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SEMICONDUCTOR EQUIPMENT MANUFACTURING AND MATERIALS SERVICE

COMPANY BACKGROUNDERS

Air Products and Chemicals, Inc.

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Fax: (215) 481-5800
Dun's Number: 00-300-1070

Date Founded: 1940

CORPORATE STRATEGIC DIRECTION

Air Products and Chemicals, Inc., consists of four segments: industrial gases, chemicals, environmental and energy, and equipment and technology. The industrial gases segment produces and distributes industrial gases such as oxygen, nitrogen, argon, and hydrogen, and a variety of medical and specialty gases. Air Products is the fourth largest industrial gas manufacturer in the world. The chemicals segment produces industrial and specialty chemicals used in adhesives, coatings, polyurethane, herbicides, pesticides, and water treatment chemicals. The environmental and energy segment includes activities in cogeneration, flue gas desulfurization, and waste-to-energy conversion, as well as landfill gas recovery and wastewater treatment. The equipment and technology segment supplies cryogenic process equipment, including air separation equipment and liquid natural gas heat exchange equipment.

The Company's total revenue increased 8.6 percent to $2.6 billion* in fiscal year 1989, from $2.4 billion in fiscal year 1988. Air Products attributed the rise in revenue to the strengthened demand for industrial gases and strategic chemicals, resulting in record shipments in most major product lines. Net income reached $222.1 million for fiscal 1989, resulting in a growth rate of 3.9 percent over fiscal 1988. Air Products employs 14,100 people.

Air Products' sales are concentrated in the North American region. Revenue from North American sales accounted for 78.0, 76.0, and 76.4 percent for fiscal year 1987, 1988, and 1989. Revenue from international sales accounted for 23.6 percent during fiscal 1989, of which 85.4 percent was from European sales.

*All dollar amounts are in US dollars.

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.

BUSINESS SEGMENT STRATEGIC DIRECTION

Industrial Gases

The principal industrial gases sold by Air Products are oxygen, nitrogen, argon, hydrogen, carbon monoxide, and helium. All these gases are used heavily in the fabrication of semiconductors, steel, and chemicals. Medical and specialty gases are manufactured or blended by Air Products or purchased for resale. This segment accounts for 60 percent of the Company's sales and 80 percent of its profits.

Chemicals

Air Products' strategic chemical business can be grouped into three categories: polymer products (emulsions and polyvinyl alcohol), polyurethane intermediates and additives (dinitrotoluene, toluene diamine, catalysts, surfactants, and mold release agents), and amines and specialty additives (alkylamines and a line of amines used principally in crop protection and water treatment). The total sales from these three businesses constituted approximately 28 percent of the Company's consolidated sales in fiscal 1989. Other chemical businesses that contributed to 9 percent of the Company's consolidated sales over the past three years are acetic acid, ammonia, and ammonia products, methanol, and polyvinyl chloride resins.

Environmental and Energy

Air Products' environmental and energy segment consists of two joint ventures. American Ref-Fuel, established through a joint venture with Browning-Ferris, builds, owns, and operates trash-to-energy facilities. Pure Air, formed through a joint venture with Mitsubishi, designs and operates facilities to remove sulfur emissions from coal-fired utilities flue gas. Air Products also has an energy system component that builds, runs, and operates cogeneration facilities.

Equipment and Technology

Air Products' equipment and technology segment designs, manufactures, and supplies cryogenic process equipment used for air separation, gas processing, natural gas liquefaction, wastewater treatment, hydrogen purification, and nitrogen rejection.

Further Information

For more information about the Company's business segments, please contact the appropriate industry service.

Table 1
Five-Year Corporate Highlights (Thousands of U.S. Dollars)

	1985	1986	1987	1988	1989
Five-Year Revenue	$1,829,600.0	$1,941,500.0	$2,132,200.0	$2,431,900.0	$2,641,800.0
Percent Change	-	6.12	9.82	14.06	8.63
Capital Expenditure	$399,000.0	$407,000.0	$367,700.0	$556,400.0	$562,000.0
Percent of Revenue	21.81	20.96	17.25	22.88	21.27
R&D Expenditure	$51,107.0	$61,091.0	$56,530.0	$71,797.0	$71,403.0
Percent of Revenue	2.79	3.15	2.65	2.95	2.70
Number of Employees	12,500	12,700	12,100	13,300	14,100
Revenue ($K)/Employee	$146	$153	$176	$183	$187
Net Income	$143,484.0	$4,735.0	$155,587.0	$213,747.0	$222,137.0
Percent Change	-	(96.70)	3,185.89	37.38	3.93

1989 Calendar Year (US$M)	Q1	Q2	Q3	Q4
Quarterly Revenue	$668.94	$663.71	$668.62	$652.50
Quarterly Profit	$56.65	$53.36	$51.01	$49.40

Source: Air Products and Chemicals, Inc.
Annual Reports and Forms 10-K
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	86.28	80.41	77.97	76.03	76.43
International	13.72	19.59	22.03	23.97	23.57*

*For 1989, Europe contributed 85.4 percent and Canada and Latin America 14.6 percent of the international revenue.

Source: Air Products and Chemicals, Inc.
Annual Reports and Forms 10-K
Dataquest (1990)

Table 3
Revenue by Distribution Channel (Percent)

Channel	1988	1989
Direct Sales	90.00	90.00
Indirect Sales	10.00	10.00

Source: Air Products and Chemicals, Inc.
Annual Reports and Forms 10-K
Dataquest (1990)

1989 SALES OFFICE LOCATIONS

North America—66
Japan—3
Europe—19
Asia/Pacific—9
ROW—1

MANUFACTURING LOCATIONS

North America

United States
Alabama—Chunchula, Decatur, Flomaton, Irondale, Lowndesboro, Monroeville, Muscle Shoals
Arizona—Chandler, Phoenix
Arkansas—Ashdown
California—City of Industry, El Segundo, Galt, Hesperia, Lathrop, Long Beach, Mountain View, Sacramento, Santa Clara, Stockton, Golden
Colorado—Colorado Springs
District of Columbia—Washington
Florida—Fort Walton Beach, Jacksonville, Jay, Largo, Orlando, Pensacola
Georgia—Conyers
Illinois—Brookfield, Chicago, Granite City, Hennepin, LaSalle, Mount Zion
Indiana—Chesterton, South Bend
Iowa—Bettendorf, Cedar Rapids, Davenport, Des Moines, Sioux City
Kansas—Lenexa, Wichita
Kentucky—Ashland, Calvert City, Louisville, Russellville
Louisiana—Geismar, Luling, New Orleans, Plaquemine, Sorrento, St. Gabriel
Maryland—Elkton, Sparrows Point
Massachusetts—Hopkinton, Marlborough
Michigan—Detroit, Saginaw
Minnesota—Shakopee
Mississippi—Greenwood, Pass Christian
Missouri—Earth City
Nebraska—Lincoln, Omaha
New Jersey—Camden, Dayton, Iselin, Manalapan, Paulsboro, Wharton
New York—Fishkill, Glenmont, Lackawanna, Latham, Oswego, Rochester
North Carolina—Charlotte, Greensboro, Laurinburg, Reidsville, Research Triangle Park, Wilmington
Ohio—Cleveland, Middletown, North Baltimore
Oklahoma—Oklahoma City, Pryor
Oregon—Albany, Tualatin
Pennsylvania—Allentown, Butler, Creighton, Dravosburg, Lancaster, Lehigh Valley, Manchester, Marcus Hook, Meadville, Mt. Holly Springs, Tamaqua, Wilkes-Barre
South Carolina—Florence, Piedmont
South Dakota—Rapid City
Tennessee—Alcoa, Huntingdon, Kingsport, Memphis, Nashville, New Johnsonville
Texas—Arlington, Austin, Baytown, Conroe, Corpus Christi, Dallas, Deer Park, Garland, Gruver, La Porte, Lubbock, Midlothian, Pasadena, Wichita Falls
Utah—Centerville
Virginia—Hampton, Richmond
Washington—Puyallup
West Virginia—Apple Grove, Ceredo, Nitro, Proctor, Weirton
Wisconsin—Oak Creek
Wyoming—Evanston

Canada
Alberta—Calgary
British Columbia—Richmond
Manitoba—Winnipeg
Ontario—Brampton, Kanata, Nanticoke, Sarnia
Quebec—LaSalle

Europe

Belgium
Ghent, Vilvoorde
Netherlands
Terneuzen

Asia/Pacific

Australia
Fitzroy, Victoria
Korea
Seoul

ROW

Brazil
Casa Verde
Mexico
Estado De Mexico
Puerto Rico
Ponce

SUBSIDIARIES

North America

Air Products Canada Ltd.
Air Products Inc.
Air Products Manufacturing Corp.
Air Products Pacific, Inc.
Air Products Refuel Holdings Corp.
Cambria Co. Gen. (I), Inc.
Cambria Co. Gen. (II), Inc.
GSF Energy Inc.
Prodair Corp.
Pure Air on the Lake (I), Inc.
Pure Air on the Lake (II), Inc.
Stockton Co. Gen. (I), Inc.

Europe

Air Products (GB) Ltd.
Air Products (UK) Ltd.
Air Products GmbH
Air Products Gases Industrialis Ltda.
Air Products Gesellschaft m.b.H.
Air Products Ireland Limited
Air Products Italia S.p.A.
Air Products Netherlands B.V.
Air Products PLC
Air Products S.A.
Anchor Chemical Group PLC
Gardner Cryogenics A/S
Gardner Cryogenics Limited
Prodair S.A.

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1988

Akzo, NV
The companies undertook a joint venture to design and develop membrane systems for air separation. Air Products is to have exclusive worldwide rights to market all membrane systems resulting from this joint venture.

Super Oxygen Sdn. Bhd.
The companies undertook a joint venture to produce and market industrial gases in Malaysia.

Bangkok Industrial Gas Co., Ltd.
The companies have a joint venture for producing and marketing industrial gases in Thailand.

San Fu Chemical Co., Ltd.
The companies have a joint venture for producing and marketing industrial gases in Taiwan.

Athens Corporation
Under an agreement, Air Products is to mark Athens' chemical purification systems for semiconductor wafer cleaning and other applications.

1987

Chun Wang Industrial Gases
The companies undertook a joint venture to supply industrial gases in China and Hong Kong.

Mitsubishi Heavy Industries America, Inc.
The companies have a joint venture establishing Pure Air to market a technology that reduces sulfur emissions from coal-fired utilities.

MERGERS AND ACQUISITIONS

1989

Dow Corning
Air Products acquired Dow Corning's polyurethane silicone surfactant business.

Athens Corporation
Air Products acquired an equity interest in Athens, a firm with proprietary systems for processing chemicals used in manufacturing semiconductor wafers.

Trimont Chemicals
Air Products acquired Trimont Chemicals, which provides Air Products with new epoxy additives and increased manufacturing capacity.

1988

Valchem
Air Products acquired Valchem to add high-performance products to Air Products' polymer chemicals technology base. Valchem is to provide a line of water-based acrylic products.

Anchor Chemical Group
Air products acquired 70.5 percent of Anchor Chemical Group, giving Air Products a 100 percent holding. Air Products acquired 29.5 percent of Anchor in November 1987.

L'Oxygene Liquide
Air products acquired 65 percent interest in L'Oxygene Liquide, an important regional gas supplier in France.

1987

Anchor Chemical Group
Air products acquired 29.5 percent of Anchor Chemical.

KEY OFFICERS

Dexter F. Baker
Chairman of the board and chief executive officer

Leon C. Holt, Jr.
Vice chairman and chief administrative officer

Frank J. Ryan
President and chief operating officer

PRINCIPAL INVESTORS

Lazard Freres & Co.—5.30 percent
Oppenheimer & Co., L.P.—5.04 percent
Wellington Management Company—5.04 percent

Table 4
Comprehensive Financial Statement
Fiscal Year Ending September
(Thousands of U.S. Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$638,130.0	$581,629.0	$577,917.0	$626,271.0	$756,784.0
Cash	32,463.0	34,657.0	54,871.0	32,696.0	45,236.0
Receivables	381,516.0	273,598.0	289,917.0	344,707.0	377,295.0
Marketable Securities	13,762.0	81,998.0	41,764.0	3,518.0	4,266.0
Inventory	128,049.0	133,234.0	127,017.0	175,399.0	215,107.0
Other Current Assets	82,340.0	58,142.0	64,348.0	69,951.0	114,880.0
Net Property, Plants	$1,782,267.0	$1,818,158.0	$1,920,520.0	$2,061,642.0	$2,217,594.0
Other Assets	$173,058.0	$261,241.0	$206,694.0	$311,597.0	$391,330.0
Total Assets	$2,593,455.0	$2,661,028.0	$2,705,131.0	$2,999,510.0	$3,365,708.0
Total Current Liabilities	$493,179.0	$401,521.0	$433,411.0	$516,759.0	$494,477.0
Long-Term Debt	$520,839.0	$698,857.0	$616,389.0	$667,937.0	$853,710.0
Other Liabilities	$416,459.0	$460,509.0	$508,700.0	$542,572.0	$572,622.0
Total Liabilities	$1,430,477.0	$1,560,887.0	$1,558,500.0	$1,727,268.0	$1,920,809.0
Total Shareholders' Equity	$1,162,978.0	$1,100,141.0	$1,146,631.0	$1,272,242.0	$1,444,899.0
Converted Preferred Stock	NA	NA	NA	NA	NA
Common Stock	31,182.0	62,364.0	62,364.0	62,364.0	62,364.0
Other Equity	103,169.0	49,547.0	(9,048.0)	(36,873.0)	(17,086.0)
Retained Earnings	1,028,627.0	988,230.0	1,093,315.0	1,246,751.0	1,399,621.0
Total Liabilities and Shareholders' Equity	$2,593,455.0	$2,661,028.0	$2,705,131.0	$2,999,510.0	$3,365,708.0

Income Statement	1985	1986	1987	1988	1989
Revenue	$1,829,600.0	$1,941,500.0	$2,132,200.0	$2,431,900.0	$2,641,800.0
U.S. Revenue	1,578,500.0	1,561,100.0	1,662,400.0	1,849,000.0	2,019,200.0
Non-U.S. Revenue	251,100.0	380,400.0	469,800.0	582,900.0	622,600.0
Cost of Sales	$1,059,220.0	$1,146,089.0	$1,275,499.0	$1,451,508.0	$1,600,832.0
R&D Expense	$51,107.0	$61,091.0	$56,530.0	$71,797.0	$71,403.0
SG&A Expense	$472,972.0	$467,658.0	$486,732.0	$545,403.0	$609,997.0
Capital Expense	$399,000.0	$407,000.0	$367,700.0	$556,400.0	$562,000.0
Pretax Income	$217,693.0	$152,319.0	$242,859.0	$303,666.0	$321,495.0
Pretax Margin (%)	11.90	7.85	11.39	12.49	12.17
Effective Tax Rate (%)	33.50	29.80	34.30	29.60	30.90
Net Income	$143,484.0	$4,735.0	$155,587.0	$213,747.0	$222,137.0
Shares Outstanding, Millions	60,402.3	58,623.0	56,366.7	54,857.8	54,941.4
Per Share Data					
Earnings	$2.38	$0.08	$2.76	$3.90	$4.04
Dividend	$0.63	$0.77	$0.90	$1.10	$1.26
Book Value	$19.25	$18.77	$20.34	$23.19	$26.30

Table 4 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending September
(Thousands of U.S. Dollars, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	1.29	1.45	1.33	1.21	1.53
Quick (Times)	1.03	1.12	1.04	0.87	1.10
Fixed Assets/Equity (%)	153.25	165.27	167.49	162.05	153.48
Current Liabilities/Equity (%)	42.41	36.50	37.80	40.62	34.22
Total Liabilities/Equity (%)	123.00	141.88	135.92	135.77	132.94
Profitability (%)					
Return on Assets	-	0.18	5.80	7.49	6.98
Return on Equity	-	0.42	13.85	17.67	16.35
Profit Margin	7.84	0.24	7.30	8.79	8.41
Other Key Ratios					
R&D Spending % of Revenue	2.79	3.15	2.65	2.95	2.70
Capital Spending % of Revenue	21.81	20.96	17.25	22.88	21.27
Employees	12,500	12,700	12,100	13,300	14,100
Revenue ($K)/Employee	$106.00	$152.90	$176.20	$182.80	$187.40
Capital Spending % of Assets	15.38	15.29	13.59	18.55	16.70

NA = Not available

Source: Air Products and Chemicals, Inc.
Annual Reports and Forms 10-K
Dataquest (1990)

Anelva Corporation

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Telex: 2832558
Fax: Not Available
Dun's Number: 69-084-8478

Date Founded: 1967

CORPORATE STRATEGIC DIRECTION

Anelva Corporation is an experienced international specialist in vacuum technology, which is essential to semiconductor and electronic device production. Anelva stands for ANalysis, ELectronics, and VAcuum, which are the Company's main areas of concentration and innovation.

Anelva is focusing its R&D on thin-film manufacturing systems, peripheral equipment, and software. Beam technology and plasma technology have demanded continuous R&D support.

Because Anelva is a privately held company, no financial statements are included.

BUSINESS SEGMENT STRATEGIC DIRECTION

Anelva has two business segments: thin-film producing systems and analyzing systems. The thin-film producing systems consist of a wide range of products. They are suitable for a number of applications including small, experimental batch use, cassette-to-cassette fully automated systems, and online systems for mass production. These systems include the following:

- Sputtering systems, which produce high-quality metallic films, oxide films, and magnetic films by magnetron high-rate sputtering
- Reactive ion etching systems, which perform fine-line etching of films such as Al, Al-alloy, Al-oxide, and poly-Si
- Plasma-chemical vapor deposition (CVD) systems, which produce amorphous silicon films for solar batteries and silicon nitride films for thin-film transistors
- Molecular beam epitaxy (MBE) systems, which perform compound semiconductor MBE, Si-MBE, and a combination of multichamber and sample transport mechanisms
- Vacuum evaporators, which are a combination of an electronic beam gun and a planetary motion substrate holder

Analyzing systems are used at pure research centers for analysis and at commercial production facilities for quality control. These systems include the following:

- Gas analyzers, which include trace gas analyzers, which perform high-sensitivity and continuous analysis by a quadruple mass spectrometer
- Surface analyzers, which include an Auger Electron Spectrometer (AES) and a Secondary Ion Mass Spectrometer (SIMS)
- Vacuum pumps, which include cryo pumps, sputter ion pumps, oil diffusion pumps, and mechanical rotary pumps
- Vacuum components, which include ICF flanges and gaskets, valve viewing ports, electrical and motion feed-through components, fittings, and ion bombardment and electron-beam guns
- Gauges and controllers, which include vacuum gauges (low vacuum to UHV), film thickness monitors and deposition controllers, residual gas analyzers, and leak detectors
- Materials, which include sputtering targets and pump oil

Further Information

For further information about the Company's business segments, please contact the appropriate Dataquest industry service.

1989 SALES OFFICE LOCATIONS

North America—1
Asia/Pacific—2

MANUFACTURING LOCATIONS

North America

San Jose, California
Testing equipment, sputtering systems, and gas and surface analyzers

Asia/Pacific

Fuchu Factory, Japan
All products
Fuchu Higashi (East) Factory, Japan
All products
Fuji Plant, Japan
Sputtering systems, REI systems, and vacuum pumps

SUBSIDIARIES

Information is not available.

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

Information is not available.

MERGERS AND ACQUISITIONS

Information is not available.

KEY OFFICERS

J. Osawa
Chairman

Y. Morisada
President

Z. Oda
Executive director

Y. Sato
Director

S. Tsuneki
Director

R. W. Kane
Director

H. Kobayashi
Director

T. Inoue
Director

K. Takada
Director

R. Yamamoto
Director

PRINCIPAL INVESTORS

Information is not available.

FOUNDERS

Information is not available.

Applied Materials, Inc.

3050 Bowers Avenue
Santa Clara, California 95054-3299
Telephone: (408) 727-5555
Fax: (408) 748-9943
Dun's Number: 04-272-8840

Date Founded: 1967

CORPORATE STRATEGIC DIRECTION

Applied Materials, Inc., develops, manufactures, and markets semiconductor wafer fabrication equipment and related parts throughout the world. It produces systems for chemical vapor deposition (CVD) and epitaxial silicon deposition, dry plasma etching, and ion implantation.

The Company's total revenue increased 38.3 percent to $501.8 million* in fiscal year 1989, from $362.8 million in fiscal 1988. Applied Materials attributes this growth to the increasing demand for its products and its well-balanced geographic position. The Company's strategy is sales penetration of all global markets. For fiscal 1989, international sales revenue accounted for 65.2 percent of total revenue. Net income reached $51.5 million in fiscal 1989, up 28.7 percent from fiscal 1988. Applied Materials employs 2,651 full-time people.

Applied Materials' research and development efforts are aimed toward the development of new wafer processing systems and new process applications for existing products. Applied Materials commits itself to working closely with its customers worldwide to design its systems to meet the customers' planned technical and production requirements. The R&D facilities are located in the United States, England, and Japan. Applied Materials allocated $31.2 million, $43.5 million, and $72.3 million to R&D in the respective fiscal years 1987, 1988, and 1989. These amounts accounted for 17.9, 12.0, and 14.4 percent of the Company's total revenue those years.

In fiscal 1989, Applied Materials saw a 56 percent revenue growth in European sales. The Company anticipates another 30 percent increase in 1990. During fiscal 1989, European sales amounted to $75 million, and the European work force increased by more than 500 people. For 1990, Applied Materials plans to expand its operations in Italy to supply service and support for SGS-Thomson and Texas Instruments. It also plans to add Japanese-speaking sales and service representatives to work with Japanese companies that have announced wafer fab facilities in Europe. In March 1990, Applied Materials announced a new service center in Japan, representing the fourth to open there in the past year. Over the past two years, Applied Materials has increased sales to Japan by more than 400 percent.

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.

BUSINESS SEGMENT STRATEGIC DIRECTION

Deposition

One of the fundamental steps in fabricating a device is deposition, a process in which a layer of either electrically insulating (dielectric) or electrically conductive material is deposited on the wafer. Applied Materials manufactures CVD and epitaxial silicon deposition systems. The CVD product line consists of film applications based on the Precision 5000 architecture, with capabilities in such areas as interlayer dielectrics (ILD), intermetal dielectrics (IMD), passivation nitrides, and tungsten CVDs (WCVDs). Epitaxial deposition involves depositing a

*All dollar amounts are in U.S. dollars.

layer of high-quality, single crystal silicon on the surface of an existing silicon wafer to change its electrical properties and form the base on which an integrated circuit is built. In May 1989, Applied Materials announced the Precision 7700 epi system for advanced silicon deposition. According to Dataquest estimates, Applied Materials held 31.7 percent of the nontube CVD worldwide market and 55.9 percent of the silicon epitaxy worldwide market in 1988.

Dry Etch

The Precision 5000 Etch system, an extension of the Precision 5000 architecture, is designed specifically for low-pressure, magnetically enhanced reactive ion etching (MERIE) of submicron features in films such as single-crystal silicon, polysilicon, and oxide. In May 1989, Applied Materials unveiled a new critical oxide etch process for its Precision 5000 Etch system, enabling the extension of Applied Materials' MERIE technology to sub-halfmicron oxide contacts. Dataquest estimates that Applied Materials captured 36 percent of the dry etch worldwide market in 1988.

Implant

In 1985, Applied Materials entered the high-current portion of the implant market. The Precision Implant 9200 was introduced in April 1988. It has been upgraded with the new option of enabling automated selection of implant angles and new hardware/software options allowing customers to perform remote monitoring and diagnostics, as well as download process recipes, from outside the fab. In 1988, Applied Materials had 10 percent of the high-current ion implant worldwide market, according to Dataquest's 1988 figures.

Further Information

For more information about the Company's business segments, please contact the appropriate industry service.

Table 1
Five-Year Corporate Highlights (Thousands of U.S. Dollars)

	1985	1986	1987	1988	1989
Five-Year Revenue	$174,595.0	$149,261.0	$174,444.0	$362,758.0	$501,846.0
Percent Change	-	(14.51)	16.87	107.95	38.34
Capital Expenditure	$12,930.0	$11,541.0	$11,491.0	$19,821.0	$42,944.0
Percent of Revenue	7.41	7.73	6.59	5.46	8.56
R&D Expenditure	$31,519.0	$24,621.0	$31,204.0	$43,477.0	$72,296.0
Percent of Revenue	18.05	16.50	17.89	11.99	14.41
Number of Employees	1,359	1,415	1,406	1,765	2,651
Revenue ($K)/Employee	$128.50	$105.50	$124.10	$205.50	$189.30
Net Income	$9,270.0	$1,860.0	$336.0	$40,020.0	$51,484.0
Percent Change	-	(79.94)	(81.94)	11,810.71	28.65

1989 Calendar Year (US$M)*	Q1	Q2	Q3	Q4
Quarterly Revenue	$106.71	$122.77	$130.19	$142.18
Quarterly Profit	$13.50	$13.92	$12.53	$11.54

*Based on fiscal year rather than calendar year.

Source: Applied Materials, Inc.
Annual Reports and
Forms 10-K
Dataquest
1990

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	67.81	44.60	49.76	44.16	34.82
International	32.19	55.40	50.24	55.84	65.18
Japan	30.07	28.20	22.63	37.26	39.87
Europe	2.12	24.62	23.56	12.73	14.87
Asia/Pacific	0	2.58	4.05	5.85	10.44

Source: Applied Materials, Inc.
Annual Reports and
Forms 10-K
Dataquest
1990

Table 3
Revenue by Distribution Channel (Percent)

Channel	1988	1989
Direct Sales	100.00	100.00
Indirect Sales	0	0

Source: Dataquest
1990

1989 SALES OFFICE LOCATIONS

North America—12
Japan—11
Europe—9
Asia/Pacific—3
ROW—0

MANUFACTURING LOCATIONS

North America

Santa Clara, California
All products except ion implant

Japan

Narita, Chiba Prefecture
Chemical vapor deposition and system customization

Europe

Horsham, England
Ion implant

SUBSIDIARIES

North America

Applied Acquisition Subsidiary
Applied Implant Technology Inc.
Applied Materials International Inc.
ILT Inc.

Europe

Applied Materials Europe B.V.
Applied Materials International B.V.
Applied Materials Limited
Applied Materials Sarl
Applied Materials Technology Electronics G.m.b.H.

Asia/Pacific

Applied Materials Asia/Pacific Ltd.
Applied Materials Hong Kong Ltd.

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1989

Peak Systems
The companies made a strategic alliance involving a development and production contract focused on adding rapid thermal processing (RTP) to semiconductor processes available to the worldwide customers of Applied Materials' Precision 5000 system. As part of the agreement, Applied Materials will acquire 10 percent ownership of Peak Systems.

1988

Gasonics
The companies made a technology agreement to explore the integration of a microwave downstream photoresist stripping capability into Applied Materials' multichamber Precision 5000 Etch system.

KEY OFFICERS

James C. Morgan
Chairman and chief executive officer

James W. Bagley
President and chief operating officer

Dan Maydan
Executive vice president

Dana C. Ditmore
Vice president, Customer Service

Steve Lindsay
Vice president, Sales and Marketing

Howard L. Neff
Vice president, Corporate Operations

Peter R. Hanely
Group vice president, Customer Business Group

Tetsuo Iwasaki
Vice president; president, Applied Materials Japan

Sasson Somekh
Vice president, Applied Conductor Technology

John G. Stewart
Vice president, Applied Implant Technology

David N. K. Wang
Vice president, Chemical Vapor Deposition and Etch Technologies

PRINCIPAL INVESTORS

FMR Corporation—9.6 percent
Neuberger & Berman—5.5 percent
T. Rowe Price Associates, Inc.—5.5 percent

Table 4
Comprehensive Financial Statement
Fiscal Year Ending October
(Thousands of U.S. Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$107,482.0	$106,166.0	$179,159.0	$276,159.0	$342,944.0
Cash	35,674.0	21,796.0	44,815.0	58,219.0	57,426.0
Receivables	31,199.0	39,577.0	49,527.0	98,624.0	131,563.0
Marketable Securities	N/A	N/A	25,907.0	42,570.0	49,682.0
Inventory	30,857.0	36,039.0	47,139.0	53,757.0	77,015.0
Other Current Assets	9,752.0	8,754.0	11,771.0	22,989.0	27,258.0
Net Property, Plants	$35,718.0	$43,358.0	$47,039.0	$55,994.0	$82,127.0
Other Assets	$5,220.0	$6,614.0	$6,428.0	$7,055.0	$8,786.0
Total Assets	$148,420.0	$156,138.0	$232,626.0	$339,208.0	$433,857.0
Total Current Liabilities	$37,582.0	$32,384.0	$48,130.0	$116,985.0	$142,852.0
Long-Term Debt	$16,880.0	$19,615.0	$21,112.0	$11,346.0	$29,445.0
Other Liabilities	$7,532.0	$10,393.0	$9,776.0	$10,070.0	$7,161.0
Total Liabilities	$61,994.0	$62,392.0	$79,018.0	$138,401.0	$179,458.0
Total Shareholders' Equity	$86,426.0	$93,746.0	$153,608.0	$200,807.0	$254,399.0
Converted Preferred Stock	N/A	N/A	N/A	N/A	N/A
Common Stock	53,673.0	55,428.0	155.0	158.0	162.0
Other Equity	1,072.0	4,407.0	119,206.0	126,382.0	128,486.0
Retained Earnings	31,681.0	33,911.0	34,247.0	74,267.0	125,751.0
Total Liabilities and Shareholders' Equity	$148,420.0	$156,138.0	$232,626.0	$339,208.0	$433,857.0

Income Statement	1985	1986	1987	1988	1989
Revenue	$174,595.0	$149,261.0	$174,444.0	$362,758.0	$501,846.0
U.S. Revenue	118,395.0	66,568.0	86,810.0	160,190.0	174,755.0
Non-U.S. Revenue	56,200.0	82,693.0	87,634.0	202,568.0	327,091.0
Cost of Sales	$94,210.0	$87,730.0	$103,061.0	$192,094.0	$257,149.0
R&D Expense	$31,519.0	$24,621.0	$31,204.0	$43,477.0	$72,296.0
SG&A Expense	$32,763.0	$31,811.0	$38,096.0	$56,659.0	$88,935.0
Capital Expense	$12,930.0	$11,541.0	$11,491.0	$19,821.0	$42,944.0
Pretax Income	$15,983.0	$3,313.0	$578.0	$66,700.0	$84,402.0
Pretax Margin (%)	9.15	2.22	0.33	18.39	16.82
Effective Tax Rate (%)	42.00	44.00	42.00	40.00	39.00
Net Income	$9,270.0	$1,860.0	$336.0	$40,020.0	$51,484.0
Shares Outstanding, Thousands	13,160.0	13,322.0	14,140.0	16,491.0	16,757.0
Per Share Data					
Earnings	$0.71	$0.14	$0.02	$2.43	$3.07
Dividends	N/A	N/A	N/A	N/A	N/A
Book Value	$6.57	$7.04	$10.86	$12.18	$15.18

Table 4 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending October
(Thousands of U.S. Dollars, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	2.86	3.28	3.72	2.36	2.40
Quick (Times)	2.04	2.17	2.74	1.90	1.86
Fixed Assets/Equity (%)	41.33	46.25	30.62	27.88	32.28
Current Liabilities/Equity (%)	43.48	34.54	31.33	58.26	56.15
Total Liabilities/Equity (%)	71.73	66.55	51.44	68.92	70.54
Profitability (%)					
Return on Assets	-	1.22	0.17	14.00	13.32
Return on Equity	-	2.06	0.27	22.58	22.62
Profit Margin	5.31	1.25	0.19	11.03	10.26
Other Key Ratios					
R&D Spending % of Revenue	18.05	16.50	17.89	11.99	14.41
Capital Spending % of Revenue	7.41	7.73	6.59	5.46	8.56
Employees	1,359	1,415	1,406	1,765	2,651
Revenue ($K)/Employee	$128.50	$105.50	$124.10	$205.50	$189.30
Capital Spending % of Assets	8.71	7.39	4.94	5.84	9.90

N/A = Not Available

Source: Applied Materials, Inc.
Annual Reports and
Forms 10-K
Dataquest
1990

Company Backgrounders by Dataquest

Please make your selection below.

