>	<u>10.2</u>	<u>12.0</u>	<u>12.1</u>	<u>20.4</u>	14.2%
Subtotal	¥ 18.9	¥ 20.4	¥ 23.1	¥ 24.9	¥ 28.8	¥ 29.2	¥ 55.5	17.8%
<b>Communications</b>								
Customer Premises	¥ 7.4	¥ 9.1	¥ 9.7	¥ 10.9	¥ 14.9	¥ 14.9	¥ 25.4	14.3%
Public Telecom.	5.7	6.1	6.3	9.3	15.1	16.5	27.6	16.2%
Radio	3.8	3.1	3.3	4.5	7.3	7.3	9.4	6.7%
Broadcast and Studio	<u>0.3</u>	<u>0.4</u>	<u>0.4</u>	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>	<u>0.3</u>	4.4%
Subtotal	¥ 17.2	¥ 18.7	¥ 19.7	¥ 25.0	¥ 37.6	¥ 39.0	¥ 62.8	13.7%
<b>Industrial</b>								
Instrumentation	¥ 7.5	¥ 8.4	¥ 7.8	¥ 7.9	¥ 10.7	¥ 11.0	¥ 15.6	9.8%
Manufacturing Systems	1.4	1.6	1.3	1.0	1.9	1.9	4.7	25.6%
Medical	1.7	2.1	2.6	2.4	3.8	4.2	5.6	9.9%
Others	<u>1.3</u>	<u>1.4</u>	<u>1.2</u>	<u>1.2</u>	<u>2.5</u>	<u>2.5</u>	<u>4.2</u>	13.6%
Subtotal	¥ 11.9	¥ 13.4	¥ 12.9	¥ 12.5	¥ 19.0	¥ 19.6	¥ 30.1	12.2%
<b>Consumer</b>								
Audio	¥ 22.7	¥ 24.4	¥ 24.5	¥ 20.0	¥ 25.3	¥ 24.8	¥ 26.8	1.4%
Video	25.8	26.7	27.0	29.1	37.0	34.2	50.4	8.0%
Personal Electronics	7.4	8.0	9.9	9.1	10.4	10.9	16.7	12.5%
Appliances	<u>6.1</u>	<u>6.5</u>	<u>8.3</u>	<u>8.5</u>	<u>9.5</u>	<u>9.3</u>	<u>17.8</u>	17.1%
Subtotal	¥ 62.0	¥ 65.6	¥ 69.7	¥ 66.7	¥ 82.3	¥ 79.2	¥ 111.8	8.0%
<b>Transportation</b>	<u>¥ 6.0</u>	<u>¥ 8.7</u>	<u>¥ 9.4</u>	<u>¥ 10.2</u>	<u>¥ 9.5</u>	<u>¥ 9.1</u>	<u>¥ 19.3</u>	19.4%
<b>Total</b>	¥115.9	¥126.8	¥134.8	¥139.4	¥177.2	¥176.0	¥279.4	12.1%
Exchange Rate (Yen/US\$1)	¥237.0	¥238.0	¥167.0	¥144.0	¥130.0	¥134.0		

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 9b

## Estimated Japanese Optoelectronic Consumption by Application Market (Millions of Dollars)

Segment	1984	1985	1986	1987	1988	1989	1992	CAGR 1988-1992
<b>Data Processing</b>								
Computers	\$ 2.5	\$ 6.7	\$ 12.0	\$ 14.7	\$ 14.0	\$ 13.4	\$ 20.6	10.2%
Data Storage	7.2	9.2	10.2	11.3	15.2	14.2	42.5	29.4%
Terminals	11.0	11.8	15.6	22.8	30.6	32.8	69.6	22.8%
Input/Output	24.9	30.3	43.7	53.9	69.7	67.2	128.9	16.6%
Dedicated Systems	<u>34.2</u>	<u>27.9</u>	<u>56.9</u>	<u>70.5</u>	<u>92.4</u>	<u>90.3</u>	<u>152.4</u>	<u>13.3%</u>
Subtotal	\$ 79.7	\$ 85.9	\$138.3	\$173.1	\$ 221.8	\$ 217.9	\$ 413.9	16.9%
<b>Communications</b>								
Customer Premises	\$ 31.2	\$ 38.2	\$ 58.1	\$ 75.3	\$ 114.5	\$ 111.2	\$ 189.9	13.5%
Public Telecom.	24.1	25.7	37.7	64.9	116.4	123.1	205.6	15.3%
Radio	16.0	13.0	19.8	31.5	56.0	54.5	70.3	5.9%
Broadcast and Studio	<u>1.1</u>	<u>1.6</u>	<u>2.1</u>	<u>2.1</u>	<u>2.2</u>	<u>2.1</u>	<u>2.6</u>	<u>3.6%</u>
Subtotal	\$ 72.4	\$ 78.5	\$117.7	\$173.8	\$ 289.1	\$ 290.9	\$ 468.3	12.8%
<b>Industrial</b>								
Instrumentation	\$ 31.6	\$ 35.3	\$ 46.7	\$ 54.6	\$ 82.5	\$ 82.1	\$ 116.5	9.0%
Manufacturing Systems	5.8	6.5	7.8	6.9	14.5	13.9	35.1	24.7%
Medical	7.3	8.7	15.6	16.7	29.2	31.3	41.4	9.1%
Others	<u>5.3</u>	<u>5.9</u>	<u>7.3</u>	<u>8.6</u>	<u>19.5</u>	<u>18.7</u>	<u>31.5</u>	<u>12.7%</u>
Subtotal	\$ 50.0	\$ 56.5	\$ 77.4	\$ 86.8	\$ 145.8	\$ 146.0	\$ 224.6	11.4%
<b>Consumer</b>								
Audio	\$ 95.8	\$102.5	\$146.7	\$138.9	\$ 194.8	\$ 185.1	\$ 200.2	0.7%
Video	108.9	112.2	161.7	202.1	284.8	255.2	376.1	7.2%
Personal Electronics	31.2	33.6	59.3	63.2	80.3	81.3	124.6	11.6%
Appliances	<u>25.5</u>	<u>27.1</u>	<u>49.7</u>	<u>59.0</u>	<u>73.0</u>	<u>69.4</u>	<u>133.1</u>	<u>16.2%</u>
Subtotal	\$261.4	\$275.4	\$417.4	\$463.2	\$ 633.0	\$ 591.0	\$ 834.0	7.1%
<b>Transportation</b>	<u>\$ 25.3</u>	<u>\$ 36.6</u>	<u>\$ 56.3</u>	<u>\$ 70.8</u>	<u>\$ 73.1</u>	<u>\$ 67.9</u>	<u>\$ 144.0</u>	<u>18.5%</u>
<b>Total</b>	\$488.9	\$532.9	\$807.0	\$967.8	\$1,362.9	\$1,313.7	\$2,084.8	11.2%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989

# Consumption by Application Market

Table 9c

## Estimated Japanese Optoelectronic Consumption by Application Market (Percentage of Total)

<u>Segment</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1992</u>
Data Processing							
Computers	0.5%	1.3%	1.5%	1.5%	1.0%	1.0%	1.0%
Data Storage	1.5	1.7	1.3	1.2	1.1	1.1	2.0
Terminals	2.2	2.2	1.9	2.4	2.2	2.5	3.3
Input/Output	5.1	5.7	5.4	5.6	5.1	5.1	6.2
Dedicated Systems	<u>7.0</u>	<u>5.2</u>	<u>7.0</u>	<u>7.3</u>	<u>6.8</u>	<u>6.9</u>	<u>7.3</u>
Subtotal	16.3%	16.1%	17.1%	17.9%	16.3%	16.6%	19.9%
Communications							
Customer Premises	6.4%	7.2%	7.2%	7.8%	8.4%	8.5%	9.1%
Public Telecom.	4.9	4.8	4.7	6.7	8.5	9.4	9.9
Radio	3.3	2.4	2.4	3.3	4.1	4.1	3.4
Broadcast and Studio	<u>0.2</u>	<u>0.3</u>	<u>0.3</u>	<u>0.2</u>	<u>0.2</u>	<u>0.2</u>	<u>0.1</u>
Subtotal	14.8%	14.7%	14.6%	18.0%	21.2%	22.1%	22.5%
Industrial							
Instrumentation	6.5%	6.6%	5.8%	5.6%	6.1%	6.2%	5.6%
Manufacturing Sys.	1.2	1.2	1.0	0.7	1.1	1.1	1.7
Medical	1.5	1.6	1.9	1.7	2.1	2.4	2.0
Others	<u>1.1</u>	<u>1.1</u>	<u>0.9</u>	<u>0.9</u>	<u>1.4</u>	<u>1.4</u>	<u>1.5</u>
Subtotal	10.2%	10.6%	9.6%	9.0%	10.7%	11.1%	10.8%
Consumer							
Audio	19.6%	19.2%	18.2%	14.4%	14.3%	14.1%	9.6%
Video	22.3	21.1	20.0	20.9	20.9	19.4	18.0
Personal Electronics	6.4	6.3	7.3	6.5	5.9	6.2	6.0
Appliances	<u>5.2</u>	<u>5.1</u>	<u>6.2</u>	<u>6.1</u>	<u>5.4</u>	<u>5.3</u>	<u>6.4</u>
Subtotal	53.5%	51.7%	51.7%	47.9%	46.4%	45.0%	40.0%
Transportation	<u>5.2%</u>	<u>6.9%</u>	<u>7.0%</u>	<u>7.3%</u>	<u>5.4%</u>	<u>5.2%</u>	<u>6.9%</u>
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
October 1989



## Data Processing

The following is a list of the material in this section:

- Semiconductor Consumption Data Processing

# Semiconductor Consumption—Data Processing

Table 1  
Japanese Semiconductor Consumption  
Data Processing—History and Forecast  
(Billions of Yen)

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
<b>Computers</b>											
General-Purpose	174.3	211.9	264.6	353.3	382.3	352.7	414.0	494.3	584.0	622.2	10.2%
Office	27.3	29.7	37.0	55.5	84.5	97.0	120.8	174.6	233.3	264.8	25.7%
Personal	72.6	80.8	89.2	135.7	225.0	261.4	294.2	367.2	515.9	591.0	21.3%
Control-Purpose	10.4	10.7	12.1	25.1	32.1	32.2	38.7	56.3	74.8	83.0	20.9%
Subtotal	284.5	333.1	402.9	569.6	723.9	743.2	867.8	1,092.3	1,408.1	1,561.0	16.6%
<b>Data Storage</b>											
Rigid Disk Drives	53.7	62.1	76.6	104.5	125.0	132.9	153.8	191.8	249.7	284.1	17.8%
Floppy Disk Drives	22.9	28.8	31.4	29.9	20.7	19.7	21.4	24.5	25.3	24.1	3.0%
Others	15.0	18.2	20.6	28.5	33.1	35.8	46.2	61.2	76.7	90.1	22.2%
Subtotal	91.5	109.2	128.6	162.9	178.8	188.3	221.4	277.5	351.6	398.2	17.4%
<b>Terminal Equipment</b>											
Terminal Equipment	108.9	120.9	144.8	187.8	206.3	219.2	254.0	301.1	338.3	363.6	12.0%
Subtotal	108.9	120.9	144.8	187.8	206.3	219.2	254.0	301.1	338.3	363.6	12.0%
<b>Input/Output Units</b>											
Printers	62.9	70.5	85.8	119.5	140.3	153.9	189.0	227.3	298.6	341.5	19.5%
Display Units	21.8	22.4	26.4	30.2	34.9	37.1	42.7	53.8	69.8	74.2	16.3%
Miscellaneous	5.2	4.9	5.1	9.4	9.3	9.1	9.9	15.9	21.3	23.0	19.9%
Subtotal	89.9	97.8	117.3	159.2	184.5	200.1	241.6	297.0	389.7	438.7	18.9%
<b>Dedicated Systems</b>											
Copying Machines	36.7	31.0	28.6	40.2	38.0	36.9	46.5	58.8	81.1	93.8	19.8%
Calculators	34.0	20.3	16.0	23.6	29.7	34.6	40.7	44.1	55.7	57.5	14.1%
Word Processors	23.6	30.8	34.8	48.0	59.3	67.5	83.3	104.7	132.2	152.7	20.8%
Typewriters	10.5	8.7	5.2	4.5	3.7	3.1	2.9	2.8	2.9	2.9	(4.5%)
Cash Registers	9.0	8.9	8.6	7.5	9.7	8.2	9.7	12.1	15.9	17.8	12.9%
Subtotal	113.8	99.7	93.2	123.7	140.4	150.2	183.1	222.5	287.7	324.9	18.3%
<b>Total Data Processing</b>	688.6	760.7	886.8	1,203.2	1,434.0	1,501.1	1,767.8	2,190.5	2,775.5	3,086.4	16.6%

Note: Columns may not add to totals shown because of rounding.  
Source: Dataquest (August 1990)

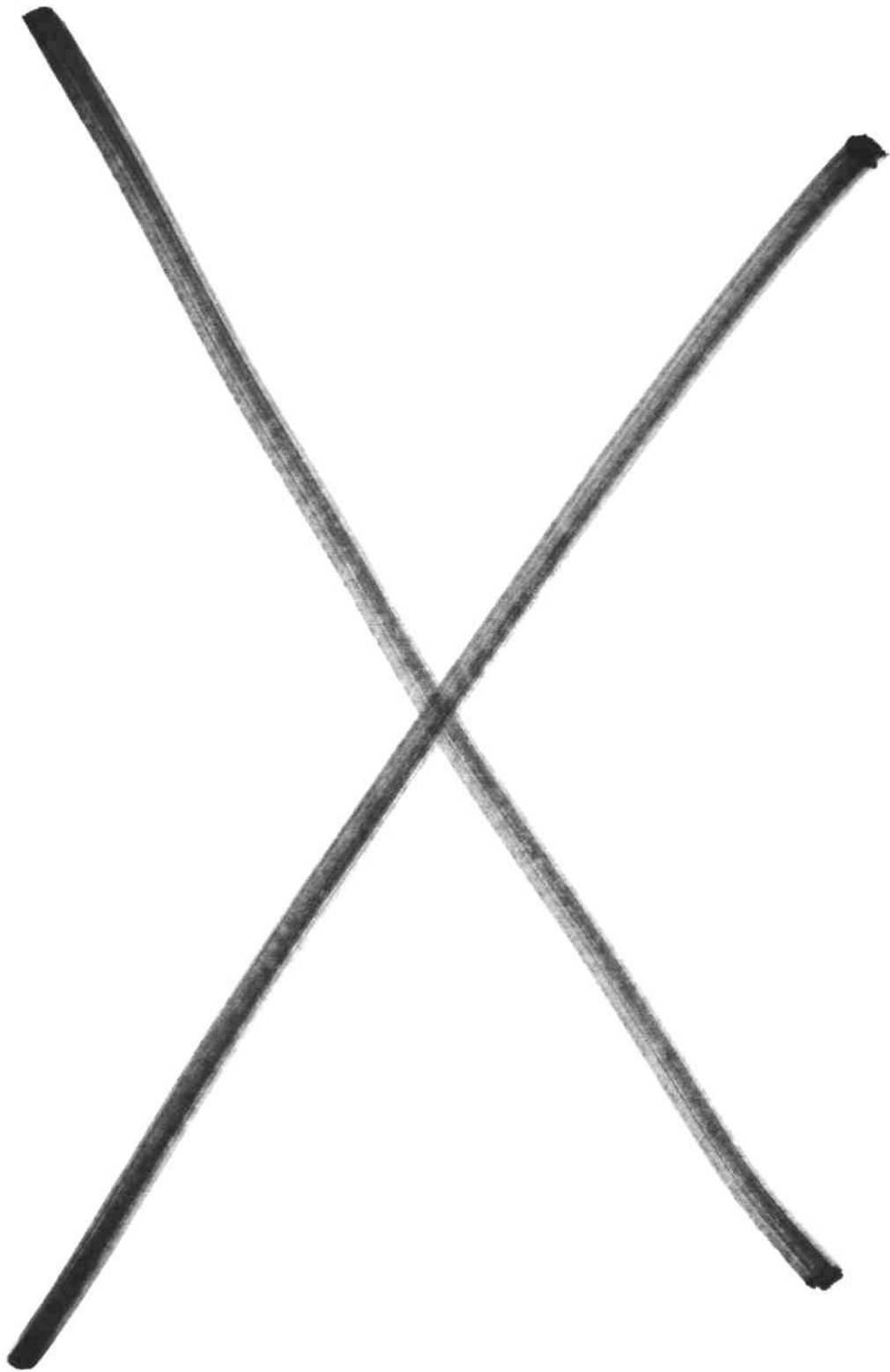


Table 2

**Japanese Semiconductor Consumption  
Data Processing—History and Forecast  
(Millions of Dollars)**

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
<b>Computers</b>											
General-Purpose	732	1,269	1,837	2,718	2,770	2,367	2,779	3,317	3,920	4,176	8.6%
Office	115	178	257	427	613	651	811	1,172	1,566	1,777	23.7%
Personal	305	484	620	1,044	1,630	1,754	1,975	2,464	3,462	3,967	19.5%
Control-Purpose	44	64	84	193	232	216	260	378	502	557	19.1%
Subtotal	1,196	1,995	2,798	4,381	5,246	4,988	5,824	7,331	9,450	10,476	14.8%
<b>Data Storage</b>											
Rigid Disk Drives	226	372	532	804	906	892	1,032	1,287	1,676	1,907	16.0%
Floppy Disk Drives	96	173	218	230	150	132	143	164	170	161	1.5%
Others	63	109	143	219	240	240	310	411	514	605	20.3%
Subtotal	385	654	893	1,253	1,296	1,264	1,486	1,862	2,360	2,673	15.6%
<b>Terminals</b>											
Terminal Equipment	458	724	1,006	1,445	1,495	1,471	1,704	2,021	2,271	2,440	10.3%
Subtotal	458	724	1,006	1,445	1,495	1,471	1,704	2,021	2,271	2,440	10.3%
<b>Input/Output Units</b>											
Printers	264	422	596	920	1,017	1,033	1,269	1,526	2,004	2,292	17.6%
Display Units	91	134	183	233	253	249	287	361	469	498	14.5%
Miscellaneous	22	29	36	72	253	61	66	107	143	154	(9.4%)
Subtotal	378	586	815	1,224	1,523	1,343	1,622	1,994	2,616	2,944	14.1%
<b>Dedicated Systems</b>											
Copying Machines	154	185	199	309	275	248	312	395	544	629	18.0%
Calculators	143	122	111	182	216	232	273	296	374	386	12.4%
Word Processors	99	184	242	369	430	453	559	702	887	1,025	19.0%
Typewriters	44	52	36	34	27	21	19	19	19	20	(5.9%)
Cash Registers	38	53	59	57	70	55	65	81	107	120	11.2%
Subtotal	478	597	647	952	1,018	1,008	1,229	1,493	1,931	2,180	16.5%
<b>Total Data Processing</b>	<b>2,893</b>	<b>4,555</b>	<b>6,159</b>	<b>9,256</b>	<b>10,577</b>	<b>10,075</b>	<b>11,865</b>	<b>14,701</b>	<b>18,628</b>	<b>20,714</b>	<b>14.4%</b>

Note: Columns may not add to totals shown because of rounding.  
Source: Dataquest (August 1990)



# Communications

The following is a list of the material in this section:

- Semiconductor Consumption Communications

Table 1

**Japanese Semiconductor Consumption  
Communications—History and Forecast  
(Billions of Yen)**

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
<b>Customer Premises</b>											
Telephones	10.5	10.6	14.6	23.5	32.6	40.2	49.7	56.5	71.7	78.3	19.1%
Standard Telephone	5.3	4.2	5.0	4.4	3.7	3.1	2.9	2.5	2.4	2.1	(10.6%)
Multifunction	3.0	3.7	6.2	8.8	11.0	12.8	16.4	18.6	24.2	26.2	18.9%
Cordless	NA	NA	NA	6.8	13.2	19.6	25.1	29.9	38.1	42.8	26.6%
Others	2.2	2.7	3.4	3.6	4.7	4.8	5.3	5.6	7.0	7.1	8.5%
Applied Telephones	7.4	8.2	7.6	6.0	6.8	7.1	7.0	8.0	9.4	9.0	5.9%
Facsimiles	31.6	33.6	46.0	67.1	78.5	80.7	95.6	125.7	168.8	192.9	19.7%
PBX Telephone Systems	14.4	18.4	23.0	25.8	27.4	28.8	33.8	42.1	47.2	50.7	13.1%
Key Telephone Systems	30.7	27.9	21.1	20.4	21.4	20.4	21.6	26.4	30.5	32.0	8.4%
Modems	8.3	8.2	13.3	16.3	14.3	14.8	15.7	17.6	18.9	16.6	3.0%
Subtotal	103.0	106.8	125.6	159.1	180.9	192.0	223.5	276.3	346.5	379.5	16.0%
<b>Public Telecom.</b>											
Carrier Transmission	24.2	23.8	33.4	49.5	60.5	61.8	66.2	75.3	93.2	97.0	9.9%
Central Office Switch	19.3	19.0	25.8	37.8	43.3	46.6	55.6	67.4	78.5	85.0	14.5%
Subtotal	43.5	42.8	59.2	87.3	103.7	108.3	121.8	142.7	171.7	182.0	11.9%
<b>Radio</b>											
Radio Communication	51.0	52.4	64.5	85.6	97.1	106.0	125.9	152.2	199.8	230.9	18.9%
Applied Radio Equipment	24.3	29.4	34.8	45.9	48.9	54.4	61.8	76.9	85.0	88.3	12.5%
Subtotal	75.3	81.9	99.3	131.5	146.0	160.4	187.7	229.1	284.8	319.1	16.9%
<b>Broadcast and Studio</b>											
Broadcasting	6.9	6.0	5.9	7.0	8.0	10.0	11.0	16.9	22.9	25.0	25.7%
Subtotal	6.9	6.0	5.9	7.0	8.0	10.0	11.0	16.9	22.9	25.0	25.7%
<b>Total Communications</b>	228.8	237.4	290.0	384.8	438.6	470.7	543.9	665.0	825.8	905.7	15.6%

NA = Not available

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (August 1990)

Table 2

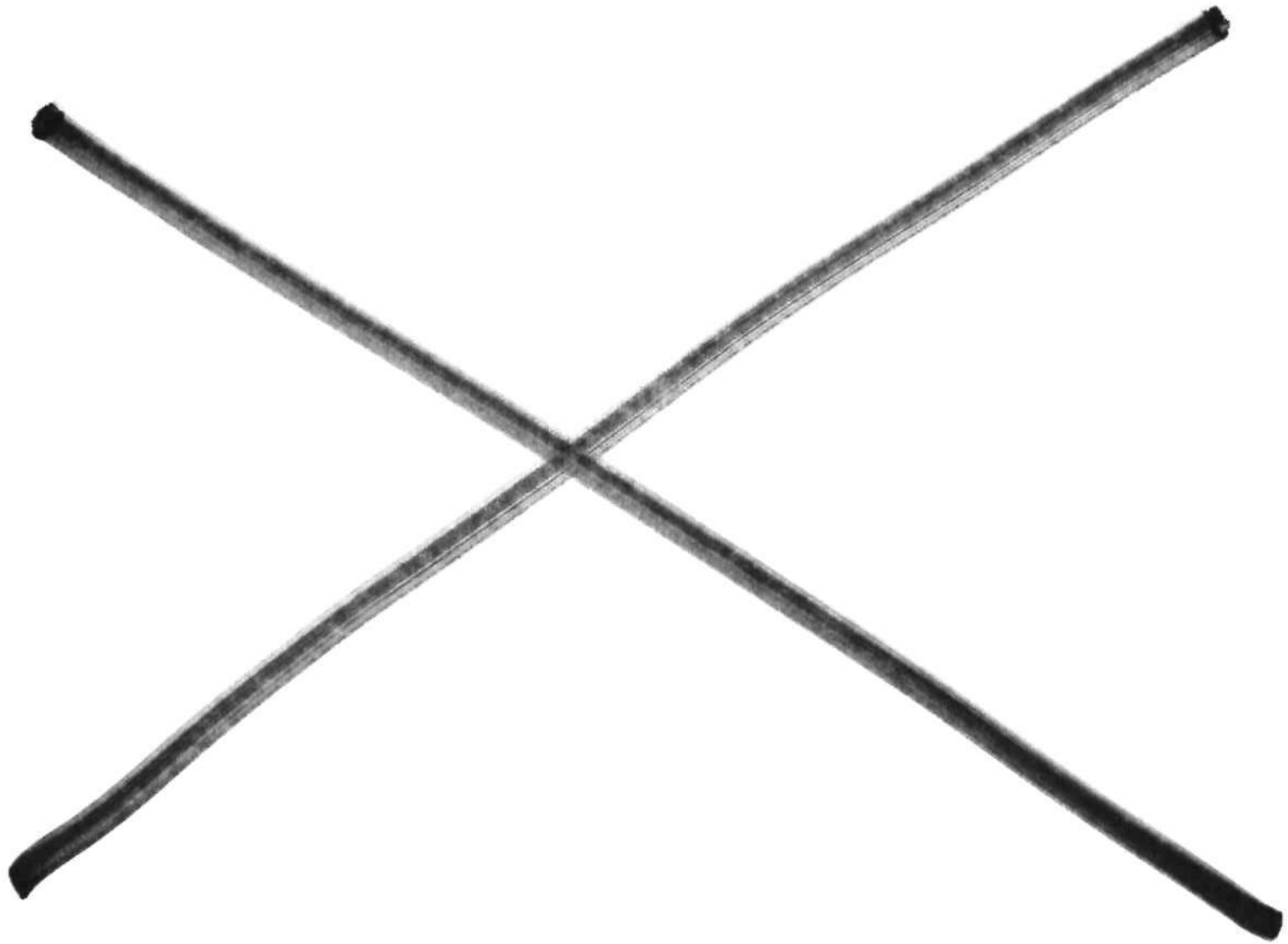
**Japanese Semiconductor Consumption  
Communications—History and Forecast  
(Millions of Dollars)**

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
<b>Customer Premises</b>											
Telephones	44	63	101	181	236	270	333	379	481	525	17.3%
Standard Telephone	22	25	35	34	27	21	19	17	16	14	(12.0%)
Multifunction	13	22	43	68	80	86	110	125	163	176	17.1%
Cordless	NA	NA	NA	52	95	131	169	201	256	287	24.7%
Other	9	16	24	27	34	32	35	37	47	48	6.9%
Telephones Applied	31	49	53	46	49	47	47	54	63	61	4.3%
Facsimiles	133	201	319	516	569	541	642	844	1,133	1,294	17.9%
PBX Telephone Systems	61	110	160	198	198	193	227	282	317	340	11.4%
Key Telephone Systems	129	167	147	157	155	137	145	177	205	215	6.7%
Modems	35	49	92	125	104	99	105	118	127	112	1.5%
Subtotal	477	703	974	1,405	1,547	1,558	1,833	2,234	2,807	3,072	14.7%
<b>Public Telecom.</b>											
Carrier Transmission	102	142	232	381	438	414	444	505	625	651	8.2%
Central Office Switch	81	114	179	290	314	313	373	452	527	571	12.7%
Subtotal	183	256	411	671	752	727	817	958	1,152	1,222	10.2%
<b>Radio</b>											
Radio Communication	214	314	448	658	704	712	845	1,021	1,341	1,550	17.1%
Applied Radio Equipment	102	176	241	353	354	365	415	516	570	592	10.8%
Subtotal	316	490	689	1,011	1,058	1,077	1,260	1,538	1,911	2,142	15.2%
<b>Broadcast and Studio</b>											
Broadcasting	29	36	41	54	58	67	74	114	153	168	23.7%
Subtotal	29	36	41	54	58	67	74	114	153	168	23.7%
<b>Total Communications</b>	<b>1,005</b>	<b>1,485</b>	<b>2,115</b>	<b>3,141</b>	<b>3,415</b>	<b>3,429</b>	<b>3,984</b>	<b>4,843</b>	<b>6,023</b>	<b>6,603</b>	<b>14.1%</b>

NA = Not available

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (August 1990)



## Industrial

The following is a list of the material in this section:

- Semiconductor Consumption Industrial

Table 1

**Japanese Semiconductor Consumption  
Industrial—History and Forecast  
(Billions of Yen)**

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
<b>Instruments</b>											
Meter Units	5.6	6.0	6.2	7.8	8.2	7.8	8.6	9.0	11.8	12.6	9.1%
Measuring Instruments	59.9	48.4	51.8	69.5	85.5	89.9	107.9	138.0	168.5	179.3	16.0%
Industrial Meters	34.3	34.2	36.0	48.0	56.9	59.3	68.7	76.7	97.6	112.2	14.6%
Subtotal	99.9	88.6	94.0	125.3	150.5	157.0	185.2	223.8	277.9	304.1	15.1%
<b>Manufacturing Systems</b>											
NC Machines	33.8	29.3	28.2	37.9	47.8	52.6	63.4	75.1	102.7	109.8	18.1%
Robotics	7.2	6.2	6.7	10.5	13.0	13.2	17.6	23.6	29.9	35.2	22.0%
Subtotal	41.0	35.5	35.0	48.4	60.8	65.8	80.9	98.7	132.6	144.9	19.0%
<b>Medical</b>											
X-Ray Systems	8.6	9.0	10.6	14.0	18.3	21.0	25.5	31.7	41.0	47.7	21.0%
Measuring Systems	2.6	2.4	2.8	3.6	3.6	3.8	4.5	5.1	6.3	7.3	14.9%
Others	10.8	12.7	16.1	19.6	24.8	27.8	34.9	44.4	60.0	69.3	22.8%
Subtotal	22.0	24.1	29.5	37.2	46.7	52.6	64.8	81.2	107.3	124.2	21.6%
<b>Others</b>											
Vending Machines	6.4	5.0	6.3	8.8	11.5	12.2	15.6	20.2	25.5	31.4	22.3%
Flight Simulators	0.8	0.3	0.4	0.7	0.2	0.6	0.9	0.9	1.1	1.2	50.2%
Television Equip.	3.0	6.2	6.0	8.9	11.1	12.2	15.7	18.3	21.7	24.3	16.9%
Electron Microscopes	2.3	1.9	1.7	1.8	2.5	3.0	3.5	4.6	5.5	6.0	19.4%
Miscellaneous	1.8	0.9	0.8	1.4	2.6	3.0	3.9	6.1	8.1	11.4	34.5%
Subtotal	14.4	14.4	15.2	21.7	27.8	31.0	39.6	50.0	61.9	74.3	21.7%
<b>Total Industrial</b>	<b>177.2</b>	<b>162.6</b>	<b>173.6</b>	<b>232.5</b>	<b>285.9</b>	<b>306.3</b>	<b>370.6</b>	<b>453.6</b>	<b>579.6</b>	<b>647.5</b>	<b>17.8%</b>

Note: Columns may not add to totals shown because of rounding.  
Source: Dataquest (August 1990)

Semiconductor Consumption—Industrial



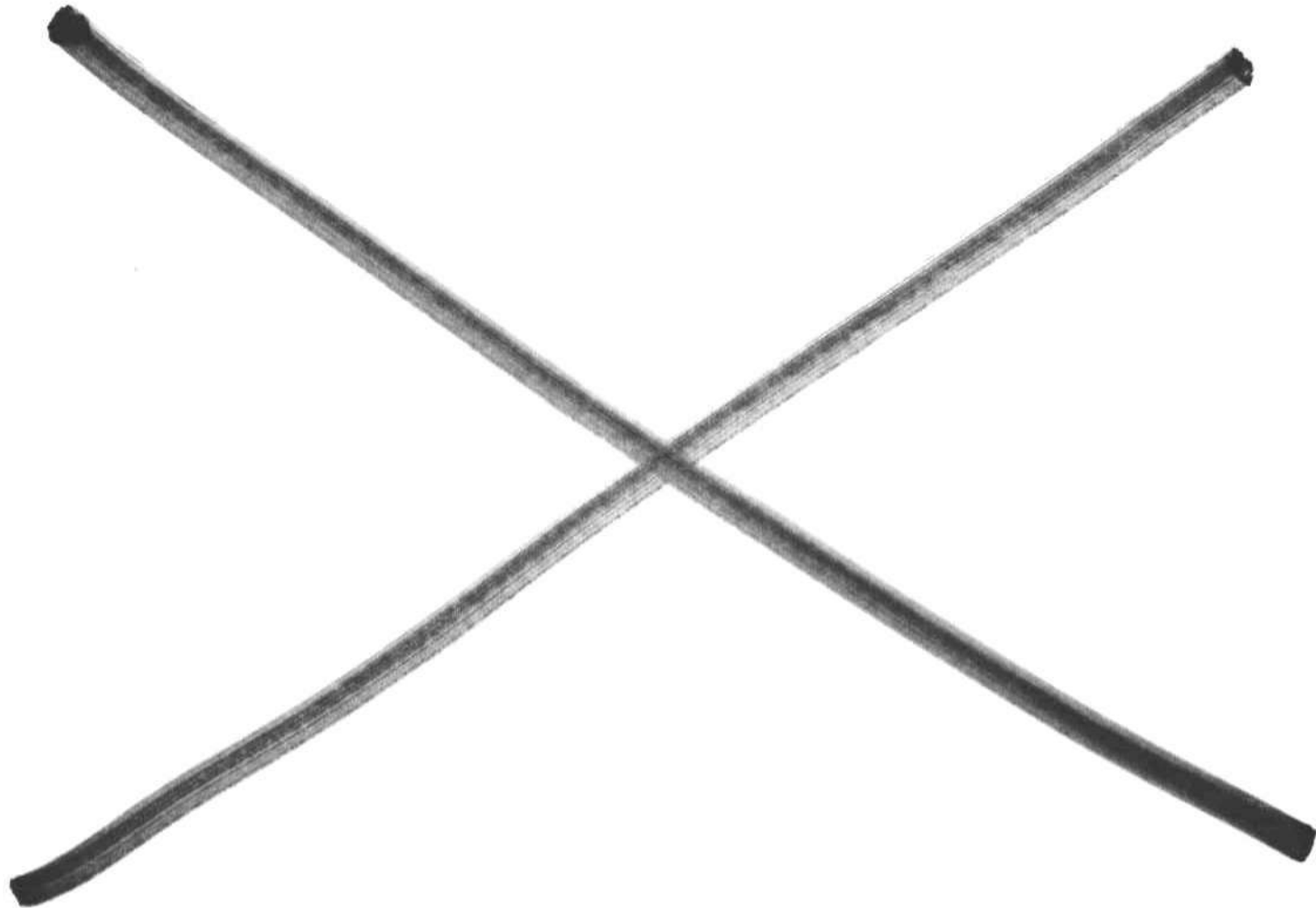
Table 2

**Japanese Semiconductor Consumption  
Industrial—History and Forecast  
(Millions of Dollars)**

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
<b>Instruments</b>											
Meter Units	24	36	43	60	59	52	57	60	79	85	7.4%
Measuring Instruments	252	290	359	534	619	604	724	926	1,131	1,203	14.2%
Industrial Meters	144	205	250	369	412	398	461	515	655	753	12.8%
Subtotal	420	530	653	964	1,091	1,054	1,243	1,502	1,865	2,041	13.3%
<b>Manufacturing Systems</b>											
NC Machines	142	176	196	291	346	353	425	504	689	737	16.3%
Robotics	30	37	47	81	94	89	118	159	200	236	20.2%
Subtotal	172	213	243	372	441	441	543	662	890	973	17.2%
<b>Medical</b>											
X-Ray Systems	36	54	74	108	133	141	171	213	275	320	19.2%
Measuring Systems	11	14	20	28	26	25	30	34	42	49	13.2%
Others	45	76	112	150	179	186	234	298	403	465	21.0%
Subtotal	92	144	205	286	339	353	435	545	720	833	19.7%
<b>Others</b>											
Vending Machines	27	30	44	68	83	82	105	135	171	210	20.4%
Flight Simulators	3	2	3	6	1	4	6	6	7	8	47.9%
Television Equip.	13	37	42	69	81	82	106	123	146	163	15.1%
Electron Microscopes	10	11	12	14	18	20	23	31	37	40	17.6%
Miscellaneous	7	6	5	11	19	20	26	41	54	77	32.5%
Subtotal	60	86	105	167	202	208	266	336	415	499	19.9%
<b>Total Industrial</b>	<b>744</b>	<b>974</b>	<b>1,206</b>	<b>1,789</b>	<b>2,071</b>	<b>2,056</b>	<b>2,487</b>	<b>3,045</b>	<b>3,890</b>	<b>4,346</b>	<b>16.0%</b>

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (August 1990)



## Consumer

The following is a list of the material in this section:

- Semiconductor Consumption Consumer

Table 1  
Japanese Semiconductor Consumption  
Consumer—History and Forecast  
(Billions of Yen)

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
<b>Audio</b>											
Audio Amplifiers	18.3	14.4	14.5	15.9	16.6	16.7	20.7	23.5	24.0	23.6	7.2%
DAT Players	47.0	62.1	51.2	58.1	49.1	44.9	39.6	36.4	34.6	32.1	(8.1%)
Radios	4.1	3.8	3.0	3.3	3.7	4.2	4.0	4.1	3.8	3.6	(0.9%)
Stereo Sets	12.0	18.6	18.6	21.8	27.9	31.4	34.4	43.9	45.2	42.7	8.9%
Tape Recorders	61.8	39.1	31.1	42.7	45.2	47.3	51.4	58.4	57.6	56.0	4.4%
Headphone Stereos	9.9	11.1	9.5	10.6	14.4	15.3	17.9	24.1	23.3	22.5	9.4%
Subtotal	153.0	149.0	127.9	152.4	156.9	159.7	167.9	190.4	188.4	180.6	2.9%
<b>Video</b>											
VCRs	262.6	238.9	195.2	203.6	213.2	223.1	233.5	268.3	296.1	301.0	7.1%
Video Camera	61.3	74.3	89.8	125.1	120.7	128.0	154.3	188.8	235.3	255.2	16.1%
Videodisc Players	8.0	7.7	8.1	13.9	18.8	21.7	26.1	32.2	40.1	44.3	18.7%
Color TVs	113.0	93.4	104.0	117.2	122.7	124.2	142.6	162.5	201.7	214.7	11.8%
B&W TVs	1.3	1.0	0.4	0.1	0.1	0	0	0	0	0	(100.0%)
LCD TVs	NA	3.3	2.4	3.1	3.6	4.0	4.8	5.9	8.5	10.1	22.8%
Subtotal	446.2	418.6	399.9	463.0	479.0	501.1	561.3	657.8	781.7	825.2	11.5%
<b>Personal Electronics</b>											
Cameras	19.9	21.4	21.2	19.8	20.3	25.2	26.8	28.3	34.0	39.8	14.4%
Sewing Machines	1.5	1.3	1.4	1.3	1.1	1.2	1.2	1.0	1.1	1.1	0.3%
Watches	20.7	17.9	15.1	16.5	16.0	16.6	17.2	19.3	24.4	23.3	7.7%
Clocks	6.0	6.1	5.9	6.1	6.0	6.7	7.0	7.2	8.0	7.9	5.7%
Musical Instruments	10.4	10.1	13.5	16.3	15.0	17.2	18.6	19.8	19.2	19.7	5.6%
Electric Toys	9.8	14.0	13.0	22.4	30.0	30.6	38.8	47.6	68.4	74.2	19.9%
Subtotal	68.3	70.8	70.1	82.4	88.3	97.6	109.6	123.2	155.1	165.9	13.4%

(Continued)

Table 1 (Continued)

**Japanese Semiconductor Consumption  
Consumer—History and Forecast  
(Billions of Yen)**

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
<b>Appliances</b>											
Air Conditioners	26.5	28.7	32.9	37.7	37.3	39.9	47.2	56.0	66.2	75.1	15.0%
Microwave Ovens	8.3	8.4	8.9	7.3	6.5	5.6	5.6	5.3	5.4	5.4	(3.7%)
Rice Cookers	3.4	3.8	3.4	3.5	3.8	4.0	5.0	5.5	5.8	5.7	8.5%
Fans	0.1	0.1	0.4	0.4	0.3	0.3	0.4	0.3	0.4	0.3	(0.3%)
Fan Heaters	0.3	0.5	0.6	0.7	1.0	1.3	1.6	1.7	2.3	2.5	20.1%
Washing Machines	3.5	3.5	4.3	4.6	4.8	5.5	6.0	7.1	9.4	9.6	14.7%
Refrigerators	10.4	10.3	13.1	12.8	12.2	13.0	14.8	17.9	22.6	22.7	13.1%
Subtotal	52.6	55.3	63.6	67.0	65.9	69.7	80.5	93.8	112.0	121.2	12.9%
Total Consumer	720.1	693.8	661.5	764.7	790.2	828.2	919.4	1,065.2	1,237.3	1,292.8	10.3%

NA = Not available

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (August 1990)

Table 2

**Japanese Semiconductor Consumption  
Consumer—History and Forecast  
(Millions of Dollars)**

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
<b>Audio</b>											
Audio Amplifiers	77	86	101	122	120	112	139	158	161	158	5.6%
DAT Players	197	372	355	447	356	301	266	244	232	216	(9.5%)
Radios	17	23	21	25	27	28	27	27	26	24	(2.4%)
Stereo Sets	50	111	129	168	202	211	231	295	303	287	7.2%
Tape Recorders	260	234	216	329	327	317	345	392	387	376	2.8%
Headphone Stereos	41	66	66	82	104	103	120	162	156	151	7.7%
Subtotal	643	892	888	1,172	1,137	1,072	1,127	1,278	1,265	1,212	1.3%
<b>Video</b>											
VCRs	1,103	1,431	1,355	1,566	1,545	1,498	1,567	1,800	1,988	2,020	5.5%
Video Cameras	258	445	624	963	875	859	1,035	1,267	1,579	1,713	14.4%
Videodisc Players	33	46	56	107	136	146	175	216	269	297	16.9%
Color TVs	475	559	723	902	889	834	957	1,091	1,354	1,441	10.1%
B&W TVs	6	6	3	1	0	0	0	0	0	0	(100.0%)
LCD TVs	NA	20	17	24	26	27	32	40	57	68	20.9%
Subtotal	1,875	2,506	2,777	3,562	3,471	3,363	3,767	4,414	5,247	5,538	9.8%
<b>Personal Electronics</b>											
Cameras	83	128	147	152	147	169	180	190	228	267	12.7%
Sewing Machines	6	8	10	10	8	8	8	7	7	7	(1.2%)
Watches	87	107	105	127	116	111	116	129	164	156	6.1%
Clocks	25	37	41	47	43	45	47	48	54	53	4.1%
Musical Instruments	44	61	94	126	109	116	125	133	129	132	4.0%
Electric Toy	41	84	90	173	217	205	260	319	459	498	18.0%
Subtotal	246	340	396	461	423	450	475	507	582	615	7.8%

(Continued)

**Table 2 (Continued)**  
**Japanese Semiconductor Consumption**  
**Consumer—History and Forecast**  
**(Millions of Dollars)**

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
<b>Appliances</b>											
Air Conditioners	111	172	229	290	270	268	316	376	444	504	13.3%
Microwave Ovens	35	50	62	56	47	37	38	35	36	36	(5.1%)
Rice Cookers	14	23	23	27	28	27	33	37	39	38	6.8%
Fans	0	1	3	3	2	2	3	2	2	2	(1.9%)
Fan Heaters	1	3	4	5	7	9	11	11	16	17	18.3%
Washing Machines	15	21	30	35	35	37	40	48	63	64	12.9%
Refrigerators	44	62	91	98	89	88	99	120	152	152	11.4%
Subtotal	221	331	442	515	478	468	540	630	752	813	11.2%
Total Consumer	2,985	4,070	4,503	5,710	5,509	5,353	5,910	6,829	7,845	8,179	8.2%

NA = Not available

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest (August 1990)







# Transportation

The following is a list of the material in this section:

- Semiconductor Consumption Transporation

Table 1

**Japanese Semiconductor Consumption  
Transportation—History and Forecast  
(Billions of Yen)**

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
Transportation											
Entertainment	22.6	21.5	24.2	23.0	22.8	22.9	24.7	26.9	31.0	31.4	6.6%
Body Control	12.4	14.6	11.7	11.0	11.2	12.0	14.8	17.3	21.3	23.4	15.7%
Power Train	21.8	24.8	34.3	44.4	61.1	68.6	80.0	102.6	125.7	137.5	17.6%
Safety and Convenience	27.3	26.7	29.5	30.5	31.5	33.8	38.5	44.9	55.0	61.5	14.3%
Driver Information	7.3	7.2	7.7	7.2	7.3	7.8	8.8	10.8	13.7	15.2	15.8%
Total Transportation	91.3	94.7	107.4	116.1	133.9	145.0	166.7	202.5	246.7	268.9	15.0%

Note: Columns may not add to totals shown because of rounding.  
Source: Dataquest (August 1990)

Table 2

**Japanese Semiconductor Consumption  
Transportation—History and Forecast  
(Millions of Dollars)**

Equipment Type	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
Transportation											
Entertainment	95	129	168	177	165	154	165	181	208	211	5.0%
Body Control	52	88	81	85	82	80	99	116	143	157	14.0%
Power Train	92	148	238	342	443	460	537	689	844	923	15.8%
Safety and Convenience	115	160	205	235	228	227	258	301	369	412	12.6%
Driver Information	31	43	53	55	53	53	59	72	92	102	14.1%
Total Transportation	384	567	746	893	970	973	1,119	1,359	1,655	1,805	13.2%

Note: Columns may not add to totals shown because of rounding.  
Source: Dataquest (August 1990)



## Semiconductor Consumption

The following is a list of the material in this section:

→ • Semiconductor Consumption

NOTE: The arrow symbol indicates the latest document(s) correct location behind the subject tab.

# Semiconductor Consumption

## INTRODUCTION

Semiconductor consumption data comprise a set of detailed tables that estimate the size of the semiconductor total available market (TAM) worldwide and for four major geographical regions for the years 1978 through 1993 and 1998. Semiconductor consumption tables contain both historical data and forecasts. Historical data begin with 1978 and end with 1987, while forecast data provide annual market size estimates for 1988 through 1993, with additional estimates for 1998. Below is a list of tables detailing the type of data, region, time period, and units of measure.

## LIST OF TABLES

<u>Table</u>	<u>Region Covered</u>	<u>Years</u>	<u>Units</u>
0	Foreign Exchange Rates	1970-1988	Various
1a	Worldwide Semiconductor Consumption	1983-1988	Dollars
1b	Worldwide Semiconductor Consumption	1989-1993, 1998	Dollars
1c	Worldwide Semiconductor Consumption	1983-1988	Percent
1d	Worldwide Semiconductor Consumption	1988-1993	Percent
2a	Worldwide Average Selling Prices	1983-1988	Dollars
2b	Worldwide Average Selling Prices	1989-1993, 1998	Dollars
2c	Worldwide Average Selling Prices	1983-1988	Percent
2d	Worldwide Average Selling Prices	1989-1993	Percent
3a	Worldwide Semiconductor Consumption	1983-1988	Units
3b	Worldwide Semiconductor Consumption	1989-1993, 1998	Units
3c	Worldwide Semiconductor Consumption	1983-1988	Percent
3d	Worldwide Semiconductor Consumption	1988-1993	Percent
4a	Japanese Semiconductor Consumption	1983-1988	Yen
4b	Japanese Semiconductor Consumption	1989-1993, 1998	Yen
4c	Japanese Semiconductor Consumption	1983-1988	Percent
4d	Japanese Semiconductor Consumption	1988-1993	Percent
5a	Japanese Semiconductor Consumption	1983-1988	Units
5b	Japanese Semiconductor Consumption	1988-1993, 1998	Units
5c	Japanese Semiconductor Consumption	1983-1988	Percent
5d	Japanese Semiconductor Consumption	1989-1993	Percent

Each table gives estimates of semiconductor consumption listed by the major semiconductor device product categories. In these tables, semiconductor components are divided into three major product groups: integrated circuits, discrete devices, and optoelectronic devices. These groups are divided into a number of subgroups, some of which are segmented further.

# Semiconductor Consumption

## DEFINITIONS AND CONVENTIONS

Dataquest uses a common manufacturer base for all data tables. This base includes all suppliers to the merchant semiconductor market. It excludes captive suppliers that manufacture devices solely for the benefit of the parent company, such as AT&T, Burroughs, Delco, and IBM. Included, however, are companies that actively market semiconductor devices to the merchant market as well as to other divisions of their own companies. For such companies, both external shipments and internal consumption are included. Devices that are used internally are valued at current market prices.

**Consumption**—Dataquest defines consumption as the purchase of a semiconductor device or devices. This definition must be differentiated from actual use of the device in a final product. Devices that are inventoried at the user level are considered consumption according to our definition. The terms consumption and market size are used interchangeably. Thus, a regional market includes all devices sold to or shipped to that region, i.e., the total available market (TAM) in that region.

**Hybrids**—In earlier consumption data, hybrid devices were included as a separate segment of integrated circuits. However, since hybrid devices are primarily a special packaging arrangement, this segment has been omitted. Hybrid devices manufactured by semiconductor companies are now included in the most appropriate product segment, usually the analog segment.

The manufacturer base, product group definitions, and guidelines for including value of output that we have used in our tables may differ from those used in other studies of this type. Our base is nearly the same as that used by the World Semiconductor Trade Statistics program (WSTS), with the following exceptions:

- Dataquest includes all of AT&T's semiconductor revenue, both merchant and captive.
- Dataquest includes—and has included all along—nonrecurring engineering (NRE) charges associated with application-specific integrated circuit (ASIC) revenue. (This applies to both the bipolar digital and MOS digital logic categories.)
- Dataquest includes the revenue generated by sales of standalone circuit design software, sold by certain U.S. manufacturers of ASIC logic devices.
- Dataquest includes Signetics revenue with that of its parent company, Netherlands-based N.V. Philips.
- Dataquest includes revenue for Taiwanese semiconductor manufacturers.



# Semiconductor Consumption

- Dataquest includes revenue for three Japanese companies not estimated by WSTS: NBM Semiconductor, Seiko Epson, and Yamaha.
- As noted herein, Dataquest includes hybrid revenue in the analog category.

Further information on the above points is available through Dataquest's Client Inquiry Center, at (408) 437-8099.

**Regions**—North America is defined as including both the United States and Canada. Latin America, including Mexico, is considered part of the Rest of World (ROW) category. The ROW region also includes Asia-Pacific (Korea, Taiwan, Hong Kong, Singapore, and China). Western Europe includes Austria, Belgium, the Federal Republic of Germany, France, Italy, Luxembourg, the Scandinavian countries (Denmark, Finland, Norway, Sweden), Spain, and the United Kingdom. Japan, the fourth region, is the only single-country region.

## **DATA SOURCES**

The information presented in the consumption data has been consolidated from a variety of sources, each of which focuses on a specific part of the market. These sources include the following:

- World Semiconductor Trade Statistics (WSTS) data, and Dataquest's estimates of regional company sales are used to determine North American consumption.
- Japanese trade statistics compiled and published by the Ministry of Finance (MOF) and the Ministry of International Trade and Industry (MITI), WSTS data, and Dataquest's estimates of regional company sales are used to determine Japanese consumption.
- For Western European markets, marketing statistics from WSTS data and Dataquest's estimates of regional company sales are used to determine consumption.
- In ROW, the major published sources used to estimate consumption are WSTS data and Dataquest's estimates of company shipments into the region.

Dataquest believes that the estimates presented here are the most accurate and meaningful generally available today. The sources of the data and the guidelines for the forecasts presented in the tables are:

- Unit sales or revenue (or both) published by major industry participants, both in the United States and abroad
- Estimates presented by knowledgeable and reliable industry spokesmen

# Semiconductor Consumption

- Government data or trade association data such as those from the Electronics Industry Association (EIA), MITI, WSTS, and the U.S. Department of Commerce
- Published product literature and price lists
- Interviews with knowledgeable manufacturers, distributors, and users
- Relevant projected world economic data

## **ACCURACY**

The tables presented here represent Dataquest estimates that we believe are reasonably accurate. Where we have no reasonable estimate, none is given. A blank space in a table indicates that a reasonably accurate estimate is unavailable, and a zero in a table represents an estimate.

## **VALUATION OF CONSUMPTION**

Regional consumption is expressed in U.S. dollars (with Japanese consumption and shipments also expressed in yen). To make the tables in this study useful in comparing different regions, it is necessary to express all values in a common currency, and we chose the U.S. dollar for convenience.

However, the choice of the U.S. dollar (or any single currency, for that matter) as the currency basis for the tables brings with it some problems that require the readers' careful consideration in interpreting the data.

## **Inflation**

All countries that participate significantly in international semiconductor markets suffered from an overall price inflation in the 1970s, continuing into the 1980s.

As a consequence, the dollar in a given year is not truly comparable with the dollar in any preceding year. Consumer and wholesale price indices and GNP deflators all measure price changes in various composite "market baskets" of goods. However, there is no price index that measures price changes of material, equipment, and labor inputs to the semiconductor industry. Indeed, the "mix" is changing so rapidly that what is used this year was sometimes unavailable last year, at any price. Nor is there a composite price index that measures price changes in aggregate semiconductor product. In an industry noted for its deflationary trends, this latter effect would tend to make the component purchaser's dollar worth more as time passed, in terms of purchasing ability.

# Semiconductor Consumption

We have made no adjustments in the historical data to account for these inflationary and deflationary effects. The data are expressed in current dollars (dollars that include the inflation rate and exchange rates of the given year) for all historical data; comparisons between different years must be interpreted accordingly.

## **Average Selling Prices**

When considering the worldwide average selling prices (ASPs) for semiconductor components, one must look at the price per function of a circuit, the complexity of the circuit, and the product mix according to this increasing complexity. It is true that one characteristic of the semiconductor industry is that the price per function for integrated circuits has been dropping an average of 30 percent per year for the last 15 years. At the same time, circuits have become denser, resulting in an overall increase in the price of a device with a decreasing cost per function. Thus, Tables 5a through 5d show the worldwide ASPs increasing after many years of decreasing, due to the move toward higher-complexity devices. There are also regional differences in ASPs due to regional competition differences and the varying regional product consumption mix. The worldwide ASP is truly an aggregate measure and may differ significantly from ASPs in any specific market at any point in time.

## **Exchange Rates**

Construction of the West European tables involves combining data from many countries, each of which has different and changing exchange rates. Dataquest uses Annual Foreign Exchange Rates for each year as published by The International Monetary Fund. As far as possible, we prepare our estimates in terms of local currencies before conversion to U.S. dollars. The exchange rates for major currencies can be found in Table 0 at the end of this introduction.

Japanese consumption is based on MITI data, originally expressed in yen. The Japanese data published in this study are expressed in both dollars (Tables 3a and 3b) and in yen (Tables 4a and 4b). The yen/dollar exchange rate used for each year can be found in Table 0. Because of the fluctuations in the exchange rate for the yen, the dollar values given tend to distort the growth rate of the Japanese market, but they do provide a useful basis for regional market size comparisons. However, the data in yen give a better picture of the real growth in the Japanese market.

## **FORECAST**

As mentioned previously, historical data are expressed in current dollars or dollars that include the given year's inflation rate and exchange rates. However, the consumption forecasts use constant dollars and exchange rates, with no allowance for inflation or variations in the rates of exchange between countries. All estimates for 1988 and beyond are made as if 1988 monetary conditions will continue through 1998 and, therefore, show the absolute year-to-year growth during this period.

# Semiconductor Consumption

Table 0

## Foreign Exchange Rates (In U.S. Dollars)

Year	Yrly/ Qtrly	Japan (Yen per US\$)	France (US\$ per Franc)	West Germany (US\$ per Deutsche Mark)	United Kingdom (US\$ per Pound Sterling)	European Basket ECU (1980 = 100)
1970	Yr.	358	\$0.18	\$0.27	\$2.38	N/A
1971	Yr.	343	\$0.18	\$0.29	\$2.44	N/A
1972	Yr.	302	\$0.20	\$0.31	\$2.50	N/A
1973	Yr.	269	\$0.22	\$0.37	\$2.44	N/A
1974	Yr.	292	\$0.21	\$0.39	\$2.33	N/A
1975	Yr.	297	\$0.23	\$0.41	\$2.22	N/A
1976	Yr.	296	\$0.21	\$0.40	\$1.82	N/A
1977	Yr.	269	\$0.20	\$0.43	\$1.75	N/A
1978	Yr.	210	\$0.22	\$0.50	\$1.92	N/A
1979	Yr.	219	\$0.24	\$0.55	\$2.13	N/A
1980	Yr.	227	\$0.24	\$0.55	\$2.33	100
1981	Yr.	221	\$0.18	\$0.44	\$2.04	124
1982	Yr.	248	\$0.15	\$0.41	\$1.75	141
1983	Yr.	235	\$0.13	\$0.39	\$1.52	158
1984	Yr.	237	\$0.11	\$0.35	\$1.33	178
1985	Yr.	238	\$0.11	\$0.34	\$1.30	185
1986	Yr.	167	\$0.14	\$0.46	\$1.47	146
1987	Yr.	144	\$0.17	\$0.56	\$1.64	126
1988	Yr.	130	\$0.17	\$0.57	\$1.79	121

N/A = Not Available

Source: The International Monetary Fund  
Financial Times  
Dataquest  
July 1989

# Semiconductor Consumption

Table 1a

## Worldwide Semiconductor Consumption (Millions of Dollars)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Total Semiconductor	19,537	28,903	24,357	30,834	38,278	50,486
Total IC	14,700	22,686	18,555	23,618	29,904	40,800
Bipolar Digital	3,015	4,771	3,672	4,325	4,762	5,197
Memory	603	774	589	606	621	670
Logic	2,412	3,997	3,083	3,719	4,141	4,527
MOS Digital	7,951	12,970	10,122	12,815	17,488	26,780
Memory	3,719	6,229	3,821	4,511	6,081	11,571
Micro	1,979	3,234	2,748	3,489	5,099	7,127
Logic	2,253	3,507	3,553	4,815	6,308	8,082
Analog	3,734	4,945	4,761	6,478	7,654	8,823
Total Discrete	3,865	4,987	4,576	5,730	6,665	7,543
Total Optoelectronic	972	1,230	1,226	1,486	1,709	2,143

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 1b

## Worldwide Semiconductor Consumption (Millions of Dollars)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1998</u>
Total Semiconductor	58,204	57,890	67,460	83,034	109,360	238,431
Total IC	47,679	47,152	55,515	69,427	93,767	215,083
Bipolar Digital	4,582	4,394	4,654	5,085	5,623	6,535
Memory	601	565	553	512	494	400
Logic	3,981	3,829	4,101	4,573	5,129	6,135
MOS Digital	33,486	32,761	39,226	50,303	71,093	179,730
Memory	16,962	15,582	18,383	23,550	36,561	105,074
Micro	7,526	8,115	9,870	12,835	16,801	38,002
Logic	8,998	9,064	10,973	13,918	17,731	36,654
Analog	9,611	9,997	11,635	14,039	17,051	28,818
Total Discrete	8,064	8,180	9,060	10,266	11,677	16,635
Total Optoelectronic	2,461	2,558	2,885	3,341	3,916	6,713

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 1c

## Worldwide Semiconductor Consumption (Percent Change)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Total Semiconductor	28.0%	47.9%	(15.7%)	26.6%	24.1%	31.9%
Total IC	34.9%	54.3%	(18.2%)	27.3%	26.6%	36.4%
Bipolar Digital	25.0%	58.2%	(23.0%)	17.8%	10.1%	9.1%
Memory	18.0%	28.4%	(23.9%)	2.9%	2.5%	7.9%
Logic	26.9%	65.7%	(22.9%)	20.6%	11.3%	9.3%
MOS Digital	40.9%	63.1%	(22.0%)	26.6%	36.5%	53.1%
Memory	37.7%	67.5%	(38.7%)	18.1%	34.8%	90.3%
Micro	50.2%	63.4%	(15.0%)	27.0%	46.1%	39.8%
Logic	38.8%	55.7%	1.3%	35.5%	31.0%	28.1%
Analog	31.5%	32.4%	(3.7%)	36.1%	18.2%	15.3%
Total Discrete	9.0%	29.0%	(8.2%)	25.2%	16.3%	13.2%
Total Optoelectronic	18.5%	26.5%	(0.3%)	21.2%	15.0%	25.4%

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 1d

## Worldwide Semiconductor Consumption (Percent Change)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Total Semiconductor	15.3%	(0.5%)	16.5%	23.1%	31.7%
Total IC	16.9%	(1.1%)	17.7%	25.1%	35.1%
Bipolar Digital	(11.8%)	(4.1%)	5.9%	9.3%	10.6%
Memory	(10.3%)	(6.0%)	(2.1%)	(7.4%)	(3.5%)
Logic	(12.1%)	(3.8%)	7.1%	11.5%	12.2%
MOS Digital	25.0%	(2.2%)	19.7%	28.2%	41.3%
Memory	46.6%	(8.1%)	18.0%	28.1%	55.2%
Micro	5.6%	7.8%	21.6%	30.0%	30.9%
Logic	11.3%	0.7%	21.1%	26.8%	27.4%
Analog	8.9%	4.0%	16.4%	20.7%	21.5%
Total Discrete	6.9%	1.4%	10.8%	13.3%	13.7%
Total Optoelectronic	14.8%	3.9%	12.8%	15.8%	17.2%

Source: Dataquest  
July 1989



# Semiconductor Consumption

Table 2a  
Worldwide Average Selling Prices  
(Dollars)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Total Semiconductor	0.32	0.36	0.30	0.34	0.33	0.42
Total IC	1.03	1.10	1.05	1.09	1.18	1.39
Bipolar Digital Memory Logic	0.65	0.65	0.71	0.71	0.69	0.70
MOS Digital	1.66	1.95	1.64	1.63	1.94	2.36
Memory	2.79	3.90	2.59	2.41	3.09	4.70
Micro	3.35	3.53	3.14	3.13	3.56	4.15
Logic	0.79	0.85	0.93	0.99	1.12	1.13
Analog	0.76	0.75	0.76	0.84	0.82	0.84
Total Discrete	0.09	0.09	0.08	0.09	0.08	0.09
Total Optoelectronic	0.28	0.28	0.22	0.25	0.28	0.34

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 2b

Worldwide Average Selling Prices  
(Dollars)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1998</u>
Total Semiconductor	0.42	0.41	0.47	0.50	0.57	0.81
Total IC	1.54	1.47	1.54	1.64	1.83	2.31
Bipolar Digital	0.70	0.69	0.70	0.72	0.70	0.69
Memory						
Logic						
MOS Digital	2.62	2.44	2.54	2.69	3.08	3.59
Memory	6.25	5.51	5.95	6.83	8.79	8.53
Micro	4.12	4.10	4.10	4.12	4.18	4.15
Logic	1.09	1.05	1.10	1.15	1.19	1.28
Analog	0.83	0.82	0.84	0.84	0.85	0.86
Total Discrete	0.08	0.08	0.09	0.09	0.09	0.09
Total Optoelectronic	0.34	0.34	0.36	0.38	0.38	0.40

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 2c

Worldwide Average Selling Prices  
(Percent Change in Dollars)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Total Semiconductor	(3.0%)	11.8%	(15.7%)	13.2%	(2.7%)	26.7%
Total IC	3.1%	7.5%	(4.4%)	3.5%	8.5%	17.8%
Bipolar Digital	4.8%	0	9.2%	0	(2.8%)	1.4%
Memory						
Logic						
MOS Digital	2.2%	17.3%	(16.0%)	(0.5%)	18.6%	22.1%
Memory	6.5%	39.8%	(33.6%)	(6.9%)	28.2%	52.1%
Micro	2.8%	5.4%	(11.0%)	(0.3%)	13.7%	16.6%
Logic	(1.3%)	7.6%	9.4%	6.5%	13.1%	0.9%
Analog	(3.8%)	(1.3%)	1.3%	10.5%	(2.4%)	2.4%
Total Discrete	(18.2%)	0	(11.1%)	15.0%	(13.0%)	12.5%
Total Optoelectronic	(3.4%)	0	(21.4%)	13.6%	12.0%	21.4%

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 2d

Worldwide Average Selling Prices  
(Percent Change in Dollars)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Total Semiconductor	(1.0%)	(2.5%)	14.2%	7.7%	13.9%
Total IC	10.6%	(4.4%)	4.7%	6.0%	12.0%
Bipolar Digital	0	(1.4%)	1.4%	2.9%	(2.8%)
Memory					
Logic					
MOS Digital	10.7%	(6.9%)	4.0%	6.3%	14.3%
Memory	33.0%	(11.8%)	8.0%	14.8%	28.7%
Micro	(0.7%)	(0.5%)	0	0.5%	1.5%
Logic	(3.5%)	(3.7%)	4.8%	4.5%	3.5%
Analog	(1.2%)	(1.2%)	2.4%	0	1.2%
Total Discrete	(11.1%)	0	12.5%	0	0
Total Optoelectronic	0	0	5.9%	5.6%	0

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 3a

## Worldwide Semiconductor Consumption (Millions of Units)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Total Semiconductor	60,743	80,377	80,380	89,881	114,684	119,373
Total IC	14,327	20,573	17,607	21,654	25,268	29,259
Bipolar Digital	4,638	7,340	5,172	6,092	6,901	7,424
Memory						
Logic						
MOS Digital	4,776	6,639	6,171	7,850	9,032	11,331
Memory	1,333	1,597	1,475	1,872	1,968	2,462
Micro	591	916	875	1,115	1,432	1,717
Logic	2,852	4,126	3,820	4,864	5,632	7,152
Analog	4,913	6,593	6,264	7,712	9,334	10,504
Total Discrete	42,944	55,411	57,200	62,283	83,313	83,811
Total Optoelectronic	3,471	4,393	5,573	5,944	6,104	6,303

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 3b

## Worldwide Semiconductor Consumption (Millions of Units)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1998</u>
Total Semiconductor	138,959	141,773	144,653	165,301	191,222	294,708
Total IC	30,921	31,999	35,972	42,442	51,172	93,092
Bipolar Digital	6,546	6,368	6,649	7,063	8,033	9,471
Memory						
Logic						
MOS Digital	12,796	13,440	15,472	18,666	23,079	50,111
Memory	2,714	2,828	3,090	3,448	4,159	12,318
Micro	1,827	1,979	2,407	3,115	4,019	9,157
Logic	8,255	8,632	9,975	12,103	14,900	28,636
Analog	11,580	12,191	13,851	16,713	20,060	33,509
Total Discrete	100,800	102,250	100,667	114,067	129,744	184,833
Total Optoelectronic	7,238	7,524	8,014	8,792	10,305	16,783

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 3c

## Worldwide Semiconductor Consumption (Percent Change in Units)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Total Semiconductor	32%	32%	0	12%	28%	4%
Total IC	31%	44%	(14%)	23%	17%	16%
Bipolar Digital Memory Logic	19%	58%	(30%)	18%	13%	8%
MOS Digital	38%	39%	(7%)	27%	15%	25%
Memory	29%	20%	(8%)	27%	5%	25%
Micro	46%	55%	(4%)	27%	28%	20%
Logic	41%	45%	(7%)	27%	16%	27%
Analog	37%	34%	(5%)	23%	21%	13%
Total Discrete	33%	29%	3%	9%	34%	1%
Total Optoelectronic	23%	27%	27%	7%	3%	3%

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 3d

## Worldwide Semiconductor Consumption (Percent Change in Units)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Total Semiconductor	16%	2%	2%	14%	16%
Total IC	6%	3%	12%	18%	21%
Bipolar Digital	(12%)	(3%)	4%	6%	14%
Memory					
Logic					
MOS Digital	13%	5%	15%	21%	24%
Memory	10%	4%	9%	12%	21%
Micro	6%	8%	22%	29%	29%
Logic	15%	5%	16%	21%	23%
Analog	10%	5%	14%	21%	20%
Total Discrete	20%	1%	(2%)	13%	14%
Total Optoelectronic	15%	4%	7%	10%	17%

Source: Dataquest  
July 1989



# Semiconductor Consumption

Table 4a

## Japanese Semiconductor Consumption (Millions of Dollars)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Total Semiconductor	5,722	8,774	8,149	11,855	14,992	20,332
Total IC	4,167	6,517	5,985	8,802	11,318	15,748
Bipolar Digital	706	955	824	1,295	1,563	1,849
Memory	109	163	136	169	227	318
Logic	597	792	688	1,126	1,336	1,531
MOS Digital	1,948	3,621	3,232	4,762	6,430	10,185
Memory	893	1,579	1,185	1,738	2,268	4,204
Micro	594	979	884	1,368	1,902	2,585
Logic	461	1,063	1,163	1,656	2,260	3,396
Analog	1,513	1,941	1,929	2,745	3,325	3,714
Total Discrete	1,217	1,756	1,621	2,242	2,703	3,202
Total Optoelectronic	338	501	543	811	971	1,382

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 4b

## Japanese Semiconductor Consumption (Millions of Dollars)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1998</u>
Total Semiconductor	23,366	23,060	26,656	31,931	42,548	88,145
Total IC	18,301	18,045	21,016	25,512	35,088	77,080
Bipolar Digital	1,774	1,708	1,788	1,942	2,179	2,424
Memory	305	297	287	261	248	185
Logic	1,469	1,411	1,501	1,681	1,931	2,239
MOS Digital	12,551	12,254	14,533	18,096	26,427	64,355
Memory	5,823	5,445	6,316	7,895	13,027	36,675
Micro	2,875	2,972	3,540	4,354	5,747	11,813
Logic	3,853	3,837	4,677	5,847	7,653	15,867
Analog	3,976	4,083	4,695	5,474	6,482	10,301
Total Discrete	3,436	3,350	3,742	4,236	4,906	6,564
Total Optoelectronic	1,629	1,665	1,898	2,183	2,554	4,501

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 4c

## Japanese Semiconductor Consumption (Percent Change in Dollars)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Total Semiconductor	40.2%	53.3%	(7.1%)	45.5%	26.5%	35.6%
Total IC	46.0%	56.4%	(8.2%)	47.1%	28.6%	39.1%
Bipolar Digital	41.8%	35.3%	(13.7%)	57.2%	20.7%	18.3%
Memory	25.3%	49.5%	(16.6%)	24.3%	34.3%	40.1%
Logic	45.3%	32.7%	(13.1%)	63.7%	18.7%	14.6%
MOS Digital	54.2%	85.9%	(10.7%)	47.3%	35.0%	58.4%
Memory	67.2%	76.8%	(25.0%)	46.7%	30.5%	85.4%
Micro	33.2%	64.8%	(9.7%)	54.8%	39.0%	35.9%
Logic	62.9%	130.6%	9.4%	42.4%	36.5%	50.3%
Analog	38.3%	28.3%	(0.6%)	42.3%	21.1%	11.7%
Total Discrete	25.5%	44.3%	(7.7%)	38.3%	20.6%	18.5%
Total Optoelectronic	31.5%	48.2%	8.4%	49.4%	19.7%	42.3%

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 4d

## Japanese Semiconductor Consumption (Percent Change in Dollars)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Total Semiconductor	14.9%	(1.3%)	15.6%	19.8%	33.2%
Total IC	16.2%	(1.4%)	16.5%	21.4%	37.5%
Bipolar Digital	(4.1%)	(3.7%)	4.7%	8.6%	12.2%
Memory	(4.1%)	(2.6%)	(3.4%)	(9.1%)	(5.0%)
Logic	(4.0%)	(3.9%)	6.4%	12.0%	14.9%
MOS Digital	23.2%	(2.4%)	18.6%	24.5%	46.0%
Memory	38.5%	(6.5%)	16.0%	25.0%	65.0%
Micro	11.2%	3.4%	19.1%	23.0%	32.0%
Logic	13.5%	(0.4%)	21.9%	25.0%	30.9%
Analog	7.1%	2.7%	15.0%	16.6%	18.4%
Total Discrete	7.3%	(2.5%)	11.7%	13.2%	15.8%
Total Optoelectronic	17.9%	2.2%	14.0%	15.0%	17.0%

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 5a

## Japanese Semiconductor Consumption (Billions of Yen)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Total Semiconductor	1,344.7	2,079.3	1,939.4	1,979.7	2,158.8	2,643.2
Total IC	979.3	1,544.4	1,424.4	1,469.9	1,629.8	2,047.2
Bipolar Digital	165.9	226.3	196.1	216.2	225.1	240.3
Memory	25.6	38.6	32.4	28.2	32.7	41.3
Logic	140.3	187.7	163.7	188.0	192.4	199.0
MOS Digital	457.8	858.1	769.2	795.3	925.9	1,324.1
Memory	209.9	374.2	282.0	290.2	326.6	546.5
Micro	139.6	232.0	210.4	228.5	273.9	336.1
Logic	108.3	251.9	276.8	276.6	325.4	441.5
Analog	355.6	460.0	459.1	458.4	478.8	482.8
Total Discrete	286.0	416.2	385.8	374.4	389.2	416.3
Total Optoelectronic	79.4	118.7	129.2	135.4	139.8	179.7
Exchange Rate Yen/\$	235	237	238	167	144	130

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 5b

## Japanese Semiconductor Consumption (Billions of Yen)

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>	<u>1998</u>
Total Semiconductor	2,990.7	2,951.6	3,411.9	4,087.2	5,446.2	11,282.6
Total IC	2,342.4	2,309.7	2,690.0	3,265.6	4,491.3	9,866.3
Bipolar Digital	227.0	218.6	228.8	248.6	278.9	310.3
Memory	39.0	38.0	36.7	33.4	31.7	23.7
Logic	188.0	180.6	192.1	215.2	247.2	286.6
MOS Digital	1,606.5	1,568.5	1,860.2	2,316.3	3,382.7	8,237.5
Memory	745.3	697.0	808.4	1,010.6	1,667.5	4,694.4
Micro	368.0	380.4	453.1	557.3	735.6	1,512.1
Logic	493.2	491.1	598.7	748.4	979.6	2,031.0
Analog	508.9	522.6	601.0	700.7	829.7	1,318.5
Total Discrete	439.8	428.8	479.0	542.2	628.0	840.2
Total Optoelectronic	208.5	213.1	242.9	279.4	326.9	576.1
Exchange Rate Yen/\$	128	128	128	128	128	128

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 5c

## Japanese Semiconductor Consumption (Percent Change in Yen)

	<u>1983</u>	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>1987</u>	<u>1988</u>
Total Semiconductor	32.8%	54.6%	(6.7%)	2.1%	9.0%	22.4%
Total IC	38.3%	57.7%	(7.8%)	3.2%	10.9%	25.6%
Bipolar Digital	34.3%	36.4%	(13.3%)	10.2%	4.1%	6.8%
Memory	18.5%	50.8%	(16.1%)	(13.0%)	16.0%	26.3%
Logic	37.7%	33.8%	(12.8%)	14.8%	2.3%	3.4%
MOS Digital	46.2%	87.4%	(10.4%)	3.4%	16.4%	43.0%
Memory	58.5%	78.3%	(24.6%)	2.9%	12.5%	67.3%
Micro	26.2%	66.2%	(9.3%)	8.6%	19.9%	22.7%
Logic	54.3%	132.6%	9.9%	(0.1%)	17.6%	35.7%
Analog	31.1%	29.4%	(0.2%)	(0.2%)	4.5%	0.8%
Total Discrete	18.9%	45.5%	(7.3%)	(3.0%)	4.0%	7.0%
Total Optoelectronic	24.6%	49.5%	8.8%	4.8%	3.2%	28.5%

Source: Dataquest  
July 1989

# Semiconductor Consumption

Table 5d

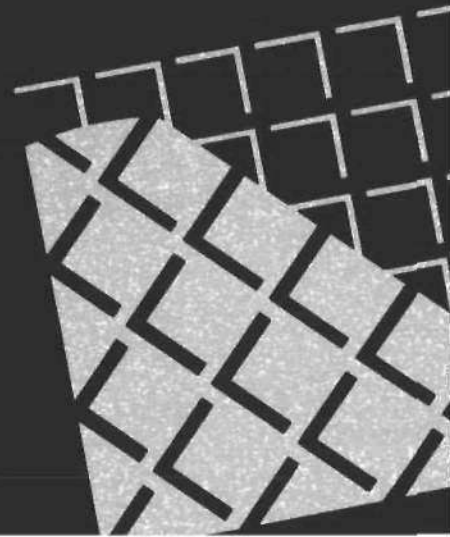
## Japanese Semiconductor Consumption (Percent Change in Yen)

	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Total Semiconductor	22.4%	13.1%	(1.3%)	15.6%	19.8%	33.3%
Total IC	25.6%	14.4%	(1.4%)	16.5%	21.4%	37.5%
Bipolar Digital	6.8%	(5.5%)	(3.7%)	4.7%	8.7%	12.2%
Memory	26.3%	(5.6%)	(2.6%)	(3.4%)	(9.0%)	(5.1%)
Logic	3.4%	(5.5%)	(3.9%)	6.4%	12.0%	14.9%
MOS Digital	43.0%	21.3%	(2.4%)	18.6%	24.5%	46.0%
Memory	67.3%	36.4%	(6.5%)	16.0%	25.0%	65.0%
Micro	22.7%	9.5%	3.4%	19.1%	23.0%	32.0%
Logic	35.7%	11.7%	(0.4%)	21.9%	25.0%	30.9%
Analog	0.8%	5.4%	2.7%	15.0%	16.6%	18.4%
Total Discrete	7.0%	5.6%	(2.5%)	11.7%	13.2%	15.8%
Total Optoelectronic	28.5%	16.0%	2.2%	14.0%	15.0%	17.0%

Source: Dataquest  
July 1989



# Revenue and Forecast



# Semiconductor Revenue and Shipment Forecast

*October 1990*

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**Dataquest**

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October 1990

# Semiconductor Revenue and Shipment Forecast

## Introduction

Semiconductor revenue and shipment data comprise a set of detailed tables that estimate the size of the semiconductor total available market (TAM) worldwide and for four major geographical regions for the years 1980 through 1995 and 2000. Semiconductor revenue and shipment tables contain both historical data and forecasts. Historical data begin with 1980 and end with 1989, while forecast data provide annual market size

estimates for 1990 through 1995, with additional estimates for 2000. Below is a list of tables detailing the type of data, region, time period, and units of measure.

Each table gives estimates of semiconductor revenue or shipments listed by the major semiconductor device product categories. In these tables, semiconductor components are divided into three major product groups: integrated circuits, discrete devices, and optoelectronic devices. These groups are divided into a number of subgroups, some of which are segmented further.

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(Continued)

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Table	Region Covered	Years	Units
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## Definitions and Conventions

Dataquest uses a common manufacturer base for all data tables. This base includes all suppliers to the merchant semiconductor market. It includes aggregate revenue estimates for North American companies that manufacture devices solely for the benefit of the parent company, such as Burroughs, Delco, and IBM. Also included are companies that actively market semiconductor devices to the merchant market as well as to other divisions of their own companies. For such companies, both external and internal shipments are included. Devices that are used internally are valued at current market prices.

**Shipment**—Dataquest defines shipment as the purchase of a semiconductor device or devices. This definition must be differentiated from actual use of the device in a final product. A regional market size includes all devices sold to or shipped to that region, i.e., the total available market (TAM) in that region.

**Hybrids**—In earlier consumption data, hybrid devices were included as a separate segment of integrated circuits. Hybrid devices manufactured by semiconductor companies are now included in the most appropriate product segment, usually the analog segment.

The manufacturer base, product group definitions, and guidelines for including value of output that we have used in our tables may differ from those used in other studies of this type. Our base is nearly the same as that used by the World Semiconductor Trade Statistics (WSTS) program, with the following exceptions:

- Dataquest includes all of AT&T's semiconductor revenue, both merchant and captive.
  - Dataquest includes—and has included all along—nonrecurring engineering (NRE) charges associated with application-specific integrated circuit (ASIC) revenue. (This applies to both the bipolar digital and MOS digital logic categories.)
  - Dataquest includes the revenue generated by sales of standalone circuit design software, sold by certain US manufacturers of ASIC logic devices.
  - Dataquest includes Signetics revenue with that of its parent company, Netherlands-based N.V. Philips.
  - Dataquest includes revenue for Taiwanese semiconductor manufacturers.
  - Dataquest includes revenue for three Japanese companies not estimated by WSTS: NMB Semiconductor, Seiko-Epson, and Yamaha.
- As noted herein, Dataquest includes hybrid revenue in the analog category.

Further information on the above points is available through Dataquest's Client Inquiry Center at (408) 437-8099.

**Regions**—North America is defined as including both the United States and Canada. Latin America, including Mexico, is considered part of the Asia/Pacific-ROW category. Asia/Pacific includes South Korea, Taiwan, Hong Kong, Singapore, China, India, and the countries of Oceania. Western Europe includes Austria, Belgium, the Federal Republic of Germany, France, Italy, Luxembourg, the Netherlands, the Scandinavian countries (Denmark, Finland, Norway, Sweden), Spain, the United Kingdom and Ireland, and the rest of Europe. As a result of the union of West Germany and East Germany in 1990, henceforth the unified Germany will be included in Western Europe. Japan, the fourth region, is the only single-country region.

## Data Sources

The historical information presented in the revenue and shipment data has been consolidated from a variety of sources, each of which focuses on a specific part of the market. These sources include the following:

- World Semiconductor Trade Statistics (WSTS) data and Dataquest's estimates of regional company sales are used to determine sales to North America.
- Japanese trade statistics compiled and published by the Ministry of Finance (MOF) and the Ministry of International Trade and Industry (MITI), WSTS data, and Dataquest's estimates of regional company sales are used to determine sales to Japan.
- For Western European markets, WSTS data and Dataquest's estimates of regional company sales are used to determine market size.
- In Asia/Pacific-ROW, the major sources used to estimate market size are WSTS data and Dataquest's estimates of company sales into the region.

Dataquest believes that the estimates presented here are the most accurate and meaningful generally available today. The sources of the data and the guidelines for the forecasts presented in the tables are as follows:

- Unit shipments or revenue (or both) published by major industry participants, both in the United States and abroad

- Estimates presented by knowledgeable and reliable industry spokespersons
- Government data or trade association data such as those from the Electronics Industry Association (EIA), MITI, WSTS, and the U.S. Department of Commerce
- Published product literature and price lists
- Interviews with knowledgeable manufacturers, distributors, and users
- Relevant projected world economic data

## Accuracy

The tables presented here represent Dataquest estimates that we believe are reasonably accurate. Where we have no reasonable estimate, none is given. A zero in a table represents an estimate.

## Valuation of Shipments

Regional market size is expressed in US dollars (with the Japanese market also expressed in yen). To make the tables in this study useful in comparing different regions, it is necessary to express all values in a common currency, and we chose the US dollar for convenience. However, the choice of the US dollar (or any single currency, for that matter) as the currency basis for the tables brings with it some problems that require the readers' careful consideration in interpreting the data.

## Inflation

All countries that participate significantly in international semiconductor markets suffered from an overall price inflation in the 1970s, continuing into the 1980s and 1990s. As a consequence, the dollar in a given year is not truly comparable with the dollar in any preceding year. Consumer and wholesale price indexes and GNP deflators all measure price changes in various composite "market baskets" of goods. However, there is no price index that measures price changes of material, equipment, and labor inputs to the semiconductor industry. Indeed, the "mix" is changing so rapidly that what is used this year was sometimes unavailable last year, at any price. Nor is there a composite price index that measures price changes in aggregate semiconductor product. In an industry noted for its deflationary trends, this latter effect would tend to make the component purchaser's dollar worth more as time passed, in terms of purchasing ability.

We have made no adjustments in the historical data to account for these inflationary and deflationary effects. The data are expressed in current dollars (dollars that include the inflation rate and exchange rates of the given year) for all historical data; comparisons between different years must be interpreted accordingly.

## Average Selling Prices

When considering the worldwide average selling prices (ASPs) for semiconductor components, one must look at the price per function of a circuit, the complexity of the circuit, and the product mix according to this increasing complexity. It is true that one characteristic of the semiconductor industry is that the price per function for integrated circuits has been dropping an average of 30 percent per year for the last 15 years. At the same time, circuits have become denser, resulting in an overall increase in the price of a device with a decreasing cost per function. Thus, Tables 7a through 7g show the worldwide ASPs increasing after many years of decreasing, due to the move toward higher-complexity devices. There are also regional differences in ASPs due to regional competition differences and the varying regional product consumption mix. The worldwide ASP is truly an aggregate measure and may differ significantly from ASPs in any specific market at any point in time.

## Exchange Rates

Construction of the West European tables involves combining data from many countries, each of which has different and changing exchange rates. Dataquest uses Annual Foreign Exchange Rates for each year as published by The International Monetary Fund. As far as possible, we prepare our estimates in terms of local currencies before conversion to US dollars. The exchange rates for major currencies can be found in Table 0 at the end of this introduction.

Japanese market size is originally expressed in yen. The Japanese data published in this study are expressed in both dollars (Tables 3a through 3g) and in yen (Tables 4a through 4g). The yen/dollar exchange rate used for each year can be found in Table 0. Because of the fluctuations in the exchange rate for the yen, the dollar values given tend to distort the growth rate of the Japanese market, but they do provide a useful basis for regional market size comparisons. However, the data in yen give a better picture of the real growth in the Japanese market.

## Forecast

As mentioned previously, historical data are expressed in current dollars or dollars that include the given year's inflation rate and exchange rates. However, the revenue forecasts use constant dollars and exchange rates, with

no allowance for inflation or variations in the rates of exchange between countries. All estimates for 1990 and beyond are made as if 1990 monetary conditions will continue through 2000 and, therefore, show the absolute year-to-year growth during this period.

Table 0

### Japan and Western Europe Exchange Rates (In US Dollars)

Year	Yrly/Qtrly	Japan (Yen per US\$)	France (US\$ per Franc)	West Germany (US\$ per Deutsche Mark)	United Kingdom (US\$ per Pound Sterling)
1970	YR	358	0.18	0.27	2.38
1971	YR	343	0.18	0.29	2.44
1972	YR	302	0.20	0.31	2.50
1973	YR	269	0.22	0.37	2.44
1974	YR	292	0.21	0.39	2.33
1975	YR	297	0.23	0.41	2.22
1976	YR	296	0.21	0.40	1.82
1977	YR	269	0.20	0.43	1.75
1978	YR	210	0.22	0.50	1.92
1979	YR	219	0.24	0.55	2.13
1980	YR	227	0.24	0.55	2.33
1981	YR	221	0.18	0.44	2.04
1982	YR	248	0.15	0.41	1.75
1983	YR	235	0.13	0.39	1.52
1984	YR	237	0.11	0.35	1.33
1985	YR	238	0.11	0.34	1.30
1986	YR	167	0.14	0.46	1.47
1987	YR	144	0.17	0.56	1.64
1988	YR	130	0.17	0.57	1.79
1989	YR	138	0.16	0.53	1.50

Source: The International Monetary Fund, Financial Times, Dataquest (October 1990)



Table 1a

**Worldwide Semiconductor Market**  
(Millions of Dollars)

	1980	1981	1982	1983	1984
Total Including Captives	14,118	14,828	15,261	21,552	31,325
North American Captives	NA	NA	NA	2,015	2,500
Total Semiconductor	14,118	14,828	15,261	19,537	28,825
Total IC	9,546	10,046	10,894	14,700	22,618
Bipolar Digital	2,374	2,337	2,412	3,015	4,783
Memory	572	558	511	603	774
Logic	1,802	1,779	1,901	2,412	4,009
MOS Digital	4,715	4,822	5,642	7,951	12,947
Memory	2,230	2,075	2,701	3,719	6,225
Micro	862	1,085	1,318	1,979	3,229
Logic	1,623	1,662	1,623	2,253	3,493
Analog	2,457	2,887	2,840	3,734	4,888
Total Discrete	3,883	3,985	3,547	3,865	4,986
Total Optoelectronic	689	797	820	972	1,221

NA = Not available  
Source: Dataquest (October 1990)

Table 1b

**Worldwide Semiconductor Market**  
(Percent Change)

	1980	1981	1982	1983	1984
Total Including Captives	NA	NA	NA	NA	45.3
North American Captives	NA	NA	NA	NA	24.1
Total Semiconductor	27.0	5.0	2.9	28.0	47.5
Total IC	35.8	5.2	8.4	34.9	53.9
Bipolar Digital	41.8	(1.6)	3.2	25.0	58.6
Memory	76.5	(2.4)	(8.4)	18.0	28.4
Logic	33.5	(1.3)	6.9	26.9	66.2
MOS Digital	40.9	2.3	17.0	40.9	62.8
Memory	33.1	(7.0)	30.2	37.7	67.4
Micro	59.3	25.9	21.5	50.2	63.2
Logic	43.8	2.4	(2.3)	38.8	55.0
Analog	22.4	17.5	(1.6)	31.5	30.9
Total Discrete	10.2	2.6	(11.0)	9.0	29.0
Total Optoelectronic	22.2	15.7	2.9	18.5	25.6

NA = Not available  
Source: Dataquest (October 1990)

Table 1c

**Worldwide Semiconductor Market**  
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990
Total Including Captives	27,116	33,729	41,478	54,521	61,454	61,031
North American Captives	2,773	2,895	3,227	3,662	4,241	4,562
Total Semiconductor	24,343	30,834	38,251	50,859	57,213	56,469
Total IC	18,552	23,618	29,887	41,068	46,924	45,946
Bipolar Digital	3,684	4,325	4,760	5,200	4,510	4,253
Memory	589	606	621	689	540	452
Logic	3,095	3,719	4,139	4,511	3,970	3,801
MOS Digital	10,103	12,815	17,473	26,988	33,024	31,677
Memory	3,817	4,511	6,056	11,692	16,361	13,413
Micro	2,745	3,489	5,108	7,144	8,202	9,198
Logic	3,541	4,815	6,309	8,152	8,461	9,066
Analog	4,765	6,478	7,654	8,880	9,390	10,016
Total Discrete	4,578	5,730	6,655	7,612	7,662	7,806
Total Optoelectronic	1,213	1,486	1,709	2,179	2,627	2,717

Source: Dataquest (October 1990)

Table 1d

**Worldwide Semiconductor Market**  
(Percent Change)

	1985	1986	1987	1988	1989	1990
Total Including Captives	(13.4)	24.4	23.0	31.4	12.7	(0.7)
North American Captives	10.9	4.4	11.5	13.5	15.8	7.6
Total Semiconductor	(15.5)	26.7	24.1	33.0	12.5	(1.3)
Total IC	(18.0)	27.3	26.5	37.4	14.3	(2.1)
Bipolar Digital	(23.0)	17.4	10.1	9.2	(13.3)	(5.7)
Memory	(23.9)	2.9	2.5	11.0	(21.6)	(16.3)
Logic	(22.8)	20.2	11.3	9.0	(12.0)	(4.3)
MOS Digital	(22.0)	26.8	36.3	54.5	22.4	(4.1)
Memory	(38.7)	18.2	34.2	93.1	39.9	(18.0)
Micro	(15.0)	27.1	46.4	39.9	14.8	12.1
Logic	1.4	36.0	31.0	29.2	3.8	7.2
Analog	(2.5)	35.9	18.2	16.0	5.7	6.7
Total Discrete	(8.2)	25.2	16.1	14.4	0.7	1.9
Total Optoelectronic	(0.7)	22.5	15.0	27.5	20.6	3.4

Source: Dataquest (October 1990)

Table 1e

**Worldwide Semiconductor Market  
(Millions of Dollars)**

	1991	1992	1993	1994	1995	2000
Total Including Captives	70,318	83,528	102,250	110,855	117,467	225,569
North American Captives	5,377	6,269	7,573	8,299	8,582	16,480
Total Semiconductor	64,941	77,259	94,677	102,556	108,885	209,089
Total IC	53,311	64,367	80,470	87,382	93,125	186,097
Bipolar Digital	4,542	4,856	5,002	4,674	4,497	3,842
Memory	423	423	412	388	358	263
Logic	4,119	4,433	4,590	4,286	4,139	3,579
MOS Digital	37,296	46,333	60,218	65,782	71,256	151,630
Memory	16,004	20,620	27,625	29,580	32,149	71,677
Micro	10,869	13,047	16,726	18,644	20,162	41,250
Logic	10,423	12,666	15,867	17,558	18,945	38,703
Analog	11,473	13,178	15,250	16,926	17,372	30,625
Total Discrete	8,592	9,522	10,396	11,061	11,302	15,989
Total Optoelectronic	3,038	3,370	3,811	4,113	4,458	7,003

Source: Dataquest (October 1990)

Table 1f

**Worldwide Semiconductor Market  
(Percent Change)**

	1991	1992	1993	1994	1995
Total Including Captives	15.2	18.8	22.4	8.4	6.0
North American Captives	17.9	16.6	20.8	9.6	3.4
Total Semiconductor	15.0	19.0	22.5	8.3	6.2
Total IC	16.0	20.7	25.0	8.6	6.6
Bipolar Digital	6.8	6.9	3.0	(6.6)	(3.8)
Memory	(6.4)	0	(2.6)	(5.8)	(7.7)
Logic	8.4	7.6	3.5	(6.6)	(3.4)
MOS Digital	17.7	24.2	30.0	9.2	8.3
Memory	19.3	28.8	34.0	7.1	8.7
Micro	18.2	20.0	28.2	11.5	8.1
Logic	15.0	21.5	25.3	10.7	7.9
Analog	14.5	14.9	15.7	11.0	2.6
Total Discrete	10.1	10.8	9.2	6.4	2.2
Total Optoelectronic	11.8	10.9	13.1	7.9	8.4

Source: Dataquest (October 1990)

Table 1g

**Worldwide Semiconductor Market  
(Compound Annual Growth Rate)**

	CAGR (%) 1980-1985	CAGR (%) 1985-1990	CAGR (%) 1990-1995	CAGR (%) 1995-2000	CAGR (%) 1980-1990	CAGR (%) 1990-2000
Total Including Captives	13.9	17.6	14.0	13.9	15.8	14.0
North American Captives	NA	10.5	13.5	13.9	NA	13.7
Total Semiconductor	11.5	18.3	14.0	13.9	14.9	14.0
Total IC	14.2	19.9	15.2	14.9	17.0	15.0
Bipolar Digital	9.2	2.9	1.1	(3.1)	6.0	(1.0)
Memory	0.6	(5.2)	(4.6)	(6.0)	(2.3)	(5.3)
Logic	11.4	4.2	1.7	(2.9)	7.7	(0.6)
MOS Digital	16.5	25.7	17.6	16.3	21.0	17.0
Memory	11.3	28.6	19.1	17.4	19.7	18.2
Micro	26.1	27.4	17.0	15.4	26.7	16.2
Logic	16.9	20.7	15.9	15.4	18.8	15.6
Analog	14.2	16.0	11.6	12.0	15.1	11.8
Total Discrete	3.3	11.3	7.7	7.2	7.2	7.4
Total Optoelectronic	12.0	17.5	10.4	9.5	14.7	9.9

NA = Not available

Source: Dataquest (October 1990)

Table 2a

**North American Semiconductor Market**  
(Millions of Dollars)

	1980	1981	1982	1983	1984
Total Including Captives	6,053	6,529	6,970	10,625	15,033
North American Captives	NA	NA	NA	1,623	2,027
Total Semiconductor	6,053	6,529	6,970	9,002	13,006
Total IC	4,562	4,867	5,466	7,301	11,089
Bipolar Digital	1,411	1,339	1,367	1,664	2,818
Memory	396	375	320	373	441
Logic	1,015	964	1,047	1,291	2,377
MOS Digital	2,442	2,595	3,183	4,326	6,503
Memory	1,230	1,107	1,592	2,051	3,426
Micro	377	489	641	1,034	1,634
Logic	835	999	950	1,241	1,443
Analog	709	933	916	1,311	1,768
Total Discrete	1,269	1,378	1,201	1,353	1,503
Total Optoelectronic	222	284	303	348	414

NA = Not available  
Source: Dataquest (October 1990)

Table 2b

**North American Semiconductor Market**  
(Percent Change)

	1980	1981	1982	1983	1984
Total Including Captives	NA	NA	NA	NA	41.5
North American Captives	NA	NA	NA	NA	24.9
Total Semiconductor	33.4	7.9	6.8	29.2	44.5
Total IC	43.5	6.7	12.3	33.6	51.9
Bipolar Digital	56.6	(5.1)	2.1	21.7	69.4
Memory	114.1	(5.3)	(14.7)	16.6	18.2
Logic	41.8	(5.0)	8.6	23.3	84.1
MOS Digital	43.4	6.3	22.7	35.9	50.3
Memory	19.6	(10.0)	43.8	28.8	67.0
Micro	102.7	29.7	31.1	61.3	58.0
Logic	70.8	19.6	(4.9)	30.6	16.3
Analog	23.3	31.6	(1.8)	43.1	34.9
Total Discrete	9.3	8.6	(12.8)	12.7	11.1
Total Optoelectronic	12.1	27.9	6.7	14.9	19.0

NA = Not available  
Source: Dataquest (October 1990)

Table 2c

**North American Semiconductor Market**  
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990
Total Including Captives	11,663	13,171	15,454	18,789	21,348	21,126
North American Captives	2,243	2,327	2,596	2,945	3,411	3,669
Total Semiconductor	9,420	10,844	12,858	15,844	17,937	17,457
Total IC	7,757	8,986	10,886	13,815	15,909	15,360
Bipolar Digital	1,926	2,030	2,099	2,012	1,701	1,670
Memory	288	267	271	235	203	170
Logic	1,638	1,763	1,828	1,777	1,498	1,500
MOS Digital	4,322	4,912	6,738	9,606	11,682	11,014
Memory	1,753	1,775	2,497	4,298	6,163	4,925
Micro	1,258	1,362	2,012	2,707	2,972	3,328
Logic	1,311	1,775	2,229	2,601	2,547	2,761
Analog	1,509	2,044	2,049	2,197	2,526	2,676
Total Discrete	1,295	1,542	1,642	1,676	1,683	1,715
Total Optoelectronic	368	316	330	353	345	382

Source: Dataquest (October 1990)

Table 2d

**North American Semiconductor Market**  
(Percent Change)

	1985	1986	1987	1988	1989	1990
Total Including Captives	(22.4)	12.9	17.3	21.6	13.6	(1.0)
North American Captives	10.7	3.7	11.6	13.4	15.8	7.6
Total Semiconductor	(27.6)	15.1	18.6	23.2	13.2	(2.7)
Total IC	(30.0)	15.8	21.1	26.9	15.2	(3.5)
Bipolar Digital	(31.7)	5.4	3.4	(4.1)	(15.5)	(1.8)
Memory	(34.7)	(7.3)	1.5	(13.3)	(13.6)	(16.3)
Logic	(31.1)	7.6	3.7	(2.8)	(15.7)	0.1
MOS Digital	(33.5)	13.7	37.2	42.6	21.6	(5.7)
Memory	(48.8)	1.3	40.7	72.1	43.4	(20.1)
Micro	(23.0)	8.3	47.7	34.5	9.8	12.0
Logic	(9.1)	35.4	25.6	16.7	(2.1)	8.4
Analog	(14.6)	35.5	0.2	7.2	15.0	5.9
Total Discrete	(13.8)	19.1	6.5	2.1	0.4	1.9
Total Optoelectronic	(11.1)	(14.1)	4.4	7.0	(2.3)	10.7

Source: Dataquest (October 1990)

Table 2e

**North American Semiconductor Market**  
(Millions of Dollars)

	1991	1992	1993	1994	1995	2000
Total Including Captives	24,681	28,831	34,818	38,146	39,437	73,922
North American Captives	4,324	5,042	6,091	6,675	6,902	13,255
Total Semiconductor	20,357	23,789	28,727	31,471	32,535	60,667
Total IC	18,074	21,262	26,017	28,621	29,696	56,139
Bipolar Digital	1,783	1,905	1,844	1,707	1,592	987
Memory	149	148	137	122	110	50
Logic	1,634	1,757	1,707	1,585	1,482	937
MOS Digital	13,144	15,934	20,227	22,484	23,536	46,044
Memory	5,837	7,112	9,103	10,236	10,649	21,217
Micro	4,076	4,848	6,156	6,814	7,290	14,036
Logic	3,231	3,974	4,968	5,434	5,597	10,791
Analog	3,147	3,423	3,946	4,430	4,568	9,108
Total Discrete	1,871	2,088	2,240	2,350	2,338	3,583
Total Optoelectronic	412	439	470	500	501	945

Source: Dataquest (October 1990)

Table 2f

**North American Semiconductor Market**  
(Percent Change)

	1991	1992	1993	1994	1995
Total Including Captives	16.8	16.8	20.8	9.6	3.4
North American Captives	17.9	16.6	20.8	9.6	3.4
Total Semiconductor	16.6	16.9	20.8	9.6	3.4
Total IC	17.7	17.6	22.4	10.0	3.8
Bipolar Digital	6.8	6.8	(3.2)	(7.4)	(6.7)
Memory	(12.4)	(0.7)	(7.4)	(10.9)	(9.8)
Logic	8.9	7.5	(2.8)	(7.1)	(6.5)
MOS Digital	19.3	21.2	26.9	11.2	4.7
Memory	18.5	21.8	28.0	12.4	4.0
Micro	22.5	18.9	27.0	10.7	7.0
Logic	17.0	23.0	25.0	9.4	3.0
Analog	17.6	8.8	15.3	12.3	3.1
Total Discrete	9.1	11.6	7.3	4.9	(0.5)
Total Optoelectronic	7.9	6.6	7.1	6.4	0.2

Source: Dataquest (October 1990)

Table 2g

**North American Semiconductor Market  
(Compound Annual Growth Rate)**

	<b>CAGR (%) 1980-1985</b>	<b>CAGR (%) 1985-1990</b>	<b>CAGR (%) 1990-1995</b>	<b>CAGR (%) 1995-2000</b>	<b>CAGR (%) 1980-1990</b>	<b>CAGR (%) 1990-2000</b>
Total Including Captives	14.0	12.6	13.3	13.4	13.3	13.3
North American Captives	NA	10.3	13.5	13.9	NA	13.7
Total Semiconductor	9.2	13.1	13.3	13.3	11.2	13.3
Total IC	11.2	14.6	14.1	13.6	12.9	13.8
Bipolar Digital	6.4	(2.8)	(1.0)	(9.1)	1.7	(5.1)
Memory	(6.2)	(10.0)	(8.3)	(14.6)	(8.1)	(11.5)
Logic	10.0	(1.7)	(0.2)	(8.8)	4.0	(4.6)
MOS Digital	12.1	20.6	16.4	14.4	16.3	15.4
Memory	7.3	22.9	16.7	14.8	14.9	15.7
Micro	27.3	21.5	17.0	14.0	24.3	15.5
Logic	9.4	16.1	15.2	14.0	12.7	14.6
Analog	16.3	12.1	11.3	14.8	14.2	13.0
Total Discrete	0.4	5.8	6.4	8.9	3.1	7.6
Total Optoelectronic	10.6	0.7	5.6	13.5	5.6	9.5

NA = Not available

Source: Dataquest (October 1990)



Table 3a

**Japanese Semiconductor Market**  
(Millions of Dollars)

	1980	1981	1982	1983	1984
Total Including Captives	3,383	4,295	4,082	5,834	8,909
North American Captives	NA	NA	NA	112	135
Total Semiconductor	3,383	4,295	4,082	5,722	8,774
Total IC	2,201	2,793	2,855	4,167	6,517
Bipolar Digital	345	438	498	706	955
Memory	57	77	87	109	163
Logic	288	361	411	597	792
MOS Digital	991	1,174	1,263	1,948	3,621
Memory	423	491	534	893	1,579
Micro	269	404	446	594	979
Logic	299	279	283	461	1,063
Analog	865	1,181	1,094	1,513	1,941
Total Discrete	986	1,237	970	1,217	1,756
Total Optoelectronic	196	265	257	338	501

NA = Not available

Source: Dataquest (October 1990)

Table 3b

**Japanese Semiconductor Market**  
(Percent Change)

	1980	1981	1982	1983	1984
Total Including Captives	NA	NA	NA	NA	52.7
North American Captives	NA	NA	NA	NA	20.5
Total Semiconductor	22.2	27.0	(5.0)	40.2	53.3
Total IC	26.6	26.9	2.2	46.0	56.4
Bipolar Digital	13.5	27.0	13.7	41.8	35.3
Memory	9.6	35.1	13.0	25.3	49.5
Logic	14.3	25.3	13.9	45.3	32.7
MOS Digital	30.1	18.5	7.6	54.2	85.9
Memory	65.2	16.1	8.8	67.2	76.8
Micro	26.3	50.2	10.4	33.2	64.8
Logic	2.0	(6.7)	1.4	62.9	130.6
Analog	28.7	36.5	(7.4)	38.3	28.3
Total Discrete	10.9	25.5	(21.6)	25.5	44.3
Total Optoelectronic	39.0	35.2	(3.0)	31.5	48.2

NA = Not available

Source: Dataquest (October 1990)

Table 3c

**Japanese Semiconductor Market**  
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990
Total Including Captives	8,300	12,018	15,107	20,977	23,234	21,632
North American Captives	151	163	180	205	237	255
Total Semiconductor	8,149	11,855	14,927	20,772	22,997	21,377
Total IC	5,985	8,802	11,263	16,127	17,946	16,569
Bipolar Digital	824	1,295	1,523	1,906	1,750	1,524
Memory	136	169	227	348	246	194
Logic	688	1,126	1,296	1,558	1,504	1,330
MOS Digital	3,232	4,762	6,424	10,501	12,497	11,353
Memory	1,185	1,738	2,268	4,424	5,992	4,685
Micro	884	1,368	1,902	2,573	2,828	2,864
Logic	1,163	1,656	2,254	3,504	3,677	3,804
Analog	1,929	2,745	3,316	3,720	3,699	3,692
Total Discrete	1,621	2,242	2,693	3,282	3,321	3,100
Total Optoelectronic	543	811	971	1,363	1,730	1,708

Source: Dataquest (October 1990)

Table 3d

**Japanese Semiconductor Market**  
(Percent Change)

	1985	1986	1987	1988	1989	1990
Total Including Captives	(6.8)	44.8	25.7	38.9	10.8	(6.9)
North American Captives	11.9	7.9	10.4	13.9	15.6	7.6
Total Semiconductor	(7.1)	45.5	25.9	39.2	10.7	(7.0)
Total IC	(8.2)	47.1	28.0	43.2	11.3	(7.7)
Bipolar Digital	(13.7)	57.2	17.6	25.1	(8.2)	(12.9)
Memory	(16.6)	24.3	34.3	53.3	(29.3)	(21.1)
Logic	(13.1)	63.7	15.1	20.2	(3.5)	(11.6)
MOS Digital	(10.7)	47.3	34.9	63.5	19.0	(9.2)
Memory	(25.0)	46.7	30.5	95.1	35.4	(21.8)
Micro	(9.7)	54.8	39.0	35.3	9.9	1.3
Logic	9.4	42.4	36.1	55.5	4.9	3.5
Analog	(0.6)	42.3	20.8	12.2	(0.6)	(0.2)
Total Discrete	(7.7)	38.3	20.1	21.9	1.2	(6.7)
Total Optoelectronic	8.4	49.4	19.7	40.4	26.9	(1.3)

Source: Dataquest (October 1990)

Table 3e

**Japanese Semiconductor Market**  
(Millions of Dollars)

	1991	1992	1993	1994	1995	2000
Total Including Captives	24,316	28,733	34,335	35,718	38,688	70,471
North American Captives	301	351	423	464	480	921
Total Semiconductor	24,015	28,382	33,912	35,254	38,208	69,550
Total IC	18,772	22,696	27,728	28,727	31,202	59,714
Bipolar Digital	1,610	1,679	1,751	1,686	1,702	1,672
Memory	192	192	192	190	185	170
Logic	1,418	1,487	1,559	1,496	1,517	1,502
MOS Digital	12,957	16,219	20,702	21,336	23,739	49,578
Memory	5,435	7,338	9,759	9,272	10,292	22,468
Micro	3,160	3,691	4,559	5,010	5,511	10,657
Logic	4,362	5,190	6,384	7,054	7,936	16,453
Analog	4,205	4,798	5,275	5,705	5,761	8,464
Total Discrete	3,329	3,580	3,800	4,000	4,200	5,620
Total Optoelectronic	1,914	2,106	2,384	2,527	2,806	4,216

Source: Dataquest (October 1990)

Table 3f

**Japanese Semiconductor Market**  
(Percent Change)

	1991	1992	1993	1994	1995
Total Including Captives	12.4	18.2	19.5	4.0	8.3
North American Captives	18.0	16.6	20.5	9.7	3.4
Total Semiconductor	12.3	18.2	19.5	4.0	8.4
Total IC	13.3	20.9	22.2	3.6	8.6
Bipolar Digital	5.6	4.3	4.3	(3.7)	0.9
Memory	(1.0)	0	0	(1.0)	(2.6)
Logic	6.6	4.9	4.8	(4.0)	1.4
MOS Digital	14.1	25.2	27.6	3.1	11.3
Memory	16.0	35.0	33.0	(5.0)	11.0
Micro	10.3	16.8	23.5	9.9	10.0
Logic	14.7	19.0	23.0	10.5	12.5
Analog	13.9	14.1	9.9	8.2	1.0
Total Discrete	7.4	7.5	6.1	5.3	5.0
Total Optoelectronic	12.1	10.0	13.2	6.0	11.0

Source: Dataquest (October 1990)

Table 3g

**Japanese Semiconductor Market**  
**(Compound Annual Growth Rate in US Dollars)**

	CAGR (%) 1980-1985	CAGR (%) 1985-1990	CAGR (%) 1990-1995	CAGR (%) 1995-2000	CAGR (%) 1980-1990	CAGR (%) 1990-2000
Total Including Captives	19.7	21.1	12.3	12.7	20.4	12.5
North American Captives	NA	11.0	13.5	13.9	NA	13.7
Total Semiconductor	19.2	21.3	12.3	12.7	20.2	12.5
Total IC	22.1	22.6	13.5	13.9	22.4	13.7
Bipolar Digital	19.0	13.1	2.2	(0.4)	16.0	0.9
Memory	19.0	7.4	(0.9)	(1.7)	13.0	(1.3)
Logic	19.0	14.1	2.7	(0.2)	16.5	1.2
MOS Digital	26.7	28.6	15.9	15.9	27.6	15.9
Memory	22.9	31.6	17.0	16.9	27.2	17.0
Micro	26.9	26.5	14.0	14.1	26.7	14.0
Logic	31.2	26.7	15.8	15.7	29.0	15.8
Analog	17.4	13.9	9.3	8.0	15.6	8.7
Total Discrete	10.5	13.8	6.3	6.0	12.1	6.1
Total Optoelectronic	22.6	25.8	10.4	8.5	24.2	9.5

NA = Not available  
Source: Dataquest (October 1990)

Table 4a

**Japanese Semiconductor Market**  
(Billions of Yen)

	1980	1981	1982	1983	1984
Total Including Captives	768.0	949.3	1,012.3	1,371.0	2,111.3
North American Captives	NA	NA	NA	26.3	32.0
Total Semiconductor	768.0	949.3	1,012.3	1,344.7	2,079.3
Total IC	499.7	617.3	708.0	979.3	1,544.4
Bipolar Digital	78.3	96.8	123.5	165.9	226.3
Memory	12.9	17.0	21.6	25.6	38.6
Logic	65.4	79.8	101.9	140.3	187.7
MOS Digital	225.0	259.5	313.2	457.8	858.1
Memory	96.0	108.5	132.4	209.9	374.2
Micro	61.1	89.3	110.6	139.6	232.0
Logic	67.9	61.7	70.2	108.3	251.9
Analog	196.4	261.0	271.3	355.6	460.0
Total Discrete	223.8	273.4	240.6	286.0	416.2
Total Optoelectronic	44.5	58.6	63.7	79.4	118.7
Exchange Rate (Yen/\$)	227	221	248	235	237

NA = Not available

Source: Dataquest (October 1990)

Table 4b

**Japanese Semiconductor Market**  
(Percent Change in Yen)

	1980	1981	1982	1983	1984
Total Including Captives	NA	NA	NA	NA	54.0
North American Captives	NA	NA	NA	NA	21.7
Total Semiconductor	26.7	23.6	6.6	32.8	54.6
Total IC	31.3	23.5	14.7	38.3	57.7
Bipolar Digital	17.6	23.6	27.6	34.3	36.4
Memory	13.2	31.8	27.1	18.5	50.8
Logic	18.5	22.0	27.7	37.7	33.8
MOS Digital	34.8	15.3	20.7	46.2	87.4
Memory	71.1	13.0	22.0	58.5	78.3
Micro	31.1	46.2	23.9	26.2	66.2
Logic	5.8	(9.1)	13.8	54.3	132.6
Analog	33.4	32.9	3.9	31.1	29.4
Total Discrete	14.9	22.2	(12.0)	18.9	45.5
Total Optoelectronic	44.0	31.7	8.7	24.6	49.5

NA = Not available

Source: Dataquest (October 1990)

Table 4c

**Japanese Semiconductor Market**  
(Billions of Yen)

	1985	1986	1987	1988	1989	1990
Total Including Captives	1,975.3	2,006.9	2,175.4	2,727.0	3,212.6	3,309.7
North American Captives	35.9	27.2	25.9	26.7	32.8	39.0
Total Semiconductor	1,939.4	1,979.7	2,149.5	2,700.3	3,179.8	3,270.7
Total IC	1,424.4	1,469.9	1,621.9	2,096.4	2,481.4	2,535.1
Bipolar Digital	196.1	216.2	219.3	247.7	242.0	233.2
Memory	32.4	28.2	32.7	45.2	34.0	29.7
Logic	163.7	188.0	186.6	202.5	208.0	203.5
MOS Digital	769.2	795.3	925.1	1,365.1	1,727.9	1,737.0
Memory	282.0	290.2	326.6	575.1	828.5	716.8
Micro	210.4	228.5	273.9	334.5	391.0	438.2
Logic	276.8	276.6	324.6	455.5	508.4	582.0
Analog	459.1	458.4	477.5	483.6	511.5	564.9
Total Discrete	385.8	374.4	387.8	426.7	459.2	474.3
Total Optoelectronic	129.2	135.4	139.8	177.2	239.2	261.3
Exchange Rate (Yen/\$)	238	167	144	130	138	153

Source: Dataquest (October 1990)

Table 4d

**Japanese Semiconductor Market**  
(Percent Change in Yen)

	1985	1986	1987	1988	1989	1990
Total Including Captives	(6.4)	1.6	8.4	25.4	17.8	3.0
North American Captives	12.2	(24.2)	(4.8)	3.1	22.8	18.9
Total Semiconductor	(6.7)	2.1	8.6	25.6	17.8	2.9
Total IC	(7.8)	3.2	10.3	29.3	18.4	2.2
Bipolar Digital	(13.3)	10.2	1.4	13.0	(2.3)	(3.6)
Memory	(16.1)	(13.0)	16.0	38.2	(24.8)	(12.6)
Logic	(12.8)	14.8	(0.7)	8.5	2.7	(2.2)
MOS Digital	(10.4)	3.4	16.3	47.6	26.6	0.5
Memory	(24.6)	2.9	12.5	76.1	44.1	(13.5)
Micro	(9.3)	8.6	19.9	22.1	16.9	12.1
Logic	9.9	(0.1)	17.4	40.3	11.6	14.5
Analog	(0.2)	(0.2)	4.2	1.3	5.8	10.4
Total Discrete	(7.3)	(3.0)	3.6	10.0	7.6	3.3
Total Optoelectronic	8.8	4.8	3.2	26.8	35.0	9.2

Source: Dataquest (October 1990)

Table 4e

**Japanese Semiconductor Market**  
(Billions of Yen)

	1991	1992	1993	1994	1995	2000
Total Including Captives	3,769.1	4,453.7	5,321.8	5,536.5	5,996.7	10,923.0
North American Captives	46.7	54.4	65.6	71.9	74.4	142.8
Total Semiconductor	3,722.4	4,399.3	5,256.2	5,464.6	5,922.3	10,780.2
Total IC	2,909.7	3,518.0	4,297.7	4,452.9	4,836.4	9,255.6
Bipolar Digital	249.6	260.3	271.4	261.4	263.8	259.2
Memory	29.8	29.8	29.8	29.5	28.7	26.4
Logic	219.8	230.5	241.6	231.9	235.1	232.8
MOS Digital	2,008.3	2,514.0	3,208.7	3,307.2	3,679.6	7,684.5
Memory	842.4	1,137.4	1,512.6	1,437.2	1,595.3	3,482.5
Micro	489.8	572.1	706.6	776.6	854.2	1,651.8
Logic	676.1	804.5	989.5	1,093.4	1,230.1	2,550.2
Analog	651.8	743.7	817.6	884.3	893.0	1,311.9
Total Discrete	516.0	554.9	589.0	620.0	651.0	871.1
Total Optoelectronic	296.7	326.4	369.5	391.7	434.9	653.5
Exchange Rate (Yen/\$)	155	155	155	155	155	155

Source: Dataquest (October 1990)

Table 4f

**Japanese Semiconductor Market**  
(Percent Change in Yen)

	1991	1992	1993	1994	1995
Total Including Captives	13.9	18.2	19.5	4.0	8.3
North American Captives	19.7	16.5	20.6	9.6	3.5
Total Semiconductor	13.8	18.2	19.5	4.0	8.4
Total IC	14.8	20.9	22.2	3.6	8.6
Bipolar Digital	7.0	4.3	4.3	(3.7)	0.9
Memory	0.3	0	0	(1.0)	(2.7)
Logic	8.0	4.9	4.8	(4.0)	1.4
MOS Digital	15.6	25.2	27.6	3.1	11.3
Memory	17.5	35.0	33.0	(5.0)	11.0
Micro	11.8	16.8	23.5	9.9	10.0
Logic	16.2	19.0	23.0	10.5	12.5
Analog	15.4	14.1	9.9	8.2	1.0
Total Discrete	8.8	7.5	6.1	5.3	5.0
Total Optoelectronic	13.5	10.0	13.2	6.0	11.0