A

- ❐ 3COM Corp
- ❐ 3M (Minnesota Mining & Mfg Co)
- ❐ AEG-Olympia International
- ❐ Acer Technologies Corp (Altos)
- ❐ Adobe Systems Inc
- ❐ Advanced Micro Devices Inc
- ❐ Advanced Microelectronic Products Inc
- ❐ Air Products & Chemicals Inc
- ❐ Alcatel NV
- ❐ Aldus Corp
- ❐ Alpha Microsystems
- ❐ Alpharel Inc
- ❐ Alps Electric Co Ltd
- ❐ AM International Inc
- ❐ Amdahl Corp
- ❐ American Information Technologies Corp
- ❐ American Peripheral Industries Inc
- ❐ American Telephone & Telegraph Co
- ❐ Amstrad Plc
- ❐ Analog Devices Inc
- ❐ Anelva Corp
- ❐ Apple Computer Inc
- ❐ Applied Digital Data Systems Inc
- ❐ Applied Materials Inc
- ❐ Applix Inc
- ❐ Archive Corp
- ❐ ARIX Corp
- ❐ Ashton-Tate Corp
- ❐ ASM International NV
- ❐ AST Research Inc
- ❐ Atari Corp
- ❐ Atex Systems Inc (Eastman Kodak)
- ❐ Autodesk Inc

B

- ❐ Bell Atlantic Corp
- ❐ Bell & Howell Co
- ❐ BellSouth Corp
- ❐ Bitstream Inc
- ❐ Boeing Co
- ❐ Borland Intl Inc
- ❐ British Telecommunications Plc

B

- ❐ Brother Industries Ltd
- ❐ Burr-Brown Corp

C

- ❐ C Itoh & Co Ltd
- ❐ Cadence Design Systems Inc
- ❐ CalComp Inc (Lockheed)
- ❐ Canon Inc
- ❐ Casio Computer Co Ltd
- ❐ Centigram Corp
- ❐ Central Point Software Inc
- ❐ Chartered Semiconductor Pte Ltd
- ❐ Chips & Technologies Inc
- ❐ Citizen America Corp
- ❐ Commodore International Ltd
- ❐ CPT
- ❐ Compaq Computer Corp
- ❐ Comparex
- ❐ Computer Associates International Inc
- ❐ Compugraphics Corp
- ❐ Concurrent Computer Corp
- ❐ Conner Peripherals Inc
- ❐ Control Data Corp
- ❐ CONVEX Computer Corp
- ❐ Copyer Co
- ❐ Cray Research Inc
- ❐ Cypress Semiconductor Corp

D

- ❐ Daewoo Telecommunications Co Ltd
- ❐ DataEase International
- ❐ Data General Corp
- ❐ Datapoint Corp
- ❐ Data Translation Inc
- ❐ Decision Data Inc
- ❐ Dell Computer Corp
- ❐ Delphax Systems (Unit Xerox)
- ❐ Digital Equipment Corp
- ❐ Digital Microwave Corp
- ❐ Digital Research Inc

D

- ❐ DSC Communications Corp
- ❐ Dowty Plc
- ❐ DS America
- ❐ Du Pont E I (Crosfield)

E

- ❐ Eastman Kodak Co
- ❐ ESRI (Environ Sys Research Inst)
- ❐ Esprit Systems Inc
- ❐ E-Systems Inc
- ❐ Evans & Sutherland Computer Co
- ❐ Executone Information Systems Inc

F

- ❐ Facit AB
- ❐ Falco Data Products Inc
- ❐ Ferranti Intl Signal Plc
- ❐ FileNet Corp
- ❐ Foxboro Co
- ❐ Fuji Electric Co Ltd
- ❐ Fuji Xerox
- ❐ Fujitsu Ltd

G

- ❐ General DataComm Industries Inc
- ❐ General Dynamics Corp
- ❐ General Electric Co Plc (A B Dick)
- ❐ General Electric Corp
- ❐ General Signal Corp
- ❐ Genicom Corp
- ❐ Gestetner Plc
- ❐ GM Hughes Electronics Corp
- ❐ Goldstar Electronics Co Ltd
- ❐ GPT
- ❐ Groupe Bull
- ❐ Grumman Corp
- ❐ GTE Corp

Company Backgrounders by Dataquest

Please make your selection below.

H

- ❐ Harris Corp
- ❐ Hewlett-Packard Co
- ❐ Hitachi Ltd (Dataproducts)
- ❐ HMC (Hualon Microelectronics Co)
- ❐ Hoechst AG
- ❐ Hyundai Electronics Co Ltd

I

- ❐ IDEAssociates
- ❐ IMNET Corp
- ❐ Informix Software Inc
- ❐ Infotron System Corp
- ❐ Intel Corp
- ❐ Integrated Device Technology Inc
- ❐ Intergraph Corp
- ❐ Integrated Automation Inc
- ❐ Interleaf Inc
- ❐ International Business Machines Corp
- ❐ International Computers
- ❐ International Telephone & Telegraph
- ❐ Intuit
- ❐ Italtel Group

K

- ❐ KLA Instruments Corp
- ❐ Konica Corp
- ❐ Korea Electronics Co Ltd (KEC)
- ❐ Kyocera Corp

L

- ❐ LAM Research Corp
- ❐ Laser Data Corp
- ❐ Laser Magnetic Storage International
- ❐ Letraset
- ❐ LM Ericsson Co
- ❐ LSI Logic Corp
- ❐ Linotype Co
- ❐ Lockheed Corp
- ❐ Loral Corp
- ❐ Lotus Development Corp

M

- ❐ MAI Basic Four Inc
- ❐ MacNeal Schwendler Corp
- ❐ MCI Communications Corp
- ❐ McDonnell Douglas Corp
- ❐ Mannesmann Kienzle GmbH
- ❐ Matra SA
- ❐ Martin Marietta Corp
- ❐ Matsushita Elec Industrial Co Ltd
- ❐ Maxtor Corp
- ❐ Memorex Telex NV
- ❐ Mentor Graphics Corp
- ❐ Micro Dynamics
- ❐ Micron Technology Inc
- ❐ Micropolis Corp
- ❐ Microrim Inc
- ❐ Microsoft Corp
- ❐ Minolta Camera Company Ltd
- ❐ Mita International Co
- ❐ Mitac Electronics Ltd
- ❐ Mitel Corp
- ❐ Mitsubishi Electric Corp
- ❐ Monotype Inc
- ❐ Monroe Systems for Business Inc
- ❐ Motorola Inc

N

- ❐ NCR Corp
- ❐ NEC Corp
- ❐ Nakimichi (Mountain Computer)
- ❐ Nashua Corp
- ❐ National Semiconductor Corp
- ❐ Network Computing Devices
- ❐ Network Equipment Technologies Inc
- ❐ Nikon Corp
- ❐ Nippon Telegraph & Telephone Corp
- ❐ Nippondenso Co Ltd
- ❐ Nippon Sanso
- ❐ Nixdorf Computer AG
- ❐ Nokia Corp
- ❐ Norsk Data AS
- ❐ Northern Telecom LTD

N

- ❐ Northrop Corp
- ❐ Novell Inc
- ❐ NV Phillips
- ❐ NYNEX Corp

O

- ❐ Oce-van der Grinten NV
- ❐ Octel Communications Corp
- ❐ Oki Electric Industries Co Ltd
- ❐ Olin Corp
- ❐ Olivetti & Co SpA C Ing
- ❐ Omron Tateisi Electronics Co
- ❐ Osaka Titanium Co
- ❐ Oracle Systems Corp

P

- ❐ Pacific Telesis Group
- ❐ Packard Bell
- ❐ Pitney Bowes Inc
- ❐ Plessey Co Plc
- ❐ Prime Computer Inc
- ❐ Printronix Inc

Q

- ❐ QMS Inc
- ❐ Quadratron Systems Inc
- ❐ Quantum Corp
- ❐ Qume Corp

R

- ❐ Racal Electronics Plc
- ❐ Radius Inc
- ❐ Ramtek Corp
- ❐ Rank Xerox
- ❐ Raytheon Co
- ❐ Recognition Equipment Inc
- ❐ Robert Bosch GmbH
- ❐ Ricoh Co Ltd
- ❐ Rockwell International Corp
- ❐ Rohm Co Ltd

Company Backgrounders by Dataquest

Please make your selection below.

S

- ❐ STC Plc (ICL)
- ❐ Samna Corp
- ❐ Samsung Electronics Co Ltd
- ❐ Sanken Electronic Co Ltd
- ❐ Sanyo Electric Co Ltd
- ❐ Savin Corp
- ❐ Schlumberger Industries
- ❐ Scitex America Corp
- ❐ Seagate Technology Co
- ❐ Seiko Epson Corp
- ❐ Sequent Computer Systems Inc
- ❐ Sequoia Systems Inc
- ❐ SGS-Thompson Microelectronics
- ❐ Sharp Corp
- ❐ Shin-Etsu Chemical Co Ltd
- ❐ Siemens AG
- ❐ Sigma Designs
- ❐ Silicon Graphics Inc
- ❐ Silicon Valley Group Inc
- ❐ Software Publishers Corp
- ❐ Sony Corp
- ❐ Southwestern Bell Tel Corp
- ❐ Star Micronics
- ❐ Star Technologies Inc
- ❐ Storage Technology Inc
- ❐ Stratus Computer Inc
- ❐ Sun Microsystems Inc
- ❐ Supermac
- ❐ Summit Software
- ❐ Symantec Corp

T

- ❐ TAB Products Co
- ❐ Tandem Computers Inc
- ❐ Tandon Corp
- ❐ Tandy Corp
- ❐ Tagea-Varityper Inc
- ❐ Tektronix Inc
- ❐ Telefonica
- ❐ Telenorma
- ❐ Telefunken Elektronic GmbH
- ❐ TeleVideo Systems Inc

T

- ❐ Texas Instruments Inc
- ❐ Thomson SA
- ❐ Thorn-EMI Plc
- ❐ Tokyo Electron Ltd
- ❐ Tokyo Ohka Kogyo
- ❐ Toshiba Corp
- ❐ TRW Inc
- ❐ TSMC (Taiwan Semiconductor Mfg Co)

U

- ❐ Ultimate Corp
- ❐ Uniplex Integration Systems Inc
- ❐ Union Carbide Corp
- ❐ Unisys Corp
- ❐ United Microelectronics Corp
- ❐ United Telecommunications Inc
- ❐ US West Inc

V

- ❐ Valid Logic Systems Inc
- ❐ Varian Associates Inc
- ❐ VLSI Technology Inc
- ❐ VMX Inc

W

- ❐ Wang Laboratories Inc
- ☑ Western Digital Corp
- ❐ Westinghouse Electric Corp
- ❐ Winbond Electronics Corp
- ❐ Wordstar International Inc
- ❐ WordPerfect Corp
- ❐ Wyse Technology Inc

X

- ❐ Xerox Corp

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		Total	

Source: XA

Advanced Semiconductor Materials International N.V.

Jan Steenlaan 9
3723 BS Bilthoven
Netherlands
Phone: (31) 30-281836
Fax: (31) 30-281863
Dun's Number: Not Available

Date Founded: 1968

CORPORATE STRATEGIC DIRECTION

Advanced Semiconductor Materials International N.V. (ASM International N.V.) is a worldwide supplier of semiconductor process and assembly equipment. Products include assembly automation and encapsulation equipment, microcomputer-controlled wafer processing equipment, chemical vapor deposition (CVD) systems, epitaxial reactors, components for gas control systems, and semiconductor leadframe products and materials.

ASM markets its products to semiconductor manufacturers on a worldwide basis. Customers vary from independent semiconductor manufacturers to large, vertically integrated electronic systems companies that manufacture semiconductors for internal use. ASM's strategy addresses the needs of both types of customers, emphasizing sales among the largest manufacturers. New products are being designed in a modular style that will provide configurations for various customer requirements and that allow incorporation of technological advances in semiconductor processing technology.

Net sales of ASM products were slightly over F 416.2 million (US$195.4 million) for the year ended December 31, 1989. This represents a 14.7 percent increase over 1988 sales of F 362.9 million (US$183.3 million). (Percentage changes refer only to F amounts; US$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) Sales in the Far East and Japan showed the greatest gains, at F 130.9 million and F 110.5 million (US$61.5 million and US$51.9 million), respectively. This compares with 1988 sales of F 93 million and F 89 million (US$47 million and US$45 million). Product sales in Europe slowed during 1989, down to F 129.7 million (US$60.9 million), compared with F 135.7 million (US$68.5 million) in 1988. Sales in the United States remained fairly flat, at F 45.1 million (US$21.2 million) in 1989, versus F 45.2 million (US$22.8 million) in 1988.

In order to develop and manufacture products to accommodate local needs and to market and service products in a worldwide market, ASM has manufacturing, sales, and service facilities in Europe, the United States, Hong Kong, and Japan. Most of the Company's sales are through its direct sales force. In addition to individual sales and service offices throughout the world, ASM maintains a specialized group of sales, support, and service personnel to meet specific technology and application requirements for each of the main product categories.

ASM has R&D facilities in Arizona, Tokyo, Hong Kong, and the Netherlands that enable it to draw on innovative and technical capabilities on an international basis. Each location is the center of expertise for a specific product or technology. ASM also has established an international research center in the Netherlands for the development of semiconductor manufacturing technology.

During 1989, ASM opened a factory in the Shenzen economic zone of the People's Republic in China. In addition, ASM intends to set up a factory and R&D facility in Singapore and a new customer engineering facility in Kyushu, Japan, during the next few years. ASM plans to continue its significant investments in R&D to expand and improve product lines. During 1989, the Company spent F 39.7 million (US$18.6 million) on R&D, a 39 percent increase over the 1988 level of F 28.6 million (US$14.4 million).

As of December 31, 1989, ASM employed more than 2,200 people worldwide. ASM employment is highest in Hong Kong at 1,044, followed by the Netherlands with 635, the United States with 252, Japan with 177, and other European countries with 105.

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. Tables 4 and 5, comprehensive financial statements, are at the end of this backgrounder.

BUSINESS SEGMENT STRATEGIC DIRECTION

ASM's business is divided into three main segments: wafer processing, assembly and encapsulation, and materials. The biggest revenue producer for 1989 was the wafer processing segment with net sales of F 224.5 million (US$105.4 million), or 54 percent of total net sales. The assembly and encapsulation segment was second, with net sales of F 128.0 million (US$60.1 million), followed by material segment sales of F 63.0 million (US$30.0 million). Sales for the latter two business segments represented 31 and 15 percent of total net sales, respectively.

The wafer processing equipment products are used in the semiconductor manufacturing process, during which a series of thin films is deposited, or grown, on a silicon wafer. ASM manufactures equipment that uses CVD and diffusion technologies in this process. Dataquest estimates ASM's market share of the worldwide CVD equipment market at 12 percent for 1989 based on estimated sales of F 147.0 million (US$69 million). For the 1989 worldwide diffusion tube market, Dataquest estimates ASM's market share at 9 percent based on estimated diffusion tube sales of F 61.8 million (US$29 million).

The Company's wafer processing equipment sector has two main product categories: horizontal tube plasma-enhanced CVD reactors (PECVDs) used in wafer processing for VLSI devices such as 4Mb DRAMs, and micropressure CVD systems (LPCVD) used for low-pressure wafer processing that permits high deposition rates at moderate temperatures. LPCVD systems include the horizontal tube systems of the DFS 210 and 250 series as well as the vertical tube LPCVD system, the VMP100 PRO. The DFS 210 and 250 series encompass diffusion and oxidation capabilities with LPCVD. Dataquest estimates ASM's 1989 sales at F 108 million (US$51 million) in the PECVD market and F 38 million (US$18 million) in the LPCVD market.

During 1989, ASM introduced the VMP100 PRO, which is a vertical tube LPCVD system, in Japan. The DFS 210 and 250 series of diffusion and oxidation systems are ASM's mainstream products in Europe.

Another wafer processing equipment category is epitaxial reactors, which are used for epitaxial growth of crystal structures on silicon wafers, a process commonly used in the manufacturing of advanced bipolar devices and CMOS devices. Dataquest estimates ASM's sales in this market for 1989 at F 13.2 million (US$6.2 million). In 1988, ASM announced the Epsilon One, which features single-wafer production with high uniformity of layers and low particulate contamination. The system is aimed at the fast-growing CMOS device market. In 1989, ASM introduced the E2 model, with 200mm wafer capability.

Recent developments in ASM's wafer processing product line include the integration of microprocessor-based controls and the addition of automated wafer handling to existing products and newly developed systems. During 1989, ASM announced the Advance 600, a new family of multiprocessing systems for use in submicron chip manufacturing. The Advance 600 products incorporate ASM's Central Loadlock Systems, to which various modules for processing and handling can be connected. ASM's strategy is to make modular systems that allow a variety of system configurations to address selected applications.

ASM's assembly and encapsulation segment provides equipment used after the wafer processing step. The assembly equipment line includes automated systems for die inspection and separation, die bonders, wire bonders, molding systems, and trim-and-form systems. ASM's bonding equipment integrates mechanical and computer-based automation technology to meet productivity and quality criteria, while maintaining cost effectiveness.

During 1989, a new aluminum wire bonder, the AB509, was introduced. This product is targeted to the LED market for consumer electronics applications. More recently, in March 1990, ASM introduced the AB309 gold wire bonder. This product incorporates a new pattern recognition system and an ultralight moving bondhead for high-speed production rates. The AB309 system specifications are designed to provide higher productivity for customers in the high-volume IC market.

The Company's transfer molds, used in plastic packaged circuits, also provide fully automated systems operation. This category includes the AMS 480, a high-capacity, automated in-line molding system introduced several years ago. In 1987, lower-capacity automatic and semiautomatic molding systems, the AMS 140 and MS 100, were added to address a growing market for high-variety/small-series production of semiconductors. Similar to trends in wafer processing equipment, these encapsulation systems include the integration of microprocessor-based controls for process and information handling.

ASM expanded its molding systems product line with the introduction of the AMS 280 from ASM Fico in May 1989. This AMS 280 system offers a midrange production capacity, fitting between the MS 100 and AMS 140 at the low end and the AMS 480 at the high end. To further strengthen its position in the assembly markets, ASM is also developing advanced versions of its automatic and semiautomatic trim-and-form systems.

Manufacturing of assembly equipment is concentrated in Hong Kong for sale worldwide. ASM's encapsulation products are manufactured in the Netherlands and Hong Kong. The Company also has established precision machine tooling facilities in those locations to manufacture very high-precision transfer molds for encapsulation and automated trim-and-form tooling.

Further Information

For further information regarding the Company's business segments, please contact the appropriate Dataquest industry service.

Table 1
Five-Year Corporate Highlights (Thousands of US Dollars)

	1985	1986	1987	1988	1989
Five-Year Revenue	$105,677.7	$128,463.7	$136,614.3	$183,276.8	$195,401.4
Percent Change	-	21.56	6.34	34.16	6.62
Capital Expenditure	$18,660.2	$14,679.2	$11,852.7	$9,623.2	$18,028.6
Percent of Revenue	17.66	11.43	8.68	5.25	9.23
R&D Expenditure	$11,056.3	$18,730.6	$17,476.8	$14,447.0	$18,659.6
Percent of Revenue	10.46	14.58	12.79	7.88	9.55
Number of Employees	1,868	2,092	2,056	1,984	2,213
Revenue ($K)/Employee	$56,573	$61,407	$66,447	$92,377	$88,297
Net Income	($5,794.6)	($25,182.0)	($22,544.8)	$21,314.6	$4,510.8
Percent Change	-	95.96	3,514.20	(194.54)	(78.84)
Exchange Rate (US$1=F)	F 3.32	F 2.45	F 2.03	F 1.98	F 2.13

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	NA	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

NA = Not available

Source: Advanced Semiconductor Materials International N.V.
Quarterly Reports
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	27.00	15.00	12.00	12.00	11.00
International	73.00	85.00	88.00	88.00	89.00
Europe	24.00	44.00	46.00	37.00	31.00
Asia/Pacific	49.00	41.00	42.00	51.00	58.00

Source: Advanced Semiconductor Materials International N.V.
Annual Reports
Dataquest (1990)

Table 3
Revenue by Distribution Channel (Percent)

Channel	1985	1986	1987	1988	1989
Direct Sales	100.0	100.0	100.0	100.0	100.0
Indirect Sales	0	0	0	0	0

Source: Advanced Semiconductor Materials International N.V.
Annual Reports
Dataquest (1990)

1989 SALES OFFICE LOCATIONS

North America—7
Europe—4
Asia/Pacific—11

MANUFACTURING LOCATIONS

North America

Phoenix, Arizona
  Wafer processing equipment (PECVD)
Tempe, Arizona
  Wafer processing equipment (epitaxy)

Europe

Bilthoven, Netherlands
  CVD, diffusion, and oxidation wafer processing products
Brunssum, Netherlands
  Encapsulation equipment manufacturing
Herwen, Netherlands
  Encapsulation and tooling products manufacturing
Montpellier, France
  Gas component manufacturing, small CVD systems, MOCVD

Asia/Pacific

Kwai Chung, N.T. Hong Kong
  Assembly automation equipment, encapsulation, and leadframe manufacturing
Nagaoka, Japan
  Wafer processing equipment
Shenzhen, People's Republic of China
  Precision metal tooling
Singapore
  Assembly automation equipment

SUBSIDIARIES

North America

ASM America, Inc. (United States)
ASM Epitaxy (United States)
ASM Pacific Assembly Products, Inc. (United States)
ASM Rio USA, Inc. (United States)

Europe

ASM Europe B.V. (Netherlands)
ASM Fico Tooling B.V. (Netherlands)
ASM Finance Ltd. (Germany)
ASM France SARL (France)
ASM Germany Sales B.V. (Germany)
ASM UK Sales B.V. (England)

Asia/Pacific

ASM Asia Ltd. (Hong Kong)
ASM Assembly Automation Ltd. (Hong Kong)
ASM Assembly Materials Ltd. (Hong Kong)
ASM Japan K.K. (Japan)
ASM Pacific International Marketing Ltd. (Singapore)
ASM Pacific Technology Ltd. (Hong Kong)
ASM Technology Singapore Pte. Ltd. (Singapore)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

Information is not available.

MERGERS AND ACQUISITIONS

Information is not available.

KEY OFFICERS

Arthur H. del Prado
  Managing director, president, and chief executive officer

Andre C. van Rhee
  Managing director, vice president of Finance, and chief financial officer

Lam See-Pong (Patrick)
  Vice president of Asian Operations and managing director of ASM Pacific Technology Ltd., the holding company for Asia/Pacific subsidiaries

William H. de Leeuw
  Managing director of ASM Europe B.V.

Herbert O. Lakens
Director of Marketing

Jan Willem Baud
Managing director of ASM Fico Tooling B.V.

Yo Miyazaki
Vice president of Japanese Operations and managing director of ASM Japan K.K.

John E. Krickl
President of ASM America, Inc., and ASM Epitaxy

L. David Sikes
General manager of ASM America, Inc., and ASM Epitaxy

PRINCIPAL INVESTORS

Stichting Administratiekantoor ASMI—47.3 percent
All officers and directors as a group (13 persons)—49.7 percent

FOUNDERS

Arthur H. del Prado

Table 4
Comprehensive Financial Statement
Fiscal Year Ending December
(Thousands of US Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$78,714.5	$104,304.9	$129,632.0	$140,244.4	$121,505.2
Cash	5,773.8	5,429.8	8,390.1	27,736.9	9,533.3
Receivables	20,345.5	34,413.9	47,794.1	59,249.5	53,110.8
Marketable Securities	0	0	0	0	6,316.4
Inventory	43,688.9	51,894.7	60,249.8	42,367.7	41,808.0
Other Current Assets	8,906.3	12,566.5	13,198.0	10,890.4	10,736.6
Net Property, Plants	$32,566.6	$45,131.4	$52,610.8	$47,658.1	$48,378.4
Other Assets	$1,622.3	$1,243.7	$1,513.3	$5,236.9	$7,079.3
Total Assets	$112,903.3	$150,680.0	$183,756.2	$193,139.4	$176,962.9
Total Current Liabilities	$51,525.6	$80,199.6	$111,408.9	$94,344.9	$85,153.1
Long-Term Debt	$13,341.3	$24,071.8	$27,545.3	$21,649.0	$17,894.4
Other Liabilities	$758.4	$13,357.1	$32,869.5	$41,495.5	$35,659.6
Total Liabilities	$65,625.3	$117,628.6	$171,823.6	$157,489.4	$138,707.0
Total Shareholders' Equity	$47,278.0	$33,051.4	$11,932.5	$35,650.0	$38,255.9
Converted Preferred Stock	0	0	0	0	0
Common Stock	63.0	85.3	103.0	105.6	104.2
Other Equity	34,831.0	41,366.5	44,512.8	47,738.4	44,976.1
Retained Earnings	12,384.0	(8,400.4)	(32,683.3)	12,193.9	(6,824.4)
Total Liabilities and Shareholder's Equity	$112,903.3	$150,680.0	$183,756.2	$193,139.4	$176,962.9
Income Statement	**1985**	**1986**	**1987**	**1988**	**1989**
Revenue	$105,677.7	$128,463.7	$136,614.3	$183,276.8	$195,401.4
Cost of Sales	$64,604.2	$87,338.8	$87,996.6	$112,505.6	$116,165.3
R&D Expense	$11,056.3	$18,730.6	$17,476.8	$14,447.0	$18,659.6
SG&A Expense	$31,314.8	$37,197.6	$39,388.2	$47,189.9	$47,188.3
Capital Expense	$18,660.2	$14,679.2	$11,852.7	$9,623.2	$18,028.6
Pretax Income	($1,802.4)	($18,302.9)	($13,820.2)	$12,318.7	$7,900.9
Pretax Margin (%)	NA	NA	NA	NA	NA
Effective Tax Rate (%)	43.0	43.0	43.0	43.0	43.0
Net Income	($5,794.6)	($25,182.0)	($22,544.8)	$21,314.6	$4,510.8
Shares Outstanding, Millions	$6,959.0	$6,959.0	$6,959.0	$6,959.0	$6,959.0
Per Share Data					
Earnings	($0.8)	($3.6)	($3.3)	$3.1	$0.6
Dividend	NA	NA	NA	NA	NA
Book Value	NA	NA	NA	NA	NA
Exchange Rate (US$1=F)	F 3.32	F 2.45	F 2.03	F 1.98	F 2.13

NA = Not available

Source: Advanced Semiconductor Materials International N.V. Annual Reports and Forms 10-K
Dataquest (1990)

Table 5
Comprehensive Financial Statement
Fiscal Year Ending December
(Thousands of Guilders, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	F 261,332.0	F 255,547.0	F 263,153.0	F 277,684.0	F 258,806.0
Cash	19,169.0	13,303.0	17,032.0	54,919.0	20,306.0
Receivables	67,547.0	84,314.0	97,022.0	117,314.0	113,126.0
Marketable Securities	0	0	0	0	13,454.0
Inventory	145,047.0	127,142.0	122,307.0	83,888.0	89,051.0
Other Current Assets	29,569.0	30,788.0	26,792.0	21,563.0	22,869.0
Net Property, Plants	F 108,121.0	F 110,572.0	F 106,800.0	F 94,363.0	F 103,046.0
Other Assets	F 5,386.0	F 3,047.0	F 3,072.0	F 10,369.0	F 15,079.0
Total Assets	F 374,839.0	F 369,166.0	F 373,025.0	F 382,416.0	F 376,931.0
Total Current Liabilities	F 171,065.0	F 196,489.0	F 226,160.0	F 186,803.0	F 181,376.0
Long-Term Debt	F 44,293.0	F 58,976.0	F 55,917.0	F 42,865.0	F 38,115.0
Other Liabilities	F 2,518.0	F 32,725.0	F 66,725.0	F 82,161.0	F 75,955.0
Total Liabilities	F 217,876.0	F 288,190.0	F 348,802.0	F 311,829.0	F 295,446.0
Total Shareholders' Equity	F 156,963.0	F 80,976.0	F 24,223.0	F 70,587.0	F 81,485.0
Converted Preferred Stock	0	0	0	0	0
Common Stock	209.0	209.0	209.0	209.0	222.0
Other Equity	115,639.0	101,348.0	90,361.0	94,522.0	95,799.0
Retained Earnings	41,115.0	(20,581.0)	(66,347.0)	24,144.0	(14,536.0)
Total Liabilities and Shareholders' Equity	F 374,839.0	F 369,166.0	F 373,025.0	F 382,416.0	F 376,931.0

Income Statement	1985	1986	1987	1988	1989
Revenue	F 350,850.0	F 314,736.0	F 277,327.0	F 362,888.0	F 416,205.0
Cost of Sales	F 214,486.0	F 213,980.0	F 178,633.0	F 222,761.0	F 247,432.0
R&D Expense	F 36,707.0	F 45,890.0	F 35,478.0	F 28,605.0	F 39,745.0
SG&A Expense	F 103,965.0	F 91,134.0	F 79,958.0	F 93,436.0	F 100,511.0
Capital Expense	F 61,952.0	F 35,964.0	F 24,061.0	F 19,054.0	F 38,401.0
Pretax Income	(F 5,984.0)	(F 44,842.0)	(F 28,055.0)	F 24,391.0	F 16,829.0
Pretax Margin (%)	NA	NA	NA	NA	NA
Effective Tax Rate (%)	43.0	42.0	42.0	40.0	35.0
Net Income	(F 19,238.0)	(F 61,696.0)	(F 45,766.0)	F 42,203.0	F 9,608.0
Shares Outstanding, Millions	F 6,959.0	F 6,959.0	F 6,959.0	F 6,959.0	F 7,185.0
Per Share Data					
Earnings	(F 2.8)	(F 8.9)	(F 6.6)	F 6.1	F 1.3
Dividend	NA	NA	NA	NA	NA
Book Value	NA	NA	NA	NA	NA

Table 5 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending December
(Thousands of Guilders, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	1.53	1.30	1.16	1.49	1.43
Quick (Times)	0.68	0.65	0.62	1.04	0.94
Fixed Assets/Equity (%)	68.88	136.55	440.90	133.68	126.46
Current Liabilities/Equity (%)	108.98	242.65	933.66	264.64	222.59
Total Liabilities/Equity (%)	138.81	355.90	1,439.96	441.77	362.58
Profitability (%)					
Return on Assets	(10.26)	(16.58)	(12.33)	11.17	2.53
Return on Equity	(24.51)	(51.86)	(87.01)	89.03	12.64
Profit Margin	(5.48)	(19.60)	(16.50)	11.63	2.31
Other Key Ratios					
R&D Spending % of Revenue	10.46	14.58	12.79	7.88	9.55
Capital Spending % of Revenue	17.66	11.43	8.68	5.25	9.23
Employees	1,868	2,092	2,056	1,984	2,213
Revenue (F K)/Employee	F 187,821	F 150,447	F 134,887	F 182,907	F 188,073
Capital Spending % of Revenue	16.53	9.74	6.45	4.98	10.19
Exchange Rate (US$1=F)	F 3.32	F 2.45	F 2.03	F 1.98	F 2.13

NA = Not available

Source: Advanced Semiconductor Materials International N.V. Annual Reports and Forms 10-K
Dataquest (1990)

Canon Incorporated

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Shinjuku-ku, Tokyo 163, Japan
Telephone: (03) 348-2121
Fax: (03) 349-8957
Dun's Number: 69-054-9662

Date Founded: 1937

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$8,633.3 million) in fiscal 1988. (Percantage changes refer only ¥ amounts; US$ 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 flatbed 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
Copyer 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)

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.

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 NZDlr13.25 million to a newly established subsidiary of Canon.

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

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)

Balance Sheet	1985	1986	1987	1988	1989
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
Total Assets	$4,196.5	$5,990.4	$7,811.2	$10,146.3	$11,864.7
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
Total Liabilities	$2,613.9	$3,735.0	$4,913.0	$6,389.2	$7,268.0
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)
Total Liabilities and Shareholders' Equity	$4,196.5	$5,990.4	$7,811.2	$10,146.3	$11,864.7
Income Statement	**1985**	**1986**	**1987**	**1988**	**1989**
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
Per Share Data					
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)

Balance Sheet	1985	1986	1987	1988	1989
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
Total Assets	¥1,001,044	¥1,009,504	¥1,133,881	¥1,299,843	¥1,636,380
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
Total Liabilities	¥623,518	¥629,423	¥713,175	¥818,524	¥1,002,402
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)
Total Liabilities and Shareholders' Equity	¥1,001,044	¥1,009,504	¥1,133,881	¥1,299,843	¥1,636,380

Income Statement	1985	1986	1987	1988	1989
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
Per Share Data					
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)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
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
Profitability (%)					
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
Other Key Ratios					
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)

Digital Equipment Corporation

146 Main Street
Maynard, Massachusetts 01754
Telephone: (508) 897-5111
Fax: (508) 493-8780
Dun's Number: 00-103-8066

Date Founded: August 23, 1957

CORPORATE STRATEGIC DIRECTION

Digital Equipment Corporation was founded by Kenneth Olsen and Harland Anderson, two former employees of MIT's Lincoln Laboratory. Digital has grown from its origin as a manufacturer of computer logic modules into one of the largest computer manufacturers in the United States. Digital is a leading supplier of networked computer systems, minicomputer systems, software, and services, including systems integration.

Digital designs, manufactures, and sells a variety of hardware and software products that integrate personal computers into local and wide area networks and interconnect networked personal computers with departmental and mainframe Digital and IBM systems. The company also manufactures and sells data storage and associated peripheral devices, which are used with and sold as part of the company's various computer systems. These devices include magnetic tape transports, tape cassette and disk storage devices, cathode ray tube display systems, analog to digital converters, terminals, and line printers. Selected peripherals and components are also sold separately for other independent applications to other system and peripheral equipment manufacturers. The company is a major manufacturer and supplier of video terminals and buys selected personal computer and peripheral equipment from other manufacturers for use with its own computer systems.

Today, Digital is offering a complete line of systems from networked PCs to mainframes. The company's product and marketing strategy is that Digital is in four businesses: offering commodity products that are standard in the industry; offering VAX systems that meet all common standards; offering systems integration; and offering a wide range of services for its customers. Digital's emphasis for the 1990s is on an extension of its multivendor integration strategy, which is to combine Digital's broad range of products with those supplied by other vendors to provide the user with a complete computing solution.

In fiscal year 1990, the company began a series of restructuring actions to improve its cost structure, including absorbing a restructuring charge of $550 million.* This restructuring charge covered the cost of employee separations, retraining and relocation, facility consolidations, retirement of equipment, and related administrative costs.

During fiscal 1991, Digital had a $617 million loss, which included a $1.1 billion restructuring charge. According to Digital, this restructuring charge was needed to close facilities and reduce staff. The company, however, did not cut back on investments in computer technology.

Digital's total revenue increased 7.48 percent to $13.9 billion for the fiscal year ended June 29, 1991, compared with $12.9 billion in fiscal 1990. All of the company's growth occurred in its overseas operations. Net income decreased to negative $617 million in fiscal 1991, in comparison with $74 million in fiscal 1990. According to Digital, these results reflect intense price competition throughout the industry because of the recession, compounded by dramatic improvements in the performance of computers.

The company introduced a number of new computer systems for both UNIX and the company's own VMS operating systems, as well as a broad range of multivendor client/server software, service, and hardware products. In addition, the company increased the performance and functionality of its systems and lowered its prices on many products, thereby improving price/performance.