Source: Dataquest (October 1990)

Table 4g

**Japanese Semiconductor Market**  
**(Compound Annual Growth Rate in Yen)**

	CAGR (%) 1980-1985	CAGR (%) 1985-1990	CAGR (%) 1990-1995	CAGR (%) 1995-2000	CAGR (%) 1980-1990	CAGR (%) 1990-2000
Total Including Captives	20.8	10.9	12.6	12.7	15.7	12.7
North American Captives	NA	1.7	13.8	13.9	NA	13.9
Total Semiconductor	20.4	11.0	12.6	12.7	15.6	12.7
Total IC	23.3	12.2	13.8	13.9	17.6	13.8
Bipolar Digital	20.2	3.5	2.5	(0.4)	11.5	1.1
Memory	20.2	(1.7)	(0.7)	(1.7)	8.7	(1.2)
Logic	20.1	4.4	2.9	(0.2)	12.0	1.4
MOS Digital	27.9	17.7	16.2	15.9	22.7	16.0
Memory	24.0	20.5	17.4	16.9	22.3	17.1
Micro	28.1	15.8	14.3	14.1	21.8	14.2
Logic	32.5	16.0	16.1	15.7	24.0	15.9
Analog	18.5	4.2	9.6	8.0	11.1	8.8
Total Discrete	11.5	4.2	6.5	6.0	7.8	6.3
Total Optoelectronic	23.8	15.1	10.7	8.5	19.4	9.6

NA = Not available  
Source: Dataquest (October 1990)



Table 5a

**West European Semiconductor Market**  
(Millions of Dollars)

	1980	1981	1982	1983	1984
Total Including Captives	3,686	3,041	3,167	3,650	5,202
North American Captives	NA	NA	NA	280	338
Total Semiconductor	3,686	3,041	3,167	3,370	4,864
Total IC	2,333	1,892	1,988	2,323	3,731
Bipolar Digital	510	454	434	483	741
Memory	116	103	100	107	144
Logic	394	351	334	376	597
MOS Digital	1,139	882	948	1,227	2,123
Memory	543	426	469	581	986
Micro	189	149	168	239	471
Logic	407	307	311	407	666
Analog	684	556	606	613	867
Total Discrete	1,192	995	1,011	866	942
Total Optoelectronic	161	154	168	181	191

NA = Not available  
Source: Dataquest (October 1990)

Table 5b

**West European Semiconductor Market**  
(Percent Change)

	1980	1981	1982	1983	1984
Total Including Captives	NA	NA	NA	NA	42.5
North American Captives	NA	NA	NA	NA	20.7
Total Semiconductor	22.1	(17.5)	4.1	6.4	44.3
Total IC	33.5	(18.9)	5.1	16.9	60.6
Bipolar Digital	30.8	(11.0)	(4.4)	11.3	53.4
Memory	36.5	(11.2)	(2.9)	7.0	34.6
Logic	29.2	(10.9)	(4.8)	12.6	58.8
MOS Digital	45.8	(22.6)	7.5	29.4	73.0
Memory	48.0	(21.5)	10.1	23.9	69.7
Micro	51.2	(21.2)	12.8	42.3	97.1
Logic	40.8	(24.6)	1.3	30.9	63.6
Analog	18.8	(18.7)	9.0	1.2	41.4
Total Discrete	4.7	(16.5)	1.6	(14.3)	8.8
Total Optoelectronic	21.1	(4.3)	9.1	7.7	5.5

NA = Not available  
Source: Dataquest (October 1990)

Table 5c

**West European Semiconductor Market**  
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990
Total Including Captives	5,174	5,992	6,949	9,003	10,348	11,204
North American Captives	379	405	451	512	593	638
Total Semiconductor	4,795	5,587	6,498	8,491	9,755	10,566
Total IC	3,615	4,116	4,840	6,669	7,794	8,285
Bipolar Digital	719	719	727	772	640	636
Memory	150	147	88	74	72	70
Logic	569	572	639	698	568	566
MOS Digital	1,933	2,270	2,761	4,364	5,458	5,646
Memory	745	813	854	1,797	2,548	2,232
Micro	486	574	805	1,212	1,469	1,762
Logic	702	883	1,102	1,355	1,441	1,652
Analog	963	1,127	1,352	1,533	1,696	2,003
Total Discrete	969	1,207	1,377	1,516	1,594	1,872
Total Optoelectronic	211	264	281	306	367	409

Source: Dataquest (October 1990)

Table 5d

**West European Semiconductor Market**  
(Percent Change)

	1985	1986	1987	1988	1989	1990
Total Including Captives	(0.5)	15.8	16.0	29.6	14.9	8.3
North American Captives	12.1	6.9	11.4	13.5	15.8	7.6
Total Semiconductor	(1.4)	16.5	16.3	30.7	14.9	8.3
Total IC	(3.1)	13.9	17.6	37.8	16.9	6.3
Bipolar Digital	(3.0)	0	1.1	6.2	(17.1)	(0.6)
Memory	4.2	(2.0)	(40.1)	(15.9)	(2.7)	(2.8)
Logic	(4.7)	0.5	11.7	9.2	(18.6)	(0.4)
MOS Digital	(8.9)	17.4	21.6	58.1	25.1	3.4
Memory	(24.4)	9.1	5.0	110.4	41.8	(12.4)
Micro	3.2	18.1	40.2	50.6	21.2	19.9
Logic	5.4	25.8	24.8	23.0	6.3	14.6
Analog	11.1	17.0	20.0	13.4	10.6	18.1
Total Discrete	2.9	24.6	14.1	10.1	5.1	17.4
Total Optoelectronic	10.5	25.1	6.4	8.9	19.9	11.4

Source: Dataquest (October 1990)

Table 5e

**West European Semiconductor Market**  
(Millions of Dollars)

	1991	1992	1993	1994	1995	2000
Total Including Captives	12,870	15,220	19,042	21,170	22,401	43,887
North American Captives	752	876	1,059	1,160	1,200	2,304
Total Semiconductor	12,118	14,344	17,983	20,010	21,201	41,583
Total IC	9,621	11,561	14,908	16,733	17,846	37,012
Bipolar Digital	662	729	785	719	642	627
Memory	70	72	74	69	57	42
Logic	592	657	711	650	585	585
MOS Digital	6,718	8,251	11,060	12,626	13,690	30,854
Memory	2,772	3,461	4,838	5,639	6,244	16,195
Micro	2,071	2,524	3,382	3,798	4,065	8,319
Logic	1,875	2,266	2,840	3,189	3,381	6,340
Analog	2,241	2,581	3,063	3,388	3,514	5,531
Total Discrete	2,043	2,283	2,528	2,672	2,725	3,646
Total Optoelectronic	454	500	547	605	630	925

Source: Dataquest (October 1990)

Table 5f

**West European Semiconductor Market**  
(Percent Change)

	1991	1992	1993	1994	1995
Total Including Captives	14.9	18.3	25.1	11.2	5.8
North American Captives	17.9	16.5	20.9	9.5	3.4
Total Semiconductor	14.7	18.4	25.4	11.3	6.0
Total IC	16.1	20.2	29.0	12.2	6.7
Bipolar Digital	4.1	10.1	7.7	(8.4)	(10.7)
Memory	0	2.9	2.8	(6.8)	(17.4)
Logic	4.6	11.0	8.2	(8.6)	(10.0)
MOS Digital	19.0	22.8	34.0	14.2	8.4
Memory	24.2	24.9	39.8	16.6	10.7
Micro	17.5	21.9	34.0	12.3	7.0
Logic	13.5	20.9	25.3	12.3	6.0
Analog	11.9	15.2	18.7	10.6	3.7
Total Discrete	9.1	11.7	10.7	5.7	2.0
Total Optoelectronic	11.0	10.1	9.4	10.6	4.1

Source: Dataquest (October 1990)

Table 5g

**West European Semiconductor Market**  
(Compound Annual Growth Rate)

	CAGR (%) 1980-1985	CAGR (%) 1985-1990	CAGR (%) 1990-1995	CAGR (%) 1995-2000	CAGR (%) 1980-1990	CAGR (%) 1990-2000
Total Including Captives	7.0	16.7	14.9	14.4	11.8	14.6
North American Captives	NA	11.0	13.5	13.9	NA	13.7
Total Semiconductor	5.4	17.1	14.9	14.4	11.1	14.7
Total IC	9.2	18.0	16.6	15.7	13.5	16.1
Bipolar Digital	7.1	(2.4)	0.2	(0.5)	2.2	(0.1)
Memory	5.3	(14.1)	(4.0)	(5.9)	(4.9)	(5.0)
Logic	7.6	(0.1)	0.7	0	3.7	0.3
MOS Digital	11.2	23.9	19.4	17.6	17.4	18.5
Memory	6.5	24.5	22.8	21.0	15.2	21.9
Micro	20.8	29.4	18.2	15.4	25.0	16.8
Logic	11.5	18.7	15.4	13.4	15.0	14.4
Analog	7.1	15.8	11.9	9.5	11.3	10.7
Total Discrete	(4.1)	14.1	7.8	6.0	4.6	6.9
Total Optoelectronic	5.6	14.2	9.0	8.0	9.8	8.5

NA = Not available  
Source: Dataquest (October 1990)

Table 6a

Asia/Pacific-ROW Semiconductor Market  
(Millions of Dollars)

	1980	1981	1982	1983	1984
Total Including Captives	996	963	1,042	1,443	2,181
North American Captives	NA	NA	NA	0	0
Total Semiconductor	996	963	1,042	1,443	2,181
Total IC	450	494	585	909	1,281
Bipolar Digital	108	106	113	162	269
Memory	3	3	4	14	26
Logic	105	103	109	148	243
MOS Digital	143	171	248	450	700
Memory	34	51	106	194	234
Micro	27	43	63	112	145
Logic	82	77	79	144	321
Analog	199	217	224	297	312
Total Discrete	436	375	365	429	785
Total Optoelectronic	110	94	92	105	115

NA = Not available  
Source: Dataquest (October 1990)

Table 6b

Asia/Pacific-ROW Semiconductor Market  
(Percent Change)

	1980	1981	1982	1983	1984
Total Including Captives	NA	NA	NA	NA	51.1
North American Captives	NA	NA	NA	NA	NM
Total Semiconductor	26.1	(3.3)	8.2	38.5	51.1
Total IC	23.6	9.8	18.4	55.4	40.9
Bipolar Digital	36.7	(1.9)	6.6	43.4	66.0
Memory	50.0	0	33.3	250.0	85.7
Logic	36.4	(1.9)	5.8	35.8	64.2
MOS Digital	43.0	19.6	45.0	81.5	55.6
Memory	36.0	50.0	107.8	83.0	20.6
Micro	58.8	59.3	46.5	77.8	29.5
Logic	41.4	(6.1)	2.6	82.3	122.9
Analog	7.6	9.0	3.2	32.6	5.1
Total Discrete	30.5	(14.0)	(2.7)	17.5	83.0
Total Optoelectronic	19.6	(14.5)	(2.1)	14.1	9.5

NA = Not available  
NM = Not meaningful  
Source: Dataquest (October 1990)

Table 6c

**Asia/Pacific-ROW Semiconductor Market**  
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990
Total Including Captives	1,979	2,548	3,968	5,752	6,524	7,069
North American Captives	0	0	0	0	0	0
Total Semiconductor	1,979	2,548	3,968	5,752	6,524	7,069
Total IC	1,195	1,714	2,898	4,457	5,275	5,732
Bipolar Digital	215	281	411	510	419	423
Memory	15	23	35	32	19	18
Logic	200	258	376	478	400	405
MOS Digital	616	871	1,550	2,517	3,387	3,664
Memory	134	185	437	1,173	1,658	1,571
Micro	117	185	389	652	933	1,244
Logic	365	501	724	692	796	849
Analog	364	562	937	1,430	1,469	1,645
Total Discrete	693	739	943	1,138	1,064	1,119
Total Optoelectronic	91	95	127	157	185	218

Source: Dataquest (October 1990)

Table 6d

**Asia/Pacific-ROW Semiconductor Market**  
(Percent Change)

	1985	1986	1987	1988	1989	1990
Total Including Captives	(9.3)	28.8	55.7	45.0	13.4	8.4
North American Captives	NM	NM	NM	NM	NM	NM
Total Semiconductor	(9.3)	28.8	55.7	45.0	13.4	8.4
Total IC	(6.7)	43.4	69.1	53.8	18.4	8.7
Bipolar Digital	(20.1)	30.7	46.3	24.1	(17.8)	1.0
Memory	(42.3)	53.3	52.2	(8.6)	(40.6)	(5.3)
Logic	(17.7)	29.0	45.7	27.1	(16.3)	1.3
MOS Digital	(12.0)	41.4	78.0	62.4	34.6	8.2
Memory	(42.7)	38.1	136.2	168.4	41.3	(5.2)
Micro	(19.3)	58.1	110.3	67.6	43.1	33.3
Logic	13.7	37.3	44.5	(4.4)	15.0	6.7
Analog	16.7	54.4	66.7	52.6	2.7	12.0
Total Discrete	(11.7)	6.6	27.6	20.7	(6.5)	5.2
Total Optoelectronic	(20.9)	4.4	33.7	23.6	17.8	17.8

NM = Not meaningful

Source: Dataquest (October 1990)

Table 6e

**Asia/Pacific-ROW Semiconductor Market**  
(Millions of Dollars)

	1991	1992	1993	1994	1995	2000
Total Including Captives	8,451	10,744	14,055	15,821	16,941	37,289
North American Captives	0	0	0	0	0	0
Total Semiconductor	8,451	10,744	14,055	15,821	16,941	37,289
Total IC	6,844	8,848	11,817	13,301	14,381	33,232
Bipolar Digital	487	543	622	562	561	556
Memory	12	11	9	7	6	1
Logic	475	532	613	555	555	555
MOS Digital	4,477	5,929	8,229	9,336	10,291	25,154
Memory	1,960	2,709	3,925	4,433	4,964	11,797
Micro	1,562	1,984	2,629	3,022	3,296	8,238
Logic	955	1,236	1,675	1,881	2,031	5,119
Analog	1,880	2,376	2,966	3,403	3,529	7,522
Total Discrete	1,349	1,571	1,828	2,039	2,039	3,140
Total Optoelectronic	258	325	410	481	521	917

Source: Dataquest (October 1990)

Table 6f

**Asia/Pacific-ROW Semiconductor Market**  
(Percent Change)

	1991	1992	1993	1994	1995
Total Including Captives	19.6	27.1	30.8	12.6	7.1
North American Captives	NM	NM	NM	NM	NM
Total Semiconductor	19.6	27.1	30.8	12.6	7.1
Total IC	19.4	29.3	33.6	12.6	8.1
Bipolar Digital	15.1	11.5	14.5	(9.6)	(0.2)
Memory	(33.3)	(8.3)	(18.2)	(22.2)	(14.3)
Logic	17.3	12.0	15.2	(9.5)	0
MOS Digital	22.2	32.4	38.8	13.5	10.2
Memory	24.8	38.2	44.9	12.9	12.0
Micro	25.6	27.0	32.5	14.9	9.1
Logic	12.5	29.4	35.5	12.3	8.0
Analog	14.3	26.4	24.8	14.7	3.7
Total Discrete	20.6	16.5	16.4	11.5	0
Total Optoelectronic	18.3	26.0	26.2	17.3	8.3

NM = Not meaningful

Source: Dataquest (October 1990)

Table 6g

**Asia/Pacific-ROW Semiconductor Market**  
(Compound Annual Growth Rate)

	CAGR (%) 1980-1985	CAGR (%) 1985-1990	CAGR (%) 1990-1995	CAGR (%) 1995-2000	CAGR (%) 1980-1990	CAGR (%) 1990-2000
Total Including Captives	14.7	29.0	19.1	17.1	21.6	18.1
North American Captives	NA	NA	NA	NA	NA	NA
Total Semiconductor	14.7	29.0	19.1	17.1	21.6	18.1
Total IC	21.6	36.8	20.2	18.2	29.0	19.2
Bipolar Digital	14.8	14.5	5.8	(0.2)	14.6	2.8
Memory	38.0	3.7	(19.7)	(30.1)	19.6	(25.1)
Logic	13.8	15.2	6.5	0	14.5	3.2
MOS Digital	33.9	42.8	22.9	19.6	38.3	21.2
Memory	31.6	63.6	25.9	18.9	46.7	22.3
Micro	34.1	60.4	21.5	20.1	46.7	20.8
Logic	34.8	18.4	19.1	20.3	26.3	19.7
Analog	12.8	35.2	16.5	16.3	23.5	16.4
Total Discrete	9.7	10.1	12.8	9.0	9.9	10.9
Total Optoelectronic	(3.7)	19.1	19.0	12.0	7.1	15.4

NA = Not available  
Source: Dataquest (October 1990)



Table 7a

Worldwide Average Selling Prices  
(Dollars)

	1980	1981	1982	1983	1984
Total Semiconductor	0.33	0.31	0.33	0.32	0.36
Total IC	1.07	1.02	0.99	1.03	1.10
Bipolar Digital	0.70	0.70	0.62	0.65	0.65
Memory	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA
MOS Digital	1.81	1.66	1.63	1.66	1.95
Memory	4.90	3.17	2.62	2.79	3.90
Micro	3.61	3.40	3.26	3.35	3.53
Logic	0.85	0.86	0.80	0.79	0.85
Analog	0.83	0.81	0.79	0.76	0.75
Total Discrete	0.12	0.11	0.11	0.09	0.09
Total Optoelectronic	0.44	0.39	0.29	0.28	0.28

NA = Not available  
Source: Dataquest (October 1990)

Table 7b

Worldwide Average Selling Prices  
(Percent Change in Dollars)

	1980	1981	1982	1983	1984
Total Semiconductor	11.7	(6.4)	7.5	(3.0)	11.8
Total IC	9.8	(3.9)	(2.8)	3.1	7.5
Bipolar Digital	22.8	0	(11.4)	4.8	0
Memory	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA
MOS Digital	(6.3)	(8.4)	(1.8)	2.2	17.3
Memory	(4.9)	(35.3)	(17.4)	6.5	39.8
Micro	(8.8)	(5.8)	(4.1)	2.8	5.4
Logic	(4.5)	1.2	(7.0)	(1.3)	7.6
Analog	6.4	(2.4)	(2.5)	(3.8)	(1.3)
Total Discrete	0	(8.3)	0	(18.2)	0
Total Optoelectronic	(12.8)	(11.9)	(25.6)	(3.4)	0

NA = Not available  
Source: Dataquest (October 1990)

Table 7c

Worldwide Average Selling Prices  
(Dollars)

	1985	1986	1987	1988	1989	1990
Total Semiconductor	0.30	0.34	0.33	0.42	0.42	0.40
Total IC	1.05	1.09	1.18	1.32	1.45	1.35
Bipolar Digital	0.71	0.71	0.69	0.70	0.70	0.65
Memory	NA	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA	NA
MOS Digital	1.64	1.63	1.94	2.38	2.65	2.35
Memory	2.59	2.41	3.09	4.87	5.88	4.86
Micro	3.14	3.13	3.56	4.15	3.77	4.08
Logic	0.93	0.99	1.12	1.13	1.13	1.07
Analog	0.76	0.84	0.82	0.72	0.70	0.71
Total Discrete	0.08	0.09	0.08	0.09	0.08	0.08
Total Optoelectronic	0.22	0.25	0.28	0.34	0.27	0.26

NA = Not available  
Source: Dataquest (October 1990)

Table 7d

Worldwide Average Selling Prices  
(Percent Change in Dollars)

	1985	1986	1987	1988	1989	1990
Total Semiconductor	(15.7)	13.2	(2.7)	24.8	(0.3)	(4.3)
Total IC	(4.4)	3.5	8.5	11.6	10.0	(7.3)
Bipolar Digital	9.2	0	(2.8)	1.4	0	(7.1)
Memory	NA	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA	NA
MOS Digital	(16.0)	(0.5)	18.6	23.0	11.5	(11.5)
Memory	(33.6)	(6.9)	28.2	57.6	20.7	(17.3)
Micro	(11.0)	(0.3)	13.7	16.6	(9.2)	8.2
Logic	9.4	6.5	13.1	0.9	0	(5.3)
Analog	1.3	10.5	(2.4)	(12.2)	(2.8)	1.4
Total Discrete	(11.1)	15.0	(13.0)	12.5	(11.1)	0
Total Optoelectronic	(21.4)	13.6	12.0	21.4	(20.6)	(3.7)

NA = Not available  
Source: Dataquest (October 1990)

Table 7e

**Worldwide Average Selling Prices  
(Dollars)**

	1991	1992	1993	1994	1995	2000
Total Semiconductor	0.42	0.45	0.50	0.50	0.51	0.65
Total IC	1.47	1.55	1.73	1.70	1.69	2.01
Bipolar Digital	0.70	0.71	0.72	0.70	0.69	0.69
Memory	NA	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA	NA
MOS Digital	2.71	2.85	3.23	3.07	3.02	3.51
Memory	5.70	6.81	7.80	8.30	7.30	11.00
Micro	4.16	4.23	4.29	4.16	4.10	4.15
Logic	1.25	1.25	1.42	1.31	1.33	1.45
Analog	0.72	0.72	0.73	0.73	0.69	0.70
Total Discrete	0.08	0.08	0.08	0.08	0.08	0.08
Total Optoelectronic	0.26	0.26	0.26	0.26	0.26	0.26

NA = Not available

Source: Dataquest (October 1990)

Table 7f

**Worldwide Average Selling Prices  
(Percent Change in Dollars)**

	1991	1992	1993	1994	1995
Total Semiconductor	5.3	6.5	11.2	0.8	2.1
Total IC	9.5	5.6	11.3	(1.6)	(1.0)
Bipolar Digital	7.7	1.4	1.4	(2.8)	(1.4)
Memory	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA
MOS Digital	15.4	5.2	13.3	(5.0)	(1.4)
Memory	17.3	19.5	14.5	6.4	(12.0)
Micro	2.0	1.7	1.5	(3.1)	(1.5)
Logic	16.7	0	13.3	(7.5)	1.5
Analog	1.4	0	1.4	0	(5.5)
Total Discrete	0	0	0	0	0
Total Optoelectronic	0	0	0	0	0

NA = Not available

Source: Dataquest (October 1990)

Table 7g

**Worldwide Average Selling Prices  
(Compound Annual Growth Rate)**

	CAGR (%) 1980-1985	CAGR (%) 1985-1990	CAGR (%) 1990-1995	CAGR (%) 1995-2000	CAGR (%) 1980-1990	CAGR (%) 1990-2000
Total Semiconductor	(1.7)	5.6	5.1	5.1	2.5	5.1
Total IC	(0.2)	5.0	4.6	3.6	1.8	4.1
Bipolar Digital	0.3	(1.8)	1.2	0	0	0.6
Memory	NA	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA	NA
MOS Digital	(2.0)	7.4	5.2	3.1	1.5	4.1
Memory	(12.0)	13.4	8.5	8.5	4.2	8.5
Micro	(2.8)	5.4	0.1	0.2	0.1	0.2
Logic	1.8	2.8	4.4	1.7	0.9	3.1
Analog	(1.7)	(1.4)	(0.6)	0.3	0.1	(0.1)
Total Discrete	(7.8)	0	0	0	0	0
Total Optoelectronic	(13.0)	3.4	0	0	0	0

NA = Not available  
Source: Dataquest (October 1990)

Table 8a

**Worldwide Semiconductor Shipments  
(Millions of Units)**

	1980	1981	1982	1983	1984
Total Semiconductor	42,870	48,081	46,022	60,743	80,377
Total IC	8,955	9,809	10,949	14,327	20,573
Bipolar Digital	3,391	3,339	3,890	4,638	7,340
Memory	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA
MOS Digital	2,603	2,906	3,464	4,776	6,639
Memory	455	655	1,031	1,333	1,597
Micro	239	319	404	591	916
Logic	1,909	1,933	2,029	2,852	4,126
Analog	2,960	3,564	3,595	4,913	6,593
Total Discrete	32,358	36,227	32,245	42,944	55,411
Total Optoelectronic	1,557	2,045	2,828	3,471	4,393

NA = Not available

Source: Dataquest (October 1990)

Table 8b

**Worldwide Semiconductor Shipments  
(Percent Change in Units)**

	1980	1981	1982	1983	1984
Total Semiconductor	13.7	12.2	(4.3)	32.0	32.3
Total IC	23.7	9.5	11.6	30.9	43.6
Bipolar Digital	15.5	(1.6)	16.5	19.2	58.2
Memory	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA
MOS Digital	50.4	11.6	19.2	37.9	39.0
Memory	39.8	43.8	57.5	29.3	19.8
Micro	74.8	33.6	26.7	46.1	55.1
Logic	50.5	1.2	5.0	40.6	44.7
Analog	15.0	20.4	0.9	36.7	34.2
Total Discrete	10.2	12.0	(11.0)	33.2	29.0
Total Optoelectronic	40.1	31.3	38.3	22.8	26.5

NA = Not available

Source: Dataquest (October 1990)

Table 8c

**Worldwide Semiconductor Shipments  
(Millions of Units)**

	1985	1986	1987	1988	1989	1990
Total Semiconductor	80,380	89,881	114,551	122,085	137,808	142,162
Total IC	17,607	21,654	25,260	31,098	32,303	34,137
Bipolar Digital	5,172	6,092	6,899	7,429	6,443	6,543
Memory	NA	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA	NA
MOS Digital	6,171	7,850	9,028	11,336	12,446	13,487
Memory	1,475	1,872	1,960	2,401	2,782	2,760
Micro	875	1,115	1,435	1,721	2,176	2,254
Logic	3,820	4,864	5,633	7,214	7,488	8,473
Analog	6,264	7,712	9,334	12,333	13,414	14,107
Total Discrete	57,200	62,283	83,188	84,578	95,775	97,575
Total Optoelectronic	5,573	5,944	6,104	6,409	9,730	10,450

NA = Not available  
Source: Dataquest (October 1990)

Table 8d

**Worldwide Semiconductor Shipments  
(Percent Change in Units)**

	1985	1986	1987	1988	1989	1990
Total Semiconductor	0	11.8	27.4	6.6	12.9	3.2
Total IC	(14.4)	23.0	16.7	23.1	3.9	5.7
Bipolar Digital	(29.5)	17.8	13.2	7.7	(13.3)	1.6
Memory	NA	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA	NA
MOS Digital	(7.1)	27.2	15.0	25.6	9.8	8.4
Memory	(7.6)	26.9	4.7	22.5	15.9	(0.8)
Micro	(4.5)	27.4	28.7	20.0	26.4	3.6
Logic	(7.4)	27.3	15.8	28.1	3.8	13.2
Analog	(5.0)	23.1	21.0	32.1	8.8	5.2
Total Discrete	3.2	8.9	33.6	1.7	13.2	1.9
Total Optoelectronic	26.9	6.7	2.7	5.0	51.8	7.4

NA = Not available  
Source: Dataquest (October 1990)

Table 8e

**Worldwide Semiconductor Shipments  
(Millions of Units)**

	1991	1992	1993	1994	1995	2000
Total Semiconductor	155,274	173,381	191,092	205,394	213,681	319,263
Total IC	36,189	41,394	46,484	51,312	55,260	92,466
Bipolar Digital	6,489	6,839	6,947	6,677	6,517	5,568
Memory	NA	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA	NA
MOS Digital	13,766	16,252	18,647	21,448	23,566	43,148
Memory	2,808	3,028	3,542	3,564	4,404	6,516
Micro	2,613	3,083	3,895	4,481	4,918	9,940
Logic	8,345	10,141	11,210	13,403	14,244	26,692
Analog	15,935	18,303	20,890	23,186	25,177	43,750
Total Discrete	107,400	119,025	129,950	138,263	141,275	199,863
Total Optoelectronic	11,685	12,962	14,658	15,819	17,146	26,935

NA = Not available

Source: Dataquest (October 1990)

Table 8f

**Worldwide Semiconductor Shipments  
(Percent Change in Units)**

	1991	1992	1993	1994	1995
Total Semiconductor	9.2	11.7	10.2	7.5	4.0
Total IC	6.0	14.4	12.3	10.4	7.7
Bipolar Digital	(0.8)	5.4	1.6	(3.9)	(2.4)
Memory	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA
MOS Digital	2.1	18.1	14.7	15.0	9.9
Memory	1.7	7.8	17.0	0.6	23.6
Micro	15.9	18.0	26.4	15.0	9.7
Logic	(1.5)	21.5	10.5	19.6	6.3
Analog	13.0	14.9	14.1	11.0	8.6
Total Discrete	10.1	10.8	9.2	6.4	2.2
Total Optoelectronic	11.8	10.9	13.1	7.9	8.4

NA = Not available

Source: Dataquest (October 1990)

Table 8g

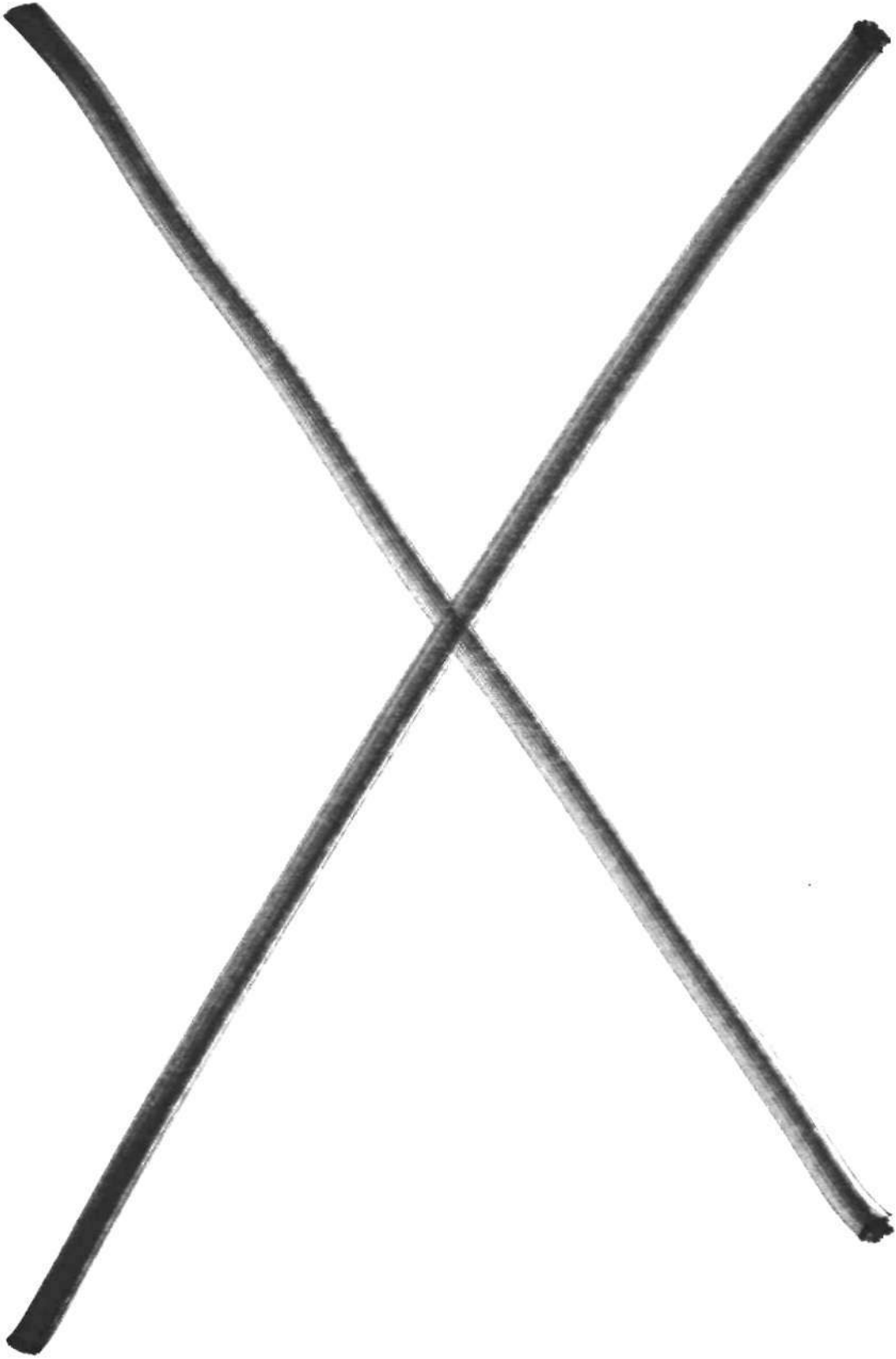
**Worldwide Semiconductor Shipments**  
**(Compound Annual Growth Rate of Units)**

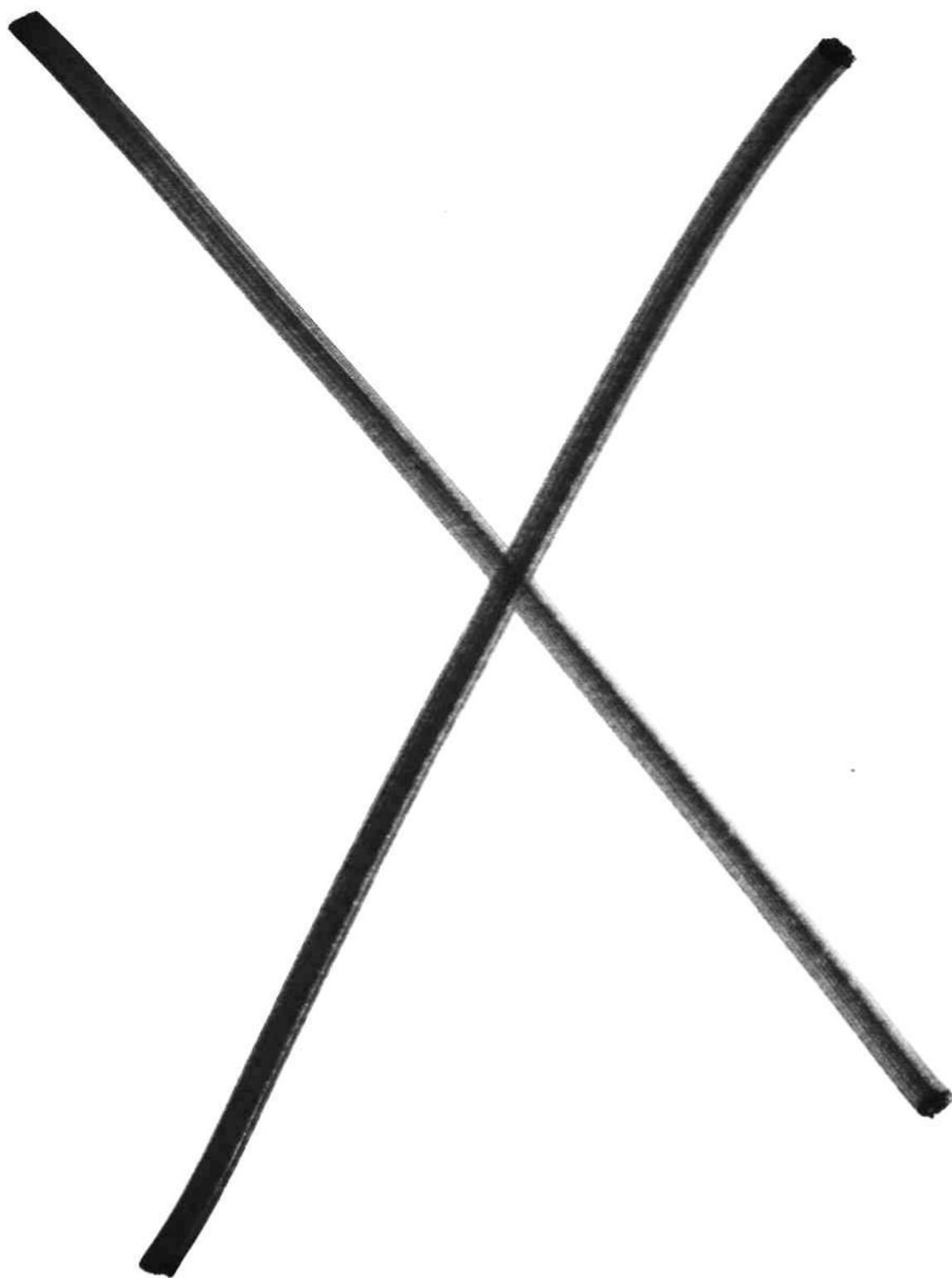
	CAGR (%) 1980-1985	CAGR (%) 1985-1990	CAGR (%) 1990-1995	CAGR (%) 1990-2000	CAGR (%) 1990-2000	CAGR (%) 1990-2000
Total Semiconductor	13.4	12.1	8.5	8.4	4.1	8.4
Total IC	14.5	14.2	10.1	10.8	5.3	10.5
Bipolar Digital	8.8	4.8	(0.1)	(3.1)	(1.6)	(1.6)
Memory	NA	NA	NA	NA	NA	NA
Logic	NA	NA	NA	NA	NA	NA
MOS Digital	18.8	16.9	11.8	12.9	6.2	12.3
Memory	26.5	13.3	9.8	8.2	4.0	9.0
Micro	29.7	20.8	16.9	15.1	7.3	16.0
Logic	14.9	17.3	10.9	13.4	6.5	12.2
Analog	16.2	17.6	12.3	11.7	5.7	12.0
Total Discrete	12.1	11.3	7.7	7.2	3.5	7.4
Total Optoelectronic	29.0	13.4	10.4	9.5	4.6	9.9

NA = Not available  
Source: Dataquest (October 1990)









# Table of Contents

## **JAPANESE SEMICONDUCTOR APPLICATION MARKETS COMPANY BACKGROUNDEERS**

<b>Company</b>	<b>Fiscal Year-End</b>
Canon Incorporated	December
Casio Computer Co., Ltd.	March
Fuji Electronic Co., Ltd.	March
Fujitsu Limited	March
International Business Machines Corporation (IBM)	December
Kyocera Corporation	March
Mitsubishi Electric Corporation	March
NEC Corporation	March
Nippondenso Co., Ltd.	-
Nippon Telegraph and Telephone Corporation (NTT)	March
Omron Corporation	March
Ricoh Company, Ltd.	March
Sanyo Electric Company, Ltd.	November
Sharp Corporation	March
Sony Corporation	March

## **Canon Incorporated**

7-1, Nishi-shinjuku 2-chome  
Shinjuku-ku, Tokyo 163, Japan

Telephone: (03) 348-2121

Fax: (03) 349-8957

Dun's Number: 69-054-9662

*Date Founded: 1937*

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### **CORPORATE STRATEGIC DIRECTION**

Canon Incorporated, a Japanese parent/holding company, is the world's largest (in unit sales) maker of copiers and a leading producer of office equipment and cameras. Its business is divided into three product segments—business machines, cameras, and optical and other products—with net sales of 80 percent, 13 percent, and 7 percent, respectively. The Company conducts the majority of its business in Japan, Europe, and North America with approximately 30 percent of net sales coming from each respective region.

The main market factors affecting the Company are trade sanctions, exchange rate risk, and a rapidly expanding global economy. Trade sanctions affect all Japanese companies. Because of increasing anti-Japanese sentiment, European countries have imposed or threatened to impose import restrictions on products manufactured in Japan. Many of Canon's products are affected by these trade sanctions.

Another factor affecting the Company is fluctuating exchange rates. Because of the yen's decline over the past five years, profit margins on exported products have deteriorated. Japanese copier manufacturers have had to raise prices five times since 1987. In 1989 alone, foreign exchange translation adjustments affected Canon by ¥17,928 million (US\$123.4 million).

Last, with a globalizing economy, Canon and other multinational companies are expanding their sales and distribution to worldwide markets. By doing so, they are entering new markets where market demand challenges will be heightened.

In 1987, Canon implemented a five-year "Global Corporation Plan" to address these issues. The plan calls for an increase in international investment and

production, which effectively limits the effects of the trade sanctions because products manufactured outside Japan are not considered "Japanese" products. Rather, they are considered to be native to the country in which they are manufactured. Also, by increasing foreign investment and production, Canon's foreign branches are becoming more self-sufficient, thereby decreasing the number of cross-border transactions and reducing the Company's exposure to interest-rate volatility. By establishing a direct interest in the foreign market, the Company gains a closeness to the market that it would not otherwise be able to achieve.

Going one step further, Canon has begun to emphasize increases in research and development (R&D), joint company ventures, and product sourcing in the foreign markets. These steps are expected to improve the geopolitical relationships that Canon has with the foreign nations and to help its corporate image on an international level.

The Company is financially able to follow this strategy because it conducts business in large foreign markets, which can support large-scale, local production. It also has a significant cash base from which it may make the investments. The Company's cash base is ¥514,312 million (US\$3,729.0 million) with a net working capital to total asset ratio of 30 percent.

The Company's net sales increased by 22.1 percent to ¥1,350,917 million, (US\$9,794.9 million) in fiscal 1989 from ¥1,106,010 million (US\$8,633.3 million) in fiscal 1988. (Percentage changes refer only to ¥ amounts; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) Business machines and optical and other products net sales were both up approximately 23.0 percent in fiscal 1989. Contributing to the strong growth were copiers and computer peripherals.

Operating profit surpassed the improvement in sales by increasing 31.9 percent to ¥115,985 million (US\$840.0 million) in fiscal 1989 from ¥87,914 million (US\$686.2 million) in fiscal 1988. The increase was primarily due to the aforementioned increase in net sales as well as the introduction of higher profit margin products. R&D expense increased 15 percent to ¥75,566 million (US\$548.1 million) in fiscal 1989 from ¥65,522 million (US\$511.5 million) in fiscal 1988. However, as a percent of sales, R&D expense remained fairly stable at approximately 6 percent.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 and 4, comprehensive financial statements, are at the end of this profile.

## BUSINESS SEGMENT STRATEGIC DIRECTION

### Copiers

Copiers alone represent over one-quarter of the Company's business. In fiscal 1989, the Company retained its leadership position by capturing 23 percent of the copier market, while its closest competitors, Xerox and Sharp, captured 15 percent and 14.6 percent, respectively. The Company is striving to add value to the basic copier and capture more of the market by implementing editing and full-color capabilities. Some of the outstanding products introduced in 1989 are as follows:

- **Color Laser Copier 500 (CLC-500)**—In 1989, Canon introduced its top of the line digital full-color model, the CLC-500. The 400-dpi printer/copier produces photographic-quality, plain paper copies of color images at a rate of 5 pages per minute (ppm).
- **PS-IPU**—The PS-IPU is a new PostScript language interpreter for the Company's CLC-500 system. This interpreter enables color laser copier users to access, manipulate, and print more than 4,000 different computer software packages that support the PostScript page description language (PDL).
- **Color Bubble-Jet Copier A1**—One of Canon's outstanding new copiers is the Color Bubble-Jet Copier, which last year was sold as an output printer. However, at the 1989 Canon Expo, the copier was presented as a standalone device, capable of producing full-color documents up to 22 x 33 inches that are scanned on the color copier.

### Peripherals

The peripheral segment of Canon's product line includes printers and data storage systems. Sales of the computer peripheral segment reached ¥274,048 million (US\$1,987 million) in fiscal 1989.

Canon is one of the leading manufacturers of electronic printers. In 1989, Canon accounted for approximately 80 percent of the less than 10-ppm electronic printer market (the market share figure is based on the machine unit itself, not the brand name). Canon's significant product introductions for 1989 include the following:

- **LBP-4**—The LBP-4 is Canon's first 4-ppm desktop laser beam printer. It has a printing resolution of 300 dpi and is equipped with nine scalable fonts.
- **LBP-8 Mark III series**—The LBP-8 Mark III series is a new series of laser beam printers that use Canon's new page control language, LBP Image Processing System. There are three products in this series, all equipped with scalable fonts, 1.5Mb standard memory, increased software support, and improved vector graphics capabilities.
- **BJ-130e**—The BJ-130e is a bubble-jet printer aimed at the impact matrix printer market. It offers 240-cps printing, automatic sheet feeder, 360-dpi resolution, and built-in Courier and Gothic fonts.

In data storage systems, Canon manufactures large-volume memory systems. One of the Company's products, the MOD, is an innovative small format memory device with a 256MB capacity per side, which is equivalent to 190,000 A4-size pages. The MOD's main application is in computer external storage peripherals. However, the first application of the MOD technology was incorporated in the memory of the NeXT workstation.

Another application of Canon's memory technology is the data card. In 1989, Canon unveiled its new Optical Memory Cards, which improved upon the magnetic and integrated circuit (IC) designs by allowing users to store graphics as well as alphanumeric data. The card's technology embeds optical-recording material onto a 2MB plastic card, immunizing it from static electricity or magnetic forces and making it more difficult to alter. These new cards have a higher storage capacity and cost less to manufacture than their predecessors. Applications for the card include personal identification, personal medical record storage, and security access cards.

## Business Systems

The business systems segment of Canon encompasses a broad range of products, including facsimile transceivers, workstations, microcomputers, word processors, and desktop publishing (DTP), micrographics equipment, calculators, and electronic typewriters. The 1989 product introductions include the following:

- FAX-L6500—Canon refers to the plain paper FAX-L6500 facsimile transceiver as a Group 4, Class 1 "image terminal" capable of providing networking for Group 3 and 4 facsimiles, making it truly multifunctional. It combines the laser print engine of Canon's 9330 digital copier with a flat-bed scanner and 20MB of hard-disk memory. The user can use this product as a facsimile machine or a full-range copier, capable of reducing or enlarging documents by 35 to 800 percent. Its image editing and output is 30 ppm.
- FAX-L4600—This new plain paper laser beam G4 fax machine is designed for high-volume communication. This product provides true networking capabilities by accepting documents from either a G3 or G4 terminal without reprogramming.
- Navigator—The most innovative of Canon's new products is the Navigator. This compact, integrated personal workstation has the multifunctional features of a word processor, facsimile transceiver, telephone, IBM-compatible microcomputer, and personal data management—all of which can be operated from the touch of a screen.

- Bubble-Jet Word Processor and Thermal Transfer Word Processor—These are compact, all-in-one word processors that do not require a separate printer. They are marketed toward the home office and feature Canon's "nonimpact" printing systems.

## Cameras

The camera is what first introduced the Canon name to the world. Along with cameras, Canon is involved in video camcorders, still video, and camera lenses. The camera division accounted for 13.1 percent of total net sales.

## Optical Products

The optical product division comprises high-tech, precision products including semiconductor production equipment, broadcasting lenses, and medical equipment. The Company is currently one of the largest suppliers of optical lithography equipment used in semiconductor device manufacturing. Optical products contributed 5 percent to net sales.

## Further Information

For further information about the Company's business segments, please contact the appropriate industry service.

**Table 1**  
**Five-Year Corporate Highlights (Millions of US Dollars)**

	1985	1986	1987	1988	1989
Five-Year Revenue	\$4,006.8	\$5,276.6	\$6,728.5	\$8,633.3	\$9,794.9
Percent Change	-	31.69	27.52	28.31	13.46
Capital Expenditure	\$384.7	\$482.3	\$437.4	\$648.4	\$777.9
Percent of Revenue	9.60	9.14	6.50	7.51	7.94
R&D Expenditure	\$207.2	\$328.3	\$393.3	\$51.1	\$547.9
Percent of Revenue	5.17	6.22	5.84	0.59	5.59
Number of Employees	34,129	35,498	37,521	37,521	44,401
Revenue (\$K)/Employee	\$117.40	\$148.65	\$179.33	\$230.09	\$220.60
Net Income	\$155.3	\$63.7	\$91.1	\$289.6	\$277.6
Percent Change	-	(59.02)	43.10	217.89	(4.13)
Exchange Rate (US\$1=¥)	¥238.54	¥168.52	¥145.16	¥128.11	¥137.92
1989 Calendar Year	Q1	Q2	Q3	Q4	
Quarterly Revenue	NA	NA	NA	NA	
Quarterly Profit	NA	NA	NA	NA	

NA = Not available

Source: Canon Incorporated  
Annual Reports  
Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1985	1986	1987	1988	1989
North America	37.87	34.77	32.48	30.24	30.55
International	71.44	69.17	70.27	68.49	69.36
Japan	28.56	30.83	29.73	31.51	30.64
Europe	24.22	27.45	30.48	30.70	31.36
ROW	9.35	6.95	7.31	7.55	7.45

Source: Canon Incorporated  
Annual Reports



## 1989 SALES OFFICE LOCATIONS

North America—4  
Europe—13  
Asia/Pacific—6  
Japan—4  
ROW—3

## MANUFACTURING LOCATIONS

### *North America*

Canon Business Machines, Inc. (United States)  
Produces electronic typewriters and facsimiles, as well as copier and electronic typewriter consumables  
Canon Virginia, Inc. (United States)  
Manufactures copiers, laser printers, and printer consumables

### *Europe*

Canon Bretagne S.A. (France)  
Manufactures electronic typewriters and facsimile transceivers  
Canon Giessen GmbH (West Germany)  
Manufactures plain paper copiers

### *Asia/Pacific*

Canon Chemical Co., Inc. (Japan)  
Produces rollers and blades for copiers  
Canon Components, Inc. (Japan)  
Manufactures hybrid ICs and other high-tech components  
Canon Electronics, Inc. (Japan)  
Manufactures precision components such as floppy disk drives, magnetic heads, single lens reflex (SLR) components, and micrographics  
Canon Inc. (Taiwan) (Japan)  
Manufactures 35mm range-finder cameras and micromotors for audio products  
Canon Precision, Inc. (Japan)  
Manufactures micromotors used in audio products, video tape recorders, business machines, and computers  
Canon Seiko Co., Ltd. (Japan)  
Manufactures molded parts and electronic flash guns  
Copolyer Co. Ltd. (Japan)  
Manufactures copiers and copier supplies

Dai-ichi Seiki Kogyo Co., Ltd. (Japan)  
Produces cartridges and accessories for copiers  
Oita Canon Inc. (Japan)  
Manufactures 35mm range-finder cameras

## SUBSIDIARIES

### *North America*

Ambassador Office Equipment, Inc. (United States)  
Astro Office Products, Inc. (United States)  
Canon Canada Inc. (Canada)  
Canon U.S.A., Inc. (United States)  
MCS Business Machines Inc. (United States)

### *Europe*

Canon Business Machines Belgium N.V./S.A. (Belgium)  
Canon Copylux GmbH. (West Germany)  
Canon Espana S.A. (Spain)  
Canon Europa N.V. (Netherlands)  
Canon Euro-Photo Handelsgesellschaft m.b.H. (West Germany)  
Canon France S.A. (France)  
Canon Gesellschaft m.b.H. (West Germany)  
Canon Italia S.p.A. (Italy)  
Canon Photo Video France S.A. (France)  
Canon Rechner Deutschland GmbH. (West Germany)  
Canon Svenska AB (Sweden)  
Canon (UK) Ltd. (United Kingdom)  
Canon Verkooporganisatie Nederland B.V. (Netherlands)  
Oy Canon Ab (Finland)  
Selex France S.A. (France)

### *Asia/Pacific*

Canon Australia Pty. Ltd. (Australia)  
Canon Copyer Sales, Co., Ltd. (Japan)  
Canon Eiken Co., Inc. (Japan)  
Canon Hong Kong Trading Co., Ltd. (Hong Kong)  
Canon Marketing (Malaysia) Sdn. Bhd. (Malaysia)  
Canon Marketing Services Pte. Ltd. (Singapore)  
Canon Sales Co., Inc. (Japan)  
Canon Singapore Pte. Ltd. (Singapore)  
Canon Software Inc. (Japan)  
Canon System Sales Co., Inc. (Japan)

### *ROW*

Canon de Brasil Industria e Comercio Limitada (Brazil)  
Canon Latin America, Inc. (Panama)  
Canon Panama S.A. (Panama)

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## ALLIANCES, JOINT VENTURES, LICENSING AGREEMENTS

1989

### NeXT Incorporated

Canon agreed to be the exclusive distributor of NeXT computers in Asia.

### Software Limited

Software Limited agreed to distribute Canon's LBP-4 and LPB-8 III laser printers, as well as the BJ-130 Bubble-Jet printer, in the United Kingdom.

### Hewlett-Packard

Canon and Hewlett-Packard agreed to codevelop the specifications for a Japanese language version of the HP NewWave software.

### Hitachi, Ltd.

Canon agreed to market Hitachi's high-capacity PBXs (Private Branch Exchanges) in combination with its own Office Automation equipment.

### Adobe Systems

Canon licensed the Adobe Systems PostScript interpreter to implement into its own line of printers.

1988

### Apple Computers

Canon distributes 80 to 90 percent of all Apple computers sold in Japan.

### Eastman Kodak Company

Canon agreed to supply copiers and medical equipment to Kodak.

### Intel Corporation

Canon and Intel agreed to jointly develop specialized large-scale integration for copiers. Canon has cosigned production to Intel.

### Nippon Typewriter Co., Ltd.

Nippon commissioned the production of Canon's LBP-ST, a compact laser printer.

### Ricoh Co., Ltd.

Canon and Ricoh agreed to OEM supply each other with plain paper copiers in order to supplement their respective copier lines.

### Computer Automation

Canon acquired the patent rights for micro channel technology from Computer Automation.

1987

### Siemens

Canon agreed to supply facsimiles and original bubble-jet printers to Siemens on an OEM and technology license basis.

### Olivetti S.p.A. Inc.

Olivetti-Canon Industriale S.p.A. was established by Canon and Olivetti to produce plain paper copiers and laser printers.

### National Semiconductor Corporation

National and Canon formed a technology agreement. The first by-product of this agreement is the 1989 LBP-8 Mark III model laser printers.

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## MERGERS AND ACQUISITIONS

1989

### NeXT Incorporated

Canon purchased a 16.7 percent interest in NeXT stock, valued at \$100 million.

### New Zealand Canon

DRG sold its New Zealand Canon business machines operations for NZD\$13.25 million to a newly established subsidiary of Canon.

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## KEY OFFICERS

### Ryuzaburo Kaku

Chairman and representative director

### Dr. Keizo Yamaji

President and representative director

### Hajime Mitarai

Senior managing and representative director

### Kazuo Naito

Senior managing director

### Hiroshi Tanaka

Senior managing director

### Fujio Mitarai

Senior managing director

### Shigeru Nishioka

Senior managing director

### Torakiyo Yamanaka

Managing director

### Masahiro Tanaka

Managing director

**Hideharo Takemoto**  
Managing director

**Takeshi Mitarai**  
Managing director

**Tsuneo Enome**  
Managing director

**Giichi Marushima**  
Managing director

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## **PRINCIPAL INVESTORS**

Dai-Ichi Mutual Life Insurance Co.—6.7 percent  
Mitsubishi Trust & Banking Co., Ltd.—4.4 percent  
Sumitomo Trust & Banking Co., Ltd.—4.0 percent  
Fuji Bank Ltd.—3.5 percent  
Yasuda Trust & Banking Co., Ltd.—3.2 percent

**Table 3**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending December**  
**(Millions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	\$3,061.9	\$4,239.2	\$5,703.2	\$7,499.0	\$8,731.8
Cash	742.0	806.2	1,740.0	3,033.7	3,729.1
Receivables	701.6	1,002.5	1,125.7	1,512.8	1,758.3
Marketable Securities	489.8	734.1	1,061.5	412.5	210.6
Inventory	983.3	1,473.7	1,513.2	2,167.6	2,494.8
Other Current Assets	145.2	222.7	262.9	372.5	538.9
Net Property, Plants	\$902.8	\$1,373.3	\$1,630.2	\$1,999.5	\$2,191.5
Other Assets	\$231.9	\$377.9	\$477.9	\$647.8	\$941.4
<b>Total Assets</b>	<b>\$4,196.5</b>	<b>\$5,990.4</b>	<b>\$7,811.2</b>	<b>\$10,146.3</b>	<b>\$11,864.7</b>
Total Current Liabilities	\$2,004.2	\$2,680.9	\$3,303.1	\$4,695.7	\$5,172.6
Long-Term Debt	\$563.3	\$989.3	\$1,534.7	\$1,608.6	\$2,012.4
Other Liabilities	\$46.4	\$64.8	\$75.1	\$84.9	\$83.0
<b>Total Liabilities</b>	<b>\$2,613.9</b>	<b>\$3,735.0</b>	<b>\$4,913.0</b>	<b>\$6,389.2</b>	<b>\$7,268.0</b>
Total Shareholders' Equity	\$1,582.7	\$2,255.4	\$2,898.2	\$3,757.1	\$4,596.7
Common Stock	726.4	1,079.3	1,517.4	1,845.6	2,367.7
Other Equity	212.8	301.7	396.0	574.6	668.1
Retained Earnings	688.2	990.7	1,190.2	1,575.7	1,669.5
Currency Adjustments	(44.8)	(116.3)	(205.4)	(238.8)	(108.5)
<b>Total Liabilities and Shareholders' Equity</b>	<b>\$4,196.5</b>	<b>\$5,990.4</b>	<b>\$7,811.2</b>	<b>\$10,146.3</b>	<b>\$11,864.7</b>
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	\$4,006.8	\$5,276.6	\$6,728.5	\$8,633.3	\$9,794.9
Japan	1,144.3	1,627.0	2,000.4	2,720.0	3,000.7
International	2,862.5	3,649.7	4,728.1	5,913.3	6,794.3
Cost of Sales	\$1,603.4	\$2,346.6	\$3,248.8	\$4,493.5	\$4,258.5
R&D Expense	\$207.3	\$328.3	\$393.3	\$51.1	\$547.9
SG&A Expense	\$1,439.0	\$1,941.1	\$2,330.1	\$2,942.1	\$3,369.7
Capital Expense	\$384.7	\$482.3	\$437.4	\$648.4	\$777.9
Pretax Income	\$355.4	\$164.7	\$277.2	\$670.0	\$660.5
Pretax Margin (%)	8.87	3.12	4.12	7.76	6.74
Effective Tax Rate (%)	53.40	64.60	62.70	62.70	50.80
Net Income	\$155.3	\$63.7	\$91.1	\$289.6	\$277.6
Shares Outstanding, Thousands	661,142	678,280	679,140	612,489	780,546
<b>Per Share Data</b>					
Earnings	\$0.25	\$0.11	\$0.15	\$0.40	\$0.36
Dividend	\$0.05	\$0.05	\$0.07	\$0.09	\$0.09
Book Value	\$0.0024	\$0.0033	\$0.0043	\$0.0061	\$0.0059
Exchange Rate (US\$1=¥)	¥238.54	¥168.52	¥145.16	¥128.11	¥137.92

Source: Canon Incorporated  
Annual Reports  
Dataquest (1990)

**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending December**  
**(Millions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	¥730,374	¥714,393	¥827,878	¥960,699	¥1,204,283
Cash	176,987	135,860	252,576	388,645	514,312
Receivables	167,359	168,946	163,410	193,800	242,511
Marketable Securities	116,838	123,717	154,085	52,843	29,052
Inventory	234,545	248,349	219,649	277,691	344,077
Other Current Assets	34,645	37,521	38,158	47,720	74,331
Net Property, Plants	¥215,360	¥231,242	¥236,637	¥256,151	¥302,258
Other Assets	¥55,310	¥63,687	¥69,366	¥82,993	¥129,839
<b>Total Assets</b>	<b>¥1,001,044</b>	<b>¥1,009,504</b>	<b>¥1,133,881</b>	<b>¥1,299,843</b>	<b>¥1,636,380</b>
Total Current Liabilities	¥478,092	¥451,780	¥479,483	¥601,562	¥713,399
Long-Term Debt	¥134,366	¥166,722	¥222,784	¥206,083	¥277,556
Other Liabilities	¥11,060	¥10,921	¥10,908	¥10,879	¥11,447
<b>Total Liabilities</b>	<b>¥623,518</b>	<b>¥629,423</b>	<b>¥713,175</b>	<b>¥818,524</b>	<b>¥1,002,402</b>
Total Shareholders' Equity	¥377,526	¥380,081	¥420,706	¥481,319	¥633,978
Common Stock	173,277	181,892	220,273	236,443	326,547
Other Equity	50,765	50,838	57,478	73,607	92,146
Retained Earnings	164,161	166,947	172,766	201,866	230,252
Currency Adjustments	(10,677)	(19,596)	(29,811)	(30,597)	(14,967)
<b>Total Liabilities and Shareholders' Equity</b>	<b>¥1,001,044</b>	<b>¥1,009,504</b>	<b>¥1,133,881</b>	<b>¥1,299,843</b>	<b>¥1,636,380</b>
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	¥955,780	¥889,217	¥976,711	¥1,106,010	¥1,350,917
Japan	272,966	274,174	290,382	348,462	413,854
International	682,814	615,043	686,329	757,548	937,063
Cost of Sales	¥382,481	¥395,445	¥471,592	¥575,659	¥587,329
R&D Expense	¥49,461	¥55,330	¥57,085	¥6,552	¥75,566
SG&A Expense	¥343,269	¥327,108	¥338,231	¥376,915	¥464,747
Capital Expense	¥91,763	¥81,273	¥63,497	¥83,069	¥107,290
Pretax Income	¥84,780	¥27,759	¥40,237	¥85,829	¥91,091
Pretax Margin (%)	8.87	3.12	4.12	7.76	6.74
Effective Tax Rate (%)	53.40	64.60	62.70	62.70	50.80
Net Income	¥37,056	¥10,728	¥13,224	¥37,100	¥38,293
Shares Outstanding, Thousands	661,142	678,280	679,140	612,489	780,546
<b>Per Share Data</b>					
Earnings	¥58.72	¥18.34	¥21.61	¥51.27	¥49.31
Dividend	¥12.50	¥12.50	¥10.00	¥11.36	¥11.93
Book Value	¥0.57	¥0.56	¥0.62	¥0.79	¥0.81

**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending December**  
**(Millions of Yen, except Per Share Data)**

<b>Key Financial Ratios</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
<i>Liquidity</i>					
Current (Times)	1.53	1.58	1.73	1.60	1.69
Quick (Times)	1.04	1.03	1.27	1.14	1.21
Fixed Assets/Equity (%)	57.05	60.89	56.25	53.22	47.68
Current Liabilities/Equity (%)	126.64	118.86	113.97	124.98	112.53
Total Liabilities/Equity (%)	165.16	165.60	169.52	170.06	158.11
<i>Profitability (%)</i>					
Return on Assets	-	1.07	1.32	3.05	2.61
Return on Equity	-	2.83	3.30	8.23	6.87
Profit Margin	3.88	1.21	1.35	3.35	2.83
<i>Other Key Ratios</i>					
R&D Spending % of Revenue	5.17	6.22	5.84	0.59	5.59
Capital Spending % of Revenue	9.60	9.14	6.50	7.51	7.94
Employees	34,129	35,498	37,521	37,521	44,400
Revenue (¥K)/Employee	¥28,005	¥25,050	¥26,031	¥29,477	¥30,425
Capital Spending % of Assets	9.17	8.05	5.60	6.39	6.56
Exchange Rate (US\$1=¥)	¥238.54	¥168.52	¥145.16	¥128.11	¥137.92

Source: Canon Incorporated  
Annual Reports  
Dataquest (1990)

## Casio Computer Co., Ltd.

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Shinjuku-ku, Tokyo 163, Japan

Telephone: (03) 347-4803

Fax: (03) 348-3629

Dun's Number: 05-185-7019

*Date Founded: 1957*

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### CORPORATE STRATEGIC DIRECTION

Casio Computer Co., Ltd., was founded in Tokyo in 1946 by four Kashio brothers. (The name *Casio* is the Anglicized version of the surname *Kashio*.) In 1957, following Toshio Kashio's invention of the electric calculator, the brothers organized Casio as Japan's only manufacturer specializing in electric calculators. The development of semiconductor technology made possible the electronic calculator. Casio introduced the first electronic desktop calculator with memory in 1965 and remains a leading innovator in electronic calculator technology.

Casio relies on advanced technologies to develop and produce high-quality, multifunctional electronic products for both consumer and business markets. In addition to advanced calculators for business and science, Casio manufactures digital and analog watches and clocks, electronic musical keyboards and synthesizers, liquid crystal display pocket televisions, music systems, office equipment, and electronic cash registers.

Casio markets its products worldwide in more than 140 countries. The Company operates international divisions and units in the United States, Canada, the United Kingdom, Germany, Taiwan, and South Korea. In 1986, Casio established Casio Europe B.V., headquartered in Amsterdam, to coordinate sales to all European countries other than Great Britain and Germany. Casio, Inc., headquartered in New Jersey, is the American subsidiary of Casio Computer Co., Ltd. This unit generates about 23 percent of Casio's worldwide sales.

Casio's consolidated revenue of ¥270.8 billion (US\$2.1 billion) in the period ending March 31, 1989, increased 9 percent from ¥248.4 billion (US\$1.8 billion) in fiscal 1988. (Percentage changes

refer only to ¥ amounts; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) Net income increased 37.5 percent to ¥6.6 billion (US\$51.8 million) in fiscal 1989, compared with ¥4.8 billion (US\$35.0 million) in 1988.

R&D expenditure increased to ¥10.4 billion (US\$81.3 million), or 3.8 percent of total sales. Total capital investment was ¥22.6 billion (US\$176.1 million). The Japanese domestic sales contribution to Casio's total revenue was ¥96.0 billion (US\$748.5 million) for fiscal 1989, which represented 35 percent of sales.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information regarding revenue by distribution channel is not available. Tables 3 and 4, comprehensive financial statements, are at the end of this backgrounder.

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### BUSINESS SEGMENT STRATEGIC DIRECTION

#### Consumer Products

The calculator division is dedicated to applying Casio's technology to high-performance products. Casio's Digital Diaries, with expanded memory capacity and wide displays, have been especially successful in the domestic Japanese market. Worldwide sales for this division totaled ¥103.6 billion (US\$807.8 million), or about 38 percent of total revenue.

In the digital timepiece segment, Casio offers a wide range of products. In fiscal 1989, Casio established a

manufacturing facility in South Korea for full-scale production of digital and analog watches. Casio has developed the Data Bank series of watches, which are capable of storing telephone numbers and dialing them automatically when held to a standard touch-tone telephone. This division contributed 22 percent of Casio's sales with revenue of ¥60 billion (US\$467.8 million).

Casio also sells a wide range of products through its electronic musical instrument division. In both the domestic and international markets, a new line of electronic keyboards featuring Casio's newly developed Casio Dynamic (CD) sound source has been offered. This division also creates a wide selection of products for performing musicians, including advanced digital synthesizers and guitar synthesizers. Total sales reached ¥36.5 billion (US\$284.6 million) and represented 14 percent of Casio's total revenue.

The electronic office equipment and other divisions earned revenue of ¥70.8 billion (US\$552 million) and represented 26 percent of Casio's sales. In the personal computer market, the Company focuses its efforts on the development and marketing of computers that feature the UNIX operating system. The computers are capable of networking and high-speed data processing. In fiscal 1989, Casio introduced its Active Data Processing System (ADPS) product. The ADPS R1 is capable of automated data processing without the necessity of programming. Casio values ADPS as a strategic product and aims to expand its business activities by making use of ADPS in the Company's overall business foundation.

#### Further Information

For further information about Casio's business segments, please contact Dataquest's Japanese Semiconductor Application Markets Service.



**Table 1**  
**Corporate Highlights\*** (Millions of US Dollars)

	1988	1989		
Two-Year Revenue	\$1,799.6	\$2,111.7		
Percent Change	-	17.34		
Capital Expenditure	\$169.1	\$176.1		
Percent of Revenue	9.40	8.34		
R&D Expenditure	\$89.8	\$81.3		
Percent of Revenue	4.99	3.85		
Number of Employees	NA	NA		
Revenue (\$K)/Employee	NA	NA		
Net Income	\$35.0	\$51.8		
Percent Change	-	48.00		
Exchange Rate (US\$1=¥)	¥138.03	¥128.25		
1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	NA	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

\*Financial information for 1985 through 1987 is not available.  
 NA = Not available

Source: Casio Computer Co., Ltd.  
 Annual Reports  
 Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1988	1989
Japan	NA	35.00
International	NA	65.00

NA = Not available

Source: Casio Computer Co., Ltd.  
 Annual Reports  
 Dataquest (1990)

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## 1989 SALES OFFICE LOCATIONS

Information is not available.

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## MANUFACTURING LOCATIONS

### *North America*

Casio Manufacturing Corporation (United States)  
Musical instruments

### *Asia/Pacific*

Casio Korea Co., Ltd. (South Korea)  
Watches  
Kofu Product Control and Technical Center (Japan)  
Function not available  
Ome Product Control and Technical Center (Japan)  
Function not available  
Tokyo Product Control and Technical Center (Japan)  
Function not available

### *ROW*

Casio Electromex SA CV (Mexico)  
Function not available

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## SUBSIDIARIES

### *North America*

Casio Canada Limited (Canada)  
Casio, Inc. (United States)

### *Europe*

Casio Computer Co., GmbH Deutschland (Germany)  
Casio Electronics Co., Ltd. (United Kingdom)  
Casio Europe B.V. (Netherlands)

### *Asia/Pacific*

Aichi Casio Co., Ltd (Japan)  
Casio Central System Corporation (Japan)  
Casio Computer (Hong Kong), Ltd. (Hong Kong)  
Casio Electronics Manufacturing Co., Ltd. (Japan)

Casio Information Service Co., Ltd. (Japan)  
Casio Korea Co., Ltd. (South Korea)  
Casio Micronics Co., Ltd. (Japan)  
Casio System Development Co., Ltd. (Japan)  
Casio Taiwan, Ltd. (Taiwan)  
Keiji Casio Co., Ltd. (Japan)  
Kofu Casio Co., Ltd. (Japan)  
Kyowa Seiki Co., Ltd. (Japan)  
Osaka Minami Casio Co., Ltd. (Japan)  
The Casio Lease Co., Ltd. (Japan)  
Yamagata Casio Co., Ltd. (Japan)  
Yamato Seimitsu Industrial Co., Ltd. (Japan)  
Yokohama Casio Systems Co., Ltd. (Japan)

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## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

### *1990*

#### **Sogo Data Center**

Casio Computer Co., Ltd., plans to purchase a 35 percent stake in Sogo Data Center, a software development firm located in Tokyo. Sogo Data Center develops systems for financial organizations.

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## MERGERS AND ACQUISITIONS

Casio has not participated in any mergers or acquisitions.

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## KEY OFFICERS

**Toshio Kashio**  
Chairman

**Kazuo Kashio**  
President

**Tadao Kashio**  
Senior advisor

**Yukio Kashio**  
Senior managing director

**Toshio Kohzai**  
Senior managing director

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**PRINCIPAL INVESTORS**

Information is not available.

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**FOUNDERS**

Toshio Kashio  
Kazuo Kashio  
Tadao Kashio  
Yukio Kashio

Table 3  
 Comprehensive Financial Statement\*  
 Fiscal Year Ending March  
 (Millions of US Dollars, except Per Share Data)

Balance Sheet	1988	1989
Total Current Assets	\$1,312.7	\$1,898.5
Cash	562.0	879.7
Receivables	347.9	392.5
Marketable Securities	70.5	58.1
Inventory	297.8	512.8
Other Current Assets	34.5	55.4
Net Property, Plants	\$519.7	\$565.0
Other Assets	\$108.2	\$148.1
Total Assets	\$1,940.6	\$2,611.6
Total Current Liabilities	\$778.2	\$789.9
Long-Term Debt	\$295.6	\$701.7
Other Liabilities	\$32.3	\$36.3
Total Liabilities	\$1,106.6	\$1,527.9
Total Shareholders' Equity	\$834.0	\$1,083.7
Converted Preferred Stock	0	0
Common Stock	173.0	273.6
Other Equity	356.4	475.1
Retained Earnings	304.6	335.0
Total Liabilities and Shareholders' Equity	\$1,940.6	\$2,611.6
Income Statement	1988	1989
Revenue	\$1,799.6	\$2,111.7
Japan	NA	748.5
International	NA	1363.2
Cost of Sales	\$1,370.5	\$1,469.4
R&D Expense	\$89.8	\$81.3
SG&A Expense	\$377.1	\$459.6
Capital Expense	\$169.1	\$176.1
Pretax Income	\$78.5	\$102.7
Pretax Margin (%)	4.36	4.86
Effective Tax Rate (%)	56.00	56.00
Net Income	\$35.0	\$51.8
Shares Outstanding, Millions	NA	NA
Per Share Data	NA	NA
Earnings	NA	NA
Dividend	NA	NA
Book Value	NA	NA
Exchange Rate (US\$=¥)	¥138.03	¥128.25

\*Financial information for 1985 through 1987 is not available.  
 NA = Not available

Source: Casio Computer Co., Ltd.  
 Annual Reports  
 Dataquest (1990)

**Table 4**  
**Comprehensive Financial Statement\***  
**Fiscal Year Ending March**  
**(Millions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1988</b>	<b>1989</b>
<b>Total Current Assets</b>	<b>¥181,186.0</b>	<b>¥243,479.0</b>
Cash	77,568.0	112,827.0
Receivables	48,015.0	50,334.0
Marketable Securities	9,732.0	7,445.0
Inventory	41,107.0	65,765.0
Other Current Assets	4,764.0	7,108.0
<b>Net Property, Plants</b>	<b>¥71,732.0</b>	<b>¥72,457.0</b>
<b>Other Assets</b>	<b>¥14,947.0</b>	<b>¥19,003.0</b>
<b>Total Assets</b>	<b>¥267,865.0</b>	<b>¥334,939.0</b>
<b>Total Current Liabilities</b>	<b>¥107,409.0</b>	<b>¥101,303.0</b>
<b>Long-Term Debt</b>	<b>¥40,801.0</b>	<b>¥89,988.0</b>
<b>Other Liabilities</b>	<b>¥4,545.0</b>	<b>¥4,657.0</b>
<b>Total Liabilities</b>	<b>¥152,755.0</b>	<b>¥195,948.0</b>
<b>Total Shareholders' Equity</b>	<b>¥115,110.0</b>	<b>¥138,991.0</b>
Converted Preferred Stock	0	0
Common Stock	23,876.0	35,087.0
Other Equity	49,193.0	60,935.0
Retained Earnings	42,041.0	42,969.0
<b>Total Liabilities and Shareholders' Equity</b>	<b>¥267,865.0</b>	<b>¥334,939.0</b>
<b>Income Statement</b>	<b>1988</b>	<b>1989</b>
<b>Revenue</b>	<b>¥248,405.0</b>	<b>¥270,821.0</b>
Japanese	NA	94,787.4
International	NA	176,033.6
<b>Cost of Sales</b>	<b>¥175,772.0</b>	<b>¥188,448.0</b>
<b>R&amp;D Expense</b>	<b>¥12,394.0</b>	<b>¥10,425.0</b>
<b>SG&amp;A Expense</b>	<b>¥52,057.0</b>	<b>¥58,950.0</b>
<b>Capital Expense</b>	<b>¥23,337.0</b>	<b>¥22,590.0</b>
<b>Pretax Income</b>	<b>¥10,837.0</b>	<b>¥13,173.0</b>
<b>Pretax Margin (%)</b>	<b>4.36</b>	<b>4.86</b>
<b>Effective Tax Rate (%)</b>	<b>56.00</b>	<b>56.00</b>
<b>Net Income</b>	<b>¥4,832.0</b>	<b>¥6,644.0</b>
<b>Shares Outstanding, Millions</b>	<b>NA</b>	<b>NA</b>
<b>Per Share Data</b>	<b>NA</b>	<b>NA</b>
Earnings	NA	NA
Dividends	NA	NA
Book Value	NA	NA

**Table 4 (Continued)**  
**Comprehensive Financial Statement\***  
**Fiscal Year Ending March**  
**(Millions of Yen, except Per Share Data)**

<b>Key Financial Ratios</b>	<b>1988</b>	<b>1989</b>
<i>Liquidity</i>		
Current (Times)	1.69	2.40
Quick (Times)	1.30	1.75
Fixed Assets/Equity (%)	62.32	52.13
Current Liabilities/Equity (%)	93.31	72.88
Total Liabilities/Equity (%)	132.70	140.98
<i>Profitability (%)</i>		
Return on Assets	-	2.20
Return on Equity	-	5.23
Profit Margin	1.95	2.45
<i>Other Key Ratios</i>		
R&D Spending % of Revenue	4.99	3.85
Capital Spending % of Revenue	9.39	8.34
Employees		
Revenue (\$K)/Employee	NA	NA
Capital Spending % of Assets	8.71	6.74

\*Financial information for 1985 through 1987 is not available.  
 NA = Not available

Source: Casio Computer Co., Ltd.  
 Annual Reports  
 Dataquest (1990)

## Fuji Electric Co., Ltd.

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Tokyo 100, Japan

Telephone: Tokyo 211-7111

Telex: J22331 FUJIELEA or FUJIELEB

Fax: (03) 215-8321

Dun's Number: 05-667-2785

*Date Founded: 1923*

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### CORPORATE STRATEGIC DIRECTION

Since its founding in 1923, Fuji Electric Co., Ltd., has been supplying high-quality products to a wide variety of industries. Expanding outward while maintaining its base as a heavy electrical manufacturer, the Company has achieved leading market positions in products such as uninterruptible power supplies, inverters, high-voltage silicon diodes, and vending machines.

Fuji Electric's business is organized into five divisions: Heavy Electrical; Systems; Electronic Devices; Motors, Drives, and Controls; and Vending Machines and Specialty Appliances. The Heavy Electrical Division manufactures thermal power plant equipment, hydroelectric power plant equipment, nuclear power plant equipment, electric motors, transformers, computer control equipment, and other heavy electrical equipment. This division was responsible for approximately 37.3 percent of total revenue, or ¥286.7 billion (US\$2.0 billion) for fiscal year ended March 1990.

The Systems Division was responsible for 11.0 percent of total revenue, or ¥84.5 billion (US\$593.4 million) for year ended March 1990. Products in this division include industrial measuring instruments and instrumentation, remote control equipment, analyzers, radiation monitoring equipment, microcomputers, microcontrollers, video sensors, laser devices, industrial robots, automated transport systems, and clean room systems.

The Electronic Devices Division accounted for 13.8 percent of total revenue, or ¥106.1 billion (US\$744.5 million) for year ended March 1990. Products include power transistors, high-voltage

silicon diodes, thyristors, application-specific ICs (ASICs), LSIs, hybrid ICs, surge absorbers, semiconductors, sensors, photoconductive drums for copiers, printers, hard-disk drives, magnetic recording disks, and watt-hour meters.

Products in the Motors, Drives, and Controls Division include induction motors, variable-speed controlled motors, brake and geared motors, pumps, fans and blowers, inverters, servomotor systems, small precision motors, magnetic contractors, and molded case circuit breakers. This division accounted for 20.5 percent of total revenue, or ¥157.6 billion (US\$1.1 billion) for year ended March 1990.

The Vending Machines and Specialty Appliances Division accounted for 17.4 percent of revenue, totaling ¥133.7 billion (US\$938.7 million) for fiscal year ended March 1990. Products include vending machines, coin and currency mechanisms, bill validators, beverage dispensers, tea servers, open freezer and refrigerating showcases, and the Hotel Vendor System.

Consolidated revenue totaled ¥768.6 billion (US\$5.4 billion) for fiscal year ended March 1990, which was a 13.0 percent increase over the previous year's figure of ¥680.2 billion (US\$5.3 billion). (Percentage changes refer only to ¥ amounts; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) This increase was fueled by a 15.7 percent increase in revenue from the Electronic Devices Division and a 13.7 percent increase in Systems Division revenue.

Net income increased 46.2 percent to ¥13.9 billion (US\$97.6 million) in year ended March 1990, from ¥9.5 billion (US\$74.2 million). The increase is

partially due to the continued expansion of the Japanese economy, supported by stable personal consumption and brisk investment in plants and equipment by the private sector. However, increased effectiveness on the part of the Company's sales organization, shorter lead times for new products, and improved manufacturing capabilities all contributed to the increase in net income.

R&D increased 17.6 percent to ¥28.7 billion (US\$201.4 million) during year ended March 1990 from ¥24.4 billion (US\$190.3) in the previous year. These figures respectively represented 3.7 percent and 3.6 percent of revenue. The R&D focus was on integrated circuits and fuel cells.

Capital expenditure totaled ¥25.3 billion (US\$177.6 million), representing 3.3 percent of revenue for year ended March 1990. This is an increase of 14.5 percent over the previous year's total of ¥22.1 billion (US\$172.3 million). Part of the investment went toward constructing computer-integrated manufacturing (CIM) facilities that will enable the Company to manufacture and ship magnetic switches within 24 hours after receiving an order. Other product lines singled out for concentrated investment included the TWIN BREAKER, magnetic recording disks, and vending machines. Fuji Electric Co. employed 19,830 people at the close of March 1990.

More detailed information is available in Table 1, which appears after "Business Segment Strategic Direction" and presents corporate highlights. Information on revenue by region and distribution channel is not available. Tables 2 and 3, comprehensive financial statements, are at the end of this background.

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## BUSINESS SEGMENT STRATEGIC DIRECTION

### Systems

In the Systems Division, information systems and instrumentation and control posted growth in all major product areas: distributed control systems, MICREX microcontrollers, the Ace and FASMIC G series of 32-bit superminicomputers, pressure and

differential pressure transmitters, electromagnetic and ultrasonic flowmeters, compact controllers, and general-purpose temperature controllers.

Industrial equipment posted significant increases in orders due to large capital investments by semiconductor and precision equipment manufacturers. Uninterruptible power supply orders increased nearly 33 percent. Factory automation and control components also posted increases. The Company offers a complete lineup of equipment, systems, and personal computers for both flexible manufacturing and CIM.

### Electronic Devices

The Company strategy for the integrated circuit (IC) market stresses technology specialization and the development of niche markets. Recent successes include such devices as autofocus ICs for cameras and high-voltage driver ICs for flat-panel displays and thermal printheads. During the past year, the Company implemented a strategy of augmenting its custom IC activities with the production of application-specific standard product ICs in order to increase the Company's client base.

Dataquest estimates that Fuji Electric captured less than 1 percent of the total worldwide semiconductor market for calendar year 1989. However, Dataquest estimates that Fuji Electric ranked ninth and had 3.7 percent of the worldwide total discrete market based on ¥41.0 billion (US\$287.0 million) in revenue for calendar year 1989.

The Company's computer peripherals products are 3.5-inch hard-disk drives and 3.5- and 5.25-inch thin-film sputtered magnetic recording disks. Both segments exhibited strong growth in the past year.

### Further Information

For further information about the Company's business segments, please contact the appropriate Dataquest industry service.



**Table 1**  
**Corporate Highlights\* (Millions of Dollars)**

	1988	1989	1990	
Three-Year Revenue	\$4,037.1	\$5,303.6	\$5,394.8	
Percent Change	-	31.37	1.72	
Capital Expenditure	\$109.4	\$172.3	\$177.6	
Percent of Revenue	2.71	3.25	3.29	
R&D Expenditure	\$163.7	\$190.3	\$201.4	
Percent of Revenue	4.06	3.59	3.73	
Number of Employees	NA	19,248	19,830	
Revenue (\$K)/Employee	-	\$276	\$272	
Net Income	\$48.6	\$74.2	\$97.6	
Percent Change	-	52.77	31.59	
Exchange Rate (US\$1=¥)	¥138.03	¥128.25	¥142.47	
1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	NA	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

NA = Not available

\*No fiscal 1986 and 1987 information is available because consolidated reports were not generated during those years.

Source: Fuji Electric Co., Ltd.  
 Annual Reports and Forms 10-K  
 Dataquest (1990)

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## 1990 SALES OFFICE LOCATIONS

North America—4

Europe—3

Asia/Pacific—34

ROW—3

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## MANUFACTURING LOCATIONS

### *North America*

Fuji Cone, Inc., United States

Paper cones for stereo speakers

Fuji Copian Corp., United States

Printer ribbon cartridges

Fuji Foods Inc., United States

Soup mixes, flavors

Fuji High-Tech, Inc., United States

Power supplies for magnetic disk equipment

Fuji Koki America Inc., United States

Expansion valves for automotive air-conditioning systems

U.S. Fuji Electric, United States

Photoconductive drums for copiers

### *Asia/Pacific*

Chiba Factory (Japan)

Transformers, cubicle-type gas-insulated switchgears, medium and small power supply equipment, fuel cells, and solar power generation systems

Fukui Factory (Japan)

Magnetic starters and contactors, circuit breakers, control relays, programmable controllers, and data transmission instruments

Kawasaki Factory (Japan)

Hydraulic and thermal power generation equipment, large rotating electric machinery, and circuit breakers

Kobe Factory (Japan)

Controls and switchgears, power supplies, and control equipment for motors

Matsumoto Factory (Japan)

Semiconductor elements and devices, photoconductive drums, solar cells, coin-handling and bill-validator mechanisms, external computer memories, watt-hour meters, demand meters, etc.

Mie Factory (Japan)

Vending machines, automatic servers, freezing and refrigerating showcases, hotel vending systems, solar equipment, small and precision motors, ring blowers, servo systems, medical treatment equipment, etc.

Ohtawara Factory (Japan)

Earth leakage circuit breakers, molded-case circuit breakers, timers, proximity switches, optical sensors, gas detectors, etc.

Suzuka Factory (Japan)

Medium-size motors and generators, induction furnaces, heating systems, compressors, and fans

Tokyo Factory (Japan)

Measuring instruments and analyzing equipment

### *ROW*

Fuji Electric Nordeste, Brazil

Instrument panels and industrial instruments

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## SUBSIDIARIES

### *North America*

Fuji Electric Corp. of America (United States)

Fuji Hi-Tech, Inc. (United States)

U.S. Fuji Electric Inc. (United States)

### *Europe*

Fuji Electric GmbH (Germany)

### *Asia/Pacific*

Fuji Electric Singapore Pte., Ltd. (Singapore)

Fuji/GE Private Ltd. (Singapore)

Hong Kong Fuji Denki Co., Ltd. (Hong Kong)

### *ROW*

Fuji Electric do Brasil Industria E Comercio Ltda. (Brazil)

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## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

### *1990*

#### *Astro Technology*

Astro Technology will market a powerful new chip placer from Fuji in the United Kingdom.

**Korean FA Systems Co., Ltd. (KFA)**

Fuji will invest in KFA. Fuji hopes that the move will allow it to cope with an increasing demand for factory automation (FA) system software.

1989

**IIMAK**

IIMAK is licensed to sell and manufacture thermal transfer products and ribbons in North America.

**BASF**

The companies have a joint partnership to build a facility for 3.5-inch microfloppy disks for the North American market.

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**MERGERS AND ACQUISITIONS**

1989

**Crosfield Electronics**

Fuji Photo Film and Du Pont agreed to acquire the electronic prepress division of Crosfield Electronics.

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**KEY OFFICERS**

**Hideo Abe**

Chairman and representative director

**Takeshi Nakao**

President and representative director

**Yoshihiko Nakazato**

Executive vice president and representative director

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**PRINCIPAL INVESTORS**

Information is not available.

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**FOUNDERS**

Information is not available.

**Table 2**  
**Comprehensive Financial Statement\***  
**Fiscal Year Ending March**  
**(Millions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
<b>Total Current Assets</b>	<b>\$3,594.5</b>	<b>\$4,361.0</b>	<b>\$4,205.6</b>
Cash	781.3	816.4	682.7
Receivables	1,141.1	1,522.9	1,512.2
Marketable Securities	430.1	538.2	511.3
Inventory	912.1	1,166.4	1,149.6
Other Current Assets	329.9	317.2	349.8
<b>Net Property, Plants</b>	<b>\$750.7</b>	<b>\$913.9</b>	<b>\$937.4</b>
<b>Other Assets</b>	<b>\$313.5</b>	<b>\$331.3</b>	<b>\$329.9</b>
<b>Total Assets</b>	<b>\$4,658.8</b>	<b>\$5,606.2</b>	<b>\$5,472.9</b>
<b>Total Current Liabilities</b>	<b>\$3,101.4</b>	<b>\$3,768.3</b>	<b>\$3,793.8</b>
<b>Long-Term Debt</b>	<b>\$554.5</b>	<b>\$560.6</b>	<b>\$425.9</b>
<b>Other Liabilities</b>	<b>\$139.2</b>	<b>\$216.9</b>	<b>\$212.5</b>
<b>Total Liabilities</b>	<b>\$3,795.2</b>	<b>\$4,545.8</b>	<b>\$4,432.2</b>
<b>Total Shareholders' Equity</b>	<b>\$863.6</b>	<b>\$1,060.4</b>	<b>\$1,040.7</b>
Common Stock	305.9	351.7	326.7
Other Equity	275.4	325.3	308.0
Retained Earnings	282.3	383.4	405.9
<b>Total Liabilities and Shareholders' Equity</b>	<b>\$4,658.8</b>	<b>\$5,606.2</b>	<b>\$5,472.9</b>
<b>Income Statement</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
<b>Revenue</b>	<b>\$4,037.1</b>	<b>\$5,303.6</b>	<b>\$5,394.8</b>
<b>Cost of Sales</b>	<b>\$3,187.3</b>	<b>\$4,159.4</b>	<b>\$4,197.3</b>
<b>R&amp;D Expense</b>	<b>\$163.7</b>	<b>\$190.3</b>	<b>\$201.4</b>
<b>SG&amp;A Expense</b>	<b>\$736.7</b>	<b>\$898.5</b>	<b>\$928.7</b>
<b>Capital Expense</b>	<b>\$109.4</b>	<b>\$172.3</b>	<b>\$177.6</b>
<b>Pretax Income</b>	<b>\$144.4</b>	<b>\$221.0</b>	<b>\$232.1</b>
<b>Pretax Margin (%)</b>	<b>3.58</b>	<b>4.17</b>	<b>4.30</b>
<b>Effective Tax Rate (%)</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>
<b>Net Income</b>	<b>\$48.6</b>	<b>\$74.2</b>	<b>\$97.6</b>
<b>Shares Outstanding, Millions</b>	<b>678.8</b>	<b>699.7</b>	<b>709.1</b>
<b>Per Share Data</b>			
Earnings	\$0.07	\$0.11	\$0.14
Dividend	\$0.04	\$0.05	\$0.05
Book Value	\$1.27	\$1.52	\$1.47
<b>Exchange Rate (US\$1=¥)</b>	<b>¥138.03</b>	<b>¥128.25</b>	<b>¥142.47</b>

NA = Not available

\*No fiscal 1986 and 1987 information is available because consolidated reports were not generated during those years.

Source: Fuji Electric Co., Ltd.  
Annual Reports and Forms 10-K  
Dataquest (1990)

**Table 3**  
**Comprehensive Financial Statement\***  
**Fiscal Year Ending March**  
**(Millions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
<b>Total Current Assets</b>	¥496,150.0	¥559,303.0	¥599,168.0
Cash	107,838.0	104,697.0	97,259.0
Receivables	157,512.0	195,315.0	215,439.0
Marketable Securities	59,362.0	69,024.0	72,842.0
Inventory	125,898.0	149,587.0	163,787.0
Other Current Assets	45,540.0	40,680.0	49,841.0
<b>Net Property, Plants</b>	¥103,626.0	¥117,211.0	¥133,556.0
<b>Other Assets</b>	¥43,273.0	¥42,487.0	¥46,997.0
<b>Total Assets</b>	¥643,049.0	¥719,001.0	¥779,721.0
<b>Total Current Liabilities</b>	¥428,090.0	¥483,286.0	¥540,509.0
<b>Long-Term Debt</b>	¥76,538.0	¥71,896.0	¥60,673.0
<b>Other Liabilities</b>	¥19,218.0	¥27,821.0	¥30,274.0
<b>Total Liabilities</b>	¥523,846.0	¥583,003.0	¥631,456.0
<b>Total Shareholders' Equity</b>	¥119,203.0	¥135,998.0	¥148,265.0
Common Stock	42,225.0	45,102.0	46,551.0
Other Equity	38,013.0	41,725.0	43,884.0
Retained Earnings	38,965.0	49,171.0	57,830.0
<b>Total Liabilities and Shareholders' Equity</b>	¥643,049.0	¥719,001.0	¥779,721.0
<b>Income Statement</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
<b>Revenue</b>	¥557,244.0	¥680,192.0	¥768,602.0
<b>Cost of Sales</b>	¥439,937.0	¥533,440.0	¥597,989.0
<b>R&amp;D Expense</b>	¥22,600.0	¥24,400.0	¥28,700.0
<b>SG&amp;A Expense</b>	¥101,685.0	¥115,234.0	¥132,312.0
<b>Capital Expense</b>	¥15,100.0	¥22,100.0	¥25,300.0
<b>Pretax Income</b>	¥19,937.0	¥28,341.0	¥33,072.0
<b>Pretax Margin (%)</b>	3.58	4.17	4.30
<b>Effective Tax Rate (%)</b>	NA	NA	NA
<b>Net Income</b>	¥6,702.0	¥9,513.0	¥13,906.0
<b>Shares Outstanding, Millions</b>	678.8	699.7	709.1
<b>Per Share Data</b>			
Earnings	¥10.18	¥13.73	¥19.69
Dividend	¥6.00	¥6.00	¥7.00
Book Value	¥175.61	¥194.37	¥209.09

**Table 3 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending in Month**  
**(Millions of Yen, except Per Share Data)**

Key Financial Ratios	1987	1988	1989
<i>Liquidity</i>			
Current (Times)	1.16	1.16	1.11
Quick (Times)	0.86	0.85	0.81
Fixed Assets/Equity (%)	86.93	86.19	90.08
Current Liabilities/Equity (%)	359.13	355.36	364.56
Total Liabilities/Equity (%)	439.46	428.68	425.90
<i>Profitability (%)</i>			
Return on Assets	-	1.40	1.86
Return on Equity	-	7.46	9.78
Profit Margin	1.20	1.40	1.81
<i>Other Key Ratios</i>			
R&D Spending % of Revenue	4.06	3.59	3.73
Capital Spending % of Revenue	2.71	3.25	3.29
Employees	NA	19,248	19,830
Revenue (¥K)/Employee	NA	\$35,338	\$38,760
Capital Spending % of Assets	2.35	3.07	3.24
Exchange Rate (US\$1=¥)	138.03	128.25	142.47

NA = Not available

\*No fiscal 1986 and 1987 information is available because consolidated reports were not generated during those years.

Source: Fuji Electric Co., Ltd.  
 Annual Reports and Forms 10-K  
 Dataquest (1990)

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Chiyoda-du, Tokyo 100, Japan  
Telephone: 03-216-3211  
Fax: 03-216-9365  
Dun's Number: 08-292-1644  
*Date Founded: 1935*

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## **CORPORATE STRATEGIC DIRECTION**

Fujitsu Limited, founded in 1935 as a spin-off of the Communications Division of Fuji Electric Company, Ltd., is a multinational Japanese firm with 73 wholly owned, consolidated subsidiaries. Fujitsu designs, manufactures, and markets computer and data processing systems, telecommunications equipment, electronic devices, and other electronic products such as car stereos and digital audiotape (DAT) players. To organize and unify such a diverse product offering, Fujitsu has segmented its corporate structure into four main divisions by each of the four aforementioned product types. Approximately 60 percent of Fujitsu's revenue is derived from the Computer and Data Processing Systems Division.

Fujitsu currently is one of the largest companies in Japan with over ¥2.39 trillion (US\$18.6 billion) in revenue and over ¥2.62 trillion (US\$19.0 billion) in total assets. However, because it is a large, diverse, multinational company, Fujitsu is confronted with some very complex issues. Two main issues are the geographical expansion of the world's markets and the unification the European Community (EC). With the opening to trade of certain Eastern European countries and the economic development of several third-world countries, as well as the unification of the EC, new markets and subsequently new opportunities are emerging rapidly.

Fujitsu is responding to these issues by increasing its global presence at a local level. The Company is pursuing this strategy by increasing its foreign investment and by globally establishing local subsidiaries. As a consequence of this strategy, Fujitsu hopes to obtain an early foothold in the new markets and thereby position itself to take full advantage of emerging opportunities as the new markets evolve. Furthermore, Fujitsu will be in closer contact with the individual consumer so that it can respond in an appropriate and timely manner to local market demands.

In 1990, Fujitsu took a major step toward increasing its global presence by acquiring an 80 percent share in ICL, Ltd., a computer unit of STC Plc. The merger makes Fujitsu the second largest computer vendor in the world. The merger also gives Fujitsu a 43 percent share of the mainframe market in Great Britain.

Along with global expansion and unification issues, the Company is confronted with an adverse exchange rate. Since 1985, the value of the yen has risen approximately 70 percent against the US dollar, thereby decreasing profit margins on exported goods. In response, Fujitsu is streamlining its organization, reducing costs, and de-emphasizing cross-border transactions. The Company implemented a "Fresh Fujitsu '88" campaign focused toward redefining management roles for consolidating certain duties and centralizing responsibility, thereby increasing managerial efficiency. Also, the Company has begun to increase raw material sourcing and product development from within local markets in which it has manufacturing plants, thereby reducing cross-border transactions and effectively reducing the Company's exposure to adverse movement in the exchange rate.

The results of these strategies are reflected in the Company's financial performance. Net sales increased 6.8 percent to ¥2.6 trillion (US\$17.9 billion) in the fiscal year ending March 31, 1990, from ¥2.4 trillion (US\$18.6 billion) in fiscal 1989. (Percentage changes refer only to ¥ amounts; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) International sales increased 15.4 percent to ¥609.4 billion (US\$4.2 billion) in fiscal 1990 from ¥528.3 billion (US\$4.1 billion) in fiscal 1989. International sales accounted for 23.9 percent and 22.1 percent of the Company's total revenue in fiscal 1990 and 1989, respectively. Net income increased 24.0 percent to ¥86.6 billion (US\$607.0 million) in fiscal 1990 from ¥69.9 billion (US\$545.0 million) in fiscal 1989. The

preceding 1990 financial figures were published prior to Fujitsu's Annual Report. Specific financial figures have not yet been made available. Consequently, 1990 figures are not included in the financial tables, which are located at the end of this profile.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channels is not available. Tables 3 and 4, comprehensive financial statements, are at the end of this profile.

## BUSINESS SEGMENT STRATEGIC DIRECTION

### Computers and Data Processing

Dataquest estimates that Fujitsu was one of the five largest information systems manufacturers in the world and the largest in Japan in the calendar year 1989. The Computer and Data Processing Division's net sales increased approximately 7 percent to ¥1.69 trillion (US\$11.86 billion) in fiscal 1990, accounting for 66.1 percent of the Company's total net sales. The division's product offerings include computer systems, office automation equipment, VAN services, computer storage, electronic printers, CAD/CAM/CAE, and software. Fujitsu's main competitors, in order of their degree of competitiveness with Fujitsu, are IBM, Digital, Hewlett-Packard, Groupe Bull, NEC, Unisys, and Hitachi.

### Computer Systems

Within the computer systems product line, Fujitsu offers supercomputers, retail automation systems, and general-purpose computers. The following occurred for Fujitsu during fiscal 1989:

- It introduced eight new models of the VP-2000 Series supercomputers, which offer one of the world's highest vector processing powers at 4 Gflops (floating-point operations per second).
- It made strong gains in the point-of-sale (POS) market with the FAST Series of retail automation systems.
- It released the FACT III Series, an automated teller and cash-dispensing machine.
- It enjoyed increased demand for its M Series general-purpose computers, with substantial orders from the Tokyo and Osaka stock exchanges.

### Office Automation

Within the office automation product line, Fujitsu offers small business computers, workstations, word processors, and personal computers, including business, hypermedia, desktop, portable, and laptop. The following occurred for Fujitsu during fiscal 1989:

- It released the K-600 Series and K-100 Series of small business computers as office processors for strategic information systems.
- It released the Fujitsu S Family of engineering workstations in response to the growing need for UNIX.
- It introduced the OASYS Series of Japanese-language word processors with improved document production generation and graphics functions.
- It released new machines in the FM R Series of business computers, completing the lineup of desktop, portable, and laptop models.
- It introduced the FM TOWNS hypermedia personal computer, an Intel 80386-based multimedia computer system with a CD-ROM drive, featuring a bit-mapped graphical user interface (GUI) with pull-down menus and icons.

### VAN Services

Within the VAN services product line, Fujitsu offers industry VANs, local VANs, corporate VANs, and personal communication services. The following occurred for Fujitsu during fiscal 1989:

- It expanded the FENICS VAN service by offering an industry VAN for application-specific services such as sending and receiving orders, a local VAN to increase the efficiency of local distribution in a common network, and a corporate VAN to expand corporate data services and telecommunications networks.
- It offered new personal computer communications services, including CompuServe, which provides an easy way to communicate with the United States through international telecommunication lines, and NIFTY-Serve, which offers various services using the FENICS network.

### Computer Storage

Dataquest estimates that Fujitsu acquired a 10 percent share of the worldwide rigid disk market (by revenue) and a 6 percent share of the worldwide tape drive market in calendar year 1989. Fujitsu produces 1/2-inch reel-to-reel, start-stop, and streaming tape drives. In the rigid disk drive market, the Company produces 3.5-inch fixed drives ranging in size up to 100MB.



### *Electronic Printers*

The Company manufactures and markets line-impacted, fully formed printers, serial impact dot matrix printers, baud printers, and laser printers.

### *CAD/CAM/CAE*

Fujitsu strengthened its position in the CAD/CAM/CAE market in 1989, with revenue growing by 13.7 percent to a US dollar equivalent of \$269 million. The Company continues to be among the major OEMs of Sun Microsystems workstations. The key strategic issue to be resolved concerns the recent IBM acquisition of Cadam, which develops Fujitsu's primary CAD/CAM product. IBM has honored all contractual commitments to date. However, a continued long-term relationship is unlikely.

### *Software*

Within the software product line, Fujitsu offers operating system software, application software, translation support systems, and architectures. The following occurred for Fujitsu during fiscal 1989:

- It introduced the MSP-EX operating system, which is targeted toward the heavy-use demands of host computers.
- It developed application programs targeted for computer use in individual companies.
- It released the ATLAS-G Japanese-English translation support system, which runs on the M Series general-purpose computers.
- It experienced increased sales of the knowledge system architecture and applications, released in the prior year.

### *Telecommunication*

The Telecommunications Division's product line is ISDN systems, corporate information network systems (COINS), switching systems, and transmission systems. In fiscal 1990, the division recorded net sales of \$394.3 billion, an increase of approximately 5.0 percent over fiscal 1989. Net sales of the division accounted for 15.5 percent of total net sales.

### *Integrated Services Digital Network (ISDN) Services*

Within the ISDN services, Fujitsu offers various facsimile equipment, ISDN terminals, moving image television phones, handwriting communication terminals, and key telephones. During fiscal 1989, Fujitsu introduced the F1865A Facsimile Connection Unit.

This device functions as a facsimile machine, as a printer with laser printer-quality output, and as a data entry terminal with support for handwritten optical character recognition (OCR). It is designed for use on a Fujitsu Network Architecture around an M Series mainframe.

### *Corporate Information Network System (COINS)*

COINS is a corporate information network system that is receiving significant interest from companies as a multimedia network with excellent economy and extensibility.

### *Switching Systems*

Within the switching systems product line, Fujitsu offers central office switching systems and digital PBX switching systems. The following occurred for Fujitsu during calendar year 1989:

- It introduced five new models of the FETEX-5000A Series, which is compatible with ISDN and supports 1.5MB per second transmission between packet-switching systems and long packets (up to 4,096 octets).
- It introduced the Starlog Business Management Package, which expands the cost management and user analysis capabilities of the Starlog PBX system, enabling telecommunications managers to better supervise use of telephone and related facilities within their companies.
- It announced expansion of its F9600 PBX product into a strategic ISDN PBX platform supporting as many as 10,000 lines or as few as 100 lines.
- It introduced the 300A Series digital PBX information switching system.

### *Transmission Systems*

Within the transmission systems product line, Fujitsu offers digital communications equipment and earth station systems for satellite communication. During fiscal 1989, Fujitsu supplied some of the equipment for the Transpacific Cable No. 3 (TPC-3), and supplied mobile and portable earth stations to Telecom SAT and VIDEO SAT.

### *Electronic Devices*

Dataquest estimates that Fujitsu was the fifth largest (by revenue) semiconductor vendor in the worldwide market in calendar year 1989, with a US dollar equivalent of \$2.96 billion in net sales. Net sales increased 6.7 percent over the previous year. The division accounted for 14.0 percent of total net sales.

with ¥356.8 billion, (US\$2.8 billion). The semiconductor product line can be broken down into IC memories (MOS and bipolar technology), ASICs (MOS and bipolar technology), LSIs, and electronic components.

#### *IC Memories*

In fiscal 1989, IC memory sales grew dramatically, reflecting the growth of computers, office automation equipment, and telecommunications equipment. Domestic and international demand for the 1MB DRAM and the 4MB DRAM increased. Fujitsu also began production of BiCMOS memories.

#### *ASICs*

In fiscal 1989, the Company increased its product offering by introducing the following:

- ASIC Design Kits, which are developed specifically for the Daisy/Cadnetix Inc. (DAZIX) design environment on the Sun-4 family of workstations running UNIX (SunOS 4.0.3)
- Two new ECL gate arrays, E10040VHM and E10160VHR, which offer on-chip memory and are the newest additions to the Company's VH series of ECL arrays
- A new series of BiCMOS gate arrays, the BC-H series, which provides bipolar performance and high-current drive with low power dissipation

#### *LSIs*

During fiscal 1989, Fujitsu announced the development of 54,000-gate ultralarge-scale integration ECL gate arrays that use a substrate power supply structure, and the development of a 64MB DRAM memory cell.

#### *Electronic Components*

The Company offers a range of products from plasma display panels and membrane keyboards to connectors and relays. Hybrid ICs and other new products that use advances in thin-film technology are developed in this division.

#### *Others*

Other operations range from products such as car stereos to automatic vehicle monitors. This division accounted for only 4.3 percent of total net sales. However, sales did increase 10.1 percent to ¥109 billion (US\$765 million) in fiscal 1990.

#### *Further Information*

For further information pertaining to the Company's business segments, please contact the appropriate Dataquest industry service.

**Table 1**  
**Five-Year Corporate Highlights (Millions of US Dollars)**

	1985	1986	1987	1988	1989
Five-Year Revenue	\$6,415	\$7,646	\$11,218	\$14,829	\$18,616
Percent Change	-	19.19	46.70	32.19	25.54
Capital Expenditure	\$1,998	\$1,559	\$1,964	\$3,161	\$4,167
Percent of Revenue	31.14	20.39	17.51	21.32	22.39
R&D Expenditure	\$545	\$710	\$1,043	\$1,377	\$1,925
Percent of Revenue	8.49	9.28	9.30	9.29	10.34
Number of Employees	74,187	84,277	89,293	94,825	104,503
Revenue (\$K)/Employee	\$86	\$91	\$126	\$156	\$178
Net Income	\$366	\$176	\$135	\$305	\$545
Percent Change	-	(51.88)	(23.00)	125.24	78.75
Exchange Rate (US\$=¥)	¥243.53	¥221.26	¥159.51	¥138.02	¥128.25
1989 Calendar Year	Q1	Q2	Q3	Q4	
Quarterly Revenue	NA	NA	NA	NA	
Quarterly Profit	NA	NA	NA	NA	

NA = Not available

Source: Fujitsu Limited  
Annual Reports and Forms 10-K  
Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1985	1986	1987	1988	1989
Asia/Pacific	73.06	76.29	78.06	77.89	77.87
Japan	73.06	76.29	78.06	77.89	77.87
International	26.94	23.71	21.94	22.11	22.13

Source: Fujitsu Limited  
Annual Reports and Forms 10-K  
Dataquest (1990)

## 1989 SALES OFFICE LOCATIONS

North America—3  
Europe—4  
Asia/Pacific—90  
Japan—82  
ROW—3

## MANUFACTURING LOCATIONS

### *North America*

Amdahl Corporation  
Communications and information processing equipment  
Fujitsu America  
Communications and information processing equipment, development of software  
Fujitsu Business Communications of America  
Communications equipment  
Fujitsu-GTE Business Systems  
Development of large PBXs  
Fujitsu Microelectronics  
Semiconductor devices (256K DRAMs, 1MB DRAMs, ASICs)  
Intellistor, Inc.  
Development of information processing equipment

### *Europe*

Anamartic Ltd. (United Kingdom)  
Semiconductor memories  
Fujitsu Espana (Spain)  
Communications and information processing equipment  
Fujitsu Microelectronics (Ireland)  
Semiconductor devices (256K DRAMs, 1MB DRAMs)  
Fujitsu Microelectronics (United Kingdom)  
Development of ASICs

### *Asia/Pacific*

Advantest Corporation (Japan)  
Measuring instruments, IC testers  
FKL-Dongwa (South Korea)  
Magnetic floppy disk drive heads  
Fanuc Ltd. (Japan)  
CNC equipment, applied machines  
Fuji Electrochemical (Japan)  
Ferrites, electronic equipment, dry batteries

Fuji Facom (Japan)  
Development of computer systems for control  
Fujitsu (Singapore)  
Electronic parts (digital switching systems)  
Fujitsu Australia (Australia)  
Digital key telephones, digital PBXs  
Fujitsu Automation (Japan)  
Automation equipment  
Fujitsu Buhin (Japan)  
Electronic parts  
Fujitsu Component (Malaysia)  
Electronic parts (relays, keyboards, connectors)  
Fujitsu Computer Technology (Japan)  
Development of LSIs, software for information processing equipment  
Fujitsu Denso (Japan)  
Communications/electronic equipment  
Fujitsu General (Japan)  
Home electric appliances, communications equipment, data processing equipment  
Fujitsu Isotec (Japan)  
Peripherals  
Fujitsu Kasei (Japan)  
Plastic products for communications equipment  
Fujitsu Kiden (Japan)  
Data processing equipment, indicators, molds  
Fujitsu Microelectronics Asia (Singapore)  
Semiconductor devices (plans 1MB DRAM production)  
Fujitsu Microelectronics (Malaysia)  
MOS memories, linear ICs, standard logic  
Fujitsu Miyagi Electronics (Japan)  
Semiconductor devices  
Fujitsu Peripherals (Japan)  
Peripherals  
Fujitsu TEN (Japan)  
Car radios, stereos  
Fujitsu Thailand (Thailand)  
Magnetic disk drive heads, magnetic heads for printers  
Fujitsu Tohoku Electronics (Japan)  
Semiconductor devices  
Fujitsu VLSI (Japan)  
Development of semiconductor devices  
Fujitsu Yamanashi Electronics (Japan)  
Semiconductor devices  
Hasegawa Electric (Japan)  
Communications equipment  
Kyushu Fujitsu Electronics (Japan)  
Semiconductor devices  
Nihon Dengyon (Japan)  
Radio and digital communications equipment  
PFU Ltd. (Japan)  
Microcomputers, peripherals  
Shinano Fujitsu (Japan)  
Electronic parts

Shinko Electric Industries (Japan)  
Semiconductor parts  
Takamisawa Electric (Japan)  
Switching systems, parts  
Towa Electron (Japan)  
Capacitors, hybrid ICs  
Yamagata Fujitsu (Japan)  
Peripherals

## SUBSIDIARIES

### *North America*

Fujitsu America, Inc. (United States)  
Fujitsu Business Communication Systems Inc.  
(United States)  
Fujitsu Canada, Inc. (Canada)  
Fujitsu Component of America, Inc. (United States)  
Fujitsu Customer Service of America, Inc. (United States)  
Fujitsu Imaging Systems of America, Inc. (United States)  
Fujitsu Microelectronics, Inc. (United States)  
Fujitsu Microsystems of America, Inc. (United States)  
Fujitsu Network Switching of America, Inc. (United States)  
Fujitsu Systems of America, Inc. (United States)  
Fujitsu Systems Engineering of America, Inc. (United States)  
Intelligensor, Inc. (United States)  
Intellistor, Inc. (Canada)

### *Europe*

Fujitsu Deutschland GmbH (Germany)  
Fujitsu Espana S.A. (Spain)  
Fujitsu Europe Ltd. (England)  
Fujitsu Finance (U.K.) Plc (United Kingdom)  
Fujitsu International Finance B.V. (Netherlands)  
Fujitsu Italia S.p.A. (Italy)  
Fujitsu Microelectronics Ireland Ltd. (Ireland)  
Fujitsu Microelectronics Italia S.r.l. (Italy)  
Fujitsu Microelectronics Ltd. (England)  
Fujitsu Mikroelektronik GmbH (Germany)  
Fujitsu Nordic AB (Sweden)

### *Asia/Pacific*

Fuji Electrochemical Co. Ltd. (Japan)  
Fujitsu (Singapore) Pte. Ltd. (Singapore)  
Fujitsu (Thailand) Co. Ltd. (Thailand)  
Fujitsu Advanced Printing and Publishing Co. Ltd.  
(Japan)

Fujitsu Aichi Engineering Limited (Japan)  
Fujitsu Australia Ltd. (Australia)  
Fujitsu Australia Software Technology Pty. Ltd.  
(Australia)  
Fujitsu Australia Wholesale Pty. Ltd. (Australia)  
Fujitsu Automation Limited (Japan)  
Fujitsu Basic Software Corporation (Japan)  
Fujitsu Buhin Limited (Japan)  
Fujitsu Business Systems Limited (Japan)  
Fujitsu Component (Malaysia) Sdn. Bhd. (Malaysia)  
Fujitsu Dai-ichi Communication Software Limited  
(Japan)  
Fujitsu Dai-ichi System Engineering Limited (Japan)  
Fujitsu Denso Ltd. (Japan)  
Fujitsu Digital Technology Limited (Japan)  
Fujitsu Distribution Systems Engineering Limited  
(Japan)  
Fujitsu Documents Service Limited (Japan)  
Fujitsu Electronics (Singapore) Pte. Ltd. (Singapore)  
Fujitsu FACOM Information Processing Corporation  
(Japan)  
Fujitsu Financial Information Systems Limited  
(Japan)  
Fujitsu Financial Systems Engineering Limited  
(Japan)  
Fujitsu Fudosan Ltd. (Japan)  
Fujitsu Hong Kong Ltd. (Hong Kong)  
Fujitsu Isotec Limited (Japan)  
Fujitsu Kansai Communication Systems Limited  
(Japan)  
Fujitsu Kansai System Engineering Limited (Japan)  
Fujitsu Kasei Ltd. (Japan)  
Fujitsu Keihin Systems Engineering Limited (Japan)  
Fujitsu Kiden Ltd. (Japan)  
Fujitsu Korea Ltd. (Korea)  
Fujitsu Kosan Limited (Japan)  
Fujitsu Kyushu Communication Systems Limited  
(Japan)  
Fujitsu Kyushu Systems Engineering Ltd. (Japan)  
Fujitsu Laboratories Ltd. (Japan)  
Fujitsu Logistics Limited (Japan)  
Fujitsu Microcomputer Systems Limited (Japan)  
Fujitsu Microdevices Ltd. (Japan)  
Fujitsu Microelectronics Asia Pte. Ltd. (Singapore)  
Fujitsu Microelectronics (Malaysia) Sdn. Bhd.  
(Malaysia)  
Fujitsu Microelectronics Pacific Asia Ltd. (Hong Kong)  
Fujitsu Minami-Kyushu Systems Engineering Limited  
(Japan)  
Fujitsu Miyagi Electronics Ltd. (Japan)  
Fujitsu Nagano Systems Engineering Limited (Japan)  
Fujitsu Network Engineering Limited (Japan)  
Fujitsu New Zealand Holdings Ltd. (New Zealand)  
Fujitsu New Zealand Ltd. (New Zealand)  
Fujitsu OA Limited (Japan)

Fujitsu Office Machines Limited (Japan)  
Fujitsu Oita Software Laboratories Limited (Japan)  
Fujitsu Peripherals Limited (Japan)  
Fujitsu Program Laboratories Limited (Japan)  
Fujitsu Shikoku Infotec Limited (Japan)  
Fujitsu Shizuoka Engineering Limited (Japan)  
Fujitsu Sinter Limited (Japan)  
Fujitsu Social Science Laboratory Limited (Japan)  
Fujitsu Social Systems Engineering Limited (Japan)  
Fujitsu Supplies Limited (Japan)  
Fujitsu System Integration Laboratories Ltd. (Japan)  
Fujitsu TEN Limited (Japan)  
Fujitsu Technosystems Limited (Japan)  
Fujitsu Tohoku Electronics Ltd. (Japan)  
Fujitsu Tohoku Systems Engineering Limited (Japan)  
Fujitsu Tokia Systems Engineering Limited (Japan)  
Fujitsu Trading Ltd. (Japan)  
Fujitsu VLSI Limited (Japan)  
Fujitsu Yamanashi Electronics Limited (Japan)  
Gunma Fujitsu Limited (Japan)  
Hasegawa Electric Co. Ltd. (Japan)  
Ishikawa Fujitsu Software Limited (Japan)  
Iwaka Densi Ltd. (Japan)  
Kyushu Fujitsu Electronics Ltd. (Japan)  
Nihon Dengyo Limited (Japan)  
Okinawa Fujitsu Systems Engineering Ltd. (Japan)  
PFU Limited (Japan)  
Shinano Fujitsu Ltd. (Japan)  
Shinko Electric Industries Co. Ltd. (Japan)  
Ten Onkyo Ltd. (Japan)  
Totalizator Engineering Limited (Japan)  
Yamagata Fujitsu Limited (Japan)

#### ROW

Fujitsu de Brasil Limitada (Brazil)  
Fujitsu Vitonia Computadores e Servicos Ltda  
(Brazil)

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## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

### 1990

#### Novell K.K.

A joint marketing venture to sell Netware products in Japan was formed with Novell and six partners, Fujitsu being one of them.

#### Isuzu

The two companies have formed an automotive electronics venture and currently are attempting to get General Motors to join.

#### Matsushita

The companies have set up an OEM agreement whereby Fujitsu will receive the M550 and M600 series of 32-bit desktop personal computers from Matsushita and will give Matsushita its high-end laptop and desktop 32-bit PCs.

#### Poquet Computer

Fujitsu will produce and market Poquet Computer's pocket-sized computer under license. The companies will build a joint plant in Japan and Fujitsu will sell the computer worldwide.

#### Nokia Data Systems Oy

An agreement has been made whereby Nokia will OEM digital PBX systems (the F-620 and F-640) for Fujitsu.

#### Matsushita Electric Industrial

The two companies plan to strengthen their business relationship by mutually supplying their computers on an OEM basis.

#### UNIX International

Fujitsu has joined a new marketing group comprising 21 other high-tech companies. The group will promote UNIX's System V release 4 and further standard developments.

#### Molecular Design Ltd. and IBM

Fujitsu has formed a relationship with the two companies to ensure that Molecular Design software for managing and communicating scientific information will run on their computers.

#### Mitsui Bank Research Institute

The two companies have agreed to establish a system consulting service.

#### MEDIAGENIC

MEDIAGENIC has agreed to develop entertainment software for the Fujitsu FM TOWNS.

#### Daisy/Cadnetix Inc.

The companies jointly produced an ASIC design kit developed for the DAZIX design environment on the Sun-4 family of workstations running on UNIX.

#### Vitesse Semiconductor Corporation

The companies have entered into an alternated source agreement with regard to Vitesse's Fury gallium arsenide (GaAs) VLSI gate-array family.

### 1989

#### Japan Tobacco Inc.

Fujitsu formed a tie-up agreement with Japan Tobacco whereby Fujitsu will market two of Japan Tobacco's software modules.

**The Australian National University in Canberra**  
The two organizations signed an R&D agreement for two three-year projects. One project is to develop a small image processing system; the other is to develop software for parallel processors.

**Vitesse Semiconductor**  
The two agreed to jointly develop GaAs gate arrays.

**Southern New England Telecommunications Systems**

Southern New England Telecommunications agreed to market Fujitsu's ISDN telecommunications equipment in the United States on an exclusive basis. The list of products includes digital telephones and terminal adapters.

**NTT Data Communications Systems**  
The two companies will jointly market their respective logic chip design software products as a total CAE design system.

**Sony**  
The two companies jointly developed a trial common rule to develop CD-ROM XA software for their personal computers.

**Bell Atlantic Optical Network (SONET)**  
Fujitsu agreed to sell Bell Atlantic's transmission products under a two-year, \$2 million contract. Fujitsu will provide its FLM 50/150 Fiber LOOP Multiplexer for deployment in Bell Atlantic areas.

**Poquet Computer Corporate**  
An agreement provides Poquet with funding and credit guarantees; the companies made a cooperative technology agreement allowing for mutual adaptation of technologies and joint development of new technology.

**Sun Microsystems**  
Sun and Fujitsu will jointly develop a high-speed RISC chip.

## 1988

**Telecom Australia**  
Telecom Australia agreed to sell Fujitsu's digital PBXs in Australia; the companies established a sales joint-venture, Information Switching Technology.

**Daisy Systems**  
Fujitsu's FAME was made available on Daisy's Advansys Series of CAD/CAE systems.

**Hitachi**  
The two companies agreed to cooperate on the development of a 32-bit MPU and peripheral LSI family based on TRON architecture.

## 1987

**Texas Instruments**  
The two companies signed a semiconductor device cross-licensing agreement.

**Motorola**  
The two companies signed a semiconductor device cross-licensing agreement.

**Hyundai Electronics Industries**  
The two companies signed a facsimile licensing agreement.

**Fujian Province, PRC**  
Software for digital switching systems will be developed under a joint venture.

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## MERGERS AND ACQUISITIONS

**ICL, Ltd.**  
Fujitsu purchased 80 percent of ICL, a subsidiary of STC Plc. The merger increases Fujitsu's global presence and makes it the second largest computer manufacturer in the world.

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## KEY OFFICERS

**Takuma Yamamoto**  
President

**Matami Yasufuku**  
Executive vice president

**Kazuo Watanabe**  
Executive director

**Mamoru Mitsugi**  
Executive director

**Yusaku Onaga**  
Executive director

**Akira Ohguro**  
Executive director

**Mikio Ohtsuki**  
Executive director

**Tadashi Sekizawa**  
Executive director

**Mutujiro Shiromizup**  
Executive director

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**PRINCIPAL INVESTORS**

Fuji Electric—14.3 percent  
Asahi Mutual Life Insurance—6.9 percent

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**FOUNDERS**

Information is not available.



**Table 3**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	\$3,877	\$4,555	\$7,035	\$9,818	\$11,369
Cash	654	660	1,125	1,764	2,379
Receivables	1,515	1,888	2,903	3,644	4,615
Marketable Securities	149	65	137	648	189
Inventory	1,451	1,763	2,562	3,353	3,734
Other Current Assets	108	179	307	408	452
Net Property, Plants	\$2,043	\$2,504	\$3,424	\$4,288	\$5,481
Other Assets	\$1,146	\$1,400	\$2,067	\$2,677	\$3,617
<b>Total Assets</b>	<b>\$7,066</b>	<b>\$8,459</b>	<b>\$12,526</b>	<b>\$16,783</b>	<b>\$20,467</b>
Total Current Liabilities	\$2,922	\$3,211	\$4,991	\$7,058	\$8,581
Long-Term Debt	\$1,037	\$1,609	\$2,117	\$2,185	\$2,467
Other Liabilities	\$609	\$763	\$1,153	\$1,548	\$1,924
<b>Total Liabilities</b>	<b>\$4,567</b>	<b>\$5,583</b>	<b>\$8,261</b>	<b>\$10,792</b>	<b>\$12,973</b>
Total Shareholders' Equity	\$2,499	\$2,876	\$4,265	\$5,992	\$7,495
Common Stock	1,182	1,348	2,115	3,364	4,252
Other Equity	37	46	71	92	110
Retained Earnings	1,280	1,482	2,080	2,536	3,133
<b>Total Liabilities and Shareholders' Equity</b>	<b>\$7,066</b>	<b>\$8,459</b>	<b>\$12,526</b>	<b>\$16,783</b>	<b>\$20,467</b>
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	\$6,415	\$7,646	\$11,218	\$14,829	\$18,616
Japanese Revenue	4,687	5,833	8,756	11,550	14,496
Non-Japanese Revenue	1,728	1,813	2,461	3,279	4,120
Cost of Sales	\$3,939	\$5,156	\$7,728	\$9,702	\$11,914
R&D Expense	\$545	\$710	\$1,043	\$1,377	\$1,925
SG&A Expense	\$1,133	\$14,010	\$2,057	\$2,883	\$3,328
Capital Expense	\$1,998	\$1,559	\$1,964	\$3,161	\$4,167
Pretax Income	\$734	\$230	\$301	\$768	\$1,210
Pretax Margin (%)	11.43	3.01	2.68	5.18	6.50
Net Income	\$366	\$176	\$135	\$305	\$545
Shares Outstanding, Millions	1,299.5	1,438.6	1,593.3	1,710.0	1,760.1
<b>Per Share Data</b>					
Earnings	\$64.70	\$25.40	\$13.40	\$23.50	\$36.80
Dividend	\$9.00	\$8.00	\$8.00	\$8.00	\$9.00
Book Value	\$1.92	\$2.00	\$2.68	\$3.50	\$4.26
Exchange Rate (US\$1=¥)	¥243.53	¥221.26	¥159.51	¥138.02	¥128.25

Source: Fujitsu Limited  
 Annual Reports and Forms 10-K  
 Dataquest (1990)

**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	¥944,189	¥1,007,841	¥1,122,175	¥1,355,124	¥1,458,057
Cash	159,225	146,000	179,409	243,492	305,166
Receivables	368,821	417,806	463,150	503,035	591,815
Marketable Securities	36,374	14,399	21,863	89,402	24,219
Inventory	353,394	390,103	408,718	462,869	478,840
Other Current Assets	26,375	39,533	49,035	56,326	58,017
Net Property, Plants	¥497,449	¥554,082	¥546,233	¥591,921	¥702,988
Other Assets	¥279,007	¥309,808	¥329,779	¥369,549	¥463,882
<b>Total Assets</b>	<b>¥1,720,645</b>	<b>¥1,871,731</b>	<b>¥1,998,187</b>	<b>¥2,316,594</b>	<b>¥2,624,927</b>
Total Current Liabilities	¥711,485	¥710,479	¥796,143	¥974,268	¥1,100,577
Long-Term Debt	¥252,484	¥356,051	¥337,660	¥301,618	¥316,395
Other Liabilities	¥148,209	¥168,862	¥183,980	¥213,685	¥246,778
<b>Total Liabilities</b>	<b>¥1,112,178</b>	<b>¥1,235,392</b>	<b>¥1,317,783</b>	<b>¥1,489,571</b>	<b>¥1,663,750</b>
Total Shareholders' Equity	¥608,467	¥636,339	¥680,404	¥827,023	¥961,177
Common Stock	287,824	298,187	337,308	464,365	545,369
Other Equity	8,929	10,153	11,359	12,659	14,050
Retained Earnings	311,714	327,999	331,737	349,999	401,758
<b>Total Liabilities and Shareholders' Equity</b>	<b>¥1,720,645</b>	<b>¥1,871,731</b>	<b>¥1,998,187</b>	<b>¥2,316,594</b>	<b>¥2,624,927</b>
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	¥1,562,260	¥1,691,826	¥1,789,417	¥2,046,802	¥2,387,442
Japanese Revenue	1,141,387	1,290,694	1,396,819	1,594,254	1,859,101
Non-Japanese Revenue	420,872.8	401,131.9	392,598.1	452,547.9	528,340.9
Cost of Sales	¥959,282	¥1,140,728	¥1,232,722	¥1,339,183	¥1,527,908
R&D Expense	¥132,708	¥157,028	¥166,342	¥190,130	¥246,906
SG&A Expense	¥275,791	¥3,099,940	¥328,184	¥397,968	¥426,779
Capital Expense	¥486,471	¥344,903	¥313,330	¥436,354	¥534,447
Pretax Income	¥178,635	¥50,920	¥48,012	¥106,048	¥155,152
Pretax Margin (%)	11.43	3.01	2.68	5.18	6.50
Net Income	¥89,028	¥38,926	¥21,609	¥42,115	¥69,948
Shares Outstanding, Millions	1,299.5	1,438.6	1,593.3	1,710.0	1,760.1
<b>Per Share Data</b>					
Earnings	¥64.70	¥25.40	¥13.40	¥23.50	¥36.80
Dividend	¥9.00	¥8.00	¥8.00	¥8.00	¥9.00
Book Value	¥468.23	¥442.33	¥427.04	¥483.64	¥546.09

**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of Yen, except Per Share Data)**

<b>Key Financial Ratios</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
<i>Liquidity</i>					
Current (Times)	1.33	1.42	1.41	1.39	1.32
Quick (Times)	0.83	0.87	0.90	0.92	0.89
Fixed Assets/Equity (%)	81.75	87.07	80.28	71.57	73.14
Current Liabilities/Equity (%)	116.93	111.65	117.01	117.80	114.50
Total Liabilities/Equity (%)	182.78	194.14	193.68	180.11	173.10
<i>Profitability (%)</i>					
Return on Assets	5.63	2.17	1.12	1.95	2.83
Return on Equity	16.22	6.25	3.28	5.59	7.82
Profit Margin	5.70	2.30	1.21	2.06	2.93
<i>Other Key Ratios</i>					
R&D Spending % of Revenue	8.49	9.28	9.30	9.29	10.34
Capital Spending % of Revenue	31.14	20.39	17.51	21.32	22.39
Employees	74,187	84,277	89,293	94,825	104,503
Revenue (¥)/Employee	¥21,058	¥20,075	¥20,040	¥21,585	¥22,846
Capital Spending % of Assets	28.27	18.43	15.68	18.84	20.36
Exchange Rate (US\$1=¥yen)	¥243.53	¥221.26	¥159.51	¥138.02	¥128.25

Source: Fujitsu Limited  
Annual Reports and Forms 10-K  
Dataquest (1990)

# International Business Machines Corporation

Corporate Headquarters  
Old Orchard Road  
Armonk, New York 10504  
Telephone: (914) 765-1900  
Fax: (914) 765-4190, 765-4191  
Dun's Number: 00-136-8083

*Date Founded: 1911*

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## CORPORATE STRATEGIC DIRECTION

International Business Machines Corporation (IBM) was incorporated in New York State in June 1911 as the Computing-Tabulating-Recording Company, a consolidation of four companies. In 1924, the Company merged with International Business Machines Corporation and assumed that company's name. Today it is the world's largest manufacturer of data processing machines and information-handling systems.

Acknowledged as the largest computer systems vendor in the world, IBM designs, manufactures, sells, and supports an array of information processing systems. IBM's product line includes the following:

- Mainframes
- Superminicomputers
- Mini- and microcomputers
- Workstations
- Personal computers
- Systems software
- Display terminals
- Computer storage devices
- Communication systems
- Printers
- Typewriters
- Educational and training materials
- Related supplies and services

In addition to these products, IBM is a major systems integration vendor, offering clients complete solutions to information processing needs.

During the past several years, IBM has been undergoing a number of changes to compensate for shifts in market conditions and user demand. IBM has trimmed employee and administrative costs and sold

off several subsidiaries to concentrate on its core businesses whereby it can control costs through economies of scale. This activity supports IBM's strategy of becoming a leaner and more responsive organization. Since 1988, IBM has reduced its work force by 50,000. With just over 383,000 employees at the end of fiscal 1989, IBM expects further reductions of up to 10,000 during 1990.

A major element of IBM's restructuring has been to flatten and streamline the organization. As a result, IBM has set up seven lines of business (LOBs) to simplify the decision-making process and increase responsiveness to its clients' needs. Each LOB is responsible for developing and manufacturing product and services for its customers. IBM has also been working to push decision-making responsibility down to the branch level in an effort to stimulate independence and an entrepreneurial spirit.

Another part of IBM's "reshaping" involves redirecting resources. IBM eliminated nearly 20 percent of its overhead jobs and switched nearly 30,000 positions to operations such as sales, systems engineering, and programming. At the end of 1989, IBM had increased the number of employees in software development to 35,000 and increased the number of worldwide sales and marketing employees to over 70,000. IBM restructured its marketing education program to better address customer needs and to sharpen the focus on industry specialization. Technical support was enhanced by redeploying engineers and product developers from IBM labs to branch offices worldwide to assist in analyzing and solving customer problems.

IBM anticipates that the information systems markets will become more software and service oriented and intends to increase its investments in these areas. Its five-year plan is to have a revenue split of approximately 60 to 40, emphasizing software over

hardware. During 1989, IBM developed equity-based strategic alliances with over 30 software companies in order to provide improved software applications for its customers. The Company also consolidated several manufacturing plants and redirected the activities of some of its development laboratories to respond to increased demand for software and services.

Although IBM maintains its number-one ranking in most of the industries that Dataquest follows, its earnings continue to slow. IBM's total revenue for 1989 increased only 5.1 percent over 1988 levels to \$62.7 billion,\* despite increased sales. Net earnings for the year ended December 31, 1989, were \$3.8 billion compared with \$5.8 billion in 1988. Growth continued stronger in non-US sales, up 7.6 percent from 1988 levels to \$37 billion. Sales in Europe remain strong, accounting for over 60 percent of IBM's non-US revenue in 1989.

A portion of IBM's earnings loss can be attributed to its ongoing restructuring of US business, which resulted in a \$2.4 billion charge during the fourth quarter of 1989. IBM also increased operating lease activity, which contributed to lower earnings for 1989 but should result in increased rental revenue in the future. The Company expects its expense-cutting measures and restructuring to result in a \$1 billion expense reduction in 1990.

IBM's computer product lines were the revenue leaders in 1989. The 3090 mainframe, AS/400 minicomputer, and PS/2 personal computer lines achieved double-digit revenue growth in 1989, according to IBM. In the business marketplace, the Company maintained its first-place ranking (based on revenue) according to Dataquest estimates. In the multiuser micro- and minicomputer markets, Dataquest ranked IBM third in 1989, behind Unisys and NEC. In the personal computer market, Dataquest estimates IBM's revenue market share to be 14 percent, remaining the world leader.

More detailed information is available in Tables 1 through 3, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region and distribution channel. Table 4, a comprehensive financial statement, is at the end of this profile.

\*All dollar amounts are in US dollars.

## BUSINESS SEGMENT STRATEGIC DIRECTION

The structure of IBM's seven LOBs are shown below:

- Personal Systems—Desktop systems, typewriters, displays, printers
- Application Business Systems—Midrange systems, storage devices
- Enterprise Systems—All system/370 products, high-volume printers, storage subsystems
- Technology Products—Worldwide development and US manufacturing of logic and memory technology and the electronic packaging used throughout the IBM product line
- Communication Systems—Communication products, information network services
- Programming Systems—Development of data management and application development software, development and implementation of SAA
- US Marketing and Services—Marketing, customer service, systems integration

Material overlaps and interdependencies exist among IBM's operating units, and, therefore, the information may not be indicative of the financial results or investments in the reported area if they were independent organizations.

IBM classifies its revenue-producing business into two main segments, Information Technology (IT) and Federal Systems. Federal Systems consists of specialized information technology products and services primarily for the United States defense, space, and other government agencies.

Over 90 percent of IBM's consolidated revenue comes from its Information Technology segment. The IT segment is made up of Processors, defined as user-programmable equipment having the capability of manipulating data arithmetically or logically and making calculations in a manner directly addressable by the user through the operation of a stored program. The second classification under IT is Workstations, which IBM defines as personal systems, typewriters, and other display-based terminals. The remaining categories in the IT segment are Peripherals, including printers, storage, and telecommunications devices; Software, both applications and systems software;

Maintenance Services; and "Other," which consists mainly of customer solution services, financing revenue, and supplies.

The following lists Dataquest's industry segmentation of IBM's product lines:

- Microcomputer system for PC hardware and software
- Business computer systems, consisting of mainframe, midrange, supermini and minicomputers for business applications
- Technical computers, technical workstations, and supercomputers
- Telecommunications, consisting of communications controllers, networking and telecommunications products
- Display terminals, electronic printers, and computer storage are considered separately by Dataquest industry services

### Microcomputer Systems

IBM remained the number-one seller of personal computers for 1989. Strong sales of its PS/2 products boosted IBM's revenue despite a sagging market. Dataquest estimates the Company's worldwide market share to be 11 percent on units shipped, 14 percent on revenue. In the US market, IBM regained its first-place title, taken over by Apple in 1988, with a 14 percent unit market share and 18 percent revenue market share. This gain is an increase over 1988 levels of 12.4 percent and 15.7 percent, respectively. It is significant because overall revenue for the PC market in the United States were lower for 1989 than the previous year.

In the European market, IBM retained its number-one ranking overall with a 1989 market share of 15.9 percent based on Dataquest's estimates. In the business applications market segment, IBM's market share dropped slightly to 19.7 percent in 1989, down from 20.6 percent in 1988. The Company is working to strengthen sales and distribution in Europe, evidenced by the introduction of IBM Systems Centers for PCs during the summer of 1989. These centers represent the highest-qualified IBM dealers throughout Europe. The Systems Centers will provide a greater level of technical knowledge and enhanced sales and service capabilities to better respond to the needs of IBM's European client base.

During 1989, IBM announced several new offerings to its PS/2 line, including the transportable model P70/386. During the fourth quarter of 1989, IBM was the first vendor to offer products based on Intel's i486

processor. In February 1990, IBM signed an agreement with NeXT Computer Inc. to provide the NeXTStep graphical user interface on PS/2 models. In May 1990, it introduced the PS/2 Model 80, an 80386-based file server, providing greater storage and output capacity in a desktop system. IBM also maintains its commitment to the Open Software Foundation (OSF) and plans to have an OSF/1-compliant product available for the PS/2 by 1991.

### Business Computers

IBM remains the number-one manufacturer and supplier in the business computer marketplace. According to Dataquest's Business Computer Systems Industry Service newsletter 1990-8 entitled, "Business Computer Systems: The 1989 Market in Review": "What saved the day for the business computer market was the popularity of IBM's AS/400 . . . . The AS/400 last year accounted for the bulk of the business systems' revenue growth."

### Mainframes

In the business mainframe segment, technological hitches within IBM contributed to the market's sluggish growth rate of 3.3 percent. Delayed deliveries of IBM's newly announced 3090S series processors and 3390 disk drives contributed to the slight erosion of IBM's worldwide mainframe factory revenue market share for 1989, an estimated 53.7 percent, down from 54.2 percent in 1988. Dataquest believes that sales in the mainframe segment of the market will continue to slow as users await the introduction of IBM's Summit product slated for 1991.

### Superminicomputers

In 1989, the superminicomputer market experienced strong growth over 1988 levels due to the success of the AS/400 line. IBM's revenue market share in this market segment for 1989 is estimated to be 62 percent. Dataquest analysts believe that 1990 sales of the AS/400 product will slow as upgrade and replacement demand is filled. In February 1990, IBM announced three new models to fill out the low-end of the AS/400 line. These models, the C10, C20, and C30, provide increased memory and faster access times than previously available in the B10 and B20 AS/400 models.

In March 1990, IBM announced three new versions to its 9370 product line, Models 10, 12, and 14. Based on an Intel 80386 microprocessor and IBM's Micro Channel Architecture, these models were developed to fill the need for an entry-level version of the 9370. These new models also provide a link between the PS/2 and 9370 product lines.

### *Mini- and Microcomputers*

The minicomputer and microcomputer markets continued to be very competitive in 1989. Dataquest estimates IBM's revenue market share to be 14.4 percent for 1989, behind Unisys and NEC. PCs, superminis, and workstations continued to encroach upon the minicomputer market, contributing to an overall revenue market decline of 38 percent in 1989.

### *Technical Computing*

Dataquest ranks IBM second in the worldwide supercomputing market, based on estimated sales of \$299 million. Internal conflicts at Cray Research, and the departure of ETA, Evans and Sutherland, SCS, and other supercomputer vendors from the market, contributed to IBM's increased sales in 1989. Dataquest believes that the high-end IBM 3090/vf line has become a significant contender in the corporate supercomputing market. The success of IBM indicates that supercomputing is gaining acceptance in the industrial environment and that there is strong potential for future growth in the corporate supercomputing market.

An important event in the workstation market was IBM's introduction of the RISC System/6000 series in February 1990. The RS/6000 series consists of nine models with CPU performances ranging from 27.5 to 41.1 mips. Using IBM's proprietary RISC microprocessor and the AIX version of the UNIX operating system, this new product line has an impressive price/performance ratio and an improved number of software applications in comparison with the RT product. Although IBM entered the technical workstation market late in the game, Dataquest believes that there is enough growth potential for IBM to capture a sizable portion of the market.

### *CAD/CAM*

IBM remains number one in the CAD/CAM/CAE market for 1989. Dataquest estimates IBM's revenue market share at 13.9 percent worldwide. The strongest growth in the PC CAD market in 1989 remained in high-end systems.

In November 1989, IBM and Lockheed announced that IBM would be purchasing CADAM, a subsidiary of Lockheed and a major supplier of CAD/CAM software to IBM. CADAM will be positioned as a wholly owned subsidiary reporting to IBM's Industrial Systems sector, in parallel with IBM's own CAD/CAM/CIM marketing group.

Another major announcement in 1989 was IBM's introduction of CIM Advantage, a comprehensive approach to computer-integrated manufacturing. The offering comprises over 50 hardware and software products that integrate design, engineering, production planning, and plant operations with business planning, marketing, and distribution.

### *Display Terminals*

Dataquest estimates IBM's total worldwide market share to be approximately 27 percent for 1989. Overall growth in the display terminals market remained relatively flat for the year.

Display terminal product highlights for 1989 include IBM's introduction of the InfoWindow family of display terminals, the 3151 ASCII display stations, and two new 5250 twin-ax terminals—the 3476 and 3477. In May 1989, IBM announced nine new models of the 3174 Control unit, supporting its continued dedication to the 3270 product line. In conjunction with its announcement of the RS/6000 workstation in February 1990, IBM entered the X Window display market with its XStation 120.

### *Computer Storage Industry*

One of the most significant announcements in the computer storage market in 1989 was IBM's introduction in November of the long-awaited 3390 Direct Access Storage Device (DASD). The 3390 is a 14-inch rigid disk drive system that provides up to 22.7-billion-byte capacity and 4.2MB-per-second transfer rate. IBM's 3390 is one of the fastest, largest-capacity mainframe disk storage devices currently available.

In October 1989, IBM's General Products Division announced the 3490 1/2-inch tape cartridge product. The 3490 provides cartridge capacity of 200MB and a transfer rate of 3MB per second. At the same time, IBM announced the 9348 model, an open-reel, front-loading drive that Dataquest believes will replace the older IBM 2440 model in the lineup of S/370 storage products.

The 1/2-inch tape drive market experienced an overall decline in 1989; however, strong sales of 1/2-inch cartridge products kept IBM listed in the top three vendors with an estimated 7 percent revenue market share in 1989. Dataquest believes that the overall softening of this market is due to weakening sales of midrange computers and declining sales of 1/2-inch reel-to-reel drives, which are being replaced by 1/2-inch cartridge products.

In the PC storage markets, 1989 was a year of change for IBM. The Company moved from first place in the 3.5-inch disk drive market to third, behind Seagate and Conner. Dataquest estimates IBM's share of this market at 19 percent in 1989, based on production of over 2.2 million units and estimated revenue of \$640 million. According to Dataquest, in the 5.25-inch disk drive market, IBM ranked fifth worldwide in 1989, with an estimated market share of 4.7 percent.

In April 1989, IBM began marketing a 320MB, 3.5-inch Winchester disk drive to OEM customers. Although the drive will be used in IBM systems, the move to market a leading-edge product to OEMs is highly significant because the company has not been a major player in the OEM channel.

### Office System Industry

Although IBM's worldwide market share slipped from 43 percent in 1988 to 34 percent in 1989, it remained the leading proprietary integrated office systems (IOS) vendor in terms of licenses sold, according to Dataquest estimates. In the US market, IBM holds an estimated 36.5 percent share of proprietary IOS software license shipments for 1989. IBM had strong sales of its IOS products in Europe, garnering an estimated 31 percent share of the market in 1989. Increased sales of its AS/400 office package accounted for the majority of its revenue in the IOS market.

On May 16, 1989, IBM announced the components of its long-awaited Systems Application Architecture (SAA) compliant office system called OfficeVision. OfficeVision is supported on IBM's MVS, VM, OS/400, and OS/2 LAN. The LAN version uses OS/2 Extended Edition to provide its graphical user interface, multitasking capabilities, and program-to-program communications. Through OfficeVision, IBM will fulfill its SAA commitment to provide a consistent platform for the development of easy-to-use, well-connected systems and applications. New in 1990 is the February announcement of a Multimedia product for use with the PS/2 product line.

### Printers

In the electronic printer market, 1989 was a year of significant activity for IBM, beginning with the introduction in January of the ProPrinter X24E and XL24E dot matrix printers as the successors to the X24 and XL24 models. In April, IBM introduced two new midrange page printers, the 3816 and 3825. The 3816 has a print resolution of 240 dpi and rated printing speed of 24 ppm for letter-size paper. The 3825 is a duplex laser printer rated at 58 ppm and designed for use with IBM's 30XX, 43XX, or 9370 processors. In November, IBM introduced its duplexing version of the 3816 page printer, the 3816-01D.

During the second half of 1989, IBM announced the 4019 laser printer, with a rated speed of 10 ppm. This was its first entry into the low-end page printer market. IBM followed with the introduction in March 1990 of the 4019 LaserPrinter E, a 5-ppm, entry-level version of the 4019 LaserPrinter, and availability of PostScript upgrades for both products.

Although line, impact printer shipments were lower in 1989 than during the previous year, IBM maintained its lead in the market. Dataquest estimates IBM's North American unit market share at approximately 32 percent for 1989. IBM also remained one of the top five vendors of serial and page printers in 1989.

### Software

The emergence of the first of a series of products under IBM's Systems Application Architecture (SAA) occurred in 1989. The SAA strategy was designed to provide users with a common interface and connectivity across all IBM operating environments. This strategy is the cornerstone of IBM's product plans for the next decade. IBM will use SAA to integrate current product platforms with future products, unifying all software under a single architecture.

OfficeVision, introduced in May, is the first application to incorporate the SAA guidelines. Another SAA-based product announced in 1989 was CIM Advantage, a family of products for use in manufacturing operations. In November, IBM debuted the AD/Cycle product, a set of application development tools for use with the MVS systems environment that further supports the SAA framework. In addition, IBM's SAA standard has been endorsed by more than 100 other software companies that have committed to developing products using the SAA guidelines.



IBM also strengthened its commitment to the Open Software Foundation (OSF) and the UNIX operating system marketplace. In March, IBM began shipments of the AIX operating system on PS/2 products. IBM has also stepped up AIX development through its IBM business partners program. The announcement of the RS/6000 in February 1990 should erase any lingering doubts about IBM's commitment to UNIX.

IBM increased investments in third-party software development, in continued support of its role as a leader in the software industry. As noted earlier, IBM made equity investments in over 30 software companies during 1989. The Company continues to invest heavily in software development. By the end of 1990, IBM expects to have expanded development by 59 percent over 1986 levels. Software sales accounted for \$8.4 billion in revenue for IBM in 1989—roughly 13 percent of total revenue for the year.

#### Telecommunications

IBM entered into the PBX manufacturing market with the purchase of ROLM, which turned out to be a money-losing operation. It solved this problem by aligning with Siemens in a joint venture. During 1989, the Company completed the sale of Rolm manufacturing and development activities to Siemens AG. A newly formed company, jointly owned by IBM and Siemens, will market and service Siemens telephones, switching systems, and other telecommunications products in the United States. IBM will also remarket Siemens telephone products in Europe and Australia.

#### Semiconductors

In October 1989, IBM opened the Advanced Semiconductor Technology Center (ASTC) in East Fishkill, New York. This center will develop advanced chip technology for future IBM products. Motorola is participating in IBM's research on the use of X-ray lithography technology, which will be conducted at the ASTC facility. In March 1990, IBM entered into a joint agreement with Siemens to develop 64M DRAM technology. This research also will be carried out at the ASTC, utilizing X-ray lithography technology.

The year 1989 saw the launch of IBM's first products incorporating their proprietary RISC chips. IBM also began shipments of products utilizing its 4-million-bit memory chips. In addition, IBM has licensed its 4M DRAM technology to Micron Technology, Inc., to increase US-based supply of the semiconductor.

Because IBM is not a merchant supplier of semiconductors, the total extent of IBM's semiconductor manufacturing is unknown. Dataquest estimates that IBM supplies at least one-half of its own semiconductor needs and would rank among the top three manufacturers worldwide.

#### Further Information

For further information about the Company's business segments, please contact the appropriate industry service.

**Table 1**  
**Five-Year Corporate Highlights (Millions of US Dollars)**

	1985	1986	1987	1988	1989
Five-Year Revenue	\$50,056.0	\$51,250.0	\$54,217.0	\$59,681.0	\$62,710.0
Percent Change	8.97	2.39	5.79	10.08	5.08
Capital Expenditure	\$6,430.0	\$4,620.0	\$4,304.0	\$5,390.0	\$6,414.0
Percent of Revenue	12.85	9.01	7.94	9.03	10.23
R&D Expenditure	\$4,723.0	\$5,221.0	\$5,434.0	\$5,925.0	\$6,827.0
Percent of Revenue	9.44	10.19	10.02	9.93	10.89
Number of Employees	405,535	403,508	389,348	387,112	383,220
Revenue (\$K)/Employee	\$123.43	\$127.01	\$139.25	\$154.17	\$163.64
Net Income	\$6,555.0	\$4,789.0	\$5,258.0	\$5,806.0	\$3,758.0
Percent Change	(0.41)	(26.94)	9.79	10.42	(35.27)
1989 Calendar Year	Q1	Q2	Q3	Q4	
Quarterly Revenue	\$12,730.0	\$15,213.0	\$14,305.0	\$20,462.0	
Quarterly Profit	\$950.0	\$1,340.0	\$877.0	\$591.0	

Source: IBM  
Annual Reports  
Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1985	1986	1987	1988	1989
North America	56.96	49.49	45.99	42.43	43.11
International	43.04	50.51	54.01	57.57	56.89

Source: IBM  
Annual Reports

**Table 3**  
**Revenue by Distribution Channel (Percent)**

Channel	1988*	1989*
Direct Sales	70.00	70.00
Indirect Sales	30.00	30.00
VARs	10.00	10.00
Dealers	20.00	20.00

\*Dataquest estimate

Source: Dataquest (1990)

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## 1989 SALES OFFICE LOCATIONS

North America—280  
Japan—Not available  
Europe—Not available  
Asia/Pacific—Not available  
ROW—Not available

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## MANUFACTURING LOCATIONS

### *North America*

Boca Raton, Florida  
PS/2 workstations, displays, printers, typewriters, publishing and consumer systems, and related operating systems software

Boulder, Colorado  
PS/2 workstations, displays, printers, typewriters, publishing and consumer systems, and related operating systems software

Charlotte, North Carolina  
Personal System/2 workstations, displays, printers, typewriters, publishing and consumer systems, and related operating systems software

Danbury, Connecticut  
Circuit packaging, intermediate processors, and printers; develops programming systems

Essex Junction, Vermont  
Major manufacturing facility; direct products not available

Hopewell Junction, New York  
PS/2 workstations, displays, printers, typewriters, publishing and consumer systems, and related operating systems software

Lexington, Kentucky  
Major manufacturing facility; direct products not available

Raleigh, North Carolina  
Communications products and related operating systems software

San Jose, California  
Electronic data processing systems, storage systems, mass storage systems, tape disk drive products

Somers, New York  
Communications products and related operating systems software

### *White Plains, New York*

Small and intermediate systems, general-purpose systems and related programming, direct access storage devices, typewriter printer copiers and associated supplies, logic memory, special semiconductor devices, and multilayer ceramics

### *Europe*

Greenlock, Scotland  
Personal computers

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## SUBSIDIARIES

### *North America*

Canada Limited (Canada)  
IBM Americas/Far East Systems Corp. (United States)  
IBM Credit Corp. (United States)  
IBM Credit Leasing Corp. (United States)  
IBM Foreign Sales Corp. Ltd. (United States)  
IBM International Corp. (United States)  
IBM Roece Inc. (United States)  
IBM Southeast Asia Services Ltd. (United States)  
IBM World Trade Corp. (United States)  
IBM World Trade Europe/Middle East/Africa Corp. (United States)  
Satellite Transponder Leasing Corp. (United States)  
WTC Insurance Corp. Ltd. (United States)

### *Japan*

IBM Japan Ltd.  
IBM World Trade Asia Corp.

### *Europe*

Compagnie IBM France, S.A. (France)  
Companhia IBM Portuguesa, S.A. (Portugal)  
IBM Danmark A/S (Denmark)  
IBM Deutschland GmbH (Netherlands)  
IBM Distribution and Support, S.A. (Spain)  
IBM Eurocoordination, S.A. (Spain)  
IBM Europe, S.A. (Spain)  
IBM Hellas Information Handling Systems S.A. (Spain)

IBM Ireland Ltd. (Ireland)  
 IBM Italia Ltd. S.p.A. (Italy)  
 IBM Latin American Region, S.A. (Spain)  
 IBM Nederland, N.V. (Netherlands)  
 IBM Oesterreich, Internationale Bueromaschinen  
 Gesellschaft MbH (West Germany)  
 IBM of Belgium S.A. (Belgium)  
 IBM S.A.E. (Spain)  
 IBM Svenska Aktiebolag (Sweden)  
 IBM Switzerland (Switzerland)  
 IBM Trade Development, S.A. (Spain)  
 IBM United Kingdom Holdings Ltd. (United  
 Kingdom)  
 Oy IBM AB (Finland)

#### *Asia/Pacific*

IBM Australia Ltd. (Australia)  
 IBM China/Hong Kong Corp. (Hong Kong)  
 IBM Korea, Inc. (Korea)  
 IBM Korea Systems Corp. (Korea)  
 IBM New Zealand, Ltd. (New Zealand)  
 IBM Philippines, Inc. (Philippines)  
 IBM Singapore Pte. Ltd. (Singapore)  
 IBM Taiwan Corp. (Taiwan)  
 IBM Thailand Co. Ltd. (Thailand)  
 Thai Systems Corp. Ltd. (Thailand)

#### *ROW*

IBM Argentina, S.A. (Argentina)  
 IBM Bahamas Ltd. (Bahamas)  
 IBM Brasil-Industria, Maquinas E Servicos Ltda.  
 (Brazil)  
 IBM De Bolivia, S.A. (Bolivia)  
 IBM De Chile S.A.C. (Chile)  
 IBM De Colombia, S.A. (Colombia)  
 IBM De Costa Rica, S.A. (Costa Rica)  
 IBM De Guatemala, S.A. (Guatemala)  
 IBM De Honduras, S.A. (Honduras)  
 IBM Del Ecuador, C.A. (Ecuador)  
 IBM Del Peru, S.A. (Peru)  
 IBM Del Uruguay, S.A. (Uruguay)  
 IBM De Mexico, S.A. (Mexico)  
 IBM De Panama, S.A. (Panama)  
 IBM De Venezuela, S.A. (Venezuela)  
 IBM Israel Ltd. (Israel)  
 IBM Turk Ltd. Sirketi (Turkey)

## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1989

Toshiba  
 Joint venture to produce lightweight computer  
 screens

NCR  
 MCA licensing agreement

Wang Laboratories  
 MCA licensing agreement

Haushahn GmbH  
 Developing automated tape drive library

Samsung  
 Patent cross-licensing agreement

Baxter International  
 Codeveloping computer products and services for  
 the rapidly growing health-care information  
 management market

Motorola  
 Joint development of a national X-ray lithography  
 program

Micron Technology  
 Licensed Micron's 4Mb DRAM technology

Microsoft  
 Codeveloping an open industry standard for multi-  
 media personal computing systems

Chips and Technologies  
 Codeveloping and marketing chip sets that are  
 used in busmasters and other Micro Channel  
 adapter cards

Intel  
 Codeveloping and marketing Micro Channel  
 chip sets

Modicon  
 Development and marketing alliance in which  
 Modicon will support mutual development of  
 products that move Modicon controller and com-  
 munication products and IBM industrial computer  
 products

1988

Siemens AG  
 Joined forces to compete in the global PBX and  
 private networking markets (As a part of this  
 agreement, IBM sold its ROLM subsidiary to  
 Siemens.)

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## KEY OFFICERS

**John F. Akers**

Chairman of the board, chief executive officer

**Jack D. Kuehler**

President

**C. Michael Armstrong**

Chairman of the board and president, WTC

**George H. Conrades**

Senior vice president

**Carl J. Conti**

Senior vice president and general manager, ES

**Terry R. Lautenbach**

Senior vice president and general manager, IBM  
US

**David E. McKinney**

Chairman, CEO, and president, E/MEA

**Frank A. Metz, Jr.**

Senior vice president, Corporate Finance and Plan-  
ning

**Patrick A. Toole**

Senior vice president

**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending December**  
**(Millions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	\$26,070.0	\$27,749.0	\$31,020.0	\$35,343.0	\$35,875.0
Cash	896.0	755.0	770.0	1,072.0	741.0
Receivables	10,566.0	10,825.0	13,849.0	18,100.0	20,164.0
Marketable Securities	4,726.0	6,502.0	6,197.0	5,051.0	1,261.0
Inventory	8,579.0	8,039.0	8,645.0	9,565.0	9,463.0
Other Current Assets	1,303.0	1,628.0	1,559.0	1,555.0	4,246.0
Net Property, Plants	\$19,680.0	\$21,268.0	\$22,922.0	\$23,426.0	\$24,943.0
Other Assets	\$6,884.0	\$8,797.0	\$9,746.0	\$14,268.0	\$16,916.0
<b>Total Assets</b>	<b>\$52,634.0</b>	<b>\$57,814.0</b>	<b>\$63,688.0</b>	<b>\$73,037.0</b>	<b>\$77,734.0</b>
Total Current Liabilities	\$11,433.0	\$12,743.0	\$13,377.0	\$17,387.0	\$21,700.0
Long-Term Debt	\$3,955.0	\$4,169.0	\$3,858.0	\$8,518.0	\$10,825.0
Other Liabilities	\$5,256.0	\$6,528.0	\$8,190.0	\$7,623.0	\$6,700.0
<b>Total Liabilities</b>	<b>\$20,644.0</b>	<b>\$23,440.0</b>	<b>\$25,425.0</b>	<b>\$33,528.0</b>	<b>\$39,225.0</b>
Total Shareholders' Equity	\$31,990.0	\$34,374.0	\$38,263.0	\$39,509.0	\$38,509.0
Converted Preferred Stock	0	0	0	0	0
Capital Stock	6,267.0	6,321.0	6,417.0	6,442.0	6,341.0
Other Equity	(1,511.0)	219.0	2,830.0	1,917.0	1,691.0
Retained Earnings	27,234.0	27,834.0	29,016.0	31,150.0	30,477.0
<b>Total Liabilities and Shareholders' Equity</b>	<b>\$52,634.0</b>	<b>\$57,814.0</b>	<b>\$63,688.0</b>	<b>\$73,037.0</b>	<b>\$77,734.0</b>
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	\$50,056.0	\$51,250.0	\$54,217.0	\$59,681.0	\$62,710.0
US Revenue	28,511.0	25,362.0	24,937.0	25,320.0	31,480
Non-US Revenue	21,545.0	25,888.0	29,280.0	34,361.0	31,230
Cost of Sales	\$14,911.0	\$16,197.0	\$17,332.0	\$25,648.0	\$27,701.0
R&D Expense	\$4,723.0	\$5,221.0	\$5,434.0	\$5,925.0	\$6,827.0
SG&A Expense	\$13,000.0	\$15,464.0	\$16,431.0	\$19,362.0	\$21,289.0
Capital Expense	\$6,430.0	\$4,620.0	\$4,304.0	\$5,390.0	\$6,414.0
Pretax Income	\$11,619.0	\$8,389.0	\$8,609.0	\$8,746.0	\$6,893.0
Pretax Margin (%)	23.21	16.37	15.88	14.65	10.99
Effective Tax Rate (%)	43.60	42.90	38.90	39.20	43.4
Net Income	\$6,555.0	\$4,789.0	\$5,258.0	\$5,806.0	\$3,758.0
Shares Outstanding, Millions	614.0	612.8	602.9	592.4	581.1
<b>Per Share Data</b>					
Earnings	\$10.67	\$7.81	\$8.72	\$9.27	\$6.47
Dividend	\$4.40	\$4.40	\$4.40	\$4.40	\$4.73
Book Value	\$52.10	\$56.09	\$63.46	\$66.69	\$66.27

**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending December**  
**(Millions of US Dollars, except Per Share Data)**

<b>Key Financial Ratios</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
<i>Liquidity</i>					
Current (Times)	2.28	2.18	2.32	2.03	1.65
Quick (Times)	1.53	1.55	1.67	1.48	1.22
Fixed Assets/Equity (%)	61.52	61.87	59.91	59.29	64.77
Current Liabilities/Equity (%)	35.74	37.07	34.96	44.01	56.35
Total Liabilities/Equity (%)	64.53	68.19	66.45	84.86	101.86
<i>Profitability (%)</i>					
Return on Assets	13.74	8.67	8.66	8.49	4.99
Return on Equity	22.42	14.43	14.48	14.93	9.63
Profit Margin	13.10	9.34	9.70	9.73	5.99
<i>Other Key Ratios</i>					
R&D Spending % of Revenue	9.44	10.19	10.02	9.93	10.89
Capital Spending % of Revenue	12.85	9.01	7.94	9.03	10.23
Employees	405,535	403,508	389,348	387,112	383,220
Revenue (\$K)/Employee	\$123.43	\$127.01	\$139.25	\$154.17	\$163.64
Capital Spending % of Assets	12.22	7.99	6.76	7.38	32.09

Source: IBM  
Annual Reports  
Dataquest (1990)

**Kyocera Corporation**  
5-22 Kitainoue-cho Higashino  
Yamashina-ku, Kyoto 607 Japan  
Telephone: (075) 592-3851  
Fax: (075) 501-6536  
Dun's Number: Not Available  
*Date Founded: 1959*

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## **CORPORATE STRATEGIC DIRECTION**

Kyocera Corporation witnessed its 30-year anniversary on April 1, 1989. Since its formation in 1959 by Kazuo Inamori, Kyocera Corporation has developed into one of the leading ceramic manufacturers supplying advanced ceramic technology solutions to complex problems encountered in electronics, machinery, automotive, communication, and other industries, as well as in medical and energy-related fields. Kyocera Corporation is the parent/holding company with high-tech operating units involved in the computer hardware, energy, high-tech service, advanced material, subassembly, test and measurement, telecommunication, and transportation industries. Kyocera divides its products into eight segments: semiconductor packaging (33.0 percent of total sales), electronic components (19.8 percent), consumer-related products (7.0 percent), industrial ceramics (5.7 percent), ceramic material for the electronic industry (2.3 percent), electronic equipment (19.4 percent), optical and precision instruments (11.4 percent), and others (1.4 percent). The electronic equipment and consumer-related products business segments represented the greatest growth in sales, with respective 25.6 percent and 22.5 percent growths over fiscal year 1988 sales figures.

Total revenue increased 12.8 percent to ¥338.7 billion (US\$2.6 billion) in fiscal year 1989, up from ¥300.4 billion (US\$2.2 billion) in fiscal year 1988. Net income accounted for ¥29.7 billion (US\$231.2 million) in fiscal year 1989, representing a 30.8 percent growth over fiscal year 1988. (Percentage changes refer only to ¥ amounts; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.)

Kyocera markets its products worldwide through its direct sales force, distributors, and dealers. Kyocera

sells the majority of its products in the Japanese marketplace. During fiscal years 1989 and 1988, respective sales within Japan totaled 73.2 and 73.8 percent of total revenue. North American sales accounted for 16.7 and 17.1 percent, respectively, of total revenue during fiscal years 1989 and 1988. Kyocera utilizes its subsidiaries as sales representatives.

During fiscal years 1989 and 1988, research and development expenditure equaled ¥13.1 billion (US\$102.5 million) and ¥10.1 billion (US\$164.3 million), respectively. These figures represent 3.9 and 3.4 percent, respectively, of total revenue. Kyocera promotes research and development activities through combining new and existing technologies while targeting customer needs and market trends. Kyocera's Corporate Technology and Planning Division coordinates overall research and development activities at two laboratories, focusing on basic materials and applied products as well as on manufacturing technology. Research and development activities are divided into three categories: the development of fine ceramic materials and their applications, the development of electronic components made up of ceramics with unique dielectric and piezoelectric characteristics and devices using thin-film technology, and the development of assembled equipment and related systems within the electronic equipment and optical instrument sectors. Other R&D activities are conducted at Kyocera's many sites throughout the world.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channels is not available. Tables 3 and 4, comprehensive financial statements, are at the end of this profile.



## BUSINESS SEGMENT STRATEGIC DIRECTION

### Semiconductor Parts

The semiconductor parts business segment experienced a 5.2 percent growth in fiscal 1989 over sales in fiscal year 1988. During the first half of fiscal year 1989, activity in the office automation equipment market resulted in a large demand for Kyocera's integrated circuits packages. In the second half of fiscal year 1989, demand slowed because of inventory adjustments within the semiconductor industry, according to Kyocera. Kyocera's major products consist of layer packages, CERDIP, advanced packages, ceramic modules, and metallized products.

### Electronic Components

Sales in fiscal 1989 for Kyocera's electronic components business segment increased 19.9 percent over fiscal year 1988. Its products are chip capacitors, chip resistors, quartz oscillators, ceramic filters, thermal printheads, amorphous silicon drums, and liquid-crystal displays. According to Kyocera, sales of thermal printheads increased as a result of the strong facsimile equipment markets. Kyocera plans to concentrate on expanded sales of thermal printheads for other applications such as high value-added color printers. Because of large-scale copiers, sales of amorphous silicon drums increased.

### Consumer-Related Products

The consumer-related products business segment had the second largest sales increase of all of Kyocera's products, with 1989 growth of 22.5 percent over fiscal year 1988. This segment's major products are jewelry (crescent vert), dental and orthopedic implants (bioceram), home and business solar systems, solar cells applied equipment, cutting tools, ceramic scissors, and ceramic knives. Kyocera introduced the Cermet TN-60, a ceramic cutting tool material with an advantageous balance of elasticity and wear resistance.

### Industrial Ceramics

Sales for the industrial ceramics business segment increased 12.4 percent in 1989 over fiscal year 1988. According to Kyocera, the increase was attributed to strong demand from domestic manufacturers and strong demand for ceramic pump parts and valve components. Kyocera's products are parts for

machine tools, forming board for the paper industry, pump and valve parts, parts for semiconductor fabrication, parts for optical communication equipment, and automotive parts.

### Ceramic Materials for the Electronics Industry

In 1989, the ceramic materials for the electronics industry business segment showed a decrease of 3.5 percent from fiscal year 1988 in total sales. Kyocera's products in this segment include substrates for hybrid integrated circuits, substrates for volume controls, substrates for resistors, substrates for thermal printheads, cathode holders, and multiform glass for color televisions. To enhance profitability, Kyocera has intensified its efforts to reduce costs, refined its automated production methods, rationalized production, and responded to the growing demand for quick-turnaround, low-volume orders of various ceramic substrates. Kyocera is continuing its development of new materials and has been researching aluminum nitride, a substrate material with higher thermal conductivity than the commonly used alumina substrates.

### Electronic Equipment

Sales in the electronic equipment business segment represented the largest sales growth over fiscal year 1988 of all of Kyocera's business segments: an increase of 25.6 percent. Kyocera's major products are communication equipment, information equipment, peripheral equipment, memory equipment, and video conference systems. Kyocera sells an 8-pages-per-minute (ppm) printer, three 10-ppm printers, and an 18-ppm model page printer in North America. Kyocera experienced increases in the sale of laser printers in Europe. In November, Kyocera introduced the Japanese-language AX-type microcomputer. Sales of desktop and laptop computers were favorable for Kyocera, especially in the European market.

### Optical and Precision Instruments

The optical and precision instruments business segment experienced a 4.5 percent increase in 1989 in sales over fiscal year 1988. Kyocera's products are single-lens reflex cameras, compact cameras, 8mm video camcorders, and optical applied equipment. Kyocera introduced new models of the SAMURAI camera series with 4X zoom lenses that originally began shipment in December 1988.

### **Further Information**

For more information about Kyocera's business segments, please contact Dataquest's Japanese Semiconductor Applications Markets and/or Electronic Printer Industry Service.

**Table 1**  
**Five-Year Corporate Highlights (Millions of US Dollars)**

	1985	1986	1987	1988	1989
Five-Year Revenue	\$1,337.5	\$1,261.4	\$1,731.0	\$2,176.4	\$2,641.0
Percent Change	-	(5.69)	37.22	25.73	21.35
Capital Expenditure	\$143.0	\$94.4	\$85.5	\$120.9	\$164.0
Percent of Revenue	10.69	7.48	4.94	5.55	6.21
R&D Expenditure	\$21.4	\$29.1	\$49.5	\$73.1	\$102.5
Percent of Revenue	1.60	2.31	2.86	3.36	3.88
Number of Employees	NA	NA	NA	NA	NA
Revenue (\$K)/Employee	NA	NA	NA	NA	NA
Net Income	\$156.3	\$83.1	\$109.5	\$164.3	\$231.2
Percent Change	-	(46.85)	31.73	50.10	40.74
Exchange Rate (US\$1=¥)	¥243.52	¥221.26	¥159.56	¥138.03	¥128.25
1989 Calendar Year		Q1	Q2	Q3	Q4
Quarterly Revenue		NA	NA	NA	NA
Quarterly Profit		NA	NA	NA	NA

NA = Not available

Source: Kyocera Corporation  
Annual Reports and Forms 10-K  
Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1985	1986	1987	1988	1989
North America	24.67	19.99	18.21	17.06	16.66
International	75.33	80.01	81.79	82.94	83.34
Japan	69.44	73.67	74.19	73.78	73.20
Others	5.89	6.34	7.60	9.16	10.14

Source: Kyocera Corporation  
Annual Reports and Forms 10-K  
Dataquest (1990)

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## 1989 SALES OFFICE LOCATIONS

Information is not available.

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## MANUFACTURING LOCATIONS

### North America

Kyocera America, Inc. (United States)  
Semiconductor parts  
Kyocera Feldmuhle, Inc. (United States)  
Industrial ceramics and cutting tools  
Kyocera Northwest, Inc. (United States)  
Electronic components

### Asia/Pacific

Tomioka Optical Co., Ltd. (Japan)  
Optical and precision instruments

### ROW

Kyocera Mexicana, S.A. de C.V. (Mexico)  
Semiconductor parts  
Yashica do Brasil-Industria e (Brazil)  
Optical and precision instruments

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## SUBSIDIARIES

### North America

AVX Corporation (United States)  
Elco Corporation (United States)  
Kinamed, Inc. (United States)  
Kyocera America, Inc. (United States)  
Kyocera Canada, Inc. (Canada)  
Kyocera Electronics, Inc. (United States)  
Kyocera Feldmuhle, Inc. (United States)  
Kyocera International, Inc. (United States)  
Kyocera Northwest, Inc. (United States)  
Kyocera Unison, Inc. (United States)  
Yashica, Inc. (United States)

### Europe

Kyocera Electronics Europe GmbH (Germany)  
Kyocera Electronics U.K., Ltd. (United Kingdom)  
Kyocera Europa Elektronische Bauelemente GmbH  
(Germany)

Kyocera Europe GmbH (Germany)  
Kyocera Yashica U.K., Ltd. (United Kingdom)  
Yashica A.G. (Switzerland)  
Yashica Handelsgesellschaft mbH (Austria)  
Yashica Kyocera GmbH (Germany)

### Asia/Pacific

Kyocera (Hong Kong), Ltd. (Hong Kong)  
Kyocera Asia, Ltd. (Hong Kong)  
Kyocera Building Co., Ltd. (Japan)  
Kyocera Electronic Equipment Co., Ltd. (Japan)  
Tomioka Optical Co., Ltd. (Japan)  
Universal Optical Industries, Ltd. (Hong Kong)  
Yashica Hong Kong Co., Ltd. (Hong Kong)

### ROW

Comercio Ltda. (Brazil)  
Industria Ltda. (Brazil)  
Kyocera Mexicana, S.A. de C.V. (Mexico)  
Yashica do Brasil-Exportacao e (Brazil)  
Yashica do Brasil-Industria e (Brazil)

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## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

### 1989

#### Sony Corporation

Kyocera will market Hi-8-Format camcorders  
OEM-supplied by Sony Corporation.

### 1988

#### Lund Science A.B.

Kyocera began domestic marketing of the Lund-Buchler-Hyperthermia 4010 System, a device manufactured by Lund Science A.B. for use in cancer thermotherapy.

### 1987

#### Vitellic

Kyocera began marketing DRAMs and SRAMs supplied by Vitelic.

#### CAECO Incorporated

Kyocera and CAECO Incorporated signed a sales agent agreement. Under the terms of the agreement, Kyocera will market CAECO's very large-scale integration layout system, which enables full-custom designing of chips with more than 1 million transistors.

**Iscar**

Kyocera, in cooperation with Iscar, developed a cutting bit that shortens cutting times. The bit, "Cut Grip," is being manufactured by Iscar, and Kyocera imports and sells it in the domestic market.

**AIDA Corporation**

A marketing agreement provided for Kyocera's marketing of CAE systems imported from AIDA Corporation.

**Pictel**

Kyocera obtained the right to produce and market Pictel's cod-decs, which are used in videoconferencing systems.

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**MERGERS AND ACQUISITIONS**

**1990**

**AVX Corporation**

Kyocera acquired AVX Corporation, the largest US ceramic capacitor manufacturer.

**1989**

**Elco Corporation**

Kyocera acquired Elco Corporation, a maker of electrical connectors and connection systems in Germany, Japan, and the United States.

**DDI Corporation**

Kyocera acquired 25 percent of DDI Corporation, a newly established common carrier.

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**KEY OFFICERS**

**Kazuo Inamori**

Chairman of the board and representative director

**Kinju Anjo**

President and representative director

**Kensuke Itoh**

Executive vice president and representative director

**Toshinori Inamori**

Senior managing director

**Masaaki Hiwatashi**

Senior managing director

**Shoichi Hamamoto**

Senior managing director

**Yoshiteru Hamano**

Senior managing director

**Yoshizo Yasuda**

Senior managing director

**Katsumi Nishimura**

Senior managing director

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**PRINCIPAL INVESTORS**

Leonard Stein-Sapir—13.8 percent

Richard Arons—12.1 percent

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**FOUNDER**

Kazuo Inamori

**Table 3**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	\$1,124.7	\$1,088.0	\$1,993.3	\$2,466.1	\$3,010.7
Cash	19.3	17.9	24.2	31.1	42.3
Receivables	385.7	338.8	460.6	594.2	640.9
Marketable Securities	34.0	31.2	50.7	31.5	34.5
Inventory	209.4	214.7	273.4	342.6	386.0
Other Current Assets	476.3	485.3	1,184.4	1,466.6	1,907.1
Net Property, Plants	\$297.6	\$329.6	\$428.6	\$504.4	\$588.0
Other Assets	\$135.3	\$186.9	\$252.1	\$295.0	\$467.4
Total Assets	\$1,557.6	\$1,604.5	\$2,673.9	\$3,265.5	\$4,066.1
Total Current Liabilities	\$354.0	\$253.5	\$374.8	\$514.2	\$600.3
Long-Term Debt	\$1.6	\$2.9	\$379.2	\$313.2	\$574.4
Other Liabilities	\$25.1	\$27.8	\$38.1	\$41.7	\$47.6
Total Liabilities	\$380.7	\$284.2	\$792.1	\$869.1	\$1,222.4
Minority Interest	\$0.3	\$1.1	\$2.3	\$3.0	\$3.0
Total Shareholders' Equity	\$1,176.6	\$1,319.2	\$1,879.5	\$2,393.4	\$2,840.7
Common Stock	139.7	153.8	213.2	309.1	342.9
Other Equity	413.7	430.7	583.5	721.5	857.9
Retained Earnings	623.2	734.7	1,082.7	1,362.8	1,639.9
Total Liabilities and Shareholders' Equity	\$1,557.6	\$1,604.5	\$2,673.9	\$3,265.5	\$4,066.1
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	\$1,337.5	\$1,261.4	\$1,731.0	\$2,176.4	\$2,641.0
US Revenue	329.9	252.2	315.2	371.4	440.0
Non-US Revenue	1,007.6	1,009.2	1,415.8	1,805.0	2,201.0
Cost of Sales	\$850.1	\$901.7	\$1,245.2	\$1,494.9	\$1,783.2
R&D Expense	\$21.4	\$29.1	\$49.5	\$73.1	\$102.5
SG&A Expense	\$192.1	\$203.9	\$273.9	\$380.4	\$434.6
Capital Expense	\$143.0	\$94.4	\$85.5	\$120.9	\$164.0
Pretax Income	\$337.9	\$194.0	\$237.2	\$364.9	\$477.5
Pretax Margin (%)	25.26	15.38	13.70	16.77	18.08
Effective Tax Rate (%)	56.00	58.00	58.00	58.00	56.00
Net Income	\$156.3	\$83.1	\$109.5	\$164.3	\$231.2
Shares Outstanding, Thousands	150,000	150,000	150,000	163,599	163,599
<b>Per Share Data</b>					
Earnings	\$1.04	\$0.55	\$0.73	\$1.02	\$1.43
Dividend	\$0.18	\$0.20	\$0.28	\$0.32	\$0.34
Book Value	\$7.84	\$8.79	\$12.53	\$14.63	\$17.36
Exchange Rate (US\$1=¥)	¥243.52	¥221.26	¥159.56	¥138.03	¥128.25

NA = Not available

Source: Kyocera Corporation  
 Annual Reports and Forms 10-K  
 Dataquest (1990)

**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of Yen, Except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	¥273,899.0	¥240,720.0	¥318,045.0	¥340,391.0	¥386,125.0
Cash	4,711.0	3,956.0	3,857.0	4,298.0	5,425.0
Receivables	93,916.0	74,971.0	73,492.0	82,018.0	82,192.0
Marketable Securities	8,280.0	6,914.0	8,094.0	4,351.0	4,426.0
Inventory	51,000.0	47,507.0	43,624.0	47,293.0	49,499.0
Other Current Assets	115,992.0	107,372.0	188,978.0	202,431.0	244,583.0
Net Property, Plants	¥72,464.0	¥72,922.0	¥68,380.0	¥69,623.0	¥75,409.0
Other Assets	¥32,944.0	¥41,362.0	¥40,227.0	¥40,721.0	¥59,943.0
Total Assets	¥379,307.0	¥355,004.0	¥426,652.0	¥450,735.0	¥521,477.0
Total Current Liabilities	¥86,215.0	¥56,099.0	¥59,801.0	¥70,981.0	¥76,991.0
Long-Term Debt	¥393.0	¥641.0	¥60,511.0	¥43,227.0	¥73,668.0
Other Liabilities	¥6,110.0	¥6,146.0	¥6,082.0	¥5,749.0	¥6,109.0
Total Liabilities	¥92,718.0	¥62,886.0	¥126,394.0	¥119,957.0	¥156,768.0
Minority Interest	¥73.0	¥238.0	¥372.0	¥419.0	¥389.0
Total Shareholders' Equity	¥286,516.0	¥291,880.0	¥299,886.0	¥330,359.0	¥364,320.0
Common Stock	34,023.0	34,023.0	34,023.0	42,663.0	43,979.0
Other Equity	100,734.0	95,303.0	93,104.0	99,587.0	110,028.0
Retained Earnings	151,759.0	162,554.0	172,759.0	188,109.0	210,313.0
Total Liabilities and Shareholders' Equity	¥379,307.0	¥355,004.0	¥426,652.0	¥450,735.0	¥521,477.0
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	¥325,719.0	¥279,103.0	¥276,192.0	¥300,409.0	¥338,704.0
US Revenue	80,339.0	55,801.0	50,294.0	51,260.0	56,430.0
Non-US Revenue	245,380.0	223,302.0	225,898.0	249,149.0	282,274.0
Cost of Sales	¥207,013.0	¥199,516.0	¥198,680.0	¥206,337.0	¥228,695.0
R&D Expense	¥5,212.0	¥6,441.0	¥7,897.0	¥10,093.0	¥13,147.0
SG&A Expense	¥46,784.0	¥45,113.0	¥43,702.0	¥52,509.0	¥55,732.0
Capital Expense	¥34,833.0	¥20,885.0	¥13,649.0	¥16,682.0	¥21,034.0
Pretax Income	¥82,278.0	¥42,934.0	¥37,843.0	¥50,369.0	¥61,237.0
Pretax Margin (%)	25.26	15.38	13.70	16.77	18.08
Effective Tax Rate (%)	56.00	58.00	58.00	58.00	56.00
Net Income	¥38,072.0	¥18,385.0	¥17,465.0	¥22,677.0	¥29,654.0
Shares Outstanding, Thousands	150,000	150,000	150,000	163,599	163,599
<b>Per Share Data</b>					
Earnings	¥253.81	¥122.57	¥116.43	¥140.56	¥183.04
Dividend	¥44.00	¥44.00	¥44.00	¥44.00	¥44.00
Book Value	¥19.10	¥19.50	¥20.00	¥20.20	¥22.30

**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of Yen, Except Per Share Data)**

Key Financial Ratios	1985	1986	1987	1988	1989
<b>Liquidity</b>					
Current (Times)	3.18	4.29	5.32	4.80	5.02
Quick (Times)	2.59	3.44	4.59	4.13	4.37
Fixed Assets/Equity (%)	25.29	24.98	22.80	21.07	20.70
Current Liabilities/Equity (%)	30.09	19.22	19.94	21.49	21.13
Total Liabilities/Equity (%)	32.36	21.55	42.15	36.31	43.03
<b>Profitability (%)</b>					
Return on Assets	-	5.01	4.47	5.17	6.10
Return on Equity	-	6.36	5.90	7.20	8.54
Profit Margin	11.69	6.59	6.32	7.55	8.76
<b>Other Key Ratios</b>					
R&D Spending % of Revenue	1.60	2.31	2.86	3.36	3.88
Capital Spending % of Revenue	10.69	7.48	4.94	5.55	6.21
Employees	NA	NA	NA	NA	NA
Revenue (¥K)/Employee	NA	NA	NA	NA	NA
Capital Spending % of Assets	9.18	5.88	3.20	3.70	4.03
Exchange Rate (US\$1=¥)	¥243.52	¥221.26	¥159.56	¥138.03	¥128.25

NA = Not available

Source: Kyocera Corporation  
 Annual Reports and Forms 10-K  
 Dataquest (1990)



# Mitsubishi Electric Corporation

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Chiyoda-ku, Tokyo 100 Japan  
Telephone: (03) 218-2111  
Fax: (03) 218-3686  
Dun's Number: 09-141-8897

*Date Founded: 1921*

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## CORPORATE STRATEGIC DIRECTION

Established in 1921, Mitsubishi Electric Corporation is one of the world's foremost electronics and electrical appliance manufacturers. The Corporation is a pioneer in information processing equipment and new communications systems, incorporating teleconferencing technology, satellite relay, and optical fiber communications. Applying advances in electronics to industrial equipment, power generation, transportation, and consumer products, Mitsubishi Electric has been instrumental in improved efficiency, automation, and safety.

The Company achieved record net sales and profit during fiscal year 1990. Total revenue increased 7.3 percent to ¥2.9 billion (US\$20.9 billion) in fiscal year ending March 1990, up from ¥2.8 billion (US\$21.6 billion) in year ending March 1989. (Percentage changes refer only to ¥ amounts; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) Net income totaled ¥76.8 billion (US\$539 million) for fiscal 1990, representing an increase of 44.3 percent over fiscal 1989.

Mitsubishi Electric divides its products into four separate segments: information and communications systems and electronic products, systems, and devices; consumer products; heavy machinery; and industrial products and automotive equipment. The Company's information and communications systems and electronic products, systems, and devices segment generated the greatest amount of sales. This segment made up 30.4 percent of the Company's total sales. Consumer products sales represented the second most profitable segment, with 25.5 percent of the total, followed closely by the heavy machinery segment, which contributed 23.0 percent. Industrial products and automotive equipment accounted for 21.1 percent of total sales.

For 1990, Mitsubishi Electric's growth strategies are targeted at the restructuring of its operations and the promotion of globalization. The Company plans to focus on three main objectives: establishing a high value-added business organization centered on information and communications systems and electronic products, systems, and devices; improving its international manufacturing and sales network; and utilizing its management resources in an effective manner.

The Company believes its greatest global marketing challenge lies in the completion of construction of an efficient international manufacturing and sales network. During 1990, the Company took many actions geared at achieving this goal. In May 1990, the Company purchased the computer hardware division of Apricot Computers Plc of the United Kingdom. The company has been renamed Apricot Computers Ltd. and will be a subsidiary of Mitsubishi Electric UK Ltd. Mitsubishi Electric Europe GmbH is investing approximately ¥42.0 billion (US\$294 million) in the construction of a new production facility in Germany. Mass production of 4MB DRAMs is expected to begin in 1991 and will be followed by the manufacture of application-specific integrated circuits (ASICs) and ICs using advanced production technology. In September 1989, Mitsubishi Electric Corporation was listed on the London Stock Exchange and in November became listed on the Paris Stock Exchange.

During fiscal years 1990 and 1989, R&D expenditure totaled ¥145.1 billion (US\$1.0 billion) and ¥118.5 billion (US\$924 million), respectively. These figures represented 4.9 percent and 4.3 percent of total revenue, respectively. The Company's R&D efforts developed a digital image signal processor (DISP) during 1990, which is suitable for use in a wide range of high-precision, high-speed digital-image and video-signal processing such as that used

in video teleconferencing systems. Also developed during the year was a superconductive ceramic fiber with a diameter of 30 to 50 microns.

Capital expenditure totaled ¥223.5 billion (US\$1.6 billion), representing 7.5 percent of total revenue for year ending March 1990. This is an increase of nearly 7 percent of the 1989 figure of ¥209.5 billion (US\$1.6 billion). The Company's efforts went to construct a synchrotron radiation facility for use in the R&D of ultrafine processing semiconductors and the analysis of new materials.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 and 4, comprehensive financial statements, are at the end of this profile.

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## **BUSINESS SEGMENT STRATEGIC DIRECTION**

### **Information and Communications Systems, Electronic Products, Systems, and Devices**

Products in the information and communications systems, electronic products, systems, and devices area include semiconductors, mobile telephones, computers, radar systems, satellites, CRTs, printers, disk drives, POS terminals, facsimile transceivers, and information network systems and equipment. This segment produced the greatest amount of sales in 1990, totaling ¥903.5 billion (US\$6.0 billion), an 11.7 percent increase over 1989. The growth was attributed to increased sales of microcomputers, power devices, and communications equipment. A rise in export sales of semiconductors, cellular telephones, and computer peripherals also contributed significantly to this segment's growth.

#### **Semiconductors**

According to Dataquest, Mitsubishi ranks seventh in worldwide semiconductor market with an estimated ¥333.5 billion (US\$2.6 billion) in semiconductor sales for 1989. Mitsubishi ranked fifth in the MOS memory segment with ¥153.9 billion (US\$1.2 billion), or a 7.1 percent share of the worldwide market,

and fifth in the MOS microcomponents segment with ¥55.8 billion (US\$435 million), or a 5.3 percent market share, according to Dataquest estimates.

Throughout fiscal 1990, Mitsubishi Electric had many product developments, as well as expansion of its production facilities. The Company produced a memory card that it claims can accommodate one thousand 8.25 x 11.75-inch pages of information in Japanese. The Company also developed a 1MB EPROM with full capabilities, an access time of 120 nanoseconds, and a large-scale integrated (LSI) circuit that processes images and pictures ten times faster than existing models. Building began on Mitsubishi Electric's 32-bit MPU to The Real-Time Operating System Nucleus (TRON) specifications. The Company also developed a 64-bit RISC MPU using the UNIX operating system. Early in 1988, 4MB DRAMs were developed and tested and, in early 1989, the Company started production of 4MB DRAMs at the Saijo plant.

During fiscal 1989, Mitsubishi Electric expanded its 1MB DRAM manufacturing capabilities by installing a 1MB DRAM mass-production line in its Saijo and Kochi plants. This allowed production of 1MB DRAMs to reach 1 million units per month. The Kochi plant also expanded its facilities for microcomponents, enabling plant production capacity to reach 4 million units per month. The Company is enlarging its Durham, North Carolina, facility to accommodate the manufacturing of 1MB DRAMs and application-specific integrated circuits (ASICs). The full process of wafer fabrication to assembly to testing will be completed in-house.

#### **Communications**

Mitsubishi Electric's communications products include digital private branch exchanges (PBXs), facsimile machines, satellites, and video teleconferencing systems. During April 1989, the Company introduced small-capacity digital PBXs and upgraded its facsimile machines to G4 Integrated Services Digital Network (ISDN) specifications. The Company developed multichannel access mobile facsimile transmission and receiving equipment in 1988. Another innovation in digital communication being produced by Mitsubishi Electric is a packet multiplexer that connects computers and terminal units to a switching packet network.

Mitsubishi Electric is a leading manufacturer of satellite technology. In spring 1989, Mitsubishi Electric established a partnership with an American Company and a French company, receiving orders for commercial communications satellites meeting the INTELSAT-VII series standards. The Company also manufactures Japan's ETS-VI Engineering Test Satellite, which uses an ion engine for correcting the satellite's attitude and for extending the satellite's life by lightening the load. Both the INTELSAT-VII and the ETS-VI are planned for departure in 1992. Over the past three years, the Company has been involved in the development of the CS-3b domestic communications satellite, the IR-5120A thermal imager, a variety of active-phased array radars for the Japan Defense Agency, and mission computers and electronic equipment for use in fighter planes.

### Information Processing Systems

Information processing systems include general-purpose, small business, and personal computers in addition to other systems. Mitsubishi Electric introduced the mp286L laptop computers and the mp386s desktop computer to the US and European markets in 1988 and 1989, respectively. The mp386s utilizes a 32-bit central processing unit. The Company began domestic marketing of its AX computers as well in 1988. In April 1989, the Company opened a subsidiary that provides systems development and information-processing services using MIND, a digital value-added network. MIND was first used to connect the Company's domestic facilities. However, it is now being extended to the Company's overseas facilities as well as being offered to other companies and clients.

### Consumer Products

Sales of Mitsubishi Electric consumer products increased 8.4 percent over 1989, equaling ¥757.5 billion (US\$5.1 billion). The Company credits the growth to increased domestic consumer spending on value-added items such as color televisions, refrigerators, washing machines, and air conditioners.

### Heavy Machinery

Mitsubishi Electric's sales of heavy machinery totaled ¥685.6 billion (US\$4.6 billion), representing a 7.2 percent increase over the previous year. Despite lower expected sales resulting from a drop in large-scale orders, strong domestic demand for elevators and transportation equipment, supported by major contracts for power systems and other items, allowed for a slight growth in sales.

### Industrial Products and Automotive Equipment

In Mitsubishi Electric's industrial products and automotive equipment segment, the 10.5 percent increase in sales to ¥629.7 billion (US\$4.2 billion) was due primarily to extensive investment in plant and equipment and expansion of factory automation that occurred throughout the industry. This was complemented by strong domestic automobile production and increased use of mechatronics equipment.

### Further Information

For more information about the Company's business segments, please contact the appropriate Dataquest industry service.

**Table 1**  
**Five-Year Corporate Highlights (Millions of US Dollars)**

	1986	1987	1988	1989	1990
Five-Year Revenue	\$9,752	\$13,208	\$17,571	\$21,637	\$20,892
Percent Change	-	35.44	33.03	23.14	(3.44)
Capital Expenditure	\$697	\$791	\$1,038	\$1,633	\$1,569
Percent of Revenue	7.15	5.99	5.91	7.55	7.51
R&D Expenditure	\$403	NA	\$739	\$924	\$1,018
Percent of Revenue	4.13	NA	4.20	4.27	4.87
Number of Employees	71,479	73,536	75,795	85,723	85,723
Revenue (\$K)/Employee	\$136	\$180	\$232	\$252	\$244
Net Income	\$136	\$66	\$161	\$415	\$539
Percent Change	-	(51.09)	142.29	157.94	29.86
Exchange Rate (US\$1=¥)	¥221.26	¥159.56	¥138.03	¥128.25	¥142.47
1990 Calendar Year	Q1	Q2	Q3	Q4	
Quarterly Revenue	NA	NA	NA	NA	
Quarterly Profit	NA	NA	NA	NA	

NA = Not available

Source: Mitsubishi Electric Corporation  
Annual Reports  
Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1986	1987	1988	1989	1990
Asia/Pacific	NA	NA	NA	NA	77.40
Japan	NA	NA	NA	NA	77.40
International	NA	NA	NA	NA	22.60

NA = Not available

Source: Mitsubishi Electric Corporation  
Annual Reports  
Dataquest (1990)

## 1989 SALES OFFICE LOCATIONS

North America—22  
 Europe—9  
 Asia/Pacific—36  
 Japan—34  
 ROW—7

## MANUFACTURING LOCATIONS

### *North America*

Mitsubishi Consumer Electronics America, Inc.  
 (United States)  
 Color TVs, projection TVs, car telephones  
 Mitsubishi Electric Manufacturing Cincinnati, Inc.  
 (United States)  
 Electrical auto parts, car audio equipment  
 powerex, diodes, thyristors, and transistors  
 Mitsubishi Electric Sales Canada (Canada)  
 Color TVs  
 Mitsubishi Electronics Industries Canada, Inc.  
 (Canada)  
 Color CRTs  
 Mitsubishi Semiconductor America, Inc. (United States)  
 Semiconductors

### *Europe*

Mitsubishi Electric (United Kingdom)  
 Color TVs, VCRs

### *Asia/Pacific*

D. B. Seiko (Japan)  
 Electrical auto parts  
 Dahsen Electronic Industries (Malaysia)  
 Audio equipment  
 K. K. Sowa (Japan)  
 Electrical equipment  
 Kanebo Denshi (Japan)  
 IC assembly  
 Kang Yong Electric Manufacturing (Malaysia)  
 TVs, air conditioners, fans  
 Koryo Denki (Japan)  
 Electrical/electronic materials  
 Koshin Denki (Japan)  
 Measuring instruments, electrical equipment  
 MELCO Manufacturing Thailand (Thailand)  
 FDDs for personal computers

Mitsubishi Australia Pte. Ltd. (Australia)  
 Color TVs, car telephones  
 Mitsubishi Electric Home Appliance (Japan)  
 Home electrical appliances  
 Mitsubishi Electronics Manufacturing (Singapore)  
 Color TVs, car audio equipment  
 Mitsubishi Kochi (Japan)  
 1Mb DRAMs  
 Mitsubishi Precision (Japan)  
 Electronic instruments  
 Mitsubishi Sajo (Japan)  
 1Mb DRAMs  
 Oi Electric (Japan)  
 Communications equipment  
 Omori Denki Kogyo (Japan)  
 Electrical equipment  
 Osram Melco (Japan)  
 Lamps  
 Ryoden Denshi Kiko (Japan)  
 Antennas  
 Ryoden Kasei (Japan)  
 Electrical/electronic materials  
 Ryoden Tokki (Japan)  
 Electronic applied equipment  
 SPC Electronics (Japan)  
 Microwave/ultrasonic applied equipment  
 Sanryo Sangyo (Japan)  
 Electronic equipment  
 Sanwa Denki (Japan)  
 Electrical equipment  
 Seiryu Buhin (Japan)  
 Electrical equipment parts  
 Shihlin Electric and Engineering (Malaysia)  
 Capacitors, electrical auto parts, transformers  
 Shizuki Electric (Japan)  
 Capacitors  
 Shoryo Denshi (Japan)  
 Electrical equipment  
 Thai CRT (Thailand)  
 Color CRTs  
 Toyo Kiko Seisakusho (Japan)  
 Air conditioning equipment  
 VXL India (India)  
 Wattmeters, relays, time buses

### *ROW*

Comercio e Industria Induco (South America)  
 Power systems for communications equipment  
 Friem S. A. de C. V. (South America)  
 Refrigerators, washing machines  
 Grupo Industrial Comasa (South America)  
 Compressors for refrigerators

## SUBSIDIARIES

### *North America*

Horizon Research, Inc. (United States)  
Mitsubishi Consumer Electronics America, Inc.  
(United States)  
Mitsubishi Electric America, Inc. (United States)  
Mitsubishi Electric Manufacturing Cincinnati, Inc.  
(United States)  
Mitsubishi Electric Sales America, Inc. (United States)  
Mitsubishi Electric Sales Canada, Inc. (Canada)  
Mitsubishi Electronics America, Inc. (United States)  
Mitsubishi Electronics Industries Canada, Inc.  
(United States)  
Mitsubishi Semiconductor America, Inc. (United States)

### *Europe*

Melco Iberia S.A. (Spain)  
Mitsubishi Electric Europe GmbH (Germany)  
Mitsubishi Electric France S.A. (France)  
Mitsubishi Electric Netherlands B.V. (Netherlands)  
Mitsubishi Electric (UK) Ltd. (United Kingdom)

### *Asia/Pacific*

Ad. Melco Co., Ltd. (Japan)  
Koryo Denki (Japan)  
Koshin Denki (Japan)  
Melcom Business Machines Co., Ltd. (Japan)  
Mitsubishi Electric Credit Co., Ltd. (Japan)  
Mitsubishi Electric Home Appliance Co., Ltd. (Japan)  
Mitsubishi Electric Service Engineering Co., Ltd.  
(Japan)  
Mitsubishi Electronics Manufacturing Singapore  
(Pte.) Ltd. (Singapore)  
Mitsubishi Space Software Co., Ltd. (Japan)  
Nakayama Kikai Co., Ltd. (Japan)  
Ryoden Denshi Kiko (Japan)  
Ryoden Elevator Construction Co., Ltd. (Japan)  
Ryoden Engineering Co., Ltd. (Japan)  
Ryoden Estate Co., Ltd. (Japan)  
Ryoden Kasei (Japan)  
Ryoden Service Co., Ltd. (Japan)  
Ryoden Tokki Co., Ltd. (Japan)  
Ryoden Unyu Co., Ltd. (Japan)  
Ryoreisha Co., Ltd. (Japan)  
Ryowa Shoko Co., Ltd. (Japan)  
SPC Electronics Corporation (Japan)  
Sanryo Sangyo (Japan)  
Seiryu Buhin (Japan)

Shiga Bolt Co., Ltd. (Japan)  
Tada Electric Co., Ltd. (Japan)  
The Kodensha Co., Ltd. (Japan)  
Toyo Electric Co., Ltd. (Japan)  
Toyo Kiko Seisakusho (Japan)

## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

### *1990*

#### **Interactive Systems Corporation**

Mitsubishi Electric Corporation signed an agreement to distribute Interactive Systems Corporation's UNIX products in Europe.

#### **Yokogawa Hewlett-Packard Company**

Yokogawa Hewlett-Packard Company has agreed to work with Mitsubishi Electric Corporation to develop in-circuit emulators and software development equipment for Mitsubishi's 16-bit microcontrollers.

#### **AT&T Microelectronics**

Mitsubishi Electric Corporation signed a technology-sharing and marketing agreement with AT&T Microelectronics. Under this five-year agreement, AT&T will receive access to Mitsubishi's SRAM design and process technology. AT&T also will get global manufacturing and marketing rights to all of Mitsubishi's SRAM products.

#### **Raytheon**

Mitsubishi Electric Corporation will produce US-developed Aim-7M Sparrow missiles under license from Raytheon. The Aim-7M Sparrow is an all-weather, air-to-air, medium-range missile that will be used with a fleet of F-15 fighters.

### *1989*

#### **Siam Cement**

Under a joint venture, Mitsubishi established capital participation in Siam Compressor Industry Co., Ltd.

### *1988*

#### **Fujitsu and Hitachi**

Fujitsu, Hitachi, and Mitsubishi Electric Corporation developed the first silicon on the TRON-based H32/200 32-bit MPU. First silicon was also achieved on several peripheral devices.

**National Semiconductor**

Mitsubishi Electric Corporation began importing National Semiconductor's 32-bit MPUs and assembling National's high-speed TTLs in Japan.

**RCA Corporation**

The companies made a licensing agreement for TV sets and color CRTs.

**Goldstar Electric Equipment**

The companies made a licensing agreement for CD players.

1987

**Texas Instruments**

The companies made a licensing agreement for semiconductors and ICs.

**Motorola Inc.**

The companies made a licensing agreement for semiconductors and ICs.

**Samtel Color**

The companies made a licensing agreement for color CRTs.

**Melco Manufacturing**

The companies made a licensing agreement for floppy disk devices.

**KEFICO Corporation**

The companies made a licensing agreement for automotive engine control equipment.

**Thai CRT**

The companies made a licensing agreement for color CRTs.

**National Semiconductor**

The companies made an agreement for the OEM import of 32-bit microprocessors by Mitsubishi.

**Intel Corp.**

Mitsubishi subcontracts production of Intel 8-bit microcontrollers for the Japanese market.

**Osram GmbH**

The companies undertook a joint venture in Japan to produce lamps.

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**MERGERS AND ACQUISITIONS**

1990

**Apricot Computers**

Mitsubishi Electric Corporation acquired Apricot Computers' computer hardware division for \$64.0 million. The PC unit will trade under

the name Apricot Computers Ltd. as a subsidiary of Mitsubishi Electric (UK) Ltd., while Apricot will change its name to ACT. The hardware unit makes IBM-compatible Micro Channel Architecture (MCA) machines.

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**KEY OFFICERS**
**Nihachiro Katayama**

Chairman

**Moriya Shiki**

President

**Shinichi Yufu**

General manager, International Operations Group

**Kokichi Sonda**

General manager, Headquarters—Marketing

**Yasuo Endo**

General manager, Information and Communication Systems Group

**Hideo Morii**

General manager, Corporate Strategic Planning Office

**Hisao Oka**

General manager, Headquarters—Research and Development; Headquarters—Engineering and Manufacturing

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**PRINCIPAL INVESTORS**

Mitsubishi Trust & Banking—5.6 percent  
 Meiji Mutual Life Insurance—4.1 percent  
 Mitsui Trust & Banking—4.1 percent  
 Nippon Life Insurance—3.7 percent  
 Mitsubishi Bank—3.2 percent  
 Japan Securities Clearing—2.7 percent  
 Sumitomo Trust & Banking—2.3 percent  
 Yasuda Trust & Banking—2.1 percent  
 Employees' Association—2.0 percent  
 Norinchukin Bank—1.9 percent

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**FOUNDERS**

Information is not available.

**Table 3**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Total Current Assets	\$5,446	\$8,051	\$10,668	\$14,490	\$17,532
Cash	462	NA	2,482	3,738	4,557
Receivables	2,077	NA	3,994	5,133	5,024
Marketable Securities	494	NA	833	985	3,059
Inventory	1,810	NA	2,478	3,336	3,602
Other Current Assets	604	NA	881	1,299	1,290
Net Property, Plants	1,756	NA	3,501	4,050	3,901
Other Assets	1,083	NA	1,979	2,559	841
Total Assets	\$8,284	\$12,182	\$16,149	\$21,099	\$22,274
Total Current Liabilities	\$4,810	NA	\$9,817	\$12,698	\$11,612
Long-Term Debt	\$974	NA	\$1,489	\$2,112	\$4,082
Other Liabilities	\$389	NA	\$808	\$1,206	\$1,337
Total Liabilities	\$6,173	NA	\$12,114	\$16,016	\$17,032
Minority Interest	\$17	NA	\$38	\$100	\$118
Total Shareholders' Equity	\$2,095	NA	\$3,996	\$4,982	\$5,125
Common Stock	532	NA	1,096	1,328	1,214
Other Equity	506	NA	1,168	1,504	1,577
Retained Earnings	1,057	NA	1,732	2,150	2,334
Total Liabilities and Shareholders' Equity	\$8,284	\$12,182	\$16,149	\$21,099	\$22,274
<b>Income Statement</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Revenue	\$9,752	\$13,208	\$17,571	\$21,637	\$20,892
Japanese Revenue	NA	NA	NA	NA	16,162
Non-Japanese Revenue	NA	NA	NA	NA	4,730
Cost of Sales	\$7,285	\$10,187	\$13,162	\$15,612	\$14,828
R&D Expense	\$403	NA	\$739	\$924	\$1,018
SG&A Expense	\$1,547	\$2,594	\$2,679	\$3,424	\$3,449
Capital Expense	\$697	\$791	\$1,038	\$1,633	\$1,569
Pretax Income	\$327	\$239	\$455	\$1,005	\$1,267
Pretax Margin (%)	3.36	1.81	2.59	4.65	6.06
Effective Tax Rate (%)	58.0	58.0	56.0	56.0	54.0
Net Income	\$136	\$66	\$161	\$415	\$539
Shares Outstanding, Millions	1,799	1,864	2,023	2,124	2,135
<b>Per Share Data</b>					
Earnings	\$6.18	\$3.44	\$7.80	\$19.24	\$24.36
Dividend	NA	NA	NA	NA	NA
Book Value	\$1.16	0	\$1.98	\$2.35	\$2.40
Exchange Rate (US\$1=¥)	¥221.26	¥159.56	¥138.03	¥128.25	¥142.47

NA = Not available

Source: Mitsubishi Electric Corporation  
 Annual Reports  
 Dataquest (1990)



**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Total Current Assets	¥1,204,998	¥1,284,614	¥1,472,490	¥1,858,299	¥2,497,749
Cash	102,119	NA	342,638	479,376	649,249
Receivables	459,647	NA	551,235	658,279	715,763
Marketable Securities	109,215	NA	115,044	126,281	435,817
Inventory	400,423	NA	341,987	427,791	513,199
Other Current Assets	133,594	NA	121,586	166,572	183,721
Net Property, Plants	¥388,487	NA	¥483,311	¥519,387	¥555,846
Other Assets	¥239,533	NA	¥273,194	¥328,241	¥119,823
Total Assets	¥1,833,018	¥1,943,779	¥2,228,995	¥2,705,927	¥3,173,418
Total Current Liabilities	¥1,064,193	NA	¥1,355,048	¥1,628,557	¥1,654,413
Long-Term Debt	¥215,532	NA	¥205,548	¥270,815	¥581,555
Other Liabilities	¥86,129	NA	¥111,537	¥154,669	¥190,538
Total Liabilities	¥1,365,854	NA	¥1,672,133	¥2,054,041	¥2,426,506
Minority Interest	¥3,715	NA	¥5,263	¥12,887	¥16,781
Total Shareholders' Equity	¥463,449	NA	¥551,599	¥638,999	¥730,131
Common Stock	117,658	NA	151,310	170,285	172,984
Other Equity	111,981	NA	161,273	192,935	224,646
Retained Earnings	233,810	NA	239,016	275,779	332,501
Total Liabilities and Shareholders' Equity	¥1,833,018	¥1,943,779	¥2,228,995	¥2,705,927	¥3,173,418
<b>Income Statement</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Revenue	¥2,157,708	¥2,107,505	¥2,425,319	¥2,774,931	¥2,976,420
Japanese Revenue	NA	NA	NA	NA	2,302,603
Non-Japanese Revenue	NA	NA	NA	NA	673,817
Cost of Sales	¥1,611,843	¥1,625,497	¥1,816,806	¥2,002,269	¥2,112,504
R&D Expense	¥89,118	NA	¥101,948	¥118,507	¥145,076
SG&A Expense	¥342,333	¥413,835	¥369,750	¥439,127	¥491,343
Capital Expense	¥154,192	¥126,236	¥143,291	¥209,454	¥223,500
Pretax Income	¥72,461	¥38,175	¥62,784	¥128,950	¥180,472
Pretax Margin (%)	3.36	1.81	2.59	4.65	6.50
Effective Tax Rate (%)	58.0	58.0	56.0	56.0	54.0
Net Income	¥30,047	¥10,598	¥22,213	¥53,236	¥76,796
Shares Outstanding, Millions	1,799	1,864	2,023	2,124	2,135
<b>Per Share Data</b>					
Earnings	¥1,367	¥549	¥1,077	¥2,468	¥3,471
Dividend	NA	NA	NA	NA	NA
Book Value	¥258	0	¥273	¥301	¥342

**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of Yen, except Per Share Data)**

Key Financial Ratios	1986	1987	1988	1989	1990
<i>Liquidity</i>					
Current (Times)	1.13	NA	1.09	1.14	1.51
Quick (Times)	0.76	NA	0.83	0.88	1.20
Fixed Assets/Equity (%)	83.83	NA	87.62	81.28	76.13
Current Liabilities/Equity (%)	229.62	NA	245.66	254.86	226.59
Total Liabilities/Equity (%)	294.72	-	303.14	321.45	332.34
<i>Profitability (%)</i>					
Return on Assets	-	0.56	1.06	2.16	2.61
Return on Equity	-	4.57	8.05	8.94	11.22
Profit Margin	1.39	0.50	0.92	1.92	2.58
<i>Other Key Ratios</i>					
R&D Spending % of Revenue	4.13	NA	4.20	4.27	4.87
Capital Spending % of Revenue	7.15	5.99	5.91	7.55	7.51
Employees	71,479	73,536	75,795	85,723	89,113
Revenue (¥K)/Employee	¥30,187	¥28,660	¥31,998	¥32,371	¥33,401
Capital Spending % of Assets	8.41	6.49	6.43	7.74	7.04
Exchange Rate (US\$1=¥)	¥221.26	¥159.56	¥138.03	¥128.25	¥142.47

NA = Not available

Source: Mitsubishi Electric Corporation  
Annual Reports  
Dataquest (1990)

## NEC Corporation

33-1 Shiba 5-chome  
Minato-ku, Tokyo 108, Japan  
Telephone: (03) 454-1111  
Fax: (03) 452-6351  
Dun's Number: 00-183-6014  
*Date Founded: July 1899*

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### CORPORATE STRATEGIC DIRECTION

NEC Corporation (known as Nippon Electric Company, Ltd., prior to April 1, 1983) was founded in 1899 as a manufacturer of telephone sets and switchboards. NEC is a leading global supplier of a broad range of communications systems, computer and electronic systems, electronic devices, consumer electronics, and information services.

NEC is divided into five product groups:

- Communications Systems and Equipment (26 percent of net sales)—Carrier transmission, microwave and satellite communications, and mobile communications equipment; digital central office switching systems; facsimiles
- Computers and Industrial Electronic Systems (43 percent of net sales)—Mainframe, personal, and small business computers; building automation and communications network control systems
- Electronic Devices (19 percent of net sales)—Memories, microcomputers and software, linear ICs, gate arrays, standard cells
- Home Electronics Products (7 percent of net sales)—Color TV receivers and projectors, VCRs, videodisc players
- Other Operations (5 percent of net sales)—VAN services, electrical connectors, semiconductor equipment, measuring and testing systems

NEC reported consolidated revenue for fiscal year ending March 31, 1989, of \$23.5 billion,\* up 6 percent from fiscal 1988. Net income rose 137 percent from \$205 million in fiscal 1988 to \$485 million in fiscal 1989.

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\*All dollar amounts are in U.S. dollars.

Capital expenditures increased during fiscal 1989 to \$2.1 billion, or 9.1 percent of total revenue. Research and development expenditures totaled \$3.7 billion for fiscal 1989, representing 15.5 percent of revenue.

In order to increase its market penetration, NEC markets its products aggressively. Dataquest believes that 70 to 80 percent of the Company's products are sold domestically (in Japan) through distributors. NEC has 10 distributors in Japan, the top 4 of which are Ryosan, Sanshin, Satori, and Shinko. Approximately 22 percent of NEC's semiconductor production is consumed internally.

Overseas sales accounted for 25 percent of total sales in fiscal 1989, down from 27 percent and 28 percent in fiscal years 1988 and 1987, respectively.

More detailed information is available in Tables 1 through 3, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region and distribution channel. Table 4, a comprehensive financial statement, is at the end of this profile.

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### BUSINESS SEGMENT STRATEGIC DIRECTION

#### Semiconductors

For the past two years, NEC has maintained its position as the world leader in semiconductor sales, with approximately 9 percent of the market and \$4.5 billion in semiconductor revenue.

Dataquest estimates that 69 percent of NEC's 1988 semiconductor sales were MOS devices, or \$3.1 billion in revenue. The largest product family in 1988

was again MOS memory, with sales of \$1.5 billion. MOS memory sales grew 76.7 percent, MOS micro sales grew 39.6 percent, and MOS logic sales grew 40.0 percent in 1988. Optoelectronics sales increased approximately 60.0 percent, from \$55 million in fiscal 1987 to \$88 million in fiscal 1988.

### Computer Systems

During fiscal year ending 1989, 43 percent of NEC's revenue came from products in the Computers and Industrial Electronic Systems Group.

Dataquest estimates that in 1988, NEC slipped one spot to fourth among PC vendors, behind third-ranked Compaq Computers. NEC added six new PC models during 1988 and 1989, including the UltraLite laptop computer; the PowerMate Portable SX computer, the first portable to use Intel's 386SX processor; the ProSpeed 386 modular portable PC, which provides 386-based power and full desktop expandability; the ProSpeed 286 laptop computer; and the PowerMate Portable Plus computer, a 286-based portable. The sixth model, introduced in September 1989, is the ProSpeed CSX personal computer, which is the first color laptop computer available for purchase in the United States.

The newest addition to NEC's supercomputer line was introduced in April 1989, the SX-3. The SX-3 is said to be up to eight times faster than U.S.-made supercomputers.

During 1988, NEC introduced the 3100 and 3050 series of small business computers.

### Telecommunications

NEC holds the number five market share position in data communications. The Company is one of the largest suppliers of communications equipment to Nippon Telegraph and Telephone Corporation (NTT), formerly Japan's domestic telecommunications monopoly, as well as to the new common carriers (NCCs) that were created as a result of Japan's market liberalization.

### Computer Storage

NEC ranked ninth in the 1988 3.5-inch disk drive market with less than 2 percent of the market. The top three players in this market, IBM, Miniscribe, and Conner, together held 60 percent of the market.

### Printers

NEC's overall ranking for 1988 in the printer market by units shipped was eleventh, behind Citizen, Hewlett-Packard, and Seikosha.

### Further Information

For further information about the Company's business segments, please contact the appropriate industry service.

**Table 1**  
**Five-Year Corporate Highlights (Millions of U.S. Dollars)**

	1985	1986	1987	1988	1989
Five-Year Revenue	\$9,232	\$13,501	\$17,159	\$22,220	\$23,510
Percent Change	-	46.24	27.09	29.49	5.81
Capital Expenditure	\$1,472	\$1,648	\$1,326	\$2,016	\$2,148
Percent of Revenue	15.94	12.20	7.73	9.07	9.14
R&D Expenditure	\$1,144	\$1,836	\$2,629	\$3,496	\$3,657
Percent of Revenue	12.39	13.60	15.32	15.73	15.56
Number of Employees	90,102	95,796	101,227	102,452	104,022
Revenue (\$K)/Employee	\$102.46	\$140.94	\$169.51	\$216.88	\$226.01
Net Income	\$268	\$153	\$103	\$205	\$485
Percent Change	-	(42.92)	(32.55)	98.54	137.07
1989 Calendar Year	Q1	Q2	Q3	Q4	
Quarterly Revenue	N/A	N/A	N/A	N/A	
Quarterly Profit	N/A	N/A	N/A	N/A	

N/A = Not Available

Source: NEC Corporation  
Annual Reports  
Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1985	1986	1987	1988	1989
Japan	66.00	67.00	72.00	73.00	75.00
All Others	34.00	33.00	28.00	27.00	25.00

Source: Dataquest (1990)

**Table 3**  
**Revenue by Distribution Channel (Percent)**

Channel	1988
Direct Sales	N/A
Indirect Sales	N/A

N/A = Not Available

Source: Dataquest (1990)

## 1988 SALES OFFICE LOCATIONS

Japan—More than 200

Overseas—170

## MANUFACTURING LOCATIONS

### *Japan*

Ando Electric  
Measuring and testing systems

Anelva Corp.  
Semiconductor manufacturing equipment, vacuum equipment

Anritsu Corp.  
Communications and electronic equipment, measuring instruments

Anten Kogyo  
Antennas, related equipment

Japan Aviation Electronics  
Electrical connectors, electronic equipment

Kaijo Denki  
Industrial marine equipment

NEC Akita  
ICs, discrete semiconductor devices

NEC Data Terminals  
Computer terminals

NEC Fukui  
ICs, discrete semiconductor devices

NEC Fukuoka  
ICs

NEC Fukushima  
Communications equipment, related components

NEC Gunma  
Computers, related systems

NEC Hiroshima  
4Mb DRAMs

NEC Home Electronics  
TVs, home electronic appliances, electronic parts

NEC Hyogo  
Communications equipment parts

NEC Ibaraki  
Computers, related systems

NEC Kagoshima  
Electronic devices

NEC Kansai  
ICs, discrete semiconductor devices, electronic devices

NEC Kofu  
Development of computers

NEC Kumamoto  
ICs

NEC Kyushu  
ICs

NEC Miyagi  
Communications equipment, related components

NEC Nagano  
Home electrical appliances

NEC Niigata  
Computers, related systems

NEC Oita  
ICs

NEC Radio & Electronics  
Communications equipment, related components

NEC Saitama  
Communications equipment, related components

NEC San-ei Instruments  
Medical electronic equipment, industrial measuring systems

NEC Shizuoka  
Communications equipment, computer terminals

NEC Tohoku  
Communications equipment, computer terminals

NEC Toyama  
Electronic devices

NEC Yamagata  
ICs, discrete semiconductor devices

NEC Yamaguchi  
ICs

NEC Yonezawa  
Communications equipment, computer terminals

Nico Electronics  
Special communications equip, vending machines

Nippon Avionics  
Electronic equipment for aircraft

Nippon Electric Glass  
CRTs, other glass products

Nippon Electric Industry  
Electrical machinery, precision instruments

Nitsuko Ltd.  
Communications equipment and parts

Showa Koki Seizo  
Optical precision instruments

Takasago Ltd.  
Telephones, communications equipment

Tama Electric  
Resistors

Tohoku Metal Industries  
Magnetic materials  
Tokin Corp.  
Magnetic materials, electric parts  
Toyo Communication Equipment.  
Communications equipment and parts

#### *North America*

NEC America  
Faxes, printers, magnetic disk drives  
NEC Electronics  
256K DRAMs  
NEC Home Electronics  
Home electronic products, laptop PCs  
NEC Information Systems  
Office computers, printers, etc.  
NEC Research Institute  
R&D center

#### *Europe*

NEC Ireland  
ICs  
NEC Semiconductor, United Kingdom  
256K DRAMs  
NEC Technologies, United Kingdom  
VCRs, printers, car telephones, Faxes

#### *Asia/Pacific*

NEC Electronics Singapore  
Linear ICs, 256K DRAMs  
NEC Home Electronics, Malaysia  
Home electronic products  
NEC Semiconductor, Malaysia  
ICs, discrete semiconductor devices  
NEC Technologies, Thailand  
Telephones  
PERNAS NEC Telecommunications, Malaysia  
Communications equipment  
Siam NEC Company (Thailand)  
Color TVs  
Taiwan Telecommunications Ind.  
Communications equipment

#### *ROW*

NEC Australia  
ICs  
NEC de Mexico  
Communications equipment

NEC do Brazil  
Telephone switching systems, radio equipment  
electronics  
NEC Home Electronics, Australia  
Color TVs  
PECOM-NEC, Argentina  
Digital electronic switching  
Philco Argentina  
TVs, radios, etc.

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## SUBSIDIARIES

#### *Japan*

ANELVA Corporation  
Ando Electric Company, Ltd.  
Japan Aviation Electronics Industry, Ltd.  
NEC Akita, Ltd.  
NEC Data Terminals, Ltd.  
NEC Engineering, Ltd.  
NEC Factory Engineering, Ltd.  
NEC Field Service, Ltd.  
NEC Fukui, Ltd.  
NEC Fukuoka, Ltd.  
NEC Fukushima, Ltd.  
NEC Gunma, Ltd.  
NEC Home Electronics, Ltd.  
NEC Hyogo, Ltd.  
NEC Ibaraki, Ltd.  
NEC Information Service, Ltd.  
NEC Kagoshima, Ltd.  
NEC Kansai, Ltd.  
NEC Kumamoto, Ltd.  
NEC Kyushu, Ltd.  
NEC Miyagi, Ltd.  
NEC Nagano, Ltd.  
NEC Niigata, Ltd.  
NEC Oita, Ltd.  
NEC Radio & Electronics, Ltd.  
NEC Saitama, Ltd.  
NEC San-ei Instruments, Ltd.  
NEC Shizuoka, Ltd.  
NEC Software, Ltd.  
NEC System Integration & Construction, Ltd.  
NEC Tohoku, Ltd.  
NEC-Toshiba Information Systems Inc.  
NEC Toyama, Ltd.  
NEC Warehouse and Distribution, Ltd.  
NEC Yamagata, Ltd.  
NEC Yamaguchi, Ltd.  
NEC Yonezawa, Ltd.  
Nippon Avionics Co., Ltd.

*North America*

NEC America, Inc. (United States)  
NEC Electronics, Inc. (United States)  
NEC Home Electronics, Inc. (United States)  
NEC Industries, Inc. (United States)  
NEC Information Systems, Inc. (United States)

*Europe*

NEC Deutschland GmbH (West Germany)  
NEC Electronics GmbH (West Germany)  
NEC Semiconductors (United Kingdom) Limited  
(United Kingdom)  
NEC Semiconductors Ireland Limited (Ireland)  
NEC (UK) Ltd. (United Kingdom)

*Asia/Pacific*

NEC Australia Pty. Ltd. (Australia)  
NEC Electronics Singapore Pte. Ltd. (Singapore)  
NEC Semiconductors Sdn. Bhd. (Malaysia)

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**ALLIANCES, JOINT VENTURES, AND  
LICENSING AGREEMENTS**

*January 1989*

**MIPS Computer Systems**

Siemens MIPS entered into a royalty-bearing technology exchange with Siemens and NEC for its RISC MPUs. NEC plans to manufacture the R2000A and R3000 devices and peripherals in Japan and Europe. Siemens will manufacture in Europe.

*December 1988*

**Optoelectronics Research Labs**  
Photodiodes

*November 1988*

**Summit Microcircuits**  
64K/256K fast SRAMS

*April 1988*

**Enabling Technologies, Inc.**  
Strategic alliance with NEC Home Electronics (United States) to develop products and explore new technologies in graphics manipulation, animation, and optical media.

*1988*

**British Telecom U.K.**

Jointly developed car telephones. NEC's U.K. subsidiary, NEC Technologies, manufactures the new products for British Telecom.

**Honeywell Bull**

NEC Computer Systems and Honeywell Bull will cooperate in R&D of artificial intelligence.

**Corvus Systems**

NEC and Corvus Systems are involved in joint development of a CMOS single-chip controller.

**Digital Research**

NEC has a joint-marketing agreement with Digital Research regarding a CP/M operating system for the V Series.

**Oki**

NEC has developed a CMOS signal processor (uPD77C20) with Oki.

**Sharp**

NEC and Sharp agreed to jointly develop and produce V Series microperipherals. Under the agreement, NEC will provide its original microperipherals to Sharp on an OEM basis, and Sharp will develop new microprocessors for NEC.

**Sharp and Sony**

Sharp and Sony have been announced as second sources for the NEC V Series.

*November 1987*

**Matra-Harris**  
16-bit single-chip MCUs

*July 1987*

**SMC**  
Peripheral controllers

*Cross-Licensing Partners, Patents, and Contract Terms*

**IBM Corporation**  
Information processing systems, N/A-12/90



*Technology Export, Patents, and Contract Terms***Unisys Corporation**

Optical character readers, 6/81-6/89

**Honeywell Bull**

Supercomputers, 3/84-3/94

**Standard Microsystems**

Controllers for microcomputers, 7/88-N/A

**Indian Telephone Industries****Bharat Electronics**

Digital microwave equipment, 8/88-N/A

**China**

Large-capacity microwave equipment, 9/88-N/A

**KEY OFFICERS****Koji Kobayashi**

Chairman emeritus

**Atsuyoshi Ouchi**

Chairman of the board

**Kenzo Nakamura**

Vice chairman of the board

**Tadahiro Sekimoto**

President

**Yoshiteru Ishii**

Senior executive vice president

**Koji Maeda**

Senior executive vice president

**Toshio Egashira**

Senior executive vice president

**Shozo Shimizu**

Senior executive vice president

**PRINCIPAL INVESTORS**

Sumitomo Life Insurance—7.2 percent

Sumitomo Trust &amp; Banking—5.0 percent

Sumitomo Bank—4.8 percent

Mitsubishi Trust &amp; Banking—3.5 percent

Nippon Life Insurance—3.3 percent

Dai-ichi Mutual Life Insurance—3.1 percent

Sumitomo Marine &amp; Fire Insurance—2.7 percent

Toyo Trust &amp; Banking—2.7 percent

Sumitomo Electric Industries—2.3 percent

Sumitomo Corporation—2.3 percent

Foreign-owned—7.0 percent

**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Millions of U.S. Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	\$7,087.3	\$8,731.3	\$12,052.2	\$14,757.6	\$15,971.4
Cash	533.0	822.6	1,229.0	1,685.9	2,930.5
Receivables	2,615.7	3,635.7	4,670.8	5,987.3	6,568.7
Marketable Securities	1,214.4	437.0	558.8	404.9	442.9
Inventory	2,096.4	3,087.9	4,100.2	5,243.0	5,140.1
Other Current Assets	627.8	748.1	1,493.4	1,436.5	889.2
Long-Term Receivables and Investments	\$1,070.7	\$1,563.9	\$1,662.1	\$2,101.1	\$2,247.4
Net Property, Plants	\$2,204.4	\$3,621.0	\$4,395.2	\$5,490.5	\$5,787.7
Other Assets	\$439.0	\$612.8	\$834.9	\$1,077.5	\$1,154.6
<b>Total Assets</b>	<b>\$10,801.4</b>	<b>\$14,529.0</b>	<b>\$18,944.4</b>	<b>\$23,426.7</b>	<b>\$25,161.1</b>
Total Current Liabilities	\$6,280.4	\$7,987.6	\$10,162.9	\$12,878.5	\$13,234.8
Long-Term Debt	\$2,527.4	\$3,579.7	\$5,052.8	\$5,480.4	\$6,431.1
Other Liabilities	\$92.3	\$163.7	\$206.4	\$283.9	\$311.9
<b>Total Liabilities</b>	<b>\$8,900.1</b>	<b>\$11,731.0</b>	<b>\$15,422.1</b>	<b>\$18,642.8</b>	<b>\$19,977.8</b>
Total Shareholders' Equity	\$1,901.5	\$2,798.1	\$3,522.6	\$4,784.2	\$5,183.2
Common Stock	405.5	600.0	784.3	1,184.9	1,202.8
Additional Paid-In Capital	646.2	953.6	1,220.0	1,716.7	1,842.9
Other Equity	52.9	44.9	49.1	64.0	75.1
Retained Earnings	797.4	1,199.7	1,470.0	1,818.8	2,068.9
Treasury Stock	(0.5)	(0.1)	(0.8)	(0.2)	(6.5)
<b>Total Liabilities and Shareholders' Equity</b>	<b>\$10,801.6</b>	<b>\$14,529.1</b>	<b>\$18,944.7</b>	<b>\$23,427.0</b>	<b>\$25,161.0</b>
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	\$9,232.0	\$13,501.3	\$17,159.1	\$22,219.5	\$23,509.5
Cost of Sales	\$6,038.2	\$8,868.7	\$1,1654.5	\$15,120.0	\$15,778.2
R&D Expense	\$1,144.2	\$1,836.2	\$2,629.2	\$3,495.7	\$3,657.4
SG&A Expense	\$2,250.3	\$3,422.9	\$4,492.3	\$5,863.0	\$6,011.2
Capital Expense	\$1,472.0	\$1,647.7	\$1,326.2	\$2,016.0	\$2,148.3
Pretax Income	\$555.9	\$661.9	\$397.6	\$566.0	\$993.9
Pretax Margin (%)	6.02	4.90	2.32	2.55	4.23
Effective Tax Rate (%)	58.00	58.00	58.00	56.00	56.00
Net Income	\$267.5	\$152.7	\$103.0	\$204.5	\$484.8
Shares Outstanding, Millions	1,177	1,309	1,380	1,398	1,438
<b>Per Share Data</b>					
Earnings	\$0.19	\$0.11	\$0.07	\$0.14	\$0.31
Dividends	\$0.03	\$0.05	\$0.06	\$0.07	\$0.07
Book Value	\$1.62	\$2.14	\$2.55	\$3.42	\$3.60

**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Millions of U.S. Dollars, except Per Share Data)**

<b>Key Financial Ratios</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
<i>Liquidity</i>					
Current (Times)	1.13	1.09	1.19	1.15	1.21
Quick (Times)	0.79	0.71	0.78	0.74	0.82
Fixed Assets/Equity (%)	115.93	129.41	124.77	114.76	111.66
Current Liabilities/Equity (%)	330.29	285.47	288.51	269.19	255.34
Total Liabilities/Equity (%)	468.06	419.25	437.80	389.67	385.43
<i>Profitability (%)</i>					
Return on Assets	-	1.21	0.62	0.97	2.00
Return on Equity	-	6.50	3.26	4.92	9.73
Profit Margin	2.90	1.13	0.60	0.92	2.06
<i>Other Key Ratios</i>					
R&D Spending % of Revenue	12.39	13.60	15.32	15.73	15.56
Capital Spending % of Revenue	15.94	12.20	7.73	9.07	9.14
Employees	90,102	95,796	101,227	102,452	104,022
Revenues(\$K)/Employee	\$102.46	\$140.94	\$169.51	\$216.88	\$226.01
Capital Spending % of Assets	13.63	11.34	7.00	8.61	8.54

Source: NEC Corporation  
Annual Reports  
Dataquest (1990)

## Nippondenso Co., Ltd.

1-1 Showa-cho  
Kariya City, Aichi, Japan  
Telephone: 0566-25-5511  
Telex: 59916  
Fax: 0566-25-4520  
Dun's Number: 69-087-9853

*Date Founded: 1949*

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### CORPORATE STRATEGIC DIRECTION

Nippondenso Co., Ltd., is a manufacturer of electronic and electrical parts for automobiles. The Company is the second largest in the Toyota Motor Group. Nippondenso supplies parts to virtually all domestic automakers except for Nissan Motor. Nearly 60 percent of the Company's products are made for Toyota; the remaining 40 percent are marketed to other automobile manufacturers.

Revenue for fiscal year ended December 1989 totaled ¥1.3 trillion (US\$10.2 billion). This was an 11 percent increase over the fiscal 1988 figure of ¥1.2 trillion (US\$8.5 billion). Net income increased 24.4 percent in fiscal 1989 to ¥48.4 billion (US\$377.1 million) from ¥38.9 billion (US\$281.8 million) in fiscal 1988. (Percentage changes refer to ¥ amounts only; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.)

Sales breakdown for fiscal 1989 is as follows: Automobile air conditioners accounted for 37 percent, or ¥482.0 billion (US\$3.8 billion); automotive electrical equipment 24 percent, or ¥313.0 billion (US\$2.4 billion); electronic fuel injection (EFI) and control equipment 17 percent, or ¥221.5 billion (US\$1.7 billion); radiators 6 percent, or ¥78.2 billion (US\$609.7 million); meters 5 percent, or ¥65.2 billion (US\$508.4 million); and other automobile electronic product 11 percent, or ¥143.3 billion (US\$1.1 billion).

Fiscal 1989 R&D expenditure totaled ¥83.3 billion (US\$649.5 million). Capital expenditure totaled ¥115.9 billion (US\$903.7 million) for fiscal 1989

and is expected to decrease to ¥100 billion (US\$701.9 million) by the close of fiscal 1990. Nippondenso employed 37,214 people at the close of fiscal 1989.

Because comprehensive financial information is not available, a financial statement is not included in this backgrounder.

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### BUSINESS SEGMENT STRATEGIC DIRECTION

Nippondenso produces heating and air-conditioning systems, electrical and diesel components, remanufactured starters, alternators, spark plugs, windshield wiper systems, electronic and mechanical components for vehicles, and powertrain control, body control, chassis control, instrument, and communications products.

Approximately 30 percent of Nippondenso's revenue is derived from products using semiconductors. These products include automotive electrical equipment, electronic fuel injection systems, and control equipment. In 1989, the Japanese automotive semiconductor market was worth \$600 million. However the Semiconductor Industry Association (SIA) expects the market to drop to approximately \$530 million in 1990.

Dataquest estimates that Nippondenso is in the top three of the world's largest car component manufacturers. The Company aims to maintain a growth rate 3 to 5 percent higher than that of the automobile market.

## Further Information

For further information about the Company's business segments, please contact the appropriate Dataquest industry service.

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## 1989 SALES OFFICE LOCATIONS

North America—2

Europe—1

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## MANUFACTURING LOCATIONS

### *North America*

Nippondenso Manufacturing USA, Inc., United States

Function not available

Nippondenso of Los Angeles Inc., United States

Function not available

### *Europe*

Nippondenso Ltd., Telford, United Kingdom

Function not available

Nippondenso Ltd., United Kingdom

Function not available

### *Asia/Pacific*

Nippondenso Aichi, Japan

Auto electronics

Nippondenso Aichi, Japan

EFI systems and air conditioners

Nippondenso Mie, Japan

Auto electronics

Nippondenso Pty., Australia

Function not available

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## SUBSIDIARIES

Information is not available.

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## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

### **Denso Trim Co., Ltd.**

Nippondenso has set up a joint venture company, named Denso Trim Co., Ltd., in Mie Prefecture to produce generators for use in motorcycles. The new company will be 60 percent owned by Nippondenso and the remainder by its two subcontractors.

### **Facet Enterprises**

Purodenso of Jackson, Tennessee, has been jointly formed by Nippondenso and Facet Enterprises for \$22 million. The new formation will manufacture air and oil filters for Suzuki, Toyota, and US automakers.

### **Magneti Marelli**

Magneti Marelli has linked with Nippondenso to jointly produce air-conditioning and thermal control systems for cars.

### **Robert Bosch GmbH**

Associated Fuel Pump Systems of Anderson, South Carolina, has been jointly formed by Robert Bosch and Nippondenso. The new equally owned joint venture company will produce fuel pumps in a plant now under construction.

### **Valeo Group**

The Valeo Group has formed a joint venture with Nippondenso in Spain for the manufacture of spark coils.

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## MERGERS AND ACQUISITIONS

Information is not available.