*All dollar amounts are in U.S. dollars.

North America represented 40 percent of Digital's total revenue, while Europe accounted for almost 45 percent of total revenue. In fiscal 1991, almost 60 percent of Digital's revenue came from foreign markets. Digital has approximately 500 worldwide sales offices, 53 percent of which are located in the United States.

R&D expenditure increased 2 percent and represented 11.85 percent of total revenue. Total R&D investment for fiscal 1991 was $1,649 million, compared with $1,614 million in fiscal 1990. R&D activities include developing or enhancing systems, related peripheral equipment and software, and expanding product applications and multivendor systems integration.

Capital expenditure decreased from $1,028 million in 1990 to $738 million in 1991, which represented 5.3 percent of revenue. Much of this investment was focused on improving manufacturing and engineering efficiency and advancing employee productivity throughout the organization. Approximately 69 percent of the current year's total was spent for machinery and equipment; the balance was for buildings, leasehold improvements, and land.

In January 1991, Digital acquired from Mannesmann AG 65 percent of its Mannesmann Kienzle Computer Systems Division, along with the PROCAD GmbH and PCS GmbH divisions of Mannesmann Kienzle. The name of the new company is Digital-Kienzle Computersysteme GmbH & Co. K.G. Digital's investment in Digital-Kienzle was $233 million. According to Digital, this investment advances the company's strategic thrust in selling to small and medium-size businesses worldwide and complements a series of new products, services, and channels for small and medium-size businesses announced by the company during fiscal 1991. This investment also complements the company's development and support of UNIX-based applications and enhances the company's position in selling into emerging markets in central and eastern Europe.

In addition, shortly after the close of fiscal 1991, Digital reached an agreement in principle with Philips Electronics N.V. of the Netherlands to acquire most of the Philips' Information Systems Division, subject to receipt of necessary regulatory approvals and negotiation and execution of final agreements.

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 through 5 at the end of this backgrounder provide comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Technical Computers

For the year ended December 31, 1990, Dataquest estimated Digital's worldwide factory revenue market share to be 20.51 percent for the total technical computer market. This places Digital in the No. 1 position in this market, with revenue of $3,695 million.

In the supercomputer market, Dataquest ranked Digital sixth with a market share of 3.09 percent and revenue of $53.3 million; in the mainframe market, Digital ranked tenth with a market share of 1.18 percent and revenue of $50.4 million; in the midrange market, Digital ranked first with a market share of 46.33 and revenue of $2.4 billion.

During fiscal 1990, Digital introduced the VAX 9000 mainframe, the VAX 4000 system, and vector processing capabilities for the VAX 9000 and the VAX 6000 systems. During fiscal 1991, more than 330 VAX 9000 systems were shipped to customers and over 15,000 VAX 6000 systems were sold. In October 1991, Digital announced new versions of the VAX 4000 and VAX 6000 systems.

Business Computers

In business markets and applications, Dataquest ranked Digital as follows: in the midrange market, it ranked second with a market share of 7.19 percent and revenue of $1.7 billion; and in the workstation market, it ranked second with a market share of 24.27 percent and revenue of $149.5 million.

In August 1991, Digital introduced a family of computers based on massively parallel processing (MPP), a high-performance technology targeted at very complex problems of technical, scientific, and commercial users. The new DECmpp 12000 system series will be supplied by MasPar Computer Corporation.

Microcomputer Systems

In May 1991, Digital introduced a series of the DECpc product line. The "T" series deskside systems are being positioned as a combination of PC and server products; the "N" series of products are being aimed at windowing- and graphics-oriented network clients; the "D" series are general-purpose desktop systems; and the "P" series units are portable products: notebooks and laptops.

Digital also introduced the world's first true PC-workstation crossover product. The DECpc 433 Workstation is not a true workstation in the sense that it is not built on a RISC processor architecture, nor is it a true PC because it features many capabilities not presently found in the PC market. This product can perform many of the graphics-oriented functions normally associated with true workstations and yet provide the end-user community access to the more than 32,000 DOS-based applications.

Dataquest believes that Digital's reentry into the world of PCs will be a successful one, not only because of the breadth and depth of these new products, but also because the 433 Workstation is the first implementation of a true PC-workstation crossover product. The development of this type of product indicates that Digital now understands not only the minicomputer and workstation marketplace, but also the importance that the PC plays and will continue to play in the world of corporate computing.

Software

Digital provides several operating system environments including MS-DOS, UNIX, and VMS. Digital incorporated UNIX into its technical computer products in 1983 and currently offers users of both business and technical systems choices between VMS and ULTRIX (Digital's version of the UNIX operating system).

Digital has worked closely with other hardware and software vendors to develop guidelines for an open systems environment, and the ULTRIX software is compliant with open systems standards developed by the Open Software Foundation. ULTRIX also is an integral part of Network Application Support, Digital's plan for application integration in a distributed, multivendor environment.

Although VMS software supports most of the same open systems standards as the UNIX operating systems, the VMS environment supports vector processing, clustering, symmetrical multiprocessing, and other capabilities not commonly found on UNIX operating systems, but which are critical in high-volume production data processing environments.

Digital and more than two hundred other computer companies including Compaq, Microsoft, MIPS Computer Systems, and The Santa Cruz Operation have agreed on a common set of standards that will enable high-performance desktop computers and workstations from different manufacturers to run the same software. This initiative addresses both personal computers and workstations—and both hardware and software—so there will no longer be disconnects among desktop systems.

Telecommunications

Digital has incorporated a standard for local area networks, for public packet-switching networks, for communicating with UNIX and IBM systems, and for long-distance data transmission over telephone networks into ADVANTAGE-NETWORKS. It integrates Open Systems Interconnection (OSI), transmission control protocol/internet protocol (TCP/IP), and DECnet protocols to provide the infrastructure needed to connect personal computer networks, ethernet and token-ring local area networks, SNA networks, Novell networks, and public and private wide area networks to support distributed applications, client/server computing, and inter-enterprise communications.

According to Dataquest, Digital is the worldwide leading industry vendor of ethernet-based LANs. Approximately 725,000 DECnet nodes are in operation at sites all over the world. Although DEC's existing support is based on DECnet and TCP/IP, the company will refocus its communications support to the OSI model in releases of DECnet/OSI for ULTRIX and VMS.

Display Terminals

According to Dataquest estimates, Digital had 8.0 percent of the market share in the worldwide display terminal market in calendar year 1990, with shipments of 510,000 units. Current products include the VT420 Text Terminal, the VT330+ text/graphics terminal, the VT340 terminal, the VT1200 X Window System display terminal, the DECimage 1200 display terminal, and the VT1300 color X Window System terminal. According to Dataquest, Digital is the third-largest manufacturer of desktop units in the world, trailing only Wyse Technology Inc. (including Link) and IBM in terminal sales volume.

Printers

Digital's worldwide printer strategy is to provide a comprehensive range of user solutions regardless of user applications or operating systems. It is following through on this strategy by buying print engines from other vendors and then enhancing or adding value to the product. The company adds value by providing user transparency through DECPrint, paper handling, and user-service ability.

In October 1991, Digital and Printronix Inc. celebrated the first shipments of their jointly developed LG06 Line Matrix printer. By teaming up with Printronix, Digital has tapped into Printronix line matrix printing technology as well as the printer company's experience and expertise in bar code applications. In addition to featuring reliable text and graphics printing for business applications, the LG06 supports 13 bar code symbologies for increased productivity.

CAD/CAM/CAE

According to Dataquest, Digital's worldwide market share of the CAD/CAM/CAE electronic design automation market in calendar 1990 was 7.3 percent, based on end-user revenue (OEM revenue excluded). The company's market share for hardware was 11 percent and software 3 percent. Digital's actual 1990 revenue for this market was $230.3 million, with hardware accounting for $163.9 million and software $3.9 million. The actual shipment of workstations during this period was 1,941.

Digital's strategy in the CAD/CAM/CAE market is to develop strategic relationships with key vendors of software applications and create pull-through demand for the Digital hardware platform. Digital continues to build these relationships and has developed the System Cooperative Marketing Program and the Cooperative Marketing Program to focus on applications development.

Computer Storage

In 1990, Digital maintained its first place ranking in the total worldwide 1/2-inch tape drive market with 27.9 percent market share, based on unit shipments. Digital also ranked first in the worldwide total 1/2-inch cartridge market with a 46.0 percent market share, based on unit shipments. The company ranked seventh in worldwide total tape drives, with a market share of 6.2 percent.

In November 1991, Digital and Tandberg Data Inc. announced that Tandberg Data's 525MB TDC tape drive, using linear scan quarter-inch cartridge (QIC) technology, will be used in a new series of tape backup products supplied by Digital for the PC market. The 525MB QIC tape backup system from Digital is part of a new initiative in the DECpc 433 product line and is compatible with desktop and tower products.

In September 1991, Cipher Data Products Inc. (a subsidiary of Archive Corporation) and Digital signed a business alliance. The companies will develop a new range of high-performance tape drives that will be compatible with all major hardware families. The drives will be based around DEC's TF857. The drives are being designed to give storage capacities of 2.6GB per cartridge, with a total unattended storage capacity of 18.2Gb, using an automatic cartridge loader.

In August 1991, Digital converted its mass-storage plant in Colorado Springs, Colorado, from large-diameter, centralized hard disk drive subsystems to concentrate on 2-1/2- and 3-1/2-inch drives for desktop and laptop systems. Digital intends to move production of the large-diameter, centralized hard disk drive subsystems to a plant in Kaufbeuren, Germany, by July 1992.

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)

	1987	1988	1989	1990	1991
Five-Year Revenue	9,389	11,475	12,742	12,943	13,911
Percent Change	23.70	22.22	11.04	1.58	7.48
Capital Expenditure	748	1,518	1,223	1,028	738
Percent of Revenue	7.97	13.23	9.60	7.94	5.31
R&D Expenditure	1,010	1,307	1,525	1,614	1,649
Percent of Revenue	10.76	11.39	11.97	12.47	11.85
Number of Employees	110,500	121,500	125,800	124,000	121,000
Revenue ($K)/Employee	84.97	94.44	101.29	104.38	114.97
Net Income	1,137	1,306	1,073	74	(617)
Percent Change	84.28	14.86	(17.84)	(93.10)	(933.78)

1991 Fiscal Year	Q1	Q2	Q3	Q4
Quarterly Revenue	3,093	3,353	3,520	3,945
Quarterly Profit	26	111	117	(871)

Source: Digital Equipment Corporation
Annual Reports
Dataquest (December 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1987	1988	1989	1990	1991
North America	53.40	50.60	45.91	45.00	40.16
Europe	34.60	36.80	40.26	40.51	44.68
Japan, Asia/Pacific, and ROW	12.00	12.60	13.83	14.49	15.16

Source: Digital Equipment Corporation
Annual Reports
Dataquest (December 1991)

1991 SALES AND SERVICE OFFICE LOCATIONS

North America—263
Japan—29
Europe—117
Asia/Pacific—31
ROW—54

MANUFACTURING LOCATIONS

North America

Albuquerque, New Mexico
  Video displays
Augusta, Maine
  CPU expansion cabinets
Boston, Massachusetts
  Keyboards
Burlington, Vermont
  Computers
Colorado Springs, Colorado
  Disk drives
Greenville, South Carolina
  Printed wiring boards
Hudson, Massachusetts
  Custom ICs, network interface boards
Kanata, Q.A., Canada
  Computers, backplanes, subassemblies
Maynard, Massachusetts
  Module production
Salem, New Hampshire
  Special systems
Shrewsbury, Massachusetts
  Thin film heads, disk and tape drives
Springfield, Massachusetts
  Disk drives
Westfield, Massachusetts
  Computers
Westminster, Massachusetts
  Software

Japan

  Computer Systems

Europe

Ayr, Scotland
  Components, subassemblies
Galway, Ireland
  VAX systems and supplies
Kaufbeuren, West Germany
  Storage arrays
South Queensferry, Scotland
  Custom ICs
Valbonne, France
  Terminals

Asia/Pacific

Hong Kong
  Terminals
Singapore
  Disk drives, heads
Tachi, Taiwan
  Terminals

ROW

Aguadilla, Puerto Rico
  CPU manufacturing, printed wiring boards
Chihuahua, Mexico
  Power supplies
San German, Puerto Rico
  Electronic cards

SUBSIDIARIES

North America

Computer Insurance Company Limited
Digital Equipment Caribbean Inc. (United States)
Digital Equipment Co. Limited (United States)
Digital Equipment Corporation International (United States)
Digital Equipment (DEC) Limited (United States)
Digital Equipment Filipinas Inc. (United States)
Digital Equipment Finance Corporation (United States)
Digital Equipment International Limited (United States)
Digital Equipment of Canada Limited/Digital Equipment Du Canada Limite (Canada)
Digital Equipment Services Inc. (United States)
Digital Growth Inc. (United States)
Digital Incorporated (United States)
Digital International Sales Corporation (United States)
Old Colony Insurance Ltd. (United States)

Japan

Nihon Digital Equipment Corporation KK

Europe

Digital Equipment Aktiebolag (Sweden)
Digital Equipment Betriebliche Altersversorgungsgesellschaft GmbH (Germany)
Digital Equipment B.V. (Netherlands)
Digital Equipment Centre Technique (Europe) SARL
Digital Equipment Corporation A/S (Denmark)
Digital Equipment Corporation A/S (Norway)
Digital Equipment Corporation Espana S.A. (Spain)
Digital Equipment Corporation Finance B.V. (Netherlands)
Digital Equipment Corporation Gesellschaft GmbH (Germany)
Digital Equipment Corporation International (Europe)
Digital Equipment Corporation Ireland Limited (Ireland)
Digital Equipment Corporation Oy (Finland)
Digital Equipment Corporation S.A./A/G (Germany)
Digital Equipment Corporation Services (Europe)
Digital Equipment Foreign Sales Corporation B.V. (Netherlands)
Digital Equipment France (France)
Digital Equipment GmbH (West Germany)
Digital Equipment Hellas Ltd. (Greece)
Digital Equipment (Holdings) B.V. (Netherlands)
Digital Equipment International B.V. (Netherlands)
Digital Equipment International GmbH (Germany)
Digital Equipment N.V./S.A. (Belgium)
Digital Equipment Overseas Finance N.V. (Netherlands)
Digital Equipment Parts Center B.V. (Netherlands)
Digital Equipment PLC Limited (United Kingdom)
Digital Equipment Portugal, Limitada (Portugal)
Digital Equipment Scotland Limited (Scotland)
Digital Equipment S.p.A. (Italy)

Asia/Pacific

Digital Computer Taiwan Limited (Taiwan)
Digital Equipment China Inc. (China)
Digital Equipment Corporation Limited (New Zealand)
Digital Equipment Corporation Pty. Ltd. (Australia)
Digital Equipment Hong Kong Limited (Hong Kong)
Digital Equipment Inc. (Korea)
Digital Equipment Sdn. Bhd. (Malaysia)
Digital Equipment Singapore (Pte.) Limited (Singapore)
Digital Equipment Ltd. (Thailand)
Digital Equipment Taiwan Limited (Taiwan)

ROW

Digital Equipment Corporation de Puerto Rico (Puerto Rico)
Digital Equipment de Brazil Ltda. (Brazil)
Digital Equipment (DEC) Technical Center Limited (Israel)
Digital Equipment de Mexico S.A. De C.V. (Mexico)
Digital Equipment Panama Inc. (Panama)
Kam Hon Development Company Limited

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Silicon Graphics
Silicon Graphics licensed its graphics software, the IRIS Graphics Library, to Digital.

Mannesmann Kienzle GmbH
Mannesmann Kienzle GmbH (a subsidiary of Mannesmann AG) sold its data systems activity to Digital for $230 million. The sale will involve the two companies forming a joint venture in the computer business, with Digital owning 65 percent and Mannesmann owning the remaining 35 percent of a new company that will be called Digital-Kienzle Computersysteme GmbH & Co. K.G.

LM Ericsson Telephone
LM Ericsson Telephone and Digital signed a cooperation agreement on radio data communication linked to the Mobitex system. Digital will distribute Ericsson equipment for the Mobitex network and will provide systems integration services to customers. Mobitex is a radio network that allows communication with a computer network through a portable computer. Both companies will develop software tools to aid in the integration of Digital's products into the network.

Cipher Data Products Inc.
Cipher Data Products (a subsidiary of Archive Corporation) and Digital signed a business alliance. As part of the alliance, Cipher will adapt and customize Digital's high-performance, high-capacity 5.25-inch tape drive and market it under the Cipher name. Cipher will be the exclusive worldwide marketer of this product. Digital will try and sell the product to large OEMs for more private-labeling arrangements.

Adobe Systems Incorporated
Adobe Systems and Digital signed a licensing agreement for the DEC-fonts Typeface Collection. This agreement includes more than 1,000 fonts

from the Adobe Type Library in the Adobe 1 Type format. The agreement will enable Digital to make fonts available to users of networked ULTRIX and VMS-based systems.

Poqet Computer Corporation
Poqet Computer Corporation and Digital signed an agreement to offer Mobiliser for ALL-IN-1 packages with the Poqet PC.

Sonda of Chile
Sonda of Chile and Digital have entered into a joint venture. The partnership involved selling U.S. software and software specifically tailored for Latin American needs.

Olivetti Systems & Networks
Olivetti Systems & Networks and Digital have signed a licensing agreement for Digital's Enterprise Management Architecture (EMA). The five-year licensing agreement will enable Olivetti to port Digital's DECmcc technology to UNIX System V Release 4.0. The agreement also includes Digital's Concert Multithread Architecture, DECmcc Director, and other management applications. Olivetti will use the technology to create PC LAN and network management packages.

Odesta Corporation
Odesta Corporation and Digital signed a licensing agreement. Under the terms of the agreement, Digital will distribute and support a future version of Odesta Document Management Systems, which are object-oriented work flow and document management systems.

Joint Marketing Alliances

Automated Systems Inc. (ASI)
Digital to supply workstations, networks; ASI to supply Prance GT software in a cooperative marketing program

Combustion Engineering
Plant systems joint marketing

Cullinet
Voice-processing products; VAX/IBM communications

Calma
MicroVAX II-based mechanical CAD systems

Cincinnati Bell
Billing management systems for cellular nets

Daisy Systems
MicroVAX II-based workstations for CAE

Datap
Marketing of real-time data management systems

The Eastman Kodak Company
Marketing of PostScript networked printer

Ericsson Systems
Integration and marketing of banking systems

Prime Computer Incorporated
VAX-based MEDUSA CAD/CAM systems

Tektronix Incorporated
MicroVAX II-based CAD/CAE systems

Technology Licensing Agreements

Elebra Computadores
License to manufacture VAX 11/750s in Brazil

Planar Systems
OEM agreement to resell EL flat panel displays

Relational Technologies
Bundling Ingres RDBMS with ULTRIX licenses

RSA Data Security
License for RSA data encryption and security software

Tandy Corporation
OEM agreement to resell Tandy PCs

Product Development Agreements

Alberta Telecom
Joint development of optic research projects

Allen-Bradley
Industrial control and management systems

Alcatel N.V.
Display terminals development

Apollo Computer Inc.
Joint development, licensing of NCS software

Apple Computer Inc.
DECnet-Appletalk communications interfaces

Ashton-Tate Corporation
Multiuser database product development

CAI
Utility software development

Codex Corporation
Development of DEC EMA access modules

Cray Research Inc.
VAX/CRAY high-performance interface

Digital Comm Assoc.
Development of DEC EMA access modules

DSC Communications
Development of network service control systems

EDA Systems
Design management software

Evans & Sutherland
Development of workstation products

Insignia
VAXpc, PC emulation software running under VMS

Locus Computing
Connectivity software development

Lotus Development Corporation
VAX application software development

MIPS Computer Systems
OEM agreement to buy/manufacture MIPS RISC chip set

Motorola Incorporated
Jointly design a fiber-distributed data interface chip set

Northern Telecom Limited
Development of integrated voice/data products

Olivetti
PC-DECnet interface technology exchange

Open Software Foundation
UNIX development standards group

Phoenix Technologies Inc.
BIOS port to MicroVAX

Schlumberger Ltd.
Develop Bravo3 CAD/CAM software under VMS

Scientific Calc.
Digital minority interest in CAD software company

Siemens AG
Development of DEC EMA access modules and gateways for packetswitching

SPEC
Standards group for workstations and minis

Stratacom Inc.
Development of DEC EMA access modules

3Com Corporation
OS/2 and DOS connectivity to VAX/VMS

Timeplex Inc.
Development of DEC EMA access modules

TSB International
Development of DEC EMA access modules

Valid Logic System Inc.
CAD/CAE system software

Vitalink Communications Corporation
Remote LAN bridges; develop EMA access modules

X/Open
Software standards consortium

MERGERS AND ACQUISITIONS

Digital has made no recent mergers or acquisitions.

KEY OFFICERS

Kenneth H. Olsen
President

Winston R. Hindle, Jr.
Senior vice president

John F. Smith
Senior vice president, Engineering, Manufacturing, Product Marketing

Pier Carlo Falotti
Vice president, president, and CEO, Europe

FOUNDERS

Kenneth H. Olsen (MIT)
Harland Anderson (MIT)

Table 3
Balance Sheet
Fiscal Year Ending in June
(Millions of U.S. Dollars)

Balance Sheet	1987	1988	1989	1990	1991
Cash	2,118	2,164	1,655	2,009	1,924
Receivables	2,312	2,592	2,965	3,207	3,317
Marketable Securities	0	0	0	0	0
Inventory	1,453	1,575	1,638	1,538	1,595
Other Current Assets	318	599	636	868	818
Total Current Assets	6,201	6,930	6,894	7,622	7,654
Net Property, Plants	2,127	3,095	3,646	3,868	3,778
Other Assets	79	87	128	165	443
Total Assets	8,407	10,112	10,668	11,655	11,875
Total Current Liabilities	1,825	2,414	2,394	3,290	4,091
Long-Term Debt	269	124	136	$150	150
Other Liabilities	20	63	102	$33	10
Total Liabilities	2,114	2,601	2,632	3,473	4,251
Converted Preferred Stock	0	0	0	0	0
Common Stock	130	130	130	130	130
Other Equity	1,753	1,917	1,540	1,795	2,149
Retained Earnings	4,410	5,464	6,366	6,257	5,345
Total Shareholders' Equity	6,293	7,511	8,036	8,182	7,624
Total Liabilities and Shareholders' Equity	8,407	10,112	10,668	11,655	11,875

Source: Digital Equipment Corporation Annual Reports
Dataquest (December 1991)

Table 4
Consolidated Income Statement
Fiscal Year Ending in June
(Millions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1987	1988	1989	1990	1991
Revenue	9,389	11,475	12,742	12,943	13,911
Domestic Revenue	4,976	5,746	7,952	7,743	7,787
Overseas Revenue	4,413	5,729	4,790	5,200	6,124
Cost of Sales	4,514	5,468	6,242	6,795	7,278
R&D Expense	1,010	1,307	1,525	1,614	1,649
SG&A Expense	2,253	3,066	3,639	3,971	4,471
Capital Expense	748	1,518	1,223	1,028	738
Pretax Income	1,689	1,740	1,421	124	520
Pretax Margin (%)	17.99	15.16	11.15	0.96	3.74
Effective Tax Rate (%)	32.70	25.00	24.50	40.00	18.80
Net Income	1,137	1,306	1,073	74	(617)
Shares Outstanding, Millions	133.3	131.9	122.0	123.0	125.0
Per Share Data					
Earnings	8.53	9.90	8.45	0.59	(5.08)
Dividend	0	0	0	0	0
Book Value	47.21	56.94	65.87	66.52	60.99

Source: Digital Equipment Corporation Annual Reports
Dataquest (December 1991)

Table 5
Key Financial Ratios
Fiscal Year Ending in June

Key Financial Ratios	1987	1988	1989	1990	1991
Liquidity					
Current (Times)	3.40	2.87	2.88	2.32	1.87
Total Assets/Equity (%)	133.59	134.63	132.74	142.44	155.76
Current Liabilities/Equity (%)	29.00	32.14	29.79	40.21	53.66
Total Liabilities/Equity (%)	33.59	34.63	32.75	42.45	55.76
Profitability (%)					
Return on Assets	13.52	12.92	10.06	0.63	(5.20)
Return on Equity	18.07	17.39	13.35	0.90	(8.09)
Profit Margin	12.11	11.38	8.42	0.57	(4.44)
Other Key Ratios					
R&D Spending % of Revenue	10.76	11.39	11.97	12.47	11.85
Capital Spending % of Revenue	7.97	13.23	9.60	7.94	5.31
Employees	110,500	121,500	125,800	124,000	121,000
Revenue ($K)/Employee	84.97	94.44	101.29	104.38	114.97
Capital Spending % of Assets	8.90	15.01	11.47	8.82	6.21

Source: Digital Equipment Corporation Annual Reports
Dataquest (December 1991)

E. I. du Pont de Nemours and Company

1007 Market Street
Wilmington, Delaware 19898
Telephone: (302) 774-1000
Fax: (302) 724-9560
Dun's Number: 00-1131-5704

Date Founded: 1802

CORPORATE STRATEGIC DIRECTION

E. I. du Pont de Nemours and Company was founded in 1802 and incorporated in Delaware in 1915. The Company consists of six primary business segments: industrial products; fibers; polymers; petroleum; coal; and diversified businesses consisting of electronics, imaging systems, agricultural products, and medical products.

Du Pont has approximately 85 major businesses selling a wide array of products to many different markets that include energy, transportation, textile, construction, electronics, health care, packaging, and agriculture. Business operations of Du Pont and its subsidiaries exist in approximately 60 countries.

Total revenue increased by 10 percent to $36 billion* in fiscal 1989 from $33 billion in fiscal 1988. Net income increased 13 percent to $2.5 billion in fiscal 1989 from $2.2 billion in fiscal 1988. Du Pont employs 145,787 people worldwide.

R&D expenditure totaled $1.4 billion in fiscal 1989, representing 4 percent of revenue. Most R&D is performed internally, although some research is accomplished within joint ventures for a few embryonic businesses. R&D focus at present is being placed on health sciences, agricultural products, electronics, new imaging systems, and advanced materials.

Du Pont maintains two large research centers near Wilmington, Delaware: The Experimental Station engages in research of a fundamental, exploratory, and applied nature; the Chestnut Run Laboratories are concerned principally with technical activities related to the end-use performance and requirements of Company products. Du Pont conducts research at facilities in Ponaca City, Oklahoma, for new products and new petroleum business technology, and in Library, Pennsylvania, for coal businesses. Internationally, major research facilities are located in Canada, Belgium, Germany, Switzerland, and Japan.

Capital spending totaled $5 billion in fiscal 1989, representing 14 percent of revenue.

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 dollars amounts are in US dollars.

BUSINESS SEGMENT STRATEGIC DIRECTION

Industrial Products

In fiscal 1989, the industrial products business segment had sales of $3.7 billion. Industrial products comprise a wide range of commodity and specialty products that include white pigments, organic chemicals, polymer intermediates, fluorochemicals, petroleum additives, and mineral acids. These products are used in the construction, transportation, petroleum, agricultural, coatings, paper, cleaning agents, and textile industries.

Fibers

Du Pont produces the most extensive family of man-made fibers in the world. In fiscal 1989, the fibers business segment had sales of $6 billion. Developed through material and processing expertise, new fiber systems are being used wherever high performance is required—from advanced composites to protective apparel, active sportswear, and floor coverings.

Polymer Products

Du Pont's polymer products are used by a wide array of industries that include transportation, packaging chemical processing, construction, electrical/electronics, paper, adhesives, and textiles. Product lines include engineering polymers, ethylene polymers, elastomers, fluoropolymers, films, acrylics, membranes, and fabricated parts. In fiscal 1989, the polymer products business segment had sales of $5.6 billion.

Petroleum Exploration and Production

In fiscal 1989, the petroleum exploration and production business segment group had sales of $12.3 billion. Du Pont's petroleum operations are conducted through its Conoco subsidiary. Exploration activities are conducted worldwide, with crude oil produced in the United States, Canada, the United Kingdom, Norway, the Netherlands, Egypt, Dubai, and Indonesia. Natural gas is sold in the United States, Canada, the United Kingdom, and Norway.

Coal

In fiscal 1989, the coal business segment's sales were $1.8 billion. Du Pont's coal operations are conducted through Consolidated Coal Company (Consol), a subsidiary. Operations consist primarily of mining stream and metallurgical coal that is sold mainly to electric utilities and steel producers in the United States.

Diversified Businesses

The diversified businesses segment consists of electronics, imaging systems, agricultural products, and medical products. In fiscal 1989, the diversified businesses segment had revenue of $6.2 billion.

Electronics

Du Pont's electronics businesses seek to become a premier supplier of materials and components to the worldwide data processing, telecommunications, and information storage industries. This segment includes materials for electronic circuits; electronic components that include connectors and microelectric packages; information storage media for the audio, video, and data markets; photographic systems and products for printing and a broad array of industrial applications; finishes for the automotive, chemical, and petroleum industries; and analytical instruments for research and monitoring industrial processes. Du Pont at present ranks among the leaders of the world's broad-based material and components suppliers.

Acquisitions during 1989 concentrated on achieving a leadership position in a relatively new business—photomasks used in producing integrated circuits. New alliances were forged with National Semiconductor, SGS-Thompson, and N.V. Philips to supply them with photomasks. New plants were opened in Europe and North America.

Imaging Systems

In 1989, the imaging systems business used strategic acquisitions to improve its position as one of the top four suppliers to the world's printing industry. Howson-Algraphy, manufacturer of offset plates based in the United Kingdom, was acquired in 1989. Also, this segment expanded with the acquisitions of Imagitex and Camex. These companies provide Du Pont a strong position in the black-and-white prepress markets.

Agricultural Products

Du Pont's agricultural products include fungicides, herbicides, and insecticides.

Medical Products

The medical products segment includes a broad line of medical X-ray products; diagnostic kits, instruments, reagents, and imaging agents; prescription pharmaceuticals; and a wide range of radiolabled chemicals, biological materials, and instruments used in biomedical research.

Further Information

For more information about the Company's business segments, please contact Dataquest's Semiconductor Equipment and Materials Service.

Table 1
Five-Year Corporate Highlights (Millions of US Dollars)

	1985	1986	1987	1988	1989
Five-Year Revenue	$29,865.0	$27,421.0	$30,344.0	$32,771.0	$35,991.0
Percent Change	-	(8.18)	10.66	8.00	9.83
Capital Expenditure	$3,095.0	$2,939.0	$3,212.0	$4,207.0	$5,092.0
Percent of Revenue	10.36	10.72	10.59	12.84	14.15
R&D Expenditure	$1,144.0	$1,156.0	$1,223.0	$1,319.0	$1,387.0
Percent of Revenue	3.83	4.22	4.03	4.02	3.85
Number of Employees	146,017	141,268	140,145	140,949	145,787
Revenue ($K)/Employee	$204.53	$194.11	$216.52	$232.50	$246.87
Net Income	$1,118.0	$1,538.0	$1,786.0	$2,190.0	$2,480.0
Percent Change	-	37.57	16.12	22.62	13.24

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	$8,674.00	$9,278.00	$8,589.00	$8,993.00
Quarterly Profit	$736.00	$714.00	$547.00	$483.00

Source: E. I. du Pont de Nemours and Company
Annual Reports and Forms 10-K
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	67.98	68.41	67.09	66.63	66.31
International	32.02	31.59	32.91	33.37	33.69

Source: E. I. du Pont de Nemours and Company
Annual Reports and Forms 10-K
Dataquest (1990)

Table 3
Revenue by Distribution Channel (Percent)

Channel	1988	1989
Direct Sales	100.00	100.00
Indirect Sales	0	0

Source: Dataquest (1990)

1989 SALES OFFICE LOCATIONS

North America—80
Europe—15
Asia/Pacific—15
ROW—15

MANUFACTURING LOCATIONS

North America—35; Europe—1; Asia/Pacific—3; ROW—5

Industrial products production activities include Ti-Pure titanium dioxide, Freon fluorocarbons, sodium cyanide, hydrogen peroxide, Adi-Pure adipic acid and other polymer intermediates, sulfuric acid, formaldehyde, methanol, aniline, Tetrathane products, and fuel additives.

North America—5; Europe—2; Asia/Pacific—4; ROW—4

Electronics production activities include connectors and packaging, Riston photoresists, Kapton polyimide film, thick film and semiconductor materials and photomasks, Mylar polyester film, chromium dioxide particles, and optical disks.

North America—8; Europe—3

Imaging systems production activities include Cromalin proofing systems; Howson offset and Cyrel printing plates, chemicals and equipment; Bright Light and other silver-sensitized films and papers; a full line of color electronic systems; and color and black-and-white text systems for news, classified, and display ads for newspapers.

SUBSIDIARIES

North America

Conoco Inc.(United States)
Conoco International (United States)
Conoco Pipeline Company (United States)
Conoco Shale Company (United States)
Consolidated Coal Company (United States)
Continental Overseas Oil Company (United States)
Douglas Oil Company (United States)
Du Pont Canada Ltd. (Canada)
Du Pont Electronic Materials Inc. (Puerto Rico)
Du Pont Pharmaceutical Caribe Inc. (Puerto Rico)
Fairmont Supply Company (United States)
Kayo Oil Company (United States)
Louisiana Gas System Inc. (United States)
Remington Arms Company Inc. (United States)

Europe

Conoco Ireland Ltd. (Ireland)
Conoco Norway Inc. (Norway)
Du Pont de Nemours (Belgium)
Du Pont de Nemours B.V. (Netherlands)
Du Pont de Nemours GmbH (Germany)
Du Pont de Nemours Italiana S.p.A. (Italy)
Du Pont de Nemours International S.A. (Switzerland)
Du Pont de Nemours S.A. (France)
Du Pont de Nemours S.A. (Luxembourg)
Du Pont Iberia S.A. (Spain)
Du Pont Ltd. (United Kingdom)
Du Pont Scandinavia AB (Sweden)

Asia/Pacific

Conoco Irian Jaya Co. (Indonesia)
Du Pont China Ltd. (China)
Du Pont Company Ltd. (Thailand)
Du Pont Electronics Private Ltd. (Singapore)
Du Pont Japan Ltd. (Japan)
Du Pont Ltd. (Australia)
Du Pont Ltd. (New Zealand)
Du Pont Philippines (Philippines)
Du Pont Taiwan Ltd. (Taiwan)

ROW

Du Pont S.A. de C.V. (Mexico)
Du Pont de Brasil S.A. (Brazil)
Du Pont de Colombia S.A. (Colombia)
Du Pont de Venezuela C.A. (Venezuela)
Duclio S.A. (Argentina)
World Wide Transport Inc. (Liberia)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

Hewlett-Packard and Los Alamos National Laboratory

Du Pont, Hewlett-Packard, and the Los Alamos National Laboratory have agreed to an $11 million cooperative superconductivity R&D project. The deal, one of the biggest such pacts between industry and a government research facility, covers a three-year period and initially will be for manufacturing thin-film, high-temperature superconductors for electronics components.

Hanyang Chemical
Du Pont and Hanyang Chemical have received government approval to build a joint-venture titanium dioxide plant in South Korea that will produce 65,000 metric tons per year. Planned start-up is expected in late 1993.

Freshworld and Sunkist Growers
Freshworld, a joint venture of Du Pont and DNA Plant Technology, signed a five-year agreement with Sunkist Growers to distribute produce. Patented packaging and processing techniques developed by the joint venture produce ready-to-eat celery and carrots with a shelf life of 30 days.

Waste Management of North America
Du Pont and Waste Management of North America entered into a joint venture to build a plastics recycling plant in southwest Chicago.

Chemical Exchange Industries
Du Pont acquired worldwide marketing rights for hexamethyleneimine (HMI) from Chemical Exchange Industries.

Merck and Co., Inc.
Du Pont and Merck entered into an agreement calling for Du Pont to receive exclusive marketing rights to Sinemet, a major Parkinson's disease therapy.

Waste Management, Inc.
Du Pont and Waste Management plan joint development of a $5 million, 100,000-square-foot plastics recycling facility in the Harrowgate section of Philadelphia, Pennsylvania.

1989

Soviet Union
A discussed joint venture would have Du Pont produce and sell chemicals in the Soviet Union and be paid back in crude oil.

Biolistics
Du Pont and Biolistics entered into a licensing agreement that would have Biolistics license its biolistic gene gun technology to Du Pont.

C&C Industries
Du Pont and C&C Industries signed a marine fabrics technical and marketing pact relating to the use of woven Kevlar, along with glass fabrics, in sailboats made by C&C.

MERGERS AND ACQUISITIONS

1990

Seicor
Du Pont acquired Seicor's electronic and optoelectronic LAN component business, which produces connection devices that hook up personal computers to local area networks.

National Semiconductor
Du Pont acquired National Semiconductor's photomask operation.

1989

Howson-Algraphy
Du Pont acquired Howson-Algraphy, a leading printing plate manufacturer in the United Kingdom.

KEY OFFICERS

Edgar S. Woolard, Jr.
Chairman of the board, chief executive officer

Constantine S. Nicandros
Executive vice president

Charles L. Henry
Group vice president, Electronics

Mark A. Suwyn
Group vice president, Imaging Systems

J. Edward Newall
Group vice president, International

Alexander MacLachlan
Senior vice president, Technology

PRINCIPAL INVESTORS

Charles R. Bronfman—22.9 percent
Edgar M. Bronfman—22.9 percent

FOUNDERS

Information is not available.

Table 4
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of US Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$8,876.0	$8,960.0	$9,953.0	$10,238.0	$11,344.0
Cash	583.0	584.0	756.0	603.0	692.0
Receivables	4,044.0	3,771.0	4,376.0	4,815.0	5,298.0
Inventory	3,873.0	4,253.0	4,342.0	4,467.0	4,910.0
Other Current Assets	376.0	352.0	479.0	353.0	444.0
Net Property, Plants	$15,195.0	$15,697.0	$15,854.0	$17,221.0	$18,876.0
Other Assets	$1,069.0	$2,076.0	$2,402.0	$3,260.0	$4,495.0
Total Assets	$25,140.0	$26,733.0	$28,209.0	$30,719.0	$34,715.0
Total Current Liabilities	$5,311.0	$5,636.0	$6,140.0	$6,696.0	$9,348.0
Long-Term Debt	$3,191.0	$3,227.0	$3,018.0	$3,158.0	$4,080.0
Other Liabilities	$3,979.0	$4,496.0	$4,807.0	$5,285.0	$5,489.0
Total Liabilities	$12,481.0	$13,359.0	$13,965.0	$15,139.0	$18,917.0
Total Shareholders' Equity	$12,659.0	$13,374.0	$14,244.0	$15,580.0	$15,798.0
Converted Preferred Stock	237.0	237.0	237.0	237.0	237.0
Common Stock	401.0	400.0	398.0	399.0	411.0
Other Equity	3,761.0	3,670.0	3,621.0	4,595.0	4,399.0
Retained Earnings	8,260.0	9,067.0	9,988.0	10,349.0	10,751.0
Total Liabilities and Shareholders' Equity	$25,140.0	$26,733.0	$28,209.0	$30,719.0	$34,715.0
Income Statement	**1985**	**1986**	**1987**	**1988**	**1989**
Revenue	$29,865.0	$27,421.0	$30,344.0	$32,771.0	$35,991.0
US Revenue	20,301.0	18,758.0	20,358.0	21,834.0	23,865.0
Non-US Revenue	9,564.0	8,663.0	9,986.0	10,937.0	12,126.0
Cost of Sales	$17,898.0	$15,129.0	$16,613.0	$17,900.0	$19,604.0
R&D Expense	$1,144.0	$1,156.0	$1,223.0	$1,319.0	$1,387.0
SG&A Expense	$2,077.0	$2,350.0	$2,716.0	$3,065.0	$3,377.0
Capital Expense	$3,095.0	$2,939.0	$3,212.0	$4,207.0	$5,092.0
Pretax Income	$3,195.0	$2,985.0	$3,588.0	$3,797.0	$4,324.0
Pretax Margin (%)	10.70	10.89	11.82	11.59	12.01
Effective Tax Rate (%)	65.00	48.50	50.20	42.30	42.60
Net Income	$1,118.0	$1,538.0	$1,786.0	$2,190.0	$2,480.0
Shares Outstanding, Millions	240.6	240.0	238.8	718.3	685.3
Per Share Data					
Earnings	$4.61	$6.35	$2.46	$3.04	$3.53
Dividend	$3.00	$3.05	$3.30	$1.23	$1.45
Book Value	$52.61	$55.73	$59.65	$21.69	$23.05

Table 4 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of US Dollars, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	1.67	1.59	1.62	1.53	1.21
Quick (Times)	0.94	0.84	0.91	0.86	0.69
Fixed Assets/Equity (%)	120.03	117.37	111.30	110.53	119.48
Current Liabilities/ Equity (%)	41.95	42.14	43.11	42.98	59.17
Total Liabilities/ Equity (%)	98.59	99.89	98.04	97.17	119.74
Profitability (%)					
Return on Assets	-	5.93	6.50	7.43	7.58
Return on Equity	-	11.82	12.93	14.69	15.81
Profit Margin	3.74	5.61	5.89	6.68	6.89
Other Key Ratios					
R&D Spending % of Revenue	3.83	4.22	4.03	4.02	3.85
Capital Spending % of Revenue	10.36	10.72	10.59	12.84	14.15
Employees	146,017	141,268	140,145	140,949	145,787
Revenue ($K)/Employee	$204.53	$194.11	$216.52	$232.50	$246.87
Capital Spending % of Assets	12.31	10.99	11.39	13.70	14.67

Source: E. I. du Pont de Nemours and Company
Annual Reports and Forms 10-K
Dataquest (1990)

General Signal Corporation

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P.O. Box 10010
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Telephone: (203) 329-4100
Fax: (203) 329-4159
Dun's Number: 00-246-4100

Date Founded: 1904

CORPORATE STRATEGIC DIRECTION

General Signal Corporation produces instrumentation and controls and related systems and equipment for semiconductor production, telecommunications transmission, test and measurement, industrial automation, management of electrical energy, and transportation. General Signal serves these markets through four product areas: process controls, technology industries, electrical controls, and transportation controls.

In 1989, General Signal positioned itself for stronger worldwide sales and income growth through a series of reorganizations and consolidations in its Transportation Controls, Electrical Controls, and Technology Industries sectors, including combining Technology Industries' foreign semiconductor equipment operations into a single international unit. In addition, General Signal acquired four new businesses: GCA, Spectron, Hydromatic Pumps, and Turbo-Mueller. General Signal plans to continue pursuing these types of product line acquisitions with the purpose of sharpening its business focus and adding critical mass to its operating units.

Total revenue increased 9 percent to $1.9 billion* in fiscal 1989 from $1.76 billion in fiscal 1988. Net income increased 211 percent to $78.5 million in fiscal 1989 from $25.2 million in fiscal 1988. General Signal employs 19,377 worldwide.

Research and development expenditures totaled $111.1 million in fiscal 1989, representing about 6.0 percent of revenue. Capital spending expenditures totaled $62.0 million in fiscal 1989, representing about 3.2 percent of revenue.

*All dollar amounts are in U.S. dollars.

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.

BUSINESS SEGMENT STRATEGIC DIRECTION

Technology Industries

After two years of losses, the Technology Industries sector posted operating earnings of $8.2 million on a sales increase of 8.8 percent in fiscal 1989. Strategic consolidations among international operations, the merging of domestic photolithography sales and service organizations, and the broad support of Sematech, the principal domestic consortium dedicated to U.S. preeminence in semiconductor manufacturing technology, helped position General Signal to meet the industry's evolving product and service needs.

The 1988 reorganization of General Signal's telecommunications equipment group into clearly defined product and market segments paid off in 1989 as each of its four business units measured significant performance gains. The Company's data-network equipment manufacturer of network restoration systems is now the largest in the world and one of the most diversified suppliers of data communications test and control equipment.

Process Controls

The Process Controls sector had sales revenue of $726.5 million with an operating margin of 11.2 percent in fiscal 1989. This sector benefited from a general economic expansion fueled by high-capacity utilization and strong export demand in its major markets, which include the chemical, minerals, pharmaceutical, water/wastewater, and pulp-and-paper processing industries.

General Signal's mixing equipment operation maintained its world leadership position by meeting a heightened demand for agitator equipment. The Company's A-315 impeller, originally designed for fermentation technology, has been extended to other gas-liquid processing applications. General Signal also constructed a unique high-pressure, high-temperature oxidation test facility for gold processing and has installed flexible machining centers to boost productivity and reduce product costs.

Demand for the Company's industrial valves continued strong in 1988. General Signal introduced a cage-retained globe valve to control corrosive liquids and gases at temperatures from -100°F to 1,400°F. Export sales were paced by major orders from Korea and Mexico.

With former unit BIF's instrumentation and supervisory control and data acquisition systems merged into L&N product lines, General Signal fortified its offerings to the municipal water and wastewater treatment market.

General Signal provided software and hardware enhancements to its line of LN700 energy management systems, for both large and medium-size utilities and industrial companies. For small to medium-size applications, General Signal developed a series of software packages for its MICRO-MAX process management center. The Company also introduced a hybrid multipoint recorder, the SPEEDOMAX 25000, which combines features of analog strip-chart recorders and programmable digital data loggers.

General Signal's coal feeder and weighing products business developed a continuous coal analyzer to improve operating efficiency and ensure the environmental compliance of sulfur emissions in coal-fired plants.

General Signal's industrial pump sector improved its standing on major distribution and licensing agreements for a broad range of submersible pumps; it also acquired Hydromatic Pumps, a manufacturer of pumps for residential, commercial, and municipal applications, in 1989. A new pump developed specifically for the vacuum food-packaging industry and the introduction of foreign service centers in Italy, Taiwan, and the United Kingdom led to a successful year for the Company's vacuum pump business: Export sales increased more than 50 percent in 1987.

Electrical Controls

The Electrical Controls sector had record sales of $421.4 million with an operating margin of 11.5 percent in fiscal 1989. The strongest sales increases were derived from this sector's electrical fittings, transformer and power distribution, and fire alarm and signaling operations.

General Signal's power protection products operations experienced record sales in 1989 for uninterruptible power systems, standby power sources, and power conditioning units. To meet future market demands, a new regulating standby power source and a compact uninterruptible power system have been developed.

General Signal's line of totally encapsulated industrial control transformers was improved in 1988; primary and secondary fusing features now comply with new industrial safety requirements. In addition, General Signal expanded its soft-seal firestop product line in 1988 and introduced a microprocessor-based monitoring system for complex heat-trace applications. Also, General Signal introduced in 1988 a minimum-wire microprocessor-based fire alarm system for small buildings, a new line of emergency lighting products, and a field-programmable analog fire alarm system for high-rises.

Transportation Controls

This sector's net sales were $289 million in fiscal 1989, with an operating margin of 7.4 percent, compared with a 2.9 percent operating margin in fiscal 1988.

In fiscal 1989, General Signal manufactured 700 locomotives requiring advanced equipment such as General Signal's CCL Locomotive Control System for monitoring and regulating speed, braking, and critical electronic subsystems.

In fiscal 1988, General Signal combined its mainline railroad and transit signaling, communications, braking, and revenue control systems operations into one group. Close to 30,000 new freight cars were ordered in 1988, the highest level in eight years. The Company's development of the CCL locomotive control system has been sparked by parallel growth in the market for new and rebuilt locomotives.

In fiscal 1988, General Signal's rail signaling operation received major orders for signaling and speed control equipment on rail lines in Boston, Los Angeles, and Washington D.C. Also in 1988, the Company received a $9 million contract to provide automatic vehicle identification equipment for the national railroad of Spain.

General Signal continued to penetrate the bus fleet management systems market in fiscal 1988 with the first phase of a $29 million order from the Southern California Rapid Transit District. The Company will supply a system that provides vehicle location, passenger, and routing data; radio communication between vehicles and a central control office; and an emergency communications network for transit police.

Further Information

For more 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	$1,800.9	$1,583.4	$1,603.0	$1.760.2	$1,918.3
Percent Change	-	(12.08)	1.24	9.81	8.98
Capital Expenditure	$68.1	$45.7	$34.0	$38.8	$62.0
Percent of Revenue	3.78	2.89	2.12	2.20	3.23
R&D Expenditure	$100.7	$98.0	$105.4	$115.6	$111.1
Percent of Revenue	5.59	6.19	6.58	6.57	5.79
Number of Employees	22,312	20,180	19,126	19,082	19,377
Revenue ($K)/Employee	$80.71	$78.46	$83.81	$92.24	$99.00
Net Income	$49.3	$74.6	$69.4	$25.2	$78.5
Percent Change	-	51.32	(6.97)	(63.69)	211.51

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	$478.41	$488.54	$473.83	$477.50
Quarterly Profit	$19.82	$18.67	$17.92	$22.10

Source: General Signal Corporation
Annual Reports and Forms 10-K
Dataquest
1990

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	91.31	88.63	88.02	87.43	86.48
International	8.69	11.37	11.98	12.57	13.52
Japan	-	-	-	-	-
Europe	-	-	-	-	-
Asia/Pacific	-	-	-	-	-
ROW	-	-	-	-	-

Source: General Signal Corporation
Annual Reports and Forms 10-K
Dataquest
1990

Table 3
Revenue by Distribution Channel (Percent)

Channel	1988	1989
Direct Sales	-	-
Indirect Sales	-	-
VARs	-	-
Distributors	-	-
Dealers	-	-
Mass Merchandisers	-	-
Manufacturers' Representatives	-	-

Source: Dataquest
1990

1989 SALES OFFICE LOCATIONS

Information is not available.

MANUFACTURING LOCATIONS

Stamford, Connecticut

Manufacturing activities include process controls, semiconductor equipment, telecommunications equipment, defense electronics, and electrical controls manufactured through 30 operating units. The Company manufactures many of the components used in its products but also purchases a variety of basic materials and component parts. Also, General Signal is both a licenser and licensee of patents and realizes more income than expense from such arrangements.

SUBSIDIARIES

North America

Aerotronic Associates Inc. (United States)
Assembly Technologies (United States)
Aurora/Hydromatic Pumps Inc. (United States)
Drytek Inc. (United States)
Edwards Company, Inc. (United States)
Electric Panelboard Company (United States)
GCA Corporation-Nevada Corp. (United States)
GCA Overseas Corp. (United States)
GCA Technology Division (United States)
GSA Disc Inc. (United States)
General Signal A.S.G.M. Corp. (United States)
General Signal Controls Inc. (United States)
General Signal FSC Corp. (United States)
General Signal Holdings Co. (United States)
General Signal Ltd. (Canada)
G.R.S. Trading Corp. (United States)
Leeds and Northrup Co. (United States)
Old Company (United States)
Serveng Inc. (United States)
Sola Basic Puerto Rico Inc. (United States)
Telenex Corp. (United States)
The Merrick Corporation (United States)
Thun Inc. (United States)
Xynetics Divestiture Corp. (United States)

Japan

General Signal Kabushiki Kaisha
Stock Japan Ltd.

Europe

Algemen Sein Industrie B.V. (Netherlands)
General Railway Signal Co. Ltd. (United Kingdom)
General Signal SEG GmbH (West Germany)
General Signal SEG Ltd. (United Kingdom)
General Signal SEG SARL (France)
Leeds and Northrup GmbH (Germany)
Leeds and Northrup Italy S.r.l. (Italy)
Leeds and Northrup Ltd. (United Kingdom)
Leeds and Northrup S.A. (Spain)
Leeds and Northrup S.A.R.L. (France)
Misurazioni Industiali S.r.l. (Italy)
Misurazioni Industiali Trading S.r.l. (Italy)
Xynetics (Netherlands) B.V. (Netherlands)

Asia/Pacific

General Signal SEG Asia Ltd. (Hong Kong)
Leeds and Northrup Australia Pty. Ltd. (Australia)
Sola Basic Australia Ltd. (Australia)

ROW

Leeds and Northrup Mexicana S.A. (Mexico)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1989

Olin Hunt Specialty Products

General Signal and Olin Hunt Specialty Products agreed to set up a joint technical center in Belgium for development of a new application of wafer fabrication equipment and advanced materials. Olin Hunt currently provides photoresists to General Signal.

1987

Cognex

General Signal's Electroglas subsidiary used Cognex's MVS in its wafer prober product line. The nonexclusive agreement called for Cognex to provide its Cognex 2000 single-board vision system used to detect problems in alignment, gauging, inspection, and identification.

MERGERS AND ACQUISITIONS

1989

Atlantic Research Corporation Teleproducts Division

General Signal acquired the teleproducts division of Atlantic Research Corporation, a leading manufacturer of data communication protocol analyzers for both the WAN and LAN markets. Atlantic Research also manufactures a broad line of switching and patching equipment and network test, restoration, and management systems.

International Mirtone Production Operations

General Signal acquired International Mirtone's production operations. International Mirtone produces fire alarm equipment.

Suitomo GCA

General Signal merged its Japanese subsidiary with Suitomo GCA to form a new joint company, General Signal Japan. General Signal hopes the merger will improve its current lackluster domestic sales of steppers, etching devices, and probers, and hopes the existing joint venture will expand its lineup by using technical and maintenance personnel at General Signal.

Marley Pump Hydromatic Division

General Signal acquired Marley Pump's Hydromatic division, which makes pumps for residential, commercial, and municipal applications.

GCA

General Signal acquired GCA, a semiconductor equipment manufacturer. Through the acquisition, General Signal will make gains in the area of stepper lenses and, possibly, in the areas of short-wave length optical technology, X-ray, and e-beam technologies.

1988

Spectron

General Signal acquired Spectron, which will operate as General Signal's Telenex subsidiary. Spectron manufactures and sells data test systems and products.

KEY OFFICERS

Edmund M. Carpenter
Chairman and chief executive officer

Joel S. Friedman
Senior vice president, Operations

Peter A. Laing
Senior vice president, Operations

George Falconer
Vice president, Human Resources

J. Roberts Hipps
Vice president and controller

PRINCIPAL INVESTORS

J.P. Morgan and Company Inc.—8.6 percent
American Express Company—5.6 percent
Teachers Retirement System of Texas—5.5 percent

Table 4
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of U.S. Dollars, except Per Share Data)

Balance Sheet	**1985**	**1986**	**1987**	**1988**	**1989**
Total Current Assets	$927.0	$887.2	$867.8	$892.0	$774.0
Cash	30.3	43.6	82.9	81.4	22.9
Receivables	324.0	296.3	330.8	360.6	348.2
Marketable Securities	47.4	80.1	13.1	27.1	1.5
Inventory	426.7	360.4	343.1	372.8	324.3
Other Current Assets	98.6	106.8	97.9	50.1	77.1
Net Property, Plants	$361.5	$345.6	$310.6	$312.5	$325.1
Other Assets	$194.7	$225.3	$219.0	$192.1	$225.2
Total Assets	$1,483.2	$1,458.1	$1,397.4	$1,396.6	$1,324.3
Total Current Liabilities	$406.3	$351.0	$326.9	$395.6	$445.2
Long-Term Debt	$124.0	$124.3	$110.5	$491.7	$331.2
Other Liabilities	$48.9	$55.5	$52.8	$48.3	$41.8
Total Liabilities	$579.2	$530.8	$490.2	$935.6	$818.2
Total Shareholders' Equity	$904.0	$927.3	$907.2	$461.0	$506.1
Converted Preferred Stock	-	-	-	-	-
Common Stock	40.4	40.5	40.7	41.8	41.9
Other Equity	197.8	204.0	224.2	293.9	300.0
Retained Earnings	689.4	712.3	731.0	705.2	749.3
Less: Treasury Stock	(23.6)	(29.5)	(88.7)	(579.9)	(585.1)
Total Liabilities and Shareholders' Equity	$1,483.2	$1,458.1	$1,397.4	$1,396.6	$1,324.3

Income Statement	**1985**	**1986**	**1987**	**1988**	**1989**
Revenue	$1,800.9	$1,583.4	$1,603.0	$1,760.2	$1,918.3
U.S. Revenue	1,644.4	1,403.4	1,410.9	1,538.9	1,659.0
Non-U.S. Revenue	156.5	180.0	192.1	221.3	259.3
Cost of Sales	$1,278.6	$1,114.6	$1,151.5	$1,266.7	$1,378.0
R&D Expense	$100.7	$98.0	$105.4	$115.6	$111.1
SG&A Expense	$372.7	$348.7	$356.0	$418.6	$403.6
Capital Expense	$68.1	$45.7	$34.0	$38.8	$62.0
Pretax Income	$80.2	$117.5	$96.9	$52.8	$106.5
Pretax Margin (%)	4.45	7.42	6.04	3.00	5.55
Effective Tax Rate (%)	38.60	36.50	28.40	52.30	26.30
Net Income	$49.3	$74.6	$69.4	$25.2	$78.5
Shares Outstanding, Thousands	28,706.0	28,730.0	28,239.0	27,709.0	19,056.0
Per Share Data					
Earnings	$1.72	$2.60	$2.46	$0.91	$4.12
Dividends	$1.80	$1.80	$1.80	$1.80	$1.80
Book Value	$31.50	$32.31	$32.13	$16.64	$26.57

Table 4 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of U.S. Dollars, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	2.28	2.53	2.65	2.25	1.74
Quick (Times)	1.23	1.50	1.61	1.31	1.01
Fixed Assets/Equity (%)	39.99	37.27	34.24	67.79	64.24
Current Liabilities/Equity (%)	44.94	37.85	36.03	85.81	87.97
Total Liabilities/Equity (%)	64.07	57.24	54.03	202.95	161.67
Profitability (%)					
Return on Assets	-	5.07	4.86	1.80	5.77
Return on Equity	-	8.15	7.57	3.68	16.23
Profit Margin	2.74	4.71	4.33	1.43	4.09
Other Key Ratios					
R&D Spending % of Revenue	5.59	6.19	6.58	6.57	5.79
Capital Spending % of Revenue	3.78	2.89	2.12	2.20	3.23
Employees	22,312	20,180	19,126	19,082	19,377
Revenue ($K)/Employee	$80.71	$78.46	$83.81	$92.24	$99.00
Capital Spending % of Assets	4.59	3.13	2.43	2.78	4.68

Source: General Signal Corporation
Annual Reports and Forms 10-K
Dataquest
1990

Hitachi Ltd.

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4-chome, Chiyuoda-ku
Tokyo 101, Japan
Telephone: (03) 258-1111
Fax: (03) 253-2186
Dun's Number: 69-054-1503

Date Founded: 1910

CORPORATE STRATEGIC DIRECTION

Hitachi Ltd. was founded to develop indigenous Japanese electrical power equipment manufacturing technology. Initially, the company emphasized the development of heavy electrical equipment and industrial machinery. After World War II, Hitachi expanded into the consumer product area and in the 1950s entered the electronics field, producing computers, semiconductors, and other electronic devices.

Over the years, most of Hitachi's business operations involved large equipment such as power plants and industrial machinery. The plant-as-profit-center concept was the basis of the management system. Today, however, a large percentage of Hitachi's business relates to electric and electronic consumer goods, office automation equipment, and other mass-market products.

Under the new system, the business divisions make the decisions regarding product development and coordinate the work of the laboratory, plant, and sales division in all phases of the development process, from R&D to marketing. This new system created the Semiconductor Design and Development Center and the Institute of Advanced Business Systems, as well as a system for promoting the development and marketing of new products in new business fields. During 1990, the office computer system design operations, which had been split between two works, were consolidated under the newly established Center for Small-Scale Processors and Workstations Development. Thus, a new profit center was created under the wing of the computer division.

Hitachi also consolidated the operations of its subsidiaries in each of the three major regions—United States, Europe, and Asia—where the company has production and marketing bases. Hitachi also made an effort to expand production at overseas sites. As part of this expansion, a company was set up in France for manufacturing computer products. Hitachi also increased the production capacity of a number of bases in other parts of the world.

During fiscal year 1991, operating income was held back by the high value of the yen, the economic slowdown in the United States and Europe, and the transition to a new generation of products in key computer and semiconductor sectors. In order to offset these factors, Hitachi increased its plant and equipment investment by 19 percent to ¥781,488 million (U.S.$55.6 million). (Percentage changes refer only to ¥ amounts; U.S.$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) Most of these funds were used to strengthen and consolidate the computer and semiconductor operations.

Hitachi's consolidated revenue of ¥7,737.0 billion (U.S.$54.8 billion) for fiscal 1991 was an increase of 10.65 percent from ¥7,077.8 billion (U.S.$49.5 billion) during fiscal 1990.

Hitachi is divided into four separate segments: Information Systems and Electronics, Power and Industrial Systems, Consumer Products, and Materials and Others. Information Systems and Electronics was the largest contributor of revenue with 34 percent or ¥2,781,351 million (U.S.$19,798 million); Power and Industrial Systems contributed 28 percent or ¥2,357,892 million (U.S.$16,783 million); Materials and Others contributed 25 percent or ¥2,100,870 million (U.S.$14,953 million); and Consumer Products contributed 13 percent or ¥1,107,388 million (U.S.$7,882 million).

Net income increased by 10.4 percent to ¥230.2 billion (U.S.$1.6 billion) for fiscal 1991, compared with ¥211.0 billion (U.S.$1.5 billion) in fiscal 1990. The improved results were attributed to the company's steady expansion on a worldwide scale. Hitachi employs more than 290,000 people worldwide.

Research and development expenditure increased to ¥490.7 billion (U.S.$3.5 billion) and represented 6.3 percent of total revenue for the period. Over 60 percent of this expenditure was channeled into the Information Systems and Electronics division. During 1990, Advanced Research Laboratory was relocated to Saitama Prefecture, Japan. This laboratory concentrates on long-term research projects with a duration of 10 to 20 years. It is currently engaged in research in the areas of quantum measurement, software science, biotechnology, and materials science.

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 through 7 at the end of this backgrounder provide comprehensive financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Semiconductors

During calendar year 1990, Hitachi was the third largest worldwide semiconductor manufacturer with U.S.$3,893 million, representing a 6.7 percent market share. Dataquest estimates the company's single largest market to be Japan, which generated approximately U.S.$2.8 million, representing 12.1 percent of the semiconductor market during 1990. Dataquest ranks Hitachi third of all Japanese companies in this market. Hitachi's next largest market is North America, where Hitachi's sales were U.S.$517 million in calendar 1990, ranking eighth, with a 3.0 percent market share.

Hitachi was the third largest worldwide supplier of MOS memory in 1990, accounting for approximately U.S.$1,366 million in revenue worldwide. This represented a 10 percent share of the worldwide market, which is an increase of about 10 percent over 1989.

In the second half of 1990, the supply of MOS memories exceeded demand, increasing the downward pressure on prices. Therefore, as a result of industry cutbacks in the production of 1Mb DRAMs implemented in fall 1990, prices stabilized. During the latter half of 1990, there was a growing demand for 4Mb DRAMs for use in new workstations and 32-bit personal computers. According to Dataquest estimates, Hitachi increased its DRAM market share from 8.5 percent in 1989 to 9.7 percent in 1990, and the company ranked fourth worldwide in DRAM production, accounting for U.S.$697 million in revenue.

Computers

During fiscal 1990, Hitachi introduced the large-scale general-purpose HITACHI M-880 Processor Group. This system will become a mainstay product in Hitachi's computer operations. In addition, the technology involved will be applied extensively in other products. During 1990, in the business computer market, Hitachi had a 12.45 percent worldwide market share and ranked third in supercomputers. In mainframes, it ranked second with a 7.40 percent worldwide market share. In the technical computer market, Hitachi had a 2.09 percent worldwide market share and ranked tenth in supercomputers. In mainframes, it ranked third with a 7.79 percent worldwide market share. In the personal computer market, Hitachi had less than one percent of the market.

Computer Storage

In addition to introducing the HITACHI M-880, the company also introduced the H-6587 series of mass-storage magnetic disk storage subsystems for large computers. Dataquest estimates that Hitachi ranks third in the worldwide total optical disk drive market with 11.5 percent of the market and U.S.$23.4 million in 1990 revenue. In the CD-ROM optical disk drive market, Hitachi ranks second worldwide with revenue of U.S.$10.4 million and a market share of 17.5 percent. Hitachi also ranks third in the worldwide 12-inch WORM optical disk drive market with a 20 percent market share and U.S.$13 million in revenue.

Other Products

Hitachi's Power and Industrial Systems witnessed a 5 percent increase in fiscal 1990 sales over 1989. The main contributing factors were a higher level of industrial demand accompanying the continuing expansion of the domestic economy. Sales in Hitachi's Consumer Products division grew 10 percent in 1990 from 1989. In Japan, sales were derived from air conditioners, washing machines, and 8mm camera/recorders. Although overseas sales were severely affected by the depressed state of the U.S. market, there was a recovery in exports of color television sets and VCRs to China and brisk exports to the USSR and Eastern Europe. The Materials and Others division posted an increase of 12 percent over 1989. Hitachi Cable Ltd. achieved an increase in sales based on a combination of strong domestic demand, mostly from the electric equipment and construction industries and brisk exports. At Hitachi Metals Ltd., sales were pushed up by demand from the automobile and electronics-related industries. Active business in the electronics equipment and industries, plus a high level of new housing starts, led to increased sales for Hitachi Chemical Co. Ltd. The major part of the service sector business was derived from Hitachi Transport System. The continuing driving pace of the Japanese economy generated strong demand for freight-hauling services and produced an increase in company sales.