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## KEY OFFICERS

**Kengo Toda**

Chairman

**Taro Tanaka**

President

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**PRINCIPAL INVESTORS**

Information is not available.

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**FOUNDERS**

Information is not available.

## Nippon Telegraph and Telephone Corporation

1-6 Uchisaiwaicho 1-chome  
Chiyoda-ku, Tokyo 100, Japan  
Telephone: 011-81 (3) 509-3101  
Fax: 011-81 (3) 509-9104  
Dun's Number: 69-053-5000

*Date Founded: 1952*

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### CORPORATE STRATEGIC DIRECTION

Nippon Telegraph and Telephone Public Corporation, incorporated in 1952 by the Nippon Telegraph and Telephone Public Corporation Law, was until 1985 the Japanese public telecommunications services company. The Public Corporation took over the telephone, telegraph, and related telecommunications services from the central government. Control of Nippon Telegraph and Telephone Public Corporation's business and financial activities was exercised by various governmental bodies, with principal supervision provided by the Ministry of Posts and Telecommunications (MPT).

Nippon Telegraph and Telephone Public Corporation remained a public company until 1985, at which point all assets and liabilities were transferred to Nippon Telegraph and Telephone Corporation (NTT). All shares of stock in the Public Corporation were transferred to the Japanese government upon dissolution of the Public Corporation. Since incorporation, the government of Japan has sold 5.4 million shares (32.5 percent of outstanding shares) of the Company's common stock to the general public. In *Business Week's* 1989 rankings of the world's top 1,000 companies, NTT's market value was estimated at US\$163.86 billion, making it the largest company in the world.

NTT is a telecommunications service company primarily involved in telephone, telegraph, leased circuit, data communications facility, digital data exchange, paging, and other services. The Company is also involved in various other related services, including sales of terminal equipment, telecommunications consulting, and operator information. The Company received 79.1 percent of its revenue from its primary telecommunications services in the fiscal year ending March 31, 1989, which is a decrease of 1.3 percent from the previous year.

Through its head office in Tokyo, NTT controls 11 Telecommunications Bureaus. These bureaus oversee field administrative division offices under five classifications: telecommunications, urban telecommunications, area telecommunications, carrier communications, and radio communications. Under these divisions, offices furnish telecommunications services directly to customers. NTT does not market its computer systems directly; revenue is generated through subscriptions and equipment leasing.

NTT operates in a highly regulated industry. The Japanese government began to deregulate the telecommunications services industry in 1986 when it opened the leased circuits services market. Subsequently, it opened the long distance telephone and paging services markets in 1987 and the mobile telephone services market in 1988. To operate in the industry, a new entrant must first seek approval from the MPT. Thirty-three Type I carriers (those who have their own telecommunications circuits and facilities) have been approved by the MPT.

Although NTT is a private company, the Japanese government maintains control of 67.5 percent of the outstanding stock. NTT must still apply to the MPT for approval of its business operation plan for the upcoming year. Furthermore, the government currently is considering a proposal to split NTT into separate operating companies. A five-year study has been undertaken to evaluate the effects of a divestiture and determine NTT's future structure.

Two main arguments support divesting NTT. The first is that NTT hinders fair and effective competition in the market through its established position. Currently, for an alternate long distance carrier to access a local loop, it must obtain services from NTT, which has a monopoly on the local telecommunications service market. The second argument is that NTT suffers

from inherent management inefficiencies due to its size.

To combat the possibility of a divestiture, NTT has implemented an unusual corporate strategy. NTT is offering technical advice to its competitors to increase the competitiveness within the industry. The desired outcome of this strategy is that in five years, the telecommunications industry will display sufficient competition so as not to warrant a divestiture. Currently, Daini Denden, Japan Telecom, and Teleway Japan, the three largest long distance carriers other than NTT, together control 6 percent of the \$20 billion domestic market.

To combat the second argument favoring divestiture, the Company has undertaken strategies to streamline the administrative structure, reduce rates, and divest Company interests. In April 1989, NTT reduced the number of administrative levels from four (headquarters, regional headquarters, district headquarters, and telephone offices) to three (headquarters, telecommunications service districts, and branches). Services were also integrated at the individual branches.

The Company also has been consistently reducing its service rates. In February, it reduced its long distance rates for the second year in a row and lowered charges for adjacent area telephone calls. Fees for pocket pagers and leased circuits were also reduced during 1989 by an average of 10 percent.

Lastly, by establishing affiliates, subsidiaries, and associated companies, NTT hopes to secure diversified sources of income. Since privatization, NTT has set up 131 companies. The most recent establishments have been through joint ventures with Battelle Memorial Institute, IBM Japan, Ltd., ITT-WD, and Moli Energy Ltd. of Canada. Through these joint ventures, NTT has expanded its interest in telecommunications-related businesses and has entered various other industries, such as lithium batteries and photonic research.

Additional corporate goals include the following:

- Digitize all telecommunications systems in order to implement Integrated Services Digital Network (ISDN) throughout Japan in the near future
- Introduce INS-Net 1500, the first commercial primary rate service in Japan

- Drastically increase the overall R&D expenditure over the next three years
- Further integrate the administrative structure, specifically the management, sales networks, and customer service operations in cellular phones and pocket pagers

Operating revenue in fiscal year ending March 31, 1989, continued to grow, but was overshadowed by efficiency-building expenses. Operating revenue increased 3.2 percent to ¥5,841.9 billion (US\$45,551 million) in fiscal 1989 from ¥5,662.0 billion (US\$41,020 million) in fiscal 1988. (Percentage changes refer only to ¥ amounts; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) The gain reflected favorable economic conditions and solid growth in the demand for leased circuit, digital data exchange (DDX), data communications facility, and telegraph services. Net income decreased 1.3 percent to ¥263.6 billion (US\$2,055 million) in fiscal 1989 from ¥267.2 billion (US\$1,936 million) in fiscal 1988.

NTT's operating revenue and profits for fiscal 1990 were released prior to NTT's fiscal 1990 Annual Report. Operating revenue increased 56.7 percent to ¥9,154.0 billion (US\$64,254 million), while operating profits increased 23 percent to ¥273.7 billion (US\$1,921 million). For 1990, Dataquest estimates that NTT acquired a 9 percent share of the worldwide telecommunications market and a 90 percent share of the Japanese telecommunications market, thereby ranking as the largest (by revenue) telecommunications company in the world.

R&D expenditure increased 22 percent to ¥221.7 billion (US\$1.7 billion) in fiscal 1989 from ¥181.7 billion (US\$1.3 billion) in fiscal 1988. As a percentage of revenue, R&D expenditure was 3.8 percent and 3.2 percent in fiscal 1989 and fiscal 1988, respectively. R&D efforts in 1989 focused on digital network technologies, intelligent processing technologies, nanoelectronics, and optoelectronics.

NTT's R&D system consists of 11 functionally grouped telecommunications laboratories, applied research sections in each of NTT's business divisions, and development centers for technology advances. The R&D system is coordinated by the Research and Development Headquarters. In all, there are approximately 6,000 scientists, engineers, and technicians.



More detailed information is available in Table 1, which appears after "Business Segment Strategic Direction" and presents corporate highlights. Information on revenue by region and distribution channel is not available. Tables 2 and 3, comprehensive financial statements, are at the end of this profile.

## BUSINESS SEGMENT STRATEGIC DIRECTION

### Telephone Services

Operating revenue for the telephone services increased 1.5 percent to ¥4,622.7 billion (US\$36.0 billion) in fiscal 1989 from ¥4,553.8 billion (US\$33.0 billion) in fiscal 1988. The telephone services revenue represented 79.1 percent of NTT's total operating revenue in fiscal 1989. The revenue increase came despite growing competition from new common carriers (NCCs) and an average 10 percent reduction on all telephone service rates implemented during fiscal 1989.

The Company offers a wide range of telephone services, including telephone subscriber, public telephone, automobile telephone, and other services. Outstanding revenue performances came from the cellular telephone services, which increased 57.6 percent in sales volume, as well as the new autodial prepaid magnetic telephone card service, and the toll-free dialing service.

### Telegraph Services

Operating revenue for the telegraph service increased 7 percent to ¥53.4 billion (US\$416 million) in fiscal 1989 from ¥49.8 billion (US\$361 million) in fiscal 1988. The telegraph service revenue represented 0.9 percent of NTT's total operating revenue.

Telegraph services consist of telegram and telex services. Telegraph transmissions gradually rose from 41 billion in the early 1980s to a peak of 44 billion in 1984. Since then, telegraph transmissions have hovered at around 41 billion. NTT has introduced value-added telegrams, such as musical and scented telegrams, to help boost the market and has computerized its telegram handling system in order to maximize efficiency.

### Leased Circuit Services

Operating revenue for the leased circuit services increased 13 percent to ¥334.3 billion (US\$2.6 billion) in fiscal 1989 from ¥295.4 billion (US\$2.1 billion) in fiscal 1988. Leased circuit services operating revenue accounted for 5.7 percent of NTT's total 1989 operating revenue.

Leased circuit services consist of standard circuit, high-speed digital circuit, video communications, television relay, satellite communications, and other services. All of NTT leased circuit services showed stable growth, although high-speed digital leased circuits showed the largest growth with a 39.5 percent increase.

### Data Communication Facility Services

Operating revenue for the data communication facility services increased 5.6 percent to ¥186.0 billion (US\$1.5 billion) in fiscal 1989 from ¥176.1 billion (US\$1.3 billion) in fiscal 1988. Data communication facility services operating revenue accounted for 3.2 percent of NTT's total 1989 operating revenue.

In May 1988, NTT established Data Communications Systems Corporation (NTT Data), a wholly owned subsidiary, to assume the responsibilities of NTT's Data Communications Sector. NTT Data designs, consults on, and contracts data communications systems for government organizations and private companies in various industries. NTT Data also provides ready-made services, such as Automatic Answer Network System for Electrical Request (ANSER) and Credit and Finance Information System (CAFIS). ANSER, used primarily by financial institutions, allows companies to supply customers automatically with account information requested via telephone, facsimile, personal computer, or videotex terminal. NTT Data also provides CAFIS, a nation-wide on-line network service that links credit card companies, banks, and retailers for credit-card and bank-card validations, billing status, and other account information.

### Digital Data Exchange Services

Operating revenue for DDX services increased 48.8 percent to ¥33.3 billion (US\$260 million) in fiscal 1989 from ¥22.4 billion (US\$162 million) in

fiscal 1988. DDX services accounted for 0.6 percent of NTT's total 1989 revenue.

NTT provides circuit-switching and packet-switching DDX services. In the near future, NTT expects to add packet-switching capabilities to INS-Net 64 (NTT's first commercial ISDN) and to INS-Net 1500 (NTT's upgraded ISDN with a transmission capacity approximately 12 times that of INS-Net 64).

#### Pocket Pager Services

Operating revenue for pocket pager services increased 1.3 percent to ¥94.5 billion (US\$737 million) in fiscal 1989 from ¥93.3 billion (US\$676 million) in fiscal 1988. Pocket pager services operating revenue accounted for approximately 1.6 percent of NTT's total 1989 operating revenue.

NTT has increased its competitiveness by reducing rates and introducing new products such as the card-type pocket pager, the pen-type display pager, and the large display pager. NTT also reorganized the sales network to enable customers to purchase a wider variety of products in one store.

#### Other Services

Operating revenue for NTT's other services remained fairly stable at ¥155.8 billion (US\$1.2 billion), which accounted for 2.7 percent of NTT's total 1989 operating revenue.

Other services are facsimile network services, videoconference services, and videotex services. The most significant growth came in from the F-Net facsimile network services, which experienced a 55.9 percent increase in revenue and a 48.2 percent increase in subscriptions to ¥5.3 billion (US\$41 million) and 297,800, respectively.

#### Related Businesses

NTT's related businesses brought in over ¥361 billion (US\$2.8 billion) in operating revenue, which accounted for 6.2 percent of NTT's total 1989 operating revenue. Related businesses' operating revenue increased 14 percent from the previous year.

Related businesses include terminal equipment sales, operator information services, and telecommunications consulting services. The main revenue generator in this sector is terminal equipment sales, which rose 4.1 percent to approximately ¥259 billion (US\$2.0 billion) in fiscal 1989 from approximately ¥249 billion (US\$1.8 billion) in fiscal 1988. Terminal sales accounted for approximately 72 percent and 4 percent of the related business operating revenue and NTT's total operating revenue, respectively.

#### New Developments

NTT is currently investing heavily in X-ray lithography systems. It has thus far achieved an accuracy level of 0.07 microns; however, a level of 0.04 microns is necessary to achieve the 0.2-micron design rule. Results are expected to be three to six years away.

NTT has developed a compact, economical synchrotron orbital radiation (SOR) facility using only a 2.5-meter by 8.0-meter superconductive storage ring and a 1.7-meter linear accelerator. The SOR facility is capable of extremely fine structure processing. NTT's Large-Scale Integrated (LSI) Circuit Laboratories are developing SOR lithography as a source for advanced LSI manufacturing.

#### Further Information

For further information about the Company's business segments, please contact the appropriate Dataquest industry service.

**Table 1**  
**Corporate Highlights (Millions of US Dollars)**

	1986	1987	1988	1989
Four-Year Revenue	\$23,011	\$33,561	\$41,020	\$45,551
Percent Change	-	45.85	22.23	11.05
Capital Expenditure	\$7,144	\$10,108	\$13,013	\$13,758
Percent of Revenue	31.04	30.12	31.72	30.20
R&D Expenditure	\$616	\$936	\$1,317	\$1,729
Percent of Revenue	2.68	2.79	3.21	3.79
Number of Employees	304,000	298,000	294,369	283,294
Revenue (\$K)/Employee	\$76	\$113	\$139	\$161
Net Income	\$839	\$1,208	\$1,936	\$2,055
Percent Change	-	43.91	60.27	6.19
Exchange Rate (US\$1=¥)	¥221.26	¥159.52	¥138.03	¥128.25
<b>1989 Calendar Year</b>	<b>Q1</b>	<b>Q2</b>	<b>Q3</b>	<b>Q4</b>
Quarterly Revenue	NA	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

NA = Not available

Source: Nippon Telegraph and Telephone Corporation  
Annual Reports  
Dataquest (1990)

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## 1989 SALES OFFICE LOCATIONS

North America—2  
Europe—3  
Asia/Pacific—More than 133  
Japan—More than 130  
ROW—2

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## MANUFACTURING LOCATIONS

### *North America*

Photonic Integration Research Inc., United States  
Optical waveguide products

### *Asia/Pacific*

Business Communication System Engineering Co., Ltd., Japan  
Software  
Nippon Information and Communication Corp., Japan  
VAN and other telecommunications network services  
NTT Data Communications Systems Corp., Japan  
VAN and software  
NTT Leasing Co., Ltd., Japan  
Terminal equipment

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## SUBSIDIARIES

### *North America*

Advanced Energy Technologies Inc. (Canada)  
NTT America, Inc. (United States)  
NTT Data USA (United States)  
Photonic Integration Research, Inc. (United States)

### *Europe*

NTT Europe Limited (United Kingdom)  
NTT Finance (Holland) BV (Netherlands)  
NTT Finance (U.K.) Limited (United Kingdom)  
NTT International Scandinavia (Finland)

### *Asia/Pacific*

Advanced Telecommunications Research Institute International (Japan)  
AIREC Engineering Corp. (Japan)  
Amenity Service Kansai Co., Ltd. (Japan)  
Business Communication System Engineering Co., Ltd. (BCSE) (Japan)  
Captain Service Company Limited (Japan)  
Healthynet Hiroshima Co. (Japan)  
INS Engineering Corp. (Japan)  
International Information Inc. (Japan)  
Internetwork Inc. (Japan)  
Kokyo Securities Co., Ltd. (Japan)  
Nagoya Information Center Co. (Japan)  
Nippon Airport Radio Service Co., Ltd. (Japan)  
Nippon Computer Security Corp. (Japan)  
Nippon Directory Development Co., Ltd. (Japan)  
Nippon Information and Communication Corp. (NIC) (Japan)  
Nippon Senpaku Tsushin K.K. (Japan)  
Nippon Telematique, Inc. (Japan)  
NTT Auto Leasing Co., Ltd. (Japan)  
NTT Central Mobile Communications Corp. (Japan)  
NTT Central Network System (Japan)  
NTT Chugoku Mobile Communications Corp. (Japan)  
NTT Data Communications Systems Corp. (Japan)  
NTT Estate Co., Ltd. (Japan)  
NTT Information Development Co., Ltd. (Japan)  
NTT Intelligent Technology Co., Ltd. (Japan)  
NTT International Corp. (Japan)  
NTT Kansai Mobile Communications Corp. (Japan)  
NTT Kansai Real Estate Corp. (Japan)  
NTT Kansai Telecon Co. (Japan)  
NTT Kyushu Mobile Communications Corp. (Japan)  
NTT Kyushu Tele-control Corp. (Japan)  
NTT Learning Systems Co. (Japan)  
NTT Leasing Co., Ltd. (Japan)  
NTT Off-Talk Tushin Co., Ltd. (Japan)  
NTT PC Communications, Inc. (Japan)  
NTT Rental Engineering Co., Ltd. (Japan)  
NTT Software Corp. (Japan)  
NTT Telemarketing Co., Ltd. (Japan)  
NTT Tokai Mobile Communications Corp. (Japan)  
NTT Tokai Real Estate Corp. (Japan)  
NTT Tour-Media Company, Ltd. (Japan)  
NTT Urban Development Co., Ltd. (Japan)  
The Japan Utility Subway Company, Inc. (Japan)

### *ROW*

NTT do Brasil Ltda. (Brazil)

## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1989

### International Telecommunications Union

NTT joined this union to promote the worldwide standardization of telecommunications technologies.

### IBM Japan

NTT and IBM Japan jointly formed Nippon Information and Communication Corporation.

### Matsushita and Nissan Motor

NTT Data, Matsushita, and Nissan jointly formed Star Communication Planning Corp.

### Nissan Motor

NTT Data and Nissan agreed to jointly develop IC credit cards.

### Toshiba

NTT and Toshiba agreed to jointly develop PBX software.

### Cincinnati Bell Information Systems

Cincinnati Bell agreed to supply its software network system.

### American Telephone and Telegraph

The companies made a product development and marketing agreement.

### ITT-WD

NTT and ITT-WD jointly formed Nippon Directory Development Co., Ltd., a telephone directory consulting company.

### Battelle Memorial Institute

NTT and Battelle jointly formed Photonic Integration Research, Inc.

### Moli Energy Ltd. of Canada

NTT and Moli jointly formed Advanced Energy Technologies Inc. to develop a rechargeable lithium battery.

### Illinois Bell Telephone

NTT and Illinois Bell linked their ISDN services so that users in the companies' respective countries can access services of the other.

### Schlumberger, Ltd.

NTT and Schlumberger formed a joint venture to construct an ASIC verification system based on an NTT tester design.

### LM Ericsson Telefon AB

NTT and Ericsson formed a joint venture to develop digital cellular telephone system for Japan.

### Northern Telecom

A joint development effort has been undertaken to build systems for the TRON Operating System.

### Fujitsu, Ltd.

A joint development effort has been undertaken to build systems for the TRON Operating System.

### Hitachi, Ltd.

A joint development effort has been undertaken to build systems for the TRON Operating System.

### Matsushita Electric Industrial Company

A joint development effort has been undertaken to build systems for the TRON Operating System.

### Mitsubishi Electric Corp.

A joint development effort has been undertaken to build systems for the TRON Operating System.

### Co Corp.

A joint development effort has been undertaken to build systems for the TRON Operating System.

### Oki Electric Co.

A joint development effort has been undertaken to build systems for the TRON Operating System.

### Toshiba Corp.

A joint development effort has been undertaken to build systems for the TRON Operating System.

## MERGERS AND ACQUISITIONS

Information is not available.

## KEY OFFICERS

Haru Yamaguchi  
Chairman

Masashi Kojima  
President

Shigeo Sawada  
Senior executive vice president

Katsumi Iida  
Senior executive vice president

Shozo Iwasaki  
Senior executive vice president

**Tomeo Kambayashi**  
Senior executive vice president

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## FOUNDERS

Information is not available.

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## PRINCIPAL INVESTORS

Ministry of Finance—77.5 percent  
Mitsubishi Trust & Banking—0.5 percent  
Sumitomo Trust—0.4 percent  
Toyo Trust—0.4 percent  
Yasuda Trust—0.4 percent  
Chuo Trust—0.3 percent  
Japan Securities Clearing—0.3 percent  
Nippon Life—0.3 percent  
Sumitomo Life—0.3 percent

**Table 2**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Millions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	\$4,019	\$6,255	\$7,828	\$9,707
Cash and Equivalents	1,798	2,822	3,198	3,542
Receivables	1,524	2,488	3,352	4,157
Inventory	178	232	290	377
Other Current Assets	519	712	988	1,631
Net Property, Plants	\$45,905	\$62,444	\$72,017	\$76,225
Other Assets	\$1,457	\$2,624	\$3,152	\$4,202
<b>Total Assets</b>	<b>\$51,381</b>	<b>\$71,324</b>	<b>\$82,996</b>	<b>\$90,134</b>
Total Current Liabilities	\$7,028	\$9,877	\$11,962	\$12,872
Long-Term Debt	\$18,824	\$25,130	\$27,427	\$28,607
Other Liabilities	\$9,658	\$13,828	\$16,245	\$17,761
<b>Total Liabilities</b>	<b>\$35,510</b>	<b>\$48,835</b>	<b>\$55,635</b>	<b>\$59,239</b>
Total Shareholders' Equity	\$15,872	\$22,489	\$27,361	\$30,895
Common Stock	15,032	20,851	24,097	25,934
Other Equity	-	73	141	213
Retained Earnings	839	1,565	3,123	4,747
<b>Total Liabilities and Shareholders' Equity</b>	<b>\$51,381</b>	<b>\$71,324</b>	<b>\$82,996</b>	<b>\$90,134</b>
<b>Income Statement</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	\$23,011	\$33,561	\$41,020	\$45,551
Operating Expense	\$11,067	\$15,610	\$19,476	\$22,199
R&D Expense	\$616	\$936	\$1,317	\$1,729
SG&A Expense	\$7,904	\$11,518	\$13,602	\$15,830
Capital Expense	\$7,144	\$10,108	\$13,013	\$13,758
Pretax Income	\$1,688	\$2,576	\$4,176	\$4,054
Pretax Margin (%)	7.33	7.68	10.18	8.90
Effective Tax Rate (%)	50.27	53.11	53.65	49.29
Net Income	\$839	\$1,208	\$1,936	\$2,055
Shares Outstanding, Millions	15.6	15.6	15.6	15.6
<b>Per Share Data</b>				
Earnings	\$53.80	\$77.42	\$124.08	\$131.76
Dividend	\$22.60	\$31.34	\$36.22	\$38.99
Book Value	\$1,017	\$1,442	\$1,754	\$1,980
Exchange Rate (US\$1=¥)	¥221.26	¥159.52	¥138.03	¥128.25

Source: Nippon Telegraph and Telephone Corporation  
 Annual Reports  
 Dataquest (1990)

**Table 3**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Billions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	¥889,249	¥997,796	¥1,080,466	¥1,244,968
Cash and Equivalents	397,918	450,240	441,388	454,322
Receivables	337,133	396,901	462,696	533,104
Inventory	39,323	37,044	40,036	48,318
Other Current Assets	114,875	113,611	136,346	209,224
Net Property, Plants	¥10,156,968	¥9,961,092	¥9,940,441	¥9,775,823
Other Assets	¥322,420	¥418,646	¥435,018	¥538,866
<b>Total Assets</b>	<b>¥11,368,637</b>	<b>¥11,377,534</b>	<b>¥11,455,925</b>	<b>¥11,559,657</b>
Total Current Liabilities	¥1,555,078	¥1,575,512	¥1,651,159	¥1,650,816
Long-Term Debt	¥4,164,976	¥4,008,735	¥3,785,812	¥3,668,824
Other Liabilities	¥2,136,819	¥2,205,860	¥2,242,340	¥2,277,791
<b>Total Liabilities</b>	<b>¥7,856,873</b>	<b>¥7,790,107</b>	<b>¥7,679,311</b>	<b>¥7,597,431</b>
Total Shareholders' Equity	¥3,511,764	¥3,587,427	¥3,776,614	¥3,962,226
Common Stock	3,326,076	3,326,076	3,326,076	3,326,076
Other Equity	-	11,700	19,500	27,300
Retained Earnings	185,688	249,651	431,038	608,850
<b>Total Liabilities and Shareholders' Equity</b>	<b>¥11,368,637</b>	<b>¥11,377,534</b>	<b>¥11,455,925</b>	<b>¥11,559,657</b>
<b>Income Statement</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	¥5,091,409	¥5,353,582	¥5,662,001	¥5,841,897
Operating Expense	¥2,448,649	¥2,490,048	¥2,688,250	¥2,847,004
R&D Expense	¥136,209	¥149,255	¥181,718	¥221,692
SG&A Expense	¥1,748,804	¥1,837,353	¥1,877,527	¥2,030,231
Capital Expense	¥1,580,600	¥1,612,351	¥1,796,159	¥1,764,400
Pretax Income	¥373,421	¥410,911	¥576,457	¥519,887
Pretax Margin (%)	7.33	7.68	10.18	8.90
Effective Tax Rate (%)	50.27	53.11	53.65	49.29
Net Income	¥185,688	¥192,663	¥267,187	¥263,612
Shares Outstanding, Millions	15.6	15.6	15.6	15.6
<b>Per Share Data</b>				
Earnings	¥11,903	¥12,350	¥17,127	¥16,898
Dividend	¥5,000	¥5,000	¥5,000	¥5,000
Book Value	¥225,113	¥229,963	¥242,091	¥253,989



**Table 3 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Billions of Yen, except Per Share Data)**

<b>Key Financial Ratios</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
<i>Liquidity</i>				
Current (Times)	0.57	0.63	0.65	0.75
Quick (Times)	0.55	0.61	0.63	0.72
Fixed Assets/Equity (%)	289.23	277.67	263.21	246.73
Current Liabilities/Equity (%)	44.28	43.92	43.72	41.66
Total Liabilities/Equity (%)	223.73	217.15	203.34	191.75
<i>Profitability (%)</i>				
Return on Assets	-	1.97	2.51	2.37
Return on Equity	-	6.30	7.77	7.06
Profit Margin	3.65	3.60	4.72	4.51
<i>Other Key Ratios</i>				
R&D Spending % of Revenue	2.68	2.79	3.21	3.79
Capital Spending % of Revenue	31.04	30.12	31.72	30.20
Employees	304,000	298,000	294,369	283,294
Revenue (¥K)/Employee	¥76	¥113	¥139	¥161
Capital Spending % of Assets	13.90	14.17	15.68	15.26
Exchange Rate (US\$1=¥)	¥221.26	¥159.52	¥138.03	¥128.25

Source: Nippon Telegraph and Telephone Corporation  
Annual Reports  
Dataquest (1990)

## Omron Corporation

10, Tsuchudo-cho, Hanazono

Ukyo-ku, Kyoto 616, Japan

Telephone: 075-463-1161

Fax: 075-464-2607

Dun's Number: Not Available

*Date Founded: 1948*

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### CORPORATE STRATEGIC DIRECTION

Omron Corporation is a world leader in the production of automation systems, components, and equipment. In the field of factory automation, Omron produces a wide array of products from computer systems to components. In commercial and consumer products, the Company provides subsystems to components, electronic fund transfer systems, electronic traffic control systems, health and medical equipment, and office automation systems.

Total revenue increased 11.8 percent to ¥416.2 billion (US\$2.9 billion) from ¥372.4 (US\$2.9 billion) for the year ended March 1990. (Percentage changes refer only to ¥ amounts; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) All operations recorded higher sales, with health and medical equipment producing the most substantial gain—57.3 percent—to a total of ¥25.9 billion (US\$181.8 million). Components and systems sales were up 9 percent to ¥256.7 billion (US\$1.8 billion), accounting for 62 percent of net sales. Electronic fund transfer systems increased revenue by 4 percent over the previous year, totaling ¥65.4 billion (US\$459), representing 15.7 percent of total revenue. Office automation systems posted a 16 percent gain in fiscal 1990, totaling ¥36.6 billion (US\$256.9 million) and representing 8.8 percent of total revenue.

Net income increased 9.7 percent totaling ¥20.8 billion (US\$146.0 million) in the year ended March 1990, up from ¥18.9 billion (US\$147.8 million). A reduction of income taxes arising from carrying forward the operating loss and prior years' accounting loss of subsidiaries helped boost the posted net income for fiscal 1990.

R&D expenditure totaled ¥25.9 billion (US\$181.9 million) in the year ended March 1990, representing 6.2 percent of revenue. This increase is 15 percent over the previous year's figure of ¥22.5 billion (US\$175.6 million). Capital spending totaled ¥40.8 billion (US\$286.5 million) in the year ended March 1990, representing 6.6 percent of revenue, a 65.1 percent increase over the previous year's figure of ¥24.7 billion (US\$192.9 million). Omron Corporation employed 15,823 people worldwide in fiscal 1990.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 and 4, comprehensive financial statements, are at the end of this profile.

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### BUSINESS SEGMENT STRATEGIC DIRECTION

#### Control Components and Systems

The Control Components and Systems operating group consists of three divisions: Industrial, Consumer/Commercial, and Automotive Electronics. The Industrial Division provides such products as programmable controllers and sensors for factory automation and computer-integrated manufacturing (CIM). The 1989 introduction of the C200H, a new temperature controller, contributed significantly to the Industrial Division's sales. The Consumer/Commercial Division provides consumer electrical products, automatic vending machines, and office automation

equipment. New products that contributed significantly to sales were miniature relays for telecommunication, an input/output (I/O) terminal series, a mechanical sensor switch for consumer natural gas, and a power supply. Other products that registered substantial sales growth were scanners of the Man-Machine-Interface Products Group, and optical sensors of the Device Products Division. The Automotive Electronics Division provides such products as switches and relays for use in luxury cars.

Internationally, the Control Components and Systems group expanded its operations by developing markets and increasing local production. An important switch was made to local manufacturing and marketing subsidiaries in the second half of the fiscal year to promote conversion to regional management.

#### **Electronic Fund Transfer Systems**

The Electronic Fund Transfer Systems group provides an extensive line of unmanned banking machines, including bill changers and automatic teller machines, a multiline firm banking system, and electronic fund transfer systems (EFTSs) such as the Information Network System and the CATV System.

#### **Information Systems**

The Information Systems group provides electronic traffic control systems, security control systems, and inspection control systems. Currently, this division is involved in a large-scale project to install electronic traffic control systems in the metropolitan Tokyo area and in the Osaka and Kyoto areas.

#### **Health and Medical Equipment**

The Health and Medical Equipment group's principal products include an automatic blood cell analyzer, hyperthermia equipment for cancer treatment, a flow cytometer, a low-frequency massage machine, and rechargeable electronic sphygmomanometers and sphygmomanometers with pressure sensors or optical sensors.

#### **Office Automation Systems**

The Office Automation Systems group provides such products as personal computers, workstations, peripherals (including scanners and modems), and information networks. In 1988, the LUNA 32-bit holonic workstation was favorably received as an affordable desktop workstation. In computer peripherals, the division introduced a new modem series, scanners, and uninterruptible power supplies (UPSs). Also, Omron became the first manufacturer licensed to incorporate the Sigma workstation operating environment software into its workstations.

#### **Further Information**

For more information about the Company's business segments, please contact the appropriate industry service. Dataquest tracks Omron through the Japanese Semiconductor Application Markets (JSAM).

**Table 1**  
**Five-Year Corporate Highlights**  
 (Millions of US Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	\$1,252.8	\$1,752.1	\$2,286.6	\$2,904.1	\$2,921.5
Percent Change	-	39.85	30.50	27.00	0.60
Capital Expenditure	\$147.7	\$198.4	\$147.2	\$192.9	\$286.5
Percent of Revenue	11.79	11.33	6.44	6.64	9.81
R&D Expenditure	\$68.9	\$111.8	\$148.7	\$175.6	\$181.9
Percent of Revenue	5.50	6.38	6.50	6.05	6.23
Number of Employees	12,824	13,364	13,851	15,047	15,823
Revenue (\$K)/Employee	\$97.69	\$131.11	\$165.08	\$193.00	\$184.64
Net Income	\$11.6	\$19.1	\$78.3	\$147.8	\$146.0
Percent Change	-	64.14	309.90	88.81	(1.27)
Exchange Rate (US\$1=¥)	¥221.26	¥159.56	¥138.03	¥128.25	¥142.47
1989 Calendar Year	Q1	Q2	Q3	Q4	
Quarterly Revenue	NA	NA	NA	NA	
Quarterly Profit	NA	NA	NA	NA	

NA = Not available

Source: Omron Corporation  
Annual Reports  
Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1986	1987	1988	1989	1990
Japan	81.39	83.06	83.70	84.60	84.24
International	18.61	16.94	16.30	15.40	15.76

Source: Omron Corporation  
Annual Reports  
Dataquest (1990)

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## 1990 SALES OFFICE LOCATIONS

North America—4  
Europe—15  
Asia/Pacific—52  
Japan—47  
ROW—2

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## MANUFACTURING LOCATIONS

### *North America*

Omron Manufacturing of America Inc., Ohio, United States  
Manufacturer of control components

### *Europe*

Omron Electronics (U.K.) Ltd., United Kingdom  
Manufacturer of control components  
Omron Manufacturing of the Netherlands B.V., Netherlands  
Manufacturer of control components

### *Asia/Pacific*

Omron Malaysia Electronic Sdn. Bhd., Malaysia  
Manufacturer of control components  
Omron Taiwan Electronics Inc., Taiwan  
Manufacturer of control components

### *ROW*

Omron Componentes Ind. Nandan Factory, Brazil  
Manufacturer of control components

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## SUBSIDIARIES

### *North America*

Omron Canada Inc. (Canada)  
Omron Electronics Inc. (United States)  
Omron Manufacturing of America Inc. (United States)  
Omron Research Institute Inc. (United States)  
Omron Systems of America Inc. (United States)  
Omron Systems of Canada Inc. (Canada)

### *Europe*

Omron Electronics A.B. (Sweden)  
Omron Electronics A.G. (Switzerland)  
Omron Electronics A/S (Norway)  
Omron Electronics B.V. (Netherlands)  
Omron Electronics Componentes e Sistemas Electronicos LDA (Portugal)  
Omron Electronics Europe B.V. (OEE-H.Q.) (Netherlands)  
Omron Electronics GesmbH (Austria)  
Omron Electronics GmbH (Germany)  
Omron Electronics O.Y. (Finland)  
Omron Electronics S.A. (Belgium)  
Omron Electronics S.A. (Spain)  
Omron Electronics S.a.r.l. (France)  
Omron Electronics S.r.l. (Italy)  
Omron Electronics (UK) Ltd. (England)  
Omron Finance Netherlands B.V. (Netherlands)  
Omron Geschäftssysteme GmbH (Germany)  
Omron Terminals (UK) Ltd. (England)

### *Asia/Pacific*

Omron Asia Pacific Trading Pte. Ltd. (Singapore)  
Omron Electronics Asia Ltd. (Hong Kong)  
Omron Electronics Pte. Ltd. (Australia)  
Omron Korea Co. Ltd. (South Korea)  
Omron Malaysia Sdn. Bhd (Malaysia)  
Omron Singapore Pte. Ltd. (Singapore)  
Omron Taiwan Electronics Inc. (Taiwan)  
Omron Trisak Co. Ltd. (Thailand)

### *ROW*

Omron Business Sistemas Electronicos da America Latina Ltda. (Brazil)  
Omron Electronica do Brasil Ltda. (Brazil)

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## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

### *1988*

#### **Dalian Electronics Industries**

Omron and Dalian Electronic Industries of China reached a consignment production agreement. Under the agreement, Omron will provide parts, materials, production equipment, and technology for the production of its health care products.

**Sumitomo Electric Industries Ltd.**

Omron and Sumitomo Electric Industries will jointly market Sysnet, an optical local area network (LAN) developed jointly by the two companies for factory automation use, in Europe. The two companies will also cooperate on related operations, such as software developments tailored to users' specifications, as well as the training of system engineers. The system will be marketed through Omron's sales channels.

**Mitsui Engineering and Shipbuilding Co. Ltd.**

Omron and Mitsui Engineering and Shipbuilding Co. will establish a joint factory automation firm in Tokyo. The new firm, to be named O&M Systems Inc., will be equally owned by both parties.

1987

**Nippon Telephone and Telegraph (NTT) and Sumitomo Electric Industries Ltd.**

Omron, NTT, and Sumitomo Electric Industries jointly established a factory automation engineering firm, known as NTT Fanet Systems (Japan).

**IBM Japan Ltd.**

Omron and IBM Japan entered an agreement to link their sales of CIM systems that will integrate office systems, computer-assisted design/computer-assisted manufacturing (CAD/CAM) systems, and manufacturing systems to permit manufacturers to manage purchases, production, sales, and shipments. The companies will develop an interface that combines Omron's software for factory automation and IBM Japan's software for information processing.

**MERGERS AND ACQUISITIONS**

1990

**Buffalo Medical Specialties Manufacturing and Marshall Products**

Omron acquired Buffalo Medical Specialties Manufacturing and Marshall Products, a medical equipment manufacturer, for \$27.5 million. The US firm will be renamed Omron Marshall Products.

1987

**Carlo Gavassi Omron**

Omron acquired the remaining minority stake of Carlo Gavassi Omron (Switzerland), where it had held the majority.

**KEY OFFICERS****Takao Tateisi**

Chairman and director

**Nobuo Tateisi**

Vice chairman and director

**Yoshio Tateisi**

President and director

**Toshio Yagawa**

Vice president and director

**Kohei Jinkawa**

Vice president and director

**Noriyoshi Nakamura**

Senior managing director

**Isao Hatano**

Senior managing director

**PRINCIPAL INVESTORS**

Information is not available.

**FOUNDERS**

Information is not available.

**Table 3**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of US Dollars, except Per Share Data)**

Balance Sheet	1986	1987	1988	1989	1990
Total Current Assets	\$821.6	\$1,206.3	\$1,624.2	\$1,969.3	\$2,242.6
Cash	249.2	409.5	579.1	647.7	880.0
Receivables	295.9	417.2	556.5	678.1	666.3
Marketable Securities	39.8	64.3	112.1	182.4	207.9
Inventory	187.9	242.2	306.1	391.6	416.8
Other Current Assets	48.8	73.1	70.4	69.6	71.6
Net Property, Plants	\$333.8	\$543.3	\$634.8	\$749.0	\$824.7
Other Assets	\$64.9	\$118.3	\$120.9	\$130.8	\$168.7
Total Assets	\$1,220.3	\$1,868.0	\$2,379.9	\$2,849.0	\$3,236.0
Total Current Liabilities	\$506.6	\$676.0	\$852.3	\$1,057.7	\$1,076.2
Long-Term Debt	\$143.6	\$398.5	\$296.5	\$239.8	\$512.5
Other Liabilities	\$85.1	\$114.2	\$127.9	\$136.3	\$143.5
Total Liabilities	\$735.3	\$1,188.7	\$1,276.7	\$1,433.9	\$1,732.2
Total Shareholders' Equity	\$485.0	\$679.2	\$1,103.2	\$1,415.2	\$1,503.8
Converted Preferred Stock	-	-	-	-	-
Common Stock	38.7	53.8	190.8	260.7	259.0
Other Equity	162.9	226.3	391.8	473.0	507.5
Retained Earnings	283.4	399.1	520.6	681.5	737.3
Total Liabilities and Shareholders' Equity	\$1,220.3	\$1,868.0	\$2,379.9	\$2,849.0	\$3,236.0
<b>Income Statement</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Revenue	\$1,252.8	\$1,752.1	\$2,286.6	\$2,904.1	\$2,921.5
Japan Revenue	1,019.6	1,455.3	1,913.9	2,456.8	2,461.2
Non-Japan Revenue	233.2	296.8	372.7	447.2	460.4
Cost of Sales	\$865.7	\$1,202.8	\$1,511.3	\$1,856.7	\$1,889.0
R&D Expense	\$68.9	\$111.8	\$148.7	\$175.6	\$181.9
SG&A Expense	\$242.7	\$329.6	\$418.7	\$520.8	\$532.3
Capital Expense	\$147.7	\$198.4	\$147.2	\$192.9	\$286.5
Pretax Income	\$56.2	\$71.6	\$186.9	\$309.7	\$307.9
Pretax Margin (%)	4.49	4.08	8.17	10.66	10.54
Effective Tax Rate (%)	72.30	72.20	58.70	59.50	54.50
Net Income	\$11.6	\$19.1	\$78.3	\$147.8	\$146.0
Shares Outstanding, Millions	171.4	171.8	205.6	214.3	229.1
<b>Per Share Data</b>					
Earnings	\$0.07	\$0.09	\$0.37	\$0.69	\$0.61
Dividend	\$0.05	\$0.07	\$0.09	\$0.11	\$0.09
Book Value	\$2.83	\$3.95	\$5.37	\$6.60	\$6.56
Exchange Rate (US\$1=¥)	¥221.26	¥159.56	¥138.03	¥128.25	¥142.47

Source: Omron Corporation  
Annual Reports  
Dataquest (1990)

**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Total Current Assets	¥181,790.0	¥192,477.0	¥224,189.0	¥252,559.0	¥319,503.0
Cash	55,147.0	65,345.0	79,937.0	83,062.0	125,376.0
Receivables	65,461.0	66,566.0	76,814.0	86,965.0	94,921.0
Marketable Securities	8,813.0	10,259.0	15,477.0	23,388.0	29,615.0
Inventory	41,574.0	38,649.0	42,249.0	50,219.0	59,387.0
Other Current Assets	10,795.0	11,658.0	9,712.0	8,925.0	10,204.0
Net Property, Plants	¥73,858.0	¥86,693.0	¥87,619.0	¥96,056.0	¥117,494.0
Other Assets	¥14,355.0	¥18,881.0	¥16,692.0	¥16,771.0	¥24,038.0
<b>Total Assets</b>	<b>¥270,003.0</b>	<b>¥298,051.0</b>	<b>¥328,500.0</b>	<b>¥365,386.0</b>	<b>¥461,035.0</b>
Total Current Liabilities	¥112,095.0	¥107,862.0	¥117,640.0	¥135,655.0	¥153,324.0
Long-Term Debt	¥31,762.0	¥63,586.0	¥40,931.0	¥30,753.0	¥73,022.0
Other Liabilities	¥18,834.0	¥18,222.0	¥17,654.0	¥17,484.0	¥20,438.0
<b>Total Liabilities</b>	<b>¥162,691.0</b>	<b>¥189,670.0</b>	<b>¥176,225.0</b>	<b>¥183,892.0</b>	<b>¥246,784.0</b>
Total Shareholders' Equity	¥107,312.0	¥108,381.0	¥152,275.0	¥181,494.0	¥214,251.0
Converted Preferred Stock	-	-	-	-	-
Common Stock	8,570.0	8,589.0	26,332.0	33,431.0	36,893.0
Other Equity	36,036.0	36,113.0	54,087.0	60,666.0	72,308.0
Retained Earnings	62,706.0	63,679.0	71,856.0	87,397.0	105,050.0
<b>Total Liabilities and Shareholders' Equity</b>	<b>¥270,003.0</b>	<b>¥298,051.0</b>	<b>¥328,500.0</b>	<b>¥365,386.0</b>	<b>¥461,035.0</b>
<b>Income Statement</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Revenue	¥277,198.0	¥279,569.0	¥315,618.0	¥372,447.0	¥416,231.0
Japan Revenue	225,598.0	232,213.0	264,172.0	315,091.0	350,644.0
Non-Japan Revenue	51,600.0	47,356.0	51,446.0	57,356.0	65,587.0
Cost of Sales	¥191,538.0	¥191,914.0	¥208,602.0	¥238,120.0	¥269,132.0
R&D Expense	¥15,238.0	¥17,833.0	¥20,528.0	¥22,525.0	¥25,911.0
SG&A Expense	¥53,695.0	¥52,586.0	¥57,799.0	¥66,793.0	¥75,841.0
Capital Expense	¥32,673.0	¥31,664.0	¥20,320.0	¥24,738.0	¥40,824.0
Pretax Income	¥12,438.0	¥11,417.0	¥25,792.0	¥39,718.0	¥43,865.0
Pretax Margin (%)	4.49	4.08	8.17	10.66	10.54
Effective Tax Rate (%)	72.30	72.20	58.70	59.50	54.50
Net Income	¥2,575.0	¥3,048.0	¥10,808.0	¥18,961.0	¥20,795.0
Shares Outstanding, Millions	171.4	171.8	205.6	214.3	229.1
<b>Per Share Data</b>					
Earnings	¥15.00	¥14.90	¥50.70	¥88.20	¥87.30
Dividend	¥11.00	¥11.00	¥11.80	¥14.50	¥12.40
Book Value	¥626.09	¥630.86	¥740.64	¥846.92	¥935.19



**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March**  
**(Millions of Yen, except Per Share Data)**

<b>Key Financial Ratios</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
<i>Liquidity</i>					
Current (Times)	1.62	1.78	1.91	1.86	2.08
Quick (Times)	1.25	1.43	1.55	1.49	1.70
Fixed Assets/Equity (%)	68.83	79.99	57.54	52.93	54.84
Current Liabilities/Equity (%)	104.46	99.52	77.25	74.74	71.56
Total Liabilities/Equity (%)	151.61	175.00	115.73	101.32	115.18
<i>Profitability (%)</i>					
Return on Assets	-	1.07	3.45	5.47	5.03
Return on Equity	-	2.83	8.29	11.36	10.51
Profit Margin	0.93	1.09	3.42	5.09	5.00
<i>Other Key Ratios</i>					
R&D Spending % of Revenue	5.50	6.38	6.50	6.05	6.23
Capital Spending % of Revenue	11.79	11.33	6.44	6.64	9.81
Employees	12,824	13,364	13,851	15,047	15,823
Revenue (¥K)/Employee	¥21,615.56	¥20,919.56	¥22,786.66	¥24,752.24	¥26,305.44
Capital Spending % of Assets	12.10	10.62	6.19	6.77	8.85
Exchange Rate (US\$1=¥)	¥221.26	¥159.56	¥138.03	¥128.25	¥142.47

Source: Omron Corporation  
Annual Reports  
Dataquest (1990)

## Ricoh Company, Ltd.

15-5, Minami-Aoyama 1-chome

Minato-ku, Tokyo 107, Japan

Telephone: (03) 479-3111

Fax: (03) 403-1578

Dun's Number: 10-277-1235

*Date Founded: February 1936*

### CORPORATE STRATEGIC DIRECTION

Ricoh Company, Ltd., founded in 1936 by Kiyoshi Ichimura, has an estimated revenue of ¥729.4 billion (US\$5.7 billion) for the fiscal year ending March 1989. The Company has four major lines of business: copiers and related supplies, facsimile equipment, data processing systems, and other products (cameras, lenses, integrated circuits and other electronic devices, educational machines, measuring devices, and thermal paper). Copiers and related supplies represented 55.0 percent of net sales for the fiscal year ending March 1989; facsimile equipment, 15.2 percent; data processing systems, 15.4 percent; and other products, 14.4 percent.

Ricoh entered the business machine market by introducing a diazo copier in 1955. The Company introduced a plain paper copier in 1972, facsimile machines in 1974, text and graphic-image editing systems and ink jet printers in 1980, and laser printers in 1983.

The Japan-based Company is not a member of any larger industrial group. Ricoh is organized along product and regional lines, with centralized manufacturing and marketing organizations in North America and Europe as well as in Japan. The Company is convinced that the creation of independent overseas operations to plan, procure, manufacture, and market its products locally is the key to long-term international success. Ricoh also intends to increase product development and continue diversifying its product lines with the development of new R&D facilities.

Ricoh's estimated revenue for the fiscal year ending March 1990 was ¥810 billion (US\$5.7 billion). Ricoh reported total revenue of ¥729.4 billion (US\$5.7 billion) in the fiscal year ending March 1989, an increase of 8.2 percent over the fiscal year ending March 1988 figure of ¥674.2 billion (US\$4.9 billion).

(Percentage changes refer only to ¥ amounts; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) This increase can be attributed largely to the 21.0 percent increase in sales of other products for fiscal 1989, reflecting strong demand for the Company's electronic devices. Sales in Japan rose 10.0 percent to ¥461 billion (US\$3.6 billion) while sales in North America and Europe rose 2.7 percent and 8.3 percent, respectively. Ricoh's estimated net income for the fiscal year ending March 1990 was ¥20 billion (US\$140.4 million). The Company's net income rose 4.1 percent to ¥17.8 billion (US\$138.8 million) in 1989 from ¥17.1 billion (US\$123.9 million) in fiscal 1988.

The Company's estimated capital expenditure for the fiscal year ending March 1990 was ¥46.8 billion (US\$328.5 million), representing 5.8 percent of total revenue. Capital expenditure totaled ¥59.3 billion (US\$462 million) for fiscal 1989, representing 8.13 percent of revenue. This is an increase of nearly 72.0 percent over the fiscal 1988 figure of ¥34.5 billion (US\$177.5 million). This increase was due primarily to Ricoh's expanding manufacturing into Europe and North America. Ricoh also built or modified three manufacturing plants in Japan to increase production capacity of printed circuit boards, copiers, laser printers, and electronic devices.

Ricoh's estimated research and development expenditure for the fiscal year ending March 1990 was ¥52.3 billion (US\$367.1 million), representing 6.5 percent of revenue. Research and development expenditure totaled ¥46.5 billion (US\$362.5 million) for fiscal 1989, representing 6.4 percent of total revenue. This is an increase of 8.4 percent over the fiscal 1988 figure of ¥42.9 billion (US\$310.8 million).

Most of Ricoh's products are marketed under the Ricoh brand name, but the Company also produces

components and finished goods for OEMs including Savin and Pitney Bowes. Ricoh has major subsidiaries in Europe and the United States. These subsidiaries manufacture copiers and facsimiles and sell them and other Ricoh products into their local markets. Ricoh's Taiwanese subsidiary manufactures cameras for worldwide sale, and its Korean subsidiary manufactures copiers and facsimile machines.

Ricoh employed approximately 12,700 people in fiscal 1989.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 and 4, comprehensive financial statements, are at the end of this profile.

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## BUSINESS SEGMENT STRATEGIC DIRECTION

### Copiers

According to Ricoh, the sale of copiers and copier-related products generated approximately ¥401.1 billion (US\$3.13 billion) or 47.0 percent of total revenue in fiscal 1989. Dataquest estimates that Ricoh held 5.7 percent of the US copier market, ranking fifth in the market. Ricoh has 300 dealers with two branch offices in the United States and uses such alternate channels as manufacturers' representatives, distributors, wholesalers, and retailers to distribute its products. Dataquest believes that Ricoh can increase its market share by expanding its product offerings and services. As products are becoming more similar, vendors can differentiate themselves from their competitors through after-sales support. In addition, because of improved product design, more low-end copier users are doing their own maintenance, and alternate channels are increasing in popularity. Dataquest estimates that 16 percent of placements will go through alternate channels by 1994. Dataquest ranks Ricoh third in the worldwide plain paper copier market, with 14 percent of market share.

Ricoh released the FT9100 in Japan during the first quarter of 1989. The FT9100 is able to throughput 101 A4 copies per minute. Also released were the FW7120D, Ricoh's first digital copier for technical drawings. Internationally, Ricoh's best-performing products were the FT4480 desktop model, the

FT6620 high-speed model, and the FT2260 compact copier with zoom functions. Also introduced in 1989 were the FT2220, FT4400, FT4460, FT4490, FT5540, FT5570, FT 7770, and the LR-2.

Ricoh released the NC-100 in April 1990. The NC-100 is a xerographic full-color copier that also provides full-featured black-and-white capabilities. The Company also demonstrated a full-color copier prototype called the AGX-1, developed in a joint venture with Polaroid Corporation. The AGX-1 uses photographic technology similar to that used in Polaroid cameras.

### Facsimiles

Facsimile equipment sales rose by 7.0 percent in fiscal 1989 to ¥111 billion (US\$865.5 million), with overseas sales increasing by 20.9 percent to ¥65 billion (US\$506.8 million). Revenue generated by the sale of facsimile machines represents 15.2 percent of total revenue. Ricoh introduced the Rifax 2000 series, a family of compact plain paper laser facsimile machines, as well as the L series of speaking facsimile machines in 1989. Ricoh also introduced the Rifax 7200S plain paper facsimile machine that has provisions for incorporating a bar-code scanner. The Rifax D7000 and the Rifax T80 were introduced in the fall of 1989. To help reduce its reliance on exports and therefore ensure steady, long-term growth, Ricoh has stepped up production of facsimiles overseas through such subsidiaries as Ricoh Electronics, Inc., in the United States and Ricoh Industrie France S.A.

According to Dataquest, Ricoh ranked fifth, with 7.9 percent share of the facsimile market in the United States and sales of 118.6 million machines in calendar 1989. In the plain paper facsimile market, Ricoh ranked third in United States in 1989. Dataquest ranks Ricoh sixth in the United Kingdom, with 11.6 million units shipped and 5.6 percent of the market in fiscal 1989. Ricoh ranked first in the Japanese market in calendar 1989, with 20.3 percent share, according to Nikkei, Sangyo Shimbun, a source of information in Japan.

### Computer Storage

Ricoh competes in two of the six Dataquest segments of the worldwide computer storage market. Ricoh ranks first through Maxoptix Corporation, a joint venture with Maxtor, in the 5.25-inch write-once read-many (WORM) market, with a 36 percent market share. Dataquest estimates that Maxoptix shipped

7,500 units, contributing ¥1.24 billion (US\$9.7 million) to total revenue.

Ricoh/Olympus ranks second behind Sony in the rewritable disk drives worldwide market, with an 18 percent share in fiscal 1989. Dataquest estimates that Ricoh shipped 6,000 units, which contributed ¥1.5 billion (US\$11.7 million) to revenue in fiscal 1989. The computer storage segment of Ricoh's business contributes a total of ¥2.74 billion (US\$21 million), or less than 1 percent of the Company's total revenue.

### Semiconductors

Dataquest estimates that Ricoh generated ¥12.6 billion (US\$91 million) in semiconductor revenue for fiscal 1989, a 7 percent increase over fiscal 1988. This revenue represents nearly 2 percent of Ricoh's total revenue generated in fiscal 1989. Ricoh's largest single market is Japan, which contributes ¥12.1 billion (US\$88 million) in semiconductor revenue, representing 96 percent of the Company's semiconductor revenue. In Japan, Ricoh ranks 23rd and controls less than 1 percent of the market.

Ricoh produces a variety of NMOS, PMOS, CMOS, and BiCMOS memory, microdevices, and logic chips. Dataquest estimates that Ricoh generated ¥4.9 billion (US\$38 million) in MOS logic chips, ¥3.9 billion (US\$31 million) in MOS memory, and ¥2.8 billion (US\$22 million) in MOS microdevices in fiscal 1989. A majority of the Company's semiconductors use CMOS technology.

### Information Systems

Ricoh continued its aggressive expansion into domestic information systems, selling Hitachi Ltd. PCs and IBM System/55s and System/36s on an OEM basis. Ricoh also acts as a sales agent for NEC Corp. selling its office computers. These OEM policies resulted in

office and personal computer sales of ¥17.4 billion (US\$126 million) and ¥22.3 billion (US\$161.5 million), respectively. Profit remained at a low of 4 percent, largely because Ricoh does not sell its own hardware. Ricoh's use of OEM equipment has made it difficult for the Company to continue its efforts to expand its information systems business overseas because of difficulty in maintaining after-sales maintenance and software compatibility problems.

### Personal Computers

Ricoh produces and markets personal computers. The best selling Ricoh computer is the MR. MyTool II/III, with an estimated 40,000 units sold worldwide in 1989. The Company entered the desktop publishing market with the Riport Star 9000 in 1989.

### Printers

Ricoh produces a line of printers and laser printers, including the PC Laser 6000/PS (1060-SP3 in Japan). Other Ricoh printers include the LP-4400 and LP 5400 introduced in 1985. Dataquest estimates that Ricoh had approximately 2 to 4 percent of the US market page printer in 1989.

Revenue from computer storage devices, semiconductors, personal computers, and printers is included in the data processing systems figure of approximately ¥110.8 billion (US\$863.9 million), which represented 15.4 percent of total revenue for fiscal 1989.

### Further Information

For further information about the Company's business segments, please contact the appropriate Dataquest industry service.

**Table 1**  
**Five-Year Corporate Highlights (Billions of US Dollars)**

	1985	1986	1987	1988	1989
Five-Year Revenue	\$2.2	\$2.7	\$3.7	\$4.9	\$5.7
Percent Change	-	19.82	38.32	31.56	16.44
Capital Expenditure	\$0.2	\$0.2	\$0.2	\$0.2	\$0.5
Percent of Revenue	9.24	8.13	4.20	5.12	8.13
R&D Expenditure	\$0.1	\$0.2	\$0.2	\$0.3	\$0.4
Percent of Revenue	5.35	6.10	6.16	6.36	6.38
Number of Employees	25,000	26,500	28,000	33,000	12,700
Revenue (\$K)/Employee	\$0.09	\$0.10	\$0.13	\$0.15	\$0.45
Net Income	\$0.1	\$0.1	\$0.1	\$0.1	\$0.1
Percent Change	-	1.54	(2.48)	81.35	12.03
Exchange Rate: US\$1=¥	¥243.51	¥221.26	¥159.56	¥138.03	¥128.25
1989 Calendar Year	Q1	Q2	Q3	Q4	
Quarterly Revenue	NA	NA	NA	NA	
Quarterly Profit	NA	NA	NA	NA	

NA = Not available

Source: Ricoh Company, Ltd.  
Annual Reports  
Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1985	1986	1987	1988	1989
Japan	61.00	60.00	66.00	62.00	63.00
International	39.00	40.00	34.00	38.00	37.00
North America	27.00	25.00	20.00	22.00	21.00
Europe	8.00	10.00	10.00	11.00	11.00
All Others	4.00	5.00	4.00	5.00	5.00

Source: Ricoh Company, Ltd.  
Annual Reports  
Dataquest (1990)

## 1989 SALES OFFICE LOCATIONS

North America—3  
Europe—4  
Asia/Pacific—14

## MANUFACTURING LOCATIONS

### *North America*

Ricoh Corp.  
Facsimiles and R&D of OA equipment  
Ricoh Electronics  
Copiers, facsimiles, toners

A new manufacturing site will be completed in 1990 in Lawrenceville, Georgia, which will produce copier supplies.

### *Europe*

Ricoh Industries (France)  
Copiers, facsimiles, supplies  
Ricoh UK Products (United Kingdom)  
Copiers, facsimiles, toners

### *Asia/Pacific*

AT&T Ricoh (Japan)  
Key telephone sets, office automation (OA) equipment and peripherals  
Hasama Ricoh (Japan)  
Copier parts, photographic equipment  
Ricoh Denshi (Japan)  
Data processing equipment  
Ricoh Elemex (Japan)  
Watches, OA equipment, copier parts, FDDs, measuring instruments, semiconductor  
Ricoh Keiki (Japan)  
Copier parts, data processing equipment  
Ricoh Microelectronics (Japan)  
Printed circuit boards  
Ricoh Optical Industries (Japan)  
Photographic equipment  
Ricoh Research Institute of General Electronics (Japan)  
R&D of materials, applied electronics technologies  
Ricoh Tokki (Japan)  
Facsimiles, copiers, microfilm equipment  
Sindo Ricoh, South Korea (Korea)  
Copiers, facsimiles

Taiwan-Ricoh (Taiwan)  
Cameras, photographic equipment  
Tohoku Ricoh (Japan)  
Offset printing equipment, stencil duplicators, educational equipment, printers, copier parts

## SUBSIDIARIES

### *North America*

Ricoh Corporation (Canada), Ltd. (Canada)  
Ricoh Corporation (United States)  
Ricoh Development of California, Inc. (United States)  
Ricoh Electronics, Inc. (United States)  
Ricoh Finance Corporation (United States)  
Ricoh Thermal Systems, Inc. (United States)

### *Europe*

Ricoh Deutschland GmbH (West Germany)  
Ricoh Europe B.V. (Netherlands)  
Ricoh France S.A. (France)  
Ricoh Industries France S.A. (France)  
Ricoh UK Ltd. (United Kingdom)  
Ricoh UK Products Ltd. (United Kingdom)  
Saitama Ricoh Co., Ltd.

### *Asia/Pacific*

Aichi Ricoh Co., Ltd. (Japan)  
Daiichi Ricoh Co., Ltd. (Japan)  
Fukuoka Ricoh Co., Ltd. (Japan)  
Hasama Ricoh Co., Ltd. (Japan)  
Hokkaido Ricoh Co., Ltd. (Japan)  
Hyogo Ricoh Co., Ltd. (Japan)  
Kanagawa Ricoh Co., Ltd. (Japan)  
Kinki Ricoh Co., Ltd. (Japan)  
Miyagi Ricoh Co., Ltd. (Japan)  
Nihon Business Supply Co., Ltd. (Japan)  
Ricoh Denshi Co., Ltd. (Japan)  
Ricoh Educational Equipment Co., Ltd. (Japan)  
Ricoh Information System Co., Ltd. (Japan)  
Ricoh Keiki Co., Ltd. (Japan)  
Ricoh Microelectronics Co., Ltd. (Japan)  
Ricoh Office System Co., Ltd. (Japan)  
Ricoh Optical Industries Co., Ltd. (Japan)  
Ricoh Research Institute of General Electronics Co., Ltd. (Japan)  
Ricoh Tecnonet Co., Ltd. (Japan)  
Ricoh Tokki Co., Ltd. (Japan)  
Taiwan-Ricoh (Korea)  
Taiwan-Ricoh Co. (Taiwan)  
Tohoku Ricoh Co., Ltd. (Japan)  
Tokyo Ricoh Co., Ltd. (Japan)

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## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

*1990*

### Tokyo Computer Service Co., Ltd., and Computron

Ricoh, Tokyo Computer, and Computron will jointly establish a computer software development firm that will produce software for office computers and mainframes made by IBM Corporation.

### IBM Japan, Ltd.

Ricoh and IBM Japan will establish Rios Systems Co., Ltd., a joint venture company. The new company will develop office systems, which will include computers and other office equipment. IBM Japan also will supply the AS/400 Model C to Ricoh, which will begin to ship the computer products as the Ricoh I-Series Model 740 computer.

*1989*

### International Chip Corporation

Ricoh and International Chip have developed the Knowledge-Based Silicon Compiler (KBSC), a CAD tool that automates the chip-development process from the logic synthesis level.

### IBM Corp.

Ricoh began marketing the Ricoh PS-Series Model 5530-T, a 32-bit PC made by IBM.

### Caere Corporation

Ricoh is to OEM Caere's Omnipage page-recognition software for sale with its 286 and 386 PCs.

*September 1988*

### Olympus Optical

The companies agreed to jointly develop, produce, and market erasable optical disk drives.

*April 1988*

### Canon

The companies agreed to exchange each other's plain-paper copiers on an OEM basis.

*March 1988*

### IBM Japan

The companies agreed to market the System/55 and System/36 small business computers in Japan. Ricoh acquired a production plant in Tustin, California, which began operations in mid-1988.

*February 1987*

### Advanced Silicon

Ricoh signed a five-year contract under which Ricoh will fabricate Advanced Silicon's custom ICs.

*1982*

### Pitney Bowes

Ricoh and Pitney Bowes entered into an OEM agreement whereby Pitney Bowes will sell copiers manufactured by Ricoh.

*1973*

### Savin Corporation

Ricoh and Savin entered into an OEM agreement whereby Savin will sell copiers manufactured by Ricoh.

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## KEY OFFICERS

### Hiroshi Hamada

President

### Kenji Hiruma

Executive vice president

### Hisashi Kubo

Executive vice president

### Morio Onoe

Executive vice president

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## PRINCIPAL INVESTORS

Nippon Life—6.0 percent

Sumitomo Trust—4.5 percent

Asahi Mutual Life Insurance—3.3 percent

Fuji Bank—2.8 percent

Tokai Bank—2.8 percent

Toho Mutual Life Insurance—2.9 percent

Mitsubishi Bank—3.7 percent

Koa Fire & Marine Insurance—3.1 percent

Non-Japanese ownership—4.0 percent

**Table 3**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Billions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	\$1.5	\$1.5	\$2.4	\$3.2	\$3.8
Cash	0.3	0.3	0.7	1.0	1.1
Receivables	0.5	0.6	0.8	1.1	1.3
Marketable Securities	0.2	0.2	0.3	0.3	0.4
Inventory	0.3	0.4	0.5	0.7	0.8
Other Current Assets	0.1	0.1	0.1	0.1	0.2
Net Property, Plants	\$0.5	\$0.6	\$0.8	\$0.9	\$1.3
Investments, Other Assets	\$0.2	\$0.2	\$0.4	\$0.5	\$0.6
<b>Total Assets</b>	<b>\$2.1</b>	<b>\$2.4</b>	<b>\$3.5</b>	<b>\$4.6</b>	<b>\$5.7</b>
Total Current Liabilities	\$0.9	\$1.0	\$1.5	\$2.1	\$2.5
Long-Term Debt	\$0.3	\$0.4	\$0.6	\$0.3	\$0.6
Other Liabilities	\$0.1	\$0.1	\$0.1	\$0.1	\$0.1
<b>Total Liabilities</b>	<b>\$1.3</b>	<b>\$1.4</b>	<b>\$2.2</b>	<b>\$2.5</b>	<b>\$3.2</b>
Total Shareholders' Equity	\$0.8	\$0.9	\$1.3	\$2.1	\$2.5
Common Stock	0.1	0.1	0.2	0.5	0.6
Other Equity	0.3	0.3	0.4	0.7	0.9
Retained Earnings	0.4	0.5	0.7	0.9	1.1
<b>Total Liabilities and Shareholders' Equity</b>	<b>\$2.1</b>	<b>\$2.4</b>	<b>\$3.5</b>	<b>\$4.6</b>	<b>\$5.7</b>
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	\$2.2	\$2.7	\$3.7	\$4.9	\$5.7
US Revenue	1.4	1.6	2.4	3.0	3.6
Non-US Revenue	0.9	1.1	1.3	1.9	2.1
Cost of Sales	\$1.4	\$1.7	\$2.4	\$3.1	\$3.6
R&D Expense	\$0.1	\$0.2	\$0.2	\$0.3	\$0.4
SG&A Expense	\$0.7	\$0.8	\$1.1	\$1.5	\$1.8
Capital Expense	\$0.2	\$0.2	\$0.2	\$0.2	\$0.5
Pretax Income	\$0.1	\$0.1	\$0.2	\$0.3	\$0.3
Pretax Margin (%)	6.64	5.24	4.25	5.21	5.05
Effective Tax Rate (%)	57.80	60.90	66.20	61.00	63.00
Net Income	\$0.1	\$0.1	\$0.1	\$0.1	\$0.1
Shares Outstanding, Millions	406.6	413.1	452.3	581.5	599.7
<b>Per Share Data</b>					
Earnings	\$0.15	\$0.15	\$0.15	\$0.21	\$0.22
Dividend	\$0.04	\$0.05	\$0.06	\$0.07	\$0.08
Book Value	0	0	0	0	0
Exchange Rate: US\$1 = ¥	¥243.51	¥221.26	¥159.56	¥138.03	¥128.25

Source: Ricoh Company, Ltd.  
 Annual Reports  
 Dataquest (1990)



**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Billions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985*</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	¥354.0	¥341.7	¥382.1	¥446.1	¥488.0
Cash	83.5	68.9	110.0	138.0	145.6
Receivables	124.8	128.3	133.1	149.5	170.3
Marketable Securities	48.0	45.2	46.3	48.2	46.4
Inventory	82.7	83.2	76.3	90.7	106.3
Other Current Assets	15.0	16.1	16.4	19.7	19.4
Net Property, Plants	¥119.8	¥131.9	¥124.6	¥129.6	¥165.8
Investments, Other Assets	¥38.7	¥47.0	¥56.0	¥64.8	¥76.4
<b>Total Assets</b>	<b>¥512.5</b>	<b>¥520.6</b>	<b>¥562.7</b>	<b>¥640.5</b>	<b>¥730.2</b>
Total Current Liabilities	¥230.7	¥216.2	¥237.4	¥286.8	¥319.9
Long-Term Debt	¥73.8	¥83.1	¥97.1	¥46.5	¥73.1
Other Liabilities	¥15.8	¥15.0	¥15.1	¥15.7	¥16.6
<b>Total Liabilities</b>	<b>¥320.3</b>	<b>¥314.3</b>	<b>¥349.6</b>	<b>¥349.0</b>	<b>¥409.6</b>
Total Shareholders' Equity	¥192.2	¥206.3	¥213.1	¥291.5	¥320.6
Common Stock	26.8	28.5	29.2	63.1	70.6
Other Equity	68.3	69.8	69.5	102.1	112.4
Retained Earnings	97.1	108.0	114.4	126.3	137.6
<b>Total Liabilities and Shareholders' Equity</b>	<b>¥512.5</b>	<b>¥520.6</b>	<b>¥562.7</b>	<b>¥640.5</b>	<b>¥730.2</b>
<b>Income Statement</b>	<b>1985*</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	¥545.5	¥593.9	¥592.4	¥674.2	¥729.4
US Revenue	332.2	358.5	389.5	418.8	460.8
Non-US Revenue	213.3	235.4	202.9	255.4	268.6
Cost of Sales	¥348.5	¥378.2	¥381.0	¥426.5	¥463.9
R&D Expense	¥29.2	¥36.2	¥36.5	¥42.9	¥46.5
SG&A Expense	¥163.3	¥184.0	¥183.0	¥207.3	¥231.0
Capital Expense	¥50.4	¥48.3	¥24.9	¥34.5	¥59.3
Pretax Income	¥36.2	¥31.1	¥25.2	¥35.1	¥36.8
Pretax Margin (%)	6.64	5.24	4.25	5.21	5.05
Effective Tax Rate (%)	57.80	60.90	66.20	61.00	63.00
Net Income	¥16.8	¥15.5	¥10.9	¥17.1	¥17.8
Shares Outstanding, Millions	406.6	413.1	452.3	581.5	599.7
<b>Per Share Data</b>					
Earnings	¥37.14	¥33.93	¥24.09	¥29.48	¥28.04
Dividend	¥10.00	¥10.00	¥10.00	¥10.00	¥10.00
Book Value	¥0.47	¥0.50	¥0.47	¥0.11	¥0.12

**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Billions of Yen, except Per Share Data)**

<b>Key Financial Ratios</b>	<b>1985*</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
<i>Liquidity</i>					
Current (Times)	1.53	1.58	1.61	1.56	1.53
Quick (Times)	1.18	1.20	1.29	1.24	1.19
Fixed Assets/Equity (%)	62.33	63.94	58.47	44.46	51.72
Current Liabilities/Equity (%)	120.03	104.80	111.40	98.39	99.78
Total Liabilities/Equity (%)	166.65	152.35	164.05	119.73	127.76
<i>Profitability (%)</i>					
Return on Assets	-	3.00	2.01	2.84	2.60
Return on Equity	-	7.78	5.20	12.38	9.83
Profit Margin	3.08	2.61	1.84	2.54	2.44
<i>Other Key Ratios</i>					
R&D Spending % of Revenue	5.35	6.10	6.16	6.36	6.38
Capital Spending % of Revenue	9.24	8.13	4.20	5.12	8.13
Employees	25,000	26,500	28,000	33,000	12,700
Revenue (¥K)/Employee	¥21.82	¥22.41	¥21.16	¥20.43	¥57.43
Capital Spending % of Assets	9.83	9.28	4.43	5.39	8.12
Exchange Rate: US\$1=¥	¥243.51	¥221.26	¥159.56	¥138.03	¥128.25

\*Fiscal 1985 has been translated at the rate of ¥259 to US\$1.

Source: Ricoh Company, Ltd.  
 Annual Reports  
 Dataquest (1990)

## **Sanyo Electric Company, Ltd.**

18, Keihan-Hondori 2-chome  
Moriguchi, Osaka 570 Japan

Telephone: (06) 991-1181

Fax: (06) 991-5411

Dun's Number: 08-190-0144

*Date Founded: 1950*

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### **CORPORATE STRATEGIC DIRECTION**

Sanyo Electric Company, Ltd., was established in 1950. The Company manufactures a wide range of electric and electronic equipment, including audio and video equipment, information and communications equipment, home appliances, commercial refrigerators and freezers, batteries, solar batteries, semiconductors, compressors, and electronic devices.

Sanyo Electric Company also is the core company of the Sanyo Group, a multinational enterprise with production and sales operations throughout the world. In December 1986, the two largest companies in the Sanyo Group—Sanyo Electric Company, Ltd., and Tokyo Sanyo Electric Company, Ltd. (the semiconductor manufacturer)—merged to form a new Sanyo Electric Company, Ltd. Having absorbed Tokyo Sanyo, the Company is streamlining its product line and trying to boost its position in the semiconductor industry with relatively high investments in plants and equipment.

Sanyo's total revenue increased by 12.4 percent to ¥1.4 trillion (US\$10.2 billion) in fiscal 1989 from ¥1.2 trillion (US\$9.6 billion) in fiscal 1988. Domestic sales grew 13.6 percent, contributing ¥833.7 billion (US\$6.1 billion) to total revenue, while international sales grew 5.8 percent, accounting for ¥555.9 billion (US\$4.1 billion) of total revenue.

Sanyo's net income totaled ¥16.8 billion (US\$0.1 billion) in fiscal 1989, an increase of 173 percent over the fiscal 1988 figure of ¥6.1 billion (US\$47.5 million). Research and development (R&D) totaled ¥66.5 billion (US\$487.6 million) and was 7.6 percent of revenue in fiscal 1989. This increase is 19.8 percent over the fiscal 1988 figure of ¥55.5 billion (US\$432.6 million). Part of this expenditure was invested in the development of a high-luminance blue light-emitting diode (LED), a

full-color LED, a four-beam visible ray semiconductor laser, and a high-performance satellite broadcasting converter.

Sanyo's capital expenditure totaled ¥105.8 billion (US\$775.8 million), representing 7.6 percent of total revenue. This increase is 88.0 percent over the previous fiscal year figure of ¥56.3 billion (US\$438.8 million). A significant portion of this expenditure was used to expand production facilities for semiconductors and batteries.

The Company employed approximately 55,526 people in fiscal 1989.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information is not available on revenue by distribution channel. Tables 3 and 4, which are comprehensive financial statements, are at the end of this profile.

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### **BUSINESS SEGMENT STRATEGIC DIRECTION**

#### **Semiconductors**

As mentioned previously, Sanyo Electric merged with Tokyo Sanyo Electric, the Sanyo Group's manufacturing arm for semiconductor operations. The Company has seven product areas: bipolar digital, MOS microcomponents, analog, optoelectronics, MOS memory, MOS logic, and discrete. Dataquest estimates that Sanyo ranked seventh among Japanese semiconductor manufacturers and twelfth in the worldwide semiconductor market with a 2.1 percent market share and ¥184 billion (US\$1.36 billion).

Sanyo's analog chips contributed nearly 39.0 percent of the Company's total semiconductor revenue in 1989. Dataquest estimates that Sanyo generated ¥73.1 billion (US\$530 million) in the analog market and ranked first in Japan with a 10.8 percent market share with ¥55.3 billion (US\$401 million) in revenue in 1989.

Sanyo's second largest market is in the MOS logic chip segment, which generated ¥24.0 billion (US\$178 billion) worldwide in 1989. MOS memory chips contributed ¥17.9 billion (US\$130 million), while the MOS microcomponents contributed ¥9.7 billion (US\$70 billion) worldwide in 1989. The technology used in these chips was 93 percent CMOS and 7 percent N/PMOS.

The Company ranked eighth in the Japanese bipolar digital logic market with a 3.5 percent market share of ¥8.6 billion (US\$62 million) in 1989. Sanyo generated ¥9.3 billion (US\$67 million) in revenue for worldwide sales of the bipolar digital logic chip in 1989. All bipolar digital chips were designed in TTL bipolar.

Sanyo increased its semiconductor capital spending more than 100 percent in fiscal 1989 over 1988. Approximately 40 percent will be used for DRAM development, and 60 percent will be used for expanding the capacity of microcomponents. The Company established the VLSI research center in Gifu prefecture to do R&D on 16Mb and 64Mb DRAMs and ASICs. Sanyo announced plans to enter the BiCMOS market. The Company is developing a proprietary bipolar technology and will make proprietary logic ICs at the Niigata facility.

In the memory segment, Sanyo developed 60 to 80ns, 4Mb DRAMs with Mosaid of Canada both in anticipation of HDTV-related applications and to diversify the IC product base. Sanyo began production of 1 Mb DRAMs and announced the start of 256K SRAM production at its VLSI center. Sanyo has shifted its emphasis by decreasing production of the 16K and 64K SRAMs and increasing production of the more powerful 256K SRAMs and 1Mb DRAMs.

The Company's most successful products are in the analog area. A leading supplier of IC kits for VCRs, Sanyo has developed a single-chip solution for 1990/1991 VCR signal processing and introduced a 1-chip HDTV converter LSI to process video signals for MUSE/NTSC converters.

## Copiers

Sanyo produces plain paper copiers (PPCs) at its Information Systems Business Headquarters. The Company supplies PPCs to Apeco and TOWA to market in Europe and to TOWA and Uchida to market in Japan. Sanyo now distributes its copiers in the United States through three distributors/wholesalers to its 320 dealers across the country. According to Dataquest, Sanyo ranked eighteenth in the US market with 3,100 units shipped in 1989. A majority of these units were shipped in the PC segment and Segment 1 of the market, although Sanyo is active in Segments 2 and 3. The models include the SFT-50, the SFT-50L, the SFT-62, the SFT-70, the SFT-Z90 (introduced in January 1990), the SFT-100, the SFT-Z120, and the SFT-133.

## Personal Computers

According to Dataquest, Sanyo sold 147,000 PCs worldwide during 1989, with an if-sold value (ISV) of ¥53.9 billion (US\$390.9 million) with less than 1 percent of worldwide market share. However, Sanyo is the fourth largest Japanese PC supplier in the world. Sanyo's most lucrative computers include the MBC-25FK, which shipped 30,000 units worldwide, and the MBC-17 Plus Series, which shipped 93,000 units worldwide (30,000 of which were in the United States).

## Facsimile

Sanyo produces a full line of facsimile machines that include the SF-2U, the SF-5U, the SANFAX 200, the SANFAX-515H, the SANFAX-520, the SANFAX-525, the SANFAX-725, and the SANFAX-735. Sanyo is not a major player in the fax market but is looking to expand into it.

## Consumer Products

Sanyo Electronics is a major consumer electronics equipment manufacturer located in the United States. More than 700 companies manufacture consumer electronics equipment in the United States, accounting for more than \$20 billion in revenue. Dataquest does not track consumer electronics, which are a major part of Sanyo's business.

## Further Information

For further information pertaining to the Company's business segments, please contact the appropriate Dataquest industry service.

**Table 1**  
**Five-Year Corporate Highlights (Billions of US Dollars)**

	1985	1986	1987	1988	1989
Five-Year Revenue	\$6.3	\$7.3	\$8.0	\$9.6	\$10.2
Percent Change	-	16.45	9.64	20.01	5.71
Capital Expenditure	\$0.3	\$0.3	\$0.3	\$0.4	\$0.5
Percent of Revenue	4.31	3.64	4.06	4.55	7.61
R&D Expenditure	\$0.1	\$0.2	\$0.4	\$0.4	\$0.5
Percent of Revenue	1.63	2.12	4.48	4.49	4.79
Number of Employees	25,429	25,599	40,590	39,179	55,526
Revenue (US\$K)/Employee	\$0.2	\$0.3	\$0.2	\$0.2	\$0.2
Net Income	\$0.2	0	(\$0.1)	0	\$0.1
Percent Change	-	(94.41)	(883.30)	164.30	164.30
Exchange Rate (US\$1=¥)	¥238.41	¥161.21	¥147.70	¥128.30	¥136.37
1989 Calendar Year	Q1	Q2	Q3	Q4	
Quarterly Revenue	NA	NA	NA	NA	
Quarterly Profit	NA	NA	NA	NA	

NA = Not available

Source: Sanyo Electric Company  
Annual Reports  
Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1985	1986	1987	1988	1989
Japan	34.60	45.50	53.70	59.00	60.00
International	65.40	54.50	46.30	41.00	40.00
North America	40.60	33.30	23.20	16.00	17.00
Europe	8.00	9.00	10.20	12.00	11.00
Asia/Pacific	8.60	6.00	8.10	9.00	9.00
ROW	8.20	6.20	4.80	4.00	3.00

Source: Sanyo Electric Company  
Annual Reports  
Dataquest (1990)

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## 1989 SALES OFFICE LOCATIONS

North America—6  
Europe—7  
Asia/Pacific—27

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## MANUFACTURING LOCATIONS

Information is not available.

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## SUBSIDIARIES

### *North America*

Sanyo Fisher Corporation (United States)

### *Asia/Pacific*

Niigata Sanyo Electronic Co., Ltd. (Japan)  
Sanyo Electric Chubu Sales Co., Ltd. (Japan)  
Sanyo Electric Chugoku Sales Co., Ltd. (Japan)  
Sanyo Electric Credit Co., Ltd. (Japan)  
Sanyo Electric Hokkaido Sales Co., Ltd. (Japan)  
Sanyo Electric Kinki Sales Co., Ltd. (Japan)  
Sanyo Electric Kyushu Sales Co., Ltd. (Japan)  
Sanyo Electric Tohoku Sales Co., Ltd. (Japan)  
Sanyo Electric Tokki Co., Ltd. (Japan)  
Sanyo Electric Tokyo Sales Co., Ltd. (Japan)  
Sanyo Electric Trading Co., Ltd. (Japan)  
Sanyo Electronics (Singapore)  
Sanyo Manufacturing Corporation (Japan)  
Sanyo Semiconductor Co., Ltd. (Hong Kong)  
Tottori Sanyo Electric Co., Ltd. (Japan)

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## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

### SGS-Thomson Microelectronics

SGS-Thomson and Sanyo have agreed to use each others' sales channels in Europe and Asia.

### Olivetti

Olivetti, Sanyo, and Mitsui jointly formed Olivetti Sanyo Industriale (Italy) to produce 200,000 facsimile machines.

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## MERGERS AND ACQUISITIONS

Information is not available.

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## KEY OFFICERS

Satoshi Iue  
President

Masaru Yamano  
Executive vice president

Yasuaki Takano  
Executive vice president

Meiji Kurahashi  
Executive vice president

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## PRINCIPAL INVESTORS

Information is not available.

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## FOUNDERS

Information is not available.

**Table 3**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending November**  
**(Billions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	\$3.7	\$4.7	\$7.0	\$8.8	\$10.1
Cash	1.1	1.3	1.7	2.7	3.2
Receivables	1.4	2.0	2.5	3.0	3.0
Marketable Securities	0.2	0.1	1.4	1.5	1.3
Inventory	0.8	1.1	1.3	1.4	2.2
Other Current Assets	0.1	0.1	0.2	0.2	0.3
Net Property, Plants	\$0.8	\$1.2	\$2.4	\$2.7	\$3.4
Other Assets	\$0.8	\$1.2	\$1.1	\$1.5	\$1.4
<b>Total Assets</b>	<b>\$5.3</b>	<b>\$7.1</b>	<b>\$10.5</b>	<b>\$13.0</b>	<b>\$14.9</b>
Total Current Liabilities	\$3.0	\$3.9	\$4.6	\$6.1	\$7.1
Long-Term Debt	\$0.2	\$0.2	\$1.2	\$1.2	\$1.9
Other Liabilities	\$0.2	\$0.3	\$0.4	\$0.5	\$0.5
<b>Total Liabilities</b>	<b>\$3.4</b>	<b>\$4.4</b>	<b>\$6.2</b>	<b>\$7.8</b>	<b>\$9.6</b>
Minority Interest	\$0.1	\$0.1	\$0.1	\$0.1	\$0.1
Total Shareholders' Equity	\$1.8	\$2.6	\$4.2	\$5.1	\$5.2
Converted Preferred Stock	0	0	0	0	0
Common Stock	0.3	0.4	0.7	1.0	1.1
Other Equity	0.5	0.7	2.2	2.6	2.6
Retained Earnings	1.1	1.5	1.4	1.6	1.5
<b>Total Liabilities and Shareholders' Equity</b>	<b>\$5.3</b>	<b>\$7.1</b>	<b>\$10.5</b>	<b>\$13.0</b>	<b>\$14.9</b>
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	\$6.3	\$7.3	\$8.0	\$9.6	\$10.2
US Revenue	2.2	3.3	4.3	5.7	6.1
Non-US Revenue	4.1	4.0	3.7	3.9	4.1
Cost of Sales	\$5.1	\$6.2	\$6.8	\$8.1	\$8.0
R&D Expense	\$0.1	\$0.2	\$0.4	\$0.4	\$0.5
SG&A Expense	\$1.0	\$1.2	\$1.4	\$1.6	\$1.9
Capital Expense	\$0.3	\$0.3	\$0.3	\$0.4	\$0.8
Pretax Income	\$0.3	\$0.1	0	\$0.2	\$0.3
Pretax Margin (%)	4.50	1.06	0.05	1.96	3.35
Effective Tax Rate (%)	57.50	57.50	56.00	56.00	56.00
Net Income	\$0.2	0	(\$0.1)	0	\$0.1
Shares Outstanding, Millions	1,188.9	1,133.6	1,654.9	1,749.9	2,013.0
<b>Per Share Data</b>					
Earnings	\$0.13	\$0.01	0	\$0.03	\$0.06
Dividends	\$0.03	\$0.05	\$0.05	\$0.06	\$0.06
Book Value	0	0	0	0	0
<b>Exchange Rate (US\$1=¥)</b>	<b>¥238.41</b>	<b>¥161.21</b>	<b>¥147.70</b>	<b>¥128.30</b>	<b>¥136.37</b>

Source: Sanyo Electric Company  
Annual Reports  
Dataquest (1990)

**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending November**  
**(Billions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	¥876.2	¥751.0	¥1,032.9	¥1,124.7	¥1,373.5
Cash	267.3	216.0	251.8	341.8	441.9
Receivables	326.3	320.9	363.7	390.1	409.1
Marketable Securities	55.0	20.1	201.4	186.6	183.5
Inventory	197.7	172.4	187.5	179.4	298.2
Other Current Assets	29.9	21.6	28.5	26.8	40.8
Net Property, Plants	¥189.9	¥195.3	¥352.8	¥352.6	¥465.6
Other Assets	¥193.6	¥199.2	¥168.3	¥191.7	¥187.9
<b>Total Assets</b>	<b>¥1,259.7</b>	<b>¥1,145.5</b>	<b>¥1,554.0</b>	<b>¥1,669.0</b>	<b>¥2,027.0</b>
Total Current Liabilities	¥723.3	¥632.9	¥680.6	¥788.3	¥972.9
Long-Term Debt	¥54.7	¥40.3	¥180.3	¥149.9	¥260.9
Other Liabilities	¥39.7	¥40.8	¥57.9	¥61.1	¥72.1
<b>Total Liabilities</b>	<b>¥817.7</b>	<b>¥714.0</b>	<b>¥918.8</b>	<b>¥999.3</b>	<b>¥1,305.9</b>
Minority Interest	¥21.5	¥16.9	¥10.4	¥9.7	¥7.6
Total Shareholders' Equity	¥420.6	¥414.6	¥624.8	¥660.0	¥713.5
Converted Preferred Stock	0	0	0	0	0
Common Stock	61.6	64.1	105.7	128.8	153.6
Other Equity	108.6	107.6	308.6	330.2	358.5
Retained Earnings	250.4	242.9	210.5	201.0	201.4
<b>Total Liabilities and Shareholders' Equity</b>	<b>¥1,259.7</b>	<b>¥1,145.5</b>	<b>¥1,554.0</b>	<b>¥1,669.0</b>	<b>¥2,027.0</b>
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	¥1,500.0	¥1,181.1	¥1,186.4	¥1,236.8	¥1,389.6
US Revenue	519.0	537.4	637.1	729.7	833.7
Non-US Revenue	981.0	643.7	549.3	507.1	555.9
Cost of Sales	¥1,214.3	¥995.4	¥997.8	¥1,032.9	¥1,084.9
R&D Expense	¥24.4	¥25.0	¥53.2	¥55.5	¥66.5
SG&A Expense	¥232.7	¥197.6	¥199.5	¥208.1	¥259.4
Capital Expense	¥64.7	¥43.0	¥48.2	¥56.3	¥105.8
Pretax Income	¥67.6	¥12.5	¥608.0	¥24.3	¥46.6
Pretax Margin (%)	4.50	1.06	51.25	1.96	3.35
Effective Tax Rate (%)	57.50	57.50	56.00	56.00	56.00
Net Income	¥36.2	¥2.1	(¥17.5)	¥6.1	¥16.8
Shares Outstanding, Millions	1,188.9	1,133.6	1,654.9	1,749.9	2,013.0
<b>Per Share Data</b>					
Earnings	¥30.90	¥1.90	(¥10.60)	¥3.50	¥8.80
Dividend	¥8.00	¥8.00	¥8.00	¥8.00	¥8.00
Book Value	¥0.35	¥0.37	¥0.38	¥0.38	¥0.35



**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending November**  
**(Billions of Yen, except Per Share Data)**

Key Financial Ratios	1985	1986	1987	1988	1989
<i>Liquidity</i>					
Current (Times)	1.21	1.19	1.52	1.43	1.41
Quick (Times)	0.94	0.91	1.24	1.20	1.11
Fixed Assets/Equity (%)	45.15	47.11	56.47	53.42	65.26
Current Liabilities/Equity (%)	171.97	152.65	108.93	119.44	136.36
Total Liabilities/Equity (%)	194.42	172.21	147.06	151.41	183.03
<i>Profitability (%)</i>					
Return on Assets	-	0.21	(1.34)	0.41	0.88
Return on Equity	-	0.60	(3.48)	1.02	2.37
Profit Margin	2.41	0.18	(1.48)	0.50	1.21
<i>Other Key Ratios</i>					
R&D Spending % of Revenue	1.63	2.12	4.48	4.49	4.79
Capital Spending % of Revenue	4.31	3.64	4.06	4.55	7.61
Employees	25,429	25,599	40,590	39,179	55,526
Revenue (\$K)/Employee	¥0.20	¥0.3	¥0.2	¥0.2	¥0.2
Capital Spending % of Assets	5.14	3.75	3.10	3.37	5.22
Exchange Rate (US\$1=¥)	¥238.41	¥161.21	¥147.70	¥128.30	¥136.37

Source: Sanyo Electric Company  
Annual Reports  
Dataquest (1990)

## Sharp Corporation

22-2, Nagaike-cho

Abeno-ku

Osaka 545, Japan

Telephone: (06) 621-1221

Fax: (06) 628-1653

Dun's Number: 69-053-6925

*Date Founded: 1912*

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### CORPORATE STRATEGIC DIRECTION

Sharp Corporation is a Japanese electronics manufacturer founded in 1912 by Tokuji Hayakawa. The Company's first major product was a mechanical pencil, called the Ever-Sharp Pencil, invented by the founder.

Today, Sharp conducts a full range of business operations, from product development to production and marketing, in the fields of consumer appliances, office equipment, industrial equipment, and electronic components.

Sharp is divided into four product groups. Sales breakdown by product category as a percentage of total revenue is as follows:

- Electronic equipment (TV and video systems group)—27 percent
- Audio equipment (tape, stereo equipment, and digital audio equipment)—9 percent
- Consumer electronics (refrigerators, washing machines, microwave ovens and other home appliances)—18 percent
- Information equipment and electronic parts (PCs, CAD systems, facsimiles, copiers, ICs, optoelectronics, pocket computers)—46 percent

Sharp also has branched out into the telecommunications field.

Sharp is not a member of any of Japan's large industrial groups; however, it does have loose connections with the Sanwa Group, centered on the Sanwa Bank. Sharp is a member of the Sanwa Group's policy-making council, called *Sansui-Kai*, or Third Wednesday Conference. This council is composed of the presidents of 42 Sanwa Group companies or related companies.

Sharp's estimated revenue for the year ending March 1990 is ¥1.4 trillion (US\$9.6 billion). Sharp reported revenue of ¥1.3 trillion (US\$9.8 billion) in fiscal 1989, a 4.2 percent decrease over fiscal 1988 revenue of ¥1.3 trillion (US\$9.5 billion). (Percentage changes refer only to ¥ amounts; US\$ percentage rates will differ because of fluctuations in Dataquest exchange rates.) Domestic sales increased by 18 percent in 1989 over sales in 1988; the steady growth in sales of camcorders, electronic organizers, and word processors stimulated the increase. International growth increased by 11.9 percent in 1989, mainly because of the growth in sales of facsimile machines, video cassette recorders, and copiers. As a result, domestic sales accounted for 51.0 percent in 1989, compared with 55.0 percent in 1988. International sales accounted for 49.0 percent in 1989, which reinforces Sharp's strategy of increasing worldwide sales.

Sharp's estimated net income for year ending March 1990 was ¥42.0 billion (US\$294.8 million). Net income for 1989 increased 29.9 percent to ¥29.1 billion (US\$222.2 million), compared with ¥22.4 billion (US\$147.0 million). The increase is due in large part to cost and expense reductions throughout the group companies, and moderate rate fluctuations during the year.

Sharp's estimated capital investments for year ending March 1990 was ¥100 billion (US\$702 million), representing 13.7 percent of the estimated revenue for March 1990. Capital expenditure for year ending March 1989 increased 46.0 percent to ¥80.7 billion (US\$629.2 million) over the ¥55.3 billion (US\$400.6 million) in 1988. The 1989 figure represents 6.4 percent of total revenue. This spending was for construction of a second factory in Fukuyama, Japan, designed to expand production capacity for the LSI chips and to strengthen the production capacity for core products such as liquid crystal

displays, optoelectronic components, and hologram laser units. Sharp also opened a new factory for production of precision stamping and press metal parts for video cassette recorders, compact disc players, and microwave ovens. Construction is under way for a new copier and facsimile machine factory in France; in Thailand, a second factory was completed for the production of radio cassette recorders, facsimile machines, microwave ovens, and electric refrigerators.

A design center in Germany was completed in summer 1989. This center reports to Sharp Electronics Europe GmbH and designs custom mask ROMs and gate arrays. There are no future plans for local production in Europe. In the United States, a semiconductor R&D lab and clean rooms were completed in summer 1989 in Washington state.

Currently, Sharp is developing products based on technology using voice synthesis, voice recognition, and artificial intelligence, such as an English-Japanese electronic translation system that takes advantage of artificial intelligence. Additionally, Sharp is working on a word processor that relies on vocal entry of documents and a natural language processing computer that uses everyday language instead of computer language.

Sharp's estimated R&D expenditure for year ending March 1990 was ¥79.0 billion (US\$554.5 million). R&D expenditure was ¥68.5 billion (US\$534.1 million) in year ending March 1989 and represented 6 percent of revenue. This was a 43 percent increase over year ending March 1988 R&D spending, which totaled ¥47.8 billion (US\$346.3 million). Technologies being researched include 16 to 64Mb ULSIs, three-dimensional LSIs, and microwave devices.

Sharp employs more than 32,000 people worldwide.

Sharp has 25 manufacturing facilities around the world specializing in different products offered by the Company. Sharp has 20 factories in Asia/Pacific, including 11 in Japan, 4 in Malaysia, and 1 each in the Philippines, Korea, Thailand, Taiwan, and Australia; 1 in North America; 3 in Europe; 1 in South America. Sharp hopes to minimize fluctuations in exchange rates and meet local requirements by increasing overseas production.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic Direction" and present corporate highlights and revenue by region. Information on revenue by distribution

channel is not available. Tables 3 and 4, comprehensive financial statements, are at the end of this profile.

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## BUSINESS SEGMENT STRATEGIC DIRECTION

### Semiconductors

Dataquest estimates that Sharp's 1989 revenue in the worldwide semiconductor market was ¥147.6 billion (US\$1.2 billion), representing approximately 13 percent of total revenue. The estimated sales in Japan made it Sharp's largest market, contributing ¥142.5 billion (US\$1 billion) to revenue. The Company had 4.3 percent market share of the total semiconductor market in Japan for 1989. Estimated revenue in North America was ¥1.18 billion (US\$83 million), which represents a 48 percent increase over the previous fiscal year. Dataquest estimates that Sharp ranked fifteenth in the 1989 worldwide semiconductor market.

Sharp's product line in the semiconductor market includes MOS memory, microcomponents, and logic; and analog, optoelectronic, and ASIC components. Sharp's strength lies in its MOS memory chips and optoelectronics, representing revenue of ¥67.8 billion (US\$476 million) and ¥46.7 billion (US\$328 million), respectively. Combined, these two chips represent 65 percent of the Company's total semiconductor revenue. Revenue for MOS logic totaled ¥35.4 billion (US\$249 million) in 1989, showing an increase of 15 percent over the previous fiscal year and representing 20 percent of total semiconductor revenue. MOS microcomponents generated approximately ¥15.3 billion (US\$112 million) and represented 9 percent of total semiconductor revenue. Analog components contributed ¥8.8 billion (US\$65 million) to revenue and represented the remaining 6 percent of total semiconductor revenue.

During 1990, Sharp developed and introduced a full line of CMOS dual-port static RAMs (DP-SRAMs) that allow two independent devices to have access to the same array. Sharp also introduced a new generation of intelligent solid state relays, incorporating a variety of IC and SSR functions.

## Copiers and Page Printers

Dataquest estimates that Sharp had a 14.5 percent market share in the plain paper copier (PPC) market with 178,500 units sold in the United States during fiscal 1989. This is an increase of 10,000 units over fiscal 1988. Dataquest believes that the copier market has matured, opportunities are becoming fewer, distribution channels are changing at a fast pace, service is becoming increasingly important, and companies must compete in all market segments in order to be successful. Sharp is a major player in five of the seven copier market segments as defined by Dataquest, with 51 percent of its total US shipments occurring in Dataquest-defined Segment 1: low end, low technology. Dataquest estimates that Sharp ranks fifth in the United States color copier market, with 5.5 percent share in 1989. However, on a worldwide basis, Sharp resides with over 40 other manufacturers that control 52 percent of the market, each having less than 5 percent of the \$14.8 billion market.

In 1990, Sharp has introduced two new copiers: the SF-8350 and the SF-9800. Sharp's 1989 introductions were the CX 4500 and the CX 7500 full-color copiers.

## Facsimiles

In the facsimile market, Dataquest estimates that Sharp ranked number one in the United States in 1989, with 22.5 percent market share on 323,900 units shipped. Sharp also competes in the European, East Asian, and Japanese facsimile markets. According to Dataquest, Sharp had a 9.1 percent market share in the United Kingdom with 18,820 units shipped, ranking it fourth in that market. Sharp introduced a photo-quality, full-color desktop facsimile machine in 1990. Sharp's strength in the international facsimile market was primarily responsible for its increase in revenue for fiscal 1989.

## Printers

Sharp competes in the printer market but holds less than 1 percent of the total worldwide market. The Company's printer products include the JX-9300 laser printer, the JX-730 color ink jet printer, the JX-720 ink jet color image printer, the JX-725 ink jet printer, and the JX-550 thermal printer. Sharp also has a color scanner.

## Personal Computers

Dataquest estimates that Sharp sold 123,000 units in the worldwide personal computer market, generating ¥49.4 billion (US\$347 million) in revenue for fiscal 1989 and capturing less than 1 percent of the world market. However, the revenue generated by the sale of personal computers was nearly 4 percent of total revenue for the year. Sharp sold an estimated 67,000 personal computers in the United States, with ¥22.5 billion (US\$158 million) in revenue for 1989, also capturing less than 1 percent of the market. The two largest-selling products were the x-68000, PC-7000A/7000 series and the PC-4500 series, accounting for 85 percent of units sold worldwide. Sharp introduced the PC-5542, 286-based clamshell laptop computer in 1990. Also introduced in 1990 was the PC-5541, a similar laptop powered by the 286 microprocessor. Sharp's strategy for the 1990s is small laptop and palmtop computers.

## Other Products

Sharp also produces televisions, microwave ovens, VCRs, electronic typewriters, audio equipment, refrigerators, and washing machines.

## Further Information

For further information on the Company's business segments, please contact the appropriate Dataquest industry service.

**Table 1**  
**Five-Year Corporate Highlights (Billions of US Dollars)**

	1985	1986	1987	1988	1989
Five-Year Revenue	\$4.8	\$5.5	\$7.6	\$9.5	\$9.8
Percent Change	-	14.72	38.63	24.92	3.13
Capital Expenditure	\$0.4	\$0.4	\$0.4	\$0.4	\$0.6
Percent of Revenue	7.86	6.74	5.16	4.21	6.41
R&D Expenditure*	\$0.2	\$0.2	\$0.3	\$0.3	\$0.5
Percent of Revenue	4.09	3.27	3.79	3.64	5.44
Number of Employees	28,221	28,873	29,346	29,351	32,298
Revenue (\$K)/Employee	\$0.17	\$0.19	\$0.26	\$0.32	\$0.30
Net Income	\$0.2	\$0.2	\$0.2	\$0.2	\$0.2
Percent Change	-	(1.14)	(15.58)	(13.21)	23.24
Exchange Rate (US\$1=¥)	¥243.52	¥221.26	¥150.76	¥138.03	¥128.25
1989 Calendar Year	Q1	Q2	Q3	Q4	
Quarterly Revenue	NA	NA	NA	NA	
Quarterly Profit	NA	NA	NA	NA	

\*Dataquest estimate  
 NA = Not available

Source: Sharp Corporation  
 Annual Reports  
 Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1985	1986	1987	1988	1989
Asia/Pacific	41.00	41.00	50.00	55.00	51.00
Japan	41.00	41.00	50.00	55.00	51.00
All Others	59.00	59.00	50.00	45.00	49.00

Source: Sharp Corporation  
 Annual Reports  
 Dataquest (1990)

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## 1989 SALES OFFICE LOCATIONS

Asia/Pacific—More than 200

Japan—More than 200

All others—13

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## MANUFACTURING LOCATIONS

### *North America*

Sharp Manufacturing Co. of America

Color TVs, microwave ovens, personal computers

### *Europe*

Sharp Electronic Espana

Color TVs

Sharp Manufacturing Co. of U.K.

Microwave ovens, VCRs, electronic typewriters, copiers

Sharp Manufacturing France S.A.

Facsimile, copiers

### *Asia/Pacific*

Cosmo Denki (Japan)

Electric equipment

Kanto Tatsumi Electronics (Japan)

VCRs

Kure Nissei (Japan)

Audio equipment

Nara Nissei (Japan)

Business machines

Raiton Denshi Kogyo (Japan)

Electronic equipment

Sharp (Philippines)

TVs, refrigerators, washing machines, radio-cassette tape recorders

Sharp Appliances (Thailand)

Appliances, facsimiles, word processors, radio-cassette tape recorders

Sharp Corporation of Australia (Australia)

Color TVs

Sharp Electronics (Taiwan)

Tuners for VCRs

Sharp Hiroshige (Japan)

Electronic equipment

Sharp Korea (South Korea)

Electronic calculators, electronic typewriters

Sharp Manufacturing (Malaysia)

VCRs

Sharp Niigata Electronics Corporation (Japan)

Business machines

Sharp Precision Machinery (Japan)

Automated production systems

Sharp-Roxy Appliances Corp. (Malaysia)

Refrigerators

Sharp-Roxy Corp. (Malaysia)

Radio-cassette tape recorders, headphone stereos

Sharp-Roxy Electronics Corp. (Malaysia)

TVs

Sharp Takaya Electronics Industry (Japan)

VLSIs

Sharp Tokusen Kogyo (Japan)

Electric/electronic equipment

Takahata Denshi (Japan)

PC boards

### *ROW*

Sharp de Brasil

Calculators, TVs, stereos, VCRs, CTRs

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## SUBSIDIARIES

### *North America*

Sharp Electronics Corporation (United States)

Sharp Electronics of Canada Ltd. (Canada)

Sharp Electronics (U.K.) Limited (United Kingdom)

### *Europe*

Sharp Electronics GmbH (Germany)

Sharp Manufacturing France S.A. (France)

### *Asia/Pacific*

Nishi-Nippon Sharp Equipment Apparatus Co., Ltd. (Japan)

Sharp Corporation of Australia Pty. Ltd. (Australia)

Sharp Electronics Sales Corporation (Japan)

Sharp Engineering Corporation (Japan)

Sharp Finance Corporation (Japan)

Sharp Niigata Electronics Corporation (Japan)

Sharp Precision Machinery Co. Ltd. (Japan)

Sharp System Products Co. Ltd. (Japan)

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## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

### Nihon Semiconductor

Sharp has agreed to allow Nihon Semiconductor to produce 64-Kbit SRAMs.

### Pyramid Technology Corporation

Sharp has a distribution agreement with Pyramid Technology to market Pyramid's UNIX-based systems.

### Dexter Corporation

Sharp and Dexter's Electronic Materials Division have agreed to develop chip-in-board technology.

### Oxford Science Park

Sharp established an R&D group with Oxford Science Park for £10 million (US\$16.4 million).

1989

### Hycom Inc.

Hycom assumed marketing responsibilities in the United States for all Sharp computer peripheral products sold to OEMs.

### Texas Instruments

Sharp has an agreement with Texas Instruments to manufacture the Sharp 16-bit IBM-compatible personal computers.

### LSI Logic Corporation

Sharp has commissioned LSI Logic Corporation to produce its 256-Kbit SRAMs.

### Standard Microsystems Corp.

Standard Microsystems agreed to a series of patent and cross-licensing agreements covering semiconductor technology with Sharp.

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## MERGERS AND ACQUISITIONS

Information is not available.

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## KEY OFFICERS

Haruo Tsuji  
President

Akira Saeki  
Chairman

Akira Tobe  
Senior executive vice president

Taizo Katsura  
Senior executive vice president

Atsushi Asada  
Senior executive vice president

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## PRINCIPAL INVESTORS

Nippon Life—5.5 percent  
Fuji Bank—4.4 percent  
Daiwa Bank—4.3 percent  
Sanwa Bank—4.1 percent  
Yasuda Life—4.0 percent  
Dai Ichi Life—3.9 percent  
Sumitomo Life—3.7 percent  
Foreign-Owned—3.25 percent  
Taisho Marine & Fire—3.0 percent  
Yasuda Trust & Banking—3.0 percent  
DKB—2.8 percent

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## FOUNDER

Tokuji Hayakawa

**Table 3**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Billions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	\$2.8	\$3.6	\$6.4	\$8.1	\$9.5
Cash	0.6	1.1	2.7	3.5	3.9
Receivables	1.1	1.2	1.8	2.2	3.0
Marketable Securities	0.1	0.1	0.1	0.3	0.6
Inventory	0.9	1.0	1.6	1.7	1.8
Other Current Assets	0.1	0.2	0.2	0.3	0.2
Net Property, Plants	\$1.1	\$1.3	\$1.9	\$2.0	\$2.3
Investments, Other Assets	\$0.7	\$0.7	\$1.0	\$1.6	\$1.5
Total Assets	\$4.6	\$5.6	\$9.3	\$11.7	\$13.3
Total Current Liabilities	\$2.5	\$3.2	\$5.8	\$7.1	\$8.7
Long-Term Debt	\$0.5	\$0.6	\$0.8	\$1.1	\$0.7
Other Liabilities	\$0.1	\$0.1	\$0.1	\$0.1	\$0.1
Total Liabilities	\$3.1	\$3.9	\$6.7	\$8.3	\$9.6
Total Shareholders' Equity	\$1.5	\$1.7	\$2.6	\$3.5	\$4.1
Common Stock	0.2	0.2	0.3	0.7	0.8
Other Equity	0.6	0.6	0.9	1.3	1.5
Retained Earnings	0.7	0.9	1.3	1.5	1.8
Total Liabilities and Shareholders' Equity	\$4.6	\$5.6	\$9.3	\$11.7	\$13.7
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	\$4.8	\$5.5	\$7.6	\$9.5	\$9.8
Japanese Revenue	2.0	2.3	3.8	5.2	5.0
Non-Japanese Revenue	2.8	5.5	3.8	4.3	4.8
Cost of Sales	\$3.6	\$4.2	\$6.1	\$7.1	\$7.4
R&D Expense*	\$0.2	\$0.2	\$0.3	\$0.3	\$0.5
SG&A Expense	\$0.9	\$1.1	\$1.5	\$1.6	\$2.0
Capital Expense	\$0.4	\$0.4	\$0.4	\$0.4	\$0.6
Pretax Income	\$0.3	\$0.3	\$0.3	\$0.3	\$0.5
Pretax Margin (%)	6.71	5.83	3.73	3.29	5.45
Effective Tax Rate (%)	49.60	49.70	53.40	NA	56.00
Net Income	\$0.2	\$0.2	\$0.2	\$0.2	\$0.2
Shares Outstanding, Millions	731.3	733.2	736.9	907.9	936.6
<b>Per Share Data</b>					
Earnings	\$0.22	\$0.22	\$0.19	\$0.16	\$0.22
Dividend	\$0.05	\$0.05	\$0.07	\$0.08	\$0.07
Book Value	0	0	0	0	0
Exchange Rate (US\$1=¥)	¥243.52	¥221.26	¥150.76	¥138.03	¥128.25

\*Dataquest estimate  
 NA = Not available

Source: Sharp Corporation  
 Annual Reports  
 Dataquest (1990)



**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Billions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Total Current Assets	¥682.4	¥799.3	¥970.0	¥1,113.5	¥1,279.8
Cash	152.1	245.7	403.6	485.2	87.5
Receivables	271.0	269.0	266.1	307.9	387.8
Marketable Securities	19.0	20.5	21.2	40.5	551.1
Inventory	209.0	229.3	241.4	236.3	224.8
Other Current Assets	31.3	34.8	37.6	43.6	28.6
Net Property, Plants	¥258.0	¥283.0	¥282.8	¥279.0	¥292.8
Investments, Other Assets	¥169.8	¥150.4	¥147.6	¥226.1	¥191.4
<b>Total Assets</b>	<b>¥1,110.1</b>	<b>¥1,232.7</b>	<b>¥1,400.4</b>	<b>¥1,618.6</b>	<b>¥1,763.9</b>
Total Current Liabilities	¥608.7	¥706.6	¥872.4	¥980.8	¥1,120.6
Long-Term Debt	¥130.4	¥128.4	¥125.9	¥145.8	¥96.1
Other Liabilities	¥13.1	¥18.1	¥12.0	¥14.1	¥13.3
<b>Total Liabilities</b>	<b>¥752.2</b>	<b>¥853.2</b>	<b>¥1,010.2</b>	<b>¥1,140.7</b>	<b>¥1,229.9</b>
Total Shareholders' Equity	¥357.9	¥379.4	¥390.1	¥478.0	¥534.8
Common Stock	50.3	50.6	51.6	90.7	109.3
Other Equity	134.4	136.6	138.9	178.8	197.7
Retained Earnings	173.2	192.2	199.6	208.6	227.7
<b>Total Liabilities and Shareholders' Equity</b>	<b>¥1,110.1</b>	<b>¥1,232.6</b>	<b>¥1,400.3</b>	<b>¥1,618.7</b>	<b>¥1,764.7</b>
<b>Income Statement</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
Revenue	¥1,166.7	¥1,216.0	¥1,148.7	¥1,313.7	¥1,258.9
Japanese Revenue	478.4	498.5	574.4	722.5	642.0
Non-Japanese Revenue	688.3	717.5	574.3	591.2	616.9
Cost of Sales	¥881.1	¥932.7	¥913.1	¥977.9	¥943.1
R&D Expense*	¥47.8	¥39.7	¥43.5	¥47.8	¥68.5
SG&A Expense	¥220.1	¥240.0	¥219.2	¥226.6	¥262.1
Capital Expense	¥91.8	¥82.0	¥59.3	¥55.3	¥80.7
Pretax Income	¥78.3	¥70.9	¥42.8	¥43.2	¥68.6
Pretax Margin (%)	6.71	5.83	3.73	3.29	5.45
Effective Tax Rate (%)	49.60	49.70	53.40	NA	56.00
Net Income	¥54.6	¥49.0	¥28.2	¥22.4	¥29.1
Shares Outstanding, Millions	731.3	733.2	736.9	907.9	936.6
<b>Per Share Data</b>					
Earnings	¥54.56	¥49.01	¥28.19	¥22.40	¥31.07
Dividend	¥11.00	¥11.00	¥11.00	¥11.00	NA
Book Value	¥0.49	¥0.52	¥0.53	¥0.53	¥0.57

**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Billions of Yen, except Per Share Data)**

<b>Key Financial Ratios</b>	<b>1985</b>	<b>1986</b>	<b>1987</b>	<b>1988</b>	<b>1989</b>
<i>Liquidity</i>					
Current (Times)	1.12	1.13	1.11	1.14	1.14
Quick (Times)	0.78	0.81	0.84	0.89	0.94
Fixed Assets/Equity (%)	72.08	74.60	72.49	58.36	54.75
Current Liabilities/Equity (%)	170.06	186.25	223.62	205.19	209.55
Total Liabilities/Equity (%)	210.16	224.88	258.95	238.64	229.99
<i>Profitability (%)</i>					
Return on Assets	9.83	4.18	2.14	1.48	1.72
Return on Equity	30.49	13.29	7.33	5.16	5.75
Profit Margin	4.68	4.03	2.45	1.71	2.31
<i>Other Key Ratios</i>					
R&D Spending % of Revenue	4.09	3.27	3.79	3.64	5.44
Capital Spending % of Revenue	7.86	6.74	5.16	4.21	6.41
Employees	28,221	28,873	29,346	29,351	32,298
Revenue (¥K)/Employee	¥41.34	¥42.12	¥39.14	¥44.76	¥38.98
Capital Spending % of Assets	8.26	6.65	4.24	3.42	4.58
Exchange Rate (US\$1=¥)	¥243.52	¥221.26	¥150.76	¥138.03	¥128.25

\*Dataquest estimate  
 NA = Not available

Source: Sharp Corporation  
 Annual Reports  
 Dataquest (1990)

## Sony Corporation

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Shinagawa-ku

Tokyo 141, Japan

Telephone: (03) 448-2111

Fax: (03) 448-2244

Dun's Number: 04-065-3636

*Date Founded: 1946*

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### CORPORATE STRATEGIC DIRECTION

Sony Corporation, founded in Tokyo in 1946, is one of the world's leading manufacturers of video and audio equipment, televisions, and other products including semiconductors, computer peripherals, factory automation equipment, and engineering workstations.

Sony's business philosophy is to provide products and services that bring pleasure to its customers worldwide. Sony is one of Japan's leaders in global marketing with ¥2.9 trillion (US\$20.2 billion) in revenue for the fiscal year ended March 31, 1990. The main characteristics of the global business environment are uncertainty and volatility. Increasing trade friction with the United States, the long-term appreciation of the yen relative to the US dollar, and growing competition from Asia's newly industrializing countries (NICs) are all creating a more competitive operating environment.

Sony's strategy to improve product performance and meet customer expectations includes the following policies:

- Sony will seek to actively develop and introduce attractive consumer new products, strengthen its marketing and service structure, and keep a closer watch over product quality control.
- Sony intends to add further strength to such operations as video equipment and displays and, by incorporating cutting-edge technologies, to develop its business industrial products to meet a wider range of market needs. Sony also will continue to actively develop new technologies and expand the scope of operations through products that support a vast spectrum of business areas such as semiconductors, electronic devices, and equipment related

to computers, information processing, and telecommunication.

- By adding image-based software primarily from Columbia Pictures Entertainment (CPE) to its music software business, which has been led chiefly by the CBS Records Group, Sony will strive to further expand and develop its software business while gaining synergy with its hardware business.
- While promoting local procurement of components and production, Sony will upgrade all facets of its operations from R&D to marketing to bring its overseas operations in even closer contact with local communities.
- Sony will continue to improve its profitability and financial soundness by reducing costs and streamlining operations in all fields—from design and manufacturing through sales and distribution—and by conducting stricter inventory control and carefully appropriated capital expenditure.

Sony's ¥2.9 trillion (US\$20.2 billion) total revenue for the year ended March 31, 1990, represents an increase of 34.2 percent over the year ended March 31, 1989. (Percentage changes refer only to ¥ amounts; US\$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) The increase in revenue was led by a 30.6 percent increase in television sales and a 29.7 percent increase in video equipment sales. Audio equipment sales advanced 28.8 percent because of exceptionally strong sales of CD players in the international market, while other products sales increased 27.6 percent, showing strong growth of information-related equipment outside of Japan.

Sony is an international company with 34.0 percent of its sales occurring in Japan, 27.0 percent in the United States, 24.8 percent in Europe, and 15.2 percent in other areas. The United States posted the

highest growth rate, increasing sales 46.3 percent, while Europe grew 43.7 percent and other international markets grew 32.5 percent. The Japanese market grew at a significantly lower rate of 18.9 percent.

Net income increased 41.8 percent to ¥103 billion (US\$0.7 billion) from ¥73 billion (US\$0.6 billion) for the year ended March 31, 1989. Sony employed approximately 95,600 people in 1990.