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 U.S. Dollars)

	1987	1988	1989	1990	1991
Five-Year Revenue	30.4	36.0	49.9	49.5	54.8
Percent Change	34.19	18.61	38.48	(0.79)	10.65
Capital Expenditure	4.1	2.7	4.0	3.6	5.3
Percent of Revenue	13.56	7.49	8.04	7.27	9.61
R&D Expenditure	1.9	2.3	2.9	3.0	3.5
Percent of Revenue	6.34	6.51	5.83	6.07	6.34
Number of Employees	161,325	159,910	274,508	290,000	310,000
Revenue ($K)/Employee	0.19	0.23	0.18	0.17	0.18
Net Income	0.6	1.0	1.4	1.5	1.6
Percent Change	38.67	60.22	46.02	2.01	10.43
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports
Dataquest (November 1991)

Table 2
Revenue by Geographic Region (Percent)

Region	1987	1988	1989	1990	1991
Japan	73.82	76.00	77.05	76.58	76.02
International	26.18	24.00	22.95	23.42	23.98

Source: Hitachi, Ltd.
Annual Reports
Dataquest (November 1991)

1991 SALES OFFICE LOCATIONS

North America—2
Europe—2
Asia/Pacific—61
Japan—50
ROW—9

MANUFACTURING LOCATIONS

North America

High Voltage Breakers, Norcross, Georgia
SF6 gas breakers
Hitachi Automotive Products, Farmingtonhills, Michigan
Electronic auto parts
Hitachi Cable Manchester Inc., Manchester, New Hampshire
Cables
Hitachi Cable Manchester Inc., New Albany, Indiana
Automobile brake hose
Hitachi Computer Products (America), Norman, Oklahoma
Computer products (magnetic disk devices, magnetic tape cartridges)
Hitachi Construction Machinery Corp., Brampton, Ontario
Excavators, cranes, tunnel shield machines
Hitachi Electronic Devices USA Inc., Greenville, South Carolina
Color picture tubes
Hitachi Home Electronics of America, Anaheim, California
Color TVs, VCRs
Hitachi Denshi (Canada) Ltd., Scarborough, Ontario
Broadcast and professional video, CCTV equipment, test and instrumentation
Hitachi (HSC) Canada Inc., Pointe Claire, Quebec
TVs, VCRs, and household electric appliances
Hitachi Instruments Inc.
Medical instruments
Hitachi Semiconductor (America), Irving, Texas
Semiconductors
Hitachi Telecom, Norcross, Georgia
Digital PBXs

Europe

Hitachi Consumer Products (Europe), Germany
VCRs
Hitachi Consumer Products (U.K.), United Kingdom
Color TVs
Hitachi Semiconductor Europe, Germany
Semiconductors

Asia/Pacific

Akita Electronic Co., Akita, Japan
MOS, bipolar IC
Hanshi Electric, Japan
Ignition coils for automobiles
Haramachi Semiconductor Ltd., Ibaraga, Japan
Diodes, thyristors
Hitachi Computer Engineering, Japan
Development of automatic designing systems
Hitachi Consumer Products, Malaysia
TV parts
Hitachi Consumer Products, Singapore
Color TVs, audio equipment, vacuum cleaners
Hitachi Consumer Products, Thailand
Electric fans, refrigerators, TVs, motors, air conditioners, electric rice cookers
Hitachi Cubu Electric, Japan
Switchboards
Hitachi Denshi, Japan
Communications equipment, measuring instruments, information equipment
Hitachi Electronic Devices, Singapore
Color CRTs
Hitachi Electronics Engineering, Japan
Information equipment, semiconductor devices, energy-saving equipment
Hitachi Elevator Engineering, Singapore
Elevators, escalators
Hitachi Engineering, Japan
Electric/electronic equipment, plant engineering
Hitachi Haramachi Semiconductor, Japan
Semiconductor parts
Hitachi Kiden Kogyo, Japan
Cranes, water treatment equipment, FA-related equipment
Hitachi Kyowa Kogyo, Japan
Electric equipment
Hitachi Maxell, Japan
Dry batteries, magnetic tapes, electronic devices
Hitachi Medical, Japan
Medical equipment
Hitachi Microcomputer Engineering, Tokyo, Japan
MPUs, ASICs
Hitachi Mizusawa, Japan
Transformers for TVs
Hitachi Naka Seiki, Japan
Chromatographic equipment, scientific instruments
Hitachi Nissin Electronics, Japan
Electronic parts

Hitachi Ohira Industrial, Japan
Parts for refrigerators, air conditioners
Hitachi Process Computer Engineering, Japan
Process computers
Hitachi Semiconductor, Malaysia
Semiconductors
Hitachi Setsubi Engineering, Japan
FA equipment
Hitachi Techno Engineering, Japan
Electronic part manufacturing equipment
Hitachi Telecom Technologies, Japan
Switching systems
Hitachi Television, Taiwan
Color TVs, audio equipment, displays
Hitachi Video Engineering, Japan
Development of video equipment
Hitachi Works, Ibaraga, Japan
Discrete devices
Hitachi Yomezawa Electronic, Japan
Semiconductor elements
Hokkai Semiconductor, Hokkaido, Japan
SRAMs
Horiba Ltd., Japan
Electric measuring instruments
Japan Servo, Japan
Precision motors
Jidosha Denki Kogyo, Japan
Electrical auto parts
Kaohsiung Hitachi Electronics, Taiwan
Electronic parts, transistors, LCDs
Kokusai Electric, Japan
Electric communications equipment
Kokusan Denki, Japan
Electrical auto parts, generators, motors
Komoro Works, Nagano, Japan
Photo devices, hybrid ICs
Mobara Works, Chiba, Japan
DRAMs, CMOS logic, LCDs
Musashi Works, Tokyo, Japan
MPUs, diodes, DRAMs, SRAMs
Naka Works, Ibaraga, Japan
Semiconductor sensors, DRAMs, SRAMs
Nakayo Telecommunications, Japan
Telephone and switching systems
Nigata Works, Nigata, Japan
Linear, bipolar digital ICs
Nippon Columbia, Japan
Records, stereos, and other audio equipment
Nissin Electronics Ltd., Ibaraga, Japan
MOS
Taga Sangyo, Japan
Electric equipment
Taiwan Hitachi, Taiwan
Room air conditioners
Takasaki Works, Gunma, Japan
Bipolar and MOS ICs, EPROMs, CMOS logic
Tobu Semiconductor Ltd., Aomari, Japan
Bipolar ICs
Tobu Semiconductor Ltd., Saitama, Japan
Transistor, hybrid ICs
Tokico Ltd., Japan
Electrical auto parts and equipment
Tokyo Electronics Co., Yamanashi, Japan
Diodes, bipolar ICs
Yagi Antenna, Japan
Antennas
Yomezawa Electronic Co., Yamagata, Japan
MOS

ROW

Industrias Hitachi, Brazil
Distribution equipment, air conditioners, electronic parts, transformers, switches
Hitachi Consumer Products de Mexico, Mexico
Televisions

SUBSIDIARIES

North America

Hitachi America Ltd. (United States)
Hitachi Automotive Products (USA) Inc. (United States)
Hitachi (Canadian) Ltd. (Canada)
Hitachi Computer Products (America) Inc. (United States)
Hitachi Electronic Devices (United States)
Hitachi Farmington Technical Center (United States)
Hitachi Home Electronics of America Inc. (United States)
Hitachi Micro Systems Inc. (United States)
Hitachi Semiconductor (America) Inc. (United States)
Hitachi Telecom (USA) Inc. (United States)

Europe

Hitachi Consumer Products Europe Ltd. (United Kingdom)
Hitachi Semiconductor Europe (Germany)
Hitachi Consumer Products (Europe) (Germany)

Asia/Pacific

Asahi Kogyo Co. Ltd. (Japan)
Babcock-Hitachi K.K. (Japan)
Chuo Shoji Ltd. (Japan)

Hitachi Air Conditioning & Refrigeration Co. Ltd. (Japan)
Hitachi Australia Ltd. (Australia)
Hitachi Automobile Appliances Sales Co. Ltd. (Japan)
Hitachi Cable Ltd. (Japan)
Hitachi Chemical Co. Ltd. (Japan)
Hitachi Construction Machinery Co. Ltd. (Japan)
Hitachi Consumer Products (Malaysia) Sdn. Bhd. (Malaysia)
Hitachi Consumer Products Pte. Ltd.
Hitachi Credit Corporation (Japan)
Hitachi Electronic Components (Asia) Ltd. (Hong Kong)
Hitachi Electronic Devices (Singapore) Pte. Ltd. (Singapore)
Hitachi Denshi Ltd. (Japan)
Hitachi Electronics Engineering Co. Ltd. (Japan)
Hitachi Electronics Service Co. Ltd. (Japan)
Hitachi Elevator Engineering and Service Co. Ltd. (Japan)
Hitachi Engineering Co. Ltd. (Japan)
Hitachi Heating Appliances Co. Ltd. (Japan)
Hitachi Higashi Shohin Engineering Ltd. (Japan)
Hitachi Hokkai Semiconductor Ltd. (Japan)
Hitachi Kiden Kogyo Ltd. (Japan)
Hitachi Lighting Ltd. (Japan)
Hitachi Machinery and Engineering Ltd. (Japan)
Hitachi Maxell Ltd. (Japan)
Hitachi Medical Corporation (Japan)
Hitachi Metals Ltd. (Japan)
Hitachi Mokuzai Jisho Ltd. (Japan)
Hitachi Nishi Shohin Engineering Ltd. (Japan)
Hitachi Plant Engineering & Construction Co. Ltd. (Japan)
Hitachi Power Engineering Co. Ltd. (Japan)
Hitachi Printing Co. Ltd. (Japan)
Hitachi Sales Corporation (Japan)
Hitachi Seiko Ltd. (Japan)
Hitachi Semiconductor (Malaysia) Sdn. Bhd. (Malaysia)
Hitachi Service Engineering Co. Ltd. (Japan)
Hitachi Software Engineering Co. Ltd. (Japan)
Hitachi Techno Engineering Co. Ltd. (Japan)
Hitachi Telecom Technologie Ltd. (Japan)
Hitachi Television Ltd. (Taiwan)
Hitachi Tochigi Electronics Co. Ltd. (Japan)
Hitachi Tohbu Semiconductor Ltd. (Japan)
Hitachi Tokyo Electronics Co. Ltd. (Japan)
Hitachi Transport System Ltd. (Japan)
Hitachi Welfare Service Ltd. (Japan)
Japan Servo Co. Ltd. (Japan)
Nippon Business Consultant Co. Ltd. (Japan)
Nissei Sangyo Co. Ltd. (Japan)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1991

Texas Instruments Inc., Fujitsu Ltd., and Sony Corporation

Texas Instruments, Fujitsu, and Sony, along with Hitachi Ltd., have agreed to collaborate on HDTV chip development. Texas Instruments will be doing the frame memory store, Fujitsu the signal processors, Sony the analog components, and Hitachi the audio circuits. The full Muse chip set is scheduled for completion during the first quarter of 1992.

Bull CP8 S.A.

Bull CP8 S.A., a subsidiary of Groupe Bull, located in Trappes France, has signed Hitachi Ltd. as the first Japanese licensee of its self-programmable one-chip microcomputer (SPOM) patent. Hitachi's chips for microcomputer cards will be made available in Japan through Tokyo-based SPOM Japan KK, a joint venture between Bull CP8 and Dai Nippon Printing Co. Ltd, and worldwide through Hitachi's overseas sales office.

Dongfang Power Corp.

Hitachi Ltd. is planning to supply thermal power plant construction technology to Dongfang Power Corp., a Chinese company located in Sichuan Province. Under a 10-year agreement with the Chinese company, Hitachi will provide technology relating to steam turbines and generator for use in 600,000kw class thermal power stations. The two companies will then jointly construct four power plants.

TRW Inc.

Hitachi Ltd. and TRW Inc. formed a 15-year strategic alliance to jointly pursue opportunities in space systems and related ground systems and technologies. The two companies signed an agreement to set up a management team that will meet periodically to review future space programs, market opportunities, and technology requirements.

Ultra-Network Technologies

Ultra-Network Technologies, a U.S. network system manufacturer, and Hitachi Ltd. have formed a software agreement. The agreement will allow Hitachi to port ULTRANET software, a high-speed network software package developed by Ultra-Network, to its mainframe computers. The new version of ULTRANET will run under Hitachi's VOS3 operating system.

Hewlett-Packard Company
Hewlett-Packard Company (HP) and Hitachi Ltd. have agreed to jointly develop an artificial intelligence software product based on Hitachi's ES/Kernel expert systems technology. The new software will run on HP 9000 UNIX workstation as well as on Hitachi workstations.

National Semiconductor Corporation
National Semiconductor Corporation and Hitachi Ltd. have signed a 10-year patent cross-licensing agreement that covers all semiconductor products and technologies developed by either company in the past and during the course of the agreement. The new agreement expands and replaces a previous cross-licensing agreement between the two companies concerning FACT logic products.

Goldstar Electron Company Ltd.
Hitachi Ltd. licensed Lucky Goldstar Group's Goldstar Electron Company Ltd. to fabricate 4Mb memory chips to Hitachi's design. Part of the output will be sold back to Hitachi.

1990

Comparex Information Systems GmbH
Comparex Information Systems GmbH agreed to ship Hitachi's new Integrated Vector Feature for its 8/9X series of processors.

VLSI Technology Inc.
Hitachi plans to supply SRAMs to VLSI Technology on an OEM basis. The SRAMs have been jointly developed by the two companies.

Kansai Electric Power Co., Matsushita Electric Industrial Co. Ltd., Toshiba Corporation, Mitsubishi Electronics Corporation, Sumitomo Electric Industries Ltd., Kawasaki Heavy Industries Ltd., and Kobe Steel Ltd.
Hitachi agreed to set up a new company, which will perform research and development for free electron lasers with the preceding companies.

Sears, Roebuck and Company
Hitachi agreed to let Sears market its VY15A video printer.

1989

Sun Microsystems Inc.
Hitachi licensed Sun's Open Network Computing/Network File System technology for implementation on Hitachi's mainframe computers.

Zuken Inc.
Hitachi agreed to allow Zuken to develop CAD/CAM/CAE software packages for the 2050G Series of engineering workstations made by Hitachi.

Adaptive Information Systems (AIS)
AIS has been formed by Hitachi to market document image processing systems using optical storage technology.

Hewlett-Packard
Hewlett-Packard is licensing its proprietary Precision Architecture to Hitachi. The two companies also agreed to jointly develop a new set of chips using HP's proprietary Precision Architecture RISC MPU technology.

Texas Instruments Inc.
Texas Instruments supplied SRAMs to Hitachi on an OEM basis.

GoldStar
Hitachi signed a major pact with South Korea's GoldStar Company covering 1Mb DRAMs, for which Hitachi will provide technical consultations and manufacturing technology. Hitachi will get royalty payments from GoldStar and eventually will buy chips to sell under its own label.

Cray
This agreement gives each company the right to make use of the other's patents in designing computer hardware.

National Semiconductor
Under this production agreement for FACT logic devices, both companies can mutually produce independently defined and independently developed new functions.

MERGERS AND ACQUISITIONS

1991

Hitachi has made no merger or acquisition in 1991.

1990

Dataproducts Corporation
Two Hitachi affiliates, Hitachi Koki and Nissei Sangyo, acquired Dataproducts Corporation for approximately $160 million. Dataproducts

manufactures a broad range of band, dot matrix, laser, solid ink, and thermal printers, and a wide range of printer supplies. Dataproducts is counting on solid ink jet printers to play a significant role in the printer industry and is investing heavily to finance this strategically important technology. The 1988 acquisition of Imaging Solutions Inc. gave Dataproducts 100 percent ownership of this new technology. Dataproducts had sales of $353 million in fiscal 1989.

National Advanced Systems
Hitachi purchased National Advanced Systems from National Semiconductor Corporation. The name of the company was changed to Hitachi Data Systems. The company markets and services mainframe computers and peripheral subsystems.

KEY OFFICERS

Katsushige Mita
Chairman and representative director

Tsutomu Kanai
President and representative director

Yutaka Sonoyama
Executive vice president and representative director

Sutezo Hata
Executive vice president and representative director

Takeo Miura
Executive vice president and representative director

Toshi Kitamura
Executive vice president and representative director

Tadashi Okita
Executive vice president and representative director

Iwao Matsuoka
Executive vice president and representative director

PRINCIPAL INVESTORS

Nippon Life Insurance—3.8 percent
Sumitomo Trust—2.7 percent
Mitsubishi Trust—2.7 percent
Dai-ichi Life Insurance—2.6 percent

FOUNDERS

Namihei Odaira

Table 3
Balance Sheet
Fiscal Year Ending in March
(Billions of U.S. Dollars)

Balance Sheet	1987	1988	1989	1990	1991
Cash	5.6	8.0	12.8	13.0	11.7
Receivables	6.3	7.8	10.7	11.2	13.0
Marketable Securities	2.9	3.0	3.0	2.3	2.7
Inventory	5.6	7.0	9.7	9.5	11.3
Other Current Assets	1.1	1.4	1.7	1.8	2.0
Total Current Assets	21.6	27.2	38.0	37.7	40.7
Net Property, Plants	7.4	8.2	11.5	12.0	14.1
Other Assets	4.4	5.3	4.6	4.9	5.6
Total Assets	33.4	40.7	54.1	54.6	60.4
Total Current Liabilities	14.3	17.4	24.8	23.2	26.2
Long-Term Debt	3.1	3.1	4.1	6.2	6.3
Other Liabilities	2.2	2.8	3.8	3.5	3.7
Total Liabilities	19.6	23.3	32.6	32.9	36.2
Converted Preferred Stock	0	0	0	0	0
Common Stock	0.9	1.3	1.7	1.7	1.9
Other Equity	1.3	1.8	2.5	2.5	2.9
Retained Earnings	9.3	11.5	13.6	13.7	15.1
Total Shareholders' Equity	11.4	14.6	17.8	17.9	19.9
Minority Interests	2.3	2.8	3.7	3.8	4.3
Total Liabilities and Shareholders' Equity	33.4	40.7	54.1	54.6	60.4
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports
Dataquest (November 1991)

Table 4
Consolidated Income Statement
Fiscal Year Ending in March
(Billions of U.S. Dollars, except Per Share Data)

Consolidated Income Statement	1987	1988	1989	1990	1991
Revenue	30.4	36.0	49.9	49.5	54.8
Japanese Revenue	22.4	27.3	38.4	38.1	40.8
Non-Japanese Revenue	8.0	8.7	11.5	11.6	13.1
Cost of Sales	23.0	28.7	35.5	35.1	38.4
R&D Expense	1.9	2.3	2.9	3.0	3.5
SG&A Expense	6.0	7.5	11.0	10.7	12.8
Capital Expense	4.1	2.7	4.0	3.6	5.3
Pretax Income	1.6	2.4	3.8	3.7	4.0
Pretax Margin (%)	5.33	6.66	7.67	7.49	7.27
Effective Tax Rate (%)	57.50	56.10	56.10	53.90	51.20
Net Income	0.6	1.0	1.4	1.5	1.6
Shares Outstanding, Millions	2,816.3	2,921.7	3,017.7	3,072.8	3,273.7
Per Share Data					
Earnings	0.21	0.32	0.46	0.43	0.44
Dividend	0.06	0.07	0.07	0.06	0.06
Book Value	0	0.01	0.01	0.01	0.01
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports
Dataquest (November 1991)

Table 5
Balance Sheet
Fiscal Year Ending in March
(Billions of Yen)

Balance Sheet	1987	1988	1989	1990	1991
Cash	892.9	1,103.9	1,638.3	1,853.7	1,648.5
Receivables	1,010.6	1,080.7	1,372.2	1,594.3	1,833.9
Marketable Securities	470.6	412.3	385.1	324.8	384.9
Inventory	898.5	960.6	1,250.0	1,355.0	1,597.1
Other Current Assets	172.2	199.9	224.4	263.1	286.6
Total Current Assets	3,444.8	3,757.4	4,870.0	5,390.9	5,751.0
Net Property, Plants	1,179.1	1,133.0	1,473.1	1,708.9	1,985.7
Other Assets	704.1	730.7	594.4	705.3	789.3
Total Assets	5,327.9	5,621.1	6,937.5	7,805.1	8,526.0
Total Current Liabilities	2,288.5	2,399.0	3,183.5	3,314.9	3,694.3
Long-Term Debt	488.9	432.8	520.9	886.8	891.0
Other Liabilities	352.3	381.9	481.0	494.0	520.1
Total Liabilities	3,129.7	3,213.7	4,185.4	4,695.7	5,105.4
Converted Preferred Stock	0	0	0	0	0
Common Stock	141.2	180.3	219.4	246.9	269.7
Other Equity	199.6	244.4	322.0	357.8	410.4
Retained Earnings	1,485.0	1,593.9	1,740.3	1,956.1	2,131.0
Total Shareholders' Equity	1,825.8	2,018.6	2,281.7	2,560.8	2,811.1
Minority Interests	372.4	388.8	470.4	548.6	609.5
Total Liabilities and Shareholders' Equity	5,327.9	5,621.1	6,937.5	7,805.1	8,526.0
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports and
Dataquest (November 1991)

Table 6
Consolidated Income Statement
Fiscal Year Ending in March
(Billions of Yen, except Per Share Data)

Consolidated Income Statement	1987	1988	1989	1990	1991
Revenue	4,848.7	4,975.0	6,401.4	7,077.8	7,737.0
Japanese Revenue	3,579.3	3,781.0	4,932.3	5,420.1	5,881.6
Non-Japanese Revenue	1,269.4	1,194.0	1,469.1	1,657.7	1,855.4
Cost of Sales	3,675.0	3,961.9	4,552.1	5,023.5	5,417.2
R&D Expense	307.6	324.0	373.5	429.4	490.7
SG&A Expense	958.8	1,032.4	1,416.1	1,533.2	1,813.4
Capital Expense	657.4	320.4	532.4	514.9	743.4
Pretax Income	258.3	331.1	491.1	530.0	562.1
Pretax Margin (%)	5.33	6.66	7.67	7.49	7.27
Effective Tax Rate (%)	57.50	56.10	55.50	53.10	51.70
Net Income	98.7	136.8	185.6	211.0	230.2
Shares Outstanding, Millions	2,816.3	2,921.7	3,017.7	3,072.8	3,273.7
Per Share Data					
Earnings	33.45	44.14	58.94	61.71	65.96
Dividend	9.00	9.00	9.00	9.00	9.00
Book Value	0.65	0.69	0.76	0.83	0.86
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports
Dataquest (November 1991)

Table 7
Key Financial Ratios
Fiscal Year Ending in March

Key Financial Ratios	1987	1988	1989	1990	1991
Liquidity					
Current (Times)	1.51	1.57	1.53	1.63	1.56
Total Assets/Equity (%)	291.81	278.47	304.05	304.79	303.30
Current Liabilities/Equity (%)	125.34	118.84	139.52	129.45	131.42
Total Liabilities/Equity (%)	171.42	159.20	183.43	183.37	181.62
Profitability (%)					
Return on Assets	1.85	2.43	2.68	2.70	2.70
Return on Equity	5.41	6.78	8.13	8.24	8.19
Profit Margin	2.04	2.75	2.90	2.98	2.98
Other Key Ratios					
R&D Spending % of Revenue	6.34	6.51	5.83	6.07	6.34
Capital Spending % of Revenue	13.56	6.44	8.32	7.27	9.61
Employees	161,325	159,910	274,508	290,000	290,000
Revenue (¥K)/Employee	30.06	31.11	23.32	24.41	26.68
Capital Spending % of Assets	12.34	5.70	7.67	6.60	8.72
Exchange Rate (U.S.$1=¥)	159.56	138.03	128.25	142.93	141.21

Source: Hitachi Ltd.
Annual Reports
Dataquest (November 1991)

Hitachi, Ltd.

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Fax: (03) 253-2186
Dun's Number: 69-054-1503

Date Founded: 1910

CORPORATE STRATEGIC DIRECTION

Hitachi, Ltd., was founded to develop indigenous Japanese electrical power equipment manufacturing technology. Initially, the Company emphasized the development of heavy electrical equipment and industrial machinery. After World War II, Hitachi expanded into the consumer product area and in the 1950s entered the electronics field, producing computers, semiconductors, and other electronic devices.

Over the years, Hitachi continued to expand and diversify the scope of its business activities, which led to the development of the Hitachi Group. The Hitachi Group is made up of Hitachi, Ltd., domestic and overseas, and its subsidiaries and affiliates, including the three major subsidiaries, Hitachi Chemical, Hitachi Metals, and Hitachi Cable. The Hitachi Group companies conduct business in electrical and electronic equipment, metals, metallic products, machinery, chemicals, trading, and transportation.

Hitachi's consolidated revenue of ¥7,077.8 billion (US$49.7 billion) in the period ending March 31, 1990, increased 10.5 percent from ¥6,401.4 billion (US$49.9 billion) in 1989. (Percentage changes refer only to ¥ amounts; US$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) Information, Communication Systems, and Electronic Devices were the largest contributors, responsible for 33 percent of revenue with ¥2,318 billion ($16.3 billion). Overseas computer sales had substantial increases, primarily for large general-purpose machines.

The Japanese domestic sales contribution to Hitachi's total revenue increased to ¥5,420.1 billion (US$38.0 billion) for the period ending March 31, 1990, up from ¥4,932.3 billion (US$38.5 billion) in fiscal 1988. In fiscal 1989, domestic sales accounted for about 77 percent of total revenue.

Net income increased by 13.69 percent to ¥211.0 billion (US$1.5 billion) for the period ending March 31, 1990, compared with ¥185.6 billion (US$1.4 billion) in fiscal 1988. The improved results were attributed to the Company's steady expansion on a worldwide scale. Hitachi employs more than 290,000 people worldwide.

Research and development expenditure increased to ¥429.4 billion (US$3.0 billion) and represented 6.0 percent of total revenue for the period. This figure is an increase of 15 percent over the 1988 figure of ¥373.5 billion (US$2.9 billion). Areas of focus were the development of technologies that will enable Hitachi to respond to future increased processing power, the development of higher speed and packing density technologies for semiconductors, and development of nonsilicon devices.

Capital expenditure for the year ending March 31, 1990, were not available.

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. Tables 4 and 5, comprehensive financial statements, are at the end of this profile.

BUSINESS SEGMENT STRATEGIC DIRECTION

Semiconductors

Hitachi is the third largest worldwide semiconductor manufacturer with ¥5.09 trillion (US$3.974 billion, Dataquest exchange rate) in if-sold revenue for calendar 1989, representing a 6.9 percent market share.

Dataquest estimates the Company's single largest market to be Japan, which generates approximately ¥3.48 trillion (US$2.7 billion), representing 11.8 percent of the market. Dataquest ranks Hitachi third in this market. Hitachi's next largest market is in North America, where Hitachi earned ¥752 billion (US$587 million) in calendar 1989, ranking eighth and posting a 28 percent increase in revenue generated. Dataquest estimates that Hitachi ranks tenth in Europe with 3 percent of the market and fourth in Rest of World with a 5.8 percent market share in calendar 1989.

Dataquest estimates that the highest growth rate experienced by Hitachi in semiconductors was in BiCMOS semiconductors, which grew by 2,086 percent worldwide. Hitachi's best-selling semiconductor was the MOS memory chip, which accounted for approximately ¥1.96 trillion (US$13.75 billion) worldwide in calendar 1989. Hitachi's CMOS semiconductors accounted for ¥1.86 trillion (US$13.05 billion) worldwide in calendar 1989.

Dataquest estimates that the Company ranked second in the Japanese bipolar digital market with a 19.7 percent share. This ranking is based on ¥4.4 billion (US$345 million) in revenue for calendar 1989. The revenue figures were down 7 percent when compared with the 1988 figures of ¥4.73 billion (US$369 million), while the total market experienced an 8 percent decrease in sales.

Hitachi has focused on high-value-added products such as 1MB, 4MB, and 16MB DRAMs. However, future revenue may be gained by the Company's increasing efforts on 32-bit MPUs and ASICs. These efforts are part of a corporate goal to expand the Company's product mix and reduce dependence on any one product line.

Hitachi generates significant revenue from its bipolar (ECL) products. In calendar 1989, Hitachi earned ¥1.56 billion (US$122 million) in revenue from the ECL products.

Computers

In 1989, Hitachi and General Motors Electronic Data Systems bought National Advanced Systems, the mainframe arm of National Semiconductor. The two companies have changed the name of the company to Hitachi Data Systems (HDS).

In 1989, Hitachi had less than 1 percent of the worldwide market share in the personal, business, and technical computer industry segments. Dataquest estimates that Hitachi had 4.9 percent of the worldwide mainframe market while Hitachi Data Systems controlled 1.8 percent of the market. HDS's Andromeda system, which competes directly with IBM in the United States and elsewhere, is pushing the eventual release of IBM's Summit system.

HDS announced in 1989 extensions to its family of 370 plug-compatible machines (PCMs). The three new machines—the EX 85, EX 310, and EX 420—are upgrades of the existing EX Series. A fourth model was announced in Japan, the M880/220. The announcement precedes the release of HDS's new mainframe, "ZEUS," expected out in 1990.

Other Hitachi computers include the B16 LX XX, the B32 Series, the HL 500 Series, the PROSET 30, the PWS 2020, and the PWS 2050.

Computer Storage

Hitachi is active in two computer storage markets. Dataquest estimates that Hitachi ranks second in the 12-inch WORM optical disk drive market, with a 28 percent share based on 3,400 units shipped. Hitachi is the leader in the CD-ROM optical disk drive market. Hitachi captured 26 percent of this market in 1989 by selling 40,000 units, which generated $11.8 million in if-sold revenue. Hitachi sold CD-ROMs under its own brand name, as well as through Amdek and Denon via its subsidiary Nippon Columbia.

Printers

Dataquest estimates that in the printer peripheral market, Hitachi is in the lower 25 percent of both line printer and page printer companies. Hitachi had less than 1 percent in these markets in 1989.

Telecommunications

Hitachi is not a very significant competitor in the PBX business communications market. Dataquest estimates that Hitachi ranked tenth in the US PBX market, with a 2.3 percent market share. Hitachi is not considered a major player in the European PBX market.

CAD/CAM

Hitachi holds a 1.4 percent market share by revenue, on a worldwide basis, of the CAD/CAM market. Hitachi has concentrated on the Asian market, which is responsible for all of its market-generated revenue in 1989. The revenue generated was in turnkey systems and services.

Other Products

Hitachi's Power and Equipment Division witnessed a 10 percent increase in calendar 1989 sales because of expanded sales of thermal plants to power companies. Sales in Hitachi's Consumer Product Division, on the other hand, grew only slightly as a result of a mature VCR market, reduced export levels, and increasing competition. Revenue in the Industrial Machinery and Plants Division increased 16 percent, primarily because of expanded activities in the construction equipment field. The Wire and Cable, Metals, Chemicals, and Other Products Division witnessed a 10 percent growth in sales over the preceding year.

Further Information

For further information pertaining to the Company's business segments, please contact the appropriate industry service.

Table 1
Five-Year Corporate Highlights (Billions of US Dollars)

	1986	1987	1988	1989	1990
Five-Year Revenue	$22.6	$30.4	$36.0	$49.9	$49.7
Percent Change	-	34.19	18.61	38.48	(0.47)
Capital Expenditure	$2.0	$4.1	$2.3	$4.2	NA
Percent of Revenue	8.92	13.56	6.44	8.32	0
R&D Expenditure	$1.3	$1.9	$2.3	$2.9	$3.0
Percent of Revenue	5.90	6.34	6.51	5.83	6.07
Number of Employees	164,117	161,325	159,910	274,508	290,000
Revenue ($K)/Employee	$0.14	$0.19	$0.23	$0.18	$0.17
Net Income	$0.4	$0.6	$1.0	$1.4	$1.5
Percent Change	-	38.67	60.22	46.02	2.34
Exchange Rate (US$1=¥)	¥221.26	¥159.56	¥138.03	¥128.25	¥142.47

NA = Not available

Source: Hitachi, Ltd.
Annual Reports and Forms 20-F
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1986	1987	1988	1989	1990
Japan	99.86	99.84	76.00	77.05	76.58
International	30.16	26.18	24.00	22.95	23.42

Source: Hitachi, Ltd.
Annual Reports
Dataquest (1990)

Table 3
Revenue by Distribution Channel (Percent)

Channel	1988	1989	1990
Direct Sales	30	30	30
Indirect Sales	70	70	70
Distributor	70	70	70

Source: Hitachi, Ltd.
Annual Reports
Dataquest (1990)

1989 SALES OFFICE LOCATIONS

North America—2
Europe—2
Asia/Pacific—11
  Japan—50
ROW—9

MANUFACTURING LOCATIONS

North America

High Voltage Breakers, Norcross, Georgia
  SF6 gas breakers
Hitachi Automotive Products, Farminghills, Michigan
  Electronic auto parts
Hitachi Cable Manchester, Inc., Manchester, New Hampshire
  Cables
Hitachi Cable Manchester, Inc., New Albany, Indiana
  Automobile brake hose
Hitachi (Canadian), Ltd., Calgary, Alta.
  Turbine generator and heavy industrial equipment
Hitachi Computer Products (America), Norman, Oklahoma
  Computer products (magnetic disk devices, magnetic tape cartridges)
Hitachi Construction Machinery Corp., Brampton, Ontario
  Excavators, cranes, tunnel shield machines
Hitachi Consumer Products of America, Anaheim, California
  Color TVs, VCRs
Hitachi Denshi (Canada), Ltd., Scarborough, Ontario
  Broadcast and professional video, CCTV equipment, test and instrumentation
Hitachi (HSC) Canada, Inc., Pointe Claire, Quebec
  TVs, VCRs, and household electric appliances
Hitachi Semiconductor (America), Irving, Texas
  Semiconductors
Hitachi Telecom, Norcross, Georgia
  Digital PBXs

Europe

Hitachi Consumer Products (Europe), Germany
  VCRs
Hitachi Consumer Products (U.K.), United Kingdom
  Color TVs
Hitachi Semiconductor Europe, Germany
  Semiconductors

Asia/Pacific

Akita Electronic Co., Akita, Japan
  MOS, bipolar IC
Hanshi Electric, Japan
  Ignition coils for automobiles
Haramachi Semiconductor Ltd., Ibaraga, Japan
  Diodes, thyristors
Hitachi Computer Engineering, Japan
  Development of automatic designing systems
Hitachi Consumer Products, Malaysia
  TV parts
Hitachi Consumer Products, Singapore
  Color TVs, audio equipment, vacuum cleaners
Hitachi Consumer Products, Thailand
  Electric fans, refrigerators, TVs, motors, air-conditioners, electric rice cookers
Hitachi Cubu Electric, Japan
  Switchboards
Hitachi Denshi, Japan
  Communications equipment, measuring instruments, information equipment
Hitachi Electronic Devices, Singapore
  Color CRTs
Hitachi Electronics Engineering, Japan
  Information equipment, semiconductor devices, energy-saving equipment
Hitachi Elevator Engineering, Singapore
  Elevators, escalators
Hitachi Engineering, Japan
  Electric/electronic equipment, plant engineering
Hitachi Haramachi Semiconductor, Japan
  Semiconductor parts
Hitachi Kiden Kogyo, Japan
  Cranes, water treatment equipment, FA-related equipment
Hitachi Kyowa Kogyo, Japan
  Electric equipment
Hitachi Maxell, Japan
  Dry batteries, magnetic tapes, electronic devices
Hitachi Medical, Japan
  Medical equipment
Hitachi Microcomputer Engineering, Tokyo, Japan
  MPUs, ASICs
Hitachi Mizusawa, Japan
  Transformers for TVs
Hitachi Naka Seiki, Japan
  Chromatographic equipment, scientific instruments
Hitachi Nissin Electronics, Japan
  Electronic parts
Hitachi Ohira Industrial, Japan
  Parts for refrigerators, air conditioners
Hitachi Process Computer Engineering, Japan
  Process computers
Hitachi Semiconductor, Malaysia
  Semiconductors

Hitachi Setsubi Engineering, Japan
FA equipment
Hitachi Techno Engineering, Japan
Electronic part manufacturing equipment
Hitachi Telecom Technologies, Japan
Switching systems
Hitachi Television, Taiwan
Color TVs, audio equipment, displays
Hitachi Video Engineering, Japan
Development of video equipment
Hitachi Works, Ibaraga, Japan
Discrete devices
Hitachi Yomezawa Electronic, Japan
Semiconductor elements
Hokkai Semiconductor, Hokkaido, Japan
SRAMs
Horiba Ltd., Japan
Electric measuring instruments
Japan Servo, Japan
Precision motors
Jidosha Denki Kogyo, Japan
Electrical auto parts
Kaohsiung Hitachi Electronics, Taiwan
Electronic parts, transistors, LCDs
Kokusai Electric, Japan
Electric communications equipment
Kokusan Denki, Japan
Electrical auto parts, generators, motors
Komoro Works, Nagano, Japan
Photo devices, hybrid ICs
Mobara Works, Chiba, Japan
DRAMs, CMOS logic, LCDs
Musashi Works, Tokyo, Japan
MPUs, diodes, DRAMs, SRAMs
Naka Works, Ibaraga, Japan
Semiconductor sensors, DRAMs, SRAMs
Nakayo Telecommunications, Japan
Telephone and switching systems
Nigata Works, Nigata, Japan
Linear, bipolar digital ICs
Nippon Columbia, Japan
Records, stereos, and other audio equipment
Nissin Electronics Ltd., Ibaraga, Japan
MOS
Taga Sangyo, Japan
Electric equipment
Taiwan Hitachi, Taiwan
Room air-conditioners
Takasaki Works, Gunma, Japan
Bipolar and MOS ICs, EPROMs, CMOS logic
Tobu Semiconductor Ltd., Aomari, Japan
Bipolar ICs
Tobu Semiconductor Ltd., Saitama, Japan
Transistor, hybrid ICs
Tokico Ltd., Japan
Electrical auto parts and equipment
Tokyo Electronics Co., Yamanashi, Japan
Diodes, bipolar ICs
Yagi Antenna, Japan
Antennas
Yomezawa Electronic Co., Yamagata, Japan
MOS

ROW

Industrias Hitachi, Brazil
Distribution equipment, air-conditioners, electronic parts, transformers, switches

SUBSIDIARIES

North America

Hitachi America, Ltd. (United States)
Hitachi Automotive Products (USA), Inc. (United States)
Hitachi Computer Products (America), Inc. (United States)
Hitachi Consumer Products of America Inc. (United States)
Hitachi Semiconductor (America) Inc. (United States)
Hitachi Telecom (USA), Inc. (United States)

Europe

Hitachi Consumer Products Europe Ltd. (United Kingdom)
Hitachi Semiconductor Europe (Germany)
Hitachi Consumer Products (Europe) (Germany)

Asia/Pacific

Asahi Kogyo Co., Ltd. (Japan)
Babcock-Hitachi K.K. (Japan)
Chuo Shoji, Ltd. (Japan)
Hitachi Air Conditioning & Refrigeration Co., Ltd. (Japan)
Hitachi Australia Ltd. (Australia)
Hitachi Automobile Appliances Sales Co., Ltd. (Japan)
Hitachi Cable Ltd. (Japan)
Hitachi Chemical Co., Ltd. (Japan)
Hitachi Construction Machinery Co., Ltd. (Japan)
Hitachi Consumer Products (Malaysia) Sdn. Bhd. (Malaysia)
Hitachi Consumer Products Pte. Ltd.
Hitachi Credit Corporation (Japan)

Hitachi Electronic Components (Asia) Ltd. (Hong Kong)
Hitachi Electronic Devices (Singapore) Pte. Ltd. (Singapore)
Hitachi Denshi, Ltd. (Japan)
Hitachi Electronics Engineering Co., Ltd. (Japan)
Hitachi Electronics Service Co., Ltd. (Japan)
Hitachi Elevator Engineering and Service Co., Ltd. (Japan)
Hitachi Engineering Co., Ltd. (Japan)
Hitachi Heating Appliances Co., Ltd. (Japan)
Hitachi Higashi Shohin Engineering, Ltd. (Japan)
Hitachi Hokkai Semiconductor, Ltd. (Japan)
Hitachi Kiden Kogyo, Ltd. (Japan)
Hitachi Lighting, Ltd. (Japan)
Hitachi Machinery and Engineering, Ltd. (Japan)
Hitachi Maxell, Ltd. (Japan)
Hitachi Medical Corporation (Japan)
Hitachi Metals, Ltd. (Japan)
Hitachi Mokuzai Jisho, Ltd. (Japan)
Hitachi Nishi Shohin Engineering, Ltd. (Japan)
Hitachi Plant Engineering & Construction Co., Ltd. (Japan)
Hitachi Power Engineering Co., Ltd. (Japan)
Hitachi Printing Co., Ltd. (Japan)
Hitachi Sales Corporation (Japan)
Hitachi Seiko, Ltd. (Japan)
Hitachi Semiconductor (Malaysia) Sdn. Bhd. (Malaysia)
Hitachi Service Engineering Co., Ltd. (Japan)
Hitachi Software Engineering Co., Ltd. (Japan)
Hitachi Techno Engineering Co., Ltd. (Japan)
Hitachi Telecom Technologies, Ltd. (Japan)
Hitachi Television, Ltd. (Taiwan)
Hitachi Tochigi Electronics, Co., Ltd. (Japan)
Hitachi Tohbu Semiconductor, Ltd. (Japan)
Hitachi Tokyo Electronics Co., Ltd. (Japan)
Hitachi Transport System, Ltd. (Japan)
Hitachi Welfare Service, Ltd. (Japan)
Japan Servo Co., Ltd. (Japan)
Nippon Business Consultant Co., Ltd. (Japan)
Nissei Sangyo Co., Ltd. (Japan)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

Comparex Information Systems GmbH
Comparex Information Systems GmbH will ship Hitachi's new Integrated Vector Feature for its 8/9X series of processors.

VLSI Technology Inc.
Hitachi plans to supply SRAMs to VLSI Technology Inc. on an OEM basis. The SRAMs have been jointly developed by the two companies.

Kansai Electric Power Co., Matsushita Electric Industrial Co., Toshiba Corp., Mitsubishi Electric Corp., Sumitomo Electric Industries, Ltd., Kawasaki Heavy Industries, Ltd., and Kobe Steel, Ltd.
Hitachi has agreed to set up a new company by year end, which will perform research and development for free electron lasers with the preceding companies.

Sears and Roebuck
Hitachi agreed to let Sears and Roebuck market its VY15A video printer.

1989

Sun Microsystems
Hitachi will license Sun's Open Network Computing/Network File System technology for implementation on Hitachi's mainframe computers.

Zuken Inc.
Hitachi agreed to allow Zuken to develop CAD/CAM/CAE software packages for the 2050G Series of engineering workstations made by Hitachi.

Adaptive Information Systems (AIS)
AIS has been formed by Hitachi to market document image processing systems using optical storage technology.

Hewlett-Packard
Hewlett-Packard is licensing its proprietary Precision Architecture to Hitachi.

Texas Instruments
Texas Instruments will supply SRAMs to Hitachi on an OEM basis.

GoldStar
Hitachi signed a major pact with South Korea's GoldStar Company covering 1Mb DRAMs, for which Hitachi will provide technical consultations and manufacturing technology. Hitachi will get royalty payments from GoldStar and eventually will buy chips to sell under its own label.

Cray
This agreement gives each company the right to make use of the other's patents in designing computer hardware.

Hewlett-Packard
The two companies will jointly develop a new set of chips using HP's proprietary Precision Architecture RISC MPU technology.

National Semiconductor
Under this production agreement for FACT logic devices, both companies can mutually produce independently defined and independently developed new functions.

MERGERS AND ACQUISITIONS

1990

Dataproducts Corporation
Two Hitachi affiliates, Hitachi Koki and Nissei Sangyo, acquired Dataproducts Corporation for approximately $160 million. Dataproducts manufactures a broad range of band, dot matrix, laser, solid ink, and thermal printers, and a wide range of printer supplies. Dataproducts is counting on solid ink jet printers to play a significant role in the printer industry and is investing heavily to finance this strategically important technology. The 1988 acquisition of Imaging Solutions, Inc., gave Dataproducts 100 percent ownership of this new technology. Dataproducts had sales of $353 million in fiscal 1989, an increase of 2 percent over 1988.

1989

National Advanced Systems
Mainframe computers and peripheral subsystems

KEY OFFICERS

Katsushige Mita
President and representative director

Masataka Nishi
Executive vice president and representative director

Shiro Kawada
Executive vice president and director

Yutaka Sonoyama
Executive vice president and director

Sutezo Hata
Executive vice president and director

Takeo Miura
Executive vice president and director

Tsutomu Kanai
Executive vice president and director

Table 4
Comprehensive Financial Statement
Fiscal Year Ending March
(Billions of US Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$14.8	$21.6	$27.2	$38.0	$37.8
Cash	3.0	5.6	8.0	12.8	12.0
Receivables	4.4	6.3	7.8	10.7	11.2
Marketable Securities	2.2	2.9	3.0	3.0	3.3
Inventory	4.4	5.6	7.0	9.7	9.5
Other Current Assets	0.8	1.1	1.4	1.7	1.8
Net Property, Plants	$5.4	$7.4	$8.2	$11.5	$12.0
Other Assets	$3.1	$4.4	$5.3	$4.6	$5.0
Total Assets	$23.3	$33.4	$40.7	$54.1	$54.8
Total Current Liabilities	$10.8	$14.3	$17.4	$24.8	$23.3
Long-Term Debt	$1.7	$3.1	$3.1	$4.1	$9.7
Other Liabilities	$1.4	$2.2	$2.8	$3.8	NA
Total Liabilities	$13.9	$19.6	$23.3	$32.6	$33.0
Minority Interests	$1.5	$2.3	$2.8	$3.7	$3.9
Total Shareholders' Equity	$7.9	$11.4	$14.6	$17.8	$18.0
Common Stock	0.6	0.9	1.3	1.7	1.7
Other Equity	0.8	1.3	1.8	2.5	2.5
Retained Earnings	6.4	9.3	11.5	13.6	13.7
Total Liabilities and Shareholders' Equity	$23.3	$33.4	$40.7	$54.1	$54.8
Income Statement	**1986**	**1987**	**1988**	**1989**	**1990**
Revenue	$22.6	$30.4	$36.0	$49.9	$49.7
Japanese Revenue	22.6	30.3	27.4	38.5	38.0
Non-Japanese Revenue	6.8	8.0	8.7	11.5	11.6
Cost of Sales	$16.9	$23.0	$28.7	$35.5	$35.3
R&D Expense	$1.3	$1.9	$2.3	$2.9	$3.0
SG&A Expense	$4.4	$6.0	$7.5	$11.0	$10.8
Capital Expense	$2.0	$4.1	$2.3	$4.2	N/A
Pretax Income	$1.7	$1.6	$2.4	$3.8	$3.7
Pretax Margin (%)	7.41	5.33	6.66	7.67	7.49
Effective Tax Rate (%)	57.50	57.50	56.10	56.10	56.10
Net Income	$0.4	$0.6	$1.0	$1.4	$1.5
Shares Outstanding, Millions	2,803.4	2,816.3	2,921.7	3,017.7	3,418.6
Per Share Data					
Earnings	$0.23	$0.21	$0.32	$0.46	$0.43
Dividend	$0.04	$0.06	$0.07	$0.07	$0.06
Book Value	0	0	$0.01	$0.01	$0.01
Exchange Rate (US$1=¥)	¥221.26	¥159.56	¥138.03	¥128.25	¥142.47

Source: Hitachi Ltd.
Annual Reports
Dataquest (1990)

Table 5
Comprehensive Financial Statement
Fiscal Year Ending March
(Billions of Yen, except Per Share Data)

Balance Sheet	1986	1987	1988	1989	1990
Total Current Assets	¥3,276.2	¥3,444.8	¥3,757.4	¥4,870.0	¥5,390.9
Cash	661.7	892.9	1,103.9	1,638.3	1,705.5
Receivables	971.0	1,010.6	1,080.7	1,372.2	1,594.3
Marketable Securities	492.4	470.6	412.3	385.1	473.0
Inventory	980.0	898.5	960.6	1,250.0	1,355.0
Other Current Assets	171.1	172.2	199.9	224.4	263.1
Net Property, Plants	¥1,200.0	¥1,179.1	¥1,133.0	¥1,473.1	¥1,708.9
Other Assets	¥688.0	¥704.1	¥730.7	¥594.4	¥705.3
Total Assets	¥5,164.2	¥5,328.0	¥5,621.1	¥6,937.5	¥7,805.1
Total Current Liabilities	¥2,393.3	¥2,288.5	¥2,399.0	¥3,183.5	¥3,314.9
Long-Term Debt	¥369.7	¥488.9	¥432.8	¥520.9	¥1,380.8
Other Liabilities	¥319.6	¥352.3	¥381.9	¥481.0	NA
Total Liabilities	¥3,082.6	¥3,129.7	¥3,213.7	¥4,185.4	¥4,695.7
Minority Interests	¥338.9	¥372.4	¥388.8	¥470.4	¥548.7
Total Shareholders' Equity	¥1,742.7	¥1,825.8	¥2,018.6	¥2,281.7	¥2,560.7
Common Stock	140.3	141.2	180.3	219.4	246.8
Other Equity	186.5	199.6	244.4	322.0	357.8
Retained Earnings	1,415.9	1,485.0	1,593.9	1,740.3	1,956.1
Total Liabilities and Shareholders' Equity	¥5,164.2	¥5,327.9	¥5,621.1	¥6,937.5	¥7,805.1

Income Statement	1986	1987	1988	1989	1990
Revenue	¥5,010.5	¥4,848.7	¥4,975.0	¥6,401.4	¥7,077.8
Japanese Revenue	3,499.5	3,579.3	3,781.0	4,932.3	5,420.1
Non-Japanese Revenue	1,511.0	1,269.4	1,194.0	1,469.1	1,657.7
Cost of Sales	¥3,741.2	¥3,675.0	¥3,961.9	¥4,552.1	¥5,023.5
R&D Expense	¥295.7	¥307.6	¥324.0	¥373.5	¥429.4
SG&A Expense	¥962.7	¥958.8	¥1,032.4	¥1,416.1	¥1,533.2
Capital Expense	¥447.0	¥657.4	¥320.4	¥532.4	NA
Pretax Income	¥371.1	¥258.3	¥331.1	¥491.1	¥530.0
Pretax Margin (%)	7.41	5.33	6.66	7.67	7.49
Effective Tax Rate (%)	57.50	57.50	56.10	56.10	56.10
Net Income	¥98.7	¥98.7	¥136.8	¥185.6	¥211.0
Shares Outstanding, Millions	2,803.4	2,816.3	2,921.7	3,017.7	3,418.6
Per Share Data					
Earnings	¥50.65	¥33.45	¥44.14	¥58.94	¥61.71
Dividend	¥9.00	¥9.00	¥9.00	¥9.00	¥9.00
Book Value	¥0.62	¥0.65	¥0.69	¥0.76	¥0.75

Table 5 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending March
(Billions of Yen, except Per Share Data)

Key Financial Ratios	1986	1987	1988	1989	1990
Liquidity					
Current (Times)	1.37	1.51	1.57	1.53	1.63
Quick (Times)	0.96	1.11	1.17	1.14	1.22
Fixed Assets/Equity (%)	68.86	64.58	56.13	64.56	66.74
Current Liabilities/Equity (%)	137.33	125.34	118.84	139.52	129.45
Total Liabilities/Equity (%)	176.89	171.42	159.20	183.43	183.37
Profitability (%)					
Return on Assets	-	1.88	2.50	2.96	2.86
Return on Equity	-	5.53	7.12	8.63	8.71
Profit Margin	1.97	2.04	2.75	2.90	2.98
Other Key Ratios					
R&D Spending % of Revenue	5.90	6.34	6.51	5.83	6.07
Capital Spending % of Revenue	8.92	13.56	6.44	8.32	0
Employees	164,117	161,325	159,910	274,508	290,000
Revenue (¥K)/Employee	¥30.53	¥30.06	¥31.11	¥23.32	¥24.41
Capital Spending % of Assets	8.66	12.34	5.70	7.67	0
Exchange Rate (US$1=¥)	¥221.26	¥159.56	¥138.03	¥128.25	¥142.47

NA = Not available

Source: Hitachi, Ltd.
Annual Reports
Dataquest (1990)

Hoechst AG

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Federal Republic of Germany
Telephone: (069) 305-0
Fax: (069) 316700
Dun's Number: 31-756-2718

Date Founded: 1863

CORPORATE STRATEGIC DIRECTION

Hoechst AG (The Hoechst Group) comprises six business areas: chemicals and color, fibers and plastic film, polymers, health, engineering and technology, and agriculture. The Company is active in the European Community (EC), North America, Latin America, Africa, and the Asia/Pacific region.

Consolidated revenue increased 12.0 percent to DM 45.9 billion (US$24.4 billion) in 1989, from DM 41.0 billion (US$23.5 billion) in 1988. Growth outside Germany proved to be greater, with sales rising 14.0 percent as opposed to sales within Germany increasing 7.0 percent. Chemical sales rose 5.0 percent during 1989 totaling DM 11.6 billion (US$6.1 billion), representing 25.3 percent of total revenue. (Percentage changes refer only to DM amounts; US$ percentage changes will differ because of fluctuations in Dataquest exchange rates.)

Revenue in the fibers and plastic film business area increased 16.0 percent and totaled DM 9.0 billion (US$4.9 billion), representing 19.6 percent of total revenue. In this business area, plastic film generated approximately DM 1.6 billion (US$851 million), whereas fibers and fiber intermediates generated DM 7.4 billion (US$3.9 billion).

Revenue from the polymers business area increased approximately 5 percent to DM 7.8 billion (US$4.1 billion), representing 17 percent of total revenue. Of this total, paints and synthetic resins generated nearly DM 3.3 billion (US$1.8 billion), and plastics and waxes and engineering plastics generated DM 3.1 (US$1.6 billion) and DM 1.4 billion (US$744 million), respectively, for fiscal 1989.

In the health business area, revenue increased 14.0 percent, totaling DM 8.3 billion (US$4.4 billion) for fiscal 1989. Almost half of the sales were in Western Europe, with 11.0 percent in North America and 14.0 percent in Japan. Sales of pharmaceuticals increased nearly DM 1 billion (US$531.9 million), reaching approximately DM 8 billion (US$4.3 billion). Sales in cosmetics remained stable, totaling approximately DM 300 million (US$159.0 million). Sales in this business area represented 18.1 percent of total revenue.

The engineering and technology business area sales grew 7.0 percent to DM 6.5 billion (US$3.5 billion), representing 14.2 percent of total revenue for fiscal 1989. The industrial gases and welding technologies total sales were approximately DM 2.0 billion (US$1.1 billion), showing an 11.0 percent increase over the previous year's total. Technical information systems sales remained stable at DM 1.3 billion (US$691.5 million), whereas the new carbon products division posted DM 1.0 billion (US$532.0 million) in sales for fiscal 1989. The plant engineering division and the engineering ceramics division generated DM 500.0 million (US$266.0 million) and DM 250.0 million (US$133.0 million) during fiscal 1989, respectively.

The agriculture business area sales increased 14 percent, totaling DM 2.7 billion (US$1.4 billion) for fiscal 1989. Nearly 93 percent of these sales occurred outside Germany.

Net income increased 5.7 percent in fiscal 1989 to DM 2.1 billion (US$1.1 billion) from DM 2.0 billion (US$1.1 billion) in fiscal 1988.

R&D for fiscal 1989 totaled DM 2.6 billion (US$1.4 billion), representing 5.7 percent of revenue. This is an increase of 8.3 percent over the previous year's figure of DM 2.4 billion (US$1.4 billion). Research costs by business area show that the health business area received 44.0 percent of R&D expenditure. Chemicals and color received 13.0 percent, the polymers area received 12.0 percent, agriculture 10.0 percent, and fibers and plastic film 8.0 percent for fiscal 1989. Engineering and technology and central research received 7.0 and 6.0 percent, respectively.

Capital expenditure totaled DM 3.9 billion (US$2.1 billion) for fiscal 1989, representing 8.4 percent of revenue. This is an 87.3 percent increase from the previous year's figure of DM 2.1 billion (US$1.2 billion), which represented 5.0 percent of fiscal 1988 revenue.

The Hoechst Group employed 169,295 people at the close of fiscal 1989. Seventy percent of these employees worked in the EC, 15 percent in North America, 7 percent in Latin America, and the remaining 8 percent in the Asia/Pacific and the Rest of World regions.

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 backgrounder.

BUSINESS SEGMENT STRATEGIC DIRECTION

Products for Component Equipment

Hoechst has 12 divisions and subsidiaries that serve all areas of microelectronics. The Technical Information Systems Division serves the semiconductor manufacturer market. Materials for photolithography such as AZ positive photoresists, protective coatings, developers and thinners for photoresists, adhesion promoters, and strippers are manufactured by this division. The division provides printed circuit board (PCB) manufacturers with materials for photoprinting and screen printing, such as negative and positive Ozatec dry film, photoresists and liquid photoresists, diazo-duplicating film and screen emulsion, screen stencil films, photosolder masks, and dry film photoresist processing equipment.

Messer Griesheim GmbH provides semiconductor manufacturers with deposition gases like silane, dichlorosilane, nitrous oxide, ammonia, tungsten hexafluoride, and oxygen; and with doping gases like arsine, phosphine, diborane, and boron trifluoride. This division provides gases used in etching, such as tetrafluoromethane, trifluoromethane, silicon tetrafluoride, sulphur hexafluoride, nitrogen trifluoride, chlorine, hydrogen chloride, and boron trichloride. It also supplies storage and transfer equipment for gases, as well as purification and supply systems, including valves, pressure regulators, manifolds, and gas cabinets.

Messer Griesheim GmbH PECO manufactures seal welding machines for metal and ceramic housings for semiconductor and hybrid manufacturers; gap welding machines for bonding for PCB manufacturers; and thin- and thick-film equipment.

Riedel-de Haen AG manufactures VLSI PURANAL, which is the brand name of a product range specially designed for the cleaning and etching processes in VLSI manufacturing. Riedel-de Haen's hydrofluoric acid production also forms the basis for a number of chemicals used in the production of PCBs.

Hoechst's Chemicals Division manufactures chemicals for the doping and production of III/V compounds, as well as inorganic and fluorocarbon gases for doping and plasma etching processes. This division also produces acids, bases, and salts for etching and stripping PCBs; Frigen 113 TR for cleaning, perfluorinated inert fluids for vaporphase soldering and components testing, and lubricants for vacuum pumps.

Ringsdorff Werke GmbH produces high-purity graphite components, such as susceptors, heating elements, heat shields for crystal growth, slicing beams, SiC-coated susceptors for epitaxy, wafer trays for plasma-etched chemical vapor deposition (PECVD), electrodes, diffusers, shields for ion implantation, soldering and glass-to-metal sealing jigs, and pyrolitic boron-nitride components.

The equipment that SIGRI GmbH produces for semiconductor manufacturers includes carbon felts, graphite felts and foils, heating elements, charge carriers, charging equipment, and superstructures for furnaces.

The Hoechst Plastics and Waxes Division manufactures a sealing agent for semiconductor manufacturers. This division also produces fluoropolymers hostaflon as insulating and corrosion-resistant materials for PCB manufacturers. The Plastics and Waxes Division produces heat- and chemical-resistant components for wire and cable insulation, PCB housing, plugs, and insulating components.

Hoechst's Synthetic Resins Division manufactures phenolic and durophen, which are phenolic and epoxy resins. This division also produces Beckopox for laminates.

The Hoechst Films Division produces hostaphan, polyester films, trespaphan, polypropylene films for the component market, and carrier film for audio, video, and computer tapes. This division produces polyester films as base materials for flexible PCBs.

Hoechst CeramTec produces chip carrier and pin grid arrays for the semiconductor market. This division produces ceramic rods and tubes for carbon film, metal film, and wire wound resistors for all leading manufacturers of resistors in the components market.

Herberts produces solder, finishing varnishes, and casting resins for the PCB market.

Further Information

For further information about 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	$14,531.3	$17,518.0	$20,531.1	$23,275.0	$24,413.8
Percent Change	-	20.55	17.20	13.36	4.89
Capital Expenditure	$804.4	$1,234.6	$1,330.0	$1,171.0	$2,057.4
Percent of Revenue	5.54	7.05	6.48	5.03	8.43
R&D Expenditure	$708.5	$985.3	$1,231.7	$1,372.7	$1,394.1
Percent of Revenue	4.88	5.62	6.00	5.90	5.71
Number of Employees	180,561	153,651	167,781	164,527	169,295
Revenue ($K)/Employee	$80	$114	$122	$141	$144
Net Income	$499.3	$644.7	$848.9	$1,144.9	$1,133.0
Percent Change	-	29.12	31.66	34.87	(1.04)
Exchange Rate (US$1=DM)	DM 2.94	DM 2.17	DM 1.80	DM 1.76	DM 1.88

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	NA	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

NA = Not available

Source: Hoechst AG
Annual Reports and Forms 10-K
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
German	25.28	28.49	60.19	58.73	57.73
Non-German	74.72	71.51	39.81	41.27	42.27

Source: Hoechst AG
Annual Reports and Forms 10-K
Dataquest 1990

SALES OFFICE LOCATIONS

Information is not available.

MANUFACTURING LOCATIONS

Information is not available.

SUBSIDIARIES

Information is not available.

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

Chemiefaser Guben
Hoechst and Chemiefaser Guben have signed a letter of intent to establish a joint venture in East Germany to produce polyester tire cord, with Hoechst becoming the majority owner of the joint venture.

BASF and Bayer
Hoechst, BASF, and Bayer will form Entwicklungsgesellschaft fuer die Wiederverwertung von Kunststoffen (EWK), which will be responsible for recycling plastics waste.

Deutsche Wellcome
Hoechst has received marketing rights for Zovirax, an antiviral, from Deutsche Wellcome, a subsidiary of Wellcome Foundation (United Kingdom).

Daicel Chemical Industries, Ltd.
Hoechst and Daicel plan to establish a UK joint venture for the production and marketing of acrylonitrile butadiene styrene (ABS) resin. A production plant will be built in the United Kingdom.

Lucky Goldstar
Hoechst AG and Lucky Goldstar of South Korea have established a joint venture to produce chiefly ultrahigh molecular weight high-density plasma etchant (HDPE) in South Korea. The venture calls for the construction of a plant in South Korea.

Mitsubishi Kasei
Hoechst and Mitsubishi formed a 50/50 dyestuffs joint venture.

MERGERS AND ACQUISITIONS

1990

Benckiser-Knapsack
Joh Benckiser sold its 50 percent share in its joint venture company, Benckiser-Knapsack, to partner Hoechst.

Fincisa, Fibras Sinteticos SA of Portugal
Hoechst has agreed to purchase from Imperial Chemical Industries Plc its 50 percent share in Fincisa, Fibras Sinteticos SA of Portugal. At its Portalegre site, Finicisa produces polyester fiber staple and PET polymer for bottle and packaging applications.

Union Carbide
Union Carbide will sell its primary alcohol ethoxylates business to Hoechst. Applications for primary alcohol ethoxylates include household products such as cleaners and laundry detergents.

Schwarzkopf GmbH
Hoechst has increased its holding in Schwarzkopf to 77 percent. Schwarzkopf operates in the Eastern European cosmetics market.

KEY OFFICERS

R. Sammet
Chairman of the Supervisory Board

R. Brand
Vice chairman of the Supervisory Board

G. Bradeck
Member of the Supervisory Board

E. Bouillon
Member of the Supervisory Board

W. Hilger
Chairman of the Board of Directors

G. Metz
Vice chairman of the Board of Directors

M. Fruhauf
Member of the Board of Directors

H. Gareis
Member of the Board of Directors

PRINCIPAL INVESTORS

Information is not available.

FOUNDERS

Information is not available.

Table 3
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of US Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$6,005.6	$8,366.3	$8,866.1	$9,935.8	$9,899.5
Cash	356.0	1,875.6	946.1	970.5	763.3
Receivables	2,768.1	3,316.3	4,060.6	4,576.1	4,460.1
Marketable Securities	425.7	195.3	499.4	943.8	1,065.4
Inventory	2,455.8	2,979.0	3,360.0	3,445.5	3,610.6
Other Current Assets	0	0	0	0	0
Net Property, Plants	$3,090.1	$3,996.6	$7,118.3	$7,831.8	$4,411.6
Other Assets	$213.5	$310.5	$88.3	$61.9	$73.9
Total Assets	$9,309.3	$12,673.4	$16,072.8	$17,829.5	$14,385.0
Total Current Liabilities	$2,319.7	$2,767.6	$1,286.1	$1,607.4	$1,549.5
Long-Term Debt	$1,235.3	$1,393.3	$3,598.9	$3,497.7	$3,279.8
Other Liabilities	$2,433.7	$3,555.9	$1,762.2	$6,264.8	$6,206.9
Total Liabilities	$5,988.7	$7,716.9	$6,647.2	$11,369.9	$11,036.2
Total Shareholders' Equity	$3,320.6	$4,956.5	$9,425.6	$6,459.7	$6,701.6
Common Stock	876.9	1,264.5	1,553.9	1,608.5	1,534.0
Other Equity	1,508.0	1,212.4	4,593.3	4,148.3	4,468.1
Retained Earnings	935.7	2,479.7	3,278.3	702.8	699.5
Total Liabilities and Shareholders' Equity	$9,309.3	$12,673.4	$16,072.8	$17,829.5	$7,737.8
Income Statement	**1985**	**1986**	**1987**	**1988**	**1989**
Revenue	$14,531.3	$17,518.0	$20,531.1	$23,275.0	$24,413.8
German Revenue	3,672.8	4,991.7	12,358.3	13,669.9	14,094.1
Non-German Revenue	10,858.5	12,526.3	8,172.8	9,605.1	10,319.7
Cost of Sales	NA	NA	$12,881.1	$14,534.1	$15,572.3
R&D Expense	$708.5	$985.3	$1,231.7	$1,372.7	$1,394.1
SG&A Expense	NA	NA	$4,845.6	$5,303.4	$5,542.6
Capital Expense	$804.4	$1,234.6	$1,330.0	$1,171.0	$2,057.4
Pretax Income	$1,073.5	$1,479.7	$1,726.7	$2,321.6	$2,205.3
Pretax Margin (%)	7.39	8.45	8.41	9.97	9.03
Effective Tax Rate (%)	NA	NA	NA	NA	NA
Net Income	$499.3	$644.7	$848.9	$1,144.9	$1,133.0
Shares Outstanding, Millions	63.1	63.1	62.0	62.5	64.1
Per Share Data					
Earnings	$7.91	$10.21	$13.68	$18.30	$17.79
Dividend	$3.40	$4.61	$6.11	$6.82	$6.91
Book Value	$52.62	$78.55	$152.03	$103.35	$104.55
Exchange Rate (US$1=DM)	DM 2.94	DM 2.17	DM 1.8	DM1.76	DM 1.88

NA = Not available

Source: Hoechst AG
Annual Reports and Forms 10-K
Dataquest (1990)

Table 4
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of Deutsche Marks, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	DM 17,656.6	DM 18,154.9	DM 15,959.0	DM 17,487.0	DM 18,611.0
Cash	1,046.5	4,070.1	1,703.0	1,708.0	1,435.0
Receivables	8,138.3	7,196.4	7,309.0	8,054.0	8,385.0
Marketable Securities	1,251.7	423.9	899.0	1,661.0	2,003.0
Inventory	7,220.1	6,464.5	6,048.0	6,064.0	6,788.0
Other Current Assets	0	0	0	0	0
Net Property, Plants	DM 9,084.9	DM 8,672.7	DM 12,813.0	DM 13,784.0	DM 14,597.0
Other Assets	DM 627.8	DM 673.7	DM 159.0	DM 109.0	DM 139.0
Total Assets	DM 27,369.3	DM 27,501.3	DM 28,931.0	DM 31,380.0	DM 33,347.0
Total Current Liabilities	DM 6,820.0	DM 6,005.8	DM 2,315.0	DM 2,829.0	DM 2,913.0
Long-Term Debt	DM 3,631.8	DM 3,023.5	DM 6,478.0	DM 6,156.0	DM 6,166.0
Other Liabilities	DM 7,155.0	DM 7,716.3	DM 3,172.0	DM 11,026.0	DM 11,669.0
Total Liabilities	DM 17,606.8	DM 16,745.6	DM 11,965.0	DM 20,011.0	DM 20,748.0
Total Shareholders' Equity	DM 9,762.5	DM 10,755.7	DM 16,966.0	DM 11,369.0	DM 12,599.0
Common Stock	2,578.2	2,743.9	2,797.0	2,831.0	2,884.0
Other Equity	4,433.4	2,630.9	8,268.0	7,301.0	8,400.0
Retained Earnings	2,750.9	5,380.9	5,901.0	1,237.0	1,315.0
Total Liabilities and Shareholders' Equity	DM 27,369.3	DM 27,501.3	DM 28,931.0	DM 31,380.0	DM 33,347.0

Income Statement	1985	1986	1987	1988	1989
Revenue	DM 42,722.0	DM 38,014.0	DM 36,956.0	DM 40,964.0	DM 45,898.0
German Revenue	10,798.0	10,832.0	22,245.0	24,059.0	26,497.0
Non-German Revenue	31,924.0	27,182.0	14,711.0	16,905.0	19,401.0
Cost of Sales	NA	NA	DM 23,186.0	DM 25,580.0	DM 29,276.0
R&D Expense	DM 2,083.0	DM 2,138.0	DM 2,217.0	DM 2,416.0	DM 2,621.0
SG&A Expense	NA	NA	DM 8,722.0	DM 9,334.0	DM 10,420.0
Capital Expense	DM 2,365.0	DM 2,679.0	DM 2,394.0	DM 2,061.0	DM 3,868.0
Pretax Income	DM 3,156.0	DM 3,211.0	DM 3,108.0	DM 4,086.0	DM 4,146.0
Pretax Margin (%)	7.39	8.45	8.41	9.97	9.03
Effective Tax Rate (%)	NA	NA	NA	NA	NA
Net Income	DM 1,468.0	DM 1,399.1	DM 1,528.0	DM 2,015.0	DM 2,130.0
Shares Outstanding, Millions	63.1	63.1	62.0	62.5	64.1
Per Share Data					
Earnings	DM 23.27	DM 22.16	DM 24.63	DM 32.21	DM 33.44
Dividend	DM 10.00	DM 10.00	DM 11.00	DM 12.00	DM 13.00
Book Value	DM 154.71	DM 170.45	DM 273.65	DM 181.90	DM 196.55

Table 4 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of Deutsche Marks, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	2.59	3.02	6.89	6.18	6.39
Quick (Times)	1.53	1.95	4.28	4.04	4.06
Fixed Assets/Equity (%)	93.06	80.63	75.52	121.24	115.86
Current Liabilities/Equity (%)	69.86	55.84	13.64	24.88	23.12
Total Liabilities/Equity (%)	180.35	155.69	70.52	176.01	164.68
Profitability (%)					
Return on Assets	-	5.10	5.42	6.68	6.58
Return on Equity	-	13.64	11.02	14.22	17.77
Profit Margin	3.44	3.68	4.13	4.92	4.64
Other Key Ratios					
R&D Spending % of Revenue	4.88	5.62	6.00	5.90	5.71
Capital Spending % of Revenue	5.54	7.05	6.48	5.03	8.43
Employees	180,561	153,651	167,781	164,527	169,295
Revenue (DM K)/Employee	DM 237	DM 247	DM 220	DM 249	DM 271
Capital Spending % of Assets	8.64	9.74	8.27	6.57	11.60
Exchange Rate (US$1=DM)	DM 2.94	DM 2.17	DM 1.8	DM 1.76	DM 1.88

NA = Not available

Source: Hoechst AG
Annual Reports and Forms 10-K
Dataquest (1990)

KLA Instruments Corporation

3506 Bassett Street
Santa Clara, California 95054
Telephone: (408) 988-6100
Fax: (415) 659-1560
Dun's Number: 01-093-6193

Date Founded: 1975

CORPORATE STRATEGIC DIRECTION

KLA Instruments Corporation designs, manufactures, markets, and services automated optical inspection equipment used primarily by the semiconductor and interconnect industries in the production of all types of integrated circuits and printed circuit boards (PCBs). The need for automation arises from the complex patterns with decreasing feature dimensions that must be inspected during manufacturing.