R&D expenditure increased 14.0 percent to ¥165 billion (US\$1.2 billion) for the year ended March 1990, from ¥142 billion (US\$1.1 billion) in the year ended March 31, 1989. R&D represents 5.7 percent of revenue for the year ended March 1990. Capital expenditure for the year ended March 31, 1990, increased 50.2 percent from the previous year's ¥215.6 billion (US\$1.7 billion) to ¥323.8 billion (US\$2.3 billion), representing 11.3 percent of total revenue. The increased expenditure primarily was used for expanding production facilities to meet rising demand for semiconductors; image-based devices, such as color picture tubes; magnetic products; and audio and video equipment. Sony intends to maintain a high level of capital investment and expects next year's expenditure to exceed this year's figure.

Sony's policy is to manufacture in the markets where its products are sold. By doing this, Sony brings its products closer to customers and avoids trade problems and exchange rate variations. Sony maintains its principal manufacturing facilities in Japan, the United States, and Europe.

Sony's products are marketed by sales subsidiaries throughout the world. There are 19 sales subsidiaries in Japan and 14 overseas.

In November 1989, Sony purchased Columbia Pictures Entertainment adding image-based software to its software business. This purchase emphasized strengthening the software operations primarily through the record and video business.

On January 5, 1988, Sony purchased CBS Records Inc. and now holds 100 percent of the shares. The US\$2 billion (¥256.5 billion) acquisition was based on Sony's belief in the important relationship between the software and hardware sides of the consumer electronics business.

More detailed information is available in Tables 1 and 2, which appear after "Business Segment Strategic

Direction" and present corporate highlights and revenue by region. Information on revenue by distribution channel is not available. Tables 3 and 4, comprehensive financial statements, are at the end of this background.

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## BUSINESS SEGMENT STRATEGIC DIRECTION

### Video Equipment

The video equipment product group revenue totaled ¥743 billion (US\$5.2 billion) for the year ended March 31, 1990, or 25.8 percent of sales. Products include VTRs (a videocassette recorder and player), video cameras, Betacam systems, videotapes, optical videodisc players, and high-definition video systems.

### Audio Equipment

The audio equipment product group revenue totaled ¥722.8 billion (US\$5.1 billion) for the year ended March 31, 1990, or 25.1 percent of total sales. Products include tape recorders, audiotapes, cassette players, car stereos, amplifiers, turners, turntables, speaker systems, CD players, digital audiotape (DAT) recorders, headphones, microphones, and compact discs.

### Records

Sony's record business reported revenue of ¥455 billion (US\$3.2 billion), or 15.8 percent of total revenue.

### TV Equipment

Sony's television product group reported revenue of ¥446.4 billion (US\$3.1 billion) for the year ended March 31, 1990, or 15.5 percent of total revenue. Key products include color TVs and monitors, projection TVs, JumboTRON, direct broadcasting satellite reception systems, and security systems.

### Movies

Sony's movies reported revenue of ¥92.3 billion (US\$646 million) or 3.2 percent of sales for the year ended March 31, 1990.

## Other Products

The groups producing other products reported revenue of ¥420.5 billion (US\$2.9 billion). Key products include the 3.5-inch microfloppy disk systems, microcomputers, workstations, CD-ROM systems, information processing systems, semiconductor devices, electronic components, dictating machines, word processors, induction cooking ranges, telephones, telecommunications systems, factory automation systems, batteries, accessories, and audio and video software.

## Computer Storage

Sony was one of the leading flexible disk drive vendors in 1989. Dataquest estimates that Sony had ¥31 billion (US\$242 million) in factory revenue, with 26 percent market share in 1989 in the 3.5-inch flexible disk drive market. Dataquest estimates that Sony shipped 4.3 million 3.5-inch disk drives in 1989. In the worldwide flexible disk drive (3.5-inch and 5.25-inch) market, Dataquest ranks Sony third, with 14 percent of the market.

Dataquest ranks Sony first in the optical disk drive market with ¥9.4 billion (US\$73 million) in factory revenue and 33 percent market share. Sony dominates the rewritable market in optical disk drives with 76 percent of the market, 25,000 units shipped, and ¥2.1 billion (US\$45.5 million) in factory revenue.

Sony ranks third in the 12-inch write-once, read-many (WORM) drives with 16 percent of the market, 2,000 units shipped, and ¥2.1 billion (US\$16.3 million) in factory revenue.

Sony has entered the 3.5-inch rigid disk drive market. Dataquest expects Sony to offer a broad range of rigid drives with capacities between 40 and 200 Mbytes and access times considerably less than 20 milliseconds.

## Workstations

Sony Microsystems was formed in February 1988 to market Sony's NEWS workstation, a 32-bit UNIX workstation designed primarily for software development applications. Dataquest estimates that Sony had 6.6 percent of the worldwide workstation market share for calendar 1989. Dataquest estimates that Sony ranked fourth in the workstation market with ¥4 billion (US\$31 million) in factory revenue for 1989.

In May 1990, Sony introduced its Laptop NEWS workstation to the European market and later to the Japanese market. Sony had two major design goals for its new workstation:

- The same level of performance and functionality as the NEWS desktop workstation
- Compatibility with NEWS software and hardware products

The laptop workstation is priced between \$10,000 and \$15,000 and is targeted toward the technical user with a requirement for a transportable, fully functional technical workstation.

In 1989, Sony announced that it would develop a RISC-based workstation using MIPS R3000 processors. Sony intends to expand its NEWS line to include lower-priced models, workstations equipped with CD-ROM systems, and high-performance 32-bit CPU versions. Sony also plans to add desktop publishing applications software to the NEWS line of workstations.

## Personal Computers

Dataquest estimates that Sony manufactured 65,000 personal computer units in 1989, with an if-sold value of ¥26.8 billion (US\$209 million) and less than 1 percent worldwide market share. In calendar 1989, Sony's largest-selling machine was the HB-F1 XD J, which sold 60,000 units worldwide. However, Sony does not market its computers in the United States.

## Semiconductors

Sony began marketing semiconductors in 1984. The Company's calendar year 1989 worldwide market share was estimated to be 1.9 percent, with ¥156.7 billion (US\$1.1 billion) in revenue. Dataquest estimates that Sony ranks 19th in the total worldwide semiconductor market, while in Japan, Sony ranked 9th for the second year in row. Japan represented 81 percent of Sony's semiconductor revenue for 1989.

According to Dataquest, Sony ranked 13th in the MOS digital Japanese market, with 2.2 percent share and ¥38.5 billion (US\$270 million) in revenue. In the Japanese analog market, Sony ranked 7th, with 7.2 percent of the market and ¥38 billion (US\$267 million) in revenue for calendar 1989. In the total Japanese optoelectronics market, Dataquest ranked Sony 3rd, with 14.4 percent of the market and ¥35.5 billion (US\$249 million) in 1989. Lastly, in the

Japanese total discrete market, Sony ranked 10th, with 2.6 percent market share and ¥12.3 billion (US\$86 million) in revenue for 1989.

#### Computer Software

Sony Computer Science Laboratory Inc. was established by Sony Corporation to develop distributed operating systems, programming languages, system architectures, and user interfaces. Sony's goal is to penetrate the US software market.

#### Further Information

For further information about the Company's business segments, please contact the appropriate Dataquest industry services.

**Table 1**  
**Five-Year Corporate Highlights (Billions of US Dollars)**

	1986	1987	1988	1989	1990
Five-Year Revenue	\$7.6	\$3.4	\$10.4	\$16.7	\$20.2
Percent Change	-	(54.14)	205.19	41.94	20.84
Capital Expenditure	\$0.5	\$0.6	\$1.0	\$1.7	\$2.3
Percent of Revenue	7.10	10.62	9.33	10.05	11.25
R&D Expenditure	\$0.7	\$0.8	\$0.9	\$1.1	\$1.2
Percent of Revenue	9.16	9.27	8.91	6.62	5.74
Number of Employees	48,700	47,583	71,000	78,900	95,600
Revenue (US\$K)/Employee	\$0.16	\$0.07	\$0.15	\$0.21	\$0.21
Net Income	\$0.2	\$0.1	\$0.3	\$0.6	\$0.7
Percent Change	(24.91)	(64.89)	223.68	86.80	27.64
Exchange Rate (US\$1=¥)	¥175.09	¥159.56	¥138.03	¥128.25	¥142.47
1990 Calendar Year	Q1	Q2	Q3	Q4	
Quarterly Revenue	NA	NA	NA	NA	
Quarterly Profit	NA	NA	NA	NA	

NA = Not available

Source: Sony Corporation  
Annual Reports  
Dataquest (1990)

**Table 2**  
**Revenue by Geographic Region (Percent)**

Region	1986	1987	1988	1989	1990
North America	32.00	30.00	30.00	27.00	27.00
International	68.00	70.00	70.00	73.00	73.00
Japan	30.00	32.00	34.00	34.00	34.00
Europe	21.00	24.00	22.00	24.00	24.00
All Others	17.00	14.00	14.00	15.00	15.00

Source: Sony Corporation  
Annual Reports  
Dataquest (1990)

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## 1990 SALES OFFICE LOCATIONS (INCLUDES SALES SUBSIDIARIES ONLY)

Asia/Pacific—19  
International—14

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## MANUFACTURING LOCATIONS

### *North America*

CBS Records (United States)  
Phonograph records, tapes, CDs  
Digital Audio Disc (United States)  
CDs  
Sony Corporation of America (United States)  
TVs, CRTs, 32-bit workstations, 3.5-inch FDDs  
Sony Magnetic Products, Inc. (United States)  
Magnetic tapes, FD  
Sony Technology Center (United States)  
Video equipment  
Sony USA (United States)  
Electronic equipment

### *Europe*

DADC Austria (Austria)  
CDs  
Sony (United Kingdom)  
TVs, CRTs  
Sony Espana (Spain)  
TVs, VCRs  
Sony France (France)  
CD players, video cameras, VHS video deck  
Sony-Wega Productions (United Kingdom)  
TVs  
Television Division Europe (France)  
Development, design of TVs

### *Asia/Pacific*

Aiwa Co. (Japan)  
High-fidelity audio systems, headphone stereos  
Hagiwara Electronics (Japan)  
TV/video equipment  
Mac Precision Products (Japan)  
Precision parts

Miyagi Video-Tech (Japan)  
Magnetic tapes  
Motomiya Denshi (Japan)  
Trinitron gun, security systems, flat display tubes,  
TV parts  
Nakada Magnetics (Japan)  
Ferrites  
Sony Akebono Denshi (Japan)  
Printed circuit boards  
Sony Audio (Japan)  
Audio, video, camera, and optical systems  
Sony Bonson (Japan)  
Tape recorders, flat TVs, radios  
Sony Chemicals (Japan)  
Magnetic tapes, chemical products  
Sony Computer Science Lab (Japan)  
R&D of computer systems/software  
Sony Denshi (Japan)  
TVs and parts  
Sony Electronics (Japan)  
Radiocassette tape recorders  
Sony Ichinomiya (Japan)  
VCRs, color TVs  
Sony Inazawa (Japan)  
Color CRTs  
Sony Itakura (Japan)  
CD players, radiocassette recorders  
Sony Kisarazu (Japan)  
VCRs, CD players  
Sony Kohda (Japan)  
Video equipment  
Sony Kokubu Semiconductor (Japan)  
Bipolar ICs, CCDs  
Sony Magnescale (Japan)  
Electronic measuring instruments  
Sony Magnetic Products (Japan)  
Magnetic tapes, ferrites, videotapes  
Sony Minokama (Japan)  
Video equipment  
Sony Mizunami (Japan)  
Color CRTs  
Sony Nagasaki (Japan)  
Semiconductors  
Sony Oita (Japan)  
Semiconductors  
Sony Precision Engineering (Japan)  
Precision parts for audio equipment for Sony's  
subsidiaries worldwide  
Sony Semiconductor (Japan)  
Bipolar ICs  
Sony Shiroishi Semiconductor (Japan)  
Semiconductors  
Sony Sound Tec (Japan)  
Microphones, PA systems, furniture, hearing aids



Sony TV-Video (Japan)  
 Color TVs  
 Sony Tektronix (Japan)  
 Electronic measurements, displays, control  
 instruments, computer graphics products  
 Sony Video Taiwan (Taiwan)  
 VCRs  
 Sound Magnetics (Japan)  
 Magnetic heads  
 Sound System (Japan)  
 VCRs, CD players  
 Taron Corp. (Japan)  
 Audio and video products  
 Tohkai Electronics (Japan)  
 PC boards  
 Toyo Radio (Japan)  
 Audio products  
 Video Magnetics (Japan)  
 Ferrites

#### ROW

Magneticos de Mexico (Mexico)  
 Magnetic tapes, floppy disks  
 Sony da Amazonia (Brazil)  
 VCRs  
 Sony de Venezuela (Venezuela)  
 Color TVs  
 Sony Videobras (Brazil)  
 Video cameras, video equipment  
 Videotec de Mexico (Mexico)  
 Video equipment

## SUBSIDIARIES

As of March 31, 1990, the Company had 576 consolidated subsidiaries. The list below gives the Company's principal subsidiaries and affiliated companies as of July 31, 1990.

#### North America

CBS Records Inc. (United States)  
 Columbia Pictures Entertainment (United States)  
 Digital Audio Disc Corporation (United States)  
 Gurber-Peters Entertainment Company (United States)  
 Materials Research Corporation (United States)  
 Sony Corporation of America (United States)  
 Sony of Canada Ltd. (Canada)  
 Sony USA Inc. (United States)  
 Trans Com Systems Division (United States)

#### Europe

DADC Austria GesmbH (Austria)  
 Sony Belgium N.V. (Belgium)  
 Sony Broadcast Limited (United Kingdom)  
 Sony Communication Products B.V. (Netherlands)  
 Sony Deutschland GmbH (Germany)  
 Sony Distribution Centre (Europe) B.V. (Netherlands)  
 Sony Espana S.A. (Spain)  
 Sony Europa GmbH (Germany)  
 Sony France S.A. (France)  
 Sony GesmbH (Austria)  
 Sony Italia S.p.A. (Italy)  
 Sony Nederland B.V. (Netherlands)  
 Sony Overseas Finance B.V. (Netherlands)  
 Sony Overseas S.A. (Switzerland)  
 Sony Portugal Lda. (Portugal)  
 Sony Scandinavia A/S (Denmark)  
 Sony (Schweiz) A.G. (Switzerland)  
 Sony Service Centre (Europe) N.V.  
 Sony (U.K.) Limited (United Kingdom)  
 Sony-Wega Productions GmbH (Germany)

#### Asia/Pacific

Aiwa Co., Ltd. (Japan)  
 Akebono Electronics Inc. (Japan)  
 CBS/Sony Group Inc. (Japan)  
 Hasso Electronics Corporation (Japan)  
 Korea Toyo Radio Co., Ltd. (South Korea)  
 Max Precision Products Corporation (Japan)  
 Motomiya Denshi Corporation (Japan)  
 Sony (Australia) Pty. Limited (Australia)  
 Sony Asco Inc. (Japan)  
 Sony Bonson Corporation (Japan)  
 Sony Broadcast Products Corporation (Japan)  
 Sony Chemicals Corporation (Japan)  
 Sony Corporation of Hong Kong Limited (Hong Kong)  
 Sony Creative Products Inc. (Japan)  
 Sony Denshi Corporation (Japan)  
 Sony Electronics (Malaysia) Sdn. Bhd. (Malaysia)  
 Sony Energytec Inc. (Japan)  
 Sony Engineering Corporation (Japan)  
 Sony Enterprise Co., Ltd. (Japan)  
 Sony Finance International, Inc. (Japan)  
 Sony Ichinomiya Corporation (Japan)  
 Sony Inazawa Corporation (Japan)  
 Sony International (Singapore) Pte. Ltd. (Singapore)  
 Sony Kisarazu Corporation (Japan)  
 Sony Kohda Corporation (Japan)  
 Sony Minokamo Corporation (Japan)  
 Sony Kokubu Semiconductor Corporation (Japan)  
 Sony Logistics (Singapore) Pte. Ltd. (Singapore)  
 Sony Logistics Corporation (Japan)

Sony Magnescale Inc. (Japan)  
Sony Magnetic Products, Inc. (Japan)  
Sony Magnetic Products (Thailand)  
Sony Magnetic Tape Sales Corporation (Japan)  
Sony Mizunami Corporation (Japan)  
Sony Nagasaki Corporation (Japan)  
Sony Oita Corporation (Japan)  
Sony PCL Inc. (Japan)  
Sony Plaza Co., Ltd. (Japan)  
Sony Precision Engineering Center (Singapore) Pte. Ltd. (Singapore)  
Sony Procurement Service Corporation (Japan)  
Sony Pruco Life Insurance Co., Ltd. (Japan)  
Sony Service Co., Ltd. (Japan)  
Sony Shiroishi Semiconductor Inc. (Japan)  
Sony Shoji Corporation (Japan)  
Sony Singapore Pte. Ltd. (Singapore)  
Sony Sound Tec Corporation (Japan)  
Sony TV Video (Malaysia) Sdn. Bhd. (Malaysia)  
Sony Trading Corporation (Japan)  
Sony Tsukuba Corporation (Japan)  
Sony Video Taiwan Co., Ltd. (Taiwan)  
Sony/Tektronix Corporation (Japan)  
Sound System Corporation (Japan)  
Taron Corporation (Japan)  
Tohkai Electronics Corporation (Japan)

#### ROW

Magnetico de Mexico, S.A. de C.V. (Mexico)  
Sony CSA, S.A. (Panama)  
Sony Chile Ltda. (Chile)  
Sony Corporation of Panama S.A. (Panama)  
Sony da Amazonia Ltda. (Brazil)  
Sony de Venezuela S.A. (Venezuela)  
Sony Saudi Arabian Company Ltd. (Saudi Arabia)

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## ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

#### 1990

##### Exabyte Corporation

Exabyte renewed a supply agreement with Sony under which Sony will supply Exabyte with 5.25-inch form factor tape drives.

##### Compression Labs Inc.

Sony entered into a reseller agreement with Compression Labs under which Sony will resell Compression Labs video coder/decoders. The agreement marks Sony's entry into the US videoconferencing market.

##### Texas Instruments

Texas Instruments will produce semiconductors in Europe for Sony on a consignment basis.

##### NJK Ltd.

NJK Ltd. signed as a distributor for Sony's NEWS workstations.

##### Fujitsu

Sony and Fujitsu jointly developed a trial common rule to develop CD-ROM XA software for their personal computers.

##### Oracle Corporation

Oracle Inc. will supply the Oracle relational database management systems and applications development software products to the Sony NEWS family of UNIX workstations.

##### Novell K.K.

Novell K.K. was formed as a joint marketing venture to sell NetWare products in Japan. Novell and six partners—Canon, Fujitsu, NEC, Softbank, Sony, and Toshiba—helped fund the project.

##### Advanced Micro Devices (AMD)

AMD will enter a joint manufacturing and educational pact with Sony to manufacture SRAMs.

##### Summus Computer Systems

Summus will sell, distribute, and service 4mm DAT drives from Sony. Summus will be an original equipment manufacturer (OEM) of Sony and will integrate hardware and software that offers turnkey storage subsystems for the Apple Computer Macintosh, Digital, and Sun Microsystems PC markets.

#### 1989

##### Parallex Graphics Inc.

Sony Microsystems agreed to incorporate Parallex's color graphics and video graphics controllers in Sony's workstations.

##### Matsushita Philips

Sony, Matsushita, and Philips agreed to develop, manufacture, and market interactive compact disk drives.

##### Apple Computer

Sony signed a contract with Apple to supply 40-Mbyte rigid disk drives for the Macintosh.

##### Hewlett-Packard

Sony will supply 5.25-inch rewritable optical disk storage products to Hewlett-Packard for the new HP C17QA Optical Disk Library System.

**Pinnacle Micro**

Sony announced plans to supply \$1 million (¥128.3 million) worth of 5.25-inch rewritable optical disk storage products to Pinnacle Micro.

**Advanced Micro Devices (AMD)**

Sony and AMD entered a joint venture agreement for an SRAM memory product.

1988

**Daewoo Electronics**

Sony and Daewoo agreed to jointly develop 256K SRAMs, 64K SRAMs, 8- and 16-bit MPUs, and other microchips.

**Engineering Mechanics Research (EMR)**

Sony and EMR agreed to a joint venture in CAE software technology and sales. EMR is marketing Sony's engineering workstations (EWSs) that employ its software in the United States while Sony supports sales agents of EMR's software in Japan by supplying its EWS.

**N.V. Philips Gloeilampenfabrieken**

Sony and Philips agreed to a joint development of extended architecture CD-ROMs for audio use.

**Motorola Inc.**

Sony Microsystems is incorporating dual Motorola 68030 MPUs in high-end models of Sony's NEWS UNIX workstation family.

**Symbolics**

Sony and Symbolics completed a sales agreement for Sony's workstations in the US market. Sony Microsystems began supplying its workstations to Symbolics in May 1988 for sale in the United States under the Symbolics brand name. The two companies will jointly develop a new model of workstation using Symbolics' A1 chips.

**Texas Instruments (TI)**

TI Japan and Sony jointly developed the CXD1144AP high-performance digital filter LSI for digital audio equipment.

**Advanced Micro Devices (AMD)**

Sony and AMD agreed to a sales tie-up for Sony's workstations in South Korea.

Com Systems, a division of Sundstrand Corporation. Trans Com is engaged in designing, manufacturing, and installing in-flight AV entertainment systems in commercial aircraft worldwide.

**Materials Research Corporation (MRC)**

Sony acquired all of the outstanding shares of common stock of MRC and its affiliates. MRC is a manufacturer and supplier of sputtering and etching equipment, high-purity metals, and ceramics.

**Columbia Pictures Entertainment**

Sony acquired all of the outstanding shares of common stock of Columbia Pictures, which is primarily in the filmmaking business.

**Guber-Peters Entertainment Company (GPEC)**

Sony acquired GPEC, which is in the filmmaking business.

1988

**CBS Records Inc.**

Sony purchased CBS Records for US\$2 billion (¥256.5 billion) and holds 100 percent of the shares. (The acquisition was made using US currency.)

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**KEY OFFICERS**
**Akio Morita**

Chairman and chief executive officer

**Norio Ohga**

President and chief operating officer

**Masaaki Morita**

Deputy president

**Masahiko Morizono**

Deputy president

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**PRINCIPAL INVESTORS**

Information is not available

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**MERGERS AND ACQUISITIONS**

1989

**Trans Com Systems Division**

Sony purchased all assets and liabilities of Trans

**FOUNDERS**

Information is not available.

**Table 3**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Billions of US Dollars, except Per Share Data)**

<b>Balance Sheet</b>	<b>1986</b>	<b>1987*</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Total Current Assets	\$5.6	\$5.8	\$7.8	\$11.2	\$15.5
Cash	0.8	1.0	1.6	2.3	3.2
Receivables	1.7	1.6	2.4	3.4	5.8
Marketable Securities	0.7	0.8	0.7	0.7	0.4
Inventory	1.8	1.9	2.4	3.8	4.9
Other Current Assets	0.5	0.5	0.7	1.0	1.2
Net Property, Plants	\$1.9	\$2.2	\$3.1	\$4.2	\$6.1
Other Assets	\$0.8	\$0.9	\$2.6	\$3.0	\$9.1
<b>Total Assets</b>	<b>\$8.3</b>	<b>\$8.8</b>	<b>\$13.5</b>	<b>\$18.4</b>	<b>\$30.7</b>
Total Current Liabilities	\$3.6	\$3.7	\$6.8	\$8.7	\$14.0
Long-Term Debt	\$0.8	\$0.9	\$1.4	\$1.7	\$4.5
Other Liabilities	\$0.4	\$0.5	\$0.6	\$0.8	\$2.0
<b>Total Liabilities</b>	<b>\$4.8</b>	<b>\$5.0</b>	<b>\$8.8</b>	<b>\$11.2</b>	<b>\$20.5</b>
Total Shareholders' Equity	\$3.5	\$3.8	\$4.7	\$7.2	\$10.2
Common Stock	0.1	0.1	0.2	0.9	2.0
Other Equity	0.4	0.4	0.4	1.5	3.3
Retained Earnings	3.0	3.4	4.1	4.8	4.9
<b>Total Liabilities and Shareholders' Equity</b>	<b>\$8.3</b>	<b>\$8.8</b>	<b>\$13.5</b>	<b>\$18.4</b>	<b>\$30.7</b>
<b>Income Statement</b>	<b>1986</b>	<b>1987*</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Revenue	\$7.6	\$3.4	\$10.4	\$16.7	\$20.2
Japanese Revenue	2.2	1.1	3.5	5.7	6.1
Non-Japanese Revenue	5.3	2.3	6.9	11.0	14.1
Cost of Sales	\$5.8	\$2.6	\$7.7	\$11.5	\$13.6
R&D Expense	\$0.7	\$0.8	\$0.9	\$1.1	\$1.2
SG&A Expense	\$1.7	\$0.8	\$2.4	\$4.4	\$5.0
Capital Expense	\$0.5	\$0.6	\$1.0	\$1.7	\$2.3
Pretax Income	\$0.4	\$0.1	\$0.5	\$1.3	\$1.6
Pretax Margin (%)	5.77	4.36	5.13	7.72	7.90
Effective Tax Rate (%)	58.00	58.00	56.00	56.00	54.00
Net Income	\$0.2	\$0.1	\$0.3	\$0.6	\$0.7
Shares Outstanding, Thousands	230,887	231,236	238,768	282,602	331,928
<b>Per Share Data</b>					
Earnings	\$0.97	\$0.34	\$1.04	\$1.88	\$2.15
Dividend	\$0.25	\$0.12	\$0.32	\$0.35	\$0.35
Book Value	0	0	0	0	0
<b>Exchange Rate (US\$1=¥)</b>	<b>¥175.09</b>	<b>¥159.56</b>	<b>¥138.03</b>	<b>¥128.25</b>	<b>¥142.47</b>

\*For the five-month period ending March 31, 1987. Effective March 31, 1987, the parent company and almost all subsidiaries and affiliates changed their fiscal year-end from October 31 to March 31. Accordingly, the fiscal period ended March 31, 1987, included only 5 months of operations, whereas other fiscal years consisted of 12 months.

Source: Sony Corporation  
 Annual Reports  
 Dataquest (1990)

**Table 4**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Millions of Yen, except Per Share Data)**

<b>Balance Sheet</b>	<b>1986</b>	<b>1987*</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Total Current Assets	¥973.6	¥922.2	¥1,076.9	¥1,433.8	¥2,201.6
Cash	145.5	152.9	218.0	297.9	451.7
Receivables	294.4	256.6	325.7	433.4	832.9
Marketable Securities	129.7	132.2	99.4	91.1	54.8
Inventory	313.3	302.9	334.7	483.7	693.0
Other Current Assets	90.7	77.6	99.1	127.7	169.2
Net Property, Plants	¥332.6	¥343.1	¥426.3	¥544.7	¥868.1
Other Assets	¥143.8	¥145.9	¥363.7	¥386.2	¥1,300.4
Total Assets	¥1,450.0	¥1,411.2	¥1,866.9	¥2,364.7	¥4,370.1
Total Current Liabilities	¥628.3	¥587.0	¥945.0	¥1,119.0	¥1,995.9
Long-Term Debt	¥143.9	¥143.4	¥196.0	¥220.8	¥646.0
Other Liabilities	¥71.6	¥72.1	¥76.3	¥98.2	¥281.3
Total Liabilities	¥843.8	¥802.5	¥1,217.3	¥1,438.0	¥2,923.2
Total Shareholders' Equity	¥606.2	¥608.7	¥649.6	¥926.7	¥1,446.9
Common Stock	12.0	12.0	23.7	114.6	278.0
Other Equity	62.9	56.5	60.9	195.6	473.4
Retained Earnings	531.3	540.2	565.0	616.5	695.5
Total Liabilities and Shareholders' Equity	¥1,450.0	¥1,411.2	¥1,866.9	¥2,364.7	¥4,370.1
<b>Income Statement</b>	<b>1986</b>	<b>1987*</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Revenue	¥1,325.1	¥547.8	¥1,431.2	¥2,145.3	¥2,879.9
Japanese Revenue	391.3	177.5	479.4	731.3	869.5
Non-Japanese Revenue	933.8	370.3	951.8	1,414.0	2,010.4
Cost of Sales	¥1,009.8	¥407.8	¥1,064.6	¥1,475.4	¥1,938.0
R&D Expense	¥121.4	¥131.2	¥127.5	¥142.1	¥165.2
SG&A Expense	¥302.5	¥131.0	¥336.3	¥565.6	¥712.0
Capital Expense	¥94.1	¥101.6	¥133.5	¥215.6	¥324.0
Pretax Income	¥76.4	¥23.6	¥73.5	¥165.5	¥227.4
Pretax Margin (%)	5.77	4.36	5.14	7.71	7.90
Effective Tax Rate (%)	58.00	58.00	56.00	56.00	54.00
Net Income	¥41.9	¥13.3	¥36.7	¥72.5	¥102.8
Shares Outstanding, Millions	230,887	231,236	238,768	282,602	331,928
<b>Per Share Data</b>					
Earnings	¥169.00	¥54.20	¥143.80	¥240.80	¥306.80
Dividend	¥44.00	¥18.50	¥44.60	¥44.60	¥50.00
Book Value	0	0	0	0	0

**Table 4 (Continued)**  
**Comprehensive Financial Statement**  
**Fiscal Year Ending March 31**  
**(Millions of Yen, except Per Share Data)**

Key Financial Ratios	1986	1987*	1988	1989	1990
<i>Liquidity</i>					
Current (Times)	1.55	1.57	1.14	1.28	1.10
Quick (Times)	1.05	1.06	0.79	0.85	0.76
Fixed Assets/Equity (%)	54.87	56.37	65.63	58.78	60.00
Current Liabilities/Equity (%)	103.65	96.44	145.47	120.75	137.94
Total Liabilities/Equity (%)	139.20	131.84	187.39	155.17	202.03
<i>Profitability (%)</i>					
Return on Assets	-	0.93	2.24	3.43	3.05
Return on Equity	-	2.19	5.83	9.20	8.66
Profit Margin	3.16	2.43	2.56	3.38	3.57
<i>Other Key Ratios</i>					
R&D Spending % of Revenue	9.16	23.95	8.91	6.62	5.74
Capital Spending % of Revenue	7.10	18.55	9.33	10.05	11.25
Employees	48,700	47,583	71,000	78,900	95,600
Revenue (¥K)/Employee	¥27.21	¥11.51	¥20.16	¥27.19	¥30.12
Capital Spending % of Assets	6.49	7.20	7.15	9.12	7.41
Exchange Rate (US\$1=¥)	¥175.09	¥159.56	¥138.03	¥128.25	¥142.47

\*For the five-month period ending March 31, 1987. Effective March 31, 1987, the parent company and almost all subsidiaries and affiliates changed their fiscal year-end from October 31 to March 31. Accordingly, the fiscal period ended March 31, 1987, included only 5 months of operations, whereas other fiscal years consisted of 12 months.

Source: Sony Corporation  
Annual Reports  
Dataquest (1990)

Opened Date/Time: 24-Jul-2007 15:22 GST (Gartner Stamford Time) Due Date/Time: 31-Jul-2007 15:00 GST Next Action Date/Time: N/A Response Date/Time: N/A

Fulfillment "Talk": 0 mins  
Other Fulfillment: 0 mins  
Coordination/Support: 0 mins

Special Instructions: N/A

===== Client Question/Request ===== Does Gartner have OEM market shares in the Portable Media Player (PMP or MP3 player) market by quarter for Q1'07 and for full year 2006 for HDD and Flash players?

Thanks

Prianka

===== Gartner Advice ===== N/A

===== Estimated Potential Value to Client ===== N/A

Value Category: N/A Amount US\$: 0

===== Handling Notes =====

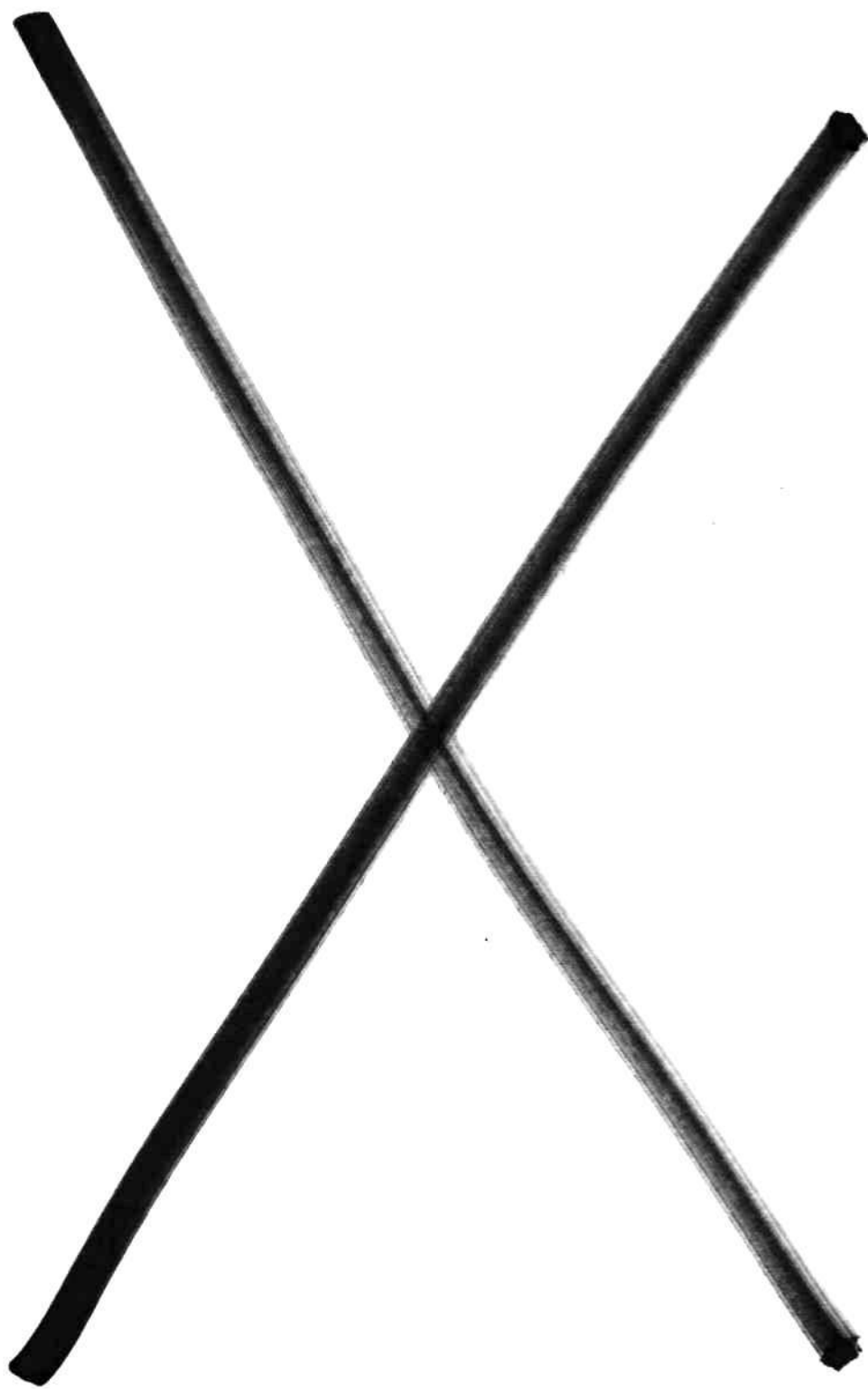
\* 24-Jul-07 15:25 GST Olga Doctorova ChgData:

Added Client Question/Request: Does Gartner have OEM market shares in the Portable Media Player (PMP or MP3 player) market by quarter for Q1'07 and for full year 2006 for HDD and Flash players?

Thanks

Prianka

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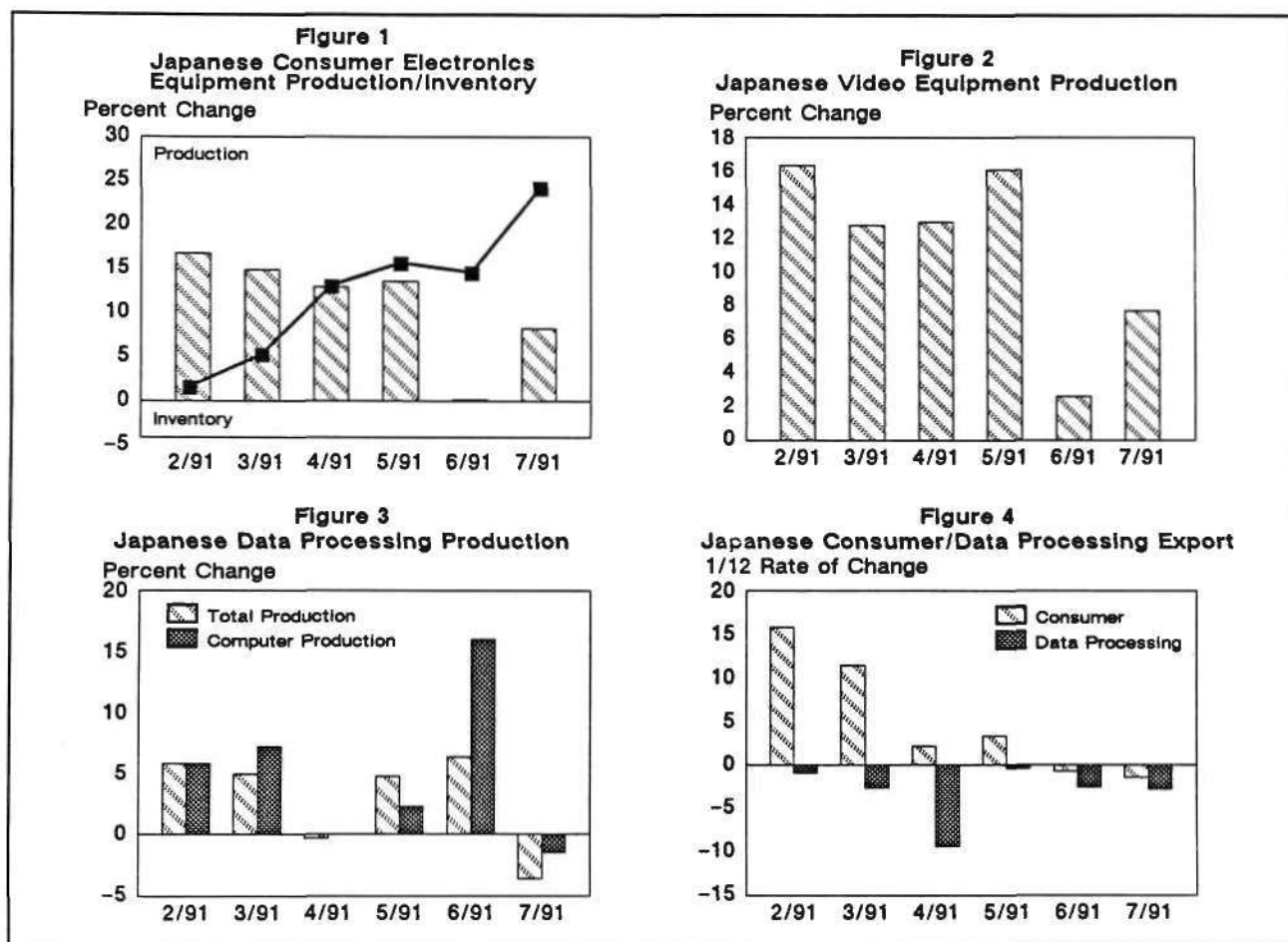


# Research *Bulletin*

## JSAMONITOR—SEPTEMBER 1991

This research bulletin is a monthly update that monitors changes in key Japanese electronic equipment markets. This publication presents important tactical leading indicators in semiconductor business activity. The sources for the graphs are

the Japanese Ministry of International Trade and Industry (MITI) and the Ministry of Finance (MOF) (see Figures 1 through 4). The data points for June 1991 have been restated in this issue.



Source: MITI, MOF, Dataquest (September 1991)

## THE EQUIPMENT MARKET

### Consumer Equipment Production and Inventories

Japanese consumer electronic equipment production increased 8.2 percent in July 1991 over July 1990, compared with June 1991's revised 0.2 percent growth. On the other hand, Japanese consumer electronic equipment inventories increased 24.4 percent in July 1991 over July 1990 (see Figure 1). On a product basis, video equipment production growth was 7.7 percent in July over July 1990, compared with June 1991's revised 1.2 percent growth (see Figure 2). Almost all video equipment posted negative growth in July 1991 over July 1990; VCR production and videodisk production dropped 2.7 percent and 3.8 percent, respectively, while color TV production slipped 1.5 percent. Video camera production increased 38.6 percent in July 1991 over the same period last year and contributed to positive growth of total video production. Video camera inventories in July 1991 rose 36.9 percent over the same period last year.

### Data Processing Equipment Production

Japanese data processing equipment production decreased 3.6 percent in July 1991, compared with a revised 6.9 percent growth in June 1991 (see Figure 3). On a segment basis, total computer production slipped 1.5 percent from the July 1990 level, the first negative growth in three months; although PC production was up 2.8 percent during July 1991 over July 1990, general-purpose computer production decreased 4.6 percent during the same period. Data storage equipment posted negative 3.9 percent growth in July 1991 over July 1990, compared with June 1991's 8.9 percent

increase. Monthly production of input/output equipment in July 1991 picked up 0.1 percent from July 1990.

## EXPORTS

### Consumer

Consumer electronic equipment exports slipped 1.4 percent in July 1991 from the July 1990 level. On a regional basis, the United States had negative 7.2 percent growth in consumer electronic equipment exports during July 1991. Consumer electronic equipment exports to Europe moved ahead 12.5 percent during July 1991 over July 1990, while consumer electronic equipment exports to Asia decreased 0.8 percent. On a product basis, video equipment exports posted negative 6.1 percent growth in July 1991 over July 1990, whereas audio equipment exports rose 7.5 percent during the same period.

### Data Processing

Data processing equipment exports during July 1991 dropped 2.8 percent compared with the July 1990 level. On a regional basis, data processing exports to the United States have had negative growth rates for 11 consecutive months, with an 8.8 percent decline in July 1991. Exports to Europe and Asia grew 0.7 percent and 15.7 percent, respectively. Total computer equipment exports showed negative growth of 2.0 percent during July 1991. Computer equipment exports to the United States fell 3.4 percent in July 1991 from the same period in the previous year, and computer equipment exports to Europe and Asia posted growth of negative 2.4 percent and positive 4.0 percent, respectively, in July 1991.

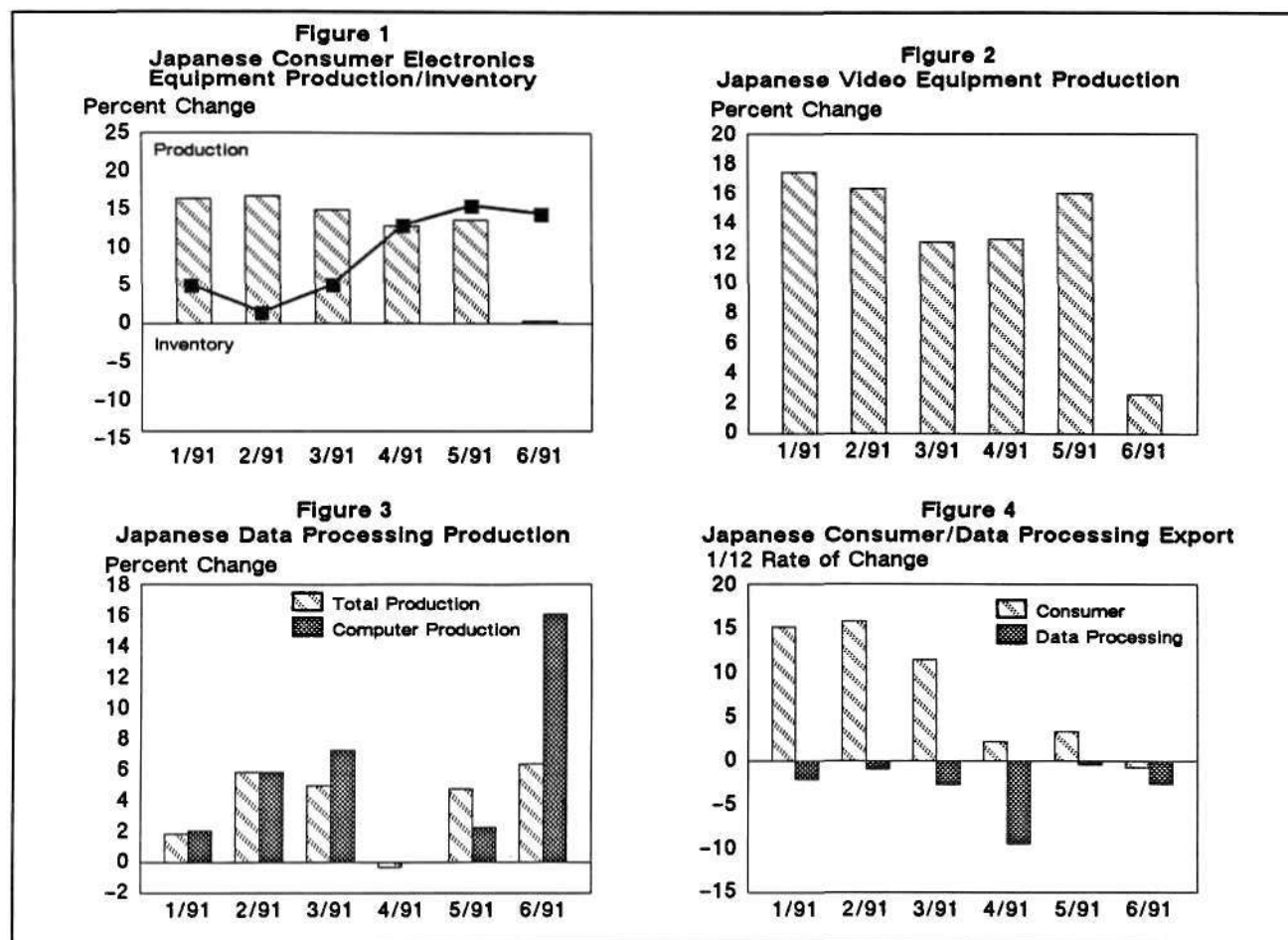
*Yoshie Shima*

# Research *Bulletin*

## JSAMONITOR—AUGUST 1991

This research bulletin is a monthly update that monitors changes in key Japanese electronic equipment markets. This publication presents important tactical leading indicators in semiconductor business activity. The sources for the graphs

are the Japanese Ministry of International Trade and Industry (MITI) and the Ministry of Finance (MOF) (see Figures 1 through 4). The data points for May 1991 have been restated in this issue.



Source: MITI, MOF, Dataquest (August 1991)

## THE EQUIPMENT MARKET

### Consumer Equipment Production and Inventories

Japanese consumer electronic equipment production picked up 0.4 percent in June 1991 over June 1990 compared with May 1991's revised 13.8 percent growth. It was the first time in the past nine months that consumer electronic equipment production scored a growth rate of less than 10 percent. On the other hand, Japanese consumer electronic equipment inventories increased 14.3 percent in June 1991 over June 1990 (see Figure 1). On a product basis, video equipment production growth was 2.6 percent in June over June 1990, which is considered low compared with the double-digit growth rates during the past eight months (see Figure 2). The same trend applies for video camera production, which posted 21.7 percent growth in June 1991 over June 1990. Color TV production decreased 3.6 percent in June 1991 compared with June 1990. Videodisc player production rose 12.2 percent during June 1991 from June 1990, and videodisc player inventory posted a 94.0 percent gain during the same period.

### Data Processing Equipment Production

Japanese data processing equipment production rose 6.4 percent in June 1991 compared with a revised 5.0 percent in May (see Figure 3). On a segment basis, total computer production increased 16.2 percent over the June 1990 level, which was the first double-digit growth in six months. Although PC production was up only 0.3 percent in June 1991 over June 1990, general-purpose computer production achieved a 29.8 percent increase during the same period. Data storage equipment posted an 8.4 percent gain in June 1991 over June 1990 compared with a 4.8 percent gain in May 1991. Monthly production of input/output equipment in June 1991 declined 3.9 percent from June 1990.

## EXPORTS

### Consumer

Consumer electronic equipment exports slipped 0.7 percent in June 1991 from the June 1990 level. On a regional basis, the United States had negative 11.3 percent growth in consumer electronic equipment exports in June 1991. Consumer electronic equipment exports to Europe moved ahead 10.1 percent in June 1991 over June 1990, and consumer electronic equipment exports to Asia increased 15.2 percent. On a product basis, video equipment exports posted negative 1.8 percent growth from June 1990, whereas audio equipment exports rose 1.4 percent during the same period.

### Data Processing

Data processing equipment exports dropped 2.6 percent in June 1991 compared with June 1990. On a regional basis, data processing exports to the United States have had negative growth rates for 10 consecutive months, with a 16.5 percent decline in June 1991. Exports to Europe and Asia grew 6.5 and 34.2 percent, respectively. Computer equipment exports showed negative 2.4 percent growth during June from the revised 3.3 percent growth in May 1991. Computer equipment exports to the United States fell 12.4 percent in June 1991 from the previous year, and computer equipment exports to Europe and Asia posted gains of 2.1 and 27.5 percent, respectively, in June 1991.

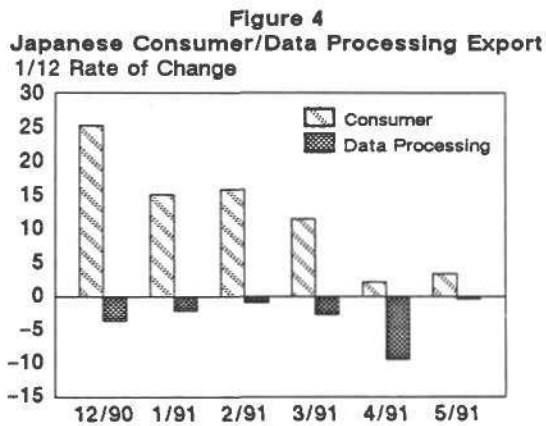
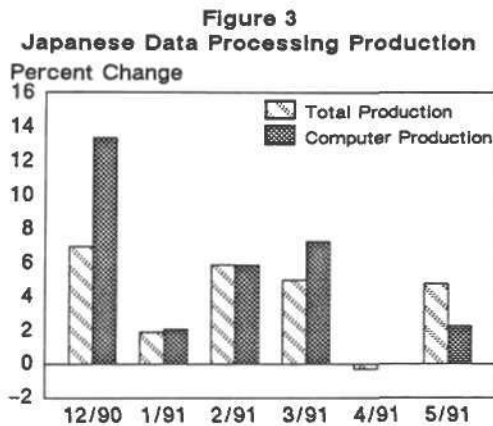
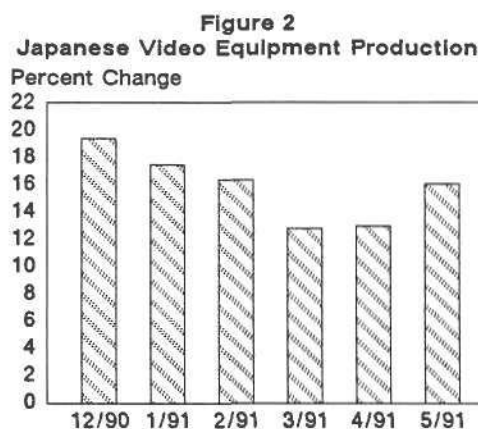
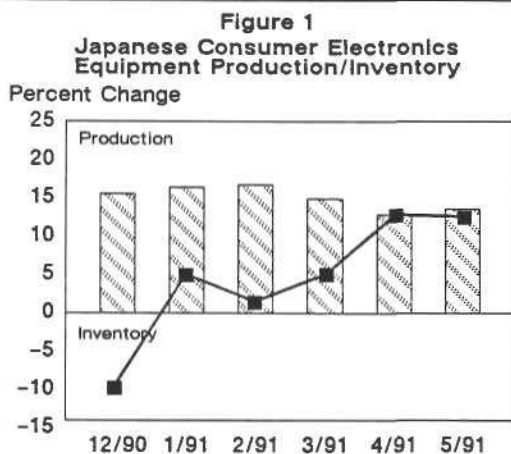
*Yoshie Shima*

# Research *Bulletin*

## JSAMONITOR—JULY 1991

This research bulletin is a monthly update that monitors changes in key Japanese electronic equipment markets. This publication presents important tactical leading indicators in semiconductor business activity. The sources for the graphs

are the Japanese Ministry of International Trade and Industry (MITI) and the Ministry of Finance (MOF) (see Figures 1 through 4). The data points for April 1991 have been restated in this issue.



Source: MITI, MOF, Dataquest (July 1991)

## THE EQUIPMENT MARKET

### Consumer Equipment Production and Inventories

Japanese consumer electronic equipment production grew 13.6 percent in May 1991 over May 1990, compared with the revised 12.9 percent growth in April 1991. Japanese consumer electronic equipment inventories increased 12.4 percent in May 1991 over May 1990 (see Figure 1). On a product basis, video equipment production growth was 16.1 percent in May 1991 compared with the revised rate of 13.0 percent in April 1991 (see Figure 2). The biggest production growth was in the video camera segment, which advanced 40.1 percent during May 1991 over the May 1990 level, whereas video camera inventory in May 1991 was up only 26.4 percent over the May 1990 level. Color TV production experienced double-digit growth of 12.5 percent in May 1991 over May 1990. Videodisc player production rose 8.6 percent during May 1991 from May 1990, and videodisc player inventory posted a 65.6 percent increase during the same period.

### Data Processing Equipment Production

Japanese data processing equipment production saw a rise of 4.8 percent in May 1991 compared with the revised negative 0.3 percent in April 1991 (see Figure 3). On a segment basis, total computer production increased 2.5 percent over the May 1990 level compared with April's revised 0 percent increase. General-purpose computer production gained 14.7 percent during May 1991 over May 1990, whereas PCs decreased in production by 8.1 percent during the same period. Data storage equipment posted a gain of 4.8 percent in May 1991 over May 1990, compared with the

April 1991 3.2 percent decline. The monthly production of input/output equipment in May 1991 rose 6.8 percent over May 1990.

## EXPORTS

### Consumer

Consumer electronic equipment exports rose 3.4 percent in May 1991. On a regional basis, consumer electronic equipment exports to the United States had negative 7.0 percent growth during May 1991. Exports to Europe moved ahead 17.9 percent during May 1991 over May 1990, while consumer electronic equipment exports to Asia increased 7.5 percent. On a product basis, video equipment exports rose 3.3 percent over May 1990; however, audio equipment exports posted negative 3.6 percent growth during the same period.

### Data Processing

Data processing equipment exports during May 1991 were down by 0.4 percent compared with the May 1990 level. On a regional basis, data processing exports to the United States have had negative growth rates for nine consecutive months, with an 11.6 percent decline in May 1991. Exports to Europe and Asia grew by 5.5 percent and 34.3 percent, respectively. Computer equipment exports increased 3.3 percent during May from the revised negative 7.1 percent growth in April 1991. Computer equipment exports to the United States decreased 3.6 percent in May 1991 from the previous year, but computer equipment exports to Europe and Asia posted gains of 6.4 percent and 23.5 percent, respectively, in May 1991.

*Yoshie Shima*

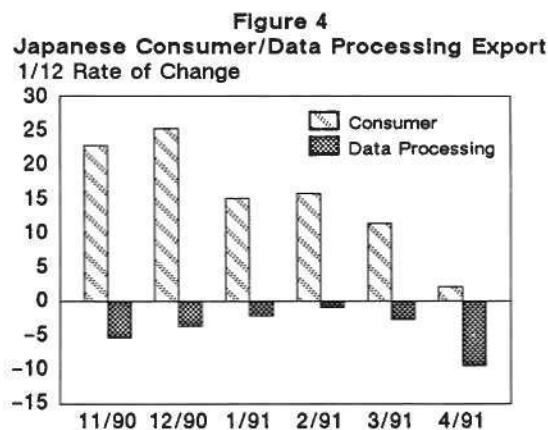
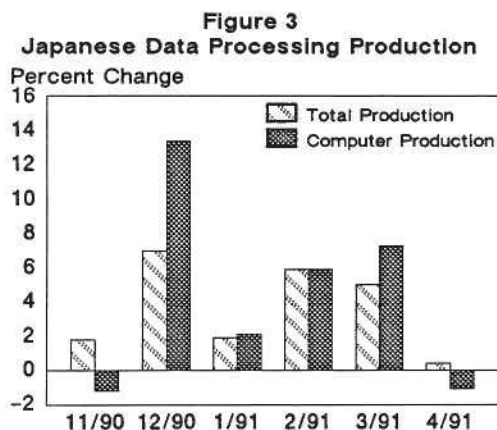
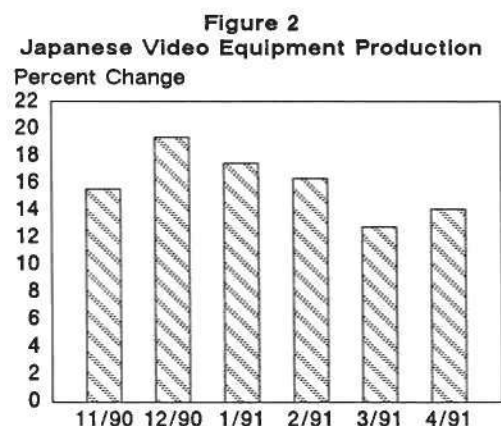
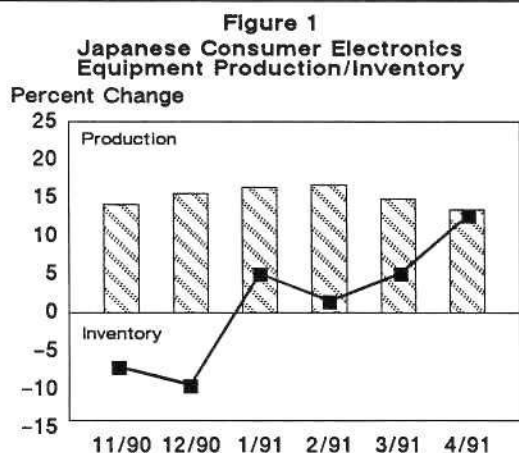


# Research *Bulletin*

## JSAMONITOR—JUNE 1991

This research bulletin is a monthly update that monitors changes in key Japanese electronic equipment markets. This publication presents important tactical leading indicators in semiconductor business activity. The sources for the graphs are

the Japanese Ministry of International Trade and Industry (MITI) and the Ministry of Finance (MOF) (see Figures 1 through 4). The data points for March 1991 have been restated in this issue.



Source: MITI, MOF, Dataquest (June 1991)

## THE EQUIPMENT MARKET

### Consumer Equipment Production and Inventories

Japanese consumer electronic equipment production increased 13.5 percent in April 1991 over April 1990, compared with March 1991's revised 14.9 percent growth. On the other hand, Japanese consumer electronic equipment inventories grew 12.7 percent in April 1991 over April 1990 (see Figure 1). On a product basis, video equipment production growth was 14.1 percent in April 1991 compared with the revised rate of 12.8 percent in March 1991 (see Figure 2). The biggest production growth was in video cameras, which advanced 30.3 percent during April 1991 over the April 1990 level, whereas video camera inventory in April 1991 was up 36 percent over April 1990. Videodisc player production declined 7 percent during April 1991 from April 1990, while videodisc player inventory posted a 98.3 percent increase during the same period.

### Data Processing Equipment Production

Japanese data processing equipment production picked up 0.4 percent in April 1991 compared with revised 5.3 percent growth in March 1991 (see Figure 3). On a segment basis, total computer production slipped slightly by 1.1 percent over the April 1990 level compared with March's revised 7.4 percent. General-purpose computers and PCs, two main products in the computer segment, decreased production value during April 1991 over April 1990, showing growth rates of negative 1.4 percent and negative 0.6 percent, respectively. The monthly production of input/output equipment in April 1991 exceeded the 1990 level, with a growth rate of 14.8 percent.

## EXPORTS

### Consumer

Consumer electronic equipment exports saw a rise of 2.2 percent in April 1991. On a regional basis, the United States had negative 13 percent growth in consumer electronic equipment exports during April 1991. Consumer electronic equipment exports to Europe moved ahead 16.9 percent during April 1991 over April 1990, while consumer electronic equipment exports to Asia slipped by 2.4 percent. On a product basis, video equipment exports rose 8.7 percent over April 1990, whereas audio equipment exports posted negative 9 percent growth during the same period.

### Data Processing

Data processing equipment exports had a growth rate of negative 9.4 percent compared with April 1990. On a regional basis, data processing exports to the United States have had negative growth rates for eight consecutive months, with a 21.3 percent decline in April 1991. Exports to Europe and Asia increased 1.5 and 12.8 percent, respectively. Computer equipment exports dropped 7.1 percent during April from the revised positive 1.1 percent growth in March 1991. Computer equipment exports to the United States decreased 17.1 percent in April 1991 from the previous year, and computer equipment exports to Europe and Asia posted gains of 3.2 and 7.2 percent, respectively, in April 1991.

*Yoshie Shima*



# Research Newsletter

## JAPANESE CONSUMER APPLICATION MARKET: 1990 BOOM AND BEYOND

### INTRODUCTION

Japanese consumer electronic equipment production grew strongly in the second half of the year despite the anticipated decline in early 1990 due to softening domestic demand. This growth created a lot of pressure on component supply and even a temporary shortage. In the fourth quarter of 1990, the Japanese economy showed ominous signs of slowdown from a seemingly everlasting expansion period. It was manifest as upheld interest rates and downbeat stock prices, but the electronic equipment industry suffered from these afflictions much less than others. This clearly reflects the industry's continuous efforts to establish offshore production bases motivated by yen appreciation and to develop domestic markets through aggressive product development and marketing strategies.

This newsletter analyzes Japanese consumer electronic equipment production in 1990 in the context of the changing economic environment in both general and major product segments, together with forecasts for quarterly growth in 1991 and midterm growth from 1991 to 1995.

### 1990 CONSUMER ELECTRONIC EQUIPMENT PRODUCTION

#### General Consumer Electronic Equipment Growth

Total consumer electronic equipment production grew to ¥7,739 billion with 8.5 percent growth in 1990 over 1989 (see Table 1). On the other hand, Japanese total consumer electronic equipment inventories declined from the second to the fourth quarter in 1990 over 1989 (see Figure 1).

Nevertheless, Japanese total consumer electronic equipment production recorded negative

growth in the second and fourth quarter of 1989 over 1988. Japanese total consumer electronic equipment inventories grew in 1989. Dataquest believes that the 1990 Japanese consumer electronic equipment market was very healthy compared with the market condition in 1989. Table 1 shows the consumer electronic equipment production breakdown in major product areas.

#### Video Production Growth

Video production grew 6.3 percent to ¥2,862 billion in 1990 over 1989. VCR and video camera production grew negative 4.9 and positive 19.8 percent, respectively. Color TV production, which recorded 6.8 percent growth, accelerated in the second half because of the expansion of domestic demand and a strong growth of exports to Asia. These two factors resulted in an impressive 22.8 percent growth rate in the fourth quarter of 1990 compared with the fourth quarter of 1989.

Notably, video production recorded healthy growth in both foreign and domestic markets; the latter was driven by video cameras and large color TVs as well as tuners and other equipment for an emerging broadcasting via satellite (BS) market in 1990. Several small segments also experienced strong growth. For example, videodisc player production showed the highest growth among the top five video equipment segments at 39.6 percent. Dataquest concludes that the increasing popularity of entertainment facilities is a major factor in this strong growth.

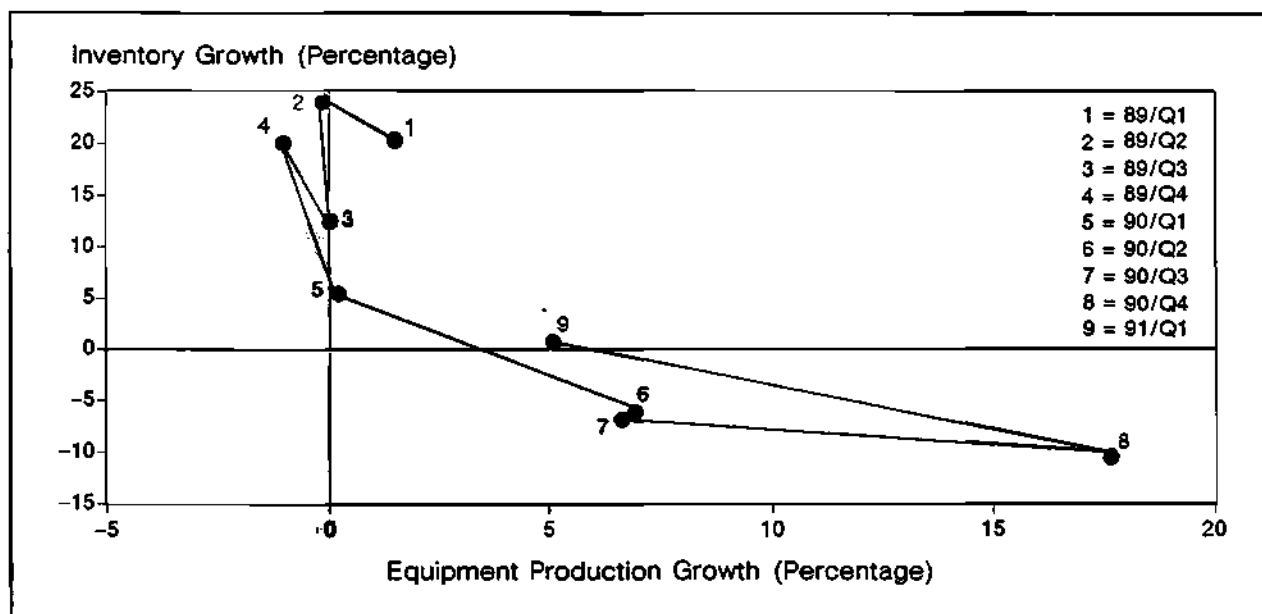
Similarly, LCD TVs showed significant production growth in 1990 at 33.5 percent. LCD TV production occupies only 1 percent of video production now, but Dataquest expects it to be one of key products in future video business.

**TABLE 1**  
**Estimated Japanese Consumer Equipment Production**  
**(Billions of Yen)**

Segment	1989	1990				1990	CAGR (%)
	Total	Q1	Q2	Q3	Q4	Total	1989-1990
Video	2,693	618	677	715	852	2,862	6.3
VCRs	1,135	247	261	272	298	1,078	-4.9
Video cameras	615	146	165	185	240	736	19.8
Videodisc players	104	33	33	35	43	144	39.6
Color TVs	819	186	211	215	263	875	6.8
LCD TVs	21	6	7	8	7	29	33.5
Audio	995	226	254	262	265	1,007	1.2
DAD players	146	30	46	51	43	171	17.3
Personal electronics	1,028	261	328	287	376	1,252	21.8
Electric toys	325	88	138	106	176	508	56.3
Appliances	2,047	505	596	492	628	2,221	8.5
Air conditioners	1,117	274	334	249	360	1,217	8.9
Other consumer equipment	372	79	95	104	119	397	6.8
Total	7,135	1,690	1,950	1,860	2,239	7,739	8.5

Source: Dataquest (June 1991)

**FIGURE 1**  
**Estimated 1990 Japanese Consumer Electronic Equipment Production and Inventory Growth**



Source: Dataquest (June 1991)

## Audio Equipment Production Growth

Audio was the only segment that experienced sluggish production growth—a meager 1.2 percent to ¥1,007 billion over 1989, as shown in Table 1. Nevertheless, in light of a fairly high percentage of audio equipment growth in Japan, this represents a hopeful improvement from negative growth in 1989. On a segment basis, digital audio disc (DAD) players grew strongly at 17.3 percent.

## Personal Electronics Production Growth

Personal electronics production recorded 21.8 percent growth to ¥1,252 billion in 1990 over 1989. In particular, electronic toy production showed large growth (56.3 percent) and contributed greatly to the robust growth of the personal electronics segment.

## Appliance Production Growth

Appliance production grew 8.5 percent to ¥2,221 billion in 1990 over 1989 (see Table 1). One of the major drivers was air conditioners, which had an 8.9 percent compound annual growth rate (CAGR) as a result of robust 27.6 percent growth in the fourth quarter of 1990 over the fourth quarter of 1989. Washer and dryer sales gained impetus from the addition of “fuzzy features,” showing 42.8 percent growth in 1990 over 1989.

## CONSUMER ELECTRONIC EQUIPMENT PRODUCTION FORECAST

### General Outlook for 1991

Although some uncertainties exist concerning Japanese industry in 1991 due to a recession in the U.S. economy, Dataquest believes that the U.S. presidential election and the Olympic Games in 1992 will help fuel the growth of the worldwide economy in 1991. However, the recession is surely having immediate impacts—sluggish consumer spending in the United States and a slowdown in capital expenditure by industries. But it did not adversely affect Japan's macroeconomy, which is still strong. Furthermore, Dataquest believes that the immediate impact will be reduced if the decline in domestic consumer electronic equipment prices fends off impending inflation and stimulates consumer spending in Japan.

Dataquest expects consumer electronic equipment production to grow to ¥8,119 billion with 4.9 percent growth in 1991 over 1990. On a quarterly basis, it should grow 5.6 percent in the first quarter of 1991 compared with the first quarter of 1990, followed by a slowdown to 2.4 percent growth in the second quarter. This growth is expected to accelerate to 5.4 percent in the third quarter and 6.1 percent in the fourth quarter (see Table 2). Thus, the industry will be mildly affected by a recession in the U.S. economy in the second quarter but will achieve sound growth in total segments for the year.

### Segment Details for 1991

Dataquest expects video production to reach ¥2,972 billion, which represents a 3.8 percent growth rate from the previous year. Video equipment should continue to drive as a major source of growth in this segment. In particular, video cameras will maintain a fast pace of growth on a value basis, and shipments are expected to reach 2.3 million units in Japan and 10 million units worldwide. This growth will be fueled by heated competition among major suppliers to introduce new products with better resolution and reduced size and weight.

Personal electronic equipment production will reach ¥1,375 billion, showing 9.9 percent growth in 1991 over 1990, the highest growth among segments. Electronic toys will continue to be a major force in this growth, particularly 16-bit game machines. These sales, which became full-fledged in 1990, will lead the market as strategic products for major suppliers.

Appliance production will reach ¥2,341 billion with 5.4 percent growth in 1991 over 1990, driven by “fuzzy control” appliances that won market success in 1990.

### Forecast Beyond 1991

Japanese consumer electronic equipment production in 1990 achieved significant growth bolstered by strong domestic markets. Dataquest expects growth to continue at a moderate rate (see Figure 2).

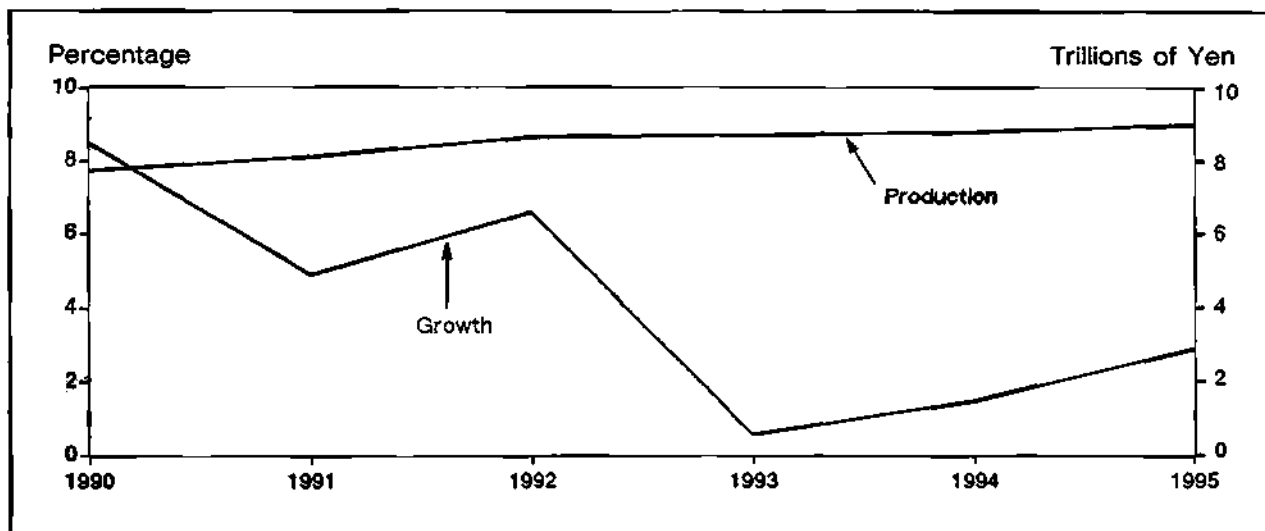
In 1992, worldwide demand for consumer products will be stimulated by the aforementioned U.S. presidential election and the Olympic Games in Barcelona. Consumer production, driven by video, is estimated to reach ¥8,654 billion, which represents a 6.6 percent growth rate from 1991.

**TABLE 2**  
**Japanese Consumer Equipment Production Forecast**  
 (Billions of Yen)

Segment	1991				1991	1992	1993	1994	1995	CAGR (%)	CAGR (%)
	Q1	Q2	Q3	Q4	Total	Total	Total	Total	Total	1990-1991	1990-1995
Consumer											
Audio	224	249	271	275	1,018	986	949	927	920	1.1	-1.8
Video	647	692	743	890	2,972	3,185	3,214	3,270	3,358	3.8	3.2
Personal electronics	290	349	317	419	1,375	1,540	1,601	1,599	1,673	9.9	6.0
Appliances	539	610	522	670	2,341	2,509	2,507	2,593	2,671	5.4	3.8
Other consumer equipment	83	98	108	123	411	434	440	448	476	3.5	3.7
Total consumer	1,784	1,998	1,961	2,376	8,119	8,654	8,710	8,838	9,098		
3/12 or 12/12 (%)	5.6	2.4	5.4	6.1	4.9	6.6	0.6	1.5	2.9		3.3

Source: Dataquest (June 1991)

**FIGURE 2**  
**Estimated Japanese Consumer Equipment Production Forecast**



Source: Dataquest (June 1991)

Dataquest forecasts that consumer electronic equipment production will grow by only 0.6 percent in 1993 over 1992 because of big growth in 1992. After 1992, it should increase moderately in 1994 and 1995, with annual growth rates of 1.5 and 2.9 percent, respectively, reaching ¥9,080 billion in 1995. Overall, Dataquest expects the CAGR to be 3.3 percent between 1990 and 1995 (see Table 2).

## 1990 SEMICONDUCTOR CONSUMPTION

Japan, a major semiconductor production base in the world, is also serving as a worldwide base developing and manufacturing a wide variety of applications that consume ¥875 billion worth of semiconductor devices for consumer electronic equipment.

On a segment basis, video, the largest semiconductor consumption segment, grew to ¥507 billion, which represents a 6.8 percent growth rate in 1990 over 1989. Audio semiconductor consumption grew to ¥180 billion, which is a 3.4 percent growth in 1990 over 1989. Dataquest estimates that personal electronics semiconductor consumption will grow to ¥104 billion, which is a 33.9 percent growth ratio due to a large increase in equipment production in 1990.

Semiconductor consumption for appliances grew to ¥77 billion, which is a 10 percent growth rate in 1990 over 1989. Both semiconductor application equipment manufacturing and semiconductor

consumption grew in 1990. In response to significant consumer demand, video production—and consequently semiconductor production—experienced healthy increases in 1990.

## SEMICONDUCTOR CONSUMPTION FORECAST

Dataquest forecasts that total consumer semiconductor consumption will increase to ¥934 billion in 1991, which represents 6.7 percent growth over 1990. Furthermore, consumer semiconductor consumption is expected to grow 9.1 percent to ¥1,019 billion in 1992 over 1991 because of big growth in consumer equipment production in 1992, and then it will increase to ¥1,165 billion with a CAGR of 5.9 percent between 1990 and 1995 (see Table 3).

## DATAQUEST CONCLUSIONS

### Consumer Equipment Production

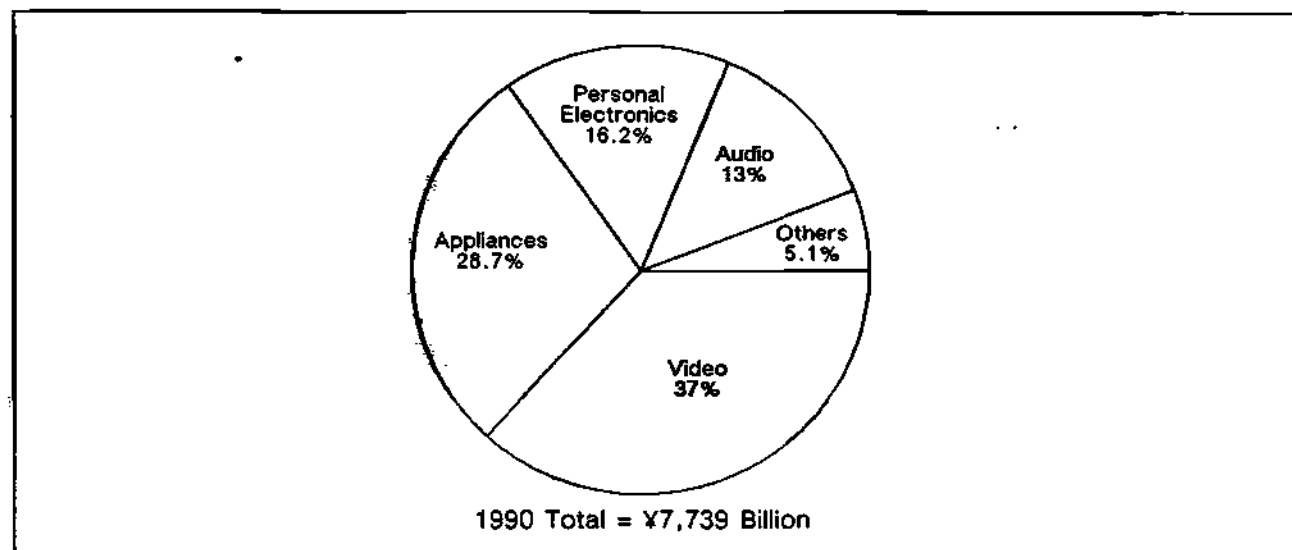
The Japanese consumer electronic equipment market sustained healthy growth in 1990. Three factors contribute to this growth. In the macroeconomic perspective, suppliers successfully followed up consumer needs, which rose with business upturns, and they continuously introduced products that appealed to consumers.

**TABLE 3**  
**Japanese Semiconductor Consumption Forecast for Consumer Applications**  
**(Billions of Yen)**

Segment	1989	1990	1991	1992	1993	1994	1995	CAGR (%)	CAGR (%)
								1989-1990	1990-1995
Video	474	507	535	587	604	628	661	6.8	5.5
Audio	175	180	185	184	181	182	184	3.4	0.4
Personal electronics	77	104	122	148	167	181	207	33.9	14.8
Appliances	70	77	83	91	92	98	103	10.0	6.1
Others	8	8	9	9	10	10	11	3.1	5.3
Total	804	875	934	1,019	1,054	1,098	1,165	8.9	5.9
12/12 (%)	5.1	8.9	6.7	9.1	3.5	4.1	6.1		

Source: Dataquest (June 1991)

**FIGURE 3**  
**Estimated 1990 Japanese Consumer Equipment Production**



Source: Dataquest (June 1991)

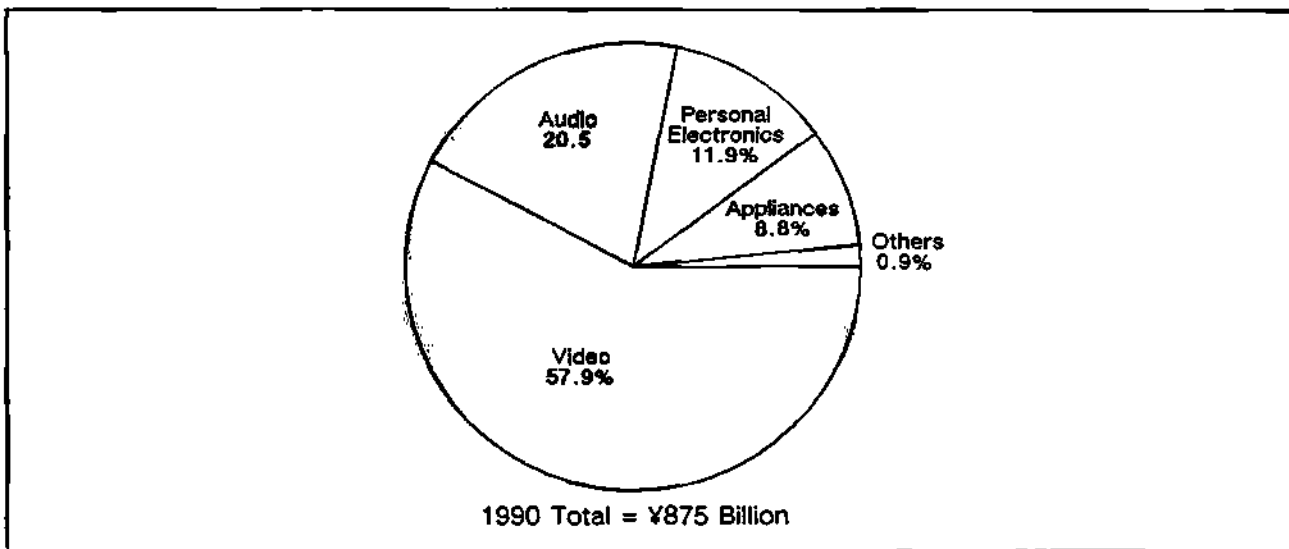
VCR and video cameras accounted for 23.5 percent of total consumer equipment production. Within this segment, production emphasis has shifted smoothly from VCRs to video cameras. Furthermore, the incorporation of man-machine interfaces into electronic products, such as those based on microcomputers, has contributed to market growth for consumer equipment. Dataquest expects total consumer production to grow moderately for the five years after 1992, which should have the highest growth rate.

## Semiconductor Consumption

Figures 3 and 4 show consumer equipment production and semiconductor consumption by segment. For example, appliances, the second-largest equipment production segment with 28.7 percent, ranked only fourth in semiconductor consumption, with 8.8 percent in 1990.

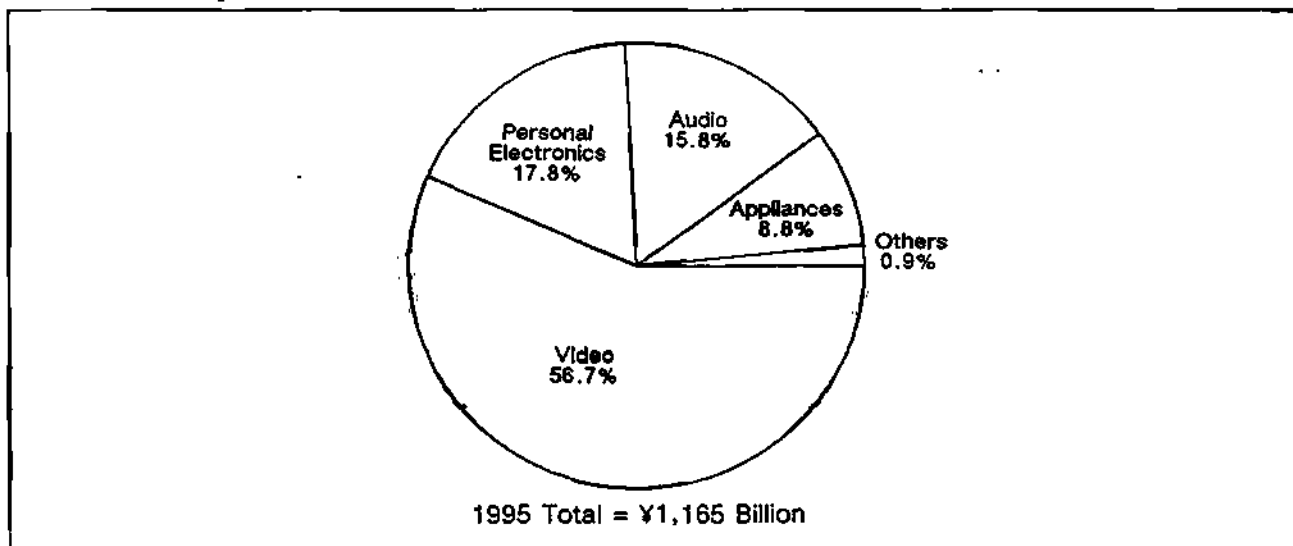
Finally, Dataquest expects two phenomena. First, video will continue to lead total semiconductor consumption from 1990 to 1995 as Japanese

**FIGURE 4**  
**Estimated 1990 Japanese Semiconductor Consumption by Consumer Application**



Source: Dataquest (June 1991)

**FIGURE 5**  
**Estimated 1995 Japanese Semiconductor Consumption for Consumer Applications**



Source: Dataquest (June 1991)

semiconductor video consumption keeps its leading position of 56.7 percent in 1995 from 57.9 percent in 1990 (see Figures 4 and 5). Second, Japanese semiconductor consumption for personal electronics will grow to 17.8 percent, and personal electronics will be the second-largest segment in 1995 (see Figure 5).

Dataquest expects video and personal electronics to be recognized as credible equipment for semiconductor consumption in the future.

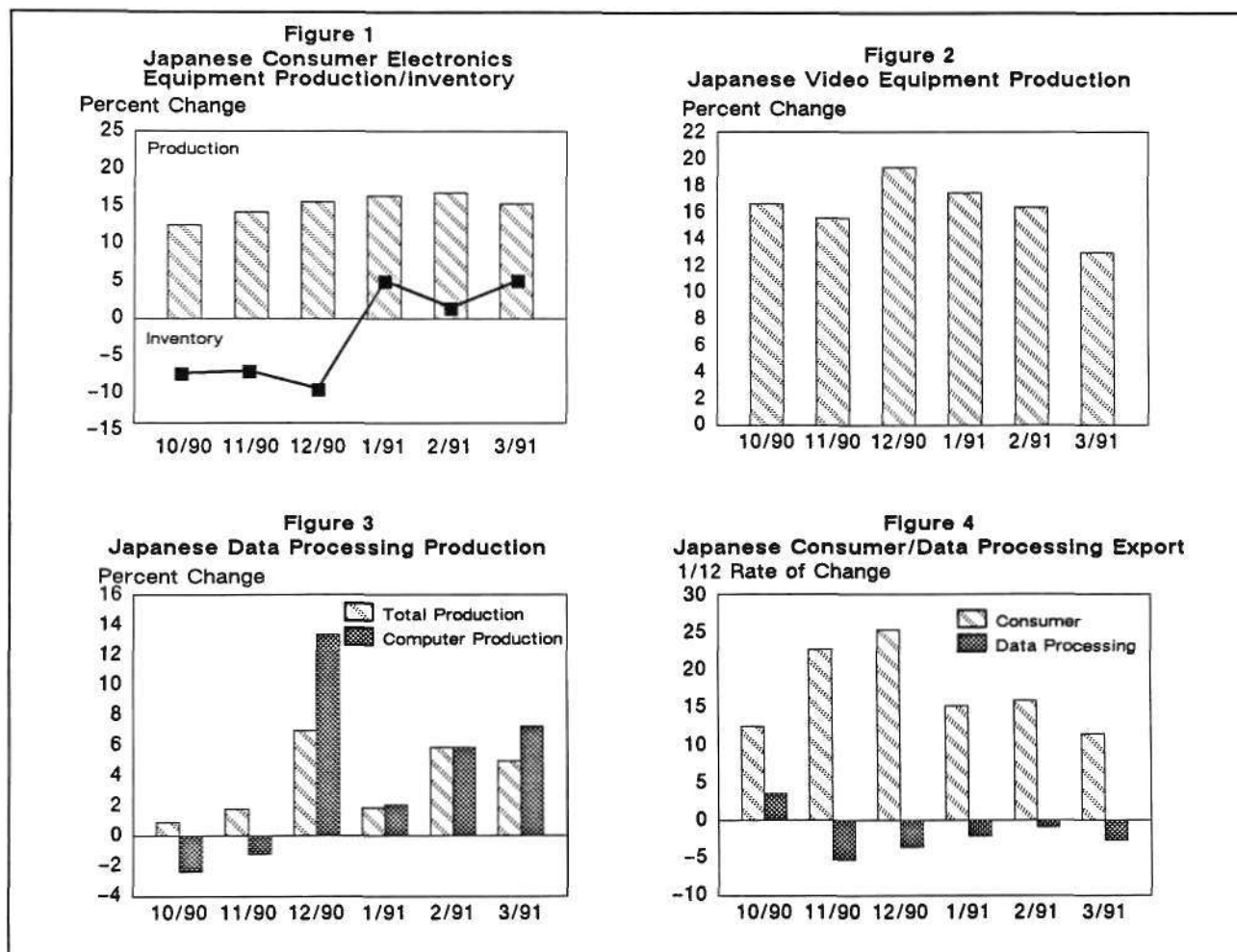
*Kun Soo Lee*

# Research *Bulletin*

## JSAMONITOR—MAY 1991

This research bulletin is a monthly update that monitors changes in key Japanese electronic equipment markets. This publication presents important tactical leading indicators in semiconductor business activity. The sources for the graphs are

the Japanese Ministry of International Trade and Industry (MITI) and the Ministry of Finance (MOF) (see Figures 1 through 4). The data points for February 1991 have been restated in this issue.



Source: MITI, MOF, Dataquest (May 1991)



## THE EQUIPMENT MARKET

### Consumer Equipment Production and Inventories

Japanese consumer electronic equipment production increased 15.4 percent in March 1991 over March 1990, compared with February 1991's revised 16.8 percent growth. On the other hand, Japanese consumer electronic equipment inventories grew 4.7 percent in March 1991 over March 1990 (see Figure 1). On a product basis, video equipment production growth was 13.0 percent in March 1991 compared with the revised rate of 16.4 percent in February 1991 (see Figure 2). Video camera and CD player production grew at high rates, with 47.0 percent and 66.6 percent gain, respectively, during March 1991. Videodisc player production declined 14.2 percent during March 1991 from March 1990, while videodisc player inventory posted an 82.9 percent increase during the same period.

### Data Processing Equipment Production

Japanese data processing equipment production rose 5.0 percent in March 1991 compared with revised 5.9 percent growth in February 1991 (see Figure 3). On a segment basis, total computer production advanced 7.3 percent over the March 1990 level compared with February's revised 5.9 percent growth. The increase was driven by a 10.8 percent growth in PC production during the same period. The biggest production growth was in the data storage segment, which showed a 12.8 percent gain. Among the dedicated system segment, calculators had the highest growth rate—27.1 percent in March 1991 over the same month last year.

## EXPORTS

### Consumer

Consumer electronic equipment exports have had double-digit growth since October 1990 and maintained a stable growth rate of 11.5 percent in March 1991. On a regional basis, the United States had negative 9.6 percent growth in consumer electronic equipment exports during March 1991. Consumer electronic equipment exports to Europe and Asia experienced double-digit growth compared with March 1990, posting 29.4 and 31.8 percent, respectively. On a product basis, video equipment exports rose 11.8 percent over March 1990. High growth rates were seen in video equipment exports to Europe and Asia, with 31.5 and 40.4 percent gains, respectively.

### Data Processing

Data processing equipment exports showed a growth rate of negative 2.7 percent compared with the March 1990 level. On a regional basis, data processing exports to the United States have had negative growth since September 1990, with negative 9.9 percent growth in March 1991. Exports to Europe and Asia had 10.7 and 2.5 percent growth, respectively. Computer equipment exports grew 1.1 percent during March from the revised positive 4.4 percent growth in February 1991. Computer equipment exports to the United States declined 7.1 percent in March 1991 from March 1990, and computer equipment exports to Europe and Asia posted gains of 12.1 and 3.1 percent, respectively, in March 1991.

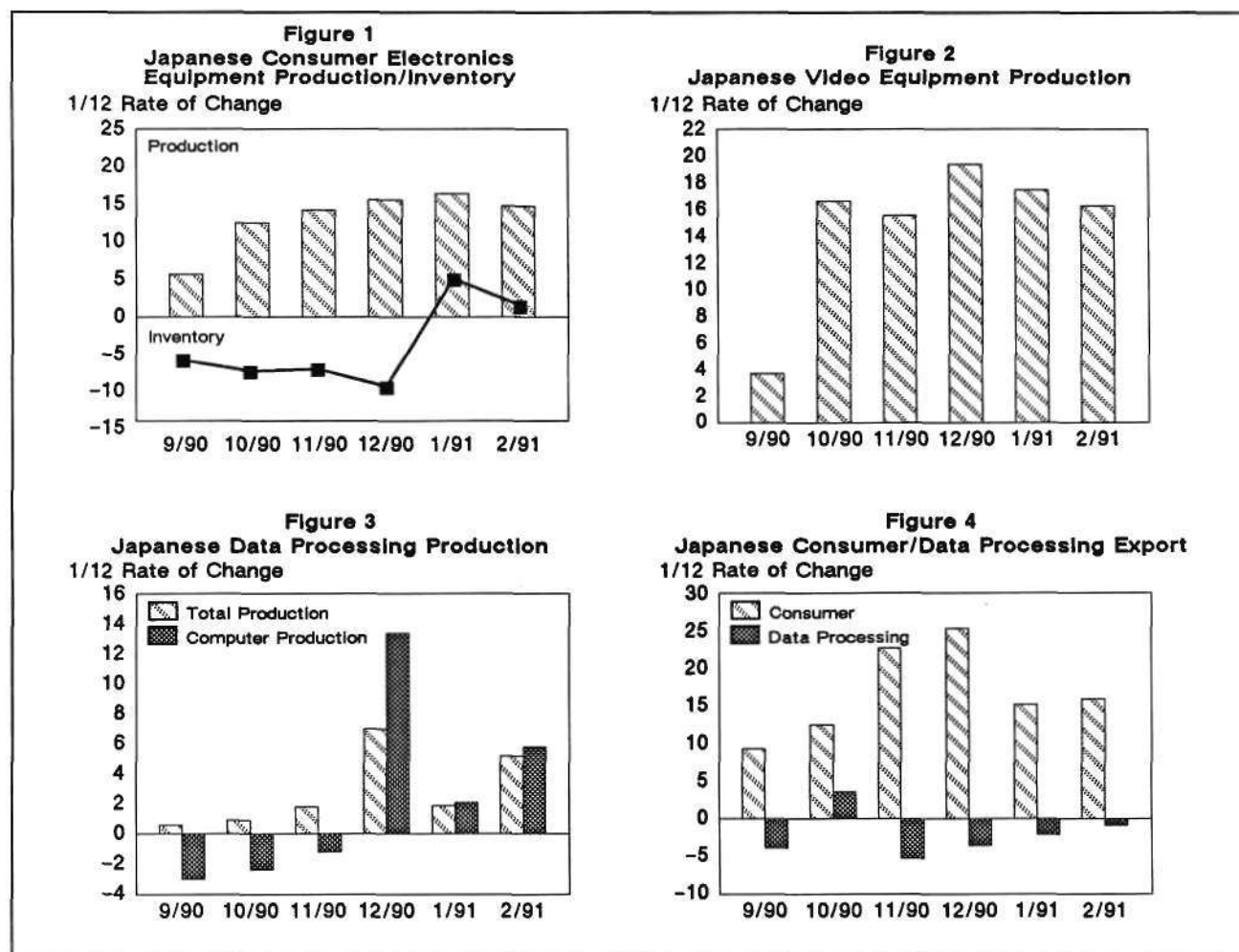
*Yoshie Shima*

# Research *Bulletin*

## JSAMONITOR—APRIL 1991

This research bulletin is a monthly update that monitors changes in key Japanese electronic equipment markets. This publication presents important tactical leading indicators in semiconductor business activity. The sources for the

graphs are the Japanese Ministry of International Trade and Industry (MITI) and the Ministry of Finance (MOF) (see Figures 1 through 4). The data points for January 1991 have been restated in this issue.



Source: MITI, MOF, Dataquest (April 1991)

## THE EQUIPMENT MARKET

### Consumer Equipment Production and Inventories

Japanese consumer electronic equipment production grew 14.8 percent in February 1991 compared with February 1990. On the other hand, Japanese consumer electronic equipment inventories grew 1.0 percent over February 1990 (see Figure 1). On a product basis, video equipment production was 16.3 percent in February 1991 compared with the revised rate of 17.5 percent in January 1991 (see Figure 2). The biggest production growth was in the video camera segment, which has had double-digit advances since May 1990 and recorded 54.1 percent growth in February 1991, whereas video camera inventory posted a 22.5 percent gain. VCR production increased 4.9 percent over the February 1990 level.

### Data Processing Equipment Production

Japanese data processing equipment production showed a 5.2 percent increase in February 1991 compared with revised 1.9 percent growth in January 1991 (see Figure 3). On a segment basis, total computer production advanced 5.8 percent over the February 1990 level. General-purpose computer production increased 3.2 percent over February 1990. PC and word processor production rose 9.2 and 16.8 percent, respectively, in February 1991.

## EXPORTS

### Consumer

Consumer electronic equipment exports had a 15.9 percent increase in February, following January's revised 15.2 percent growth. The United States had 3.2 percent growth in consumer

electronic equipment exports during February 1991, Europe had 26.8 percent growth, and Asia had 25.5 percent. On a segment basis, TV exports from Japan to China jumped 188.3 percent over February 1990 rates and VCR exports from Japan to China increased 64.0 percent over February 1990; both segments contributed to the advance of Asia's consumer electronic equipment exports.

### Data Processing

Data processing equipment exports slipped slightly compared with the February 1990 level, showing negative 0.9 percent growth in February 1991 (see Figure 4). On a regional basis, U.S. data processing exports had negative 11 percent growth compared with February 1990. European and Asian data processing exports experienced double-digit growth in February 1991, posting 12.6 and 15.0 percent gains, respectively. Computer equipment exports grew 4.4 percent during February from the revised positive 1.1 percent growth in January 1991. U.S. computer equipment exports have shown negative growth since September 1990, with negative 6.1 percent growth in February 1991. European and Asian computer equipment exports grew 15.2 percent and 17.0 percent, respectively, in February 1991.

*Yoshie Shima*

# Research Newsletter

## PRELIMINARY 1990 JAPANESE SEMICONDUCTOR MARKET SHARE ESTIMATES BY APPLICATION SEGMENT

### SUMMARY

Dataquest estimates that the Japanese semiconductor market grew 3 percent in 1990 to ¥3,270 billion, which shows steady growth in the 1990 total market. However, on an application segment basis, the biggest application segment, data processing, had the worst growth rate, with negative 7.5 percent, whereas the smallest segment, transportation, had the best growth rate with a positive 18.8 percent (see Table 1). Figure 1 shows each application segment along with their semiconductor revenue percentage share of the market. In this newsletter, Dataquest examines each application segment by presenting preliminary estimates for 1990 Japanese application segment market share by semiconductor vendor.

### THE SEGMENTS

#### Data Processing

NEC emerged as the leader in the Japanese data processing segment, with semiconductor revenue of ¥267.7 billion (see Table 2). The company supplies a broad range of semiconductor devices, ICs, discretes, and optoelectronics. The company does not rely completely on MOS memories, but it is very good at mixing memories with other products such as MOS digital devices, MOS micro and MOS logic. Production of its original V-series microprocessors helped NEC take the lead in this category. Hitachi and Fujitsu were also very strong in this application segment, with sales of ¥219.1 billion and ¥191.5 billion, respectively. These three companies all supply a huge amount of semiconductors used mainly for consumption in such equipment and systems as mainframes, supercomputers, and PCs (including portables) internally

**TABLE 1**

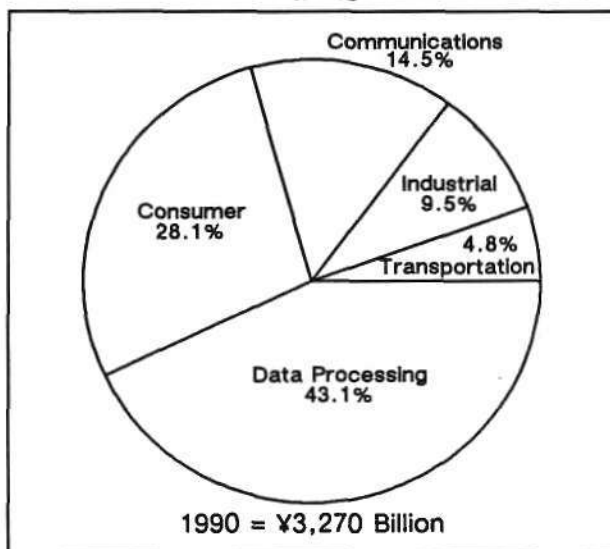
**Preliminary Estimated Japanese Semiconductor Revenue by Application Segment (Billions of Yen)**

Application	1990 Revenue	Change from 1989
Data Processing	1,408.3	-7.5
Communications	475.9	14.8
Industrial	309.9	8.1
Consumer	919.0	12.3
Transportation	157.0	18.8
Total	3,270.0	3.0

Note: Some columns do not add to totals shown because of rounding.  
Source: Dataquest (April 1991)

**FIGURE 1**

**Preliminary Estimated Japanese Semiconductor Revenue by Application Segment**



Source: Dataquest (April 1991)

**TABLE 2**  
Preliminary Estimated 1990 Japanese Semiconductor Market Share Rankings—Data Processing Segment  
(Billions of Yen)

Company	Revenue	Percent
NEC	267.7	19.0
Hitachi	219.1	15.6
Fujitsu	191.5	13.6
Toshiba	160.2	11.4
Mitsubishi	115.8	8.2
Sharp	66.5	4.7
Texas Instruments	43.9	3.1
Matsushita	43.9	3.1
Oki Electric	40.7	2.9
Intel	33.8	2.4
Total—Top 10	1,183.1	84.0
Others	225.2	16.0
Total—All	1,408.3	100.0

Source: Dataquest (April 1991)

and to U.S. manufacturers. Number 1 DRAM vendor Toshiba ranked fourth. These top four companies together occupy 59.6 percent of this application segment. Among non-Japanese companies in the top 10, Texas Instruments and Intel rank number 7 and number 10, respectively.

## Communications

NEC also emerged as the leader in the communications segment, with sales of ¥89.2 billion and 18.7 percent share of the Japanese market (see Table 3). As in the data processing application segment, NEC, Fujitsu, Toshiba, and Hitachi controlled more than half of the communications market with 53.2 percent combined share. However, this application segment differed from data processing in total market share for the top 10 companies. Because second-tier companies had relatively low market shares, the top 10 companies in communications accounted for only 72.7 percent; the data processing top 10 accounted for 84 percent. Texas Instruments ranked sixth with 3.7 percent market share, the highest among non-Japanese companies and surprisingly higher than Motorola's 2.7 percent.

## Industrial

Toshiba led industrial application shipments with ¥51.5 billion in revenue and a 16.6 percent share of the market (see Table 4). Hitachi ranked second with sales of ¥39.8 billion and 12.8 percent of the market; Mitsubishi ranked third with sales of ¥33.1 billion. All of the top three semiconductor vendors are typical examples of Japanese vertically integrated companies. They supply semiconductors to a number of industrial equipment manufacturers including their own internal industrial-equipment-producing divisions for products such as process controllers and computerized numerical control systems.

## Consumer

The second-largest Japanese application segment, consumer, is dominated by Japanese semiconductor vendors that support consumer product manufacturers with goods such as videocameras, video tape recorders (VTRs), laser videodisc players, broadcasting satellite (BS) tuners, and video games. Although this market has been showing a production shift to offshore manufacturing in the Asian countries, most key semiconductor devices are still supplied by Japanese vendors. Matsushita

**TABLE 3**  
Preliminary Estimated 1990 Japanese Semiconductor Market Share Rankings—Communication Segment  
(Billions of Yen)

Company	Revenue	Percent
NEC	89.2	18.7
Fujitsu	59.2	12.4
Toshiba	53.4	11.2
Hitachi	51.8	10.9
Matsushita	19.1	4.0
Texas Instruments	17.4	3.7
Oki Electric	15.9	3.3
Motorola	15.2	3.2
Rohm	12.8	2.7
Mitsubishi	11.8	2.5
Total—Top 10	345.8	72.6
Others	130.1	27.3
Total—All	475.9	100.0

Note: Some columns do not add to totals shown because of rounding.  
Source: Dataquest (April 1991)

TABLE 4

Preliminary Estimated 1990 Japanese Semiconductor Market Share Rankings—Industrial Segment  
(Billions of Yen)

Company	Revenue	Percent
Toshiba	51.5	16.6
Hitachi	39.8	12.8
Mitsubishi	33.1	10.7
NEC	31.5	10.2
Fuji Electric	25.9	8.4
Fujitsu	18.7	6.0
Matsushita	16.9	5.5
Sanyo	16.4	5.3
Motorola	12.2	3.9
Sony	10.4	3.4
Total—Top 10	256.4	82.7
Others	53.5	17.3
Total—All	309.9	100.0

Note: Some columns do not add to totals shown because of rounding.  
Source: Dataquest (April 1991)

emerged as the leader in this segment with ¥141.7 billion in revenue (see Table 5).

## Transportation

Toshiba emerged as the leader in the Japanese transportation application segment, with sales of ¥22.9 billion and 14.6 percent share of the Japanese market (see Table 6). Toshiba's top ranking is due to its position as the major supplier to Toyota, the automobile industry's leader. Supplying car electronics to Nissan, Hitachi ranked second with ¥19.9 billion in semiconductor shipments and 12.7 percent of the market. The leader in the worldwide transportation application segment, Motorola ranked eighth in the Japanese market (please refer to Components Group newsletter number 1990-10 entitled *Final 1989 Worldwide Semiconductor Market Share Estimates by Application Segment*).

## DATAQUEST CONCLUSIONS

According to Dataquest's preliminary 1990 worldwide semiconductor market share estimates, NEC was ranked the number one semiconductor vendor in both the worldwide and Japanese markets

TABLE 5

Preliminary Estimated 1990 Japanese Semiconductor Market Share Rankings—Consumer Segment  
(Billions of Yen)

Company	Revenue	Percent
Matsushita	141.7	15.4
NEC	120.7	13.1
Sanyo	98.2	10.7
Toshiba	91.6	10.0
Sharp	74.4	8.1
Sony	73.7	8.0
Mitsubishi	68.5	7.5
Hitachi	67.7	7.4
Rohm	45.6	5.0
Fujitsu	31.1	3.4
Total—Top 10	813.2	88.5
Others	105.8	11.5
Total—All	919.0	100.0

Note: Some columns do not add to totals shown because of rounding.  
Source: Dataquest (April 1991)

TABLE 6

Preliminary Estimated 1990 Japanese Semiconductor Market Share Rankings—Transportation Segment  
(Billions of Yen)

Company	Revenue	Percent
Toshiba	22.9	14.6
Hitachi	19.9	12.7
NEC	13.1	8.3
Fujitsu	9.3	5.9
Oki Electric	9.3	5.9
Sanken	8.5	5.4
Rohm	8.2	5.2
Motorola	7.8	5.0
Mitsubishi	5.9	3.8
Fuji Electric	5.1	3.2
Total—Top 10	110.0	70.0
Others	47.0	30.0
Total—All	157.0	100.0

Source: Dataquest (April 1991)

(please see Semiconductor Group newsletter number 1991-01 entitled *Preliminary 1990 Worldwide Semiconductor Market Share Estimates* and Japanese Semiconductor Industry Service newsletter number 1991-03, *Preliminary 1990 Japanese Semiconductor Market Shares*). In Japan, NEC emerged as the leader in both the data processing and communications segments. Emerging as the leader in both the industrial and transportation segments, Toshiba ranked third in the overall Japanese semiconductor market behind number two Hitachi. Both the industrial and transportation applications are relatively small, with ¥309.9 billion and 157.0 billion, respectively, in revenue and 9.5 and 4.8 percent of the overall Japanese market, and being the leader of those segments did not help boost Toshiba's ranking. However, ranking second with ¥219.1 billion in revenue in the biggest segment, data processing, helped Hitachi become ranked second as well in the Japanese overall market. The consumer market, which is the second-largest application market in semiconductor shipments and had 12.3 percent growth in 1990, presents opportunities not only for the currently

dominant Japanese semiconductor vendors but non-Japanese vendors such as Motorola, Philips, and Texas Instruments as well. However, these non-Japanese merchant semiconductor vendors may not be very successful in the Japanese market in terms of increasing revenue or market share if they concentrate only on the highly profitable, high-end consumer application products. Because low-end commodity consumer products are driving this application segment in Japan parallel with the high-end portion of the market, this application segment as a whole is a major driving force in the overall Japanese market along with the data processing segment, the largest application segment. Dataquest believes that the consumer application market, especially low-end commodity consumer products, provides opportunities to integrate not only circuit in scale for ultrahigh density with leading-edge manufacturing technologies but also the high-quality mass-production know-how to drive the learning curve for such volume-oriented products as DRAMs more effectively.

*Masanori Murata*

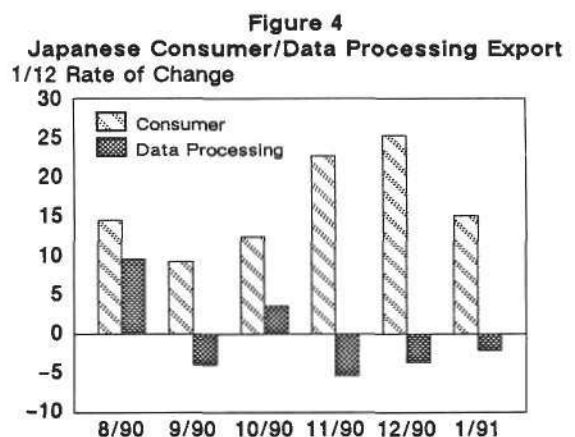
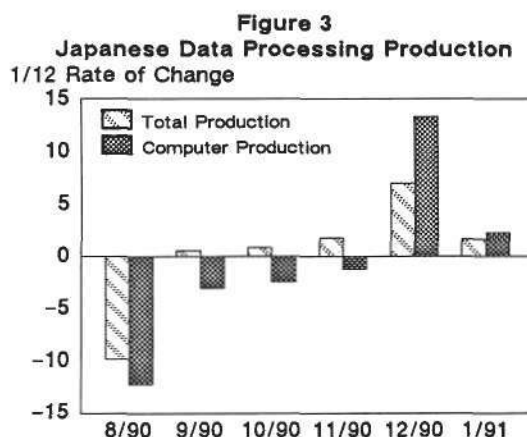
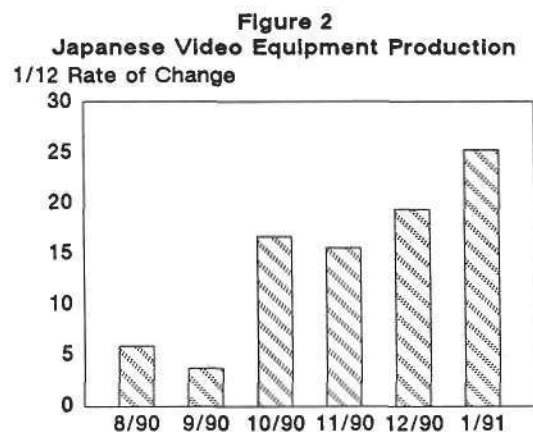
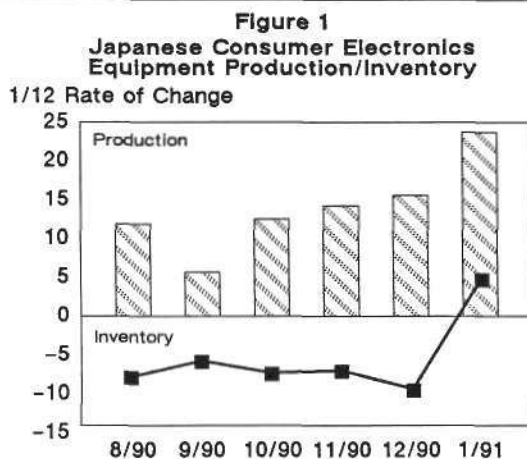


# Research *Bulletin*

## JSAMONITOR—MARCH 1991

This research bulletin is a monthly update that monitors changes in key Japanese electronic equipment markets. This publication presents important tactical leading indicators in semiconductor business activity. The sources for the graphs are the

Japanese Ministry of International Trade and Industry (MITI) and the Ministry of Finance (MOF) (see Figures 1 through 4). The commentary and analyses are solely those of Dataquest. The data points for December 1990 have been restated in this issue.



Source: MITI, MOF, Dataquest (March 1991)



## THE EQUIPMENT MARKETS

### Consumer Equipment Production and Inventories

Japanese consumer electronic equipment production had 23.7 percent growth in January 1991 over January 1990. On the other hand, Japanese consumer electronic equipment inventories increased 4.7 percent in January 1991 (see Figure 1). On a segment basis, total video production kept healthy growth in January 1991. On a product basis, video equipment (VCR and video camera) production recorded growth of 25.3 percent in January 1991, which is the highest since 1989 (see Figure 2). In particular, VCR production had rapid growth at 16.8 percent in January 1991. Video camera production and inventories grew 37.8 and 35.4 percent, respectively, in January 1991. Color TV production also recorded growth of 22 percent in January 1991, which is the highest since 1989. In other segments, digital/audio disk players grew 45.3 percent in January 1991.

### Data Processing Equipment Production

Japanese data processing equipment production had 1.7 percent growth in January 1991 over January 1990 compared with the revised 7.3 percent growth in December 1990 (see Figure 3). On a segment basis, total computer production fell to 2.3 percent growth in January 1991 compared with 13.5 percent growth in December 1990 (see Figure 3). On an equipment basis, general-purpose computers declined drastically at 0.7 percent in January 1991 compared with the revised 23.9 percent growth in December 1990. Personal computer production recovered with 4.4 percent growth in January 1991 from the revised negative 6.8 percent growth in December 1990.

## EXPORTS

### Consumer

Consumer electronic equipment exports had 15.2 percent growth in January 1991 compared with 25.6 percent growth in December 1990. On an equipment basis, color TV exports grew at a rate of 32.4 percent in January 1991 over January 1990.

On a regional basis, the growth rates for consumer electronic equipment exports for the United States, Europe, and Asia in January 1991 were negative 2.6 and positive 12.2 and 51.6 percent, respectively, over January 1990. In particular, VCR and color TV exports for Asia grew at the rates of 38.5 and 117.6 percent, respectively, in January 1991.

### Data Processing

Data processing equipment exports had negative 2.1 percent growth in January 1991 over January 1990 (see Figure 4). The growth of data processing equipment exports for the United States, Europe, and Asia in January 1991 was negative 12.1 and positive 1.3 and 42.9 percent, respectively, over January 1990. The growth rate of computer equipment exports declined 1 percent in January 1991 from 6.4 percent growth in December 1990. On a regional basis, the growth of computer equipment exports for the United States, Europe, and Asia in January 1991 was negative 8.2 and positive 1.3 and 49.6 percent, respectively, over January 1990. Computer equipment exports for the United States recorded growth of negative 8.2 percent in January 1991 compared with growth of negative 0.6 percent in December 1990.

## DATAQUEST CONCLUSIONS

Both consumer production and inventories grew in January 1991 from December 1990, reflecting large growth of total video equipment production in Japan. Dataquest believes that this growth is due to the following two reasons:

- VCR and color TV exports grew rapidly in Asia.
- VCR and color TV manufacturers prepared for an expected large demand for BS tuners for the Japanese consumer electronic equipment market.

Data processing production kept a slightly positive growth rate, affected by negative growth of general-purpose computer production in January 1991. Computer equipment exports for the United States fell again in January 1991 following December 1990. Dataquest believes that the U.S. computer market was sluggish, reflecting the U.S. economy's bad condition as affected by the recession.

*Kun Soo Lee*

# Research Newsletter

## VIDEO APPLICATION MARKET: ARE CAMERAS READY FOR NO. 1 VIDEO POSITION?

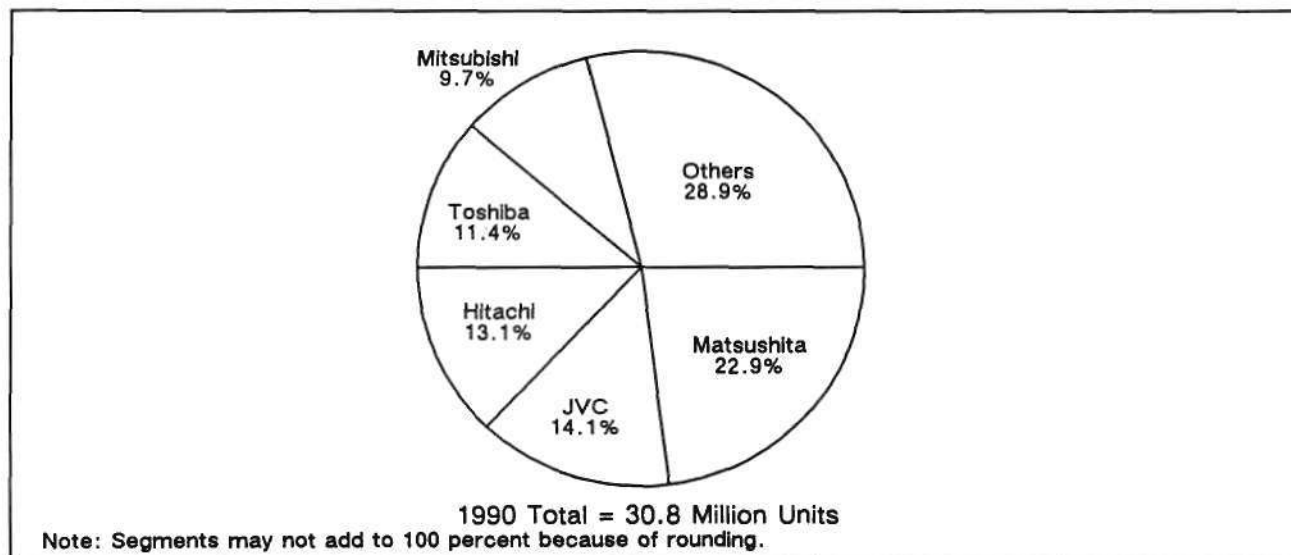
### SUMMARY

The leading Japanese consumer companies, Matsushita and Sony, have been rivals in the audio visual (AV) equipment markets for a long time, dating back to the famous VCR battles of VHS versus Betamax. The VCR market has been the biggest semiconductor application market in the consumer segment, but the video camera market recently has been growing rapidly. To determine whether the VCR market will hand over its current leadership role among all consumer electronic equipment to the video camera market, this newsletter investigates both VCR and video camera production trends and analyzes their semiconductor consumption.

### JAPANESE PRODUCTION SHARE

Matsushita maintained its number 1 position in the 1990 VCR market (see Figure 1). This market has been a well-known battlefield. Matsushita's VHS technology completely defeated Sony's Beta, and now Sony is no longer among the top five leaders. In the 1990 video camera market, on the other hand, Sony obtained a healthy adequate 35.5 percent share with its 8mm Handy-cam TR series, exceeding the combined 34.2 percent market shares of both number two Matsushita and number three Victor (see Figure 2). Dataquest believes that Sony's performance in the overall video equipment market is outstanding, compared with respective 37.0 and 34.2 percent shares held

**FIGURE 1**  
**Estimated 1990 Japanese VCR Production Share**



Source: Dataquest (March 1991)

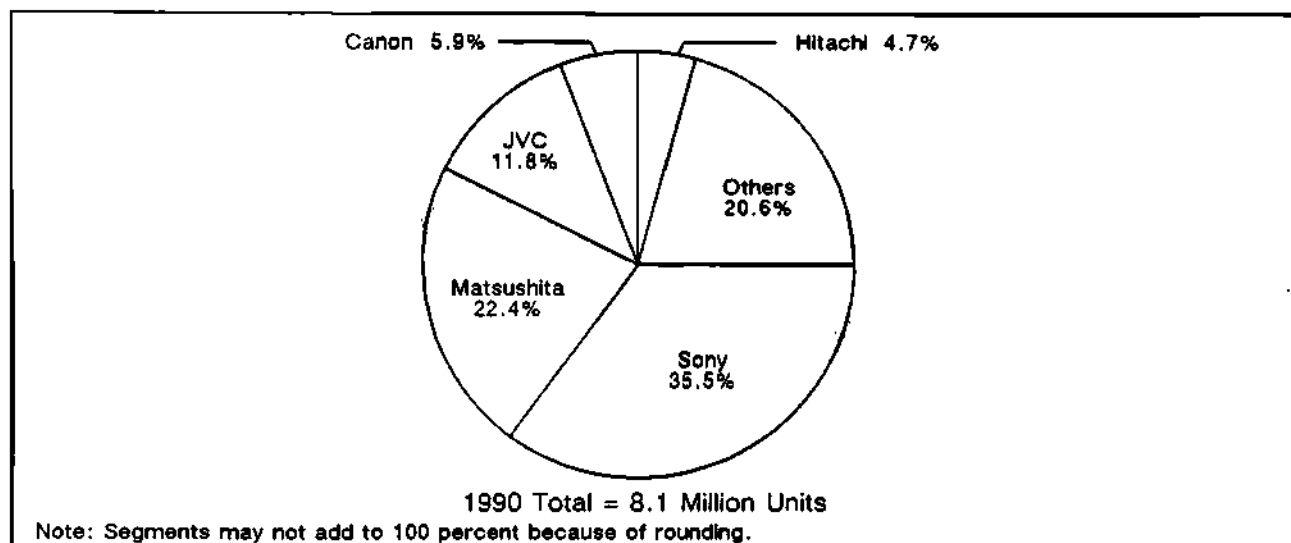
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JSAM Newsletters 1991-05

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FIGURE 2

## Estimated 1990 Japanese Video Camera Production Share



Source: Dataquest (March 1991)

by Matsushita and Victor in both the VCR and video camera markets. Number four video camera producer Canon had difficulty in the domestic market dominated by the big three AV giants and exported most of its production overseas to the U.S. and European markets. Although Canon's compact-size camera manufacturing technology is good, Dataquest believes that Canon is finding it difficult to catch up with the three AV market leaders, which are vertically integrated and produce their own semiconductors. Other vertically integrated companies such as Hitachi and Sanyo will attack the leaders, including Canon, in the near future. For example, Hitachi introduced twin-beam, autofocus 8mm video camera models E10 and H10, and Sanyo had the industry's first lunch box-shaped VMES88 ('ZEEMA' in Japan) applying fuzzy logic to both autofocus and iris architectures.

### EQUIPMENT PRODUCTION HISTORICAL TRENDS

The VCR market has experienced difficult times since 1986, whereas the video camera market has grown rapidly, except in 1989 (see Table 1). VCR production fluctuated between 30 million and 34 million units, reflecting a high penetration into more than 80 percent of homes. The average VCR unit price has declined dramatically in the last five years, from ¥49,000 to ¥34,900, which seems to be a stable price because of the value-added effect of broadcasting satellite (BS) tuning features. On the

TABLE 1  
Historical VCR and Video Camera Production

	1986	1987	1988	1989	1990
<b>VCR</b>					
Revenue (¥B)	1,659	1,243	1,212	1,135	1,076
Change (%)	-12.2	-25.1	-2.5	-6.4	-5.2
Units (M)	33.9	30.6	31.7	32.0	30.8
Price (¥K/Unit)	49.0	40.7	38.3	35.5	34.9
<b>Video Camera</b>					
Revenue (¥B)	417	483	645	613	737
Change (%)	17.8	15.8	33.5	-5.0	20.2
Units (M)	3.3	4.6	6.7	6.9	8.1
Price (¥K/Unit)	127.9	104.8	96.6	88.8	91.0
<b>Total</b>					
Revenue (¥B)	2,076	1,726	1,857	1,748	1,813
Change (%)	-7.4	-16.9	7.6	-5.9	3.7

Source: MITI, Dataquest (March 1991)

other hand, the video camera market showed double-digit-growth years four times in the last five years, except in 1989. In recovering from the 1989 slowdown, the 1990 market has reached a level two-thirds that of the VCR market.

Overall, these two video equipment markets reached bottom in 1987, with total production revenue of ¥1,726 billion. Since then, the combined

markets have been struggling to reach ¥2,000 billion in revenue. For example, 1990 production was ¥1,813 billion. Dataquest estimates that this temporary revenue target will be achieved in 1992, the year of the Olympics.

## SEMICONDUCTOR CONTENT ANALYSIS BY DEVICE

Dataquest estimates that the semiconductor market for VCRs and video cameras in 1990 was ¥331.4 billion in Japan, an increase of 4.2 percent over 1989. The total Japanese semiconductor market grew 3.0 percent in 1990 to ¥3,270 billion. Analyzing the semiconductor consumption on a device category basis, Dataquest estimates that analog IC revenue totaled ¥181.9 billion in 1990 (see Table 2). Analog ICs, mostly special-purpose ICs for consumer use or video equipment, made up more than half of the total semiconductor revenue.

Of the combined 1990 semiconductor revenue, ¥192.3 billion was for VCRs (a 3.7 percent decline over 1989), and ¥139.1 billion was for video cameras (a 17.4 percent growth over 1989). On a device category basis, the biggest VCR segment was analog ICs, which made up 54 percent of the total (see Figure 3). The largest video camera category is optoelectronics, nearly 35 percent of the total (see Figure 4). The MOS digital segment is no longer the biggest in the consumer equipment or

other equipment markets, although about one-third of all microcontroller units (MCUs) are used for consumer applications that include video equipment. Three MCUs typically are used in video equipment—two 8-bit MCUs and one for the system/servo-controller, autofocus and zoom, and record/play operation. Dataquest believes that the tendency for MCU applications is not to upgrade with the use of a 16-bit MCU, but to integrate by means of merging application-specific ICs (ASICs) and peripheral circuits to achieve a smaller package size.

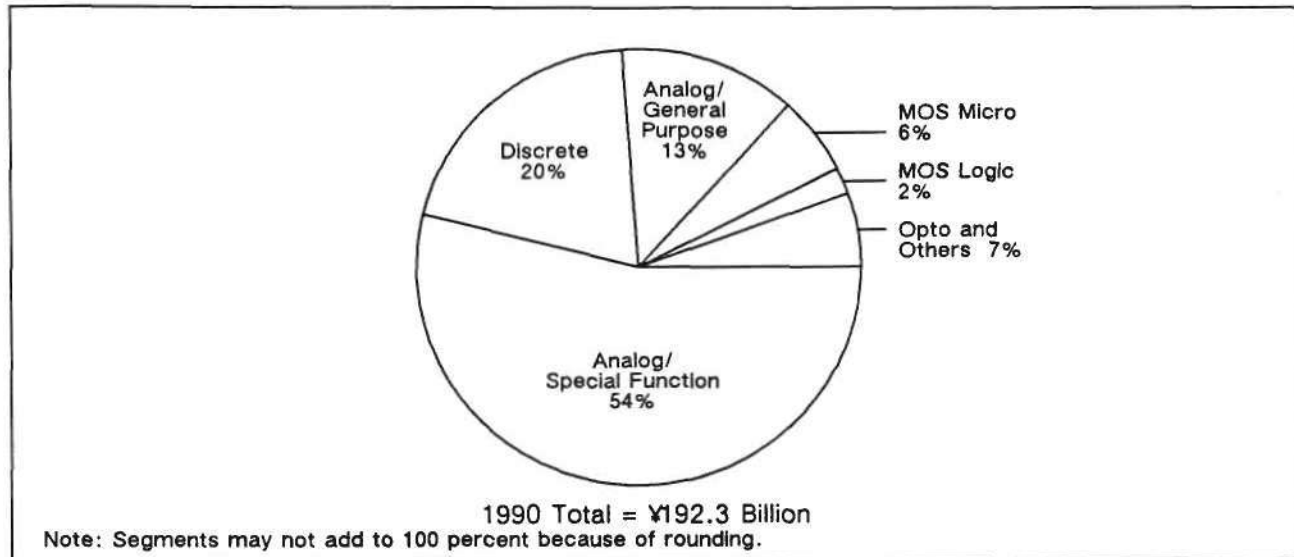
## SEMICONDUCTOR ANALYSIS FOR VIDEO CAMERAS BY FUNCTION

The four major video camera functional blocks are AV signal processing, drum and capstan motor drive, focus and zoom, and charge coupled device (CCD) image processing. Each block uses semiconductors in a different consumption configuration. For example, the signal processing block requires special-purpose analog ICs to realize its functions (see Figure 5). CCD image processing blocks use advanced optoelectronics devices such as 1/2-inch CCDs. For example, the size of Sony's 690g lightweight passport-size 8mm video camera, TR-45, using a 1/3-inch CCD with 270,000 pixels, is 108x104x168 millimeters. Dataquest believes that other 1/3-inch CCD cameras

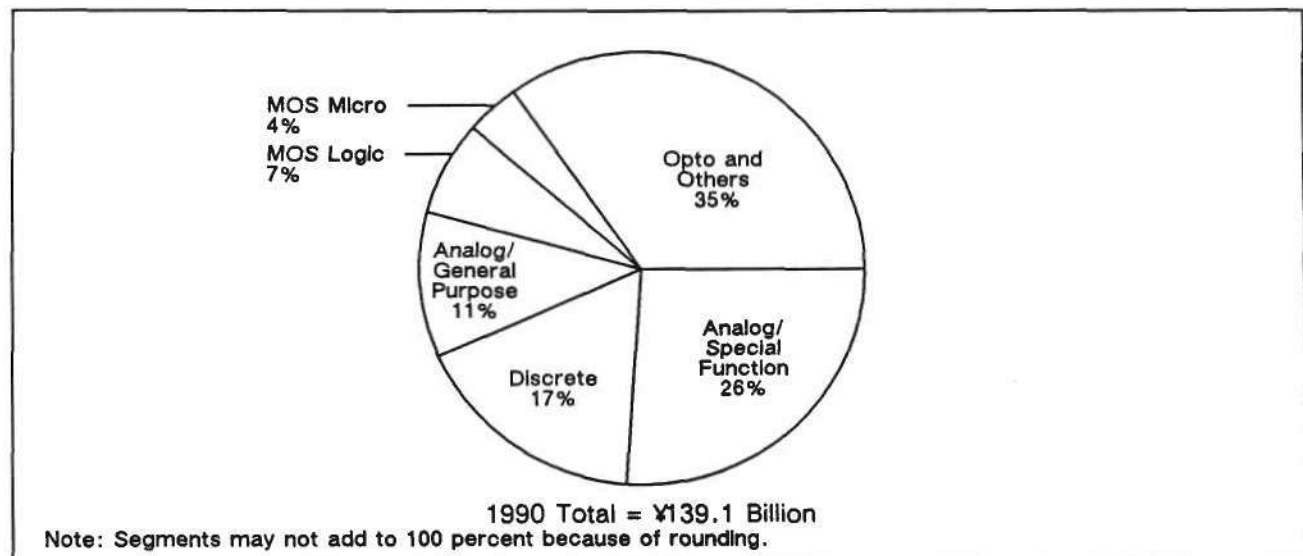
TABLE 2  
Estimated 1990 Semiconductor Market for VCR and Video Cameras

	Revenue (¥B)	Percent	VCRs (%)	Video Cameras (%)
MOS Digital	34.8	10		
Memory	2.4	1		
Micro	17.7	5	6	4
Logic	14.7	4	2	7
Analog IC	181.9	54		
General Purpose	41.3	12	13	11
Special Function	140.6	42	54	26
Discrete	61.8	19	20	17
Opto and Others	52.9	17	7	35
Total	331.4	100	100	100

Note: Columns may not add to totals shown because of rounding.  
Source: Dataquest (March 1991)

**FIGURE 3****Estimated 1990 Semiconductor Consumption for VCRs**

Source: Dataquest (March 1991)

**FIGURE 4****Estimated 1990 Semiconductor Revenue for Video Cameras**

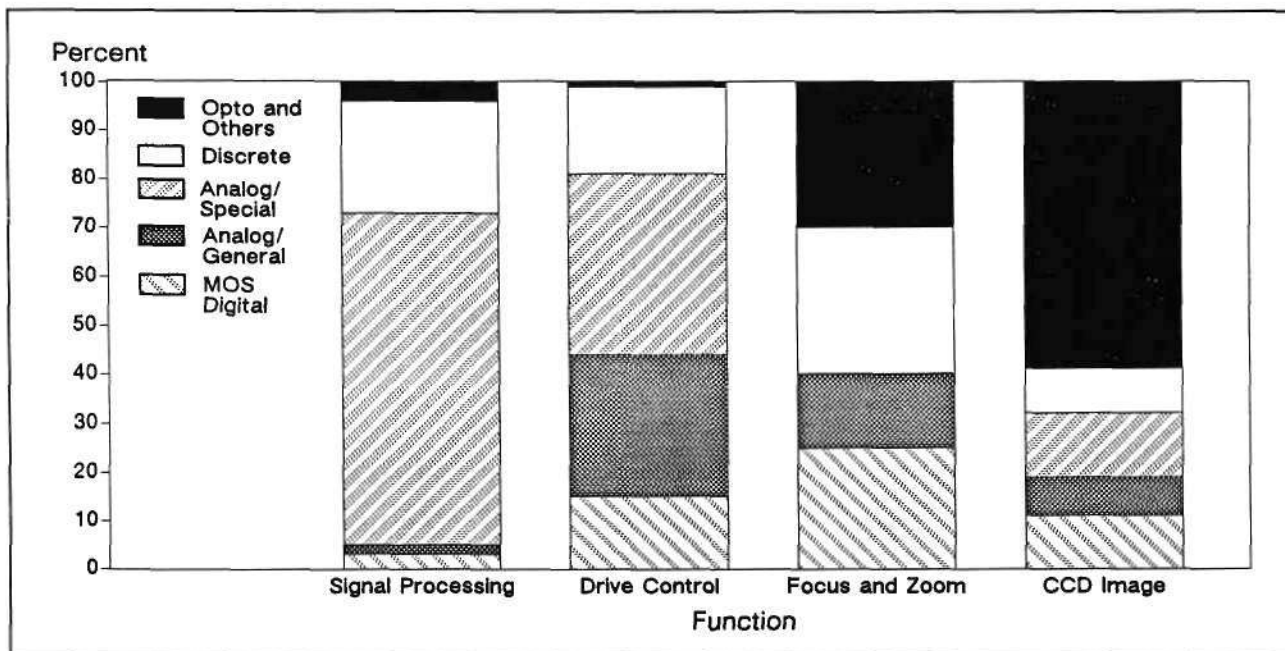
Source: Dataquest (March 1991)

will be introduced in 1991, some with 410,000 pixels. Another major trend that will emerge in the focus and zoom block is the use of a focusing method to change current drives from the outer lens to the inner lens. This technology will utilize a miniature stepping motor to minimize both package size and power consumption.

**SEMICONDUCTOR FORECAST**

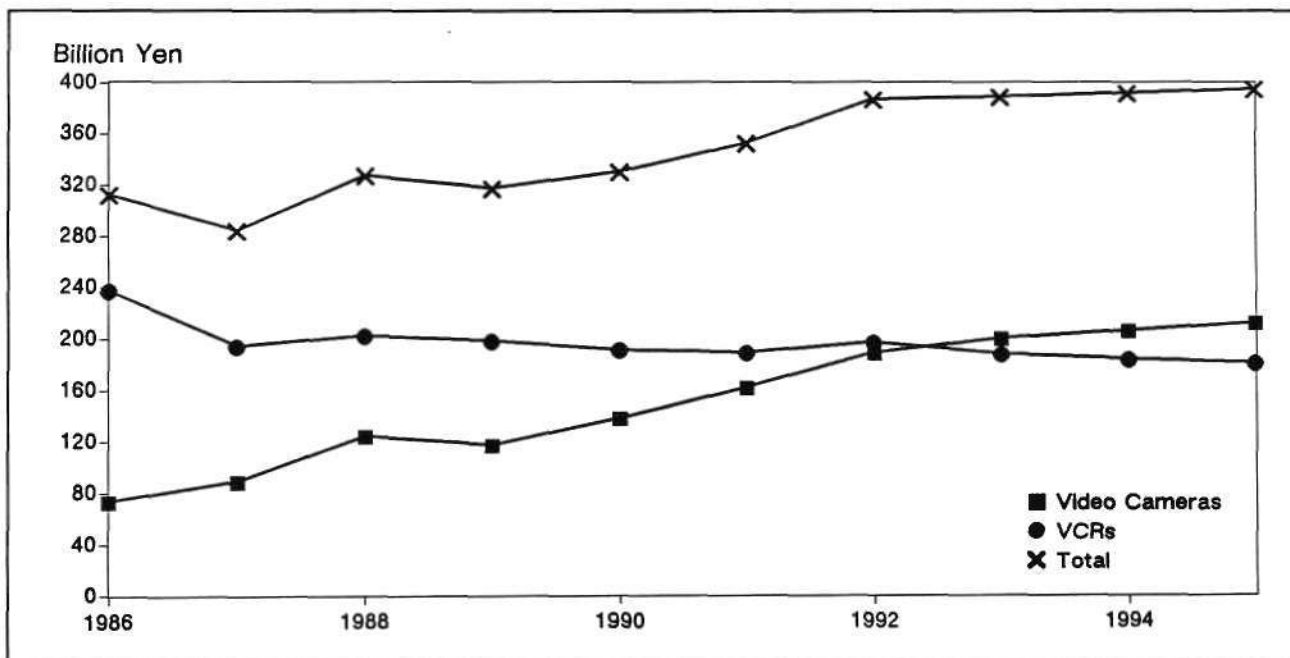
Semiconductor consumption for VCRs and video cameras reached bottom in 1987 with ¥285 billion, which was a 9 percent decline (see Figure 6). Consumption for VCRs will stay in the range between ¥180 billion and ¥200 billion, with

**FIGURE 5**  
**Estimated Device Share by Video Camera Function**



Source: Dataquest (March 1991)

**FIGURE 6**  
**Estimated Semiconductor Consumption for Video Equipment**



Source: Dataquest (March 1991)

the help of some value-added functions such as BS tuning and automatic commercial message (CM) cut recording editing introduced by Mitsubishi. On the other hand, revenue for video cameras will grow continuously, reaching ¥200 billion in the application market by about 1994. Revenue for video cameras likely will catch up with VCRs in about 1993. Combined consumption will move toward ¥400 billion.

## DATAQUEST CONCLUSIONS

The combined consumer application market segment for VCRs and video cameras has been important to semiconductor manufacturers, especially analog IC vendors. The market undoubtedly will maintain its important role for both consumer equipment and the semiconductor industry in the future, even if the video camera segment takes the number one position from VCRs. As it approaches ¥400 billion in semiconductor revenue over the next five years, the market will compare with the general-purpose computer market. Driving the market will be Olympic-year demand in 1992 and value-added functions such as the BS tuning and CM cut editing in conventional models. Furthermore, if the introduction of high-definition TV (HDTV) is successful in the consumer market, growth will be accelerated by digital VCRs.

Matsushita has developed a 2/3-inch CCD for HDTV cameras with 1.3 million pixels utilizing leading-edge technology such as 0.8-micron design rule. A session organized by an ISSCC '91 committee received five independent technical papers on video signal processors, all from Japanese companies: Fujitsu, NEC, NTT, and Sony. Matsushita and Sony are the current leading AV equipment manufacturers. Matsushita, Sanyo, and Sony controlled 25.4 percent of the ¥561.5 billion Japanese analog IC market in 1990 because of the advantages of being vertically integrated companies. Dataquest believes that those three companies will play important roles in the future.

However, despite having required digital video processing technology in addition to current analog technology, those consumer companies will possibly face challenges from more vertically integrated companies with advanced digital data or signal processing technology. Examples of the latter are Hitachi, Mitsubishi, and NEC, which are already positioned as second-tier AV companies and have the potential to become leading AV semiconductor vendors.

*Masanori Murata  
Kun Soo Lee*

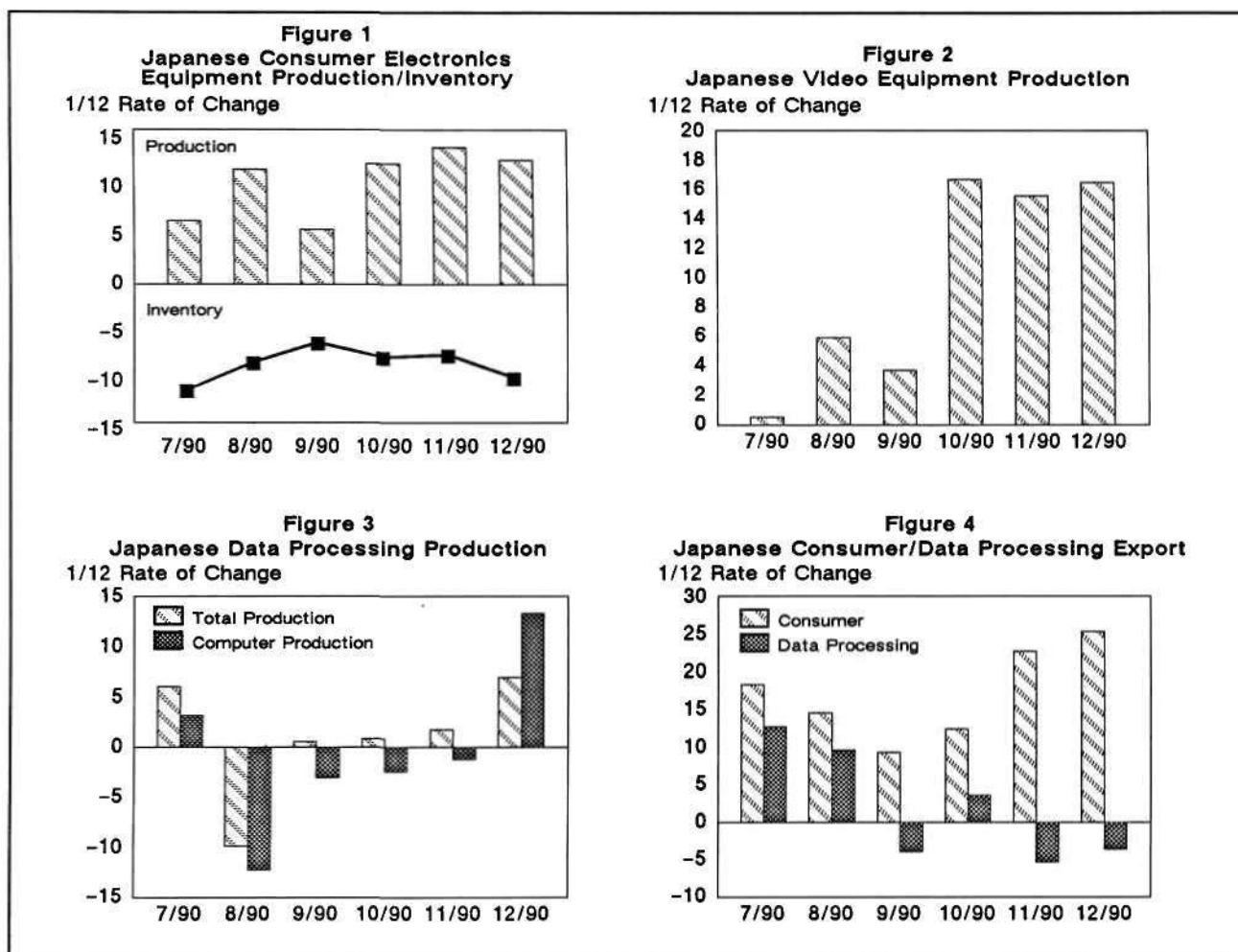


# Research *Bulletin*

## JSAMONITOR—FEBRUARY 1991

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Source: MITI, MOF, Dataquest (February 1991)



## THE EQUIPMENT MARKETS

### Consumer Equipment Production and Inventories

Japanese consumer electronic equipment production had a 12.9 percent growth rate in December 1990 over December 1989, which is favorable growth following the revised 14.2 percent growth in November 1990. Japanese consumer electronic equipment inventories had negative 10.2 percent growth in December compared with the negative 7.8 percent growth in November (see Figure 1). On a segment basis, video equipment (VCRs and video cameras) production had 16.5 percent growth in December compared with the revised 15.6 percent growth in November (see Figure 2). Video camera production and inventory had particularly high growth at 44.8 and 60.6 percent, respectively, in December. Color TV production and inventory had 8.3 and negative 10.5 percent growth, respectively, in December. In other segments, digital/audio disc player and LCD production had healthy growth of 15 and 29.5 percent, respectively, in December.

### Data Processing Equipment Production

Japan's data processing equipment production grew 7 percent in December 1990 over December 1989 from the revised 1.8 percent in November 1990 (see Figure 3). On a segment basis, computer production increased 13.4 percent in December 1990 over December 1989 (see Figure 3). General-purpose computers grew dramatically at 23.9 percent in December from the revised negative 13.6 percent in November. However, personal computer production in December declined 7.2 percent from the revised 18.8 percent growth in November.

## EXPORTS

### Consumer

Consumer electronic equipment exports in December grew 25.4 percent from 22.8 percent growth rate in November. The growth rates of

consumer electronic equipment exports for the United States, Europe, and Asia in December 1990 were 3.9, 32.7, and 44.5 percent, respectively, over December 1989.

### Data Processing

Data processing equipment exports had negative 3.6 percent growth in December from negative 5.3 percent growth in November (see Figure 4). The growth of total computer equipment exports was negative 6 percent in December, which is a slowdown from the negative 2.2 percent in November. On a regional basis, total computer equipment exports for the United States declined to negative 1.2 percent in December. Europe and Asia grew 4.7 and 38.6 percent, respectively, over December 1989.

## DATAQUEST CONCLUSIONS

Consumer production and inventories show that the market has been in good condition since 1990. Dataquest estimates that the annual growth ratio of consumer production in 1990 was 9 percent above 1989. The video camera market has been continuously expanding, with production and inventory both showing the highest growth ratio since January 1989. Data processing production grew at a rate of 7 percent. Dataquest believes that this growth is due to the introductions of new series by mainframe manufacturers such as the M-1800 Series from Fujitsu, the M-880 Series from Hitachi, and the ACOS-3800 Series from NEC. The quarterly growth ratio for data processing exports declined for the first time since the first quarter of 1990 at negative 1.8 percent, reflecting sluggish export growth for the United States.

*Kun Soo Lee*

# Research Newsletter

## FOREIGN SEMICONDUCTOR APPLICATIONS IN JAPAN—READY FOR MERCHANT SOLUTIONS?

### INTRODUCTION

In 1990, buying more foreign semiconductors was one of the major procurement activities in Japan, together with the "Import Now" campaign sponsored by the Ministry of International Trade and Industry (MITI). This newsletter reviews some typical design-wins in Japanese electronic equipment from several aspects of semiconductor applications.

### APPLICATION SEGMENTS

#### Data Processing Segment

Most of the personal computer (PC) microprocessors (MPUs) are made in the United States, mainly by Intel Corporation. The exception is the Japanese NEC V-series. In 1990, reduced-instruction-set computing (RISC) MPUs, such as SPARC, made their appearance in the fastest-growing computer market segment, namely workstations (WSs). Most of the Japanese computer vendors have been active in RISC business. Under those circumstances, Integrated Device Technology (IDT) increased its revenue in Japan in 1990 by ¥1 billion, representing more than 40 percent growth. Moreover, Japanese PC giant NEC will start manufacturing its new laptop RISC workstation in the United States next year. Dataquest believes that the RISC-type MPUs, together with conventional CISC-type (complex-instruction-set computing) MPUs, will continue to be major drivers for foreign semiconductor procurement in Japan.

#### Communications Segment

Corporate information networking has been one of the major communications business objectives for many years. Among the thousands of

kinds of key networking equipment, the facsimile, PBX (Private Branch Exchange), and carrier transmission equipment are the biggest. In designing such equipment, the six major domestic vendors—Fujitsu, Hitachi, Mitsubishi, NEC, Oki, and Toshiba—opened their doors to foreign IC vendors, especially for logic ICs. In this knowledge-oriented device category, Dataquest believes that AT&T will be able to take an important role in mixing its rich know-how on both device and network technologies. Indeed, AT&T jumped up to the 68th position in the 1990 preliminary Japanese market share rankings by Dataquest.

#### Consumer Segment

The Consumer semiconductor application segment occupies roughly about 30 percent of the Japanese electronic equipment production and 25 percent of the Japanese semiconductor consumption—second only to the Data Processing segment. Nevertheless, the two markets are rather different in that the Consumer application market is dominated by Japanese semiconductor vendors and the Data Processing market is not. Investigating the listed design-win examples in the Consumer segment, we find the majority to be custom-made logic ICs used in equipment produced in large quantities, such as video cameras and VCRs (see Table 1). Surely, those design-wins made a tremendous amount of additional revenue possible to the foreign IC vendors that could be satisfied with the revenue. However, all foreign IC vendors will not be satisfied with those logic IC design-wins because more than 40 percent of the application market consists of analog ICs. And this consumer analog IC area is no longer covered by foreign vendors, especially U.S. vendors that do not have a strong enough domestic consumer equipment market to maintain a full range of product lines.

**TABLE 1**  
**1990 Foreign Semiconductor Design-Win Examples by Application Segment**

Segment	Equipment Type	Device	IC Vendor
Data Processing	Supercomputer	Fast SRAM	Motorola
	Workstation	MPU	IDT, Performance
		RISC MCU	Intel
	PC	LCD driver	Texas Instruments
		CPU peripheral	Zilog
	Hard disk drive	Gate array	LSI Logic
	Flexible disk drive	Standard cell	Exar
	Optical disk	Mixed-mode IC	NCR, SGS-Thomson
Communications	POS terminal	Gate array	VLSI Technology
	Facsimile	ASIC	Texas Instruments
		ASIC	LSI Technology
		Gate array	National
		Full custom	AT&T
	ISDN terminal	Full custom	AMD
	TV telephone	DSP	Texas Instruments
	Carrier transmission	FIFO memory	IDT
		8-bit MCU	AT&T
		Mixed-mode IC	AT&T
Industrial	Sequencer	Gate array	VLSI Technology
Consumer	Video camera	8-bit MCU	Motorola
		Gate array	LSI Logic
		Signal processor	Texas Instruments
	VCR	Standard cell	Texas Instruments
		ASIC	LSI Logic
		Comb filter	Motorola
	TV	MCU	Philips
		Ghost canceller	ITT
	Audio	16-bit A/D conv.	Crystal
	CD player	Digital filter	Texas Instruments
	Air conditioner	8-bit MCU	Intel
Automotive	Engine controller	8-bit MCU	Motorola

Source: Dataquest (February 1991)

## DATAQUEST CONCLUSIONS AND RECOMMENDATIONS

In the 1990 Japanese semiconductor market, which had only 3 percent growth despite strong political tail winds, IC imports exceeded ¥300 billion and experienced a growth rate of more than 20 percent. It does not matter whether these winds

blow stronger in 1991 or not, in terms of the Data Processing market being considered an existing installed base for foreign MPU vendors. Therefore, Dataquest believes that the key issue in 1991 is the Consumer application market, which is dominated by vertically integrated Japanese consumer companies. Such integrated companies as Matsushita and Sony have internal major accounts

and consumer equipment manufacturing divisions; their captive semiconductor consumption ratios are as high as 60 percent. In principle, any design-wins could be foreign semiconductors instead of captive or domestic ones. However, one factor is the availability of analog application-specific standard products (ASSPs) for consumer applications by foreign IC vendors that no longer have their own domestic consumer market. As previously investigated, most of the design-wins are currently custom-made logic ICs and MPUs. MPUs tend to be continuously used in several equipment generations only with software program modifications,

but full-custom ICs and ASICs can be easily replaced in future generations for any possible merchant solutions, especially with ASSPs. Dataquest strongly recommends that foreign IC vendors work hard at staying in contact with Japanese consumer equipment companies in 1991 and beyond. Whether they have internal semiconductor-producing divisions or not, these vendors should maintain such contact not only in order to obtain new design-wins but also to be prepared for ASSP solutions in the near future.

*Masanori Murata*

# Research Newsletter

## 1990 JAPANESE SEMICONDUCTOR MARKET: STRUCTURE CHANGED?

### INTRODUCTION

Dataquest estimates that the Japanese semiconductor market grew 3 percent in 1990 to ¥3,270 billion. This percentage shows steady growth in the total market in 1990; however, there were some changes inside the market. For example, Japanese vendor revenue growth was only 1.8 percent, whereas non-Japanese vendor growth was 14.2 percent. Behind the growth rate difference between Japanese and non-Japanese vendors, was there any structural change in semiconductor vendor strategy for the Japanese market or in users' procurement policy? In this newsletter, Dataquest examines the difference in the 1990 Japanese market from both the vendors' and users' perspectives in order to avoid misunderstanding about the market.

### 1990 JAPANESE MARKET SUMMARY

The 1990 total market growth rate was a combination of a variety of growth rates among several device categories (see Table 1). The MOS micro and logic markets grew 17.3 and 13.3 percent, respectively. However, the biggest market category, that of MOS memory, declined 16.2 percent. This decline is due not only to a 1Mb DRAM price drop but also to rather weak demand for standard DRAMs for large computers. Dataquest estimates that the 1990 DRAM total bit consumption in Japan was approximately 265 trillion bits, which is only 22 percent growth over 1989. We believe that the 1990 market was not on the bottom of an ordinary silicon cycle but was affected by DRAM price and rather weak DRAM demand.

**TABLE 1**  
**1990 Japanese Market Summary by Product Category**  
(Billions of Yen)

Product	Sales Revenue (\$B)	Growth (%)	Imports (\$B)	Growth (%)
Bipolar Digital	262.8	8.9	45.4	21.1
MOS Memory	693.2	-16.2	61.6	19.3
MOS Micro	457.8	17.3	72.9	27.0
MOS Logic	573.6	13.0	43.8	34.0
Analog IC	539.9	5.8	78.9	8.4
Total IC	2,527.3	2.0	302.7	20.1
Others*	742.8	6.5	NA	NA
Total Semiconductor	3,270.1	3.0	NA	NA

\*Including discretes and optoelectronics

NA = Not available

Source: Dataquest (February 1991)

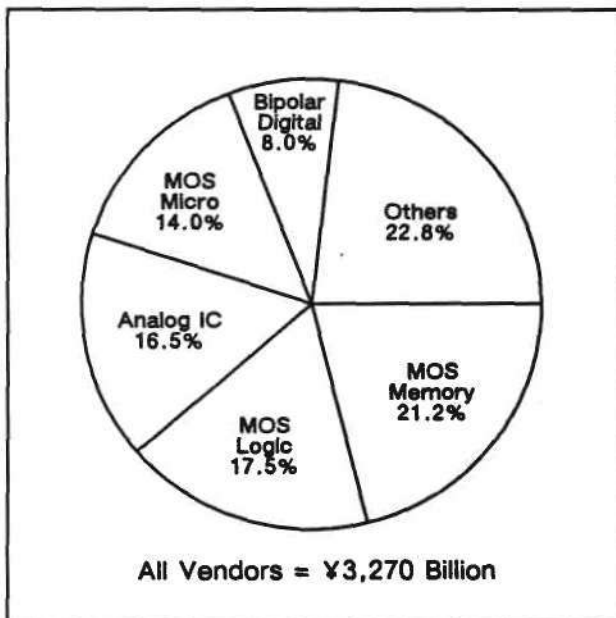


## NON-JAPANESE PRODUCT REVENUE IN JAPAN

Of the ¥3,270 billion semiconductor market in Japan, on a regional company basis, Japanese vendors' sales revenue was ¥2,896.7 billion after 1.8 percent growth, whereas non-Japanese vendors' revenue reached ¥343.4 billion after 14.2 percent growth. These revenue results bring us a 1990 non-Japanese revenue share of 11.4 percent in Japan, which is a 1.1 percentage point increase from 1989. This non-Japanese vendor share increase in Japan was anticipated by both the Japanese and non-Japanese semiconductor industries because of an improvement in access by non-Japanese vendors to the Japanese market.

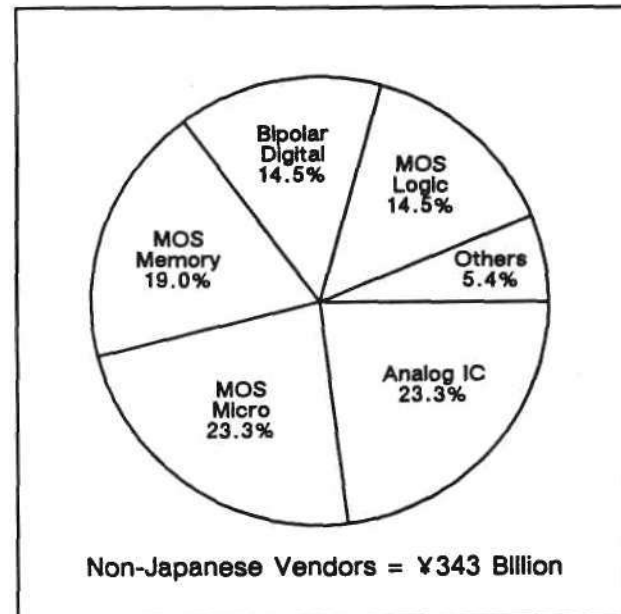
On a product category basis, the configuration of the non-Japanese revenue is quite different from that of the overall market. Figures 1 and 2 show revenue configurations by product category. Figure 1 shows that total Japanese consumption has two relatively large device categories, MOS memory and Others (discrete and opto), each of which exceeds 20 percent. Figure 2 shows that non-Japanese vendors' sales activities consist mainly of MOS micro and analog ICs; each category has a 23.3 percent share. Comparison of the two figures shows that non-Japanese vendors are quite

**FIGURE 1**  
1990 Japanese Market Revenue by Product—  
All Vendors



Source: Dataquest (February 1991)

**FIGURE 2**  
1990 Japanese Market Revenue by Product—  
Non-Japanese Vendors



Source: Dataquest (February 1991)

competitive in the bipolar digital segment and are rather weak in the discrete and opto arenas.

## JAPANESE IC IMPORTS

Dataquest estimates that 1990 Japanese total IC imports grew 21.1 percent and reached ¥300 billion (see Table 1), whereas exports declined 4.1 percent to ¥915.6 million. More than two-thirds of total IC imports were from the United States; this region had 19.5 percent growth in 1990 to ¥209.3 billion. On a device category basis, MOS micro imports totaled ¥72.9 billion with 27 percent growth mainly from the United States, which had ¥67.9 billion and 24.6 percent growth. MOS logic imports showed 34 percent growth, the highest of the five device categories. MOS micro and logic sales revenue growth rates of 17.3 and 13.0 percent, respectively, are much higher than those of the total Japanese market. Dataquest believes that these growth rates are two main reasons why non-Japanese vendors obtained their 1990 share in Japan. Another main reason is MOS memory imports, which increased despite the fact that the Japanese MOS memory market shrank by 16.2 percent.

## SEMICONDUCTOR PROCUREMENT IN JAPAN

In order to compare the 11.4 percent revenue share by non-Japanese vendors in Japan with the 22 percent of North American market share by Japanese vendors (see Dataquest's Semiconductor Group newsletter number 1991-01 "Preliminary 1990 Worldwide Semiconductor Market Share Estimates: The Microprocessor Reigns"), we must examine the semiconductor procurement structure in Japan. Japanese companies are known for their vertical integration strategies, and most major Japanese merchant semiconductor vendors are also electronic equipment manufacturers that procure a certain amount of semiconductors internally. These companies produce semiconductors not only for captive use but also for worldwide clients. Table 2 summarizes 1990 semiconductor sales and procurement activities by Japanese companies. Five major electronic appliance companies—Fujitsu, Hitachi, Mitsubishi Electric, NEC, and Toshiba—are represented (see Major 5 column in Table 2) as are four major consumer companies—Matsushita, Sanyo, Sharp, and Sony (see Consumer 4 column).

### All Japanese Companies

Japanese vendors did not do very well in both worldwide and domestic semiconductor sales in 1990. Their worldwide and domestic sales increased only 1.2 and 1.8 percent, respectively. Their worldwide and domestic market share decreased to 49.5 percent from 52.1 percent and to 88.6 percent from 89.7 percent, respectively. However, captive sales were ¥935.9 billion, up 7.7 percent from 1989. The captive sales ratio was 22.5 percent in 1990, nearly one-fourth of total sales activities. Dataquest believes that merchant sales fell below expectations, but internal captive sales held to plan.

Japanese vendors' total semiconductor consumption and procurement activities in 1990 were estimated to be consumption of ¥2,954.9 billion and merchant procurement of ¥2,019.0 billion, representing 2.6 percent and 0.4 percent increases, respectively, from 1989. When we take the average captive procurement ratio of 31.7 percent into consideration, we find that Japanese system equipment manufacturers consume almost one-third of their own semiconductor production. This captive procurement ratio together with the 22.5 percent captive sales ratio shows that Japanese companies are more dependent on captive use as users than as suppliers.

Japanese system equipment manufacturers purchased 10.8 percent more chips of foreign origin in 1990 than they did in 1989, which is an outstanding growth percentage compared with the merchant procurement growth of 0.4 percent.

### Major 5 Versus Consumer 4

The nine companies (the Major 5 and Consumer 4 in Table 2) involved in both captive and merchant sales activities among the top 20 semiconductor vendors in Dataquest's preliminary estimated market share ranking (refer to the newsletter mentioned previously) provide a typical example of vertically integrated Japanese companies. These nine companies control more than ¥2,500 billion (more than 85 percent) of Japanese semiconductor market and represent almost one-half of Japanese consumption (see Table 2).

Basically, the Major 5 represent the sales configuration of all Japanese companies; their domestic and captive sales ratios are roughly two-thirds and one-fifth, respectively. And, relying heavily on captive sales, the Consumer 4 receive 78.5 percent of sales revenue from the domestic market. Captive procurement ratios of both the Major 5 and the Consumer 4 exceed 50 percent, partly because they have their own internal supply sources. Of their merchant procurement, about one-third consists of semiconductors of foreign origin.

### DATAQUEST CONCLUSIONS

Captive semiconductor production by electronic system equipment manufacturers is not unique to Japan. The United States has captive semiconductor manufacturers such as Hewlett-Packard and IBM. The difference is how much they sell outside the company as merchant sales. Dataquest believes that Japan companies with revenue of over ¥2 trillion have semiconductor consumption of ¥3 billion, purchasing one-third of their semiconductors from captive semiconductor-producing divisions and two-thirds from the merchant semiconductor market.

Of the thousands of equipment-producing divisions inside a Japanese company of this size, some have their own strong semiconductor-producing divisions, which are good at producing not only for captive use but also for worldwide merchant sales, including exports to the United States. Unfortunately, the divisions control more than 20 percent of the North American merchant

**TABLE 2**  
**1990 Japanese Company Semiconductor Activity**

	All Companies	Major 5	Consumer 4
Worldwide Sales (Billions of Yen)	4,162.3	2,776.5	843.5
Percent Change from 1989	1.2 up	3.4 up	10.0 up
Domestic Sales (Billions of Yen)	2,896.7	1,852.4	662.5
Percent Change from 1989	1.8 up	3.8 up	6.3 up
Domestic Ratio (%)	69.7	66.7	78.5
Captive Sales (Billions of Yen)	935.9	564.3	303.6
Percent Change from 1989	7.7 up	6.7 up	6.5 up
Captive Ratio (%)	22.5	20.3	36.0
Consumption/Procurement			
(Billions of Yen)	2,954.9	977.3	495.8
Percent Change from 1989	2.6 up	3.9 up	0.6 up
Captive Ratio (%)	31.7	57.7	63.5
Merchant Procurement			
(Billions of Yen)	2,019.0	413.0	192.0
Percent Change from 1989	0.4 up	0.2 up	7.7 down
Foreign Origin (Billions of Yen)	322.5	136.3	71.6
Percent Change from 1989	10.8 up	6.5 up	28.3 up
Foreign Ratio (%)	16.0	33.0	37.3

Source: Dataquest (February 1991)

market, excluding IBM and others maintaining intensively captive semiconductor-producing divisions. Because such companies are concerned about the foreign semiconductor vendors' market share in Japan, they try to import more ICs; the big nine now purchase one-third of their semiconductors from foreign vendors, mainly from U.S. semiconductor vendors. However, counting up not only merchant sales but also captive sales as a part of the Japanese market revenue, so far a ¥2 trillion company has not reached 20 percent of foreign semiconductor procurement.

Because captive sales revenue is not counted in the United States, the North American market is in a sense underwhelmed. On the other hand, without such huge intensively captive semiconductor

divisions as the IBM General Technology Division, the Japanese market tends to be misunderstood and overwhelmed. Excluding the Japanese captive sales revenue, only two-thirds of the total ¥3,270 billion sales revenue in Japan should be considered as merchant sales, at the same level definition as in the United States. Moreover, this remaining merchant portion is open for all domestic merchants and foreign semiconductor vendors. Dataquest believes that without a common understanding of the real Japanese market and vendors' structure, the Japanese manufacturers and foreign vendors will fail to achieve mutual agreement in the near future.

*Masanori Murata*

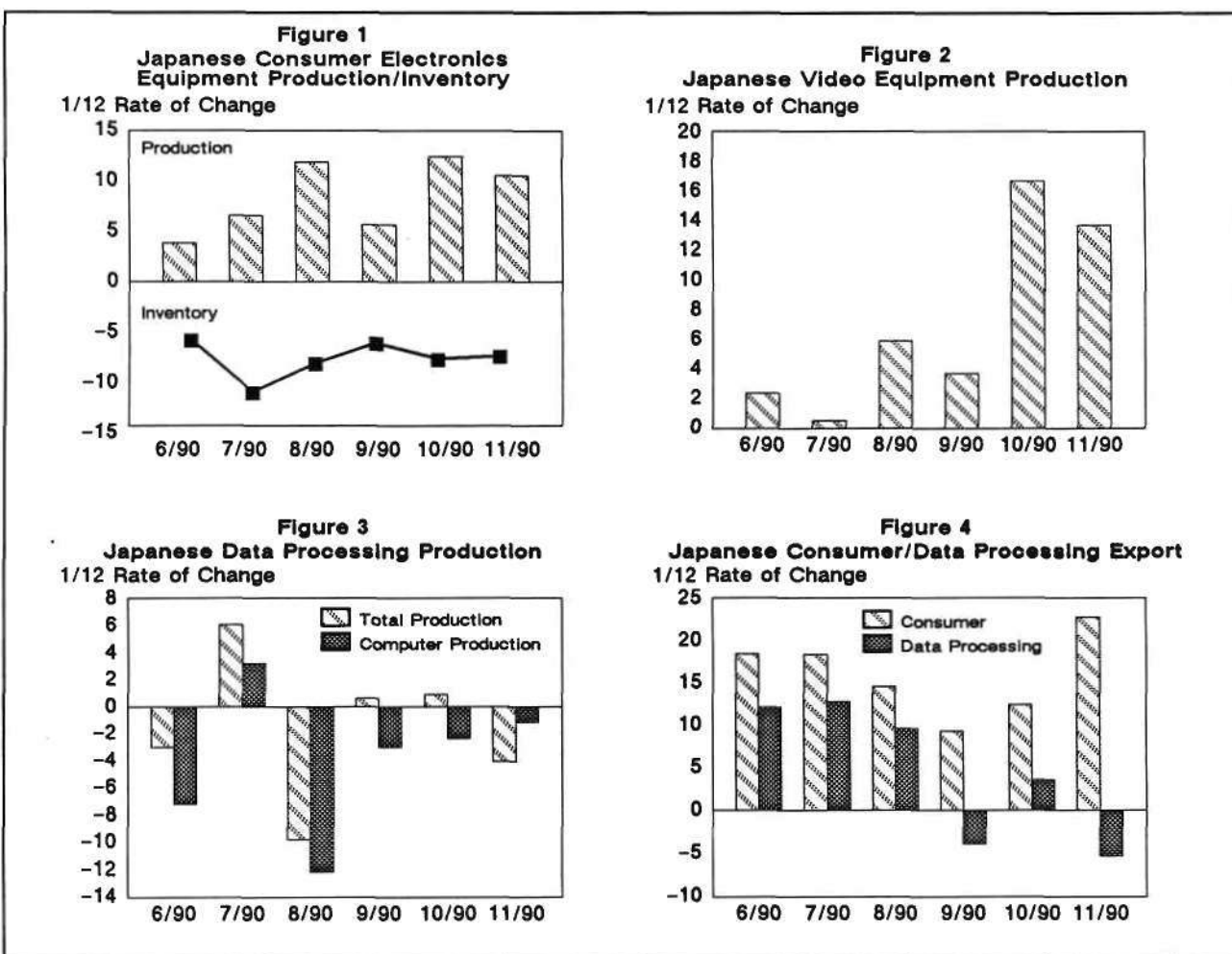


# Research *Bulletin*

## JSAMONITOR—JANUARY 1991

This research bulletin is a monthly update that monitors changes in key Japanese electronic equipment markets. This publication presents important tactical leading indicators in semiconductor business activity. The sources for the graphs are the Japanese Ministry of International Trade and

Industry (MITI) and the Japanese Ministry of Finance (MOF) (see Figures 1 through 4). The commentary and analysis are solely those of Dataquest. The data points for October 1990 have been restated in this issue.



Source: MITI, MOF, Dataquest (January 1991)

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JSAM Newsletters 1991-1

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## THE EQUIPMENT MARKETS

### Consumer Equipment Production and Inventories

Japanese consumer electronics equipment production grew at a rate of 10.6 percent in November 1990 over November 1989 and was a decrease from the revised 12.5 percent growth rate in October 1990. Japanese consumer electronics equipment inventories declined 7.8 percent in the same period, showing a slowdown from the negative 8.1 percent in October (see Figure 1). On a segment basis, the production pace of video equipment (e.g., VCRs and video cameras) slowed, representing a 13.7 percent growth rate in November compared with 16.7 percent growth in October (see Figure 2). Video camera production, however, has been brisk, growing at a rate of 39.0 percent in November; on the other hand, its inventory also rose by 37.4 percent. Color TV production and inventory showed 7.8 percent and negative 3.5 percent growth rates, respectively, supported by active exports.

### Data Processing Equipment Production

Japanese data processing equipment production had a negative 4.1 percent growth rate in November 1990 over November 1989, which was a slowdown from the revised 0.9 percent growth in October (see Figure 3). Computer production continued to slow at a negative 1.2 percent growth rate in November. On a segment basis, PC production in November grew at a rate of 18.4 percent from the revised 2.2 percent growth rate in October. Word processor production had a 7.8 percent growth rate in November, showing a recovery from the revised negative 3.1 percent growth in October. I/O device, terminal equipment, and copier production grew at rates of 8.4, 18.7, and 14.4 percent, respectively. General-purpose computer and data storage production declined at rates of 13.6 and 14.2 percent, respectively, in November 1990 from November 1989.

## EXPORTS

### Consumer

Consumer electronics equipment exports grew 22.8 percent in November 1990 over November 1989, showing a continuous increase from 12.5 percent growth in October. The growth rates of consumer electronics equipment exports for the United States, Europe, and Asia were 3.6, 30.4, and 48.6 percent, respectively, during this period. Color TV exports grew at a rate of 41.9 percent. Exports to Asian countries recorded 91.3 percent growth in November. China had especially strong growth at 357.3 percent.

### Data Processing

Data processing equipment exports had a negative 5.3 percent growth rate in November, which was a decline from positive 3.9 percent growth in October (see Figure 4). The growth rate of total computer equipment exports was negative 2.2 percent in November compared with 0.2 percent in October. On a regional basis, total computer equipment exports for the United States, Europe, and Asia were negative 7.5 and 7.8 percent and positive 17.9 percent, respectively, in November 1990 from November 1989.

## DATAQUEST CONCLUSIONS

Consumer electronics equipment production and inventory figures indicate that the market is in good condition. The video camera market in particular has been expanding quickly. Dataquest expects the 1990 video camera production growth rate to be 19.6 percent over 1989. Manufacturers are increasing video camera production in response to strong demand. Color TV production also grew steadily because of the increase of exports to Asian countries since July 1990. However, a decline in data processing exports caused negative growth of total data processing production in November. Computer exports for the United States and Europe were especially sluggish.

*Kun Soo Lee*



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# Japanese Semiconductor Application Markets Newsletters

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# Research *Bulletin*

## JSAMONITOR—DECEMBER 1990

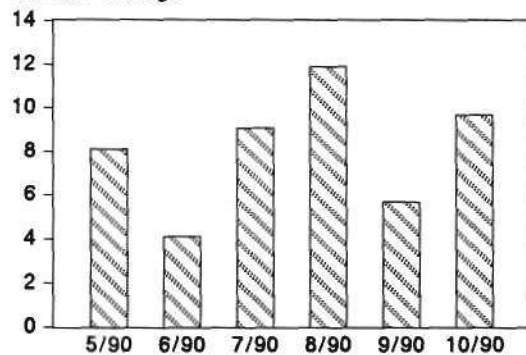
### THE EQUIPMENT MARKETS

#### Consumer Equipment Production

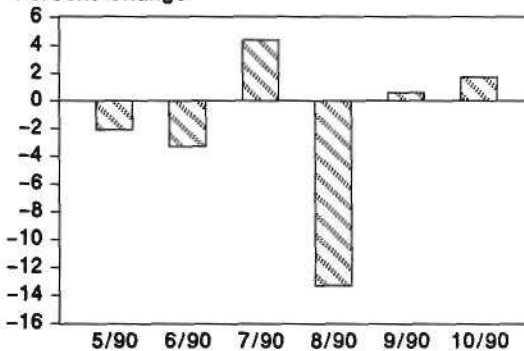
Japanese consumer equipment production continued to grow at a rate of 9.7 percent in October, increasing from a revised 5.7 percent growth in September (see Figure 1). On a segment basis, videocamera and digital audio disc player

production grew at rates of 37.0 and 20.8 percent, respectively, over October 1989. LCD TV production had an 8.8 percent growth rate in October compared with a revised negative 3.8 percent growth rate in September. VCR production in October had a 0.2 percent growth rate compared with a revised negative 8.2 percent growth rate in September.

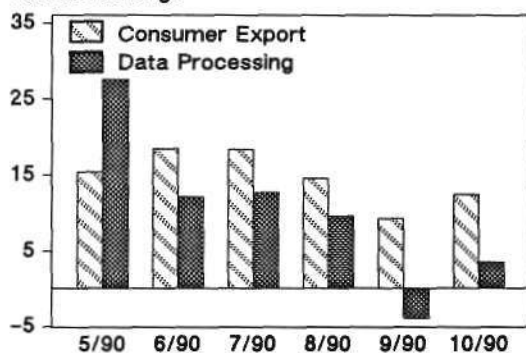
**Figure 1**  
Japanese Consumer Electronics Production  
Percent Change



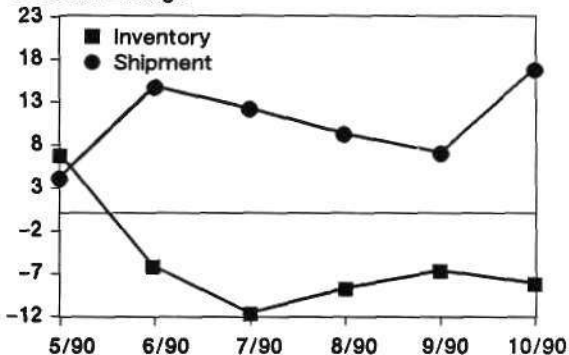
**Figure 2**  
Japanese Data Processing Production  
Percent Change



**Figure 3**  
Japanese Data Processing/Consumer Export  
Percent Change



**Figure 4**  
Japanese Consumer Inventory/Shipment  
Percent Change



Source: MITI, MOF, Dataquest (December 1990)

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JSAM Newsletters 1990-27

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## Data Processing Equipment Production

Data processing equipment production had a 1.7 percent growth rate in October 1990 over October 1989. This increase was a slow recovery following the revised 0.6 percent in September (see Figure 2). On a segment basis, personal computer production in October grew 2.7 percent, which is a decline from 12.1 percent growth in September 1990. General-purpose computer and data storage production had negative 5.0 and 10.7 percent growth rates, respectively, in October. On the other hand, I/O devices, terminal equipment, and copiers grew at rates of 10.2, 18.1, and 9.6 percent, respectively, in October.

## EXPORTS

Consumer equipment exports in October grew 12.5 percent, which is an increase from the 9.3 percent growth in September. Data processing equipment exports had 3.6 percent growth in October, which is a recovery from negative 3.9 percent in September (see Figure 3). The growth of consumer equipment exports for the United States, Europe, and Asian countries were negative 5.0 percent and positive 14.6 and 48.2 percent, respectively, over October 1989. The growth rate of total computer equipment exports was 0.2 percent in October compared with negative 10.4 percent in September. On a regional basis, the United States, Europe, and Asia were negative 8.1 percent and positive 7.8 and 22.6 percent, respectively, over October 1989.

## INVENTORIES AND SHIPMENTS

Consumer electronic equipment inventories declined 8.1 percent in October 1990 over October

1989 (see Figure 4). Consumer electronic equipment shipments had a 17.2 percent growth rate in October 1990. VCR inventories and shipments had negative 35.7 percent and positive 15.1 percent growth, respectively, in October 1990, indicating that the VCR market was under control. Videocamera inventory and shipment data showed 39.1 and 31.0 percent growth rates, respectively, in October 1990.

## DATAQUEST CONCLUSIONS

The consumer electronics production growth rate of 9.7 percent in October indicates a recovery from the slowdown in September. Videocamera production is in a healthy condition and recorded the highest growth rate in October since May 1990. VCR inventory growth has turned into negative numbers since May 1990 and reached the lowest growth rate in October in two years. VCR production seems to be well controlled, and the market is ready for the next new products. In the third quarter of 1990, digital audio disc player inventory and shipment growth recorded 21.6 and 20.4 percent, respectively, indicating that the market has been quickly expanding. Dataquest believes that favorable growth for total consumer electronic equipment shipments was a result of current prosperity in the Japanese economy. Regarding data processing equipment, I/O device production grew both in September and October. The increase in computer exports in October was due to a recovery of the exports for the United States and healthy export growth for Asian countries.

*Kun Soo Lee*



# Research Newsletter

## DATA SHOW JAPAN 1990

### INTRODUCTION

The 18th annual Data Show was held at the Tokyo International Trade Fair Center in Harumi on October 22 through 25, 1990. A total of 180 companies participated, a 14 percent increase over 1989. The total exhibition area was 18,360 square meters, the largest in the show's history. The number of visitors also reached an all-time high—230,200—up 7 percent from the previous year. A particularly notable element in this year's show was the large number of exhibitors from nonelectronic industries, such as steel and textiles; 42 companies were represented, or 23 percent of the total.

Major products displayed at the show were as follows:

- "Palmtop" personal computers, which are further miniaturized versions of the increasingly popular notebook-type PCs and offer even lighter weights and more ease in carrying, were displayed by various PC makers.
- Electronic schedulers were exhibited by NEC and other latecomers (following the two leaders, Casio and Sharp), indicating intensifying competition in this segment, with fully developed hardware and software to meet growing and diverse market demands.
- Fujitsu, Hitachi, and IBM displayed UNIX systems on their workstations.
- Fujitsu, IBM, and others presented multimedia systems.
- Cannon, NEC, Ricoh, and Toshiba displayed G4 facsimiles as their preparation for ISDN.
- Electronic file systems using new data storage systems that include magnetic tapes and optical discs were shown.

### PALMTOP PERSONAL COMPUTERS

Fujitsu, Kyocera, NEC, and Sony announced palmtop computers that featured extremely compact sizes and were very lightweight. All palmtops were equipped with 16-bit CPUs and operate on MS-DOS, which distinguishes them from electronic schedulers. They also emphasize portability with a non-AC power source, compact size, and light weight (see Table 1). This type of PC will open up a new horizon for business activities, and Dataquest expects an increasing demand for palmtop PCs with diverse business applications. Also, Dataquest analysis indicates a coming wave of technological innovation marked by an increase of processing speed from use of high-performance CPUs and augmentation of memory capacity, together with further size reduction and energy-saving technologies.

### ELECTRONIC SCHEDULERS

Dataquest anticipates that electronic schedulers will be popular because of their light weight, small size, low price, and ease of operation, all of which are expected to more than compensate for performance, which is not much higher than that of palmtop PCs. Currently, manufacturers are rushing new products to market, and the availability and variety of IC cards based on application software seem to hold the key to success. Currently, Sharp, a forerunner in this market, is leading by offering 52 types of application software (not including a basic software package). Casio, on the other hand, is eyeing a niche market or application software cards that allow users to input their own data by developing three kinds of RAM memory cards, making a total of ten kinds of cards (see Table 2).

**TABLE 1**  
Specification Comparison of Palmtop PCs

Reference Number	PC98HA	KX-1601	FMR-NBC1A.B	PTC-500
Product Name	Handy 98	Refalo	FMR-CARD	Palmtop PTC-500
Manufacturer	NEC	Kyocera	Fujitsu	Sony
Size (mm)	234x148x36	190x144x42	295.0x210.0x26.5	205x158x45
Weight (kg)	1.10	0.75	0.99	1.30
CPU	V50	V30	80C286	68HC000
Clock Frequency (MHz)	10	9.54	8 MHz/4 MHz	8.00
Memory (KB)	640	320	640	320
Power	DC12V/U3 battery	AC/U4 battery	AC/U3 battery	DC6V/9V
Working Time (Hours)	7	8	8	6
Special Features	Resume function RAM driver (1.25MB)	IC card slot 2* Lightest weight	IC-card slot 2* Long working time	Input by hand ROM (2.0MB)

Source: Dataquest (December 1990)

**TABLE 2**  
Specification Comparison of Electronic Schedulers

Reference Number	PA-9500	DK-5500	ET
Manufacturer	Sharp	Casio	NEC
Size (mm)	167x100x13.8	157x83x18	150x90x19
Weight (g)	245	210	270
Display (Dot)	192x145	191x48	160x64
Memory (KB)	64	32	32
IC Card Software	ROM38/ROM+RAM14	ROM7/ROM+RAM3	ROM8/ROM+RAM1
Special Features	Input by hand	FSTN display*	Bar-code input

\*Film super-twisted nematic

Source: Dataquest (December 1990)

## DATA STORAGE

A variety of data storage systems, described in the following paragraphs, attracted much attention at the show.

## DATA-DAT System

Victor displayed its DAT-based system, which boasted an overwhelming capacity (1.3 gigabytes) and demonstrated possible applications to medium-



and larger-size computers. The DAT system is used increasingly for workstations and other midrange systems, and Dataquest expects further increase in use. Aiwa showed a tape data storage system based on the QIC-80 standard, which would offer 120MB capacity for midrange systems. An alternative to the DAT Digital Storage (DDS) standard is used by Hewlett-Packard and Sony; the DAT standard also is used by Hitachi, Sharp, and Victor. Pioneer exhibited an optical disc system with a CD ROM drive, which provided access to six CDs by using a changer.

### Hard Disk Drive

Hard disk drives were displayed by Fuji Electric, Toshiba, Victor, and others. The 2.5-inch hard disk drive system clearly is targeted toward notebook-type PCs by emphasizing space-saving and earthquake-proof features along with further increases in storage capacity.

### G4 Facsimile

Demand is increasing for networking high-performance computers and peripherals that are used individually. ISDN-related display by several companies addressed such demand. The most feasible products were G4 facsimiles by Canon, NEC, Ricoh, and Toshiba. A major new feature on G4 fax was a reduction to one-half of the transmission time of the G3 facsimile with each maximum performance (see Table 3).

### Office Automation

Major displays included multifunctional copiers by Fuji Xerox and Ricoh, which addressed an increasingly diverse need for an office environment that emphasizes space saving.

### DATAQUEST CONCLUSIONS

Data Show 1990 depicted two major trends. The first is the move toward integrating operating systems according to equipment size and type. Examples include UNIX for workstations and MS-DOS and OS/2 for PCs, by a data compatibility between different makes that are with the same OS (Operation System) and Application software. Another trend is to propose a direction of system development in the advanced information society based on multimedia communications and ISDN networks, i.e., computers will be required to make relationships for each other in an information society. They also must arrange networking and integration environments around other computers. While demonstrating the rapid advancement of computers and other electronic systems, Data Show 1990 suggested that a new wave of networking will extend to personal equipment that has been increasingly underutilized because of improved performance. Dataquest believes that the development of an environment to facilitate interequipment communication is a pressing necessity for today's computerized society.

*Kun Soo Lee*

**TABLE 3**  
Specification Comparison of G4 Facsimiles

Reference Number	Laser 4500i	RIFAX D7000	TF-777IP/888IP	NEFAX D800
Manufacturer	Canon	Ricoh	Toshiba	NEC
Transmission Time* (second)	3	3	3	3
Sending Speed (bps)	64K	64K	64K	64K
Scanning Density (ppi)	400	400	400	400
Hard Disk Memory (MB)	20	20	20	20
VRAM (MB)	6	NA	NA	NA
Printing Method	Electric photography	Electric photography	Electric photography Thermal transfer	Electric photography

\*Sending time for one sheet of A4 paper

NA = Not available

Source: Dataquest (December 1990)

# Research *Bulletin*

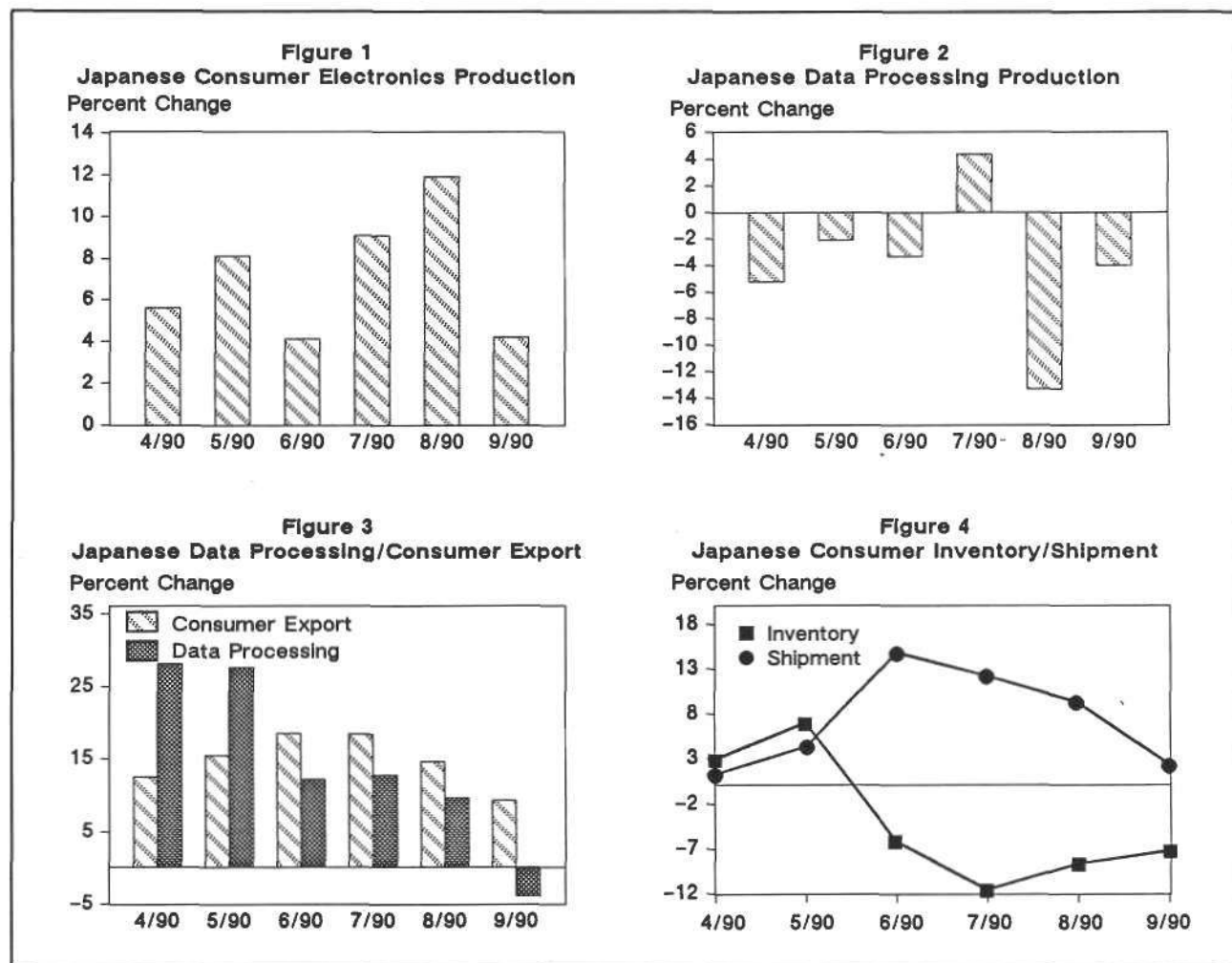
## JSAMONITOR—NOVEMBER 1990

### THE EQUIPMENT MARKETS

#### Consumer Equipment Production

Japanese consumer equipment production continued to grow at a rate of 4.2 percent in September, which decreased from the revised 11.9 percent growth in August (see Figure 1). On a

segment basis, digital audio disc player and video camera production grew at rates of 29.1 and 21.9 percent, respectively, over September 1989. LCD TV production had a growth rate of 0.8 percent in September compared with a 31.0 percent growth rate in August, which is a 30.2 percent decline from August to September. VCR production in September had a negative



Source: MITI, MOF, Dataquest (November 1990)

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10.0 percent growth rate compared with negative 4.8 percent growth in August. Color TV production had a growth rate of 3.1 percent in September.

### **Data Processing Equipment Production**

Data processing equipment production had a negative 4.0 percent growth rate in September compared with September 1989, which is a recovery from the revised negative 13.3 percent growth rate in August 1990 (see Figure 2). On a segment basis, PC production in September 1990 increased 11.4 percent over September 1989, which is a recovery from the 0.2 percent growth in August 1990 over August 1989. General-purpose computer and data storage production had negative 10.5 and negative 8.5 percent growth, respectively, in September. Electrical cash register production grew at a rate of 31.3 percent in September compared with negative 2.3 percent growth in August.

### **EXPORTS**

Consumer equipment exports in September grew at a rate of 9.3 percent, which is a slowdown from the 14.6 percent growth in August. Data processing equipment exports had negative 3.9 percent growth in September, which is a decline from the 9.6 percent growth in August (see Figure 3). Consumer equipment export growth rates for the United States, Europe, and Asian countries were negative 3.1 percent and positive 20.6 and 30.2 percent, respectively, over September 1989. The growth rates of computer equipment exports for the United States, Europe, and Asian countries were negative 28.8 percent and positive 17.8 and 10.9 percent, respectively, over September 1989.

### **INVENTORIES AND SHIPMENTS**

Consumer electronic equipment inventories declined 7.1 percent in September 1990 compared with September 1989 (see Figure 4). Consumer electronic equipment shipments had a 2.4 percent growth rate in September 1990 over September 1989. VCR inventories and shipments declined 29.3 and 8.1 percent, respectively, in September 1990 over September 1989. The VCR market has slowed down since August. Video camera inventories and shipments data showed 13.8 and 10.4 percent growth rates, respectively, in September 1990 over September 1989. LCD TV inventories and shipments had negative 8.2 and negative 17.1 percent growth rates in September compared with negative 11.8 and positive 9.8 percent growth, respectively, in August.

### **DATAQUEST CONCLUSIONS**

Consumer electronics production and shipments data show a slowdown for the first time since April 1990. VCR production declined again in September following a similar decline in August. VCR production is controlled by the manufacturers because of market saturation. Video camera production increased in both August and September because manufacturers are gradually shifting production focus from VCRs to video cameras. Regarding data processing equipment production, PC production recovered in September. Dataquest believes that the recovery resulted from the recent growth of the PC market in Japan. Data processing equipment exports, however, dropped in September, because computer equipment exports—especially for the United States—declined drastically.

*Kun Soo Lee*

# Research Newsletter

## 1990 INFORMATION SYSTEMS CONFERENCE

### INTRODUCTION

Dataquest's 1990 Information Systems Conference was held at the Tokyo American Club in early October; its main theme was "Solutions toward Open Systems and Standards." Approximately 780 people attended the conference, which covered current topics and hot issues pertaining to the data processing and telecommunications industries.

This newsletter focuses on the emerging semiconductor applications discussed at the conference, highlighting certain semiconductor-consuming products. Dataquest also examines one of the most interesting issues: 4Mb DRAM applications.

### SEMICONDUCTOR APPLICATIONS

#### Printers

The topic of laser printer controllers was one of several major semiconductor issues discussed in "Contemporary RISC versus Traditional CISC." The speech by Noriyuki Yoshino, Design Consultant Manager at Nippon Weitek, entitled "Page Printer Controller" emphasized 32-bit RISC CPU-based controllers with higher performance than previously produced printer controllers, based on 16-bit CISCs such as the Motorola 68000.

#### Copiers

Digital multifunctional copiers require higher-performance controllers to combine functions such as copying, facsimile, and printing. In the speech entitled "Digital Copiers in the '90s," a speaker from Ricoh Co. Ltd. pointed out that multifunctional copier/facsimile products are priced higher than the total cost for individual product functions.

The speaker recommended that cost reductions be directed not only to reading and writing devices such as the image sensor, but also to semiconductors, especially memories and controllers. Besides cost reduction, communication networking technology with local area networks (LANs) and integrated services digital network (ISDN) is another key issue.

#### Telecommunications

ISDN is no longer a future issue but a current one. NTT's INS Net 64 and 1500 are expected to have more than 25,000 channels in approximately 1,200 service areas by year-end. Invited to the conference, NTT's executive manager of engineering strategy/planning headquarters, Yuji Matsuo, made a speech entitled "Views on Broadband ISDN (B-ISDN) in NTT." Stressing the increased importance of leading-edge R&D in order to realize B-ISDN, he advised that B-ISDN will provide new information networking as an infrastructure supporting VIP (visual, intelligent, and personal) communications. Cellular telephones will play an important role in personal communications. Dataquest estimates that there will be over 700,000 units in Japan in 1990 and expects cellular telephones to have a 42.7 percent compound annual growth rate (CAGR) between 1990 and 1994. For smaller and lighter portable handsets with lower power consumption, GaAs semiconductors such as high-electron mobility transistors (HEMTs) are likely to find an emerging application market in this product segment.

#### Computers

The worldwide computer industry was US\$102 billion in factory revenue in 1989 and is

expected to have a CAGR of 11 percent during the next five years. Dataquest estimates that by the year 1994, workstations and PCs will increase their share in the computer industry to nearly half of the industry, reflecting the current trend of distributed computing in the 1990s to follow the personal computing trend in the 1980s. Dataquest vice president and director of the Microcomputer Systems Service, Steve Lair, announced that Dataquest expects the PC market to double to 239 million installed units in the next four years. Among PC projections, the portable PC segment is the fastest-growing segment. As a key issue in portable PC penetration, projected price per megabyte of memory emphasized further integration of DRAMs, investigating price-sensitive replacement of lower-density DRAMs by higher-density products such as 1Mb DRAMs by 4Mb DRAMs in the near future.

## DATAQUEST ANALYSIS

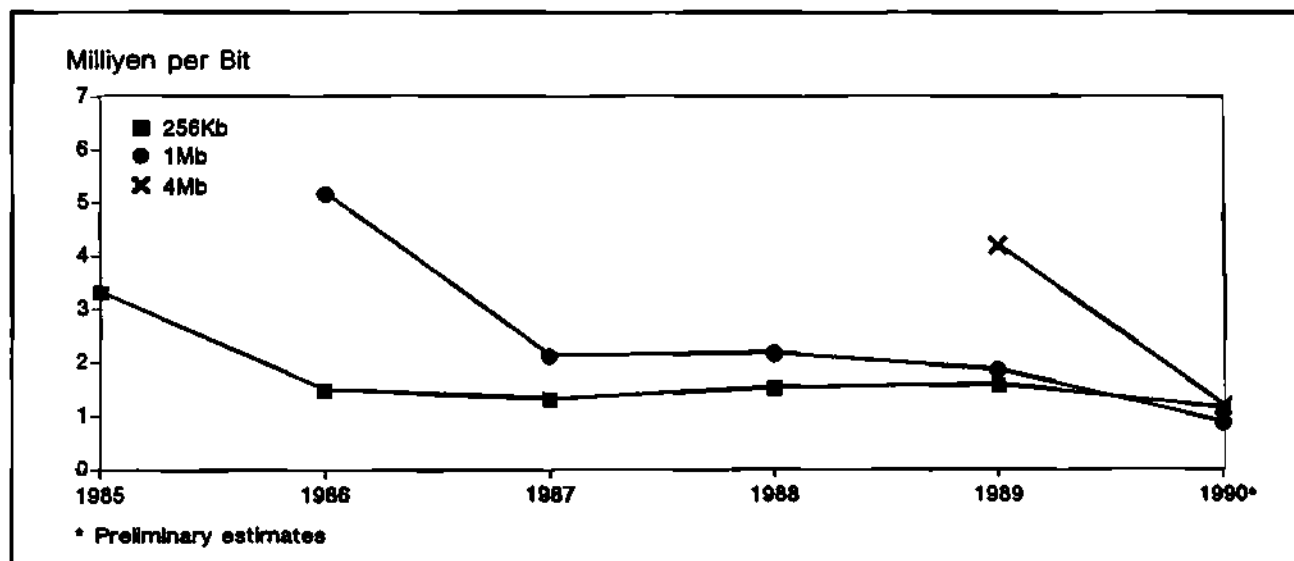
Figure 1 shows the historical trends in DRAM price per bit. In 1990, the 1Mb DRAM completely

replaced the 256K DRAM in terms of cost reduction. The 4Mb DRAM currently is priced higher than the 256K DRAM, and Dataquest believes that 4Mb DRAMs also will replace 1Mb DRAMs next year. In which application markets will 4Mb DRAMs belong? Earlier this year, mainframe computers and workstations drove the 4Mb DRAM market; then high-end portable PCs and workstations became the major drivers (see Figure 2). Making intensive capital investment in 4Mb DRAMs, major Japanese vendors are enthusiastic about captive design wins. Table 1 shows some examples of captive 4Mb DRAM systems adopted in Japan. Captive consumption continues to drive the Japanese 4Mb DRAM market, and merchandise markets will not really take off in terms of maximizing marginal utilities until after 4Mb DRAMs completely replace 1Mb DRAMs.

## DATAQUEST CONCLUSIONS

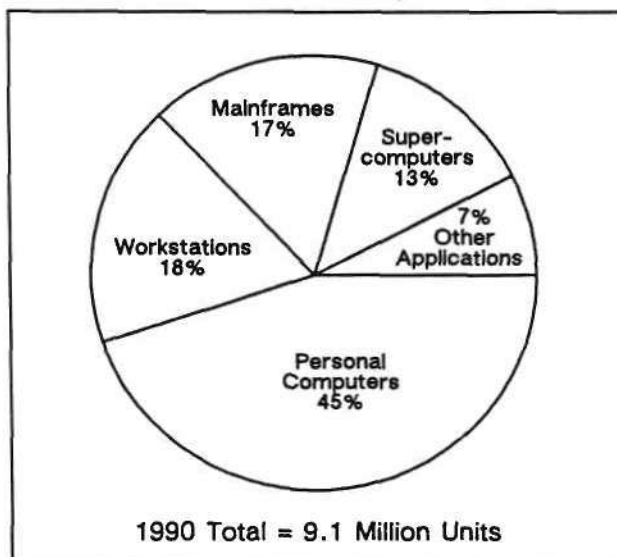
This conference gave attendees good opportunities to discuss emerging semiconductor applications in information systems. Multifunctional

**FIGURE 1**  
**Historical DRAM Price Trend**



Source: Dataquest (November 1990)

**FIGURE 2**  
**Estimated Japanese 4Mb DRAM Application**  
**Mix—Unit Basis**



Source: Dataquest (November 1990)

copiers provide a good example of the fusion of several functions. To realize such multifunctional products, the semiconductor industry should take an important role, not only in the functional fusion of ICs but also in reducing costs of semiconductor contents. As analyzed in the case of the 4Mb DRAM's contribution to the computer industry, the semiconductor industry continues to face price pressure on new-generation products from system manufacturers expecting a substitution effect, which may allow vendors price elasticity for new product demands. Dataquest believes that new multifunctional products will be offered at competitive price levels with existing target replacements.

*Masanori Murata*

**TABLE 1**  
**1990 Japanese 4Mb DRAM Captive Consumption**

Company	Shipment <sup>1</sup> (Thousands of Units)	Captive (Percentage)	System Examples	Memory <sup>2</sup> (MB)	4Mb DRAM <sup>3</sup> (Thousands of Units)
Fujitsu	280	45	Supercomputer VP200	4,096	410
			Mainframe M-1800	1,024	205
			Sure System 2000	64	85
Hitachi	500	30	Mainframe M-880	512	102
NEC	250	50	Mainframe ACOS 3800	1,024	82
			Mainframe ACOS 3600	128	64
			Notebook PC 9801N	2	960
Toshiba	600	35	Office computer TP90	56	5
			Laptop EWS Sparc LT	8	384
			PC T3100/3200SX	4	192
Total	1,630				2,489

<sup>1</sup>Estimated midyear monthly shipments

<sup>2</sup>Typical capacity

<sup>3</sup>Estimated annual consumption from mid-1990 to mid-1991

Source: Dataquest (November 1990)



# Research Newsletter

## JAPAN ELECTRONICS SHOW 1990

### SUMMARY

The 29th Japan Electronics Show, sponsored by the Electronic Industries Association of Japan (EIAJ), was held in Tokyo from October 2 through 6, with the theme "Look, Feel, and Think in Electronic Dream." Emerging semiconductor applications and opportunities were presented by 590 companies and organizations from 16 countries including Japan, and the Japan Electronics Show 1990 attracted more than 359,600 visitors.

### CONSUMER ELECTRONICS

#### VCRs

The camcorder was one of the "hot" items in the show. Many companies exhibited high-tech value-added camcorders that incorporate fuzzy gyro, 1/3-inch charge-coupled device (CCD), and color liquid crystal display (LCD) viewfinders (see Table 1). The fuzzy gyro detects unintentional movement of the camera by comparing CCD-image signals stored in a digital field memory, and the 1/3-inch CCD made the camcorder smaller by replacing the 1/2-inch CCD. Desktop VCR sets were not simply put aside by camcorders; they are fighting back with next-generation features such as pulse code modulation (PCM) digital audio recording. Also, broadcasting satellite (BS) tuners tend to be installed in VCR sets, with the first commercial service scheduled to start by year-end.

#### HDTV

High-definition television (HDTV) requires a large monitor display of at least 50 inches for the viewer to feel and enjoy its technological advantage. Besides conventional projection TVs for

HDTV, Sharp exhibited HDTV Liquid Crystal (LC) Front and Rear Projectors, utilizing three 5.5-inch LCDs with 1.2 million pixels each (see Table 1). Not only is HDTV monitoring technology already available, but so is video processing technology. For example, using an ISO 130mm optomagnetic disk at a speed of 12 MBps, an RGB high-definition (3x1,920x1,035) picture is retrievable within 1 second.

### OTHER ELECTRONICS

#### Color LCDs

Liquid crystal display was clearly one of the most attractive technologies in this show. Visitors' interest levels were the highest at company exhibits demonstrating a variety of LCDs. Manufacturers of color LCDs are finishing the development stage and have started approaching the volume production stage to satisfy next year's demand for 10-inch LCDs. Also exhibited was a state-of-the-art 15-inch thin-film transistor (TFT) color LCD and LC projection TV (see Table 1).

#### IC Cards

Table 2 lists some examples of IC card design wins. The digital storage oscilloscope (DSO) is going to use IC memory cards for waveform storage, which has far faster access than fixed-disk (FD) storage and is approaching the capacity range of 2MB.

#### MOS Memory

The 64Mb DRAM was introduced by Hitachi. This device has a chip size of 198 square

**TABLE 1**  
**Color LCD Display Application Examples**

Size (Inches)	Pixels	System Equipment/Application	Company
0.96	648x220 <sup>1</sup>	Camcorder/Viewfinder	Citizen
1.4	77,640x3 640x480	Video Projector/LC Projector <sup>2</sup> Data Projector	Citizen
2.2-2.9	109x480/146x648	Handy TV	Citizen
2.8	210,000x3	High-Resolution LC Projector <sup>2</sup>	Sharp
3.0	89,505x3	LC Vision/LC Projector <sup>2</sup>	Sharp
3.1	720x480x3	EDTV Rear Projection Display <sup>2</sup>	Sanyo
4.0-5.6	234x479 220x480	Color TV Portable VTR & TV	Sharp Casio, Hitachi
5.5	1,200,000x3	HDTV Rear Projection Display <sup>2</sup>	Sharp
8.6	456x960	Navigation System/Display Home Automation/AV Monitoring	Sharp
9.8-10.4	640x3x480 <sup>1</sup>	Laptop PC/OA Monitoring	Hitachi, Seiko, Sharp, Toshiba
10.4-14.0	640x3x480 <sup>1</sup>	Multimedia (OA & AV) Display	Sharp
15.0	1,280x80	Color TV and/or Workstation	Hoshiden

<sup>1</sup> Available only in dots

<sup>2</sup> Multiple single-color LCDs

Source: Dataquest (October 1990)

**TABLE 2**  
**IC Card Application Examples**

Memory (Kbytes)	Memory Type	System Equipment/Application	Company
24	RAM (+ROM)	IC Card S/W-package ES-300/310	Casio
64	RAM	Super Memory Computer DK-5500 Notebook Word Processor WV-700	Casio
128	RAM	Electronic Scheduler PA-9500	Sharp
256	SRAM	Sequence Controller Panel Data Controller	Shinyei Electric
1,024	SRAM	Digital Steel Camera	Toshiba

Source: Dataquest (October 1990)



millimeters (9.74x20.28) using a 0.3-micron design rule.

## DATAQUEST CONCLUSIONS

The Japan Electronics Show 1990 successfully displayed a number of new applications for leading-edge electronics devices, such as color LCDs and IC cards. Making capital investment matching or exceeding their total LCD annual revenue, Japanese LCD vendors are quite enthusiastic over captive design wins as well as the 4Mb DRAM.

Dataquest believes that continuous investment is required for further integration of memory ICs such as DRAMs and flash EEPROMs. Further integration of flash EEPROMs will be especially helpful on widespread design wins of memory IC cards replacing SRAMs because of the cost savings. The JEIDA (Japan Electronic Industry Development Association) IC Memory Card Guideline Version 4 (June 1990) will emphasize new IC card design wins getting agreement from PCMCIA (PC Memory Card International Association) for a world standard.

*Masanori Murata*

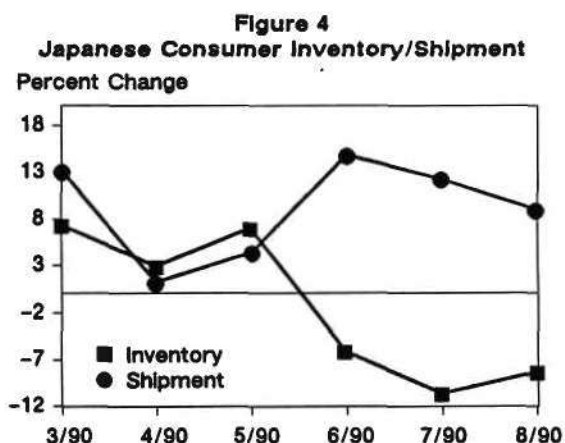
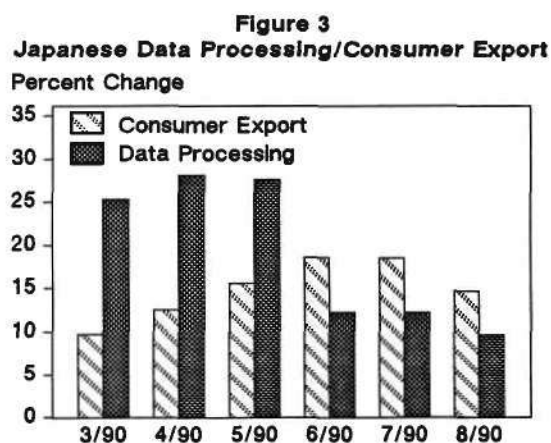
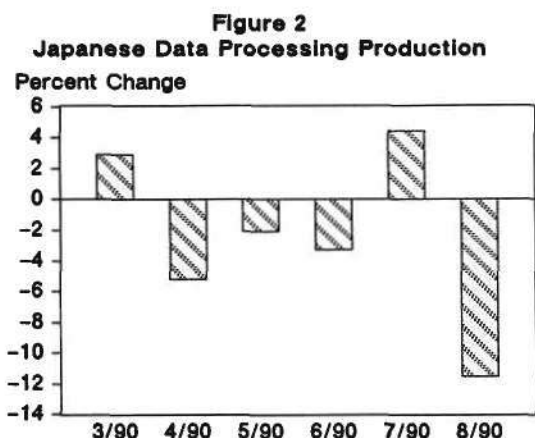
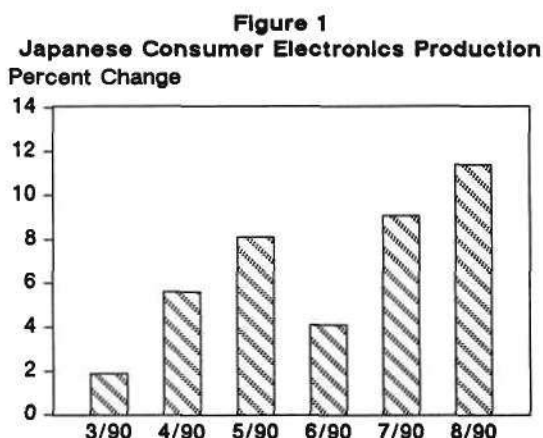
# Research *Bulletin*

## JSAMONITOR—OCTOBER 1990

### THE EQUIPMENT MARKETS

Japanese consumer equipment production continued to grow at a rate of 11.4 percent in August, which increased from the revised 9.1 percent growth in July (see Figure 1). Digital

audiodisc player and videodisc player production grew at rates of 65.1 and 55.9 percent, respectively, over August 1989. VCR production in August decreased 9.6 percent compared with August 1989, which is a decline from 1.4 percent growth in July 1990.



Source: MITI, MOF, Dataquest (October 1990)

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## Data Processing Equipment Production

Data processing equipment production had negative 11.5 percent growth in August compared with August 1989, which is also a decline from the revised 4.4 percent growth in July 1990 (see Figure 2). On a segment basis, computer production in August decreased 14.9 percent compared with August 1989. The data processing equipment production decline in August occurred because of the decrease in general-use computer and data storage production, which dropped 30.8 percent and 22.8 percent, respectively, compared with August 1989.

## EXPORTS

Consumer equipment exports in August grew 14.6 percent, which is a slowdown from the 12.8 percent in July (see Figure 3). Computer equipment exports in August continued to grow at a rate of 9.9 percent over August 1989. The growth rates of computer equipment exports for the United States, Europe, and Asian countries were 7.9, 8.2, and 29.2 percent, respectively, over August 1989.

## INVENTORIES AND SHIPMENTS

Consumer electronic equipment inventories in August continued to decline at a rate of 8.3 percent from August 1989, compared with negative

11.5 percent growth in July (see Figure 4). VCR inventory and shipment data showed negative 28.7 and negative 5.0 percent growth rates, respectively, in August 1990 compared with August 1989. This negative growth indicates that the VCR market has been slow, although production has been controlled by manufacturers. Videodisc player inventories and shipments showed growth rates of 74.6 percent and 33.6 percent, respectively, in August 1990 over August 1989. Digital audiodisc player inventories and shipments showed 39.2 percent and 21.8 percent growth, respectively, in August, which is almost equal to growth in July.

## DATAQUEST CONCLUSIONS

Consumer electronics production, export, and shipment data show the consumer market's healthy growth. Regarding data processing equipment, however, computer production and exports declined during August. Dataquest believes that the data processing market was in a pessimistic condition compared with July and will continue to be sluggish for the rest of this year.

*Kun Soo Lee*

# Research *Bulletin*

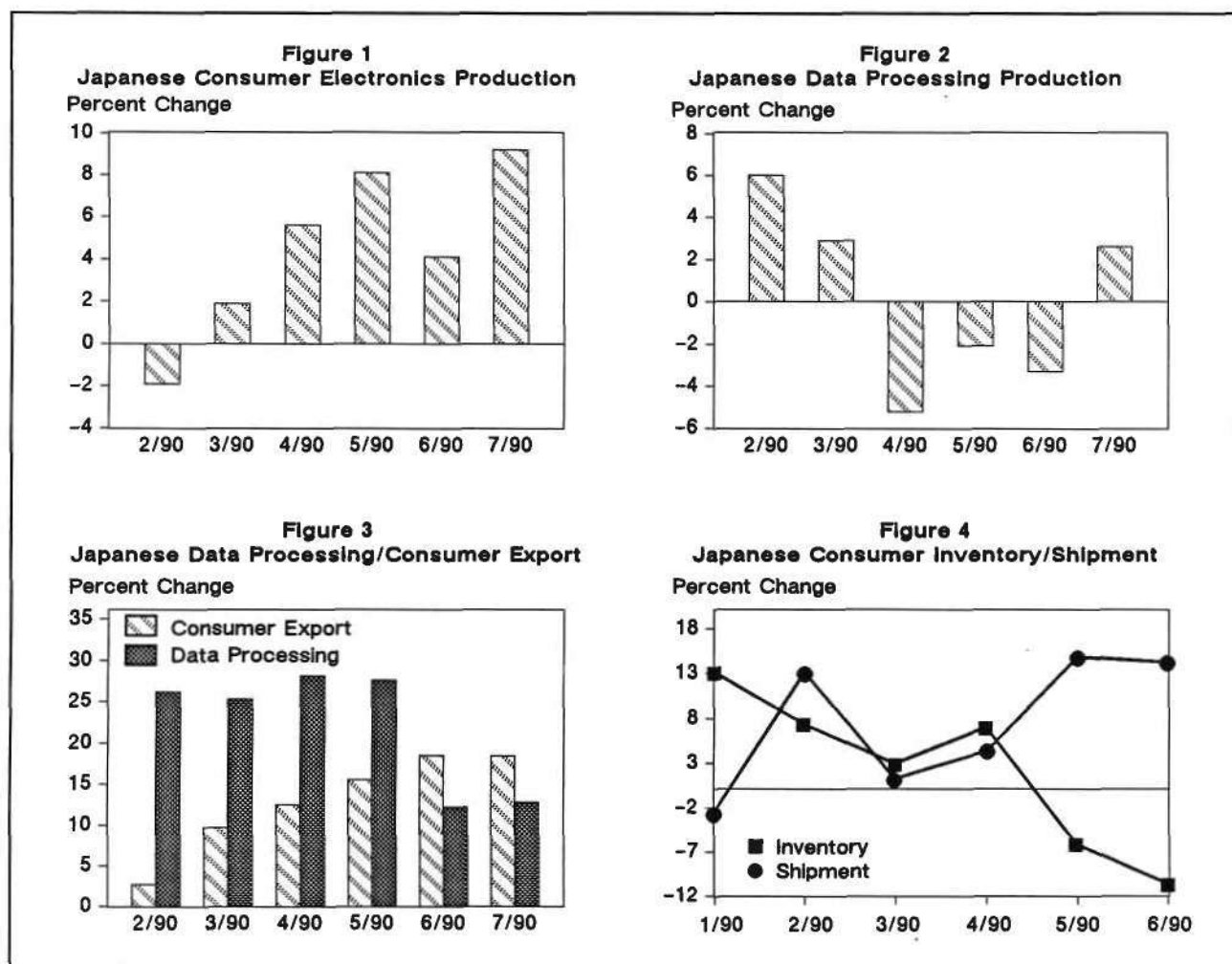
## JSAMONITOR—SEPTEMBER 1990

### THE EQUIPMENT MARKETS

#### Consumer Equipment Production

Japanese consumer equipment production continued to grow at a rate of 9.2 percent in July, which is an increase over the revised 4.1 percent growth in June (see Figure 1). Digital audio disc

player and videodisc player production grew at the rate of 43.5 and 45.9 percent, respectively, over July 1989. VCR production in July declined 5.7 percent over July 1989. The growth rate of color TV production in July was 13.5 percent, which is a recovery from the revised negative 2.0 percent growth in June.



Source: MITI, MOF, Dataquest (September 1990)

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## Data Processing Equipment Production

Data processing equipment production has grown 2.6 percent since July 1989, which is a recovery from the revised negative 3.3 percent in June 1990 (see Figure 2). On a segment basis, computer production in July increased 1.4 percent compared with the negative 4.9 percent growth in June over July 1989 and June 1989, respectively. Compared with July 1989, data storage, terminal equipments, input/output (I/O) units, and dedicated systems had growth rates of 3.2, 7.6, 16.9, and negative 1.1 percent, respectively. The recovery in July came from the growth of general-use computer and I/O unit production.

## EXPORTS

Consumer equipment exports in July grew 18.4 percent, which is almost flat compared with 18.5 percent growth in June (see Figure 3). Data processing equipment exports grew 12.8 percent in July compared with June's revised 12.2 percent over July 1989 and June 1989, respectively. Computer equipment exports in July continued to grow at a rate of 15.4 percent over July 1989. The growth rates of exports for the United States, Europe, and Asian countries are 5.1, 26.1, and 47.5 percent, respectively, over June 1989.

## INVENTORY AND SHIPMENT

Consumer electronic equipment inventories in July declined by 10.1 percent from July 1989 compared with the revised figure of negative 6.1 percent growth in June (see Figure 4). VCR inventories showed a negative 26.4 percent growth rate, although shipments grew 10.8 percent over July 1989. Video camera shipment continued to grow at a rate of 15.7 percent, and inventory showed negative 9.2 percent growth in July 1990 over July 1989. Inventory and shipment data for consumer equipment indicate that the market will continue to be in good condition.

## DATAQUEST CONCLUSIONS

Dataquest believes that inventory, production, and shipment data show the healthy growth of the consumer market. Regarding data processing equipment, the preliminary data for June indicated that the market was in a pessimistic condition. But the revised June and the preliminary July numbers show that the market is flat. Data processing equipment production had grown only 0.9 percent in the first half of 1990 over the second half of last year. Dataquest expects the data processing equipment market to continue to be sluggish for the rest of this year.

*Sumiko Takeyasu*

# Research *Bulletin*

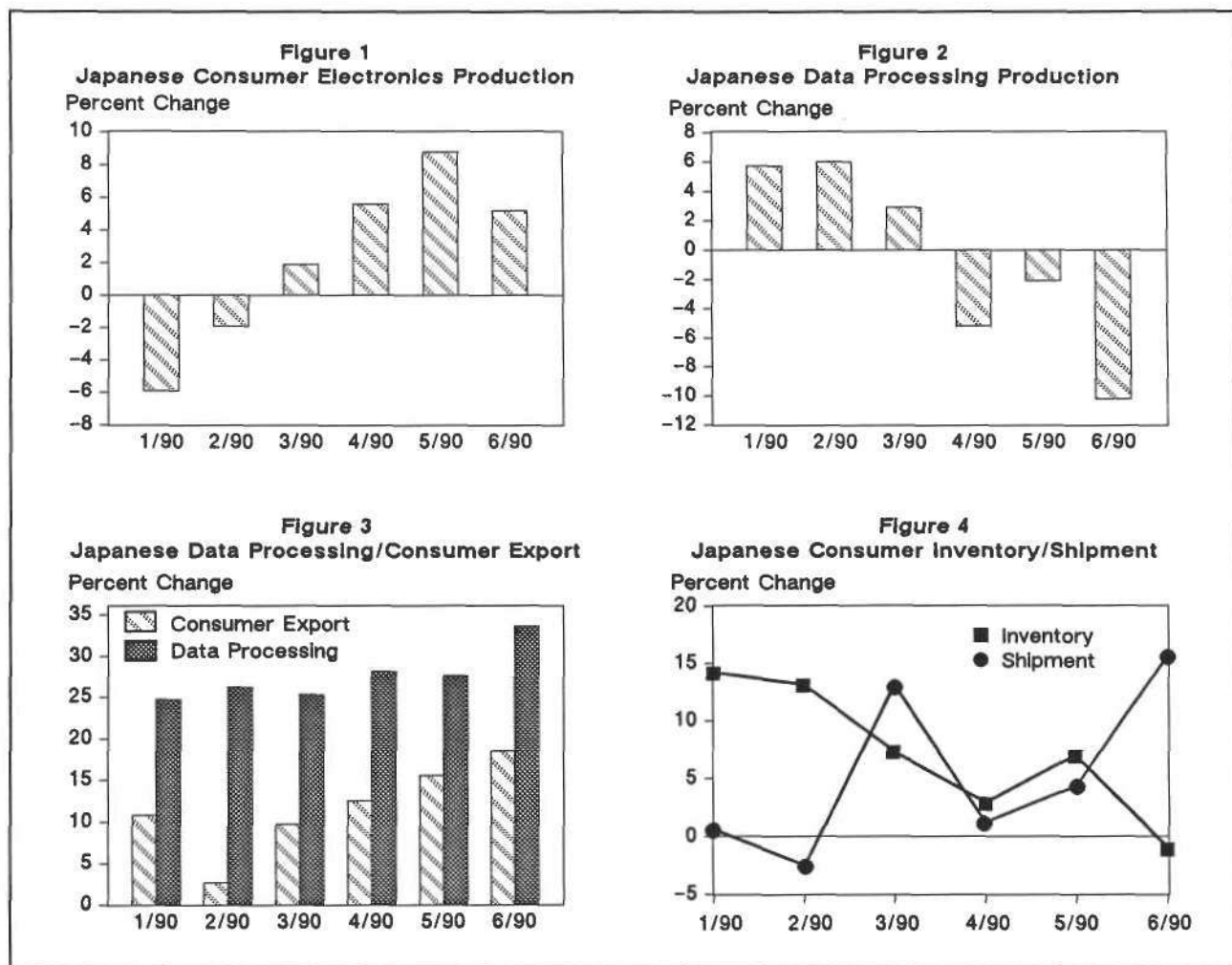
## JSAMONITOR—AUGUST

### THE EQUIPMENT MARKETS

#### Consumer Equipment Production

Japanese consumer equipment production continued to grow at a rate of 5.2 percent in June but declined from the revised 8.8 percent growth in

May. Videodisc player production also continued to show a big improvement in June, with a growth rate of 116.8 percent over June 1989. Video camera production in June 1990 grew 18.8 percent over June 1989. CD player production declined by a negative 21.7 percent from June 1989.



Source: MITI, MOF, Dataquest (August 1990)

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## Data Processing Equipment Production

Data processing equipment production declined by negative 10.2 percent from June 1989, which is a continuous decline from the revised negative 2.1 percent in May. On a segment basis, computer production in June continued to decline by negative 21.9 percent compared with the negative 3.9 percent in May over June 1989 and May 1989, respectively. Compared with June 1989, data storage, terminal equipment, input/output (I/O) units, and dedicated systems had growth rates of negative 2.9, positive 3.0, negative 2.5, and negative 7.2 percent, respectively. The decline of data processing equipment in June came from the decrease in general-use computer production, dropping 16.0 percent from June 1989.

## EXPORTS

Consumer equipment exports in June grew 18.5 percent, showing a continued increase from 15.5 percent in May. Data processing equipment exports increased 33.6 percent compared with growth of 27.6 percent in May. Computer equipment exports continued to grow at a rate of 13.2 percent. Video camera exports had a 38.5 percent growth rate that resulted from active exports to the United States, Europe, and Asian countries. The growth rates for these regions over June 1989 were 25.9, 35.0, and 94.0 percent, respectively.

## INVENTORY AND SHIPMENTS

Consumer electronic equipment inventories in June declined by 0.9 percent from June 1989, compared with the revised figure of 7.1 percent in May. Video camera inventories showed a negative 11.2 percent growth rate, although shipments grew 29.2 percent over June 1989. Videodisc player shipments grew 47.8 percent, and inventory also showed 2.1 percent growth in June 1990 over June 1989. Inventory and shipment data for consumer equipment indicate that the market is in good condition.

## DATAQUEST CONCLUSIONS

During 1989, the production of general-use computers occupied a 21 percent share of the total data processing equipment production on a value basis. Data processing equipment production is strongly affected by the production trend of general-use computers. Recently, production of general-use computers has been declining, and there is no good reason for a recovery. Dataquest expects the production of data processing equipment to continue to be sluggish while the consumer equipment market is growing.

*Sumiko Takeyasu*



# Research Newsletter

## EMERGING JAPANESE LCD MARKET: 1990 AND BEYOND

### SUMMARY

The flat-panel display market still is in its infancy stage of development, yet battle lines for market share are beginning to form. Cathode-ray tube (CRT) technology is the current low-cost favorite for displays, but it is losing some of its appeal to the power-efficient, compact, and portable flat-panel display segment. Although the venerable CRT will continue to claim future market share, four flat-panel display technologies—liquid crystal display (LCD), plasma, vacuum fluorescent, and electroluminescent (EL)—are fighting to displace this “tried and true” industry display standard.

Dataquest believes that, of the four flat-panel technologies, LCD will prevail as the display technology of choice. Major players are increasing their investments in plants and equipment while new players continue to jump into the fray. The stakes are high, but so are the possible rewards. The LCD industry is forecast to become one of the major electronics industry segments within five years, with total market size reaching ¥1 trillion.

The objective of this newsletter is to expose an application that has growth potential in two markets: the semiconductor market to control the displays and the modified semiconductor equipment market to manufacture the displays. In this newsletter, Dataquest briefly reviews competing LCD technologies, market applications, and sales and investment plans of key players.

### INTRODUCTION

An LCD consists of a liquid crystal mixture sandwiched between two plates of polarized glass. One plate of glass is lined with rows and columns of transparent electrodes. When a voltage is applied to the electrodes, the liquid crystal molecules become oriented in such a way that they either

transmit or block polarized light. Because the crystals only block or transmit light and do not emit any light of their own, an ambient or electrically produced backlight has to be shone through the display to make it readable.

Some liquid crystal molecules are called “nematic” because of their threadlike shape. A display in which liquid crystal material imposes a 90-degree rotation on the plane of polarized light is called a “twisted nematic display.” A greater degree of twist is called “supertwist,” which is 180 degrees, and the “double supertwist” or “hypertwist” is 270 degrees. Another property that LCDs possess is the birefringence effect, which is a double refraction and splitting of light as it passes through the liquid crystal. Both birefringence and the applied twist serve to increase the brightness, contrast ratio, and viewing angle, all of which are common drawbacks to LCD displays.

Another development in LCD technology is the active-matrix LCD (AMLCD), in which each pixel has its own drive transistor (essentially a semiconductor on glass). Known as thin-film transistor (TFT) technology, this arrangement serves to improve the performance or speed of the display at the expense of requiring much more complex drive electronics.

TFT technology provides the best flat-panel display quality among the LCD technologies listed in Table 1. Despite TFT's technological excellence, its manufacturing cost still is very high compared with simple-matrix LCDs such as the supertwisted nematic (STN), which currently competes with CRTs in the monochrome display market.

However, Dataquest believes that the LCD industry's major goal is to displace CRT displays with full-color LCDs. For that purpose, it is necessary for the industry to pursue TFT technology with huge R&D expenditure, in addition to heavy capital investments.



**TABLE 1**  
**LCD Technology Comparison—TN versus TFT**

	TN (Low MP)	Super-TN (High MP)	TFT
Power Consumption	Good	Poor	Fair
Response Speed	Fair	Poor	Good
Display Quality			
Contrast	Fair	Good	Excellent
Solution	Poor	Fair	Good
Visible Angle	Poor	Fair	Good
Future Extent			
Full Color	Poor	Fair	Good
Large Screen	Poor	Good	Fair
Manufacturing Cost	Good	Fair	Poor

MP = Multiplex

Source: Dataquest (July 1990)

**TABLE 2**  
**Japanese LCD Industry Review**

	1975	1980	1985	1990
Technology	Simple-matrix TN <sup>1</sup>	S-TN <sup>2</sup>	Active-matrix TFT <sup>3</sup>	TFT-color
Applications	Watches and calculators	Hand-held computers	Portable word processors and PCs	Laptop PCs and Workstations

<sup>1</sup>Twisted Nematic

<sup>2</sup>Supertwisted Nematic

<sup>3</sup>Thin-Film Transistor

Source: Dataquest (July 1990)

## JAPANESE LCD TRENDS AND DIRECTIONS

A brief historical summary of LCD developments and applications in Japan is shown in Table 2. One of the first volume applications of LCDs appeared with the advent of digital wristwatches in the 1970s. By 1980, technology improvements enabled an increase in display size while also improving display features. Gradually, applications grew beyond the wristwatches and calculators of the 1970s to the hand-held computers of the early 1980s.

Recently, dramatic improvements in LCD technology have expanded the applications markets in which LCDs compete with CRT displays. Although CRTs lead in cost and performance, power consumption and size considerations are

becoming important issues for the computer industry.

A good application example is the laptop PC, which already has incorporated the flat-panel display. In fact, growth in the LCD industry is largely being driven by the increase in demand for laptop PCs that incorporate large LCDs.

Laptop PC vendors recently took the next step in technology by incorporating color LCD displays. A list of recent introductions of laptops with color LCDs is shown in Table 3. NEC's PC-9801T/F5 and Seiko-Epson's 32-bit PC-386LSC lead the introductions with the latest LCD technologies. Although the more advanced active matrix TFT technology is available only from NEC, Seiko-Epson has developed its own active matrix metal-insulator-metal (MIM) technology.

**TABLE 3**  
**Color LCD<sup>1</sup> Laptop PCs**

Company	Type	LCD	Colors	CPU	Price (Thousands of Yen)	Date Available
Fujitsu	FMR-50LX	D-STN <sup>2</sup>	16	80386-20	748	TBA
Hitachi	B32LXC	STN	16/8	80386SX-16	728	3/90
NEC	9801LX5C	STN	8	80286-12	748	9/89
	9801T/S5	STN	8	80386SX-20	850	7/90
	9801T/F5	TFT	8	80386SX-20	1,150	6/90
Seiko-Epson	386LSC	MIM	16	80386SX-16	980	5/90
Toshiba	J-3100SGX (101S)	STN	16	80386-20	1,480	11/90

<sup>1</sup> 640 x 400 (dot matrix)

<sup>2</sup> Double-layered supertwisted nematic

TBA = To be announced

Source: Dataquest (July 1990)

**TABLE 4**  
**Ten Major Japanese LCD Manufacturers—1989 and 1990 (Billions of Yen)**

Company	Estimated Sales		Capital Investment	Main Location
	1989	1990 <sup>1</sup>	1990 <sup>2</sup>	
Alps	9.5	12.0	9.0	Iwaki
Hitachi	22.0	27.0	27.0	Mobara
Hoshi Denki	9.0	14.0	10.0	Kobe (TFT) and Shiga (STN)
Matsushita	10.0	18.0	16.7	Ishikawa
Optolex	27.0	35.0	10.0	Hiroshima
Sanyo (Tottori)	16.0	21.0	10.0	Tottori
Seiko-Epson	40.0	55.0	10.0	Nagano and China
Seiko Instruments	9.0	14.0	NA	Italy (with Olivetti)
Sharp	40.0	62.0	63.3	Tenri (small) and Mje (large)
Toshiba	18.0	24.0	40.0	Himeji
Total	200.5	282.0	196.0	

<sup>1</sup> Preliminary industry estimates

<sup>2</sup> Plan

NA = Not available

Source: Dataquest (July 1990)

## SALES AND INVESTMENT

As is the case with the semiconductor industry, substantial capital investments in conjunction with disciplined manufacturing skills and aggressive product marketing provides the winning formula for success. Japanese manufacturers have not

shied away from the required capital investments. In fact, the total revenue of the major Japanese LCD vendors listed in Table 4 is expected to leap from ¥200.5 billion in 1989 to ¥282.0 billion in 1990, a 40.6 percent increase. Furthermore, Dataquest estimates that the LCD market will grow to ¥1 trillion by 1995. Table 4 shows only a partial

list of companies; Dataquest expects to see additional electronics giants, such as Mitsubishi Electric and NEC, jumping into the market.

Highlighting the potential of this market is the commitment of the companies shown in Table 4 to making capital investments that match or exceed their total LCD revenue. In 1990, the companies listed are expected to invest ¥196.0 billion for expansion in contrast with their total LCD revenue, which is expected to be ¥282.0 billion. Although investments of this magnitude are based on long-term business diversification and expansion strategies, return on investment also is expected.

NEC's entrance into this market is a good example of this high risk for high return investment trend. Although NEC's LCD market share was negligible last year, the company plans to spend more than ¥20 billion in capital improvements. However, NEC plans on a large payoff and projects its LCD revenue to grow to ¥100 billion by 1995.

## DATAQUEST CONCLUSIONS

Dataquest expects the worldwide LCD market to grow to ¥1 trillion by 1995. Within this market, we believe that the most promising LCD application market will be color LCDs for microcomputers. Furthermore, we believe that color LCDs eventually will claim 40 percent, or 10 million units, of worldwide market share of all microcomputer color displays. Also, Japanese electronics companies, through major capital investments and focused R&D efforts, expect to reduce 10-inch color active-matrix LCD manufacturing costs to reach a target price of ¥40,000 per display unit. Thus, Dataquest expects the color LCD market for microcomputers to approach ¥400 billion, or 40 percent of the total LCD market, by 1995.