The Company's customers are semiconductor manufacturers, photomask producers, PCB manufacturers, and other companies primarily in the computer, telecommunications, and automation industries that manufacture LSI and VLSI circuits for use in their own products. The Company markets its systems in the United States, Canada, and Europe through its own sales organization.

Total revenue increased by 47 percent to $165.5 million in fiscal 1989, from $112.9 million* in fiscal 1988. Net income increased substantially to $11.7 million in fiscal 1989, from $887,000 in fiscal 1988. KLA employs 991 people worldwide.

Research and development expenditures totaled $25.1 million in fiscal 1989, representing 15 percent of revenue. The Company entered into research and development contracts with four partnerships, organized from 1981 to 1986, to develop certain new technologies—wholly owned subsidiaries of the Company are general partners in these partnerships. Approximately 25 percent of the Company's work force is engaged in engineering, research, and development.

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.

BUSINESS SEGMENT STRATEGIC DIRECTION

The Company's business activities are organized into four operating divisions and one research and development laboratory responsible for the application of the Company's image-processing technology. These groups are named the Reticle and Photomask Inspection Division (RAPID); the Wafer Inspection System for the Automatic Recognition of Defects Division (WISARD); the Automated Test Systems Division (ATS); the KLA Scanning, Inspection, and Classification Division (KLASIC); and the Company's Advanced Development Laboratory.

RAPID Division

The RAPID Division manufactures, sells, and services the KLA 100 and KLA 200 Series systems, which are the product lines. In 1989, the RAPID Division introduced the KLA 210e Automatic Reticle Inspection System, which can detect smaller defects than any previous or competing systems. Also in 1989, RAPID began deliveries of the KLA-259 System, which inspects images on transparent (quartz) substrates.

*All dollar amounts are in U.S. dollars.

WISARD Division

The WISARD Division manufactures, sells, and services the KLA 2020, KLA 2028, KLA 2029, and the KLA 2030 and KLA 2031. The KLA 2020 is the older-generation model, which has both inspection and critical-dimension measurement (CD) capability. CD is the measurement of the circuit and line dimensions on the wafer, which are typically on the order of one micron or less. The KLA 2028 and KLA 2030 models are the newer-generation products with higher resolution, which offer inspection speeds up to 15 times greater than the KLA 2020 and CD capabilities either independently or in one machine. In 1989, WISARD announced the KLA 2029 for use in defect detection and the KLA 2031 for use in defect detection and metrology by manufacturers of 4Mb dynamic random-access memory (DRAM) chips. The trend toward denser, multilayer circuits and dramatically reduced line widths resulted in the development of the KLA 5000 Coherence Probe Metrology System.

ATS Division

The ATS Division manufactures, sells, and services the KLA 1007 wafer prober, the KLAASP, the KLA 1500 Networking Controller, and the Emission Microscope for Multilayer Inspection (EMMI). The ATS Division's products address the finished chip in wafer tests and assembly, with a microscopic probe that inspects the wafer both optically and electronically. Additionally, the wafer also can be inspected to determine whether the probe itself is causing damage to the wafer.

KLASIC Division

The KLASIC Division manufactures, sells, and services the KLA 3000 Series Systems. These products optically inspect PCB layers at all interconnect points under varying surface conditions. The KLA 3000 Series provides one of the fastest throughput rates in the automatic PCB-inspection market. In 1989, the KLASIC Division introduced the CAM-300 Series, which generates PCB images by computer-aided design (CAD). KLA believes that the CAM-3000 Series will provide a high-performance central node for future integrated data networks.

KLA Advanced Development Laboratory

The KLA Advanced Development Laboratory is the central engineering, research, and development laboratory of the Company.

Further Information

For more information about the Company's business segments, please contact the appropriate industry service.

Table 1
Five-Year Corporate Highlights (Thousands of U.S. Dollars)

	1985	1986	1987	1988	1989
Five-Year Revenue	$62,878.0	$82,526.0	$88,194.0	$112,851.0	$165,459.0
Percent Change	-	31.25	6.87	27.96	46.62
Capital Expenditure	$4,452.0	$2,999.0	$2,869.0	$9,289.0	$10,692.0
Percent of Revenue	7.08	3.63	3.25	8.23	6.46
R&D Expenditure	$10,734.0	$10,141.0	$8,655.0	$13,714.0	$25,087.0
Percent of Revenue	17.07	12.29	9.81	12.15	15.16
Number of Employees	560	660	760	861	991
Revenue ($K)/Employee	$112.28	$125.04	$116.04	$131.07	$166.96
Net Income	$8,802.0	$9,854.0	$7,489.0	$887.0	$11,678.0
Percent Change	-	11.95	(24.00)	(88.16)	1,216.57

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	$42,000.00	$43,160.00	$40,200.00	NA
Quarterly Profit	$2,920.00	$3,110.00	$2,500.00	NA

N/A = Not available

Source: KLA Instruments
Annual Reports and Forms 10-K
Dataquest
1990

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	51.00	68.00	80.22	50.17	52.27
International	49.00	32.00	19.78	49.83	47.73
Japan	-	-	00	2.00	7.00
Europe	-	-	18.00	26.00	17.00
Asia/Pacific	-	-	-	21.00	24.00
ROW	-	-	-	-	-

Source: KLA Instruments
Annual Reports

Table 3
Revenue by Distribution Channel (Percent)

Channel	1988	1989
Direct Sales	77.00	76.00
Indirect Sales	23.00	24.00
VARs	-	-
Distributors	21.00	17.00
Dealers	-	-
Mass Merchandisers	2.00	7.00
Manufacturers' Representatives	-	-

Source: Dataquest
1990

1989 SALES OFFICE LOCATIONS

North America—1
Europe—3
Japan—2
ROW—1

MANUFACTURING LOCATIONS

North America

San Jose, California
Santa Clara, California

Europe

Coburg, West Germany

ROW

Migdal Ha'mek, Israel

Manufacturing activities include high-speed image processors, air-bearing stages, image digitizers and optical systems. Other manufacturing activities consist primarily of assembling standard parts and subsystems manufactured to its specifications into subassemblies that are, in turn, assembled into finished product.

SUBSIDIARIES

North America

KLA Building Corporation (United States)
KLA Instruments KLINNIK Corporation (United States)
KLA Instruments Sales Corporation (U.S. Virgin Islands)
KLA International Corporation (United States)
KLA Management Corporation (United States)
KLA PCBI Corporation (United States)

Japan

KLA Technology Center Limited

Europe

KLA Instruments France S.A. (France)
KLA Instruments GmbH (West Germany)
KLA Instruments Ltd. (United Kingdom)

ROW

KLA Instruments (Cayman) Ltd. (British West Indies)
KLA Instruments (Israel) Corporation (Israel)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

Information is not available.

MERGERS AND ACQUISITIONS

Information is not available.

KEY OFFICERS

Kenneth Levy

President, chief executive officer

Robert R. Anderson

Chairman of the board, chief financial officer

Robert J. Boehlke

Executive vice president, chief operating officer

Paul Sandland

Senior vice president, chief technical officer

PRINCIPAL INVESTORS

State Farm Mutual Automobile Insurance Co.—8.4 percent
Levy, Kenneth—7.4 percent

Table 4
Comprehensive Financial Statement
Fiscal Year Ending June
(Thousands of U.S. Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$56,745.0	$73,331.0	$79,567.0	$103,823.0	$126,421.0
Cash	15,308.0	12,204.0	15,248.0	9,917.0	18,153.0
Receivables	15,466.0	20,951.0	23,216.0	40,819.0	54,183.0
Marketable Securities	6,827.0	13,277.0	10,605.0	14,491.0	8,755.0
Inventory	18,440.0	26,195.0	29,172.0	36,717.0	42,480.0
Other Current Assets	704.0	704.0	1,326.0	1,879.0	2,850.0
Net Property, Plants	$8,891.0	$8,992.0	$8,408.0	$14,590.0	$20,024.0
Other Assets	$14,967.0	$15,854.0	$27,523.0	$16,212.0	$14,309.0
Total Assets	$80,603.0	$98,177.0	$115,498.0	$134,625.0	$160,754.0
Total Current Liabilities	$16,509.0	$20,477.0	$24,757.0	$31,477.0	$42,269.0
Long-Term Debt	-	-	-	-	-
Other Liabilities	$1,453.0	$2,104.0	$3,696.0	$5,684.0	$7,468.0
Total Liabilities	$17,962.0	$22,581.0	$28,453.0	$37,161.0	$49,737.0
Total Shareholders' Equity	$62,641.0	$75,596.0	$87,045.0	$97,464.0	$111,017.0
Converted Preferred Stock	-	-	-	-	-
Common Stock	17.0	17.0	17.0	18.0	18.0
Other Equity	42,331.0	45,432.0	49,392.0	50,983.0	52,858.0
Retained Earnings	20,293.0	30,147.0	37,636.0	46,463.0	58,141.0
Total Liabilities and Shareholders' Equity	$80,603.0	$98,177.0	$115,498.0	$134,625.0	$160,754.0

Income Statement	1985	1986	1987	1988	1989
Revenue	$62,878.0	$82,526.0	$88,194.0	$112,851.0	$165,459.0
U.S. Revenue	32,068.0	56,118.0	70,745.0	56,620.0	86,479.0
Non-U.S. Revenue	30,810.0	26,408.0	17,449.0	56,231.0	78,980.0
Cost of Sales	$28,981.0	$44,008.0	$51,076.0	$67,269.0	$91,173.0
R&D Expense	$10,734.0	$10,141.0	$8,655.0	$13,714.0	$25,087.0
SG&A Expense	$12,076.0	$14,001.0	$14,924.0	$19,637.0	$31,136.0
Capital Expense	$4,452.0	$2,999.0	$2,869.0	$9,289.0	$10,692.0
Pretax Income	$14,442.0	$16,845.0	$12,777.0	$13,876.0	$17,966.0
Pretax Margin (%)	22.97	20.41	14.49	12.30	10.86
Effective Tax Rate (%)	39.00	41.50	41.30	36.40	35.00
Net Income	$8,802.0	$9,854.0	$7,489.0	$887.0	$11,678.0
Shares Outstanding, Thousands	17,509.0	17,702.0	17,787.0	18,006.0	7,934.0
Per Share Data					
Earnings	$0.50	$0.56	$0.42	$0.49	$0.65
Dividends	-	-	-	-	-
Book Value	$3.58	$4.27	$4.89	$5.41	$13.99

Table 4 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending June
(Thousands of U.S. Dollars, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	3.44	3.58	3.21	3.30	2.99
Quick (Times)	2.32	2.30	2.04	2.13	1.99
Fixed Assets/Equity (%)	14.19	11.89	9.66	14.97	18.04
Current Liabilities/Equity (%)	26.35	27.09	28.44	32.30	38.07
Total Liabilities/Equity (%)	28.67	29.87	32.69	38.13	44.80
Profitability (%)					
Return on Assets	-	11.02	7.01	0.71	7.91
Return on Equity	-	14.26	9.21	0.96	11.20
Profit Margin	14.00	11.94	8.49	0.79	7.06
Other Key Ratios					
R&D Spending % of Revenue	17.07	12.29	9.81	12.15	15.16
Capital Spending % of Revenue	7.08	3.63	3.25	8.23	6.46
Employees	560	660	760	861	991
Revenue ($K)/Employee	$112.28	$125.04	$116.04	$131.07	$166.96
Capital Spending % of Assets	5.52	3.05	2.48	6.90	6.65

Source: KLA Instruments
Annual Reports and Forms 10-K
Dataquest
1990

Lam Research Corporation

4650 Cushing Parkway
Fremont, California
Telephone: (415) 659-0200
Fax: (415) 659-1560
Dun's Number: 03-813-7956

Date Founded: 1980

CORPORATE STRATEGIC DIRECTION

Lam Research Corporation develops, manufactures, markets, and services semiconductor wafer processing capital equipment used in the production of very large-scale integrated (VLSI) circuits. The Company's wafer fabrication equipment is designed to meet the demands of semiconductor manufacturers by offering reliable automated equipment with low particle contamination levels and high levels of process integration.

Lam Research markets and sells single wafer plasma etch systems through its Lam Research Etch Division and epitaxy wafer processing equipment through its Gemini Epitaxy Equipment Division. However, the Company has recently announced a decision to remove itself slowly from the epitaxy market.

The Company's current product market focus is on equipment for silicon epitaxy and dry etch, which are key wafer fabrication technologies. The Company's products are targeted at independent semiconductor device manufacturers that sell their semiconductor devices to others (merchants) and to computer, telecommunications, and other companies that manufacture semiconductors for use in their own products (captives).

Total revenue increased 68 percent to $126.0 million* in fiscal 1989 from $74.9 million in fiscal 1988. Net income increased 271 percent to $9.3 million in fiscal 1989 from $2.5 million in fiscal 1988. Lam Research employs 731 people worldwide.

R&D expenditure totaled $21.9 million in fiscal 1989, representing 17 percent of revenue. Lam's current R&D efforts are directed at improvements to its existing etch and epitaxy product lines and at the development of a new chemical vapor deposition (CVD) system. As part of the Company's efforts to develop a CVD system, it has acquired a portion of Monkowski-Rhine Inc. (MRI) and entered into an investment and R&D agreement. MRI engages in the development, design, and process development of the CVD of thin films used in semiconductor device fabrication. Pursuant to the R&D agreement, Lam Research employed MRI to develop a CVD system.

Process technology is essential to success in this industry. More than one-quarter of Lam's facilities are dedicated to advanced research and process development. Lam employs over 100 process engineers and researchers who work in partnership with customers, consortia, and industry leaders. Key relationships with Du Pont, Sematech, Sumitomo Metal Industries, Ltd. (SMI), and other major customers allows Lam to anticipate future process requirements and maintain the process advantages.

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. Table 3, a comprehensive financial statement, is at the end of this profile.

BUSINESS SEGMENT STRATEGIC DIRECTION

Etch Products

Dataquest estimates that the sale of dry etch products raised $85.6 million for Lam Research during 1989. The Company's largest single market was in North America, which accounted for 51.4 percent of sales, or $44 million. Lam's second largest market was Rest of World, where the Company held a 37.3 percent

*All dollar amounts are in US dollars.

share. Dataquest estimates that Lam had a 13.5 percent share of the worldwide dry etch market for 1989.

Lam manufactures two families of single wafer etch systems: the AutoEtch and Rainbow etchers. Designed to meet the full range of etch applications, the AutoEtch series includes the AutoEtch 490, 590, 690, and 790, for etching polysilicon, nitrides, silicides, refractory metals, oxides, and aluminum.

The Rainbow series (Lam's flagship product) of etchers is designed to respond to the demands of the semiconductor manufacturers to increase total circuit density and speed without sacrificing manufacturing yield or device reliability. Lam Research claims that the Rainbow's design and process capability provide its users with reduced particulate contamination and improved selectivity, etch repeatability, uniformity, system reliability, and the ability to process wafer sizes up to 8 inches in diameter.

Electron cyclotron resonance (ECR) is one of the possible techniques capable of depositing films with high aspect ratios for intermetal dielectrics—crucial in 64 and 256Mb devices. Currently, Lam markets and supports the ECR systems designed and manufactured by its Japanese trading partner, SMI.

With the continued growth of multilayer integrated circuits regulating the requirements for unconventional CVD tools, Lam has incorporated unique technologies into a low-pressure CVD system introduced in fall 1990.

Epitaxy Products

In revenue, Lam held a dominant position in the $72 million 1989 epitaxy market when compared with other manufacturers. Dataquest estimates that the sale of epitaxy products generated $25.7 million in worldwide revenue for Lam in 1989, giving it a 35.7 percent share of the market. Recently, LAM has decided to remove itself slowly from this market in favor of the more lucrative etching market.

Lam manufactures a series of epitaxy products: the Gemini-1 and Gemini-2 Reactors, the Tetron One Reactor, and the Gemini-3. The Gemini-1 and Gemini-2 are high-performance epitaxy reactors capable of addressing a wide range of process, device, and production volume variations. The Gemini-1, which is available in three different models, has the capability to process wafers up to 6 inches in diameter. The Gemini-2, which is also available in three different models, has higher productivity and processes wafers up to 8 inches in diameter. The Gemini-1 and Gemini-2 Reactors also are capable of processing thick polysilicon films required for radiation-hardened circuits and certain communications switching devices demanding long process times at high temperatures.

As of 1988, the Tetron One Reactor is believed to be the largest epitaxy reactor, with a load size of fifty 5- or 6-inch diameter wafers. The Tetron One is targeted at the MOS-on-epitaxy market, where large numbers of wafers are expected to be manufactured to a relatively small number of specifications in the centralized materials operations of larger device companies and silicon materials manufacturers. The Tetron One system consists of a large single-process chamber. It offers productivity advantages of two to five times those of the Gemini-2. The Tetron One is fully automated, with cassette-to-cassette wafer handling.

The Gemini-3 is an advanced version of the Gemini-1 and Gemini-2 Reactors. Its design provides improved uniformity, lower maintenance cost, robotic wafer handling, and advanced computer control. The Gemini-3 is targeted at advanced bipolar and BiCMOS wafer fabrication, where process control, uniformity, and particle contamination are major concerns. The Gemini-3 is also targeted at the application-specific integrated circuit (ASIC) market.

Further Information

For more information about the Company's business segments, please contact the appropriate Dataquest industry service.

Table 1
Five-Year Corporate Highlights (Thousands of US Dollars)

	1985	1986	1987	1988	1989
Five-Year Revenue	$62,816.0	$46,739.0	$35,468.0	$74,963.0	$126,048.0
Percent Change	-	(25.59)	(24.11)	111.35	68.15
Capital Expenditure	-	-	-	-	-
Percent of Revenue	0	0	0	0	0
R&D Expenditure	$5,181.0	$13,883.0	$12,809.0	$15,749.0	$21,852.0
Percent of Revenue	8.25	29.70	36.11	21.01	17.34
Number of Employees	288	323	440	558	731
Revenue ($K)/Employee	$218.11	$144.70	$80.61	$134.34	$172.43
Net Income	$7,133.0	($900.0)	($6,908.0)	$2,505.0	$9,302.0
Percent Change	-	(112.62)	667.56	(136.26)	271.34

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	$33.58	$34.24	$37.40	$35.72
Quarterly Profit	$2.54	$2.65	$2.30	$2.35

Source: Lam Research Corporation
Annual Reports and Forms 10-K
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	87.40	55.04	61.75	62.20	56.03
International	12.60	44.96	38.25	37.80	43.97
Europe	3.60	17.96	20.25	13.80	10.97
Asia/Pacific	9.00	27.00	18.00	24.00	33.00
Japan	9.00	21.00	16.00	19.00	31.00

Source: Lam Research Corporation
Annual Reports and Forms 10-K
Dataquest (1990)

1989 SALES OFFICE LOCATIONS

North America—10
Europe—2
Asia/Pacific—3
Japan—2

MANUFACTURING LOCATIONS

North America

Fremont, California

Lam Research maintains two separate manufacturing facilities for the Lam Research Etch Division and the Gemini Epitaxy Equipment Division. The Company's manufacturing activities consist of assembling and testing components and subassemblies that then are integrated into finished systems. Prior to shipping a completed etching process system, the customer's engineers may perform acceptance tests at Lam's facility, using the customer's own wafers.

Epitaxy products are tested similarly, but only for electromechanical function. Because of contamination issues, process chemicals are not introduced into the epitaxy reactor until it is installed at the customer's location.

SUBSIDIARIES

North America

Gemini Research (United States)
LRC International Inc. (United States)

Europe

Lam Research GmbH (Germany)
West Germany Monkowski-Rhine Inc. (Germany)

Asia/Pacific

Lam Research Ltd. (Japan)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1989

Perkin-Elmer Corporation

Lam Research and Perkin-Elmer entered a patent purchase and sales agreement.

Sematech

LAM Research and Sematech agreed to codevelop an enhanced metal etch system exclusively for sale to Sematech members. The agreement involves the use of each other's facilities and personnel.

Du Pont

Lam Research and Du Pont agreed to codevelop a future generation of etch systems. The five-year agreement also calls for exchanging technology regarding the process of etchant gases. The technology that results will be sold by each firm separately.

Brookside Software

Lam Research received an exclusive distribution contract to market LamStation, a software program developed by Brookside Software. LamStation is a data acquisition program tailored for Lam Research's AutoEtch plasma etch equipment and performs data analysis control process monitoring.

1988

Sumitomo Metal Industries Ltd. (SMI)

Lam Research and SMI entered into a licensing agreement calling for SMI to market Lam's Rainbow line of plasma etching systems in Japan. Also, LAM will market and service SMI's new ECR systems in North America and Europe.

1987

Tokyo Electron, Ltd.

Lam Research and Tokyo Electron converted their joint venture agreement to a five-year licensing and consulting agreement. As a result, Lam Research recorded a gain of $940,000 from the sale of its 50 percent equity position in the joint venture.

MERGERS AND ACQUISITIONS

1989

Monkowski-Rhine Inc. (MRI)
Lam Research acquired MRI, a maker of semiconductor equipment.

1988

Gemini Research
Lam Research acquired Gemini Research, a manufacturer of capital equipment for the semiconductor industry.

KEY OFFICERS

Roger D. Emerick
President and chief executive officer

Carl A. Kountz
Chief operating officer, Lam Research Corporation, and president, Etch Division

Osamu Kano
Senior vice president, Japan Operations

Joseph R. Monkowski
Senior vice president, chief technical officer

Bruce Rhine
Vice president, Marketing

PRINCIPAL INVESTORS

Merrill Pickard Anderson & Eyre I—7.7 percent
Fiduciary Management Inc.—5.2 percent

FOUNDERS

Information is not available.

Table 3
Comprehensive Financial Statement
Fiscal Year Ending June
(Thousands of US Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$44,511.0	$41,898.0	$48,607.0	$54,079.0	$79,514.0
Cash	30,893.0	23,383.0	25,814.0	11,836.0	14,579.0
Receivables	6,093.0	9,585.0	8,681.0	19,961.0	31,884.0
Inventory	6,622.0	6,284.0	12,033.0	21,408.0	30,610.0
Other Current Assets	903.0	2,646.0	2,079.0	874.0	2,441.0
Net Property, Plants	$3,205.0	$4,009.0	$7,322.0	$10,070.0	$12,901.0
Other Assets	$673.0	$2,322.0	$1,225.0	$2,199.0	$3,489.0
Total Assets	$48,389.0	$48,229.0	$57,154.0	$66,348.0	$95,904.0
Total Current Liabilities	$8,210.0	$5,220.0	$10,184.0	$16,204.0	$26,407.0
Long-Term Debt	$231.0	$306.0	$2,952.0	$3,410.0	$12,396.0
Other Liabilities	$43.0	$209.0	-	-	-
Total Liabilities	$8,484.0	$5,735.0	$13,136.0	$19,614.0	$38,803.0
Total Shareholders' Equity	$39,905.0	$42,494.0	$44,018.0	$46,734.0	$57,101.0
Common Stock	35,374.0	35,591.0	38,430.0	11.0	11.0
Other Equity	-	38,630.0	39,684.0	38,630.0	39,684.0
Retained Earnings	4,531.0	6,903.0	5,588.0	8,093.0	17,406.0
Total Liabilities and Shareholders' Equity	$48,389.0	$48,229.0	$57,154.0	$66,348.0	$95,904.0
Income Statement	**1985**	**1986**	**1987**	**1988**	**1989**
Revenue	$62,816.0	$46,739.0	$35,468.0	$74,963.0	$126,048.0
US Revenue	54,904.0	25,725.0	21,902.0	46,630.0	70,625.0
Non-US Revenue	7,912.0	21,014.0	13,566.0	28,333.0	55,423.0
Cost of Sales	$16,312.0	$24,538.0	$19,149.0	$37,995.0	$68,596.0
R&D Expense	$5,181.0	$13,883.0	$12,809.0	$15,749.0	$21,852.0
SG&A Expense	$8,951.0	$13,939.0	$14,097.0	$18,530.0	$26,827.0
Capital Expense	-	-	-	-	-
Pretax Income	$7,865.0	($3,456.0)	($9,468.0)	$3,850.0	$12,474.0
Pretax Margin (%)	12.52	(7.39)	(26.69)	5.14	9.90
Effective Tax Rate (%)	-	-	-	40.60	25.40
Net Income	$7,133.0	($900.0)	($6,908.0)	$2,505.0	$9,302.0
Shares Outstanding, Thousands	10,202.0	10,250.0	10,320.0	10,950.0	11,135.0
Per Share Data					
Earnings	($0.70)	($0.09)	($0.67)	$0.23	$0.84
Dividend	-	-	-	-	-
Book Value	$3.91	$4.15	$4.27	$4.27	$5.13

Table 3 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending June
(Thousands of US Dollars, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	5.42	8.03	4.77	3.34	3.01
Quick (Times)	4.61	6.82	3.59	2.02	1.85
Fixed Assets/Equity (%)	8.03	9.43	16.63	21.55	22.59
Current Liabilities/Equity (%)	20.57	12.28	23.14	34.67	46.25
Total Liabilities/Equity (%)	21.26	13.50	29.84	41.97	67.96
Profitability (%)					
Return on Assets	-	(1.86)	(13.11)	4.06	11.47
Return on Equity	-	(2.18)	(15.97)	5.52	17.92
Profit Margin	11.36	(1.93)	(19.48)	3.34	7.38
Other Key Ratios					
R&D Spending % of Revenue	8.25	29.70	36.11	21.01	17.34
Capital Spending % of Revenue	0	0	0	0	0
Employees	288	323	440	558	731
Revenue ($K)/Employee	$218.11	$144.70	$80.61	$134.34	$172.43
Capital Spending % of Assets	0	0	0	0	0

Source: Lam Research Corporation
Annual Reports and Forms 10-K
Dataquest (1990)

Nippon Kogaku K.K. (Nikon)

Fuji Building, 2-3, Maronouchi 3-Chome
Chiyoda-ku, Tokyo 100, Japan
Telephone: 03-214-5311
Fax: 03-201-5856
Dun's Number: Not available

Date Founded: 1917

CORPORATE STRATEGIC DIRECTION

Nippon Kogaku K.K., also known as Nikon, is the result of a 1917 merger of three leading Japanese optical manufacturers. Today, Nikon is a leading manufacturer of precision instruments, cameras and other photo products, and ophthalmic products. In recent years, Nikon has become an important developer of IC-related equipment such as steppers and inspection systems.

Total revenue increased by 33 percent to $1.9 billion* in fiscal 1989 from $1.4 billion in fiscal 1988. Net income increased to $87.1 million in fiscal 1989 from a loss of $9.6 million in fiscal 1988.

Research and development expenditures totaled $54.8 million in fiscal 1989, representing 2.8 percent of revenue. Capital spending expenditures totaled $79.0 million in fiscal 1989, representing 4.0 percent of revenue.

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.

BUSINESS SEGMENT STRATEGIC DIRECTION

Precision Equipment

In fiscal 1989, the Precision Equipment Sector segment had revenue of $989 million, a 60 percent increase over fiscal 1988. Sales from this sector accounted for 53.7 percent of total net sales, up from 42.8 percent in fiscal 1988.

This sector includes semiconductor-related equipment, measuring instruments, microscopes, surveying equipment, binoculars, and telescopes.

In semiconductor-related equipment, Nikon is the leading manufacturer worldwide of steppers used in the production of very large scale integrated (VLSI) circuits and maintains a dominant market share in Japan. In fiscal 1989, sales of semiconductor-related equipment were $628 million, almost twice the level of fiscal 1988.

In the measuring instruments area, Nikon's most sophisticated product is the Tristation. The Tristation is a computerized, three-dimensional, coordinate-measuring machine capable of measuring complex shapes. Sales of measuring instruments in fiscal 1989 were $59 million, a 20 percent increase over fiscal 1988.

Photo Products and Electronic Imaging Equipment

In fiscal 1989, consolidated sales of photo products and electronic imaging equipment were $716.6 million, a 6.5 percent increase over 1988. This sector represents 38.9 percent of the company's total revenue.

This sector includes 35mm single-lens-reflex (SLR) and automatic compact cameras; interchangeable camera lenses, speedlights, and accessories; and electronic imaging equipment such as still video camera systems, television camera lenses, and camcorders.

*All dollar amounts are in US dollars.

Ophthalmic Products

In fiscal 1989, consolidated sales for ophthalmic products were $136 million, a decrease of 7.5 percent over fiscal 1988. This sector accounted for 7.4 percent of net sales.

This sector includes equipment used by professional optometrists and ophthalmologists, including optical frames, lenses, and sunglasses.

Further Information

For more information about the Company's business segments, please contact the appropriate industry service. Dataquest tracks Nikon's semiconductor equipment products through the Component Group's Semiconductor Equipment and Materials Service (SEMS).

Table 1
Five-Year Corporate Highlights (Millions of US Dollars)

	1985	1986	1987	1988	1989
Five-Year Revenue	$1,666.9	$1,521.2	$1,386.4	$1,449.4	$1,923.5
Percent Change	-	(8.74)	(8.86)	4.54	32.71
Capital Expenditure	$106.0	$144.6	$52.8	$42.4	$79.0
Percent of Revenue	6.36	9.51	3.81	2.93	4.11
R&D Expenditure	$34.7	$46.5	$43.8	$45.5	$54.8
Percent of Revenue	2.08	3.06	3.16	3.14	2.85
Number of Employees	NA	NA	NA	NA	NA
Revenue ($K)/Employee	NA	NA	NA	NA	NA
Net Income	$54.5	$16.9	($12.0)	($9.6)	$87.1
Percent Change	-	(68.99)	(171.01)	20.00	1,007.29

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	NA	NA	NA	NA
Quarterly Profit	NA	NA	NA	NA

NA = Not available

Source: Nikon
Annual Reports and Forms 10K
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
Japan	-	-	48.70	52.80	60.40
International	-	-	51.30	47.20	39.60
North America	-	-	28.00	22.30	15.30
Europe	-	-	15.00	15.10	13.70
Asia/Pacific	-	-	7.50	9.20	10.20
ROW	-	-	0.80	0.60	0.40

Source: Nikon
Annual Reports and Forms 10K
Dataquest (1990)

Table 3
Revenue by Distribution Channel (Percent)

Channel	1988	1989
Direct Sales	100	100
Indirect Sales	0	0
VARs	-	-
Distributors	-	-
Dealers	-	-
Mass Merchandisers	-	-
Manufacturers' Representatives	-	-

Source: Nikon
Annual Reports and Forms 10K
Dataquest (1990)

1989 SALES OFFICE LOCATIONS

North America—3
Japan—17
Europe—6
Asia/Pacific—1

MANUFACTURING LOCATIONS

Japan

Ohi, Yokohama, and Kumagaya
Manufacturing activities at these locations include the making of IC production-related measuring instruments and other precision instruments, as well as industrial supplies.
Ohi, Ibaraki, Tochigi, and Miyagi
Manufacturing activities here include most of Nikon's cameras.
Yokohama, Miyagi, and Tochigi
Manufacturing activities include optical instruments such as objective lenses for microscopes and eyeglasses.

SUBSIDIARIES

Japan

Kurobane Nikon Co. Ltd.
Mito Nikon K.K.
Nasu Nikon Co. Ltd.
Nikon Photo Products Inc.
Nikon Tec Corporation
Sendai Nikon K.K.
Tochigi Nikon K.K.
Zao Nikon K.K.

North America

Nikon Canada Inc. (Canada)
Nikon Inc. (United States)
Nikon Precision Inc. (United States)

Europe

Nikon AG (Switzerland)
Nikon Europe B.V. (the Netherlands)
Nikon France S.A. (France)
Nikon GmbH (West Germany)
Nikon Precision Europe GmbH (West Germany)
Nikon U.K. Ltd. (United Kingdom)

Asia/Pacific

Nikon Hong Kong Ltd. (Hong Kong)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1988

Anam Precision
Nikon and Anam Precision (South Korea) entered into a technology transfer agreement. Under the agreement, Nikon will transfer technology related to the production of low-priced 35mm compact cameras to Anam Precision in South Korea.

1987

Davidson Optronics
Nikon and Davidson Optronics entered into a licensing agreement. Under the agreement, Davidson Optronics will market Nikon's Autocollimators in the United States. Davidson also will administer the warranty/repair service.

MERGERS AND ACQUISITIONS

Information is not available.

KEY OFFICERS

Shigetada Fukuoka
Chairman

Koji Sho
President

Isao Ichikawa
Executive vice president

Shigeo Ono
Senior managing director

Shoichiro Yoshida
Senior managing director

PRINCIPAL INVESTORS

The Mitsubishi Trust and Banking Corporation—6.74 percent
The Meji Mutual Life Insurance Company—5.45 percent
The Mitsubishi Bank Ltd.—4.81 percent
The Sumitomo Trust and Banking Company Ltd.—4.02 percent

Table 4
Comprehensive Financial Statement
Fiscal Year Ending March
(Millions of US Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$718.6	$1,116.2	$1,127.8	$1,258.4	$1,305.0
Cash	118.1	128.9	132.5	142.8	112.7
Receivables	254.8	334.9	357.7	465.9	558.7
Marketable Securities	46.5	42.7	30.0	34.9	26.6
Inventory	282.8	581.9	575.8	574.5	564.5
Other Current Assets	16.4	27.8	31.8	40.3	42.5
Net Property, Plants	$206.3	$429.2	$414.9	$432.2	$429.6
Other Assets	$72.7	$162.0	$204.6	$255.6	$317.6
Total Assets	$997.6	$1,707.4	$1,747.3	$1,946.2	$2,052.2
Total Current Liabilities	$473.8	$653.9	$704.7	$862.9	$907.7
Long-Term Debt	$116.7	$344.3	$331.9	$243.9	$243.2
Other Liabilities	$3.6	$5.9	$12.8	$16.7	$12.4
Total Liabilities	$594.1	$1,004.1	$1,049.4	$1,123.5	$1,163.3
Total Shareholders' Equity	$403.6	$703.3	$698.1	$822.7	$888.9
Converted Preferred Stock	-	-	-	-	-
Common Stock	103.1	183.1	192.8	243.2	247.9
Other Equity	161.0	287.8	301.6	373.8	380.8
Retained Earnings	139.5	232.4	203.7	205.7	260.2
Total Liabilities and Shareholders' Equity	$997.7	$1,707.4	$1,747.5	$1,946.2	$2,052.2

Income Statement	1985	1986	1987	1988	1989
Revenue	$1,666.9	$1,521.2	$1,386.4	$1,449.4	$1,923.5
Japan Revenue	-	-	675.2	765.3	1,161.8
Non-Japan Revenue	-	-	711.2	684.1	761.7
Cost of Sales	$496.6	$832.0	$831.7	$986.0	$1,112.9
R&D Expense	$34.7	$46.5	$43.8	$45.5	$54.8
SG&A Expense	$485.7	$500.9	$431.7	$523.0	$458.9
Capital Expense	$106.0	$144.6	$52.8	$42.4	$79.0
Pretax Income	$70.5	$43.5	$5.3	$48.2	$159.1
Pretax Margin (%)	4.23	2.86	0.38	3.33	8.27
Effective Tax Rate (%)	-	-	-	-	-
Net Income	$54.5	$16.9	($12.0)	($9.6)	$87.1
Shares Outstanding, Millions	262.0	300.0	349.0	362.2	363.5
Per Share Data					
Earnings	$0.17	$0.05	($0.04)	($0.03)	$0.24
Dividends	$0.04	$0.05	$0.05	$0.04	$0.06
Book Value	$1.54	$2.34	$2.00	$2.27	$2.45

Table 4 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending March
(Millions of US Dollars, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	1.52	1.71	1.60	1.46	1.44
Quick (Times)	0.92	0.82	0.78	0.79	0.82
Fixed Assets/Equity (%)	51.11	61.03	59.43	52.53	48.33
Current Liabilities/Equity (%)	117.39	92.98	100.95	104.89	102.11
Total Liabilities/Equity (%)	147.20	142.77	150.32	136.56	130.87
Profitability (%)					
Return on Assets	-	1.25	(0.69)	(0.52)	4.36
Return on Equity	-	3.05	(1.71)	(1.26)	10.18
Profit Margin	3.27	1.11	(0.87)	(0.66)	4.53
Other Key Ratios					
R&D Spending % of Revenue	2.08	3.06	3.16	3.14	2.85
Capital Spending % of Revenue	6.36	9.51	3.81	2.93	4.11
Employees	NA	NA	NA	NA	NA
Revenue ($K)/Employee	NA	NA	NA	NA	NA
Capital Spending % of Assets	10.63	8.47	3.02	2.18	3.85

NA = Not available

Source: Nikon
Annual Reports and Forms 10-K
Dataquest (1990)

Nippon Sanso K.K.

16-7, Nishi-Shinbashi 1-chome
Minato-ku, Tokyo, Japan
Telephone: (03) 581-8200
Fax: (03) 580-9425
Dun's Number: Not Available

Date Founded: 1910

CORPORATE STRATEGIC DIRECTION

Nippon Sanso K.K. is one of the world's leading industrial gas manufacturers. The Company supplies industrial gases such as oxygen, nitrogen, and argon. It also provides air separation plants and various chemical plants. Nippon Sanso's consolidated revenue was ¥191.3 billion (US$1.3 billion) in the year ended March 31, 1990, compared with revenue of ¥166.7 billion (US$1.3 billion) for fiscal year 1989. Consolidated net income totaled ¥3.5 billion (US$24.5 million) in fiscal 1990 compared with ¥3.2 billion (US$24.7 million) in fiscal 1989. Sales of oxygen and nitrogen represented 29 percent of revenue, argon 7 percent, special-purpose gases 12 percent, gas-related equipment 14 percent, foodstuffs 8 percent, and other products made up the remaining 30 percent. R&D expenditure was ¥3.1 billion (US$21.8 million) in fiscal 1990.

Financial statements are not included in this backgrounder.

BUSINESS SEGMENT STRATEGIC DIRECTION

Nippon Sanso is the largest supplier of bulk and specialty gases in Japan and a major supplier in the Pacific Rim countries. The Company is a primary manufacturer of specialty gases, including phosphine and diborane. The Company is also the largest supplier of metal oxide chemical vapor deposition (MOCVD) equipment in Japan.

Matheson's US operations were acquired in 1983 as a joint venture between Nippon Sanso of Japan and Amerigas of the United States. Matheson's European operations were acquired at the same time by Union Carbide Corporation. In 1989, Nippon Sanso acquired the 50 percent of Matheson's US operations that was owned by Amerigas. Matheson supplies specialty gases to semiconductor manufacturers in the United States and ROW.

Nippon Sanso has a strong distribution network for both bulk and specialty products in the Japanese markets. Matheson's US operations provide primary manufacturing capability for many semiconductor gases, including phosphine and diborane.

In 1988, Nippon Sanso announced that it would invest in Industrial Oxygen Inc., Malaysia's second largest gas producer. Also in 1988, Nippon Sanso and Linde AG of Wiesbaden, Germany, agreed to a joint technology exchange. This agreement involved the exchange of engineers and technology to improve the production, analysis, and safe handling of silane, arsine, and phosphine gases.

In 1990, Nippon Sanso attempted to purchase Semi-gas Systems of San Jose, California. The Justice Department is reviewing the case, and a ruling is expected later this year on whether the combined companies would control a dominant market share of semiconductor gas distribution systems. Semi-gas is the leading US manufacturer of gas containment systems used in chip manufacturing.

Further Information

For further information about Nippon Sanso's business segments, please contact the appropriate Dataquest industry service.

1989 SALES OFFICE LOCATIONS

Information is not available.

MANUFACTURING LOCATIONS

Information is not available.

SUBSIDIARIES

Information is not available.

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

AGA
Nippon Sanso and AGA formed AGA/NSK to market Japanese production technology in Europe. AGA/NSK will be based in Germany.

Nippon Sanso, Nikko Sanso, Taiyo Sanso, and Toyo Sanso
Four of Japan's leading oxygen manufacturers plan to establish a joint venture for the production of oxygen, nitrogen, and argon. The new venture will be called Shin Sagamihara Sanso Co., Ltd.

MERGERS AND ACQUISITIONS

1989

Thermos
Nippon Sanso acquired Thermos, a supplier of glass vacuum bottles.

KEY OFFICERS

Natsuro Ishizawa
Chairman

Hideo Mabuchi
President

PRINCIPAL INVESTORS

Fuji Bank
Yasuda Life Insurance
Yasuda Trust

FOUNDERS

Information is not available.

Olin Corporation

120 Long Ridge Road
Stamford, Connecticut 06904
Telephone: (203) 356-2000
Fax: (203) 356-3065
Dun's Number: 00-133-8086

Date Founded: 1892

CORPORATE STRATEGIC DIRECTION

Olin Corporation is a manufacturer of chemicals, metals and materials, defense-related products, and ammunition. The chemicals segment includes industrial chemicals, performance chemicals, and image-forming and related specialty chemicals. Products in the metals and materials area include copper alloy sheet, strip, rod, tube, and fabricated parts; stainless steel strip, specialty clad, and inlay materials; and electronic interconnect materials and services. The defense and ammunition area includes small-, medium-, and large-caliber defense ammunition and advanced technology products and services for the aerospace and defense industries.

Total revenue increased by 8.7 percent to $2.5 billion* in fiscal 1989 from $2.3 billion in fiscal 1988. Net income increased 27.0 percent to $124 million in fiscal 1989 from $98 million in fiscal 1988. Olin employs 15,400 people worldwide.

Research and development expenditure totaled $66 million in fiscal 1989, representing 2.6 percent of revenue. Capital spending totaled $142 million in fiscal 1989, representing 6.0 percent of revenue.

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. Table 3, a comprehensive financial statement, is at the end of this profile.

*All dollar amounts are in US dollars.

BUSINESS SEGMENT STRATEGIC DIRECTION

Chemicals

Olin's Chemical business segment consists of seven major operating segments: Urethane Chemicals, Electrochemicals, Pool Products, Electronic Chemicals, Cleaning Products and Services, Organics, and Specialty Chemicals.

Olin develops, manufactures, and markets industrial and performance chemicals. Olin's wholly owned subsidiary, Olin Hunt Specialty Products Inc., manufactures and markets image-forming and related specialty chemicals.

Olin Hunt's products include photoresists, high-purity semiconductor-grade acids and solvents, dopants, and etchants for use in the manufacture of semiconductors and printed wireboard products; toners and developers used in photocopiers and computer printers; and conductive materials used in the electronics industry.

Metals and Materials

Olin's Metals and Materials business segment consists of two major operating units: Olin Brass and Interconnect Materials.

The metals products business is focused on the electronics market, providing high-performance and high-quality materials needed by the electronics industry and other advanced technology customers. These materials include specialty clad and inlay materials and Copperbond, a treated copper foil marketed to the printed circuit industry.

Olin's subsidiary, Fabricated Metal Products, fabricates ferrous and nonferrous specialty stamped metal products and shaped charge copper cones and produces specialized fabricated parts for durable goods and consumer recreational items.

Olin manufactures and sells strips, sheets, rods, and seamless and welded tubes of copper and copper alloy. Principal customers include producers of electrical and electronic equipment, producers of builders' hardware and appliances, the plumbing, automobile, and air-conditioning industries, and manufacturers of a variety of consumer goods. Fabricating operations allow Olin to produce stamped, formed, and drawn parts from its strip for many of these markets. In 1988, Olin acquired Bridgeport Brass Corporation, a producer of copper and copper alloy (strips, rods, and seamless tubes).

Defense and Ammunition

Olin's Defense and Ammunition business segment consists of three major operating units: Aerospace Division, Ordnance Division, and Winchester Division.

The Defense Systems Group's Aerospace Division manufactures specialty defense products, including small rocket engines used for altitude control and guidance, pulsed power systems, power supplies, and antiarmor warheads. Olin also operates the US government-owned Lake City Ammunition Plant, the largest small-caliber ammunition facility in the United States, as well as other government arsenals. Olin manufactures small-, medium-, and large-caliber defense ammunition; Winchester sporting ammunition (including shot shells and centerfire and rimfire ammunition); and smokeless powder.

In December 1988, Olin acquired General Defense Corporation, a prime systems contractor in large-caliber ammunition. The subsidiary's Tactical Systems Division produces large-caliber tank and artillery projectiles and components.

Further Information

For more information about the Company's business segments, please contact the appropriate industry service. Dataquest tracks Olin Hunt through the Semiconductor Equipment and Materials Service (SEMS).

Table 1
Five-Year Corporate Highlights (Millions of US Dollars)

	1985	1986	1987	1988	1989
Five-Year Revenue	$1,760.0	$1,732.0	$1,930.0	$2,308.0	$2,509.0
Percent Change	-	(1.59)	11.43	19.59	8.71
Capital Expenditure	$154.0	$128.0	$115.0	$147.0	$142.0
Percent of Revenue	8.75	7.39	5.96	6.37	5.66
R&D Expenditure	$54.0	$56.0	$62.0	$58.0	$66.0
Percent of Revenue	3.07	3.23	3.21	2.51	2.63
Number of Employees	14,900	13,200	14,100	16,400	15,400
Revenue ($K)/Employee	$118.12	$131.21	$136.88	$140.73	$162.92
Net Income	($165.0)	$75.0	$78.0	$98.0	$124.0
Percent Change	-	(145.45)	4.00	25.64	26.53

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	$671.00	$658.00	$580.00	$600.00
Quarterly Profit	$34.00	$35.00	$24.00	$31.00

Source: Olin Corporation
Annual Reports and Forms 10-K
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	92.84	94.00	92.75	89.95	92.79
International	7.16	6.00	7.25	10.05	7.21

Source: Olin Corporation
Annual Reports and Forms 10-K
Dataquest (1990)

1989 SALES OFFICE LOCATIONS

North America—5
Europe—5
Asia/Pacific—5
Japan—1
ROW—3

MANUFACTURING LOCATIONS

North America

Augusta, Georgia
Chlorine, caustic soda, hydrochloric acid, sodium hypochlorite, sodium hydrosulfate
Beaumont, Texas
Sulfuric acid and a mix of ammonium sulfite-bisulfite
Berea, Ohio
Dry toners, developers
Bloomington, Illinois
Stamped metal products, fabricated parts, shaped charge copper cones
Brandenburg, Kentucky
Ethylene oxide, industrial glycols, glycol ethers, surfactants, polyols, functional fluids
Brook Park, Ohio
Urethane foam systems
Bryan, Ohio
Copper, copper alloy re-rolling
Charleston, Tennessee
Chlorine, caustic soda, sodium hypochlorite, sodium hydrosulfite, calcium hypochlorite
Cuba, Missouri
Copper alloy welded tube
East Alton, Illinois
Copper and copper alloy sheet and strip, fabricated parts, composite metal strip for coins, specialty metal products
East Providence, Rhode Island
Formulation and packaging of photoresists
Indianapolis, Indiana
Copper and copper alloy strip, rod, seamless tube
Joliet, Illinois
Industrial phosphates, high-grade fertilizers, sodium fluorides
Kansas City, Kansas
Formulated water-treatment chemicals
Lancaster, Pennsylvania
Mechanical and electronic fuses
Lincoln, Rhode Island
Photographic and reprographic chemicals, photoresists
Livonia, Michigan
Chloroisocyanurate packaging
Manteca, California
Assembly of integrated circuits and microelectric packages
McIntosh, Alabama
Chlorine, caustic soda, hydrogen, hydrazine propellant blending, storage
Mountain View, California
Tape-automated bonding materials
Nazareth, Pennsylvania
High-purity acids
New Bedford, Massachusetts
Packages for hybrid integrated circuits
Niagara Falls, New York
Chlorine, caustic soda, hydrogen, potassium hydroxide, sodium chlorite, sodium methylate, sodium hypochlorite
Ontario, California
Conductive inks, coatings
Palisades Park, New Jersey
Filming agents, liquid toners, plating chemicals
Redmond, Washington
Rocket engines, gas generators, electronic subsystems for aircraft and ships
Rochester, New York
Specialty chemicals and intermediates, biocides
Rolling Meadows, Illinois
Photographic chemical systems
San Leandro, California
Pulsed-power equipment and services, radiation simulators, ordnance components
Seward, Illinois
Electronic chemicals, delivery systems
Shreveport, Louisiana
Sulfuric acid
South Charleston, West Virginia
Chloroisocyanurates, cyanuric acid
Tempe, Arizona
Specialty etchants
Wadsworth, Ohio
Ordnance components
Waterbury, Connecticut
Copper foil, thin-gauge copper alloys and stainless steel, custom conversion rolling

SUBSIDIARIES

North America

Bridgeport Brass Corp. (United States)
General Defense Corp. (United States)
Hi-Pure Chemicals Inc. (United States)
Olin Fabricated Metal Products Inc. (United States)
Olin Financial Services Inc. (United States)
Olin Hunt Specialty Products Inc. (United States)
Olin Specialty Metals Group (United States)
Olin Technology Inc. (United States)
Pacific Electro Dynamics Inc. (United States)
Physics International Inc. (United States)
Rocket Research Co. (United States)

Europe

Olin S.p.A. (Italy)

Asia/Pacific

Olin Australia Ltd. (Australia)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1989

Asahi Glass
Olin and Asahi Glass formed Asahi-Olin America to make urethane materials principally for automotive applications. Asahi-Olin was founded in Japan in 1974 to supply automakers, and the new US company will supply Japanese companies in the United States.

MERGERS AND ACQUISITIONS

1989

Indy Electronics
Olin acquired majority ownership (55 percent) in Indy Electronics, a major contract assembler of ICs and microelectronic packages. Olin had previously had a 45 percent stake in Indy Electronics.

1988

General Defense
Olin acquired General Defense for approximately $104 million. General Defense markets large-caliber ammunition and artillery projectiles.

Bridgeport Brass
Olin acquired Bridgeport Brass, a producer of copper and copper alloy products, including rod and tube.

KEY OFFICERS

John W. Johnstone
Chairman, president and chief executive officer

Donald W. Griffin
Executive vice president

Robert L. Yohe
Executive vice president

Joseph M. Gaffney
Senior vice president, Planning and Development

Edward Pollack
Senior vice president

C. Robert Tully
Senior vice president and chief financial officer

Michael E. Campbell
Vice president, Human Resources

Irving Chain
Vice president and chief scientist

PRINCIPAL INVESTORS

Connecticut National—16.8 percent
Boatmen's Bankshares Inc.—7.1 percent

FOUNDERS

Information is not available.

Table 3
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of US Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$695.2	$601.0	$680.0	$801.0	$790.0
Cash	47.9	9.0	34.0	25.0	12.0
Receivables	324.3	321.0	362.0	437.0	453.0
Marketable Securities	-	-	-	-	-
Inventory	267.0	264.0	273.0	311.0	296.0
Other Current Assets	56.0	7.0	11.0	28.0	29.0
Net Property, Plants	$718.0	$720.0	$727.0	$801.0	$781.0
Other Assets	$185.0	$224.0	$278.0	$338.0	$333.0
Total Assets	$1,598.2	$1,545.0	$1,685.0	$1,940.0	$1,904.0
Total Current Liabilities	$391.0	$391.0	$404.0	$617.0	$585.0
Long-Term Debt	$354.0	$375.0	$392.0	$474.0	$501.0
Other Liabilities	$166.0	$125.0	$189.0	$166.0	$153.0
Total Liabilities	$911.0	$891.0	$985.0	$1,257.0	$1,239.0
Total Shareholders' Equity	$686.0	$654.0	$700.0	$683.0	$665.0
Converted Preferred Stock	-	-	-	-	-
Common Stock	24.0	21.0	22.0	20.0	19.0
Other Equity	93.0	123.0	204.0	193.0	178.0
Retained Earnings	569.0	510.0	474.0	470.0	468.0
Total Liabilities and Shareholders' Equity	$1,597.0	$1,545.0	$1,685.0	$1,940.0	$1,904.0

Income Statement	1985	1986	1987	1988	1989
Revenue	$1,760.0	$1,732.0	$1,930.0	$2,308.0	$2,509.0
US Revenue	1,634.0	1,628.0	1,790.0	2,076.0	2,328.0
Non-US Revenue	126.0	104.0	140.0	232.0	181.0
Cost of Sales	$1,389.0	$1,318.0	$1,455.0	$1,781.0	$1,929.0
R&D Expense	$54.0	$56.0	$62.0	$58.0	$66.0
SG&A Expense	$252.0	$252.0	$264.0	$289.0	$287.0
Capital Expense	$154.0	$128.0	$115.0	$147.0	$142.0
Pretax Income	($282.0)	$115.0	$127.0	$151.0	$192.0
Pretax Margin (%)	(16.02)	6.64	6.58	6.54	7.65
Effective Tax Rate (%)	(32.60)	34.80	38.60	35.10	35.40
Net Income	($165.0)	$75.0	$78.0	$98.0	$124.0
Shares Outstanding, Millions	23.0	22.4	23.1	21.1	20.0
Per Share Data					
Earnings	($8.28)	$3.36	$3.38	$4.63	$6.02
Dividend	$1.50	$1.52	$1.60	$1.70	$1.95
Book Value	$29.83	$29.20	$30.30	$32.37	$33.25

Table 3 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of US Dollars, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	1.78	1.54	1.68	1.30	1.35
Quick (Times)	1.10	0.86	1.01	0.79	0.84
Fixed Assets/Equity (%)	104.66	110.09	103.86	117.28	117.44
Current Liabilities/Equity (%)	57.00	59.79	57.71	90.34	87.97
Total Liabilities/Equity (%)	132.80	136.24	140.71	184.04	186.32
Profitability (%)					
Return on Assets	-	4.77	4.83	5.41	6.45
Return on Equity	-	11.19	11.52	14.17	18.40
Profit Margin	(9.38)	4.33	4.04	4.25	4.94
Other Key Ratios					
R&D Spending % of Revenue	3.07	3.23	3.21	2.51	2.63
Capital Spending % of Revenue	8.75	7.39	5.96	6.37	5.66
Employees	14,900	13,200	14,100	16,400	15,400
Revenue ($K)/Employee	$118.12	$131.21	$136.88	$140.73	$162.92
Capital Spending % of Assets	9.64	8.28	6.82	7.58	7.46

Source: Olin Corporation
Annual Reports and Forms 10-K
Dataquest (1990)

Osaka Titanium Co.

1, Higashi-Hamacho
Amagasaki City, Hyogo, Japan
Telephone: 06-411-1121
Fax: 06-413-3435
Telex: 64510
Dun's Number: 69-087-8475

Date Founded: 1950

CORPORATE STRATEGIC DIRECTION

Osaka Titanium Co. is the world's largest manufacturer of metallic titanium and one of Japan's top producers of semiconductor silicon. The Company is a member of the Sumitomo Metal Industries Group. Osaka has established itself in the United States by absorbing US Semiconductor Corporation, an epitaxial wafer maker, in 1987.

Revenue for year ended March 1990 was ¥6.1 billion (US$421.7 million). This is a 21.3 percent increase over the previous year's figure of ¥50.0 billion (US$347.6 million). (Percentage changes refer only to ¥ amounts; US$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) Net income was posted as a decrease of 38.5 percent at year ended March 1990 to ¥2.0 billion (US$13.7 million) from ¥3.2 billion (US$22.3 million) in the previous year.

R&D expenditure totaled ¥705 million (US$4.9 million) for year ended March, 1990. Capital expenditure totaled ¥3.2 billion (US$22.7 million) for the same period and is expected to increase to ¥4.4 billion (US$30.9 million) by year ending March 1991. The Company had 762 employees as of fiscal year ended March 1990.

No financial analysis is included in this backgrounder because financial information was unavailable.

BUSINESS SEGMENT STRATEGIC DIRECTION

Sponge titanium is currently in capacity production due to increased demand from US and European civil aircraft manufacturers. Sponge titanium also is used in seawater desalination plants. Profits are expected to rise, offsetting lowered sales resulting from silicon production cuts.

Metallic titanium is responsible for 28 percent of total revenue for year ended March 1990; semiconductor silicon is responsible for the remaining 72 percent. The Company exports approximately 20 percent of its products.

Further Information

For further information about the Company's business segments, please contact the appropriate Dataquest industry service.

1990 SALES OFFICE LOCATIONS

Information is not available.

MANUFACTURING LOCATIONS

North America

Cincinnati Semiconductor, Inc., United States
  Wafer production
OTC Semiconductor Corporation, United States
  Wafer production

US Semiconductor Corporation, United States
Wafer production

Asia/Pacific

Hyushu Electronic Metal
Silicon wafer processing
Kyushu Denshi Kinzoku
Production of silicon wafers for 4Mb chips

SUBSIDIARIES

North America

Cincinnati Semiconductor, Inc. (United States)
OTC Semiconductor Corporation (United States)
US Semiconductor Corporation (United States)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

Toho Titanium Co. and Showa Denko KK
Osaka Titanium, joined by Toho Titanium and Showa Denko, plan to build a pilot plant with a 1,000-metric-ton annual capacity on the Company's premises in Amagasaki, Japan, in 1992.

MERGERS AND ACQUISITIONS

1987

US Semiconductor
Osaka Titanium purchased US Semiconductor to help launch itself in the United States.

KEY OFFICERS

Hiroshi Kojima
Chairman of the board

Shigeru Tamamoto
President

PRINCIPAL INVESTORS

Information is not available.

FOUNDERS

Information is not available.

Shin-Etsu Chemical Co., Ltd.

6-1, Ohtemachi, 2-chome
Chiyoda-ku, Tokyo, Japan
Telephone: (03) 246-5111
Fax: (03) 246-5350
Dun's Number: Not Available

Date Founded: 1926

CORPORATE STRATEGIC DIRECTION

Established in 1926, Shin-Etsu Chemical Co., Ltd., specializes in the development and production of specialty chemicals and high-tech materials. The Company offers an extensive array of products including silicones, high-purity semiconductor silicon, synthetic quartz, polyvinyl chloride (PVC), cellulose derivatives, rare earth materials and products, and oxidized single crystals.

Shin-Etsu's consolidated revenue was ¥403,436 million (US$3,145.7 million) in the period ended March 31, 1989, compared with revenue of ¥298,447 million (US$2,162.2 million) for fiscal year ended March 31, 1988. Fiscal year 1988 was only ten months long due to a change in the account settlement date. Consolidated net income totaled ¥27,894 million (US$217.5 million) in fiscal 1989.

Shin-Etsu's five divisions are plastics, organic and inorganic chemicals, electronics materials, fertilizers and ferroalloys, and international operations. Plastics and electronics materials were the largest revenue contributors, responsible for 45.3 and 35.4 percent of revenue, respectively. Organic and inorganic chemicals represented 9.3 percent of sales, international operations 6.0 percent, and fertilizers and ferroalloys 4.0 percent.

R&D costs for the year ended March 31, 1989, and for the ten-month period ended March 31, 1988, were respectively ¥18,094 million (US$141.1 million) and ¥14,656 million (US$106.2 million). Capital expenditure for fiscal 1989 was ¥25,241 million (US$196.8 million). The Company employs 3,420 people worldwide.

This backgrounder includes no financial information.

BUSINESS SEGMENT STRATEGIC DIRECTION

Semiconductors

Shin-Etsu Handotai (also known as SEH) is the largest silicon and epitaxial wafer company in the world. The company was formed as a joint venture between Shin-Etsu Chemical and Dow Corning in 1967. In 1979, Shin-Etsu Chemical acquired full ownership of Shin-Etsu Handotai. Shin-Etsu Handotai's subsidiaries and affiliates include SEH America, SEH Europe, and SEH Malaysia. SEH's world headquarters are in Tokyo, and its R&D centers are in Isobe, Japan, and Vancouver, Washington. In addition to silicon products, SEH manufactures gallium arsenide and gallium phosphide through a joint venture with Furukawa Mining known as Iwaki Handotai. Like several of the major silicon merchant companies, Shin-Etsu Handotai's silicon manufacturing is vertically integrated, from polysilicon to polished wafers.

Further Information

For further information about Shin-Etsu Chemical, please contact the appropriate Dataquest industry service.

1989 SALES OFFICE LOCATIONS

Information is not available.

MANUFACTURING LOCATIONS

Information is not available.

SUBSIDIARIES

North America

Shin-Etsu Silicones of America, Inc. (United States)
Shin-Etsu Technical Services Inc. (United States)
Shintech Incorporated (United States)
SM Yttrium Canada Ltd. (Canada)

Europe

Companhia Industrial de Resinas Sinteticas S.A.R.L. (CIRES) (Portugal)

Asia/Pacific

Kashima Vinyl Chloride Monomer Co., Ltd. (Japan)
Nagano Electronics Industrial Co., Ltd. (Japan)
Naoetsu Electronics Co., Ltd. (Japan)
Nissin Chemical Industry Co., Ltd. (Japan)
Shinano Electric Refining Co., Ltd. (Japan)
Shin-Etsu Engineering Co., Ltd. (Japan)
Shin-Etsu Film Co., Ltd. (Japan)
Shin-Etsu Handotai Co., Ltd. (Japan)
Shin-Etsu Kasei Co., Ltd. (Japan)
Shin-Etsu (Malaysia) Sdn. Bhd. (Malaysia)
Shin-Etsu Metallurgical Co., Ltd. (Japan)
Shin-Etsu Polymer Co., Ltd. (Japan)
Shin-Etsu Quartz Products Co., Ltd. (Japan)
Shin-Etsu Silicone Korea Co., Ltd. (South Korea)
Shin-Etsu Silicone Taiwan Co., Ltd. (Taiwan)
Shin-Etsu Vinyl Acetates Co., Ltd. (Japan)
Shinken Sangyo Co., Ltd. (Japan)
Shinyo Home-Services Co., Ltd. (Japan)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

Ciba-Geigy
Shin-Etsu Chemical has supplied Ciba-Geigy with technology for the production of epoxy resin molding compound (EMC). EMC is used as a sealing material in semiconductor manufacturing.

Admatechs
Admatechs has been formed by Toyota Motor (55 percent), Shin-Etsu Chemical (25 percent), and Shin-Etsu Quartz (20 percent) to build a ceramic powder plant at Shin-Etsu's Maoetsu, Japan, complex.

MERGERS AND ACQUISITIONS

1990

MicroSci
MicroSci was formed in Delaware from Shin-Etsu Chemical's purchase of Huls America's microelectrochemical division.

KEY OFFICERS

Yutaro Kosaka
President

Chihiro Kanagawa
Executive vice president

Katsurao Fujita
Executive vice president

Fumio Wakasugi
Senior managing director

Taro Sugawara
Senior managing director

Masami Hashimoto
Senior managing director

Shunichi Koyanagi
Senior managing director

Tadashi Wada
Senior managing director

Katsuro Miyasaka
Senior managing director

PRINCIPAL INVESTORS

Nippon Life Insurance Company
The Long-Term Credit Bank of Japan, Ltd.
The Mitsubishi Bank, Ltd.
The Mitsubishi Trust and Banking Corp.
The Toyo Trust and Banking Ltd.

FOUNDERS

Information is not available.

Silicon Valley Group, Inc.

541 E. Trimble Road
San Jose, California 95131
Telephone: (408) 432-9300
Fax: (408) 432-8629
Dun's Number: 08-291-0233

Date Founded: 1977

CORPORATE STRATEGIC DIRECTION

Silicon Valley Group, Inc. (SVG), designs, manufactures, and markets semiconductor production processing equipment used in the fabrication of integrated circuits. Founded in 1977 as a manufacturer of photoresist track systems and components, the Company has expanded its operations through internal development and acquisition.

SVG expanded into the chemical vapor deposition (CVD) market in 1986 by developing a vertical thermal reactor. In 1987, SVG acquired Anicon, a manufacturer of nontube CVD equipment. In December 1988, SVG further expanded its product offerings through the acquisition of Thermco Systems. The Thermco acquisition resulted in SVG's more than doubling its previous sales volume and has provided the Company with significant expansion of its customer base in the oxidation, diffusion, and low-pressure CVD (LPCVD) processing equipment market.

All SVG divisions operate as independent profit centers, complete with operations to support product development, manufacturing, marketing, and sales. The Track Systems Division is focused on the photolithography processing equipment market; the Thermco Systems Division offers oxidation, diffusion, and LPCVD processing systems. SVG Lithography Systems, Inc. (SVGL), acquired in May 1990 when SVG acquired a controlling equity position in Perkin-Elmer Corporation's optical lithography unit in