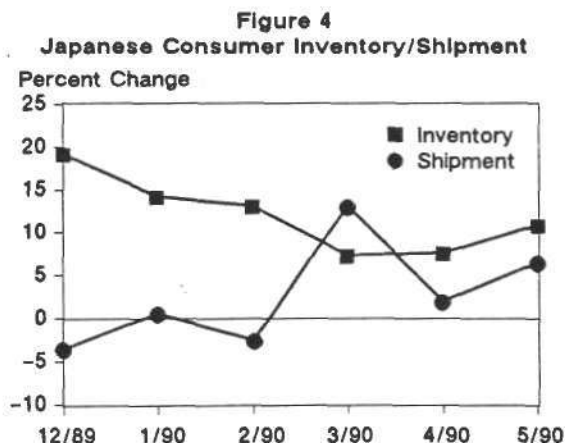
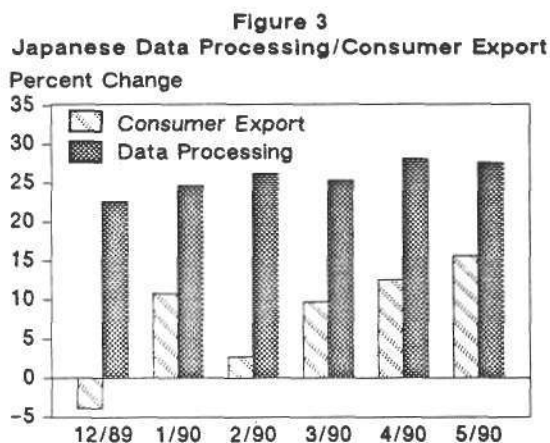
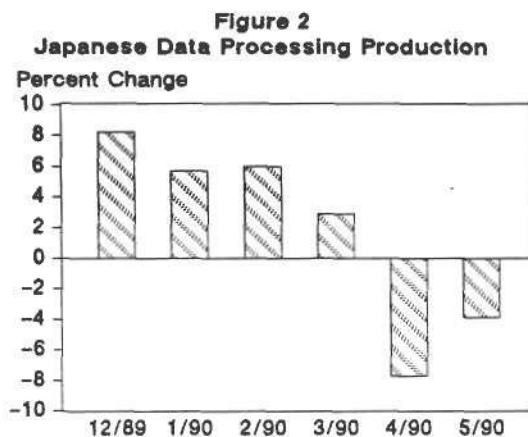
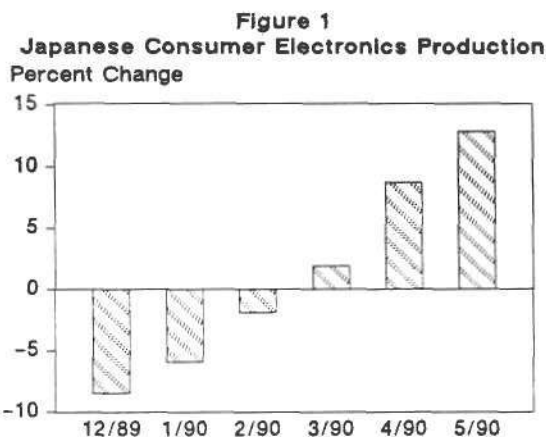
*Masanori Murata  
Len Hills*

# Research *Bulletin*

## JSAMONITOR

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Source: MITI, MOF, Dataquest (July 1990)

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JSAM Newsletters 1990-18

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## THE EQUIPMENT MARKETS

### Consumer Equipment Production

Japanese consumer equipment production continued to grow at a rate of 12.8 percent in May, which is an improvement over the revised 8.7 percent growth in April. LCD TV production continued to show a big improvement in May, with a growth rate of 76.6 percent over May 1989. Video camera production in May grew 17.6 percent over May 1989. Videodisc player production maintained its strength, growing 131.4 percent in May. CD player production in May grew 31.7 percent over May 1989.

### Data Processing Equipment Production

Data processing equipment production declined 3.9 percent from May 1989, which is a recovery from the revised negative 7.7 percent in April. Mainframe computer production in May continued to decline with negative 26.7 percent growth over May 1989. Personal computer production was stable in May, showing a growth rate of 32.3 percent over May 1989. Copier production in May grew 31.2 percent compared with the revised 26.4 percent growth in April over May 1989 and April 1989, respectively. Japanese word processor and storage production in May showed 11.1 and 13.4 percent decline, respectively, compared with the revised 0.7 and 5.8 percent growth in April.

### Exports

Consumer equipment exports in May grew 15.5 percent, showing a continued increase from 12.5 percent in April. Data processing equipment exports increased 27.6 percent compared with revised growth of 28.1 percent in April. Computer equipment exports showed continued strength, with a 29.1 percent growth rate resulting from active export to the United States, Europe, and Asian countries. The growth rates for these regions over May 1989 were 34.0, 29.9, and 41.0 percent, respectively.

### Inventory and Shipment

Consumer electronic equipment inventories in May grew 11.0 percent over May 1989, compared with the revised figure of 7.7 percent in April. Video camera inventories also showed a negative 6.6 percent growth rate, although shipments grew 10.9 percent over May 1989. Videodisc player shipments grew 41.3 percent, and inventory also showed a 124.1 percent growth in May 1990 over May 1989.

## DATAQUEST CONCLUSIONS

The consumer equipment figures for May indicate that the industry continues to grow. The data processing segment should also recover with continued active exports and domestic demand, although the growth rate in May declined.

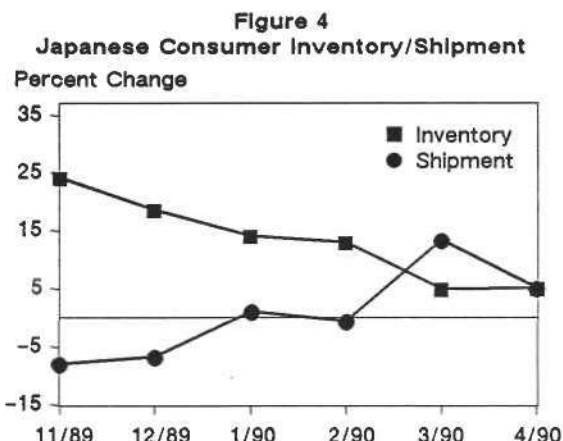
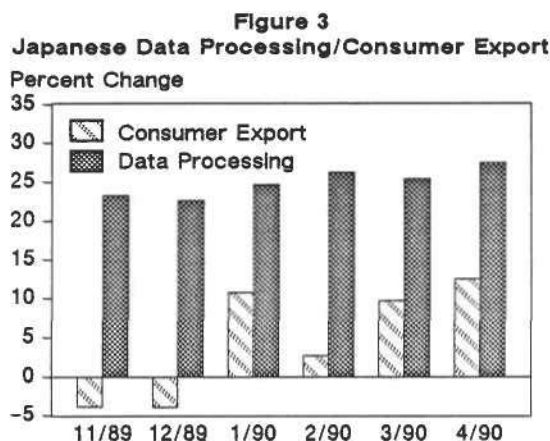
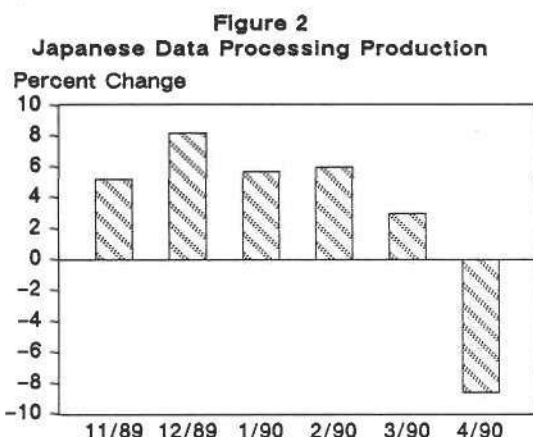
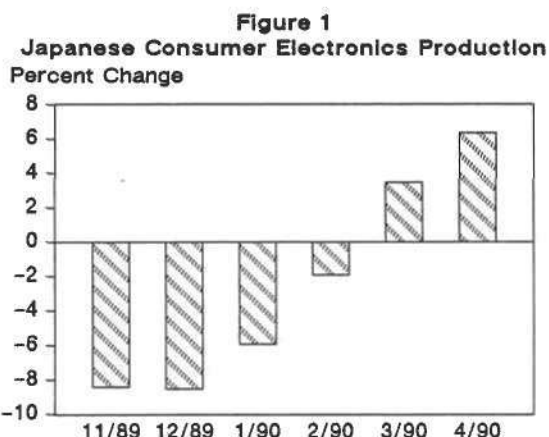
*Sumiko Takeyasu*

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JSAM Newsletters 1990-17

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## THE EQUIPMENT MARKETS

### Consumer Equipment Production

Japanese consumer equipment production continued to grow in April with a growth rate of 6.4 percent, which is an improvement from March's revised 3.5 percent. LCD TV production improved tremendously in April with a growth rate of 111.0 percent over the same month a year ago, compared with a revised growth rate of 45.0 percent in March. April's production of video cameras grew 8.0 percent over the same month a year ago. Videodisc player production maintained its strength, growing 96.0 percent in April. The growth in this category has been over 100.0 percent for the past four months.

### Data Processing Equipment Production

Data processing equipment production declined 8.6 percent, a continued decline from March's revised figure of 3.0 percent. The decline was impacted by a dramatic decrease in mainframe computer production. April's growth rate was a negative 28.0 percent compared with April 1989. Storage production also slowed, showing only 1.0 percent growth compared with March's revised 12.0 percent. Personal computer production was still strong in April, showing a growth rate of 25.0 percent over the same month last year.

### Exports

April exports of consumer equipment grew 12.5 percent, a continued increase from March's 9.7 percent. Data processing equipment exports had a 27.5 percent increase compared with March's

25.4 percent. The computer equipment category showed continued strengthening, with a growth rate of 37.4 percent as a result of active exports to the United States, the European Community, and Asian countries. The growth rates were 34.6, 32.9, and 77.7 percent, respectively.

### Inventory and Shipments

Consumer electronic equipment inventories declined by 5.2 percent compared with March's revised figure of 5.1 percent. Inventories of VCRs decreased by 6 percent, compared with March's revised 20 percent. Video camera inventories also showed a negative growth rate of 18 percent, while shipments grew 4 percent over the same month a year ago. CD player shipments grew 90 percent, and inventory showed a decline by 16 percent in April 1990 over the same month a year ago.

### DATAQUEST CONCLUSIONS

The figures for consumer equipment in April indicate that the industry is certainly recovering. The data processing segment is expected to improve and maintain its strength with active exports and domestic demand, even though the growth rate in April declined.

*Hideaki Nemoto  
Sumiko Takeyasu*



# Research Newsletter

## WORLDWIDE APPLICATIONS MARKET: TRANSPORTATION SEGMENT

### INTRODUCTION

This newsletter is the last in a series that addresses the major worldwide semiconductor applications categories. It presents the success strategies and common difficulties for companies competing in this application area. The top five companies are highlighted with a list of each company's successes and challenges. Dataquest estimates that the worldwide transportation market for 1989 was \$2,694 million. Table 1 lists the top five semiconductor suppliers in the transportation area.

Table 2 shows the top automotive makers worldwide for 1989 along with the number of vehicles manufactured.

### GENERAL SUCCESS FACTORS

Of the six application markets examined in this newsletter series, the transportation application is the second smallest (military and aerospace is estimated to be the smallest). In 1989, the amount of semiconductors used in transportation accounted for only 5 percent of the total amount of semiconductors consumed worldwide. It is possible, with current developments in transportation, that greater

opportunities will exist for semiconductor suppliers in the future. Semiconductors were first used in automotive electronics to handle fuel economy, reduce emissions, enhance safety aspects, and provide additional luxury features for consumer enjoyment. Possible future developments include using semiconductors in combination cellular telephone and facsimile systems, traction control, security systems, and navigation systems, to name a few.

Semiconductor suppliers that have established long and strong relationships with automotive manufacturers are likely to continue serving those manufacturers' needs in the future. There also is an increasing demand for higher standards of quality by the semiconductor supplier; it was the poor quality of U.S. automobiles that led to a sharp decline in U.S. manufacturers' market share from the late 1970s to the mid-1980s. Emphasis on improving gas mileage performance, quality products, safety features, and service helped U.S. automobile manufacturers gain back a small portion of their market share since the middle of the 1980s. Currently, U.S. automobile manufacturers

**TABLE 1**  
**Top Five Semiconductor Vendors**

Company	Market Share
Motorola	13.6%
Toshiba	10.1%
Hitachi	8.9%
SGS-Thomson	5.0%
Texas Instruments	4.7%

Source: Dataquest  
May 1990

**TABLE 2**  
**1989 Worldwide Automotive Manufacturers**  
**(Thousands of Units)**

Rank	Company	Number of Vehicles
1	General Motors	7,946
2	Ford	6,336
3	Toyota	4,115
4	Volkswagen	2,948
5	Nissan	2,930

Source: *Business Week*  
Dataquest  
May 1990



have 38 percent of worldwide market share, whereas Japanese manufacturers retain a 30 percent market share.

Future applications of semiconductors in the transportation area will increase. Standard types of semiconductors include microcontrollers, EPROMs, power transistors, radio ICs, and memory devices.

## COMMON CHALLENGES

North American projections for automobile consumption show a slowing trend in 1990. Reasons for this slowdown include a projected slowing U.S. economy, global competition within the North American market, exchange rate fluctuations, emphasis on quality, increasingly high costs for new automobiles, and longer life cycles for automobiles. Growth of semiconductor consumption from 1989 to 1990 is projected to remain flat.

U.S. automobile manufacturers will continue to experience stronger competition within their own domestic market because of numerous Japanese automobile manufacturers that are establishing facilities in the United States. The Japanese have demonstrated their strength in quality; they now have begun to design sophisticated automobiles with more on-board technology. This improvement in styling, combined with Japanese capital investment in the automobile industry (\$25 billion in the past three years), will keep pressure on European and U.S. manufacturers.

## TOP FIVE VENDORS

The following paragraphs show the most common success factors and difficulties for the top five semiconductor suppliers into the transportation category.

### Motorola

The following list shows Motorola's success factors:

- Develops products for current demands
- Has good relationships with all automobile manufacturers
- Has broad product offerings
- Was first automobile radio supplier

- Has dedicated Automotive Electronics Group
- Is penetrating the Japanese automotive segment; localized production

The following list shows Motorola's challenges:

- Maintain leadership position
- Increase reliability
- Improve delivery time
- Create tighter specs, wider temperature ranges
- Implement standardization

### Toshiba

The following list shows Toshiba's success factors:

- Has strong relationship with Honda
- Has broad product mix

The following list shows Toshiba's challenges:

- Penetrate North American and European markets
- Develop local inventory, lead times, pricing, failure analysis, technical support

### Hitachi

The following list shows Hitachi's success factors:

- Has good relationship with Nissan
- Has broad product mix

The following list shows Hitachi's challenges:

- Penetrate North American and European markets
- Become flexible to users' needs
- Establish local inventory, lead times, pricing, failure analysis, technical support

### SGS-Thomson

The following list shows SGS-Thomson's success factors:

- Has power technologies
- Has a joint venture with Oki Electric

- Is positioned well geographically in Europe, Asia, and the United States
- Is a quality supplier to Ford, Chrysler, and Marelli of Italy
- Has a broad product mix for automotive applications

The following list shows SGS-Thomson's challenges:

- Maintain leadership in power IC markets
- Penetrate deeper into non-European markets
- Complete and deliver bridge drivers, currently under development

### **Texas Instruments**

The following list shows Texas Instruments' success factors:

- Has MCUs and ASICs
- Has long design-in cycles and long product life cycles
- Has design joint ventures with automobile electronics OEMs

The following list shows Texas Instruments' challenges:

- Improve reliability
- Create tighter specs, wider temperature ranges

### **DATAQUEST CONCLUSIONS AND RECOMMENDATIONS**

Dataquest believes that projected new developments for automobiles such as navigation systems, cellular telephones combined with facsimile systems, and advanced stereo systems will create greater opportunities for semiconductor suppliers in this application. The existing U.S.-Japan Semiconductor Trade Arrangement, which is approaching its five-year time limit in July 1991, also has the Japanese Ministry of International Trade and Industry (MITI) placing increasing demand on Japanese automobile manufacturers to procure more foreign-manufactured semiconductors.

The Japanese automobile and semiconductor manufacturers have not overlooked the opportunities in both Europe and Southeast Asia. Both types of manufacturers have positioned manufacturing in these regions and have announced plans for more facilities to be installed during the early 1990s. The U.S. and European automobile and semiconductor manufacturers have the upper hand in Taiwan and South Korea, where the import of Japanese automobiles is strictly forbidden.

Because of the high visibility regarding the automotive trade deficit with Japan (\$27.3 billion in 1988), Dataquest expects additional Japanese transplants to move to the United States and Europe.

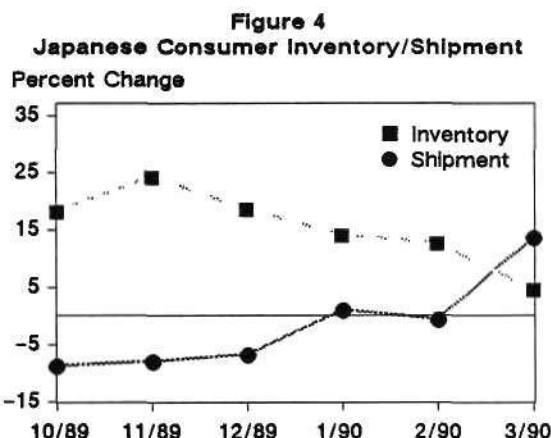
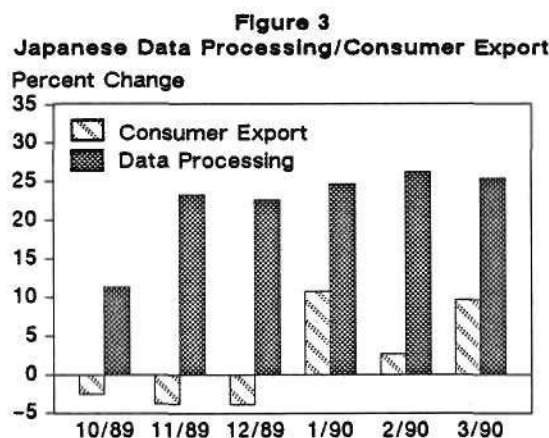
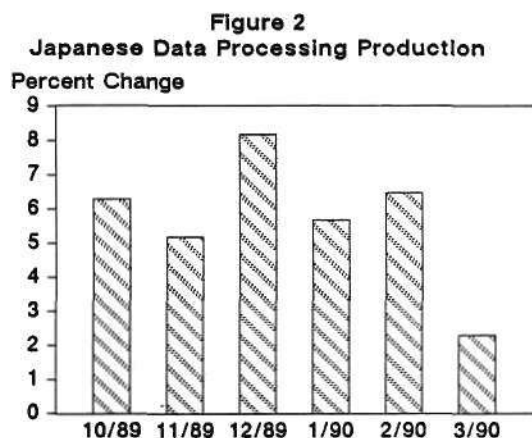
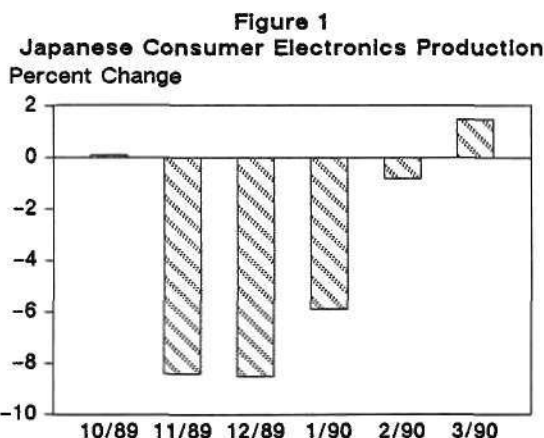
*Ione Ishii*

# Research *Bulletin*

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Source: MITI  
MOF  
Dataquest  
May 1990

## THE EQUIPMENT MARKETS

### Consumer Equipment Production

Japanese consumer equipment production broke parity in March, with a growth rate of 1.5 percent, which is an improvement from February's revised negative 0.8 percent. VCR production is still sluggish; however, it has shown improvement in March, with a negative growth rate of 5.0 percent compared with a negative growth rate of 9.0 percent in February. March's production of videocameras was relatively flat, with an increase of 2.0 percent over the same month a year ago. Videodisc player production maintained its strength, growing 112.0 percent in March and marking the third consecutive month of growth over 100.0 percent.

### Data Processing Equipment Production

Data processing equipment production grew 2.3 percent, a decline from February's revised figure of 6.5 percent. Growth was impacted by a dramatic decrease in electronic cash register (ECR) production. The March growth rate was a negative 48.0 percent compared with March 1989. Last year, the ECR manufacturers rushed to produce equipment that would meet users' demands for incorporating the new consumption tax. Personal computer production and computer storage production were stable in March, showing growth rates of 19.0 percent and 12.0 percent, respectively, over the same month last year.

### EXPORTS

March exports of consumer equipment grew 9.7 percent, showing an increase from the February figure of 2.7 percent. Color TV exports showed a

growth rate of 8.5 percent as a result of active export to the USSR and Poland. However, exports to the Republic of China declined by a negative 74.0 percent. Exports of data processing equipment showed continued strength, with a growth rate of 25.4 percent over the same month a year ago.

### INVENTORY AND SHIPMENTS

Consumer electronic equipment inventories declined by 4.8 percent, compared with February's revised figure of 12.8 percent. Inventories of color TVs and VCRs decreased by 1.0 percent and 23.0 percent, respectively. Videocamera inventories also showed a negative growth rate of 23.0 percent; videocamera shipments grew 14.0 percent over the same month a year ago. Videocamera shipments in March 1990 grew 20.0 percent over February 1990, which indicates recovery. The growth rates for color TVs and VCRs were 9.0 percent and 8.0 percent, respectively.

### DATAQUEST CONCLUSIONS

As Dataquest has forecast in the past, the consumer equipment industry is recovering, with all indicators showing improvement in March, although it is not yet a full-fledged recovery. We believe that the consumer segment will continue to grow toward the year's end. The data processing segment, with the active exports and domestic demand, will maintain its strength for the time being.

*Hideaki Nemoto*

# Research Newsletter

## WORLDWIDE APPLICATIONS MARKET: MILITARY/AEROSPACE SEGMENT

### INTRODUCTION

This newsletter, which addresses the worldwide military/aerospace market, is the fifth in a six-newsletter series. The format of the previous newsletters presented the general success strategies and common difficulties that apply to semiconductor manufacturers that supply products into a specific applications area. Because the top five suppliers all are U.S. companies, Dataquest has added a discussion that focuses on the Japanese market as well as where the leading Japanese semiconductor supplier, Mitsubishi, ranks. A list of the top five suppliers' successes and challenges follows. Dataquest estimates that the worldwide military market was \$2,268 million in 1989. Table 1 presents the 1989 top five semiconductor vendors in the military/aerospace segment.

### GENERAL SUCCESS FACTORS

As mentioned, the top five suppliers are U.S. companies; the United States holds nearly 75 percent of NATO countries' military and aerospace budgets. Because of the issue of national security,

TABLE 1  
Top Five Semiconductor Vendors—1989

Company	Market Share
Harris	11.8%
Texas Instruments	9.3%
Motorola	8.8%
National Semiconductor	8.4%
Advanced Micro Devices	6.8%

Source: Dataquest  
May 1990

the U.S. Department of Defense (DOD) has in the past granted contracts only to companies that were classified as U.S. entities and met strict government controls. During in the past few years, the U.S. government has modified its regulations from purchasing only custom products to purchasing standard or off-the-shelf devices.

Most of the military product life cycles are longer than those of products in other application areas; therefore, companies that were comfortably associated with the military enjoyed a dependable procurement contract for a longer period of time. In order to penetrate this often-bureaucratic organization to become a contractor, the United States had rather rigorous requirements on quality, delivery, citizenship, pricing, and design-in procedures. These strict qualifying processes have been changed to a "commercialization" or off-the-shelf approach of supplying products to the military segment. This change in procedure also opens the market to companies that did not previously supply products into this market.

NASA has requested a 22 percent increase from its fiscal 1990 budget for its rejuvenated space shuttle program; the increase would result in a \$13.3 billion financial package. The future space station project may be another growth opportunity for international semiconductor suppliers because the project involves participation from Canada, Japan, Europe, and the United States.

### COMMON DIFFICULTIES

In order to serve the complex military/aerospace contracts, it is necessary for a company to develop a long-term relationship with most government agencies and abide within the parameters set by the government. Companies with existing relationships are fortunate in this regard;

however, companies that want to enter into the military arena must be tenacious. This market was considered closed in the past by companies trying to win first-time contracts. It also is considered difficult to meet tight military specifications, which have become even tighter since the Challenger disaster.

During the past few years, what with military cutbacks in U.S. defense spending, some companies have elected to drop out of the defense contract business. With Eastern Europe and the USSR making steady modifications in their political stance, it appears that the Cold War is melting, and the need for heavy defense may decline. This possible decline may be the only downside to *perestroika*.

## WHERE ARE THE JAPANESE?

Mitsubishi is the tenth-ranked supplier to the worldwide military/aerospace segment and the leader in Japan's defense industry. Mitsubishi's success in supplying products to U.S. defense contracts is largely because of its relationship with Electronic Designs, Inc. (EDI). Another recent marriage for Mitsubishi is its joint venture relationship with West Germany's Daimler Benz. The scope of this agreement includes aerospace projects, which will undoubtedly generate stronger military and aerospace sales into the European market.

Because the U.S. government has changed its position on purchasing generic products, it appears that the once-closed market is now open to foreign companies as well. Mitsubishi has been allocated the Japanese portion of the joint development of the next-generation support fighter plane, which is code-named the FSX. General Dynamics is the collaborating partner for the United States. Dataquest believes that these factors should help pull Mitsubishi to a higher ranking in the future.

Japan's military and aerospace programs are in the process of growing more aggressive than in the past. Japanese defense spending had been slightly under 1.0 percent of Japan's annual gross national product (GNP), but as of 1987 the budget was increased to a figure slightly above 1.0 percent of the GNP. This change in attitude toward defense spending was influenced by the United States. The United States encouraged Japan to become more self-reliant concerning its Self-Defense Forces (SDF) when the rapid decline of the dollar against

the yen made it extremely expensive for the United States to maintain military bases in Japan. Japan's 1989 fiscal budget is an estimated 5.9 percent increase over 1988's budget, to ¥3.9 trillion (\$28 billion).

The aerospace program is the other aspect of this application market. The 1988 Japanese aerospace budget was ¥850 billion (\$6,538 million) for aircraft production and space equipment sales. The Japanese aerospace program may be small compared with the United States, Britain, or France; however, its annual growth for the past 10 years has been 9.3 percent compared with 8.9 percent growth in Japan's machinery industry and 5.8 percent for all manufacturing industries in Japan.

Starting in 1989, the Ministry of International Trade and Industry (MITI) is supporting research and development (R&D) for Japan's first supersonic airplane. The initial development work will be done exclusively by Japan; however, foreign companies will be invited to participate in the later stages of the project, thus making it a joint international project.

Japan's largest project of the century is the Japan Experiment Module (JEM), which has a budget of ¥4 trillion (\$30,769 million) and involves 11 other nations, including the United States, Canada, and European countries. This space station has tremendous possibilities for all semiconductor suppliers.

## TOP FIVE VENDOR PROFILES

### Harris

The following is a list of Harris' success factors:

- Has good business consolidation
- Has a broad product line
- Is well connected with its defense contracts
- Is successful in gallium arsenide product development for the military; however, needs to learn to cross over to other application areas
- Acquired GE Solid State, GE's Microelectronics Allied Broadcast Equipment
- Ranked 43rd overall U.S. defense contractor in 1988
- Is strong in smart-power devices

- Has strong radiation-hardened (rad-hard) product line
- Has good customer relations

The following is a list of Harris' challenges:

- Maintain leadership in ASICs and rad-hard technology
- Manage migration to the "QML" and "SMD" system, additional competition
- Face decreased government support in R&D programs
- Face decline in U.S. engineering students

### Texas Instruments (TI)

The following is a list of TI's success factors:

- Has a broad product line
- Is well connected with its defense contracts
- Is investing in expanding manufacturing facilities globally
- Has joint ventures with Fujitsu, Hitachi, Kobe Steel, Mitsubishi, NHK, and Sharp
- Is strong in bipolar logic ICs, linear devices, and memory products
- Has a \$112 million, five-year contract with Microelectronic Manufacturing Science and Technology
- Has a 0.9 percent total U.S. military market share and is ranked 19 among defense contractors in the United States
- Had \$1.2 billion in DOD contracts during 1988 fiscal year
- Had about 34 percent of 1988 total company business in defense contracts
- Has military "team" relations with General Dynamics, Lockheed, Martin Marietta, McDonnell Douglas, Northrop, Raytheon, and United Technologies
- Has Phase I of contract for development and production of GaAs microcircuits (MIMIC chip) with U.S. defense agency
- Is the leader in optoelectronics, e.g., night imaging systems

- Is the leader in solid-state radar technology, e.g., GaAs

The following is a list of TI's challenges:

- Manage migration to new technologies such as ASICs, SRAMs, and DSPs
- Compete directly with Ford Aerospace on a low-cost seeker guidance system in 1992
- Face pressure from Congress for U.S. DOC to end TI's monopoly in specific areas
- Meet competition regarding the QML and SMD systems

### Motorola

The following is a list of Motorola's success factors:

- Has broad product line
- Was ranked number 42 in U.S. defense contracts in 1988
- Was the leader in discretes and MPUs (68000)

The following is a list of Motorola's challenges:

- Manage migration to new technologies such as MCUs, MPUs, MPRs, SRAMs, DSP, and ASICs
- Cope with competition concerning QML and SMD systems

### National Semiconductor

The following is a list of National Semiconductor's success factors:

- Has a broad product line
- Implemented a new VLSI division with Integrated Systems Group, Embedded Control Group, and Interface and Peripherals Group
- Has a manufacturing location in Israel
- Purchased Fairchild; won government support

The following is a list of National Semiconductor's challenges:

- Manage migration to new technologies
- Develop MPUs, ASICs, and ASSPs
- Maintain or increase market share from QML and SMD systems



## Advanced Micro Devices (AMD)

The following is a list of AMD's success factors:

- Has high-performance chips, PLDs
- Merged with Monolithic Memories
- Has a strong bipolar logic and memories position

The following is a list of AMD's challenges:

- Manage migration to new technologies
- Integrate digital imaging and sonar satellite
- Integrate CMOS PLDs and programmable gate arrays
- Deal with stronger competition due to QML and SMD systems
- Develop position with ASSPs, FDDIs, and MPUs

## DATAQUEST CONCLUSIONS AND RECOMMENDATIONS

Dataquest forecasts that the worldwide military applications segment will grow 71 percent

from 1989 to 1994. The European regional market is projected to have the largest growth; it is forecast to grow 108 percent from 1989 to 1994. The Rest of World (ROW) region is projected to grow 83 percent in the same time frame, and the North American market is forecast to grow a conservative 59 percent.

Dataquest believes that the Japanese satellite program and its other ambitious military programs, such as mining the moon and developing a supersonic airplane, will increase Japan's military and aerospace spending significantly. With the recent United States and Japan Accord, which was signed on April 3, 1990, opportunities for international semiconductor suppliers to bid on Japanese satellite projects have opened up. Joint international projects, such as the space station project and joint communication satellite launches, also create opportunities for international semiconductor suppliers to move into the military and aerospace markets. Dataquest believes that the joint space projects will provide major opportunities worth pursuing for the semiconductor vendor.

*Ione Ishii*



# Research Newsletter

## BUSINESS OPPORTUNITIES IN JAPANESE AEROSPACE

### INTRODUCTION

On April 3, 1990, U.S. and Japanese government trade negotiators announced the signing of an accord, which could create opportunities for U.S. and other nations' aerospace firms to bid on Japanese satellite projects. The satellites affected by this accord include Japanese government projects, CS-4, communications, and weather satellites, which previously had been barred from non-Japanese bidding. The satellite agreement follows similar accords for expanding sales of American-made telecommunications equipment in the Japanese market and removing restrictions on the sales of U.S.-made supercomputers to Japanese universities and other government sectors.

This newsletter discusses government and private-sector satellite projects in Japan. The new opportunities this accord creates for semiconductor manufacturers are presented. Information about what organizations to contact concerning these and other aerospace opportunities also is provided herein.

### JAPANESE SATELLITE PROJECTS

#### Background

The Japanese aerospace agencies consist of two major companies: Institute of Space and Astronautical Science (ISAS) and the National Space Development Agency (NASDA), which develops all Japan's commercial satellites and launch vehicles. Government funding for the overall Japanese space program was \$1.1 billion (¥140 billion) in 1988 and is projected to grow to \$2.4 billion (¥300 billion) by 1999. These agencies have been responsible for launching an average of one satellite per year since 1970 and have plans to increase the number of launches to four annually.

Using the only available comparison statistics, which date back to 1986, the Japanese space budget was ¥117 billion (\$700.6 million), compared with the U.S. space budget of ¥1,192 billion (\$7,137.7 million). Table 1 lists the Japanese historical satellite launches, as well as scheduled future launches.

As a precursor to the new U.S. and Japanese accord, the Japanese negotiating delegation announced in late March that the Japanese government would scrap its plans to develop the highly controversial CS-4 satellite. The United States had claimed that the CS-4 satellite could not be totally a research and development (R&D) effort, as the Japanese claimed, because Nippon Telegraph and Telephone (NTT) was funding 75 percent of the development costs. The United States claimed that this huge investment by NTT qualified the CS-4 to be classified as a commercial, not a research, effort.

The CS-4 now will be broken out into two separate projects. The first will be a completely research-oriented satellite, the Experimental Data Relay Tracking Satellite (EDRTS), which will be wholly funded by NASDA. The earliest the EDRTS is expected to be launched is 1995 at an estimated cost of ¥65 billion (\$406 million). The major leading Japanese satellite developers (Mitsubishi Electric, NEC, and Toshiba) are expected to continue their involvement in this project.

The second project will be a commercial communications satellite, which will be open to international competition such as the United States' Hughes Aircraft, General Electric, and Ford Aerospace. Because of the pressure, NTT, the original financial supporter, could pull out of this portion of the CS-4 project. If NTT does pull out, the door would open up even wider for foreign bids.

**TABLE 1**  
**Japanese Satellites Launched**

Satellite	Launch	Main Contractor	Comments
<b>Historical Launches</b>			
GMS	Jul. 1977	NEC	N/A
CS	Dec. 1977	Mitsubishi	N/A
BS	Apr. 1978	Toshiba	N/A
GMS-2	Aug. 1981	NEC	N/A
CS-2	Feb. 1983	Mitsubishi	N/A
BS-2	Jan. 1984	Toshiba	N/A
GMS-3	Aug. 1984	NEC	N/A
CS-3	Feb. 1988	Mitsubishi	N/A
GMS-4	Nov. 1989	NEC	N/A
Muses-A	Jan. 1990	ISAS	Moon Probe
<b>Future Launches</b>			
Geotail	1991	N/A	Geophysical research
Solar-A	1991	ISAS-sponsored	Solar observer
BS-3B	1991	NEC/GE	Sister to BS-3A
ERS-1	1991	NEC/Mitsubishi	Aperture radar
HESP-1	1992	ISAS-sponsored	Solar physics
ETS-6	1992	Mitsubishi	Engineering test, H-2
H-2	1993	N/A	Space flyer unit
Astro-D	1993	ISAS	X-ray observer, M-3S-2
GMS-5	1994	NEC/Hughes	H-2, weather satellite
ADEOS	1994	N/A	Earth observation
BS-3a	Mid-1990	NEC/GE	Color TV—3 channels
H-2	Mid-1990	N/A	Venus probe
JEM	Mid-1990	NASDA	Space station module
H-2	Mid-1990	Mitsubishi	Hope, spaceplane

N/A = Not Available  
 CS = Communications satellite  
 BS = Broadcasting satellite  
 GMS = Geostationary meteorological satellite

Source: Japan Science and Technology Agency,  
 1988 Statistics  
 Dataquest  
 April 1990

## What It Means for Semiconductor Companies

Dataquest estimates that each satellite contains \$40 million worth of electronic equipment and each launch system contains \$12 million. Of this figure, 3.8 percent of both the satellite contents and launch equipment are semiconductors. Each launch will require a little less than \$2 million worth of semiconductors, bringing the cost of the

expected four Japanese launches a year almost up to \$8 million. This figure, of course, does not include the ground equipment required to monitor all satellite activities.

Semiconductor suppliers with contracts and/or close relationships with U.S. or European aerospace companies that are already well aligned with Japanese firms active in the commercial satellite business clearly are in a key position for additional sales opportunities. Firms that specialize

in radiation-hardened (rad-hard) semiconductor technologies would have a particularly strong advantage with aerospace firms. The top 10 semiconductor suppliers to the military (including aerospace) are listed in Table 2. Dataquest estimates that the military/aerospace worldwide semiconductor market in 1989 was \$2,268 million.

### Companies to Contact

The semiconductor suppliers in Table 2 clearly are in an advantageous position. But with the opportunity to supply semiconductors to the newly opened Japanese satellite market, suppliers need to know the appropriate party to contact in order to make their efforts worthwhile. Dataquest recommends that companies interested in following up on this subject contact any of the following organizations:

- American Electronics Association, Santa Clara, California
- British Aerospace, London, England
- Department of Commerce, Aerospace Policy and Analysis, Washington, D.C.
- Electronic Industry Association, Tokyo, Japan
- European Space Agency, Paris, France
- International Semiconductor Cooperation Center (INSEC), Tokyo, Japan
- Japan External Trade Organization, New York, New York, and Tokyo, Japan
- Matra Espace, Paris, France
- Semiconductor Industry Association, Cupertino, California

**TABLE 2**  
Top 10 Semiconductor Suppliers Worldwide  
Military/Aerospace Applications

Rank	Company
1	Harris
2	Texas Instruments
3	Motorola
4	National Semiconductor
5	Advanced Micro Devices
6	LSI Logic
7	SGS-Thomson
8	Philips
9	Intel
10	Mitsubishi

Source: Dataquest  
April 1990

### DATAQUEST CONCLUSIONS

Dataquest believes that more accords involving the satellite market will be made, especially because the deadline for these talks is June 19, 1990. Another approaching deadline is that of the U.S.-Japan Semiconductor Trade Arrangement, which is scheduled to expire in July 1991. The U.S. government may propose a renewal to the five-year trade agreement because of pressure from semiconductor manufacturers that want either to renegotiate to bring the market share level up to the 20 percent goal or designate Japan as an unfair trader. (Dataquest estimates that the United States had 9.7 percent of the Japanese market in 1988.) Japanese officials, however, have responded through a trade journal that they would reject a renewal proposal.

*Ione Ishii*  
*Greg Sheppard*

# Research Newsletter

## WORLDWIDE APPLICATIONS MARKET: CONSUMER SEGMENT

### INTRODUCTION

This newsletter is Dataquest's fourth in a series of six on the worldwide applications market. This installment focuses on the worldwide consumer segment and the general success strategies and common difficulties that semiconductor vendors may share in this market. Dataquest estimates that the worldwide consumer market was \$10,999 million in 1989. The consumer segment ranked second of the six categories covered by these newsletters; it follows the data processing segment, which was \$25,763 million in 1989. Table 1 presents the top five semiconductor manufacturers in the consumer application segment. An outline of the top five companies appears later in this newsletter.

### GENERAL SUCCESS FACTORS

Japanese firms, which have dominated the consumer market for nearly two decades, share the same success formula. Perhaps the key success factor for the top five semiconductor suppliers concerns their internal consumer electronics divisions' ability to master the flowchart shown in Figure 1.

TABLE 1  
Top Five Semiconductor Vendors

Company	Market Share
Toshiba	10.8%
NEC	10.3%
Matsushita	9.9%
Hitachi	8.1%
Mitsubishi	7.8%

Source: Dataquest  
April 1990

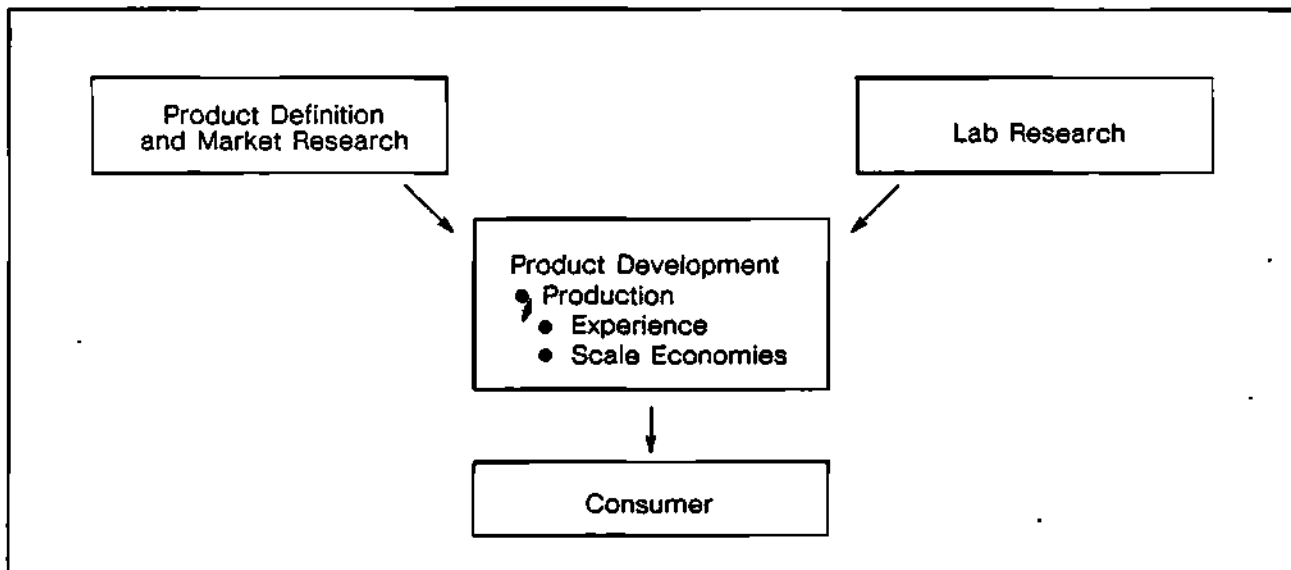
### COMMON DIFFICULTIES

Recently, Matsushita, Pioneer, Sony, and Toshiba recalled hundreds of thousands of color TVs and computers from the Japanese market because of sudden smoking and other defects. The firms stated that "imperfect quality controls in relationship to the speed of technological advances" caused the increase of failure rates in these items. The Ministry of International Trade and Industry (MITI) quickly instructed the Electronics Industry Association of Japan (EIAJ) to establish an ad hoc committee to develop tighter safety standards on television sets, computers, and high-voltage circuits. These standards then need to be voluntarily adopted by the 11 Japanese manufacturers associated with television production, as well as by computer manufacturers. The committee is also responsible for establishing procedures to handle the reported defects. This committee's efforts may curtail the failure rates.

Dataquest has observed continual strong competition from European and South Korean semiconductor suppliers. Philips ranked as the seventh-largest supplier into the consumer electronics segment. Samsung was estimated to be the tenth largest worldwide supplier of semiconductors into the consumer segment in 1989. Even with Japan's strong domination of this product category, competition from European and South Korean suppliers is expected to increase.

Challenges that may affect all suppliers in this product segment include the development of high-definition television (HDTV) and digital/audio systems and the evolution of communication systems and data processing products into consumer items. A common obstacle is the lack of international standards for all products.

**FIGURE 1**  
**Production Sequence**



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Source: Dataquest  
April 1990

## TOP FIVE VENDOR ANALYSIS

Of the top five vendors, Toshiba, NEC, Hitachi, and Mitsubishi have been highlighted extensively in previous newsletters in this series. Figure 1 applies to the top five suppliers in this segment, as well as any other Japanese supplier. Therefore, only issues that are unique to a specific company will be listed in the following outline. Matsushita, however, will be outlined in more detail because this is the first time it has been listed as a top five supplier in this series.

### Matsushita

The following list shows Matsushita's success factors:

- Has strong international presence
- Involved in joint ventures with Actel, Siemens, and Weitek
- Earns the largest profits in VCR category
- Has 50 overseas manufacturing subsidiaries and 36 sales companies worldwide
- Has well-known product names: National, Panasonic, Quasar, and Technics

The following list shows Matsushita's challenges:

- Needs to increase domestic market share
- Is slow to embrace new design methods
- Has TV picture tube manufacturing site in Beijing, China

### Hitachi

The following is a list of Hitachi's challenges:

- Has strong interest in joint ventures with China
- Has largest market share in China's electronic appliance market
  - Due to current political situation, market share and investment in jeopardy

### Mitsubishi

Mitsubishi has the following success factors:

- World leader in video technology
- World leader in large-scale televisions

## DATAQUEST CONCLUSIONS

While consumers enjoy the latest "new toy," research teams around the world are working to develop the next gimmick to entertain them. Products that were introduced recently or are due soon include color and portable facsimile machines, digital audio tape (DAT) players and Dolby S audio systems, 120-inch big-screen monitors for televisions, audio and video bonding (again), colored liquid crystal displays (LCDs) in portable televisions, personal videos, and front and rear projection televisions.

In the long term, Dataquest forecasts that the strongest growth in semiconductor consumption

will occur in Europe (221 percent growth in 1994 over 1989), primarily because of the anticipated impact of the European Community's (EC) unification at the end of 1992. The other geographic area that has been projected to grow substantially is the Rest of World (ROW) region, with 140 percent growth in 1994 over 1989. This growth could be attributed to the large amount of consumer electronic product manufacturing being performed in or moved to the Far East. On a worldwide basis, the consumer segment is anticipated to increase its semiconductor consumption by 91 percent from 1989 to 1994.

*Ione Ishii*

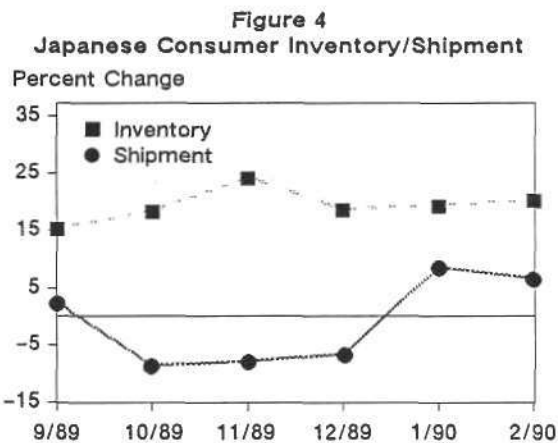
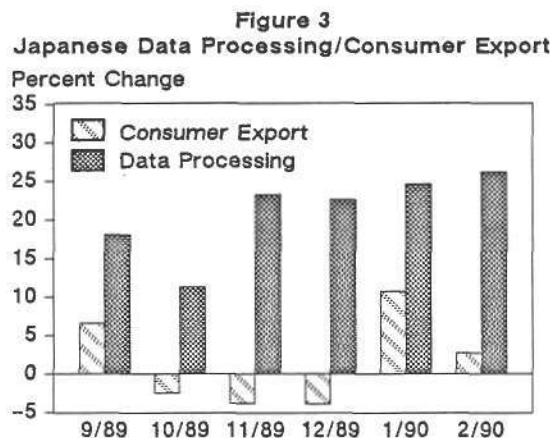
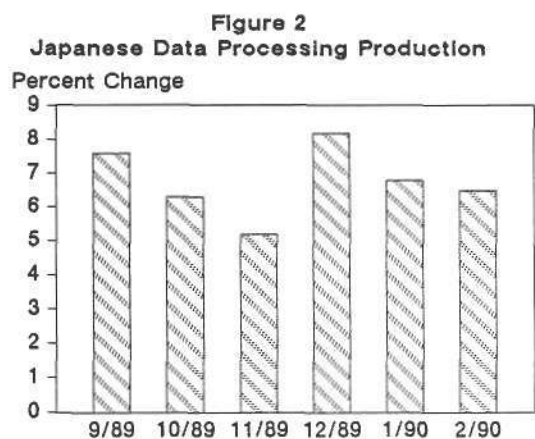
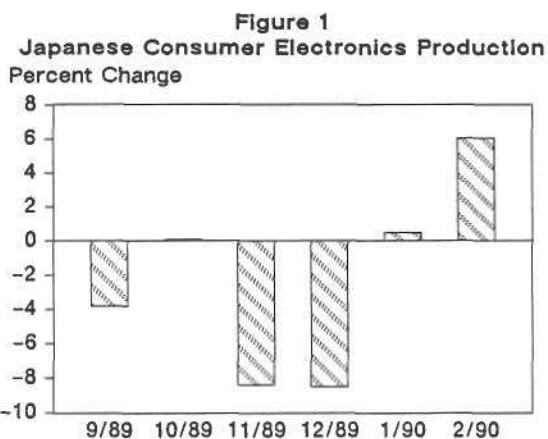


# Research *Bulletin*

## JSAMONITOR

This Research Bulletin is a monthly update that monitors changes in the key Japanese electronic equipment markets. The intention of this publication is to present important tactical leading indicators in semiconductor business activity. The

sources for the graphs are the Japanese Ministry of International Trade and Industry (MITI) and the Ministry of Finance (MOF) (see Figures 1 through 4). The commentary and analysis are solely those of Dataquest.



0006734-1

Source: MITI  
MOF  
Dataquest  
April 1990

## THE EQUIPMENT MARKETS

### Consumer Equipment Production

Japanese consumer equipment production improved in February, with a positive growth rate of 6.1 percent over the same month a year ago. As Dataquest forecast in our last *JSAMonitor*, color TV production gained momentum, growing 17 percent. VCR production showed an improvement with a negative growth rate of 1 percent compared with a negative 8 percent in January. February production of videocameras was nearly flat, with a growth rate of 2 percent compared with 3 percent in January.

### Data Processing Equipment Production

Data processing production was down slightly, with a growth rate of 6.5 percent compared with the January figure of 6.8 percent. Personal computer production maintained its strength, growing 35 percent over the same month a year ago. Computer storage production continues to grow at the high rate of 22 percent. Dataquest estimates that optical disk drive production is becoming full-fledged. I/O device production is stable, showing a growth rate of 8 percent over the same month a year ago. Japanese word processor production declined sharply at a rate of negative 16 percent.

### EXPORTS

February exports of consumer equipment grew 2.7 percent, showing a decline from the

January figure of 10.8 percent. Color TVs and VCRs, both of which are main products in the consumer exports area, showed export rates of 2.2 percent and negative 3.0 percent, respectively. Exports of data processing equipment showed continued growth and increased 26.2 percent over the same month a year ago.

### INVENTORY/SHIPMENTS

Consumer electronics inventories increased slightly by 20.5 percent, compared with the January figure of 19.5 percent. In contrast, shipments declined to 6.7 percent from 8.7 percent in January. Videocamera shipments are recovering gradually, showing a positive growth rate of 15 percent, while inventory declined 10 percent over the same month a year ago.

### DATAQUEST CONCLUSIONS

Dataquest believes that consumer electronics production has started to recover. Not only are consumers buying more than in the past, but the outlook of a weaker yen may encourage consumer equipment exports. The data processing segment maintains its strength. We believe that this area will continue to maintain its stability throughout the year.

*Hideaki Nemoto*



# Research Newsletter

## WORLDWIDE APPLICATIONS MARKET: INDUSTRIAL SEGMENT

### INTRODUCTION

This newsletter is third in a six-part series on the worldwide applications markets. The preceding newsletters discussed data processing and communications. The purpose of this series is to present the general success strategies and common difficulties of semiconductor vendors in a specific application market. The information herein is applicable not only to the top firms, but to most firms that participate in each segment. An outline of the top five companies lists each company's success factors and challenges, which are required in order to maintain or improve its position in each specific application market.

Dataquest has estimated that the worldwide industrial segment was \$6,436 million in 1989. Table 1 presents the top five semiconductor manufacturers in the industrial applications market.

**TABLE 1**  
**Top Five Semiconductor Vendors**

Company	Market Share
Motorola	11.9%
Toshiba	8.0%
Hitachi	6.1%
Mitsubishi	5.8%
NEC	5.4%

Source: Dataquest  
April 1990

### GENERAL SUCCESS FACTORS

Dataquest currently projects that the industrial applications consumption of semiconductors will decline on a worldwide basis during 1990. The projections show that 1990 consumption will

decline slightly to 3 percent or \$6,269 million from the 1989 estimate of \$6,436 million. The geographic regions that are expected to decline in 1990 are North America and Japan by 8 percent and 5 percent, respectively. Both the European and Rest of World (ROW) regions are forecast to grow 5 percent in 1990.

In the long term, Dataquest forecasts that worldwide industrial consumption of semiconductors will grow 90 percent from 1989 to 1994 (to \$12,231 million in 1994). The end use that appears to be the driving force behind this projected consumption is manufacturing systems. Within this area, the use of robots is expected to pick up momentum that started in 1989. Robots have been used in manufacturing for many years, but have yet to become widely accepted except for Japanese manufacturing.

Other applications that are projected to contribute to semiconductor consumption include security and energy management systems, instrumentation (e.g., meter units, measuring instruments, and industrial units), medical equipment, civil aerospace equipment (e.g., flight simulators), and vending machines. Dataquest anticipates that semiconductor consumption in vending machines will increase during the next few years, because vending machines are used for a wide variety of products.

### COMMON DIFFICULTIES

The common challenges faced by the top five companies and other suppliers in this category are similar to those already mentioned in the two previous newsletters: selling price erosion, possible product allocation programs, the U.S./Japan trade deficit, and the strengthening of the U.S. dollar, which could affect product export and import. Another subject of concern, mainly for the top

companies, could be the increasing presence of the newly industrialized economies (NIEs) within the industrial market.

## TOP FIVE VENDOR ANALYSIS

The analysis briefly lists the strengths and weaknesses of the top five semiconductor suppliers in the industrial applications segment. Dataquest provides only those factors that contribute to the success or are challenges within this application. We recommend that references be made to previous and future newsletters for a general, but complete list of specific companies' strengths and challenges.

### Motorola

The following is a list of Motorola's success factors:

- Power ICs
- Largest U.S. semiconductor manufacturer
- Broad product base
- Dedicated Industrial Electronics Group
- Strategic alliance with Toshiba (the number 1 worldwide supplier) concerning memory products
- Current customer service strategy thrust
- Vertically integrated
- Rapid establishment of international manufacturing facilities

The following is a list of Motorola's challenges:

- Maintain position
- Penetrate other international markets
- Challenge legal ruling on Hitachi/Motorola 68030 case
- Develop stronger position in Japanese market

### Toshiba

The following lists Toshiba's success factors:

- Power supplies
- Power plants with GE, Japanese power plant leader

- Medical equipment manufacturer, leader
- Use of robotics and automated equipment
- "E&E Concept," electronics and energy credo to create energy-efficient technologies
- Close business relationship with Ishikawajima-Harima Heavy Industries (IHI)

The following lists Toshiba's challenges:

- Overcome negative reputation from selling milling equipment into USSR
- Maintain position
- Overcome weakening demand for new power facilities
- Needs to strengthen product areas other than IC memories

### Hitachi

The following is a list of Hitachi's success factors:

- Power supplies
- Heavy industries division—first in Japan for electric machinery companies and electronics manufacturing
- Computer automatic engineering for automotive line
- Power plants
- Use of robotics and automated equipment
- Four new international R&D labs in Cambridge, the United Kingdom; University of Dublin, Ireland; and Detroit, Michigan and San Jose, California in the United States

The following is a list of Hitachi's challenges:

- Move outside family
- Maintain and/or improve position
- Continue to expand global operations and localize production, marketing, and designs

- Decrease export ratio and expand overseas manufacturing
- Has heavy investment in China; current political instability could jeopardize investment
- Expand product mix
- Challenge ruling on 68030 with Motorola lawsuit

### Mitsubishi

The following lists Mitsubishi's success factors:

- Heavy industries division
- Power supplies
- Power plants
- Joint venture with Daimler-Benz
- Computer automatic engineering for automobiles
- Use of robotics and automated equipment
- Numerous alliances/agreements with companies such as General Electric, Intel, LSI Logic, National Semiconductor, and Texas Instruments
- World leader in sophisticated video technology including radar scopes, video displays for aerospace, and defense applications
- Increased microcontroller production, specifically for industrial use
- 16-bit single-chip MCU and 3700 series

The following lists Mitsubishi's challenges:

- Move outside family
- Penetrate offshore markets

- Maintain and/or improve position
- Improve product mix

### NEC

The following is a list of NEC's success factors:

- Power supplies
- Long-time user of robotics and automated equipment
- Expanded V series microprocessor

The following is a list of NEC's challenges:

- Maintain and/or improve position
- Localize products and services to other markets
- Regain first-place memory supplier position

### DATAQUEST CONCLUSIONS AND RECOMMENDATIONS

Dataquest believes that the industrial applications market has future opportunities, even with the projected slight decline in semiconductor consumption in 1990. Companies that compete in this market should be encouraged by the 90 percent growth projected from 1989 to 1994. The political improvements in Eastern European and China could mean sudden industrial demands made on those fortunate firms that are semiconductor suppliers and have close relationships with companies focused on industrial equipment.

The application area to be discussed in the fourth newsletter of the series, which is due next week, will be the consumer segment.

*Ione Ishii*

# Research Newsletter

## WORLDWIDE APPLICATIONS MARKET: COMMUNICATIONS SEGMENT

### INTRODUCTION

This newsletter is the second in a six-part series on the worldwide applications markets. The first newsletter dealt with the Data Processing applications market. The purpose of this series is to present the general success strategies and common difficulties of semiconductor vendors in a specific application market. This information is applicable to most of the firms that participate in each segment. Each newsletter includes an analysis of each of the top five semiconductor manufacturers in the market; the analysis lists each company's success factors and the challenges it faces to maintain or improve its position in the market. Dataquest estimated that the worldwide communications segment was \$8,387 million in 1989. Table 1 presents the top five semiconductor manufacturers in the communications application segment.

**TABLE 1**  
Top Five Semiconductor Vendors

Company	Market Share
NEC	11.2%
Motorola	9.6%
Toshiba	7.9%
Fujitsu	7.9%
AT&T	7.6%

Source: Dataquest  
April 1990

### GENERAL SUCCESS FACTORS

The worldwide communications segment of semiconductor consumption is forecast by Dataquest to grow 106 percent between 1989 and 1994, bringing the forecast figure to \$17,257 million in

1994. Most of the growth is expected to occur in the Rest of World (ROW) geographic area, which has a projected growth rate of 162 percent between 1989 and 1994. However, all regions of the world are forecast to have growth rates of between 73 and 162 percent for the stated time frame.

Dataquest believes that some of the main reasons for such strong growth are because of advances in the broadcast television satellite business, sophisticated telephone systems, expanded functions in facsimile machine developments and broader acceptance of this product, the fact that ISDN will become operational approximately in the mid-1990s, greater use of local area networks (LANs), and modems as standard features rather than optional items. Other growth possibilities include interactive voice response systems, fax store-and-forward systems, E-mail services, paging services, and satellite earth station equipment.

Dataquest estimated that the Japanese market consumed \$3,111 million in semiconductor devices, while the North American market consumed \$2,549 million in semiconductor products.

### COMMON DIFFICULTIES

Problems that may affect all semiconductor firms that supply products to manufacturers in this application area include the Federal Communications Commission regulations regarding cordless telephone security codes. It is anticipated that the FCC will demand standardizing of security codes perhaps within this year.

For Japanese manufacturers, the current and possibly continuing weakening of the Japanese yen could curtail dramatic investments into non-Japanese countries. The strengthening of the yen had a positive impact on Japanese investments from mid-1985 until now.

## TOP FIVE VENDOR ANALYSIS

### NEC

The following lists NEC's success factors:

- Member of Japanese NTT family
- Supplier to satellite program and defense contracts
- Corporate motto "C&C Strategy"—communications and computers strategy
- Original product line in communications with AT&T
- Vertically integrated
- Strong manufacturing process
- Member of Japanese industrial group, Sumitomo "keiretsu," for financing
- Largest producer of communications equipment in Japan
- Long history (since 1899) as manufacturer of telephone sets and switchboards

The following lists NEC's challenges:

- Integration of C&C concept
- "Consumerization" of cellular telephone
- Coping in European, Latin American, and Asian markets
- Assimilating the breakup of Japan's NTT, vying for position
- Implement faster decision-making policies
- Improve mass-marketing skills

### Motorola

The following lists Motorola's success factors:

- Communications systems experience
- Leader in cellular telephone business
- Worldwide name recognition
- Overseas cellular telephone manufacturing plant (Scotland)
- Current emphasis on analog products in order to target ISDN

- Vertically integrated
- Toshiba alliance regarding memory products

The following lists Motorola's challenges:

- Overcoming foreign policies outside of United States
- "Consumerization" of cellular telephone
- Strong domestic competition
- Juggling its technology exchange with Toshiba without jeopardizing its prominent position in the microprocessor market
- Investment in semiconductors and mobile radio equipment facilities in Tianjian, China, currently questionable because of political unrest

### Toshiba

The following lists Toshiba's success factors:

- Successful penetration of foreign markets
- Strengthening ties with AT&T
- Vertically integrated
- Alliance with Motorola for microprocessor technology

The following lists Toshiba's challenges:

- Improve penetration of domestic market
- Vie for position what with breakup of NTT in Japan
- Develop with European, Latin Americas, and Asian communications policies

### Fujitsu

The following lists Fujitsu's success factors:

- Member of Japan's NTT family
- Has reputation for its high-quality product line
- Has active overseas operations
- Vertically integrated
- Original products (since 1935); was manufacturer of automatic telephone exchange and related telephone equipment
- GTE Communication Systems corporate joint venture

The following lists Fujitsu's challenges:

- Broaden product line
- Overcome European, Latin American, and Asian market differences
- Assimilate with the breakup of Japan's NTT, vie for position

## AT&T

The following lists AT&T's success factors:

- Knowledge and experience with communications systems
- Substantial cash flow because of brand recognition in long-distance market
- Vertical integration
- Recent alliances with semiconductor firms
- Developed UNIX systems
- Numerous joint ventures with many international telephone firms

The following lists AT&T's challenges:

- Provide user-friendly ASIC design tools
- Competing in the merchant semiconductor market
- Maximizing efficiency

## DATAQUEST CONCLUSIONS AND RECOMMENDATIONS

As is true with many of the applications areas in the future, Dataquest believes that more products will overlap; for instance, in the communications and data processing fields LANs and facsimile machines will overlap.

Dataquest also believes that more regulatory issues from all countries' communications agencies will surface, causing delays and confusion during the development of products such as ISDN and broadcast satellite television. We recommend the European Community unification at the end of 1992 as an example of opportunities and challenges for foreign suppliers.

The next newsletter in this series will discuss the worldwide industrial segment.

*Ione Ishii*

# Research Newsletter

## WORLDWIDE APPLICATIONS MARKET: DATA PROCESSING SEGMENT

### INTRODUCTION

Dataquest will present a six-newsletter series on the worldwide application market. This newsletter is the first, with the remaining five following sequentially within a week of the previous issue. The purpose of this series is to provide the general success strategies and common difficulties for semiconductor vendors that compete in each application area. This information applies to all firms that participate in each application segment. An in-depth company analysis of each of the top five semiconductor manufacturers, which lists the company's success factors and challenges, is included in this newsletter. Dataquest estimates the total worldwide data processing semiconductor consumption for 1989 to be \$25,763 million. Table 1 lists the top five semiconductor vendors for data processing for 1989.

TABLE 1  
Top Five Semiconductor Vendors

Company	Market Share
NEC	9.3%
Toshiba	8.6%
Hitachi	7.5%
Fujitsu	7.3%
Intel	7.0%

Source: Dataquest  
March 1990

### GENERAL SUCCESS FACTORS

Most of the top companies participating in this application segment benefit from company and consumer demands for constant upgrades for better and more advanced data processing systems. The

rising performance/price ratios also provide additional growth incentive. This area has been projected to continue to grow worldwide, mainly due to the technological advances that drive this market. Companies that manufacture semiconductors with larger memory capacities and faster processing times may sustain, if not increase, their market share positions worldwide. Firms that either manufacture computer systems or are aligned with computer system firms also will benefit, because joint product development will give the semiconductor manufacturer an edge over firms that are not as fortunately positioned. With the dramatic changes in personal computer systems, Japanese companies appear to have an edge because most U.S. firms lack expertise in the miniaturization process.

### COMMON DIFFICULTIES

Worldwide barriers for all firms participating in the data processing segment include the lack of international standards for data processing. The U.S. and Japan trade deficit will always cause difficulties for Japanese firms, whereas the SIA Trade Agreement may aid U.S. and European firms that sell semiconductors into the Japanese market. (The Japanese data processing segment is forecast to grow to \$80,505 million by 1994, an anticipated 40 percent growth over 1989.)

Another area to monitor in this and all application segments is that of average selling prices (ASPs) for all products, especially DRAMs. Dataquest has recently seen prices stabilizing due to cutbacks made in late December 1989 and early January 1990. The possible downside to this pricing control maneuver is expected to have an effect on product availability, which could result in longer lead times, product allocation programs, and double bookings by nervous buyers.



## TOP FIVE VENDOR ANALYSIS

The following paragraphs provide the reader with a brief list of strengths and weakness for each of the top five semiconductor manufacturers.

### NEC Analysis

The following is a list of NEC's success factors:

- V series CMOS, V20/V30/V33 in laptop
- Strong microprocessor product line
- Ability to attract high caliber of personnel
- Strong presence in memory market at number two
- Strong Japanese market presence—56 percent of PC market share in its home market
- Strong manufacturing process (applies to all of NEC)
- Historical relationship with AT&T and ongoing venture agreement
- Strong vertical integration
- Member of Japanese industrial group, Sumitomo "keiretsu," for financing
- "C&C Strategy"—Communications and computers strategy

The following is a list of NEC's challenges:

- Increase offshore revenue
- Increase penetration into U.S. microcomponent market
- Increase offshore PC sales
- Broaden product line in microprocessors
- Improve mass marketing skills
- Improve faster decision-making policies

### Toshiba Analysis

The following lists Toshiba's success factors:

- Laptop and notebook PCs (23.8 percent of portable market); is currently expanding laptop production into the United States
- Is number one ranked memory supplier

- Has good strategic international marketing
- Has cooperative activity with General Electric in the United States, Siemens in West Germany, Olivetti in Italy
- Is strengthening ties with AT&T
- Has vertical integration
- Entered a joint venture with Motorola (68000 family)

The following lists Toshiba's challenges:

- Maintain DRAM leadership
- Develop domestic market

### Hitachi Analysis

The following is a list of Hitachi's success factors:

- Has good relationship with U.S. electronic data processing vendors
- Made significant DRAM investments
- Leads MOS memory manufacturers in Japan
- Has excellent financial standing
- Has production plans in West Germany
- Has vertical integration
- Has strong microcontroller position

The following is a list of Hitachi's challenges:

- Must maintain MOS memory strength
- Needs to expand sales channels successfully
- Must create microprocessor position

### Fujitsu Analysis

The following list shows Fujitsu's success factors:

- Has strong relationship with Amdahl
- Has advanced ASIC and computer technology
- Has reputation for its high-quality product line
- Has active overseas operations
- Has vertical integration
- Is original SPARC licensee



The following list shows Fujitsu's challenges:

- Must maintain MOS memory strength
- Must maintain and/or increase worldwide market share
- Must determine how strong support is for SPARC

### Intel Analysis

The following lists Intel's success factors:

- Is a leader in the microcomponent market by a wide margin
- Has innovation, entrepreneurial skills
- Has strong PC architecture position

The following lists Intel's challenges:

- Continued development of systems (workstations) side of business
- Availability and caliber of future U.S. engineers
- Integration of NMB DRAM relationship
- Recapture of PC chip set position of business

### DATAQUEST CONCLUSIONS AND RECOMMENDATIONS

Dataquest believes that the data processing applications market will continue to provide exciting opportunities for semiconductor manufacturers in both the short and long terms. The worldwide applications forecast is for a 40 percent increase in 1994 over 1989 to \$351,535 million. All regions are expected to enjoy substantial growth in data processing. The changes in the political environment in Eastern Europe also may provide increased opportunities once various obstacles are overcome.

Dataquest recommends that firms not ranked in the top five consider the lists of the top five vendors' success factors and challenges provided herein. Opportunities can be created by knowing the weaknesses of the top firms. Successes can be imitated through alliances and joint ventures with successful and semiconductor-hungry systems manufacturers.

Our next applications newsletter will discuss the worldwide communications segment and will be available within a week.

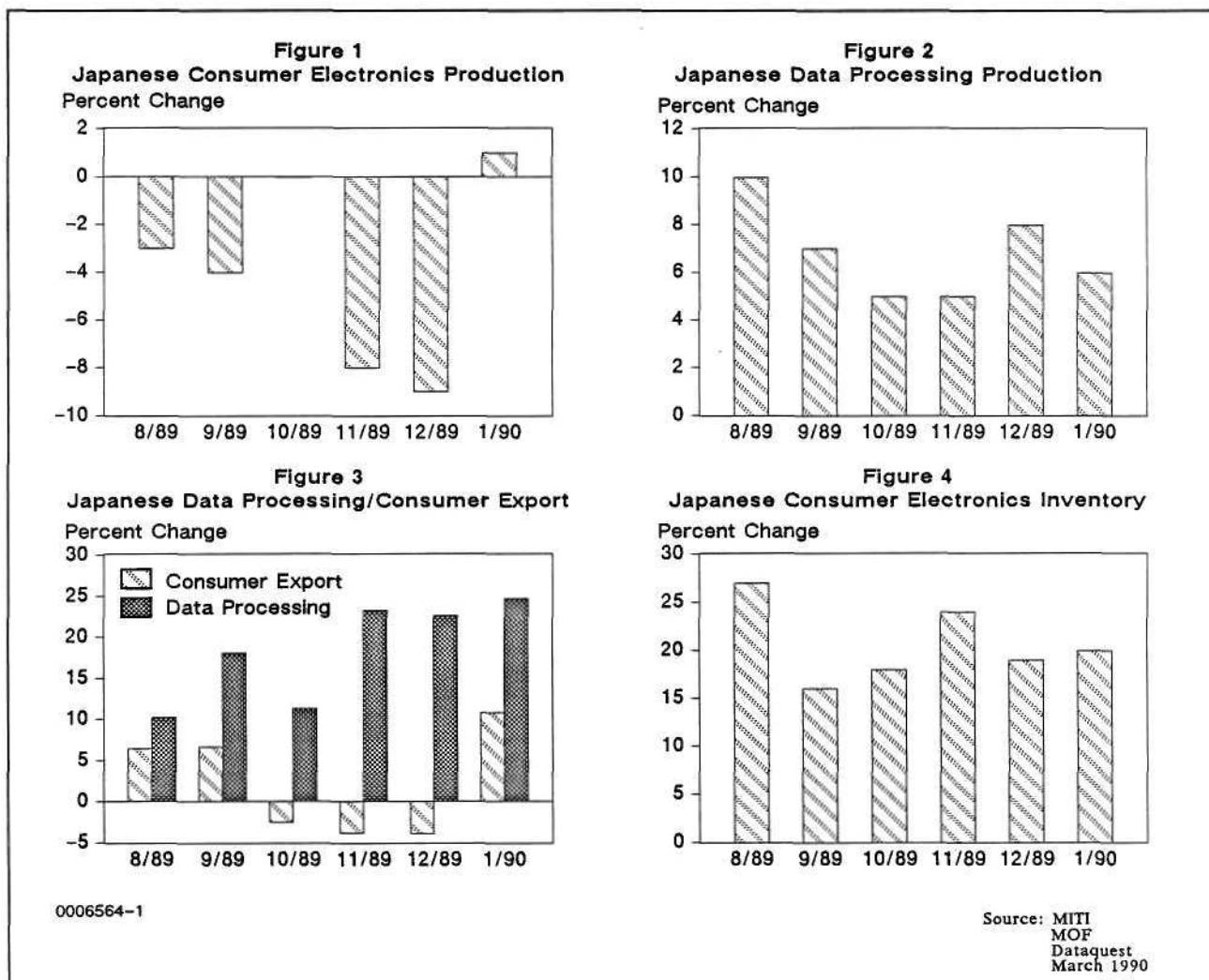
*Ione Ishii*

# Research *Bulletin*

## JSAMonitor

This Research Bulletin is the first issue of *JSAMonitor*, a monthly update that will monitor changes in the Japanese key electronics equipment markets. The intention of this publication is to present important tactical leading indicators in semiconductor business activity. The sources for

the graphs are the Japanese Ministry of International Trade and Industry (MITI) and the Ministry of Finance (MOF) (see Figures 1 through 4). The commentary and analysis are solely those of Dataquest.



## THE EQUIPMENT MARKETS

### Consumer Equipment Production

Japanese consumer equipment production is still sluggish. However, Dataquest has seen the first signs of improvement in January 1990 numbers compared with production figures for December 1989. Color TV production grew 6 percent over the same month a year ago in terms of value. Behind this growth, we estimate that sales of televisions equipped with a broad satellite tuner currently are very strong in Japan and are expected to remain strong for the rest of this year. VCR production in January showed a growth rate of negative 8 percent over the same month a year ago. Videocamera production had shown negative growth since April 1989, but it broke parity in January and grew 3 percent. Compact videocameras such as Sony's Handycam TR-55 model are experiencing skyrocketing sales.

LCD TV production doubled in January 1990 compared with January 1989. We see the following factors behind these strong sales figures:

- Declining prices
- Improved quality
- Increased use in automobiles

Concerning the use of LCD TVs in automobiles, because of the heavy use of taxicabs in Japan, it is becoming increasingly popular for taxicabs to provide televisions for customers. It is also becoming usual for the individual car owner to purchase an LCD TV to use during traffic jams. Another market for the LCD TV within the automobile segment is for a rear-view mirror to be equipped with an LCD TV. We anticipate wider uses for LCD TVs in other segments as well.

Based on these three factors, Dataquest expects this strong production of LCD TVs to continue through the end of this year and beyond.

### Data Processing Equipment Production

Data processing production maintained its stable growth in January with an increase of 6 percent over the same month in 1989. Personal computer production continues to grow at the high rate of 29 percent. Notebook PCs such as Toshiba's "Dynabook" are widely accepted in the marketplace. Supported by strong PC sales, computer storage production grew 12 percent. Japanese word processor production has increased strongly with a growth rate of 14 percent since the notebook

models have become popular. In contrast, calculator production has shown a negative growth rate for three consecutive months. Sharp's and Casio's electronic schedulers, representing a main product in the calculator segment, have grown in production for the past two years in response to strong demand from the business community. Now, however, demand is on the decline due to saturation of the market.

### EXPORTS

The growth rate in the consumer equipment exports segment picked up in January with an increase of 11 percent over the same month a year ago. According to the Electronic Industry Association of Japan (EIAJ), January's home VCR exports recorded a positive growth rate of 12.8 percent in units, marking the first time since last September that this segment has shown a positive growth rate. Color TV exports declined sharply at a rate of negative 40.6 percent. Exports to Singapore grew dramatically, increasing by 83.1 percent. Exports to China have decreased by 85.6 percent since January 1989 and are not expected to improve within the short term.

Exports of data processing equipment maintained their strength, with a positive growth of 24.7 percent. Laptop and notebook PC exports to the United States and Europe contributed at a high rate.

### INVENTORY

Consumer electronics inventory growth was flat in January compared with December 1989. Color television inventory figures for January showed a growth of 21 percent over January a year ago and a slight increase over the previous month by 18 percent.

### DATAQUEST CONCLUSIONS

In summary, we see that consumer production has increased, data processing production is maintaining its strong growth, exports are becoming stronger, and the consumer inventory levels are remaining stable during the first month of 1990. Dataquest believes that these factors are signals that the Japanese electronics industry will remain stable at least for the short term.

*Hideaki Nemoto  
Ione Ishii*

# Research *Bulletin*

## WHERE ARE SEMICONDUCTORS CONSUMED WITHIN JAPAN?

This bulletin summarizes Dataquest's estimates of 1989 Japanese semiconductor consumption in Japan's 47 provinces. Table 1 shows our estimate of the 10 largest provinces in terms of semiconductor consumption; these provinces account for 76.7 percent of Japan's total semiconductor consumption. The top 5 represent 55.6 percent of the total. Aichi, the fastest-growing province in the top 10, is a major base for car electronics and factory automation. Major

semiconductor users located in this province include Aisin Seiki, Nippon Denso, and Okuma Tekko.

Figure 1 illustrates the percentage of semiconductor consumption share by region. Kanto province had a 52.5 percent share of the total consumption in 1989, which is a 1 percent increase over 1988.

*Hideaki Nemoto*

**TABLE 1**  
Japanese Semiconductor Consumption by Province (Billions of Yen)

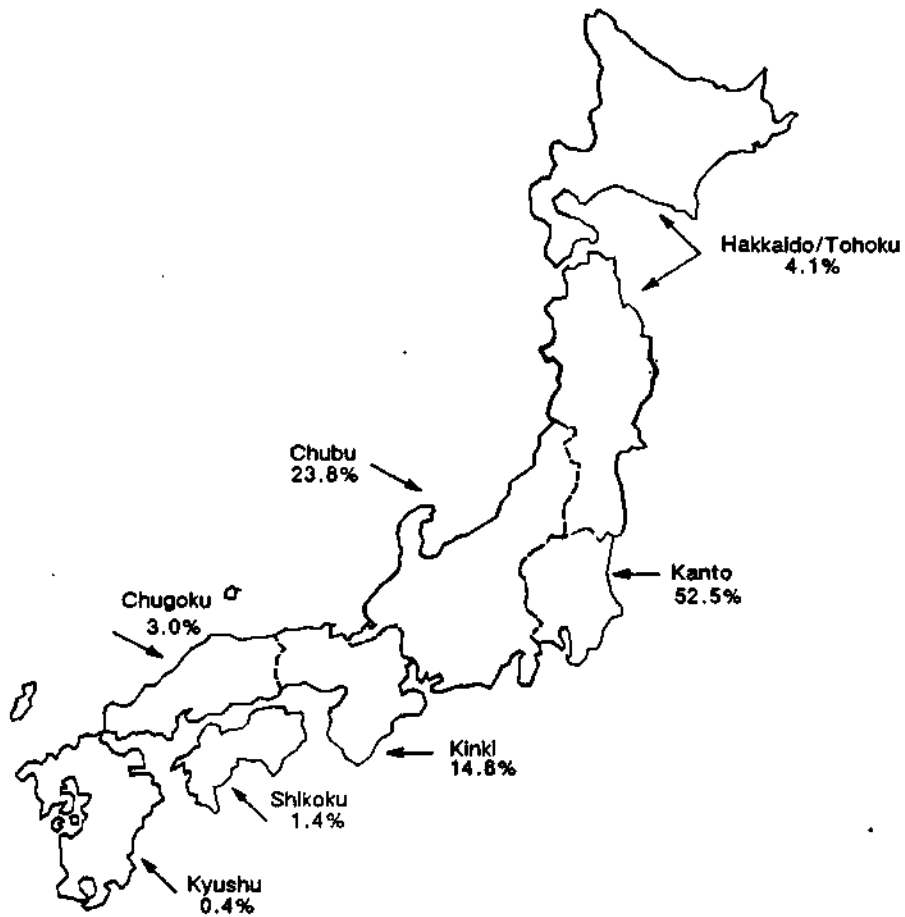
Rank	Province	1988	Percent of Total	1989	Percent of Total	Percent Change
1	Kanagawa	460	17.0%	576	18.9%	25.2%
2	Tokyo	408	15.1	471	15.4	15.4%
3	Shizuoka	282	10.4	291	9.5	3.2%
4	Aichi	163	6.0	204	6.7	25.2%
5	Osaka	143	5.3	172	5.6	20.3%
6	Shiga	137	5.1	140	4.6	2.2%
7	Tochigi	122	4.5	134	4.4	9.8%
8	Ibaraki	124	4.6	134	4.4	8.1%
9	Saitama	117	4.3	125	4.1	6.8%
10	Nagano	97	3.6	118	3.9	21.6%
	All Others	647	24.0	688	22.5	6.3%
	Total	2,700	100.0%	3,053	100.0%	13.1%

Note: Columns may not add to totals shown because of rounding.

Source: Dataquest  
March 1990

FIGURE 1

## 1989 Japanese Semiconductor Consumption by Region



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Source: Dataquest  
March 1990

# Research Newsletter

## FLAT-PANEL DISPLAY: TRENDS AND DIRECTIONS

### INTRODUCTION

Display technology has witnessed exciting progress in the past decade. Although the traditional cathode-ray tube (CRT) display remains dominant in most applications, its future has never looked so doubtful. Replacing the vacuum tube CRT with some other "flat" technology has been anticipated ever since the vacuum tube triode was replaced by the solid-state transistor.

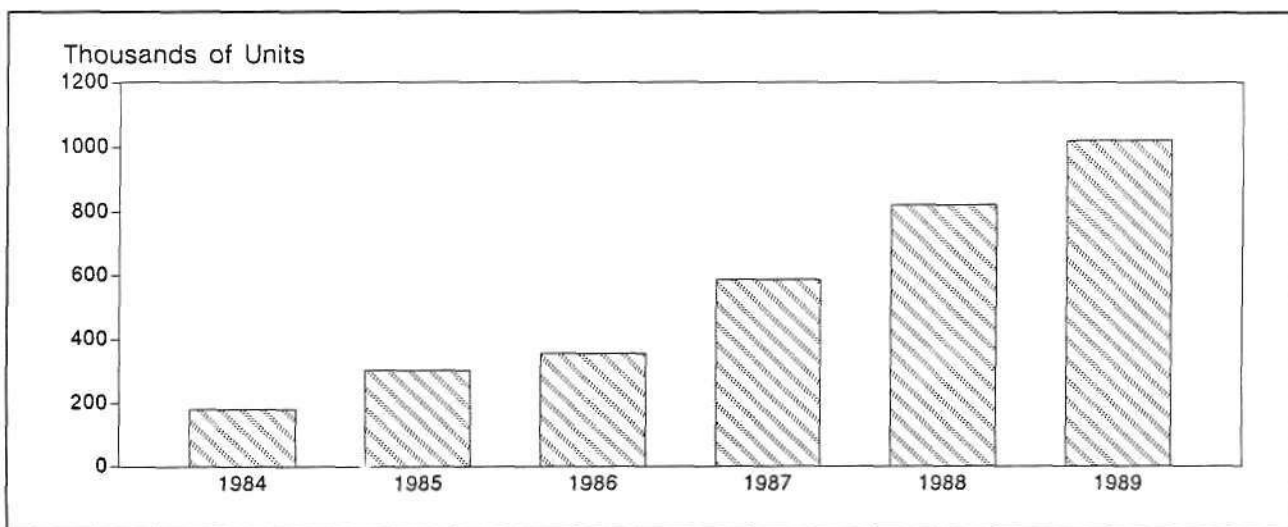
Ten years ago, liquid crystal display (LCD) development was driven by consumer electronics applications using small-area LCDs; few expected this technology to develop into a replacement for CRTs. Today, LCD technologies have emerged as the leading candidates to replace CRTs. Laptop computers are the current technological driving force for LCDs; however, LCD manufacturers also

hope that their technology will play a major role in tomorrow's high-definition TVs (HDTVs). Screen manufacturers currently are demonstrating working prototypes of large-area color LCD displays at trade shows and are creating a frenzy of excitement. Market trends in laptop computers extrapolate to rapid growth with an even faster displacement of traditional machines being limited only by the lack of a high-contrast, reasonably priced, flat-panel display. Figure 1 shows the worldwide portable computer market.

### LCD MARKET GROWS

Although many manufacturers have demonstrated impressive working models of color LCD displays, the major problems with bringing these

**FIGURE 1**  
**Worldwide Portable Computer Market**



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Source: Dataquest  
March 1990

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JSAM Newsletters 1990 1990-4

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products to market are manufacturing in nature. Specifically, obtaining a high yield from large-area display production is a monumental problem that roughly parallels the challenges of producing the next generation of DRAM products. Whereas DRAMs involve placing a larger number of working transistors on a chip, thin-film display (TFT) LCDs must make their transistors work over a larger physical area of material that is fundamentally less uniform (i.e., nonsingle crystal). Corporate efforts toward solving DRAM and TFT LCD manufacturing problems are very similar; massive investments by major manufacturers are being augmented by strategic alliances and membership in various consortia.

Last August, IBM and Toshiba announced the establishment of a new joint venture company, Display Technology Corporation (DTC). At the press conference, one of the DTC company officers predicted that TFT display panels would completely take over CRT displays. At an Osaka, Japan, electronics trade show last October, DTC demonstrated its new product, an 11.2-inch diagonal color TFT LCD fabricated on amorphous silicon. The DTC display had a pixel count of 720 x 480 and an intensity of 120 cd/m<sup>2</sup> with a contrast ratio of between 20:1 and 40:1. At the same trade show, comparable color TFT LCDs were shown by Hitachi, Seiko-Epson, and others.

Many Japanese electronics companies have begun funneling large investments into their LCD production facilities. Sharp, a leading LCD manufacturer, announced plans to invest ¥140 billion (\$970 million) in LCD production by 1994. The company currently has two factories under construction. As well as its joint venture with IBM, Toshiba will spend ¥3 billion (\$21 million) to strengthen its existing LCD production facilities during 1990. Toshiba executives have been quite explicit in their expectations that LCDs will play a key role in future corporate product strategy. Current goals at Toshiba are to fabricate 10- to 14-inch color TFT panels with one megapixel of resolution to be produced concurrently with its 4-Mbit generation of DRAM products. Hitachi, Matsushita, Mitsubishi, and Seiko-Epson all announced intentions to invest heavily—approximately ¥10 billion to ¥30 billion (\$70 million to \$210 million) apiece—in LCD manufacturing capacities. In 1990 alone, total investment in LCD technology by major electronics companies should exceed ¥100 billion. Even relatively small companies, such as Alps Electric of Tokyo, is planning to build a ¥5 billion (\$35 million) color LCD facility that

should be operational this spring. Other Japanese players include Hoshiden Electronics, NEC, and Sanyo. Most companies have relatively lofty goals, taking direct aim at color panels with dimensions greater than 10 inches, employing TFT technology, and scheduling mass production in 1990 or by early 1991.

Japanese market projections forecast a ¥1 trillion LCD business by 1995. As a large contribution to this growth, industry observers forecast a tenfold increase in the laptop computer industry from its current level until the end of 1993. In the long term, HDTV is expected to be the next bonanza for the electronics industry, with many gambling that LCD will be the primary display technology for HDTV implementation. Present Japanese domestic CRT production is approximately ¥500 billion (\$3.5 billion) per year.

## JAPANESE GOVERNMENT CONSORTIA

Because LCD development clearly is resource intensive, private enterprise in the display arena is being complemented by several government-sponsored efforts in Japan. In 1989, the Japanese government established two consortia related to LCD research. Table 1 gives the background on these two recently formed consortia, which were assembled by the Japan Key Technology Center (Japan Key-TEC), the Ministry of International Trade and Industry's (MITI's) research organizer.

Giant Technology Corporation (GTC) has the charter to develop various fundamental technologies needed to realize a 1-square-meter (about 40 x 40 inches) color TFT LCD display, thereby attempting to leap over at least one generation of LCD displays. Participants include a diverse group of traditional electronics companies and printing, glass, and vacuum technology companies. At press time, the project appears to be progressing smoothly.

High Definition Television Engineering Corporation (HDTEC) is primarily studying HDTV technology. HDTEC currently is pursuing four objectives simultaneously; one objective is the improvement of projection-type LCD displays.

## OTHER TECHNOLOGIES: DOWN WITH THE BLUES

Professor Akazaki and a team of semiconductor engineers at Japan's Nagoya University recently developed a high-intensity blue light-emitting diode

**TABLE 1**  
**Japanese Display Technology Consortia**

Giant Electronics Technology Corporation (GTC)	
Established:	March 23, 1989
Objectives:	R&D of advanced technologies for large-area TFT circuitry
Project Term:	7 years
Budget:	¥13 billion (\$90 million)
Participants:	Japan Key Technology Center (Japan Key-TEC), Asahi Glass, Casio, Chisso, Dainippon Printing, Fujitsu, Hitachi, Hoechst Japan, Japan Sheet Glass, Japan Synthetic Rubber, NEC, Sanyo, Sharp, Seiko-Epson, Semiconductor Energy Research, Thomson Japan, Toppan, Ulvac
High Definition Television Engineering Corporation (HDTEC)	
Established:	March 27, 1989
Objectives:	R&D of HDTV technologies such as computer graphics, high-speed digital information transfer systems, LCD projection type display, and evaluation of display quality
Project Term:	5 years
Budget:	¥3.5 billion (\$24 million)
Participants:	Japan Key Technology Center (Japan Key-TEC), JR Research, Meitec, NEC, NHK, Seiko-Epson

Source: Dataquest  
March 1990

(LED). Red and green LEDs have been available for some time, but blue LEDs have long eluded researchers, creating the primary barrier to the successful implementation of a flat-panel color display based on LED technology. It is likely that the first LED display products will be hybrids, i.e., discrete or small-scale devices bonded together that will not require the high manufacturing yield of monolithic devices. Because one-dimensional bonded LED arrays of page-size dimensions now are being used as imaging arrays in commercial high-resolution printers (in competition with laser printers), it is clear that this type of packaging already exists to some degree. LED displays should offer superior contrast, color, and viewing angle when compared with LCD displays. Sanyo already has made progress toward the development and commercialization of blue LEDs.

Although gas plasma and electroluminescent screens are not as well publicized as LCD displays, their contrast and response time are considered their traditional strong points. At the Osaka electronics show, Matsushita revealed a 17-inch color plasma display that it plans to sample-ship by the end of 1990. Matsushita's display had an output

intensity specification of only 25 cd/m<sup>2</sup> at a 640 x 480 pixel resolution, but it possessed a contrast ratio of 150:1. The only other non-LCD products shown at this show were a fast 12-inch monochrome plasma display from Oki and a 10-inch monochrome electroluminescent screen from Sharp. As with displays based on LEDs, progress in the development of color electroluminescent screens has been hindered by the lack of a high-intensity blue phosphor.

## DATAQUEST ANALYSIS

Dataquest believes that further erosion of the CRT market is inevitable. Although many technologies compete with the CRT in monochrome applications, the LCD is positioned to be the first to compete directly with the CRT in applications requiring color displays. The TFT LCD manufacturing learning curve will determine the price-time progression and thus define both how quickly laptop computers displace desktop machines and, more generally, how rapidly LCD panels penetrate traditional CRT markets. However, several



competing technologies should not be discounted, including plasma discharge, electroluminescence, and LEDs, all of which probably will evolve to the level needed to create a usable color flat-panel display. In the past decade, LCDs have benefited numerous advances such as the so-called super-twist technology and the advent of thin-film transistors on amorphous silicon. However, if a comparable innovation or breakthrough occurs in one

of the less publicized technologies, such as those based on gas plasmas, electroluminescence, or even cold cathodes, it could once again change the complexion of the display market. We could conceivably see a renewed interest in such a technology in the same way that there has been resurgence of interest in bipolar transistors in the digital VLSI arena.

*Junko Matsubara*

# Research Newsletter

## CAR ELECTRONICS IN JAPAN

### SUMMARY

Automobile manufacturers have been steadily increasing their consumption of semiconductor devices, and this application of semiconductor products is referred to as the car electronics segment. Semiconductor use in automobiles began with engine controls and now is progressing to transmissions and suspensions. Manufacturers expect to create an integrated control system for the engine, transmission, and suspension in the future by using a multiplex communications system.

This newsletter examines the current and future outlook for car electronics in Japan.

### ELECTRONIC EQUIPMENT AND SYSTEMS FOR AUTOMOBILES

#### The First Wave

Electronic components were first used in Japanese automobiles in the early 1970s. This application was heavily influenced by the introduction of legislation in the United States to regulate exhaust from automobiles and by the oil crisis, which intensified the issue of fuel economy. Japan similarly adopted a series of exhaust control regulations and imposed an energy-saving law requiring automobile makers to specify fuel economy in their products. Because 100 percent of the fuel is imported into Japan, the cost of fuel is three times that in the United States, making fuel economy a higher criterion. Therefore, Japanese automobile makers had more incentive to use electronic devices to control engine exhaust and fuel economy more efficiently. This period could be referred to as the first wave of car electronics.

#### The Second Wave

Starting in the late 1980s and continuing to the present time, the second wave of car electronics

deals with transmission and suspension, including antilock brakes, active suspensions, four-wheel drive, and automatic transmission control. In contrast to the first wave, which was mainly concerned with engine control, the second wave has expanded the applications into driving control devices. It is expected that future technologies to control individual equipment will be integrated through multiplexing communication technology.

#### The Third Wave

In the 1990s, car electronics is expected to enter the third wave, which will consist of the following two movements:

- Enforcement of new legal regulations
- Increasing use of electronics, including computerization

Currently, a new air pollution control bill covering nitric oxide (NOx) and other pollutants is under discussion in the U.S. Congress. In Japan, the Central Council for Environmental Pollution Control recommended stricter controls on exhaust from diesel engines in its report to the Environment Agency in 1989. These stricter laws will require automobile manufacturers to continually improve control of exhaust emission.

The computerization of automobiles is expected to add to widespread use of mobile telephones and car stereos. Dataquest expects the use of on-board facsimiles, navigation systems, and information terminals to become commonplace in the 1990s. These advancements, together with the integrated control of the engine, transmission, and suspension, will require a high-speed multitask computer.

Advancement of Japanese car electronics is closely tied to the development of a communication system to integrate the highway control systems, satellite signals, and vehicles. Current traffic conditions in Japan require the use of electronic bulletin boards to indicate road conditions and warnings that enable drivers to take alternate routes. A variety of new services—such as a communications satellite, road conditions communication services that use a series of “beacons” every mile, navigation information services, and mobile communication services—are in the trial stage or under development by various agencies in Japan. Dataquest believes that the development of these services will stimulate a wider need for computers, satellite communications equipment, and other electronic systems. These systems will enable automobiles to be operated more safely and will create a more sophisticated transportation system.

## THE JAPANESE AUTOMOBILE IC MARKET

The use of electronics in automobiles started with electrical equipment, including IC regulators and transistor ignitions. Later the microcomputer was adopted into the operating control system including the engine, transmission, suspensions, and body control systems. Today's automobiles use at least a few and sometimes several dozen microcomputers. For instance, an electronic engine control system includes 4- and 8-bit single-chip microcomputers and analog-to-digital converters, each assigned to control the carburetor, fuel injection, and ignition-timing device.

Tables 1 and 2 show the semiconductor consumption by various Japanese automobile manufacturers in 1988, broken down by applications and types of semiconductors, respectively.

Today, the engine control microcomputer system uses a single 16-bit microcontroller to operate and control all the electronic engine functions. The microcomputer also has a 16-bit microcontroller with a 10-bit analog-to-digital converter and a number of I/O functions, as well as expanded timing functions. These changes have prompted the use of microcontrollers, ASICs, and hybrid ICs in place of analog and discrete devices. More smart power ICs and smart sensors are being adopted to satisfy the demand for higher responsiveness and accuracy.

The automobile industry has been using semiconductors that were developed originally for consumer and industrial applications. Now the industry

expects to use devices that are developed to meet its unique needs, such as multiplex communication and real-time processing devices. This change will encourage chipmakers to become closer partners in product development.

At the same time, major automobile makers are moving toward establishing their own development and production capabilities. In 1989, Toyota announced plans to build a fab in Hirose, Japan, to develop, design, and manufacture custom ICs. Nissan set up an electronics division earlier this year to start the development and manufacturing of electronic control equipment and automotive ICs, as well as the development of diagnostic systems.

## SEMICONDUCTOR PROCUREMENT BY THE AUTO INDUSTRY

The rapid development of car electronics equals the rapid increase in semiconductor procurement by the Japanese automobile industry. Toyota plans to boost its purchases by 50 percent from ¥26.5 billion (\$182.8 million) in fiscal 1988 to ¥40 billion (\$275.9 million) in 1992. During the same period, Honda will increase its semiconductor purchases from ¥11 billion (\$75.9 million) to ¥20 billion (\$137.9 million) and Mazda will increase from ¥10 billion (\$69.0 million) to ¥13 billion (\$89.7 million).

Under these circumstances, the U.S. semiconductor industry stepped up sales efforts in 1989 to increase its share of this sizable market, in accordance with the U.S.-Japan semiconductor agreement. In response, the Japanese automobile makers have announced the following plans to boost procurement of foreign-made chips:

- By 1992, Toyota will increase its procurement of U.S.-made ICs by 7.5 times its 1988 figure of ¥4 billion (\$27.6 million), increasing its share of the total Japanese procurement of U.S.-made semiconductors from 2 percent to 10 percent.
- Nissan will boost its share of procurement from the present 2 percent to 10 percent in 1992.
- Honda will increase its share to 10 percent by the end of 1992.
- Mazda plans to raise its procurement from ¥0.2 billion (\$1.4 million) in 1988 to ¥1.3 billion (\$9.0 million) in 1992, representing a 10 percent share.

These automobile makers, along with their parts suppliers, are promoting the increase in procurement of foreign-made chips.

TABLE 1

Fiscal 1988 Japanese Automobile Manufacturers' Semiconductor Device Consumption by Application (Millions of Yen)

Company	Automobile Manufacturers	Entertain <sup>1</sup>	Body Control <sup>2</sup>	Powertrain <sup>3</sup>	Safety Convenience <sup>4</sup>	Driver Info <sup>5</sup>	Purchase Amount (FY 1988)
Aishin AW	Toyota, Isuzu, Mitsubishi			X			487
Aishin Seiki	Toyota, Suzuki, Daihatsu		X	X	X		1,032
Alpine Electronics	Honda	X			X		4,244
Atsugi Auto Parts	Nissan		X	X			N/A
Calsonic	Nissan, Fuji, Mazda, Mitsubishi		X		X		360
Clarion	Nissan, Mazda, Fuji	X					6,817
Denshi Giken	N/A			X			4,856
Diesel Kiki	Isuzu, Nissan, Mazda			X	X		818
Fujitsu Ten	Toyota, Mazda, Daihatsu, Isuzu	X					5,798
Hitachi	Nissan	X	X	X			7,156
Imasen Electronic Industrial	Mitsubishi, Mazda, Honda				X	X	164
Japan Automatic Transmission	Nissan, Mazda		X				N/A
Japan Electronic Con. Systems	Nissan			X			5,991
Jeco	Toyota					X	1,091
Jidoshi Denki Kogyo	Nissan, Isuzu		X				1,358
Kanto Seiki	Nissan		X		X	X	1,700
Keihin Seiki	Honda			X			N/A
Kenwood	N/A	X					N/A
Koito Manufacturing	Toyota, Nissan, Mazda				X		184
Pioneer	N/A	X					N/A
Matsushita Com. Industrial	N/A	X		X			8,917
Mitsuba Electric	Honda		X		X		681

(Continued)

TABLE 1 (Continued)

Fiscal 1988 Japanese Automobile Manufacturers' Semiconductor Device Consumption by Application (Millions of Yen)

Company	Automobile Manufacturers	Entertain <sup>1</sup>	Body Control <sup>2</sup>	Powertrain <sup>3</sup>	Safety Convenience <sup>4</sup>	Driver Info <sup>5</sup>	Purchase Amount (FY 1988)
Mitsubishi Electric	Nissan	X	X	X			9,627
NEC Home Electronics	Honda				X	X	N/A
Nikko Electric Industry	Isuzu			X			238
Nippon Seiki	Honda					X	2,084
Niles Parts	Nissan				X		2,035
Nippon ABS	Nissan				X		763
Nippondenso	Toyota, Honda, Mazda		X	X	X	X	22,723
Sanyo Electric Works	N/A					X	121
Sony	Nissan	X					N/A
Stanley Electric	Honda, Mazda, Mitsubishi					X	571
Sumitomo Electric Industries	N/A				X	X	461
Tokai Rika	Toyota, Mazda, Mitsubishi, Daihatsu		X		X		1,206
Toshiba	Toyota	X					131
Toyo Denso	N/A		X		X		153
Yazaki	Toyota, Nissan		X			X	1,453

N/A = Not Available

<sup>1</sup>Entertainment includes car stereo, car radio, cellular radio/telephone.<sup>2</sup>Body control includes steering, suspension, intermittent wiper, electronic muffler.<sup>3</sup>Powertrain includes engine control, transmission control, fuel control, ignition.<sup>4</sup>Safety and convenience includes air conditioner, antiskid braking, window control, memory seat.<sup>5</sup>Driver information includes digital gauges, engine diagnostic results, digital clock, CRT display.Source: Japan Auto Parts Industries Association  
Dataquest  
February 1990

TABLE 2

Fiscal 1988 Japanese Automobile Manufacturers' Semiconductor Device Consumption by Type (Millions of Yen)

Company	Automobile Manufacturers	Bipolar				MOS				
		Logic	Linear	Memory	Other	Logic	Memory	Other	Micro	Discrete
Aishin AW	Toyota, Isuzu, Mitsubishi		X			X			X	X
Aishin Seiki	Toyota, Suzuki, Daihatsu	X	X		X	X			X	X
Alpine Electronics	Honda		X		X	X	X	X	X	X
Atsugi Auto Parts	Nissan									
Calsonic	Nissan, Fuji, Mazda, Mitsubishi	X	X			X			X	X
Clarion	Nissan, Mazda, Fuji		X			X	X		X	X
Denshi Giken	N/A	X	X			X	X		X	X
Diesel Kiki	Isuzu, Nissan, Mazda	X	X		X	X	X		X	
Fujitsu Ten	Toyota, Mazda, Daihatsu, Isuzu	X	X	X	X	X	X	X	X	X
Hitachi	Nissan	X	X	X	X	X	X	X	X	X
Imasen Electronic Industrial	Mitsubishi, Mazda, Honda					X			X	X
Japan Automatic Transmission	Nissan, Mazda									
Japan Electronic Con. Systems	Nissan	X	X	X	X	X	X	X	X	X
Jeco	Toyota								X	X
Jidoshi Denki Kogyo	Nissan, Isuzu		X		X	X			X	X
Kanto Seiki	Nissan		X		X	X	X	X	X	X
Keihin Seiki	Honda									
Kenwood	N/A									
Koito Manufacturing	Toyota, Nissan, Mazda	X							X	X
Pioneer	N/A									
Matsushita Com. Industrial	N/A	X	X			X	X		X	X

(Continued)

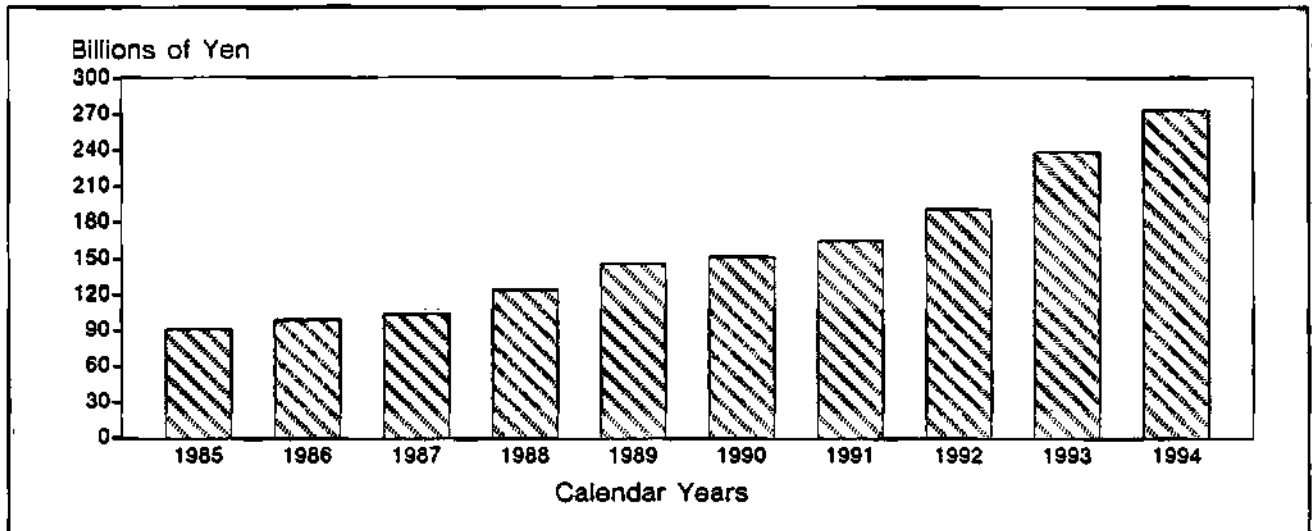
TABLE 2 (Continued)

Fiscal 1988 Japanese Automobile Manufacturers' Semiconductor Device Consumption by Type (Millions of Yen)

Company	Automobile Manufacturers	Logic	Bipolar			Other	MOS			
			Linear	Memory			Logic	Memory	Other	Micro Discrete
Mitsuba Electric	Honda		X							X
Mitsubishi Electric	Nissan	X	X		X	X	X	X	X	X
NEC Home Electronics	Honda									
Nikko Electric Industry	Isuzu	X								X
Nippon Seiki	Honda		X		X	X			X	X
Niles Parts	Nissan	X	X		X	X				X
Nippon ABS	Nissan				X	X			X	X
Nippondenso	Toyota, Honda, Mazda	X	X			X	X	X	X	X
Sanyo Electric Works	N/A	X	X		X	X	X			X
Sony	Nissan									
Stanley Electric	Honda, Mazda, Mitsubishi		X			X	X	X	X	X
Sumitomo Electric Industries	N/A	X	X	X	X	X	X	X	X	X
Tokai Rika	Toyota, Mazda, Mitsubishi, Daihatsu		X		X		X	X	X	X
Toshiba	Toyota		X							X
Toyo Denso	N/A								X	X
Yazaki	Toyota, Nissan		X		X	X			X	X

Source: Japan Auto Parts Industries Association  
Dataquest  
February 1990

**FIGURE 1**  
**Estimated Automobile Semiconductor Consumption (1985-1994) (Billions of Yen)**



0006436-1

Source: Japan Automobile Parts  
Industries Association  
Dataquest  
February 1990

### **DATAQUEST FORECAST FOR AUTOMOBILE ICS**

Dataquest forecasts that the semiconductor consumption for automobiles in Japan will grow at a compound annual growth rate (CAGR) of 13.4 percent between 1989 and 1994, reaching ¥274 billion (\$1,890 million) in 1994, as shown in

Figure 1. Particularly notable will be the safety and convenience segment, including the security and automatic door locking systems, which will grow at 17.2 percent CAGR through 1994.

*Susumu Kurama*  
*Hideaki Nemoto*



# Research Newsletter

## OUTLOOK FOR JAPAN'S ELECTRONIC EQUIPMENT PRODUCTION

### INTRODUCTION

Dataquest forecasts that electronic equipment production in Japan will grow at a compound annual growth rate (CAGR) of 5.3 percent between 1989 and 1994. The production slowdown that began in the second half of 1989 should bottom out in the second quarter of 1990. However, an upturn is forecast to occur in the third quarter and should last until 1992. This recovery is expected to have fluctuations within certain products. Japan's electronics production should continue its stable growth with the data processing sector as a driver; we expect this sector to surpass consumer electronics. Table 1 shows the Japanese electronic equipment forecast through 1994.

### OVERVIEW

In 1990, Dataquest expects the Japanese economy to register a 4.0 to 5.0 percent growth in GNP.

This projection is based on the following:

- Consumer spending will continue its healthy growth.
- Capital investment is not likely to decrease sharply.
- Housing starts will maintain a stable growth.
- Oil prices will remain at relatively low levels.

These stabilizing domestic factors should be able to compensate for some unfavorable foreign factors, such as the sluggish U.S. computer market and the slowdown in exports to China. As a result, Japan's electronics production is expected to grow at a slower rate of 3.8 percent in 1990. Production should regain momentum after 1991 and is expected to achieve 5.0 percent growth in 1991 and 8.7 percent growth in 1992.

One reason for the relatively stable growth pattern is that no product is expected to have a

**TABLE 1**  
**Japanese Electronic Equipment Forecast (Billions of Yen)**

Segment	1989	1990	1991	1992	1993	1994	CAGR 1989-1994
Data Processing	6,608	7,080	7,588	8,299	9,069	9,455	7.4%
Communications	2,752	2,934	3,116	3,321	3,570	3,832	6.8%
Industrial	2,998	3,205	3,373	3,783	4,018	4,111	6.5%
Consumer	6,742	6,627	6,733	7,157	7,211	7,269	1.5%
Transportation	2,123	2,178	2,323	2,578	2,727	2,851	6.1%
Total	21,223	22,024	23,133	25,138	26,595	27,518	5.3%

Source: Dataquest  
February 1990

major impact on electronics production, at least not until the end of the forecast period. Personal computers and VCRs contributed greatly to the remarkable growth observed in the 1980s.

## Data Processing

During the past two years, the data processing sector has recorded high growth rates due to aggressive corporate investment in upgrading information systems. Because capital investment in this area is expected to sustain robust growth during the next few years, the data processing sector is expected to maintain a growth pattern strong enough to lead the electronics industry. As a result, the data processing market share should increase from 31.1 percent in 1989 to a projected 34.4 percent in 1994. In particular, we believe that computers will continue the current trend toward smaller size and higher performance, benefited by the rapid improvements in semiconductor technology, and will be used more in offices, educational institutions, and homes. Specifically in the area of personal computers, Japanese companies are dominating the world market with laptop and notebook-size PCs. They are likely to establish an ever-stronger position with these products, which in turn will provide a major impetus for the continued high growth of the computer industry compared with the other application segments.

## Communications

Production of radio communications equipment is expected to record a favorable growth rate, while wire communications equipment growth is likely to be sluggish.

Among major products, cordless telephones appealed to consumers as handy and trendy household equipment and grew 87 percent in 1989. Dataquest forecasts that cordless telephone production will maintain a 17 percent CAGR until the end of the forecast period. However, facsimile production should slow down because of an increase in offshore production and may record an 8.4 percent CAGR until the end of the forecast period. We expect Group 4 (G4) facsimiles to make a full-scale market penetration after 1992. In contrast, switching and transmission equipment production is likely to experience lower growth rates partly because of a slowdown in Japan's NTT investment.

As mentioned previously, radio communication equipment production should continue to have

strong growth. This anticipated growth is due to the emergence of satellite communications and an anticipated rapid market acceptance of mobile and cellular telephones.

## Industrial

The industrial electronic equipment sector benefits from the rapid pace of factory automation and computerization, which promotes strengthening of competitiveness and labor saving. In particular, production systems that include numerical control (NC)-type machines and robots are expected to show high growth rates.

Similarly, the electronic instrument production sector is likely to increase at a moderate rate because of a sustainable growth of capital expenditure made by semiconductor makers, notably for IC testers and analyzers. Finally, medical equipment production should continue its stable growth because of an increase in electronic equipment used by medical facilities.

## Consumer

Further movement to offshore production and an increase in competition from the newly industrialized economies (NIEs) are likely to cause a leveling off of domestic production of consumer electronic equipment through 1994. However, the production of camcorders, videodisc players, and video games is expected to continue at a relatively high growth rate.

Approximately 20 percent of all Japanese households own camcorders; the market should peak in 1992. The production of videodisc players has been expanding rapidly since 1988, fueled by declining prices as well as the increase and lower price of software. Video games—a sector dominated worldwide by Japan—will maintain a stable production rate.

## Transportation

With recent advances in electronic control systems and consumers' preference for high-grade products, transportation equipment production sustained a robust 14.2 percent growth in 1989, which is a continuation of 1988's increase of 17.3 percent. In particular, power train-related equipment, including automatic transmissions and fuel injectors, showed an impressive 36.0 percent growth over 1988.

In car electronics, where the majority of developments have been in the engine and steering areas, we expect to see further advancements relating to the improvement of riding comfort and safety by using advanced information processing and control systems. In particular, Dataquest anticipates an increase of automatic air-conditioning systems, power-operated seats, mobile telephones, air bag systems, facsimiles, and navigation systems.

## DATAQUEST CONCLUSIONS

Dataquest believes that the rapid appreciation of the yen has seriously damaged the Japanese economy, which depends heavily on exports. The consumer electronics industry was hit hardest; sluggish exports and competition by NIEs forced the industry to boost offshore production. As a result, domestic production of consumer electronic equipment dropped sharply for two consecutive

years—1986 and 1987—and had a negative impact on Japan's electronics production. However, a successful adjustment of the Japanese economy to a domestic demand-led structure brought back healthy production activities in 1988 and 1989.

Dataquest forecasts that Japanese electronics production, which slowed during the summer of 1989, will come back after the third quarter of 1990. During this period, Dataquest anticipates that the U.S. computer market and the Japanese domestic demand for home appliances will begin to recover. In 1992, production should enter a growth cycle. Supported by active consumer spending and capital expenditure, we believe that electronics production in Japan will follow a stable growth pattern without any leading products during the first half of the 1990s rather than experiencing the violent ups and downs of the 1980s.

*Hideaki Nemoto*

# Research Newsletter

## DATA SHOW 1989

### INTRODUCTION

The 17th annual Data Show exhibition for computers, data processing products, and related products was held from October 24 through 27, 1989, at the Harumi Exhibition Center in Tokyo, Japan. Under the main theme of "New Harmonious Interface between People and Information," 155 companies (6 percent more than in 1988) exhibited their latest products and technologies at Data Show 1989. Dataquest estimates that more than 213,800 visitors, representing a 16 percent increase from the previous year, attended the exhibits.

Major highlights of Data Show 1989 include the following:

- Of the 33 companies exhibiting personal computers and/or word processors, 25 showed 32-bit PCs and 19 displayed laptop PCs.
- Workstations were displayed by 38 companies.
- Peripheral equipment products, including handy terminal equipment and storage devices, were exhibited by 76 companies.
- Handy terminals were displayed by 13 companies.
- Artificial intelligence (AI) products were shown by 13 companies also.
- IC cards and their related products were presented by 12 companies.

This newsletter provides Dataquest's analysis of the new products. It examines the future outlook for PCs, electronic scheduler (notebook) products, and word processors. These items will serve increasingly as a major application market for ICs as well as for IC cards as next-generation storage media.

### NEW PRODUCT ANALYSIS

#### Personal Computers

The PC and workstation markets have expanded steadily in response to a robust demand. The PC market is especially characterized by an increasing emphasis on laptop versions. As a result, laptops are shifting from 16-bit to 32-bit machines. We expect the laptop computer to serve as a major tool in system integration and strategic information service based on a multivendor environment as a result of this higher performance.

Dataquest observed the following major trends at the show:

- Laptop PCs
  - Shifting from 16-bit to 32-bit version—e.g., Oki, NEC, and Seiko-Epson
  - Applying color LCD (display)—e.g., Matsushita, NEC, and Sharp
  - Miniaturization of the Japanese A4-size notebook—e.g., IBM and NEC (see Table 1)
- Desktop PCs
  - Introduction of OS/2 with Presentation Manager
  - Adopting window function for desktop publishing—e.g., Sharp
  - Introduction of multitask features
  - Applying CD-ROM drive—e.g., Fujitsu and Sony
  - Application as AI workstation—e.g., Oki

**TABLE 1**  
**Comparison of Available Portable PCs**

	Products			
Ref. Number	J-3100SS	PC-286	PC-9801N	5499
Product Name	Dynabook	Note Executive	98 Note	On-Line Note
Manufacturer	Toshiba	Seiko-Epson	NEC	IBM
Size (mm)	310x254x44	315x235x35	316x253x44	297x210x45
Weight (Kg)	2.7	2.2	2.9	2.0
CPU	80C86	uPD70116 equiv.	V30 (uPD70116)	80C186
Clock (MHz)	10	10	10	8
Memory (MB)	1.5 (w/RAM-disk) (RAM-card Max 2MB)	0.64	0.64 (w/o RAM-disk) (RAM Max 2MB)	0.64
Floppy Disk	3.5 inch x 1 (720K/1.2MB)	N/A (I/F Only)	3.5 inch x 1 (1MB)	N/A (I/F Only)
IC Card	N/A	2 (128K/640K)	N/A RAM (128K/512K) or ROM (128K/2MB)	2
Modem	Option	Yes (1,200 bps)	Option	Yes (1,200/2,400 bps)

N/A = Not Available

Source: Dataquest  
January 1990

## Electronic Schedulers

Pocket calculators are, without doubt, typical of the products that have undergone significant changes with the recent advances in semiconductor technology. Today's calculators appear as multifunctional electronic schedulers, which deserve the name of hand-held PCs. Sharp, a pioneer in the electronic scheduler market, focuses on developing new IC-card application-software packages to enhance functions of electronic schedulers as well as notebook PCs, in addition to minor changes in existing models using the currently available IC cards. One of the major exhibitions was NEC's new-generation electronic notebook with a bar-code reader (see Table 2).

## Pocket-Size Word Processor

The Japanese word processing market appears to continue miniaturizing the word processor itself from notebook size to pocket size. In the process, notebook-size word processors are competing with notebook-size PCs, and the pocket-size word processors are competing with electronic schedulers, thereby losing in this niche market.

In this increasingly competitive market, Casio announced a very small (185 x 83 x 25mm) pocket-size word processor—the PW-100—at the show. This product is able to transfer data to its family word processor and PCs through a RAM card (RM-21B). IC cards are used here as a storage medium.

## IC Cards as Memory

When the 64K DRAM dominated the memory business, VCRs and PCs provided the major memory IC consumption sources. This trend has not changed; now 256K and 1Mb DRAMs are used mainly in the manufacture of PCs and office automation equipment. Originally, the IC memory card found its primary market in mask ROMs for TV games. EEPROM and SRAM IC cards are installed increasingly in the notebook-size PCs, pocket word processors, and electronic schedulers.

In the PC market, for PC miniaturization, IC cards (and/or RAM cards) are gaining acceptance as an auxiliary memory alternative to floppy disks. Depending on prices of memory ICs, the IC cards

**TABLE 2**  
Specification Comparison of Electronic Schedulers

	Product Name		
	DK-5000	PA-7500	TBA
Manufacturer	Casio	Sharp	NEC
Display (Dot)	191x48	96x64	160x64
Memory (K)	32 (+64) RAM card option	16	TBA
IC Card	Yes	Yes	No, for SRAM and/or ROM card
Hand Copier	Yes, CP-9	Yes, CE-50/60P	TBA
PC	Yes, with FA-110	Yes, with IC card type PA-7C10	TBA
Other		3.5" FDD I/F	Bar code reader

TBA = To Be Announced

Source: Dataquest  
January 1990

**TABLE 3**  
Floppy Disk versus IC Card

	Floppy Disk (3.5-inch)	SRAM IC Card	Mask ROM IC Card
Price	Good	Poor	Fair
Size	Fair	Good	Good
Memory Capacity	Good	Fair	Good
Access Time	Poor	Good	Good
Power Consumption	Poor	Good	Good

Source: Dataquest  
January 1990

may compete with successfully and finally replace floppy disks (see Table 3).

## DATAQUEST CONCLUSIONS

Data Show 1989 successfully displayed a number of new products for future office and home automation. A major point illustrated by the show is that further integration of memory ICs gives strong indications that new applications will be created in data processing and consumer electronics.

In Japan, leading-edge semiconductor technology usually is first introduced in the industrial applications and then later expands into new applications in the consumer electronics market.

The use of advanced electronics technologies will continue to boost the value of consumer electronics products. At the same time, these advanced electronics devices are undergoing a major change in purpose—from family use to personal use.

Dataquest believes that PCs, word processors, and electronic schedulers exemplify the coming of such a personalized electronics era.

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*Masanori Murata*  
*Kaz Hayashi*

# Research Newsletter

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ISIS Code: Newsletters  
1989-8  
0004202

## CHANGING TECHNOLOGY FORCES CONSUMABLE CHANGES

### SUMMARY

The computer revolution has had a profound effect on the way everyday office documents are created. Since the introduction of the microcomputer in 1981, no office, whatever its size, is immune to the computer. Office documents, once produced manually from creation to final output, are now created with the help of a computer.

Output devices for personal computers were limited more by price than technology. Serial, dot matrix printers and daisywheel printers were widely available and fairly inexpensive. Each technology had its limitations. The major drawback to the daisywheel was its inability to produce graphics; however, the text output from a daisywheel is letter quality. Dot matrix printers are able to produce limited graphics, but text output from a 9-pin dot matrix printer is not letter quality. But the growing popularity of the 18- and 24-wire dot matrix printers and their high-quality output is breathing new life into this market. Prior to this, users were forced to trade off between text and full graphics capability.

Expensive, high-speed page printers were available. But they were not the best device to be connected to a personal computer.

### The Low-End Laser Printer

In 1983, Canon made an announcement that would cause repercussions throughout the printer industry. It introduced an 8-page-per-minute (ppm) printer engine. It was quickly obvious to several original equipment manufacturers (OEMs) what the potential of such an engine was—and was the market ever ready for such a product! So successful were some of the OEM products (particularly from Hewlett-Packard and Apple), that they were the major contributors to the virtual demise of the daisywheel printer market segment.

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Users now had full graphics and letter quality text capability at a reasonable price. And, even better, these printers were the perfect candidates to attach to personal computers. In addition to a new printer segment, new applications began to find their way into offices. Desktop publishing was born. Users had the means to create, edit, and produce many different document types, such as technical manuals, proposals, and promotional materials, using the personal computer as the input device and the page printer as the output device.

This newsletter reviews the new consumables markets created by the low-end laser printer, and presents Dataquest's analysis on the impact of new technology in this industry.

## **NEW MARKETS**

The availability of the low-end page printers opened the door to new markets in the consumables industry. Dataquest estimates that the installed base for printers in the 0- to 10-ppm segment was 1.8 million units at the end of 1988, and it will grow to approximately 8.9 million in 1993, representing a compound annual growth rate (CAGR) of 38 percent. This healthy growth rate is certain to catch the attention of manufacturers looking for ways to tap into this market. Chief among these were those participants in the consumables markets.

### **Toner**

Perhaps the most innovative manufacturers have been the toner supply houses. The typical configuration of these low-end page printers is such that some of the supply items, particularly the toner and photoreceptor, are contained in one disposable cartridge. This cartridge is user replaceable every 3,000 or 4,000 pages, or whenever the print quality is less than the user desires. Because the cartridge used in the Canon-engine-based printers is patent protected, it is available only from Canon. This is a perfectly planned technological monopoly designed to make cartridge replacement a lucrative venture for Canon.

But it did not happen quite that way. In the first generation engines, Canon did not match the yields between the toner and photoreceptor, and users were discarding cartridges that still had life left on the photoreceptor. Independent toner manufacturers figured out how to "drill and fill" the cartridges with toner so that users could reuse their original cartridge until the photoreceptor was completely spent. Some toner manufacturers took the drill-and-fill strategy one step further. For a fee, they offer a course to dealers on how to recondition and fill the cartridges. They then sell the dealers enough supplies to begin their own refill business. The franchising of refilling cartridges was born.

The drillers and fillers have taken some business away from Canon. Dataquest estimates that the entire toner cartridge retail market for the low-end printers is around \$800 million. Of that, the refillers are estimated to have captured less than 5 percent.



However, this problem will become moot. The photoreceptor life in the cartridge designed for Canon's new SX engine, introduced in early 1987, is more closely aligned with the amount of toner in the cartridge. They are now designed to run out at the same time. Therefore, a company that is refilling with toner only will not be able to penetrate the aftermarket for these new engines.

As of May 1989, there is another wrinkle in the cartridge market. Materials Research Laboratories (MRL), based in Taiwan, announced the development of an organic photoreceptor that is compatible with the photoreceptor currently used in Canon copiers and Canon CX and SX engine printers. MRL states that production of the photoreceptor could begin by year-end 1989. As the cartridge is protected by patents, Dataquest wonders where and to whom MRL will be selling the photoreceptor.

### **Ribbons**

The independent ribbon manufacturers have been watching this laser printer and supplies market with interest. Daisywheel printers are big users of film ribbons. With the slowdown in the daisywheel market, some ribbon manufacturers have attempted to carve a niche in other supply areas. Aspen Ribbons now offers toner cartridges for Ricoh-engine-based printers and print bands for line printers, in addition to its regular ribbon line. Sercomp is another independent ribbon manufacturer that recently announced that it is in the toner business for Ricoh-engine-based printers.

A new area is film ribbons for dot matrix printers. These ribbons offer higher print quality than fabric ribbons. They also present special problems in that the substrate has to be strong enough so that it is not punctured by the pins in the printhead. The 18- and 24-wire dot matrix printers are forecast to make up 38 percent of serial, dot matrix printer shipments in 1989, growing to 69 percent in 1993. Considering the high quality possible with the high-wire printers and fabric ribbons, it remains to be seen if film ribbons will be able to carve a niche in the dot matrix arena.

### **Labels**

Most labels in the office are used for distribution and mailing lists. Prior to the availability of the low-end page printer, users in small to medium-size offices would type a master. The master would be used to make copies from. Updates or changes to the master were inefficient and time consuming.

The introduction of laser labels has changed this cumbersome and time-consuming method. Many data base and file management software packages, some of which are sold by label manufacturers, are capable of formatting and editing labels. It is now a simple matter to add, delete, or otherwise edit a label list. Also, laser labels can be pre-stacked in the paper-feed tray and printed without an operator in attendance.

Because of the inherent differences between copiers and printers, laser labels need to be different from copier labels. Laser printers operate at a higher internal temperature than copiers. Adhesive formulations need to be different for the two-label types. If copier

labels are used in page printers, the adhesive will melt, causing the labels to predispose and the printer to jam. Therefore, printer labels can be used in copiers, but copier labels should not be used in laser printers. Thus, the laser label makes it possible for an office to stock only one label type.

## **Paper**

Paper is paper, right? Wrong. Usually taken for granted, it is ignored until problems arise. Various printing technologies require an output medium that is just a little bit different from each other. The low end of the page printer market is no exception. To plug this market, the paper companies developed "laser paper."

Users are now faced with more choices of which paper to use. Typical questions users ask include the following:

- What is laser paper?
- Can I use my copier paper in my laser printer?
- How do I match my application to the right paper?
- How many kinds of paper do I have to stock?

Technically, laser paper is different from copier paper. Laser printers operate at a higher internal temperature than copiers. And the small footprint of most laser printers means that the paper path has tight curves. As the paper winds its way through the printer, the paper path, in combination with the higher temperature, may cause excessive paper curl. To combat this, laser paper has a higher moisture content.

All paper has a grain direction; grain is directly related to curl. Most copiers feed the paper long (11-inch) side first. But laser printers usually feed the short (8.5-inch) side first. When paper is fed against the grain, it tends to curl. Therefore, to reduce the possibility of curling, laser paper should be short grained.

Other problems may be encountered using copier paper in laser printers. The paper appears smooth to the eye and feels smooth to the touch, but under the microscope, hills and valleys are visible. Copier paper is too fibrous and rough; final copies using copier paper in laser printers may appear with ragged and uneven edges. Laser paper is smoother and harder, so that the printed material has smooth edge definition.

## **DATAQUEST CONCLUSIONS**

Technology will continue to impact the consumables market. Printer technologies will be refined or new ones will be invented, requiring new consumables. End-use applications also will change, thus creating a need for new consumable items.

But is it in the end users' best interest to need a new and different consumable for each technology? What if there are several different types of printers in a centralized environment, all needing different consumables? Differences mean more dollars tied up in stocked inventory and possible confusion and frustration when the wrong consumable is used and the results are not as anticipated.

Changing technology will not be enough to create demand. It has been difficult for the paper companies to properly market laser paper. The successful companies in this industry will be those that anticipate, and create, a market for a new consumable. In the end user's mind, a consumable is rarely given much thought. The company that is able to have the user associate a specific consumable with a specific brand name will be a winner.

*Susan Drain Beshalske*

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#### **NEW DIRECTORY OF DATAQUEST PUBLICATIONS?**

A new directory describing 30 Dataquest Research Publications is now available from Dataquest's Direct Marketing Group. The directory includes information on:

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# Research Newsletter

## HOME AUTOMATION BLUEPRINTS FUTURE WORLD

### SUMMARY

Home automation refers to a comprehensive program that will change the way houses are built and occupied. Tomorrow's construction industry will be mechanized and computerized; tomorrow's house will be modularized and automated.

Several technologies will be necessary to support home automation (see Table 1). Communications will be needed both inside and outside the home, computers will be needed for house design and energy compliance, and control will be needed for added appliance efficiency.

In this newsletter, Dataquest reviews the long-term developments in energy, houses, and appliances. We conclude that it is not too early for semiconductor suppliers to work closely with appliance manufacturers if they want to capture any part of this opportunity in the near term.

### HOUSE OF THE FUTURE

Several developments are now under way that will dramatically change the houses in which people live. In this section of the newsletter, Dataquest projects what typical housing might be like in the year 2000.

### Operation Scenario

Minimum energy consumption is the goal. Each house will be provided with an energy budget based on its geographic location (i.e., local weather), occupant lifestyle (i.e., family size), and power sources (i.e., gas or electricity). This whole-house energy consumption program will include incentives to encourage conservation (see Table 2). The broader goal is to reduce the need for more electric power plants because capacity must be built for seasonal peak loads and future demand growth.

Some appliances will need to be kept constantly in adjustment for maximum energy efficiency; to do this, they probably will have self-test capability. They also may be connected to the telephone network to let repair services monitor them remotely.

### Zone Control

Zoned sections of the house (i.e., one or more rooms) will have their own thermostats and the capability to lower energy use automatically when unoccupied. Zone control provides comfort without having to heat or cool the entire house as single-point control does.

**TABLE 1**  
**Key Technologies for Home Automation**

Communications	High-definition TV (HDTV), teletext, videotex, local area networks (LANs) for intrahome communication, wide area networks (e.g., ISDN)
Computers	Architecture workstations, computer-integrated manufacturing (CIM), laptop computers
Control	Embedded microcontrollers, smart-power semiconductors, solid-state sensors

Source: Dataquest  
September 1989

**TABLE 2**  
**Whole-House Energy Consumption Incentives (Scenario for the Year 2000)**

Time-of-use pricing	Lower rates during off-peak hours encourage rescheduling chores that are not time critical
Load shedding and duty cycling	Power company shuts down selected appliances when neighborhood energy use exceeds budget
Off-peak storage	Energy is stored locally during off-peak hours for later use during peak load hours

Source: Dataquest  
 September 1989

## Construction Scenario

The goal is to design and build houses that meet prescribed energy consumption regulations. Today's houses must meet building codes, but energy use never was considered when earlier standards were drafted. Tomorrow's building codes will probably have a mandatory energy component.

Tomorrow's house may be designed on an architecture workstation that takes energy seasonal budgets into account. In addition, 90 percent of the house (up from 55 percent today) will be built offsite to guarantee that the stringent quality assurance procedures are being met.

### Life Cycle Costing

Tomorrow's housing market should normalize the cost of ownership over the entire life (several decades) of a typical building. A well-insulated home costs more to build and less to operate. Lenders and insurers will likely favor automated homes because their standardized safety and energy features will have less risk than nonstandard designs.

## Retrofit Scenario

The installed base of existing houses will not be exempt from energy regulations. Current homes will have to be upgraded to meet local energy codes; the easiest way to police this will be at the time of sale. Separate utility programs have been and continue to be used to encourage insulation.

## FORCES DRIVING HOME AUTOMATION

The era of abundant, low-cost energy is over. Energy users (e.g., homes, automobiles, and factories) all are part of the energy equation. They also are all part of the energy solution.

A systems approach has been adopted to consider all possibilities at once. For example, the mileage and emissions standards for automobiles help deal with this crisis. Revised, as well as new, draft standards also are being written for energy use in the home.

## Energy

Today's consumers enjoy home comforts such as air conditioners, dishwashers, dryers, freezers, furnaces, ovens, refrigerators, stoves, and washing machines. Average electricity use per household increased approximately 220 percent between the years 1962 and 1985. This energy use trend has serious implications for national security because a greater amount of the needed energy cannot be supplied from domestic sources. However, less per-capita consumption would mean less dependence on imported energy. Home automation is one of the many programs that will enhance energy independence.

## Environment

Heat and pollution from electricity-generating plants are the source of 60 percent of the harmful effects in the environment. The result is a possible increase of a few degrees in the earth's temperature during the next 100 years. This global warming could be enough to cause a major disruption in the world's population because it could change the latitudes where people can live, grow food, and conduct business. Although not all scientists agree that there is a warming trend, politicians are not taking any chances. Reduced consumption means fewer facilities, slower warming, and more time to find permanent solutions.

## Economy

Wasted energy means wasted money and reduced competitiveness, and the cost of this inefficiency to the economy is substantial. The United States uses 75 percent more energy per unit of GNP than do its trading partners France and Japan.

Conservation efforts made since 1973 already are saving the United States \$150 billion per year in energy costs. However, additional potential savings of \$150 billion to \$400 billion annually are believed to be possible through further conservation efforts.

## ROLE OF CONSUMER APPLIANCES

The elements of residential energy consumption are building thermal efficiency and appliance operating efficiency. The National Appliance Energy Conservation Act of 1987 provides for progressively tougher requirements for appliances during upcoming years.

## Certified Efficiencies

Certain appliances (see Table 3) are candidates for energy efficiency certification between now and January 1, 1994. Appliances that consume a large portion of daily energy in the home could

be scheduled for further regulatory controls that are not now covered by past standards.

Appliance efficiency increases will be accomplished with a variety of electrical and mechanical designs. Electronics are expected to be used widely to increase appliance efficiency just as they have been used to increase automobile efficiency.

## Technology Advancements

Improvements in mechanical components also are expected, and these will require electronic components for sensing and driving. An example of a mechanical advancement is Hitachi's new scroll compressor, which has an improved refrigeration efficiency.

Chlorofluorocarbons (CFCs) also are being outlawed to prevent them from destroying the ozone layer of the atmosphere. (CFCs now are used in refrigeration systems and appliance insulation.) Many other opportunities exist for innovation in appliance design.

## POTENTIAL FOR SEMICONDUCTOR COMPONENTS

Home automation represents a major change in the way houses are built and energy is used. As a result, there will be a phase-in period during the

TABLE 3  
Candidate Appliances for Energy Certification (U.S. Consumption)

Appliance	1988 Unit Shipments (Millions)	1985-1988 CAGR
Air Conditioners	7.8	8.6%
Clothes Dryers	4.6	15.3%
Dishwashers	3.9	2.7%
Freezers	1.6	1.6%
Furnaces	3.4	9.1%
Portable Heaters	3.6	(5.9%)
Ranges/Ovens	7.9	8.0%
Refrigerators	8.2	6.0%
Television Sets	23.6	3.0%
Washing Machines	6.5	5.2%
Water Heaters	7.3	1.0%
Total	78.4	5.0%

Source: Industry Data  
Dataquest  
September 1989

early 1990s. The years 1991 through 1995 will create much turbulence as this program gets under way.

## Network Connections

A local area network (LAN) will connect appliances so their operations can be coordinated. The dishwasher, for example, might signal the water heater to begin operation. (The water heater normally would be in a standby mode to save energy.)

One purpose of the LAN would be to reduce peak loading by rescheduling the load to other times of the day. Another would be to allow telephone access for appliance status monitoring or time-of-operation reprogramming.

Communication semiconductors will be needed to connect the appliances to the LAN. Protocol choices include CEBus, LON, SmartHouse, and X-10. Media choices include powerline carrier, coaxial cables, radio waves, infrared waves, and optical cables.

The annual connection potential is approximately 75 million units per year in the United States (see Table 3). Dataquest believes, however, that this potential will not be reached until after the mid-1990s, because the home automation program first must pass through its start-up phase.

## Power Signals

Motors are present in most appliances. Pulse width modulation (PWM) is a technique for shaping power signal waveforms to improve efficiency. PWM can also be used to generate synthesized AC from AC/DC sources for both standard operation and as an emergency-conditions feature during power outages.

Power semiconductors will be needed to shape the waveforms of power signals. Smartpower IC technology is being developed today for automotive applications. Appliance engineers will use automotive smartpower initially because it is available.

In the long term, however, the appliance industry may want its own version of smartpower. Semiconductors that can operate directly off of the 110 VAC line will not need transformers. Another application for this technology will be general-purpose 110V power supplies.

The evolution of technology and standards is open-ended. For example, cost and efficiency

improvements in DC motors are expected to occur toward the late 1990s, and the benefit will be better appliances. Such advancements are likely to be reflected in the standards once they are updated.

## Embedded Control

Temperature control in appliances today is done with thermostats. Two metals with different coefficients of thermal expansion are used to open and close a circuit that starts and stops a motor. This approach has worked well for more than 100 years.

Greater control precision is possible with a solid-state sensor chip connected to a microcontroller (MCU). The microcoded program in the MCU can decide whether or not to start or stop a motor based on a variety of conditions.

For example, a solid-state sensor can provide a range of measurements rather than just the single on/off reading of a thermostat. The MCU can make control decisions that are based on the actual temperature of the room, not just whether the temperature is higher or lower than some preset value.

The result of the embedded system is a more sophisticated controller that causes a higher energy efficiency. Embedded control alone will not make appliances more efficient, but several approaches ranging from electronics to mechanical components will be combined to do so.

## DATAQUEST CONCLUSIONS AND RECOMMENDATIONS

The need to conserve energy was recognized 20 years ago. Conservation in automobiles is easy to handle because production is concentrated in a few suppliers. Housing, on the other hand, is dispersed among thousands of producers and millions of users and decision makers.

Housing efficiency therefore is best left to local conditions, and that is what the National Environmental Policy Act of 1969 did. However, the states (except for California and Florida) have done little since 1975 to improve building efficiencies, so the federal government now is mandating minimum residential energy standards.

## Learning from Past Generations

Houses built in the next millennium most likely will use techniques learned earlier in this

millennium. In the Middle Ages, for example, people living in cold climates discovered through trial and error that two-story buildings with tapestry-covered walls were warmer than other designs.

Home automation will use workstations to design efficient houses and robots to assemble those houses from advanced materials. The main difference is that Middle Ages society was limited by a lack of computer tools, while modern society is becoming limited by dwindling sources of proven fuel reserves.

Showcase homes are being built to examine automation use under actual conditions. For example, Diablo Research is building a house based on the CEBus standard, and Hometronics is planning regional CEBus demonstrations. There are an estimated 100,000 custom-automated homes in the United States today.

## Living with the Unknowns

Dataquest believes that the major semiconductor opportunities in home automation will come from the use of microelectronics in appliances. The standards and the markets, however, will emerge slowly because they are just tiny pieces of the much bigger panoramic energy puzzle.

We recommend that semiconductor suppliers that want to capture part of this opportunity should do so by working closely with appliance manufacturers. Sharing plans in the short term will help ensure that component and equipment strategies are aligned.

*Len Hills  
Roger Steciak*



# Research Newsletter

JSAM Code: Newsletters  
1989-6  
0004195

## TECHNICAL WORKSTATIONS GROW FASTER IN JAPAN

This newsletter examines Japan's rapidly growing technical workstation market. It reviews the technical market requirements and the enabling technology of RISC, clarifies the vendor marketing focus, and highlights the business market use of technical workstations in Japan.

### MARKET REQUIREMENTS

Japanese engineering and scientific users of technical computers expect the following features from their system purchases today:

- High-performance graphics ability
- Friendly user interface
- Standardized and extensive networking
- Excellent price/performance over a broad range
- Comprehensive applications software

These needs are driven by the intense competitive conditions between countries and companies—circumstances that impose high productivity requirements in both design and manufacturing. This situation has rapidly expanded the number of computer users.

Minicomputers and mainframes, which were the systems of choice in years past, have problems satisfying the current technical market requirements. They are unbalanced in computational ability and inflexible in expansion ability, and have expensive software and hard-to-manage resources compared with technical workstations.

Technical workstations offer many advantages in meeting the Japanese market needs for the following reasons:

- Users can utilize a processor without being disturbed by others.
- Application software is more effective and less expensive.

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- Resources can be shared across standardized networks.
- System configurations are flexible and upgradable.
- Risky investments for centralized, inflexible systems are avoided.

Additionally, open architectures and standardization of technical workstations are beginning to allow users to exercise more control over vendors through multivendor purchasing strategies.

Since 1987, Japanese computer companies have focused on the introduction of systems for the network and distributed desktop computing environments. This trend is most pronounced in the technical computer market, in manufacturing and engineering companies, for the reasons stated above. Dataquest believes that the annual growth rate of technical workstations will remain high in technical areas and that use of these workstations also will infiltrate commercial markets in Japan.

### RISC-ENABLING TECHNOLOGY TREND

During 1988 in Japan, the number of unit shipments and new RISC-based workstation announcements increased dramatically. Table 1 summarizes the activity.

Table 1

#### RISC-Based Workstation Activity—Japan

<u>Company</u>	<u>Trend</u>
Digital Equipment	In January, announced Mips version of RISC-based technical workstation at aggressive price.
JCC	Has shipped Mips and will ship next generation by Q3 1989.
Matsushita	Will ship SPARC-based workstation soon. Owns 52 percent of U.S.-based Solbourne.
Silicon Graphics	Shipping full line of Mips-based technical workstations.
Sony	Announced Mips-based NEWS technical workstation.
Sun	20 percent of 1988 shipments were the SPARC version of RISC technical workstations.
Ustation	Shipping Mips-based technical workstation.

Source: Dataquest  
June 1989

The cycle of new technical workstation introductions by various companies has been short. Approximately one new product announcement has been made every six months. These announcements usually cause price reductions of older models. Dataquest believes that technical workstations will continue to rely on RISC technology to provide inexpensive, cost-effective workstations in the short term.

## VENDOR SIZE AND MARKET STRATEGY

Technical workstation market growth in Japan from 1987 to 1988 was a remarkable 80 percent. Estimated unit numbers and observed marketing strategies for key vendors are listed in Table 2 (see also Figure 1).

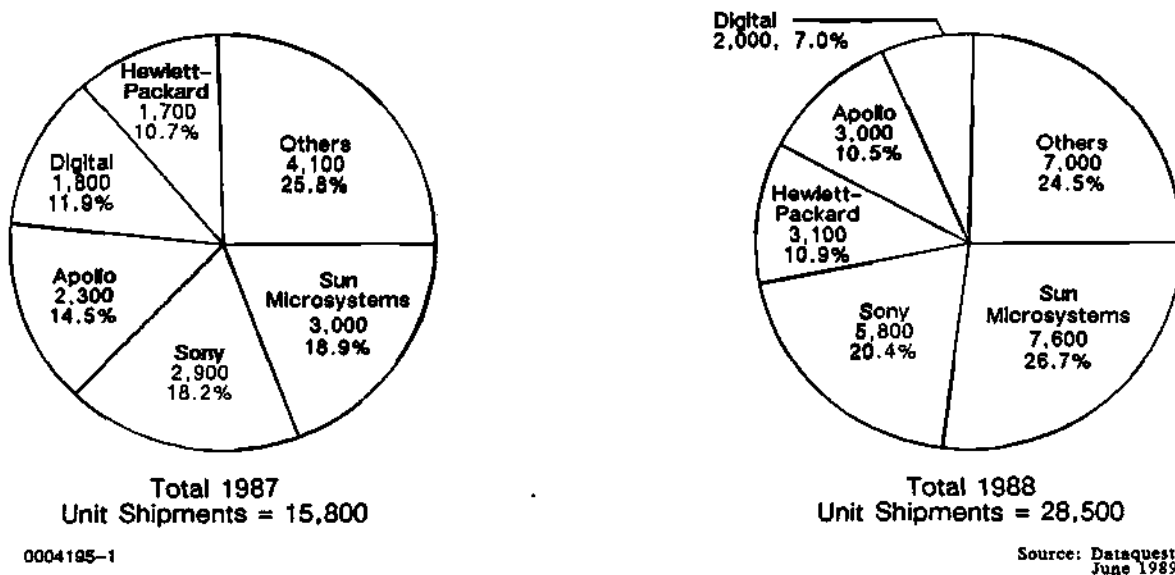
**Table 2**  
**Workstation Shipments and Marketing Strategies—Japan**

<u>Company</u>	<u>Shipments</u>		<u>Marketing Strategy</u>
	<u>1988</u>	<u>1987</u>	
Sun	7,600	3,000	OEM and VARs like C-Ito, Fujitsu, Nippon Steel, and Toshiba; strong in universities and labs; also active in commercial market
Sony	5,800	2,900	Software developer, distributed data processing
HP	3,100	1,700	CAD/CAM, lab, manufacturing
Apollo	3,000	2,300	CAD/CAM, design automation, university and lab, also active in commercial area
Digital Equipment	2,000	1,800	Software developer, lab, university, CAD/CAM
Others	<u>7,000</u>	<u>4,100</u>	
Totals	28,500	15,800	

Source: Dataquest  
June 1989

Figure 1

Technical Workstation Units—Japan  
(Unit Shipments)



## TECHNICAL WORKSTATIONS ENTER BUSINESS MARKET

Recently, banking and financial institutions have begun to introduce technical workstations into their business operations in Japan. Some of the most frequently stated reasons for this action are those that follow:

- Sophisticated user interface of the window system
- 2-D graphics capability for simulation
- High-performance computing for simulation
- Networking for resource sharing, host accessibility, and communications
- Openness for multivendor strategy
- Inexpensive solution

The competitive pressures from Japan's global activities are driving technical workstations into new business markets. The UNIX-based technical workstation appears to be the best solution in some commercial applications.

## DATAQUEST ANALYSIS

Sun is flourishing both in the Japanese and U.S. markets. Its market share was roughly 27 percent in 1988. Following are the three main reasons for Sun's success in the Japanese market:

- Much application software is available on Sun products.
- Japanese users are influenced strongly by U.S. market trends.
- Although it is a recent entrant into the Japanese market, Sun affiliated with major distribution channels and VARs like Fujitsu, Ito-chu Techno-Science, Tokyo Electron, and Toshiba. Apollo's entry into the Japanese market was, by contrast, much less aggressive than Sun's.

The shipment growth rate of Sony's NEWS workstation was also large. Sony sold 5,800 units in 1988, an increase of 100 percent over 1987. Sony is providing only basic systems. Application software has been developed by a third party.

Hewlett-Packard (Yokogawa Hewlett-Packard) is strong in the CAD/CAM area. Its other strength is that it is manufacturing in Japan, although it is a U.S. company. The proposed Hewlett-Packard/Apollo merger will rival Sun's dominant position in Japan.

Japanese mainframe computer companies have workstations of their own design, but they have not sold well. Fujitsu has started to sell Sun's workstation as an OEM product. This will help Fujitsu's mainframe business. Users can expect mainframe workstation connectivity in addition to more complete maintenance support from Fujitsu. If things go well, the company may enter into competitors' territory.

Dataquest anticipates the possibility of partnerships between Japanese manufacturers and U.S. companies, such as the Kubota-Arden, Matsushita-Solbourne, and NEC-Mips pairings. Hitachi has reached an agreement to purchase NAS from National Semiconductor and plans to use its new partner EDS as system integrators in developing software and supporting users.

Will Japanese companies play an important role in the technical workstation industry? Dataquest believes that the answer is yes, for three major reasons:

- Most Japanese companies are all-around players, from chip technology to high-performance computing to highly efficient manufacturing capabilities and telecommunications technology. They will use technical workstations internally and blend their own technology into them. For example, Fujitsu, JCC, and Sony are trying to put high-performance graphics engines into their current products.
- Technical workstations will be a more standardized and open system because this is what users are demanding. Japanese company management policies are very well suited for producing such standardized products. Japanese vendors are waiting for the conclusion of UNIX standardization.

- There are no political reasons to prevent Japanese vendors from exporting technical workstations or manufacturing them overseas because the Japanese market already has been dominated by U.S. companies' products. Dataquest believes that technical workstation exports from several companies will be ready by the fourth quarter of this year.

Finally, Japanese technical workstation vendors will continue to remain hardware suppliers, not software vendors. Without solving this software issue, Japanese companies will be subject to following the lead of their U.S. competitors. This software deficiency is the key difference between Japan's leadership role in the consumer electronics and automobile industries and its role in the technical workstation market.

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Len Hills  
Junichi Saeki

# Research Newsletter

JSAM Code: Newsletters  
1989-5  
0004089

## JAPANESE ELECTRONIC EQUIPMENT TRENDS

### SUMMARY

Major Japanese electronics manufacturers, such as Hitachi, Matsushita, NEC, and Toshiba, expect all-time high earnings from the 1988 fiscal year that ended in March. Revenue should be substantially more than previous records set in fiscal year 1984. This high performance appears to come from a robust demand for electronic products sustained by a healthy worldwide economy and high price trends in memory devices in general and 1Mb DRAMs in particular. Similarly, these manufacturers foresee a rosy outlook for 1989's performance, leading to moderate growth in electronics production. This newsletter reviews 1988 electronics production in Japan and the outlook for 1989.

### 1988 REVIEW

In 1988, the Japanese electronic equipment markets as a whole showed strong growth that was firmly supported by healthy domestic and overseas demands, as well as aggressive capital investment by private enterprises. Dataquest estimates that electronics production in 1988 rose 13.7 percent from the previous year to ¥19,093 billion, after two sluggish years, 1986 and 1987.

In the consumer electronics sector, VCR production showed a moderate 3.1 percent growth in units during the previous year to 31.5 million units, and a 2.8 percent decrease in value to ¥1,178 million. On the other hand, camcorders, a growing segment, rose 50 percent in units from the previous year to 6.7 million units, and increased 33.6 percent in value to ¥645 billion. In addition, color television sales were driven by a strong demand for 25-inch-and-larger models, reflecting consumer taste for high-grade products. This resulted in a 7.5 percent growth in value to ¥843 billion, although unit sales registered a 6.3 percent decline.

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In the industrial sector, computer and telecommunications equipment production grew steadily because of an increase in data processing and communications-related investments by financial institutions and public organizations. Specifically, PCs showed strong growth as a result of smooth sales of the 32-bit models at the initial stage and a strong increase in U.S.-bound exports of laptop models as well as a 21 percent increase in units to 2.4 million and a 27 percent growth in value to ¥487 billion. Finally, facsimile production grew steadily because of the notable increase in exports to Europe and the United States.

## **OUTLOOK FOR 1989**

### **Consumer Electronics**

Production remained at a relatively low level in the first quarter because consumers' were waiting for the introduction in April of the consumption tax. Nevertheless, consumers soon are expected to return to shopping for high-end products, and manufacturers are eagerly focusing on producing high value-added products to serve this potential market. Based on manufacturers' efforts, Dataquest estimates that consumer electronics production this year will grow 2.8 percent from 1988 to ¥6,546 billion, despite the fact that manufacturers are likely to further increase offshore production. The most promising products will be camcorders and TV sets equipped with enhanced definition television (EDTV) functions, as commercial broadcasting of "Clearvision" is scheduled to start in Japan this fall.

### **Data Processing**

A high demand still exists among Japanese corporations for information-related investments that are likely to maintain data processing equipment production at current high levels. Dataquest predicts that computer production will reach ¥615.2 billion in 1989, a 17.7 increase over 1988. Although the U.S. economy shows some future uncertainty, Japanese-made computers are relatively less dependent on exports than those made in the United States (13.9 percent of the 1988 total). When coupled with continuing strong domestic demand, the data processing sector is expected to show a bright picture for the rest of the year. Other products with high growth potential include laser beam printers, Japanese word processors, and electronic schedulers.

### **Communications**

After high growth in 1987 and 1988, the communications equipment industry is expected to resume its stable growth pattern in 1989. Facsimile machine sales grew rapidly in 1988 and should continue its high rate of growth; Dataquest estimates a 17.6 percent increase to ¥80.7 billion for 1989.

A new driving force in this sector is NTT's ISDN service "INS Net 1500," which starts this month. The network boasts features that include high speed (1.5Mbit/sec) and large capacity. Because NTT intends to expand the service from its present 27 cities to 130 cities in the near future, the equipment makers are developing ISDN-compatible equipment, including G-IV facsimiles and digital PBXs.



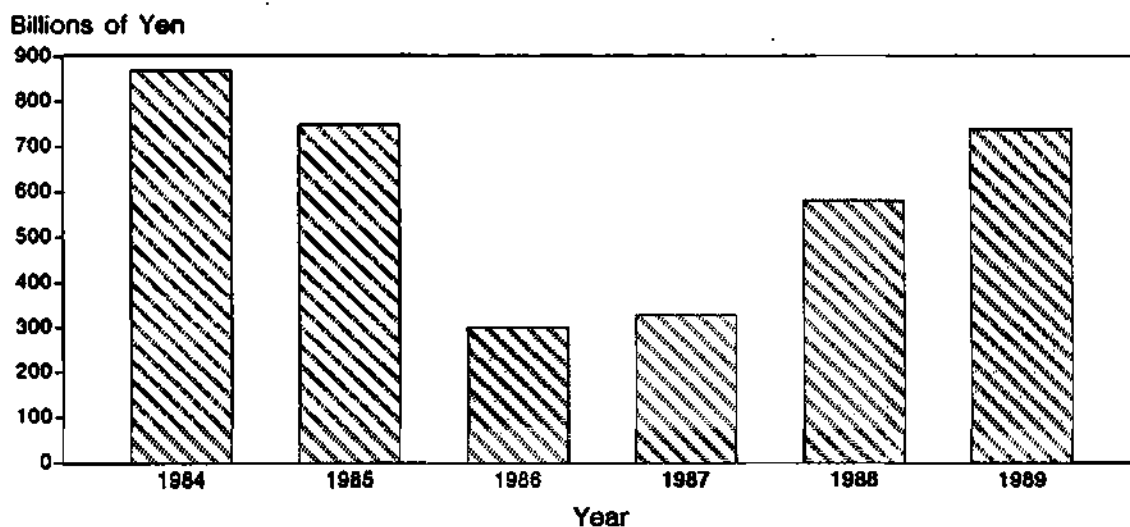
## Industrial Equipment

Dataquest estimates that, because of notable increase in capital investment by chipmakers, production of semiconductor manufacturing equipment and related industrial equipment was up 18.8 percent in 1988, from the previous year to ¥2,123 billion.

Because chip manufacturers are planning to implement the capital expenditures shown in Figure 1, strong growth of industrial equipment production is expected to continue this year.

Figure 1

### Estimated Japanese Semiconductor Capital Spending (Billions of Yen)



0004089-1

Source: Dataquest  
June 1989

## Transportation

In 1988, Japanese automobile production recorded an all-time high of 12.7 million units, a 3.7 percent increase from the previous year. Production of automotive electronic equipment grew 11.7 percent to ¥1,595 billion. With a continued high rate of auto production expected this year, as well as considerable growth of semiconductor production per vehicle prompted by rapid technological advancement of automotive electronics, healthy growth is predicted for automobile electronic equipment in 1989.

## DATAQUEST CONCLUSIONS

The Japanese economy still is in a steady expansion pattern. Consumers are showing a strong appetite for shopping, while major manufacturing companies are planning high levels of capital expenditures in FY1989, although not as high as peak levels in FY1988. However, the Japanese economy growth may slow down during the second half of 1989 if the U.S. economy experiences the sluggish growth predicted as a result of the rise in interest rates and potential for inflation. These factors suggest that the Japanese electronics industry will decelerate this year, after hitting its peak in 1988. Dataquest anticipates that Japan's 1989 electronics production will rise 7.6 percent to ¥20,546 billion in 1989.

Hideaki Nemoto

# Research *Bulletin*

JSAM Code: Newsletters  
1989-4  
0004078

## HIGH-DEFINITION VIDEO—"A NEW FRONTIER"

High-definition video technology (HDVT) will serve as the rallying cry for the United States in the 1990s as did the race to the moon in the 1960s.

U.S. residents perceived the country as lagging in technology in the 1950s; efforts to gain new technologies were intensified, and the result was the ambitious program to go to the moon. Technologies that benefited from this effort included microelectronics, systems management, materials science, and precision equipment.

Many U.S. residents today perceive the country as slipping in electronics technology, and HDVT could be the candidate to reunite its crumbling industries into a new competitive force. Technologies benefiting from HDVT applications include high-resolution displays, image computing (for education, entertainment, and military uses), semiconductors, and manufacturing.

Getting to the moon was not easy, however, and neither will be perfecting HDVT technology.

## THE CONSUMER

HDVT is perceived by the electronics industry as the next step in television's evolution, because high-definition displays would have four times as many pixels per screen than today's televisions. The consumer, on the other hand, perceives the television set as the box in the living room that delivers entertainment cheaply. If a set costs too much or delivers anything besides leisure, the consumer will buy something else for relaxation.

We believe that high-definition television will take at least a decade to become established in the United States because the only advantage it offers so far is a better picture. However, Sony and other Japanese video makers already are introducing high-definition VCRs and negotiating deals with both Hollywood and independent producers to shoot high-definition movies. We believe that HD-VCRs and cable TV will be the entry points for consumer HDVT.

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## THE INDUSTRY

TV sets represent a high-volume global business with thin profit margins; entrants to this market face a struggle. For example, Sony now has a 7.3 percent share of the U.S. market after 20 years of effort. Thomson (RCA/GE), on the other hand, has a U.S. market share of 23.4 percent.

Consumers know when uncertainties exist and avoid bad deals by refusing to purchase bad products. Quadraphonic sound, 8-track tape, Beta video standard, and AM stereo all failed when the high sales volumes needed for success never happened. We note that any of the following groups have veto power over any high-definition television plan:

- 25 programming studios
- 1,400 broadcasting stations
- 7,000 cable operators
- 10,000 video cassette rental stores
- 50,000 consumer electronics retailers
- Manufacturers of more than 50 brands and hundreds of TV and VCR models

## THE TECHNOLOGY

Television is broadcast as analog signals, and most TV sets today process these signals with analog techniques. The HDVT debate, however, opens the door to alternative technologies such as digital transmission over the air, satellite or optical cables for signal delivery, and digital processing techniques inside the set. We believe that these alternative technologies are too risky to be practical at this time.

## THE SPIN-OFFS

The real benefits of HDVT to the United States will be in the spin-offs. For example, high-resolution displays are needed for desktop publishing, battlefield graphics, medical imagers, flight simulators, and video games. Image manipulation algorithms for videocomputed graphics also are needed in education, entertainment, industrial design, personnel training, and military systems. We believe that technologies such as these will be necessary for industrial leadership in the 21st century.

## DATAQUEST CONCLUSIONS

HDVT is an important program for the United States and should be a national priority. Dataquest believes that U.S. government policy should be to encourage companies to invest in advanced video technology for use in consumer, industrial, and military electronics. We recommend patience for semiconductor companies that want to pursue opportunities in HDVT, because large orders will come very slowly. We also note that the long-term nature of HDVT requires executives to look beyond the next quarter and politicians the next election.

Roger Steciak  
Sheridan Tatsuno

# Research Newsletter

JSAM Code: Newsletters  
1989-3  
0003776

## TODAY'S JAPANESE PAGE PRINTER MARKET: ITS PRODUCTS AND PLAYERS

### INTRODUCTION

As market needs change, technology must change to satisfy the market demand. At one time the serial, impact, dot matrix (SIDM) printer was the choice technology because of its flexibility and price/performance level. However, SIDM technology matured, and the end-user requirements became more and more sophisticated. SIDM technology is now moving toward more functionality, such as paper handling and ease of operation, and some progress has been made on the quality of the printing itself. End-user needs always move toward better quality. The movement toward more use of graphics also has affected printer technologies.

Since the introduction of the Canon LBP-CX printer to the marketplace, end users have sought better and better print quality and graphics capability. This demand has been proven by the development of desktop publishing. And, in nonpublishing business environments, spreadsheet, word processing, and data base applications, which demand complex output and quiet printing operations, are also in increased demand.

In 1987, total revenue for page printers sold in the United States exceeded that of SIDM printers, even though the unit demand ratio was still ten page printers for every SIDM printer. This market is dominated by low-end page printers (less than 10 ppm). Most of the page printer engines are supplied by Japanese manufacturers.

Although the U.S. market is dominated by Japanese printer engine manufacturers, little is known about the Japanese printer market. Have similar market trends occurred in the Japanese and U.S. markets? What is the expected market growth? Who are the players? How are they managing joint development? What are the local market problems? In this newsletter, Dataquest answers some of these questions.

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## THE JAPANESE PRINTER MARKET

Table 1 shows a five-year Japanese domestic printer market history and forecast. The total market was 1.3 million units in 1987 and will grow to more than 2 million units in 1991. The compound annual growth rate (CAGR) from 1987 to 1991 will be 12.5 percent. SIDM printers totaled 0.9 million units in 1987 and will grow to 1.3 million units in 1991, with a CAGR of 9.8 percent. Dataquest estimates that the CAGR for Japanese page printers will grow to close to 90 percent. In 1987, the PNPP market was estimated to total 28,000 units and it will increase to almost 350,000 units in 1991.

**Table 1**  
**The Japanese Printer Market History and Forecast**  
**(Thousands of Units)**

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>CAGR</u> <u>1987-1991</u>
All Printers	1,300	1,432	1,743	1,933	2,082	12.5%
SIDM	900	1,080	1,200	1,270	1,310	9.8%
PNPP	28	70	150	255	344	87.4%
Other	372	282	393	408	428	3.5%

Source: Dataquest  
May 1989

### The Page, Nonimpact, Plain Paper Printer Market

The Japanese page, nonimpact, plain paper (PNPP) printer market took off just last year. The market more than doubled between 1987 and 1988. The Japanese PNPP market did not start to replace line, impact, fully formed (LIFF) printers because of kanji-character requirements until 1988. Prior to 1988, only a few manufacturers offered kanji-capable page printers. There are more than 7,000 characters for each set of kanji fonts. Many companies now offer a so-called bit-map kanji font based on Mincho type. The font has different sizing based on 24 x 24 dot, 32 x 32 dot, and/or 40 x 40 dot, etc. Some companies only offer one sizing and others offer multisizing. Some companies also offer Gothic kanji font in the same type of dot configuration.

Initially, page printer production was directed mostly to the overseas market. Production for the Japanese domestic market was delayed because of the kanji font development time and cost. The product price about two years ago was more than ¥0.5 million (about \$4,000). Now most companies are ready for the market competition, as the price point has come down to around ¥0.4 million (\$3,000). This spring, a company was expected to offer a product for less than ¥0.3 million (almost \$2,400). Now the page printer price point will become low enough to compete with the 24-pin SIDM printer, which is the dominant technology in Japan. Dataquest estimates that the page printer market will grow to approximately 150,000 units in 1989 and continue to add 100,000 units every year until 1991.

## The Market Players

Close to 60 models of page printers with speeds as high as 26 ppm are offered from at least 15 printer engine manufacturers in Japan. Of these 60 models, 6 are OEM models and 18 have kanji capability. The other models are offered on an OEM basis (see Table 2). The 18 kanji-capable models' speed range is from 5 to 11 ppm, with 8 ppm being the dominant speed category, and 12 of these 18 models offer 240-dpi resolution. The current Japanese standard is 240 dpi, but higher-resolution printers are just now starting to enter the marketplace strongly.

The following list shows the name of companies that offer these 18 kanji-capable models and the printer engine used:

<u>Company</u>	<u>Printer Engine</u>
Apple Japan	Canon engine
Bussan Digital	Fuji Xerox, Oki engine
Canon	Own
Casio	Own
Epson	Canon, Ricoh engine
Fuji Xerox	Own
Fujitsu	Own
Kyocera	Own
NEC	TEC, Own
Panasonic	Own
Ricoh	Own

Except for Apple Japan, all of these companies are Japanese. NEC offers four kanji-capable printers, the most offered by any of the 11 companies listed. Canon, Casio, Epson, and Bussan Digital each offer two kanji-capable models. The other manufacturers each offer one kanji-capable model. NEC, backed up by its strong personal computer market position, is aggressively marketing its kanji-capable printers. Even though Canon offers only two kanji-capable models, it has the most models, if non-kanji-capable models are included. As with its overseas markets, Canon holds the best position in Japan on the economy-of-production scale. Dataquest estimates that in 1988, the top three ranked market players were Canon, Casio, and NEC. Together, they held more than 80 percent share of the Japanese market.

However, in 1989, Dataquest estimates that the other companies listed previously will aggressively expand their shipments as the market continues to expand. We expect the page printer market to grow for several reasons:

- More and more lower-priced products are available.
- A dominant control language like HP PCL does not exist.
- We expect growth in the workstation market.
- Some of the page printer manufacturers also are giant electronics companies, and their computer products could be integrated with a page printer as part of a total system.

**Table 2**  
**Japanese Page Printer**  
**Specifications**

<u>Vendor</u>	<u>Model</u>	<u>Engine</u>	<u>Technology</u>	<u>Speed</u> (ppm)	<u>RAM</u> (Std.)	<u>DPI</u>	<u>Font-Access</u>	<u>PCL</u>	<u>Interface</u>	<u>Paper Size</u>
Apple Japan	LaserWriter II NTX-J	Canon	Laser	8	8.0MB	300	J2	PostScript	SCSI/RS-232	A4/B5/Letter/Legal
Bussan Digital	Laser Mega	Fuji Xerox	Laser	11	1.0MB	240	J1	HPGL-Super	Centro	A4-5/B4-5/Letter/Legal
Bussan Digital	Laser Mega Jr	Oki	LBD	4	512K	300	J2	HPGL-Super	Centro	A4-5/B5
Canon	LBP-20	Canon	Laser	20	-	240/300/ 400			Video	A3-4/B4-5
						400/480				
Canon	LBP-DX	Canon	Laser	3	-	400			Video	A3-4/B4-5
Canon	LBP-B406	Canon	Laser	8	0.5M	240	J2	LISP	Centro/RS-232	A4-5/B4-5
Canon	LBP-RX	Canon	Laser	8	-	240/300/ 400			Video	A4/B5/Letter
Canon	LBP-SX	Canon	Laser	8	-	240/300/ 400			Video	A4/B5
Canon	LBP-A408	Canon	Laser	8	0.5M	240	J2	LISP	Centro/RS-232	A4/B5
Canon	LBP-ST	Canon	Laser	8	-	240/400			Video	A4-5/B4-5
Canon	LBP-811	Canon	Laser	8	0.5M	300	W	LISP	Centro/RS-232	A4/Letter/Legal
Canon	LBP-TX	Canon	Laser	8	-	240/300/ 400			Video	A4/B5/Letter/Legal
Casio	LCS-124	Casio	LCS	6	1.0MB	240	J1	Original	Centro/RS-232	A4/B5/Letter
Casio	LCS-130	Casio	LCS	6	-	300			Video/Centro/ RS-232	A4/B5/Letter/Legal
Casio	LCS-300	Casio	LCS	8	-	300			Video/Centro/ RS-232	A4/B5
Casio	LCS-240	Casio	LCS	9	1.0MB	240	J1	Original	Centro/RS-232	A4/B4-5
Copial	SLB-6000	Copial	Laser	12	-	600			Video	A3-5
Epson	LP-5000	Ricoh	Laser	6	1.0MB	240	J2	ESC-P	Centro	A4/B5/A5
Epson	LP-7000	Canon	Laser	8	1.5M	240	J2	ESC-Page	Centro/RS-232/ 422	A4/B4-5
Fuji Xerox	XP-11 10	Fuji	Laser	11	-	240/300/ 400			Video	B4
Fuji Xerox	XP-11 30	Fuji	Laser	11	-	240/300/ 400				
Fuji Xerox	4105	Fuji	Laser	11	1.5M	240	J2	ART	Centro	A4/B4
Fuji Xerox	XP-11 40	Fuji	Laser	11	-	240/300/ 400				
Fuji Xerox	XP-11 20	Fuji	Laser	11	-	240/300/ 400				

(Continued)



Table 2 (Continued)  
Japanese Page Printer  
Specifications

Vendor	Model	Engine	Technology	Speed (ppm)	RAM (Std.)	DPI	Font-Access	PCL	Interface	Paper Size
Fujitsu	M3723M/L	Fujitsu	Laser	12	-	300/240			Centro/RS-232	A3-4/B4-5
Fujitsu	M3712L/M/N	Fujitsu	Laser	12	-	240/300/ 400			Centro/RS-232	A4/B4-5
Fujitsu	M3722M	Fujitsu	Laser	17	-	300			Centro/RS-232	A4/B4-5
Fujitsu	M3722L	Fujitsu	Laser	20	-	240			Centro/RS-232	A4/B4-5
Fujitsu	M3702L/M	Fujitsu	LED	5	-	240/400	J1/W1	Emulation	Centro/RS-232	A4/B4-5
IBM Japan	3812-002	Kentek	LED	12	1.0MB	240	W62		Centro/RS-232	Maximum 8.5 x 14-Inch
IBM Japan	4216-020	Ricoh	Laser	6	640K	300	W43		Video	Maximum 8.5-Inch
IBM Japan	5587-601	Ricoh	Laser	8	Not Open					
Kyocera	L-880S	Kyocera	Laser	10	1.0MB	300	J2/W6	J Prescrib	Centro/RS-232	A4/B5/Letter/Legal
Kyocera	F1000+	Kyocera	Laser	10	1.5M	300	W79	Prescrib	Centro/RS-232	A4/B5/Letter/Legal
NEC	PC-PR406LP2	TEC	Laser	5	Not Open	320	J1/W1	Emulation	Centro	A4/B5
NEC	PC-PR406LM	NEC	Laser	6	Not Open	320	J3/W4	Emulation	Centro	A4/B5
NEC	PC-PR602PS	NEC	LED	8	Not Open	320	J2/W15	PostScript	Centro/RS-232	A4/B4-5
NEC	PC-PR602R	NEC	LED	8	Not Open	240	J2/W2	Emulation	Centro	A4/B4-5
Oki	Photo Printer 6024	Oki	LED	24		240			Centro	A4/B5/B4
Oki	Laserline 6	Ricoh	Laser	6		300			Centro/RS-232	A4-5/B5
Panasonic	FP-L136	Panasonic	Laser	10	-	600			Video	A4-5/B4-6
Panasonic	FP-L140	Panasonic	Laser	10	-	600			Video	A4-5/B4-6
Panasonic	FP-L300	Panasonic	Laser	22	-	400/360/ 300/240			Video	A3-6/B4-6
Panasonic	FP-L330	Panasonic	Laser	22	4.5M	400	J2/W2	Emulation	Centro/RS-232	A3-A6
Ricoh	LP106U-SP3	Ricoh	Laser	6	1.0M	240			Centro/RS-232	A4-5/B5
Ricoh	LP3320-SP4	Ricoh	Laser	8	-	240	J1		Centro/RS-232	A3-5/B4-5
Ricoh	5447-G01	Ricoh	Laser	8	Not Open	240			Centro/RS-232	A3-A6
Sanyo	BPX-716	Sanyo	LED	16	-	240			Video	A4/B4-5
Sanyo	BPX-820	Sanyo	LED	20	-	300/400			Video	A4/B4/Letter
Sanyo	BPX-608	Sanyo	Laser	8	-	300			Video	A4/Letter/Legal
Sanyo	BPX-708	Sanyo	LED	8	-	240			Video	A4/B4-5
Sharp	JX9300	Sharp	Laser	6	-	300			Video	A4
Star	Laser Printer 8	Canon	Laser	8	1.0M	300			Centro/RS-232	A4/B5/Letter/Legal
TBC	LB-1301	TBC	Laser	8	-	300			Centro/RS-232	A4-5/Letter/Legal
Toshiba	TN-7750	Toshiba	Laser	26	-	300			Video	A3-4/B4-5
Toshiba	TN 7240	Toshiba	Laser	8	-	240/300/ 400			Video	A3-45/B4-5

(Continued)

Table 2 (Continued)

Japanese Page Printer  
Specifications

Vendor	Paper Cassettes	Paper Tray	Toner Kit	Drum Kit	Dimension W/D/H	Weight (Kg)	Price	Comments
Apple Japan	200	Down 100	Cartridge	¥5,000/20,000	508 x 470 x 218	21.0	¥1,190,000	
Bussan Digital	250	Up 250/Down 200	¥6,000/23,000	¥10,000/32,000	478 x 389 x 270	21.5	¥478,000	XP-11 Model 20
Bussan Digital	200	Up	Not specified	Not specified	450 x 410 x 133	11.0	¥298,000	March 1989
Canon	250 x 2	Up 100			730 x 600 x 510	100.0		Without controller
Canon	Roll	-			750 x 980 x 1,158	270.0		Without controller
Canon	200	Up 100/Down 20	Cartridge ¥5,000/27,000		510 x 529 x 235	25.0	¥525,000	
Canon	200 x 2	Down			454 x 625 x 313	28.0		OEM/dual
Canon	200	Down			454 x 482 x 232	19.0		OEM
Canon	200	Up 100/Down 20	Cartridge ¥5,000/21,500		454 x 492 x 228	20.0	¥425,000	
Canon	200	Up/Down 100			510 x 529 x 219	24.0		OEM
Canon	200	Up 100/Down 20	Cartridge ¥5,000/23,500		454 x 492 x 228	20.0	¥389,000	OEM
Canon	200	Down			454 x 493 x 313	25.0		OEM
Casio	100	Down 100	¥6,000/16,000	¥10,000/19,000	398 x 340 x 230	17.0	¥398,000	Own/OEM
Casio	100	Down 100			398 x 340 x 230	16.0		OEM
Casio	250	Up 150/Down 100			475 x 455 x 342	29.0		OEM
Casio	250	Up 150/Down 100	¥5,000/16,000	¥7,000/19,000	475 x 420 x 340	29.0	¥598,000	Own/OEM
Copal	250				570 x 495 x 330	50.0		OEM
Epson	150	Up 100/Down 150	¥1,500/4,400	¥20,000/40,000	405 x 418 x 210	17.0	¥448,000	
Epson	200	Up 100/Down 20	Cartridge ¥4,000/27,000		510 x 548 x 235	24.5	¥546,000	
Fuji Xerox	250	Up 250			478 x 370 x 222	20.7		OEM
Fuji Xerox	250 x 2	Up 250			478 x 370 x 309	24.8		OEM
Fuji Xerox	250	Up 250/Down 200	¥6,000/23,000	¥10,000/32,000	478 x 389 x 270	25.0	¥448,000	Based on Model 20
Fuji Xerox	250 x 2	Up 100/Down 250			478 x 389 x 309	25.3		OEM
Fuji Xerox	250	Up 100/Down 250			478 x 389 x 222	21.2		OEM
Fujitsu	250	Up 250			485 x 560 x 310	46.0		OEM
Fujitsu	250	Down 250			470 x 580 x 311	38.0		OEM
Fujitsu	250	Up 250			485 x 510 x 310	43.0		OEM
Fujitsu	250	Up 250			485 x 510 x 310	43.0		OEM
Fujitsu	150	Down 250	Cartridge ¥6,000/38,000		450 x 399 x 184	19.5	¥42,000	Own/OEM

(Continued)

Table 2 (Continued)

Japanese Page Printer  
Specifications

Vendor	Paper Cassettes	Paper Tray	Toner Kit	Drum Kit	Dimension W/D/H	Weight (Kg)	Price	Comments
IBM Japan	550				686 x 483 x 381	62.0		
IBM Japan	150				418 x 449 x 212.5	16.0		
IBM Japan	250	Up 100/Down 250			553 x 563 x 388	49.0	¥780,000	
Kyocera	250	Down 150	¥3,000/5,900	¥10,000/29,000	428 x 450 x 320	26.0	¥400,000	
Kyocera	250	Down 150	¥3,000/5,900	¥10,000/29,000	428 x 450 x 320	26.0	¥520,000	
NEC	150	Down 150	¥2,500/6,500	¥10,000/55,000	411 x 520 x 310	23.0	¥398,000	
NEC	150	Up/Down 150	¥1,500/4,500	¥10,000/20,000	750 x 410 x 210	16.0	¥368,000	
NEC	250	Down 250	Cartridge ¥5,000/38,000		470 x 525 x 273	30.0	¥980,000	RDD 40MB Inside
NEC	250	Down 250	Cartridge ¥5,000/38,000		470 x 525 x 273	29.0	¥498,000	
Oki	250	Up 250/Down 500			600 x 535 x 300	55.0	¥1,300,000	Own/OEM
Oki	150	Up 100/Down 150			409 x 418 x 228	17.0		
Panasonic	200	100			585 x 537 x 385	62.0		OEM
Panasonic	200	100			585 x 537 x 385	62.0		OEM
Panasonic	250	250			501 x 528 x 363	40.0		OEM
Panasonic	250	Down 250	Not specified	Not specified	501 x 512 x 363	40.0	¥1,200,000	May 1989
Ricoh	150	Up 100/Down 150			408 x 418 x 205	17.0	¥400,000	PC6000 Base
Ricoh	250	Up 100/Down 250	Not specified	Not specified	569 x 563 x 370	50.0	¥700,000	Target at September 1989
Ricoh engine	450	Up 100/Down 250	Not specified	Not specified	553 x 563 x 380	49.0	¥780,000	Same as 1328
Sanyo	200/550	250			507 x 524 x 340	33.0		OEM
Sanyo	250	250			500 x 592 x 730	77.0		OEM
Sanyo	250	Up 10/Down 100	¥3,000	¥15,000	423 x 468 x 263	23.0		OEM
Sanyo	200	250	¥5,000	¥50,000	507 x 524 x 280	29.0		OEM
Sharp	100	200	¥5,000	Dev. ¥10,000/ opc. ¥30,000	451 x 416 x 325	17.5		Sample at B-mhow
Star	200	Up 20/Down 100			454 x 492 x 219	20.0		
TBC	250				411 x 527 x 310	20.0		OEM
Toshiba	500	Down			678 x 610 x 410	70.0		2 Color/OEM
Toshiba	250	Down			480 x 450 x 204	23.0		OEM

Source: Dataquest  
May 1989

Until 1988, the market was really dominated by Canon, Casio, and NEC; however, in 1989, Dataquest anticipates that the other players listed on page 3 will aggressively expand their shipments as the page printer market size grows. Some of the reasons are as follows:

- There are more lower-priced product offerings
- Dominant superb control language like HP PCL does not exist
- Workstation market growth is expected
- Some of the page printer manufacturers are also giant electronic companies, and their computer products could be integrated with a page printer as part of a total system

#### **Semiconductor Contents Analysis of Laser Beam Printers**

The majority of laser beam printers use 8-bit, 1-chip microcontrollers in the engine sections that incorporate A-D converters and D-A converters for analog control functions, including laser power control.

The control section of most laser beam printers adopts a 16-bit 68000 microprocessor. However, increasing demand for advanced features has prompted more models to mount 32-bit 68020 MPUs.

Most laser beam printers have 0.5- to 1.5-Mbyte RAMs, usually with 2-Mbyte RAMs provided as optional memory. Although 256K DRAMs are widely used as main memories, an increase in the shipment of 1Mb DRAMs and the price drop expected later this year are likely to accelerate the shift from 256K to 1Mb devices. SRAMs are used as buffer memories to store bit image data.

Gate arrays are used for timing control, address control, I/O control, and bit shifting. Programmable logic devices (PLDs) are used in some models. Table 3 summarizes the semiconductor content of laser beam printers.

**Table 3**  
**Semiconductor Content Analysis of Midrange Laser Beam Printers**

<u>Description</u>	<u>Quantity</u>	<u>Cost</u>
Memory		
256K DRAM (NMOS, 256Kx1)	16	
64K SRAM (NMOS, 64Kx1)	2	
1Mb ROM (NMOS)	4	
Total Semiconductor	22	¥ 8,260

(Continued)

**Table 3 (Continued)**

**Semiconductor Content Analysis of Midrange Laser Beam Printers**

<u>Description</u>	<u>Quantity</u>	<u>Cost</u>
Microdevices		
16-Bit MPU	1	
8-Bit MCU	<u>1</u>	
Total Microdevices	2	¥ 1,060
ASIC		
Gate Array (660 to 1,500 gates)	5	
Cell-Based IC	<u>1</u>	
Total ASIC	6	¥ 2,090
Logic	7	¥ 200
Analog	7	¥ 260
Discrete		
Transistor	6	
Diode	<u>16</u>	
Total Discrete	22	¥ 620
Total Semiconductor	66	¥12,490
LBP Production Cost		¥84,350
I/O Ratio		14.8%

Source: Dataquest  
May 1989

**DATAQUEST ANALYSIS**

The Japanese page printer market took off only last year. The market is expected to grow by 150,000 units in 1989, and by at least 100,000 units every year until 1991. The Japanese desktop publishing market also is expected to take off strongly this year. Our forecast does not include so-called dedicated word processor systems, which use a page printer as an output device. This market segment also is making its presence felt in the marketplace. Some of the manufacturers' models listed in Table 2 also are used for this application. The dedicated Japanese word processor market could grow to more than 10,000 units this year.

Because of the complexity of the kanji character, Japanese manufacturers showed a slow start, but now end users also have begun to realize the flexibility and beauty of the printed output of PNPP printers. The page printers present a big challenge to SIDM printers. Both NEC and Apple Japan have announced PostScript-compatible page printers priced at approximately ¥1 million (\$8,000). This price is much lower than the market had expected when considering outline font development cost, and the product comes with a 40-Mbyte hard disk drive.

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# Research Newsletter

JSAM Code: Newsletters  
1989-2  
0003760

## JAPANESE SEMICONDUCTOR INDUSTRY FIVE-YEAR FORECAST: INDUSTRIAL ELECTRONIC EQUIPMENT DRIVES GROWTH

### SUMMARY

The impact of 1988, with its memory shortages and tremendous growth rates, has continued into the first half of 1989 according to Dataquest's forecast for the Japanese semiconductor industry. The industry will begin to slow in the third quarter of 1989, reaching a year-end growth rate of 14.9 percent. This is up from our previous forecast of 8.3 percent, for the following reasons:

- Memory device shortages have persisted into the first quarter of 1989.
- Domestic industrial equipment demand was strong in the first quarter of 1989 and is expected to continue through the end of the year.
- Capital spending by private companies has been active.
- Export of industrial electronics has been vigorous.

Our extended forecast shows a slowdown in 1990, picking back up again by 1991. Because of the impact of recent persistent memory shortages, we are forecasting the next peak year for the Japanese market to be 1993, which would make a five-year cycle from peak to peak. Historically, the industry has peaked every four years. We forecast this same five-year cycle in all regions except Europe, which is expected to peak in 1992 as more production moves into Europe and European manufacturers gear up for intense competition.

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## FORECASTS

### Short-Term Forecast—1988 through 1990

In the next two years, the semiconductor market in Japan will be driven by industrial equipment, through both domestic demand and exports. Products that will drive Japanese semiconductor consumption in 1989 and 1990 are as follows:

- PCs and laptops (private and public use)
  - The current installed base is very small.
  - 32-bit machines have been introduced that can handle Japanese language software.
  - Companies purchasing smaller computer systems are eligible for a tax break with the new tax system.
  - A PC-based communication system between private investors and their brokers has been introduced.
- Larger office computer equipment
  - Securities companies are being pressured to improve data processing techniques.
  - Companies that are expanding globally need to upgrade and expand computer systems.
- Automatic teller machines
  - A new system is being used where customers access their bank account directly from the store checkout.
- Fax machines
  - Growth of exports was strong in 1988 and is expected to continue into 1989 because of a small overseas installed base.
- Point of sale (POS) terminals and electronic cash registers (ECRs)
  - Retailers need to buy new hardware to meet the requirements of the newly introduced consumption tax.

Growth in industrial equipment will keep semiconductor consumption strong in 1989, despite a predicted slowdown in consumer electronics. Historically, after a year of strong growth, consumer spending drops off. Dataquest's projected growth rates for consumer electronic equipment consumption is 7.4 percent in 1988, 30.0 percent in 1989, and 4.0 percent in 1990.

Consumer spending also has been slower than normal in the first quarter of 1989 because of the expectation of lower prices after the introduction of the April 1 consumption tax. Taxes on luxury items such as CD players, VCRs, camcorders, and



color televisions dropped from 10 to 3 percent. Demand for these items is expected to pick up again in the second quarter.

Memory devices are another reason for a strong 1989 semiconductor market forecast. The current situation of supply and demand is outlined as follows:

- **1M DRAM**—At the end of the first quarter of 1989, supply is still less than demand. Expectations are that supply will equal demand by mid-1989 because of a boost in production. Prices are slowly dropping.
- **256K SRAM**—Prices and demand are increasing because of growth of POS terminals, ECRs, and electronic schedulers. There is a shift in both suppliers, as new ones enter the market, and users, as 1M DRAM supplies improve.
- **Mask ROM**—The supply-to-demand ratio is worse now than in 1988. One reason is the popularity of Nintendo game machines, which use mask ROMs.

In the next two years, we expect capital investments to remain strong, but to stay below 1984 levels. Many manufacturers are increasing investments, but cautiously, unlike what we saw in 1984. Return on investment is now 1, for the first time since 1984.

Tables 1 and 2 show quarterly growth rates based on yen and U.S. dollars, respectively, for the Japanese semiconductor market from 1988 to 1990.

Table 1

**Japanese Semiconductor Consumption Forecast**  
**Quarterly Growth Rates for 1988-1990**  
**(Percent Change in Yen)**

	<u>1987</u>	<u>Q1/88</u>	<u>Q2/88</u>	<u>Q3/88</u>	<u>Q4/88</u>	<u>1988</u>
Total Semiconductor	9.0%	(1.1%)	9.4%	7.9%	5.8%	20.5%
Total IC	10.9%	(0.4%)	10.5%	8.6%	7.1%	23.6%
Bipolar Digital	4.1%	(5.0%)	7.7%	(5.4%)	0.8%	5.0%
Memory	16.0%	11.0%	5.9%	14.2%	0.1%	24.5%
Logic	2.3%	(7.5%)	8.0%	(9.0%)	0.9%	1.7%
MOS Digital	16.4%	15.9%	14.9%	12.3%	7.7%	40.7%
Memory	12.5%	12.1%	22.4%	20.3%	15.3%	64.6%
Micro	19.9%	19.2%	12.7%	8.8%	0.6%	20.8%
Logic	17.6%	17.3%	8.9%	5.8%	3.2%	33.5%
Analog	4.5%	3.7%	1.5%	6.0%	8.7%	(0.8%)
Discrete	4.0%	3.2%	5.3%	2.9%	1.8%	5.2%
Optoelectronic	3.2%	2.1%	6.8%	12.3%	0.4%	26.5%
Exchange Rate Yen/\$	144	128	125	134	125	128

(Continued)

Table 1 (Continued)

Japanese Semiconductor Consumption Forecast  
Quarterly Growth Rates for 1988-1990  
(Percent Change in Yen)

	<u>1988</u>	<u>Q1/89</u>	<u>Q2/89</u>	<u>Q3/89</u>	<u>Q4/89</u>	<u>1989</u>
Total Semiconductor	20.5%	4.3%	2.3%	(1.4%)	(4.7%)	15.0%
Total IC	23.6%	3.5%	2.7%	(1.0%)	(4.7%)	16.3%
Bipolar Digital	5.0%	(0.6%)	(0.2%)	(3.4%)	(4.8%)	(4.0%)
Memory	24.5%	0.9%	(6.3%)	(11.5%)	(9.8%)	(4.2%)
Logic	1.7%	(1.0%)	1.3%	(1.7%)	(3.8%)	(3.9%)
MOS Digital	40.7%	6.8%	2.8%	(0.7%)	(5.6%)	23.3%
Memory	64.6%	9.7%	3.9%	(0.3%)	(9.3%)	38.6%
Micro	20.8%	3.6%	1.3%	(0.6%)	(3.4%)	11.3%
Logic	33.5%	5.0%	2.4%	(1.2%)	(1.7%)	13.5%
Analog	(0.8%)	(4.0%)	3.4%	(1.1%)	(1.6%)	7.2%
Discrete	5.2%	5.1%	0.5%	(2.4%)	(3.8%)	7.4%
Optoelectronic	26.5%	11.7%	2.1%	(3.9%)	(6.5%)	17.9%
Exchange Rate Yen/\$	128	128	128	128	128	128
	<u>1989</u>	<u>Q1/90</u>	<u>Q2/90</u>	<u>Q3/90</u>	<u>Q4/89</u>	<u>1990</u>
Total Semiconductor	15.0%	2.9%	(3.3%)	(3.1%)	(4.3%)	(1.3%)
Total IC	16.3%	2.8%	(2.9%)	(3.0%)	(4.0%)	(1.4%)
Bipolar Digital	(4.0%)	3.1%	(2.9%)	(3.0%)	(3.8%)	(3.7%)
Memory	(4.2%)	(3.2%)	(9.4%)	(3.9%)	(2.5%)	(2.5%)
Logic	(3.9%)	4.3%	(1.5%)	(2.8%)	(4.0%)	(4.0%)
MOS Digital	23.3%	2.1%	(0.7%)	(4.0%)	(4.4%)	(2.4%)
Memory	38.6%	2.2%	0.6%	(2.3%)	(4.8%)	(6.5%)
Micro	11.3%	2.0%	(5.4%)	(5.7%)	(2.9%)	3.4%
Logic	13.5%	2.1%	1.2%	(4.9%)	(5.1%)	(0.4%)
Analog	7.2%	4.8%	(9.2%)	(0.3%)	(3.0%)	2.7%
Discrete	7.4%	3.8%	(3.6%)	(1.8%)	(5.6%)	(2.5%)
Optoelectronic	17.9%	2.3%	(8.0%)	(6.5%)	(4.8%)	2.2%
Exchange Rate Yen/\$	128	128	128	128	128	128

Source: Dataquest  
May 1989

Table 2

Japanese Semiconductor Consumption Forecast  
Quarterly Growth Rate for 1988-1990  
(Percent Based on U.S. Dollars)

	<u>1987</u>	<u>Q1/88</u>	<u>Q2/88</u>	<u>Q3/88</u>	<u>Q4/88</u>	<u>1988</u>
Total Semiconductor	26.5%	4.3%	12.0%	0.7%	13.5%	35.6%
Total IC	28.6%	5.1%	13.2%	1.3%	14.9%	39.1%
Bipolar Digital	20.7%	0	10.3%	(11.7%)	8.0%	18.3%
Memory	34.3%	16.4%	8.5%	6.5%	7.3%	40.1%
Logic	18.7%	(2.6%)	10.6%	(15.1%)	8.2%	14.6%
MOS Digital	35.0%	13.4%	17.6%	4.8%	15.4%	58.4%
Memory	30.5%	19.3%	25.3%	12.2%	23.7%	85.4%
Micro	39.0%	5.6%	15.5%	1.5%	7.9%	35.9%
Logic	36.5%	13.8%	11.5%	(1.3%)	10.7%	50.3%
Analog	21.1%	(8.8%)	3.9%	(1.1%)	16.5%	11.7%
Discrete	20.6%	(2.2%)	7.8%	(4.1%)	9.1%	18.5%
Optoelectronic	19.7%	14.4%	9.4%	4.7%	7.6%	42.3%
Exchange Rate Yen/\$	144	128	125	134	125	128
	<u>1988</u>	<u>Q1/89</u>	<u>Q2/89</u>	<u>Q3/89</u>	<u>Q4/89</u>	<u>1989</u>
Total Semiconductor	35.6%	1.8%	2.3%	(1.4%)	(4.7%)	14.9%
Total IC	39.1%	1.1%	2.7%	(1.0%)	(4.7%)	16.2%
Bipolar Digital	18.3%	(3.0%)	(0.2%)	(3.3%)	(4.8%)	(4.1%)
Memory	40.1%	(1.1%)	(6.9%)	(11.1%)	(9.7%)	(4.1%)
Logic	14.6%	(3.4%)	1.4%	(1.6%)	(3.8%)	(4.0%)
MOS Digital	58.4%	4.3%	2.8%	(0.7%)	(5.6%)	23.2%
Memory	85.4%	7.2%	3.9%	(0.3%)	(9.3%)	38.5%
Micro	35.9%	1.1%	1.4%	(0.7%)	(3.4%)	11.2%
Logic	50.3%	2.5%	2.4%	(1.2%)	(1.7%)	13.5%
Analog	11.7%	(6.2%)	3.5%	(1.1%)	(1.6%)	7.1%
Discrete	18.5%	2.6%	0.6%	(2.4%)	(3.8%)	7.3%
Optoelectronic	42.3%	9.2%	1.9%	(3.8%)	(6.6%)	17.9%
Exchange Rate Yen/\$	128	128	128	128	128	128

(Continued)

Table 2 (Continued)

Japanese Semiconductor Consumption Forecast  
Quarterly Growth Rate for 1988-1990  
(Percent Based on U.S. Dollars)

	<u>1989</u>	<u>Q1/90</u>	<u>Q2/90</u>	<u>Q3/90</u>	<u>Q4/90</u>	<u>1990</u>
Total Semiconductor	14.9%	(2.8%)	3.5%	3.2%	4.5%	(1.3%)
Total IC	16.2%	(2.7%)	3.0%	3.1%	4.2%	(1.4%)
Bipolar Digital	(4.1%)	(3.1%)	3.0%	3.1%	3.9%	(3.8%)
Memory	(4.1%)	3.1%	10.4%	4.1%	2.6%	(2.6%)
Logic	(4.0%)	(4.2%)	1.5%	2.9%	4.2%	(4.0%)
MOS Digital	23.2%	(2.1%)	0.7%	4.1%	4.6%	(2.4%)
Memory	38.5%	(2.1%)	(0.6%)	2.4%	5.0%	(6.5%)
Micro	11.2%	(2.0%)	5.7%	6.0%	3.0%	3.4%
Logic	13.5%	(2.1%)	(1.2%)	5.1%	5.4%	(0.4%)
Analog	7.1%	(4.6%)	10.1%	0.3%	3.1%	2.7%
Discrete	7.3%	(3.6%)	3.8%	1.8%	6.0%	(2.5%)
Optoelectronic	17.9%	(2.2%)	8.7%	6.9%	5.0%	2.2%
Exchange Rate Yen/\$	128	128	128	128	128	128

Source: Dataquest  
May 1989

Long-Term Forecast—1991 through 1993

One area to watch in the 1992 through 1993 time frame is high-definition television (HDTV). Receivers for HDTV will consume approximately 20 to 30Mb of memory, compared with the 8 to 11Mb of memory consumed by the earlier EDTV and IDTV. Digital equipment such as faxes, copiers, VCRs, and cameras are expected to see strong growth in the 1992 to 1993 time frame.

Capital investments will be strong as new technologies are put into production and existing fabs are upgraded. We do not see an overcapacity problem developing in Japan, but we will be monitoring the worldwide situation as companies increase manufacturing facilities in Europe to meet local content requirements and in the United States and Asia to overcome trade restrictions.

The compound annual growth rate (CAGR) for semiconductor consumption from 1988 to 1993 is estimated at 15.9 percent. Tables 3 and 4 show the 1987 to 1993 yearly growth rates in yen and U.S. dollars.

Table 3

**Japanese Semiconductor Consumption Forecast  
Yearly Growth Rates for 1987-1993  
(Billions of Yen)**

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Total Semiconductor	9.0%	20.5%	15.0%	(1.3%)	15.6%	19.8%	33.2%
Total IC	10.9%	23.6%	16.3%	(1.4%)	16.5%	21.4%	37.5%
Bipolar Digital	4.1%	5.0%	(4.0%)	(3.8%)	4.7%	8.6%	12.2%
Memory	15.9%	24.5%	(4.2%)	(2.7%)	(3.3%)	(9.1%)	(5.1%)
Logic	2.3%	1.7%	(3.9%)	(4.0%)	6.4%	12.0%	14.9%
MOS Digital	16.4%	40.7%	23.3%	(2.3%)	18.6%	24.5%	46.0%
Memory	12.5%	64.6%	38.6%	(6.5%)	16.0%	25.0%	65.0%
Micro	19.9%	20.8%	11.3%	3.4%	19.1%	23.0%	32.0%
Logic	17.7%	33.5%	13.5%	(0.4%)	21.9%	25.0%	30.9%
Analog	4.5%	(0.8%)	7.2%	2.7%	15.0%	16.6%	18.4%
Discrete	4.0%	5.2%	7.4%	(2.5%)	11.7%	13.2%	15.8%
Optoelectronic	3.3%	26.5%	17.9%	2.2%	14.0%	15.0%	17.0%
Exchange Rate Yen/\$	144	128	128	128	128	128	128

Table 4

**Japanese Semiconductor Consumption Forecast  
Yearly Growth Rates for 1987-1993  
(Millions of U.S. Dollars)**

	<u>1987</u>	<u>1988</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>	<u>1993</u>
Total Semiconductor	26.5%	35.6%	14.9%	(1.3%)	15.6%	19.8%	33.2%
Total IC	28.6%	39.1%	16.2%	(1.4%)	16.5%	21.4%	37.5%
Bipolar Digital	20.7%	18.3%	(4.1%)	(3.8%)	4.7%	8.6%	12.2%
Memory	34.3%	40.1%	(4.1%)	(2.6%)	(3.4%)	(9.1%)	(5.0%)
Logic	18.7%	14.6%	(4.0%)	(4.0%)	6.4%	12.0%	14.9%
MOS Digital	35.0%	58.4%	23.2%	(2.4%)	18.6%	24.5%	46.0%
Memory	30.5%	85.4%	38.5%	(6.5%)	16.0%	25.0%	65.0%
Micro	39.0%	35.9%	11.2%	3.4%	19.1%	23.0%	32.0%
Logic	36.5%	50.3%	13.5%	(0.4%)	21.9%	25.0%	30.9%
Analog	21.1%	11.7%	7.1%	2.7%	15.0%	16.6%	18.4%
Discrete	20.6%	18.5%	7.3%	(2.5%)	11.7%	13.2%	15.8%
Optoelectronic	19.7%	42.3%	17.9%	2.2%	14.0%	15.0%	17.0%
Exchange Rate Yen/\$	144	128	128	128	128	128	128

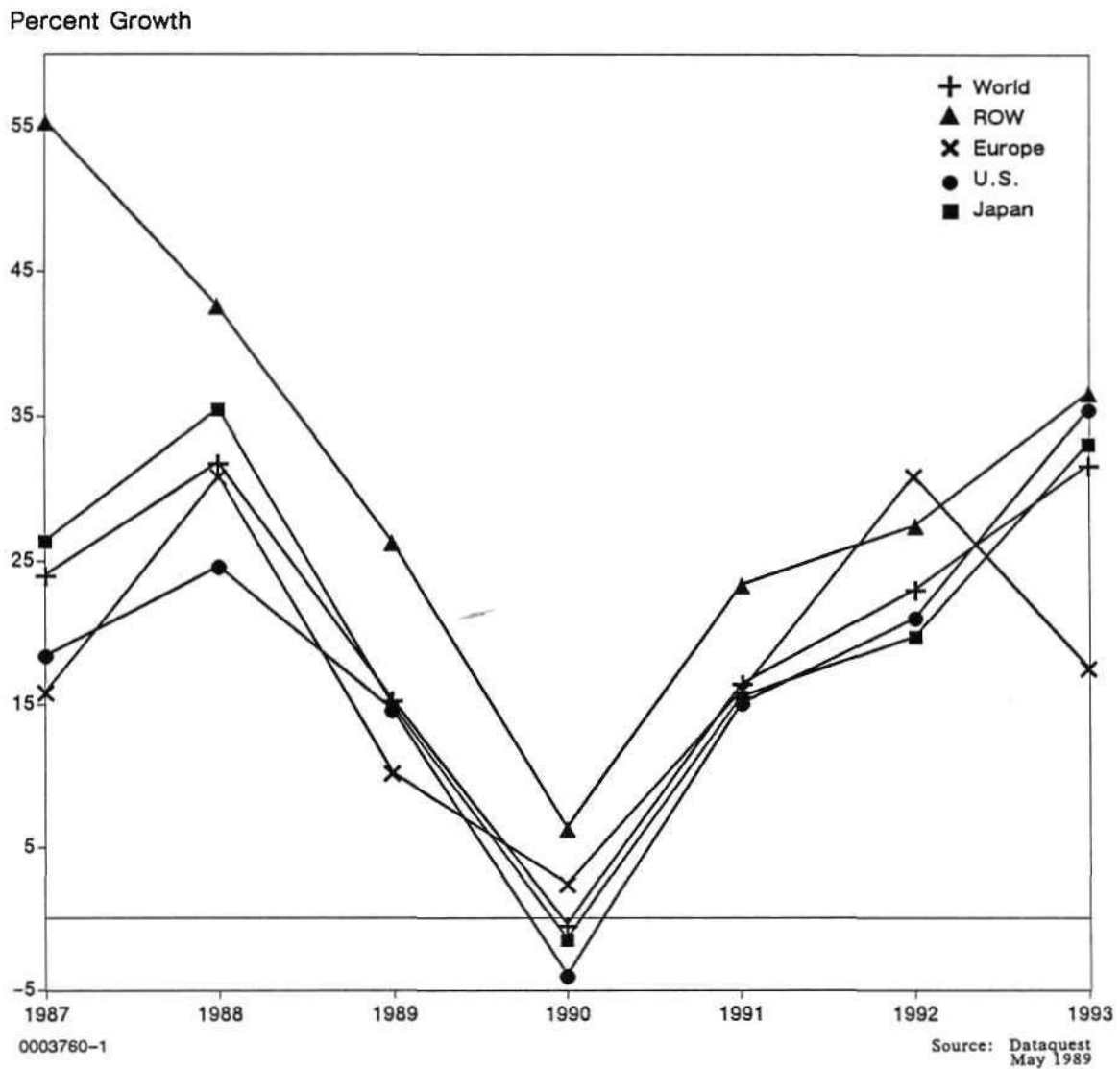
Source: Dataquest  
May 1989

## Global Semiconductor Forecast

Figure 1 shows the Japanese semiconductor forecast as it relates to the Rest of World (ROW) region. As expected, ROW is the highest growth region, with a CAGR from 1988 through 1993 of 24 percent.

Figure 1

### Worldwide Semiconductor Forecast Growth Rates by Region (Percent Growth Based on U.S. Dollars)



## **DATAQUEST RECOMMENDATIONS**

The semiconductor market in Japan remains strong, with the fastest growth of any region except ROW in both 1988 and 1989. Dataquest recommends that suppliers keep a close watch on the following areas:

- Domestic demand for computer equipment and related peripherals for both the home and the office
- Impact of HDTV and digital equipment in the 1992 to 1993 time frame
- Globalization of manufacturing, bringing new competition and increasing capacity
- Continued high growth in memory devices, which are expected to remain the high growth product for the next three years

Bridget O'Brian  
Hideaki Nemoto

# Research *Bulletin*

JSAM Code: 1988-1989 Newsletters: January  
1989-1  
0002471

## WHERE ARE SEMICONDUCTORS CONSUMED IN JAPAN?

This Research Bulletin summarizes Dataquest's estimates of 1988 Japanese semiconductor consumption by 47 provinces. Table 1 shows our estimate of the 10 largest semiconductor-consuming provinces, which account for 77 percent of Japan's semiconductor consumption. The top 5 represent 55 percent of the total. Kanagawa and Tokyo, ranked first and second, respectively, are major bases for electronics production and absorb 33 percent of the total consumption. In particular, Kanagawa boasts a 32 percent share of Japan's personal computer production and 18 percent of the country's VCR production.

Table 1

### 1988 Japanese Semiconductor Consumption by Province (Billions of Yen)

<u>Rank</u>	<u>Province</u>	<u>Consumption</u>	<u>Percentage of Total Consumption</u>
1	Kanagawa	441	17.3%
2	Tokyo	405	15.9%
3	Shizuoka	282	11.1%
4	Osaka	143	5.6%
5	Shiga	137	5.4%
6	Ibaraki	124	4.9%
7	Tochigi	122	4.8%
8	Aichi	120	4.7%
9	Nagano	97	3.8%
10	Saitama	96	3.8%

Source: Dataquest  
January 1989

Figure 1 illustrates percentage shares of semiconductor consumption by region. Of the seven regions shown in the figure, the three regions containing Tokyo, Nagoya, and Osaka consume the lion's share of semiconductors, or 91 percent of the total. These regions have 30 VCR production facilities, which produce 69 percent of the national production, and 20 PC plants, which manufacture an overwhelming 97 percent of the PCs produced in Japan.

Hideaki Nemoto

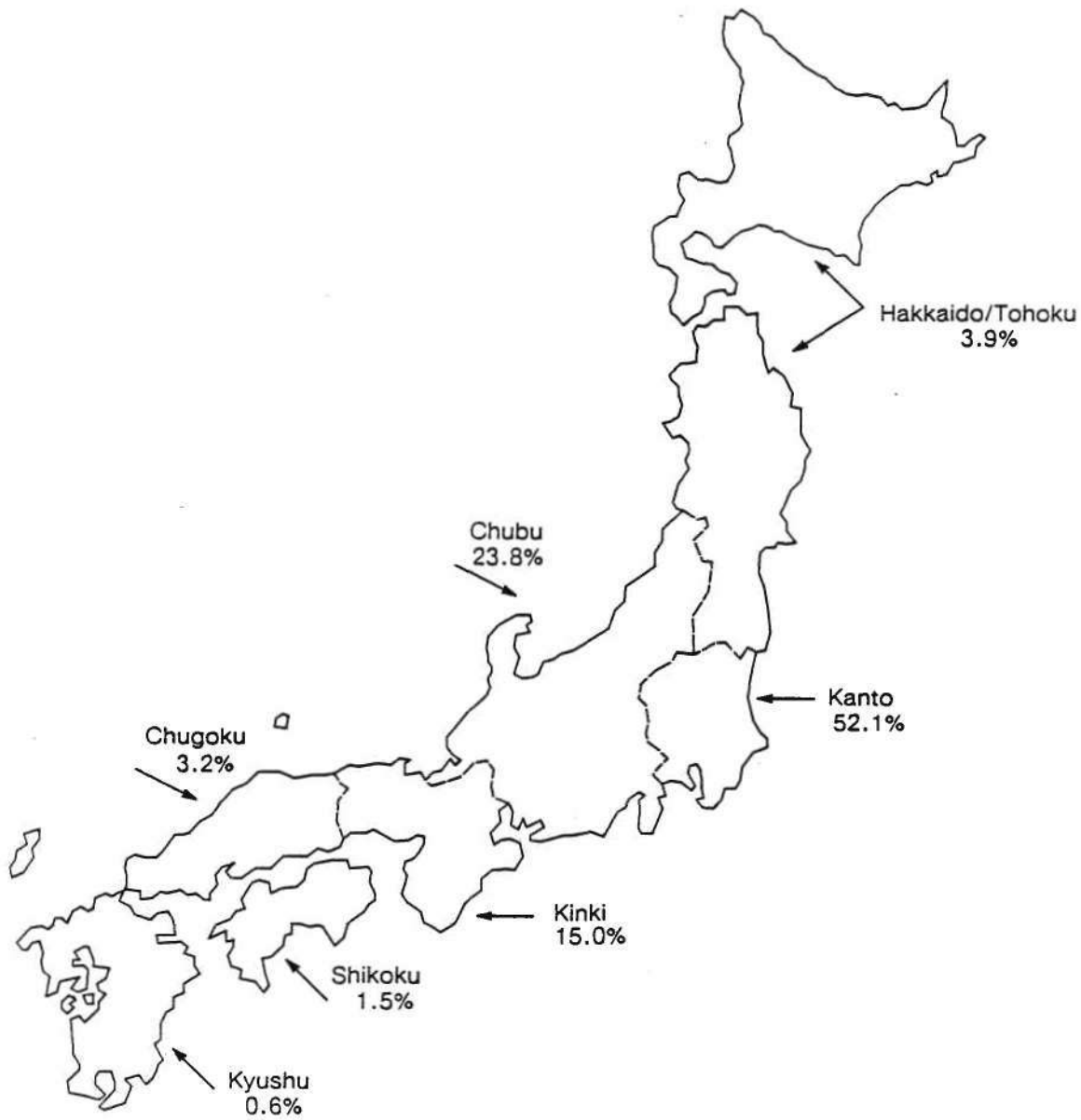
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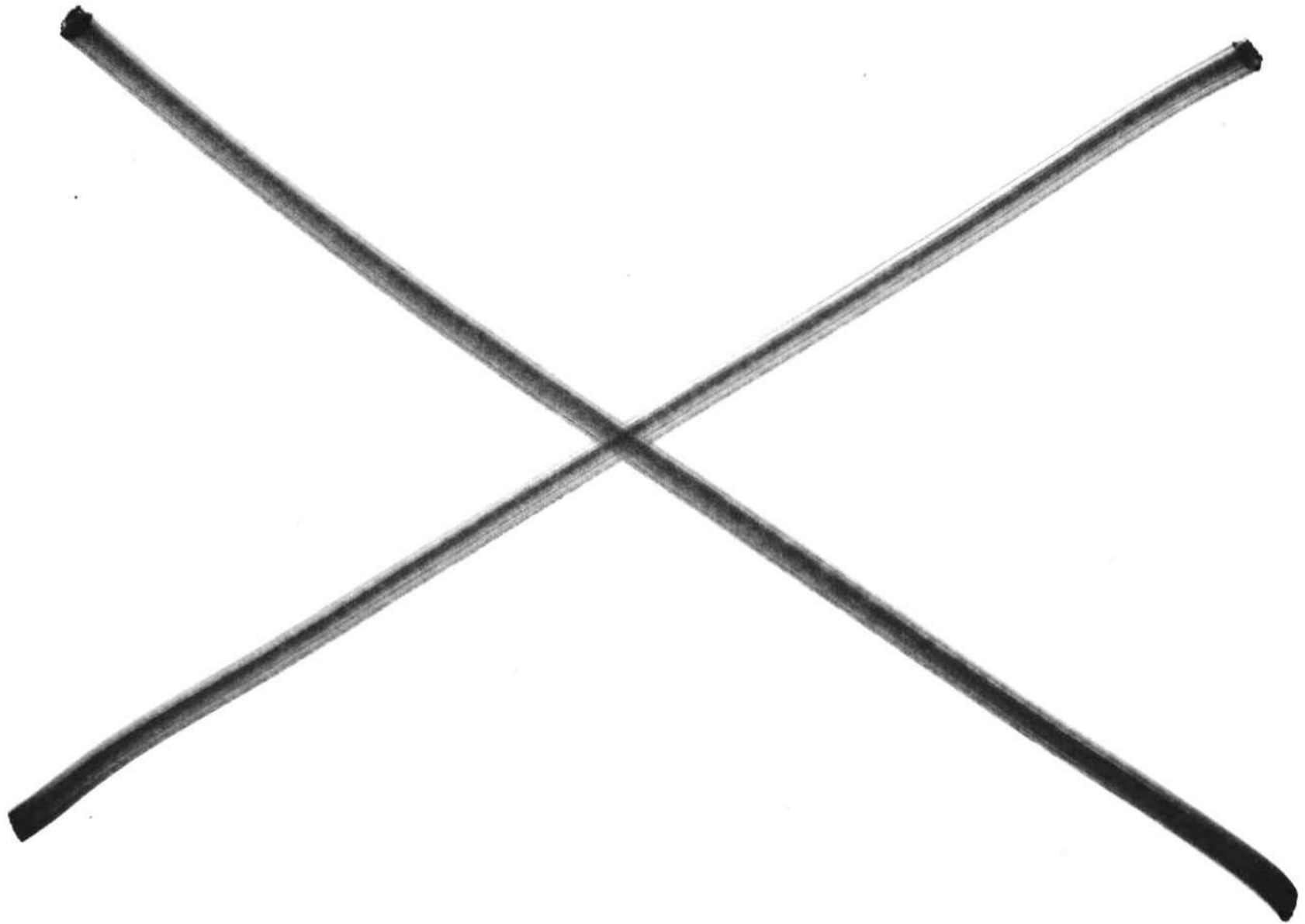
Figure 1

1988 Japanese Semiconductor Consumption by Region



0002471-1

Source: Dataquest  
January 1989



## 1988 JSAM Newsletter Index

The enclosed JSAM Newsletter Index is a quick reference guide to the JSAM 1988 newsletters. It is structured as follows:

- o Titles are organized by both subject and company.
  - The first part is a company list, e.g., LSI Logic.
  - The second part is a subject list, e.g., Memory.
- o The newsletter month and year follow each title listing in the index. Refer to the month tab to locate a specific newsletter.

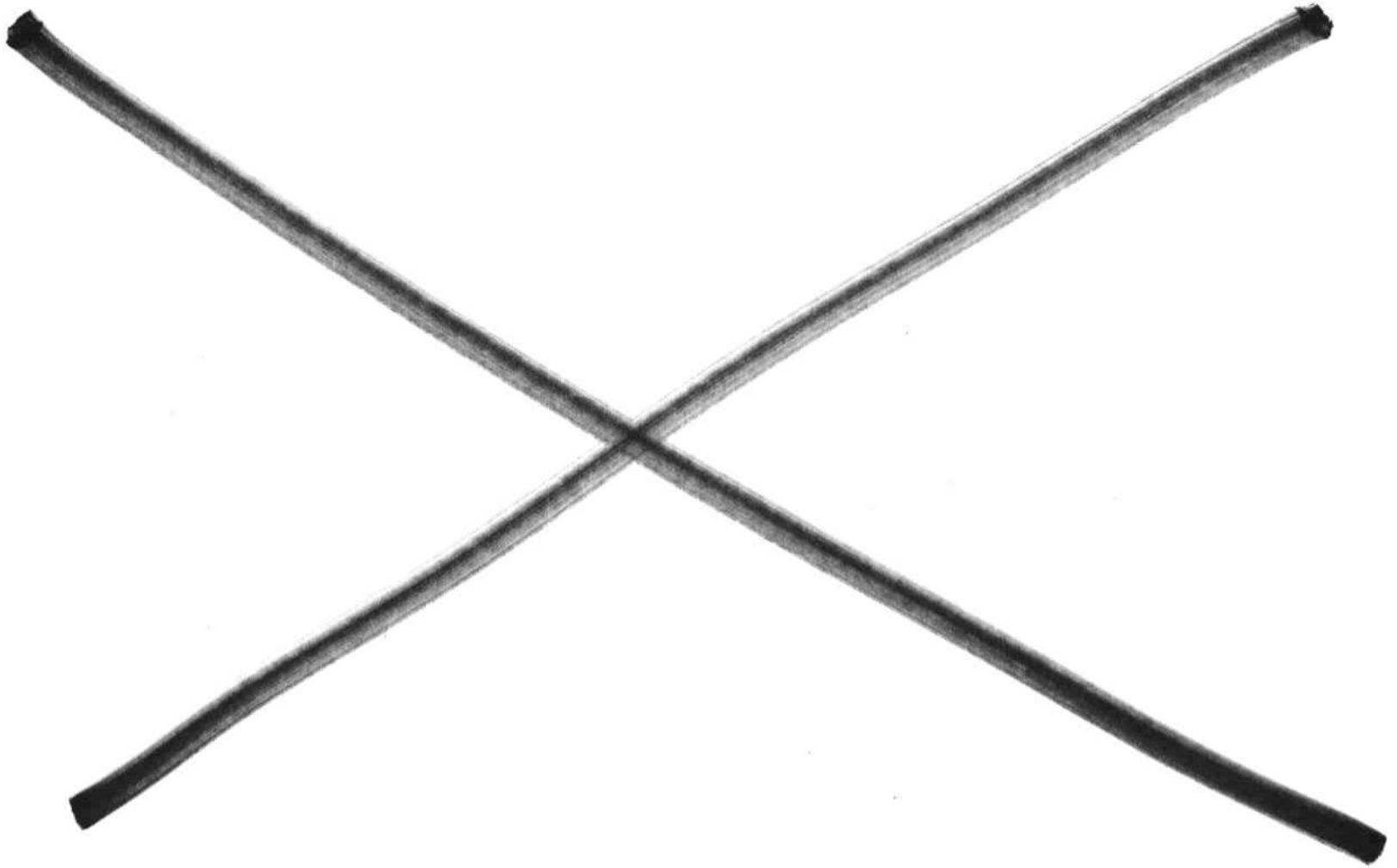
This index is updated quarterly.

## 1988 JSAM Newsletter Index

Company	Newsletter	Date
FUJITSU LTD.		
Sun Tsunami Hits Japan and Fujitsu Catches the Wave		Dec. 88
SUN MICROSYSTEMS INC.		
Sun Tsunami Hits Japan and Fujitsu Catches the Wave		Dec. 88

## 1988 JSAM Newsletter Index

Subject	Newsletter	Date
ALLIANCES		
Sun Tsunami Hits Japan and Fujitsu Catches the Wave		Dec. 88
COMMUNICATIONS		
Japanese Facsimile Production Overview: A Rapidly Growing Market		Aug. 88
EDP		
Sun Tsunami Hits Japan and Fujitsu Catches the Wave		Dec. 88



# Research Newsletter

JSAM Code: Newsletters  
1988-1  
0001181

## JAPANESE FACSIMILE PRODUCTION OVERVIEW: A RAPIDLY GROWING MARKET FOR SEMICONDUCTORS

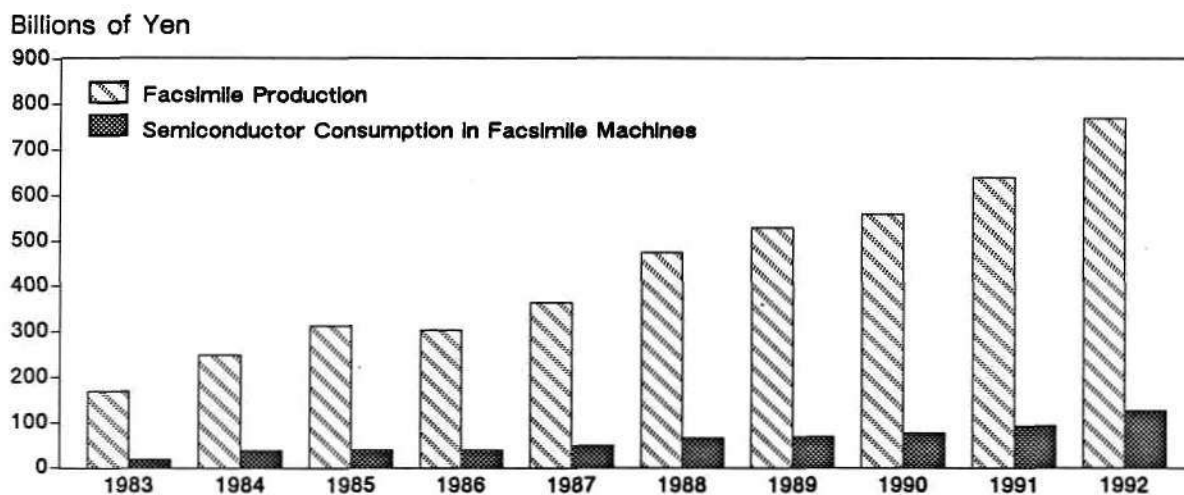
### INTRODUCTION

Facsimile production in Japan is gathering momentum because of vigorous exports to the United States and Europe and pervasiveness into small business in the Japanese domestic market. Dataquest anticipates that the worldwide facsimile market will remain one of the fastest growing telecommunications market segments over the next several years. In terms of unit shipments, we believe that the worldwide facsimile market will increase by a 30 percent compound annual growth rate (CAGR) from 1988 through 1993.

This newsletter will focus on the production of facsimiles in Japan—which dominates the worldwide market—and the semiconductor content of the facsimiles produced in 1988. As shown in Figure 1, 1987's facsimile production in Japan reached

Figure 1

### Japanese Facsimile Production Forecast (Billions of Yen)



Source: Dataquest  
August 1988

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¥365 billion (\$2.53 billion), a 20.5 percent increase over 1986. Dataquest estimates that it will reach ¥475 billion in 1988, growing 30.1 percent. Dataquest forecasts that facsimile production will reach ¥770 billion (\$6.16 billion) in 1992. This vigorous production activity will offer major opportunities for the semiconductor industry. We estimate that semiconductor consumption in Japanese-produced facsimiles will be ¥66.5 billion (\$532 billion) for 1988 alone.

## FACSIMILE PRODUCTION IN JAPAN

Table 1 lists the Japanese facsimile manufacturers, which we believe account for approximately 100 percent of the total facsimile production in Japan. We estimate that the top 5 manufacturers are Ricoh, Matsushita Communication, NEC, Toshiba, and Canon.

**Table 1**  
**Facsimile Manufacturers in Japan**

<u>Manufacturer</u>	<u>Plant Location</u>
Canon	Ami, Ibaraki
Fujitsu	Kanuma, Tochigi
Fuji Xerox	Iwatsuki, Saitama
Hitachi	Totsuka, Kanagawa
Matsushita Communication	Nagano, Nagano
	Shonan, Kanagawa
	Meguro, Tokyo
Mitsubishi Electric	Kyoto, Kyoto
Murata	Inuyama, Aichi
NEC	Shizuoka, Shizuoka
Oki Electric	Honjyo, Saitama
Ricoh	Atsugi, Kanagawa
	Saitama
Sharp	Nara, Nara
Toshiba	Hino, Tokyo

Source: Dataquest  
August 1988



It is also important to take note of the significant amount of Japanese manufacturers' overseas production. The high yen and fear of trade barriers such as tariffs and import restrictions by the European Economic Community have forced Japanese facsimile manufacturers to accelerate overseas production since 1986. It is estimated that overseas production for 1988 will total 750,000 units. Table 2 shows Japanese facsimile manufacturers' overseas plant locations.

**Table 2**

**Japanese Facsimile Manufacturers' Overseas Plants**

<u>Manufacturer</u>	<u>Plant Location</u>
Canon	France
Fuji Xerox	Korea
Matsushita Communication	United States
	Singapore
NEC	Mexico
	Brazil
	Oregon, United States
	Telford, United Kingdom
Oki Electric	Shanghai, People's Republic of China
	Scotland
Ricoh	United States
	United Kingdom
	Korea
	France (Planned)
Toshiba	Shanghai, People's Republic of China

Source: Dataquest  
August 1988

## SEMICONDUCTOR CONTENT

Table 3 shows Dataquest's estimates of the semiconductor content of midrange and low-end facsimile machines.

**Table 3**  
**Estimated Semiconductor Content of Standard Facsimile Machines**

<u>Components</u>	<u>G-III Midrange Model Quantity (Units)</u>	<u>G-III Low-End Model Quantity (Units)</u>
<b>Integrated Circuits</b>		
256K SRAM	1	0
64K SRAM	0	1
512K EPROM	1	0
256K EPROM	0	1
MPU	1	1
MCU	2	0
Standard Logic	20	10
Gate Array	2	2
Modem IC	1	1
Watch IC	1	0
Linear IC	10	10
<b>Optoelectronic</b>		
CCD	1	1
LED Array	1	1
<b>Discrete Components</b>	<b>57</b>	<b>51</b>
<b>Total Semiconductor Cost (A)</b>	<b>¥ 18,850</b>	<b>¥15,550</b>
<b>Facsimile Production Cost per Unit (B)</b>	<b>¥143,300</b>	<b>¥87,000</b>
<b>I/O Ratio (A/B)</b>	<b>13.2%</b>	<b>17.9%</b>

Source: Dataquest  
August 1988

Customization of ICs has reduced the number of standard logic and analog ICs used in facsimiles. By contrast, usage of high-density memory devices has been increasing, mainly in high-end models. Facsimiles equipped with laser beam printers use more than 50 256K DRAMs each. G-IV machines, to be standardized by the end of this year, are believed to use 3 ISDN (Integrated Services Digital Network) ICs each.

## DATAQUEST ANALYSIS

Dataquest estimates that facsimile production in Japan will maintain a high growth rate through 1992. The advent of the ISDN era will stimulate demand for expensive G-IV machines. In addition, we expect low-end machines to penetrate not only small businesses, but executive desktops as well. From the standpoint of the semiconductor industry, we can expect that memory functions such as store-and-forward capabilities and the entrance into the market of facsimiles equipped with laser beam printers will continue to propel memory device consumption.

Japanese manufacturers dominate the worldwide facsimile market with a 98 percent share of worldwide production. This situation will not change for the foreseeable future as Japanese manufacturers continue to improve facsimile production techniques through advances in semiconductor technology.

Hideaki Nemoto  
Osamu Ohtake

# Research Newsletter

JSAM Code: 1988-1989 Newsletters: October-December  
1988-2  
0002054

## SUN TSUNAMI HITS JAPAN AND FUJITSU CATCHES THE WAVE

### SUMMARY

Sun fever rages on in Japan. In a highly strategic move, Sun Microsystems announced a five-year, \$280 million original equipment manufacturer (OEM) agreement with Fujitsu Limited. Fujitsu expects to sell a minimum of 15,000 Sun workstations and servers over the next three years, marketing them as the "S Family," along with its own "G Series" of technical workstations. Fujitsu Microelectronics, a subsidiary of the Tokyo-based giant, currently manufactures Sun's SPARC (Scalable Processor Architecture) RISC chip, the microprocessor of the Sun-4 workstation.

In this newsletter, Dataquest briefly analyzes the Fujitsu-Sun alliance in terms of its mutual leveraging potential, as well as its impact in the following areas:

- Sun's global positioning and distribution channels
- Fujitsu's competitive position and platform strategy in the Japanese technical workstation and CAD/CAM markets

### THE FUJITSU-SUN ALLIANCE

#### Sun's Global Positioning

Sun has been upscaling its Japan operations recently; Nihon Sun's staff now numbers approximately 120 employees. Their direct sales force focuses on the university, R&D, and nonprofit organizations. Nihon Sun claims annual growth of 100 percent. Sun's technical workstation sales across all applications totaled \$95 million (3,712 units) in 1987 compared with rival Apollo's sales of \$45 million (2,200 units). (In the Japanese CAD/CAM market, however, the competition between Apollo and Sun is closer: Apollo's unit sales lead Sun's by 821 workstations to 571, although their respective market share is much closer, as shown in Table 1.)

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Table 1

1987 Japan CAD/CAM Market Share

<u>Rank</u>	<u>Company</u>	<u>1987 Revenue (\$M)</u>	<u>Market Share</u>
1	IBM	\$ 352.7	17.8%
2	Fujitsu	\$ 158.0	8.0%
3	Digital	\$ 146.0	7.4%
4	Hitachi	\$ 124.0	6.3%
5	NEC	\$ 123.0	6.2%
13	Mentor	\$ 42.7	2.2%
22	Sun	\$ 16.5	0.8%
23	Apollo	\$ 16.0	0.8%
Total Market		\$1,976.4	100.0%

Source: Dataquest  
December 1988

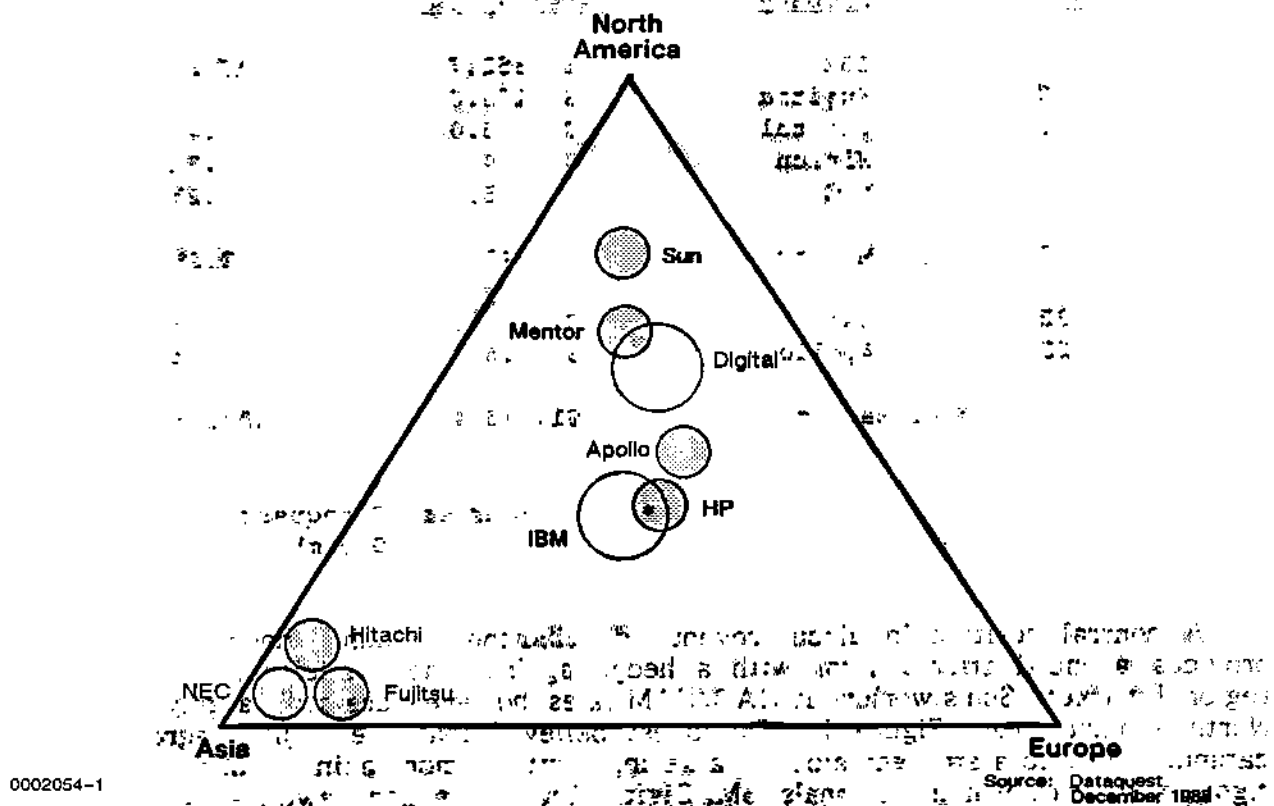
A central position in global revenue distribution is highly desirable in that it provides a multinational firm with a hedge against the cyclicity in any particular regional market. Sun's worldwide CAD/CAM sales, however, are still largely centered in North America (see Figure 1). Dataquest believes that the Fujitsu agreement will catapult Sun into a stronger global marketing position, more akin to that of Apollo and right on the trail of multinationals IBM, Digital Equipment, and Hewlett-Packard.

By Dataquest's count, Fujitsu is the most successful domestic vendor of CAD/CAM hardware in Japan. Dataquest research shows that major CAD/CAM purchasers in Japan first standardize on a hardware vendor and afterward select the application-software suppliers. Fujitsu is able to pull Sun into a more central position internationally, essentially because the choice of hardware vendor has already been made. Sun, in essence, becomes Fujitsu's adopted heir, acquiring access to its vast mainframe user empire.

This agreement completes Sun's strategy of recruiting as many partners in Japan as possible, blanketing the market with sales and support channels. Sun products are currently distributed by C. Itoh Techno-Science Company, Ltd., as well as having OEM arrangements with Nippon Steel, Tokyo Electron (TEL), and Toshiba. By contrast, Apollo distributes through its own Japanese subsidiary and indirectly through CAE vendor Mentor Graphics. Sun's Fujitsu alliance provides customers with excellent support from a local vendor that is widely respected as Japan's technology leader. The Fujitsu-Sun alliance now closes the loop from chip manufacture, to UNIX software design, to distribution and support—in short, the classic Japanese formula for success: tight vertical integration.

Figure 1

Geographical Balance of 1987  
CAD/CAM Revenue for Nine Key Players



As shown in Figure 1, a company with perfect global balance of revenue would plot at the center of gravity, marked by the asterisk (\*). A company with solely a North American source of sales revenue would plot at the top vertex of the triangle. Similarly, a company with predominantly Asian revenue would plot at the leftmost vertex. The size of each circle is grossly related to total CAD/CAM revenue. See Appendix A Table A-1 for a more detailed breakout of company revenue.)

### Fujitsu's Competitive Position

Fujitsu gains significantly in other ways as well. A late entrant into the technical workstation arena in third quarter 1987, Fujitsu workstation sales trail those of rivals NEC and Sony, which introduced their products much earlier, in 1986. The 1987 technical workstation shipment numbers underscore the lead held by these two suppliers: across all applications, Fujitsu shipped only 330 technical workstations (\$7 million), compared with NEC's 1,300 units (\$35 million) and Sony's 3,712 (\$68 million).

Fujitsu's technical workstation platform currently lacks the high-performance 3-D graphics required for certain CAD/CAM applications, as well as a rich catalog of third-party supplied software—an area for which Sun is justly renowned. The agreement allows Fujitsu time to become a full-line supplier like rival NEC—filling in its product line from supercomputer to PC, while satisfying customer demands for a more Sun-like product. It also significantly enhances Fujitsu's competitive position in the Japanese workstation market, particularly against NEC, which at this time is without a 3-D workstation product.

## DATAQUEST ANALYSIS

Dataquest believes that the Japanese technical workstation explosion has hit Japan. Pent-up user demand to migrate from mainframes to distributed processing networks on newer-generation technical workstations has resulted in a shift over the past two years from single-system buys to large-volume purchases. Success in this market, however, will not be determined solely by hardware performance and adherence to standards. As Japanese users begin considering these large-volume orders, the vendor's reliability and ability to deliver service and support will become key considerations. Applications support, distribution relationships, and marketing programs, therefore, are equally critical factors for success.

What we see in the Fujitsu-Sun agreement are indications of a win-win situation developing—strong technology coupled with strong local support. Obviously, much depends on how the partnership is executed.

We foresee no short-term negative impact on Sun's existing distributors, whose marketing strategies, by agreement, are complementary. CAD/CAM vendors that are already ported to the Sun clearly now have a stronger opportunity to penetrate the Japanese market, if they so choose.

Nevertheless, the following questions remain unanswered at this time:

- How will marketing responsibility be split between the two allies?
- How fast will Fujitsu move to incorporate Sun's Network File Server (NFS) on its own G-200 workstations (as have NEC and Sony), thereby leveraging Sun's growing Japanese network? (Fujitsu and Sun are expected to announce a technology alliance to localize Sun's SunLink products to the Fujitsu product line—much as Sun did with IBM.)
- Will Sun's almost certain success in Japan pressure the few remaining Sun hold-outs (e.g., Applicon, Intergraph, and Mentor Graphics) to port to the Sun?
- Will Sun further leverage Fujitsu's manufacturing capacity to achieve even greater profitability in the Japanese market? (Manufacturing rights are not included in the current agreement.)

Fujitsu will gain significant technological and material advantages from this new relationship. Even if Fujitsu's own workstation product falters, the company's manufacturing assembly lines, we suspect, will not be idle.

(This document is reprinted with the permission of Dataquest's CAD/CAM Industry Service. Dataquest's CAD/CAM Industry Service publishes an entire Asian binder with in-depth analyses, market shares, and forecasts for the Asian CAD/CAM market.)

David Norman  
Tony Spadarella

Japan's leading technology companies believe that the Japanese technology industry will continue to dominate the world market for a long time. This is because the Japanese technology industry has a long history of success in developing and manufacturing high-quality products. The Japanese technology industry has a strong tradition of innovation and research and development. This has allowed the Japanese technology industry to stay ahead of the competition in many areas, including semiconductors, computers, and telecommunications. The Japanese technology industry is also known for its high level of quality control and reliability. This has made Japanese products popular around the world. The Japanese technology industry is expected to continue to grow and dominate the world market for many years to come.

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## Appendix A

Table A-1

### Distribution of 1987 Worldwide CAD/CAM Revenue for Selected Companies

<u>Company</u>	<u>Total 1987 Worldwide CAD/CAM Revenue (\$M)</u>	<u>North American Share</u>	<u>European Share</u>	<u>Far Eastern Share</u>
IBM	\$1,354	39%	28%	33%
Digital	\$ 910	53%	26%	21%
Mentor	\$ 213	54%	25%	21%
Apollo	\$ 201	38%	38%	24%
Hewlett-Packard	\$ 154	34%	38%	27%
Fujitsu	\$ 158	0	0	100%
Hitachi	\$ 124	0	0	100%
NEC	\$ 123	0	0	100%
Sun*	\$ 110	68%	15%	17%

\*The geographical distribution of Sun's total fiscal year 1988 sales for all applications (including CAD/CAM, CASE, technical publishing and artificial intelligence) is similar: North America = 62 percent, Europe = 23 percent, and Asia = 15 percent.

Source: Dataquest  
December 1988

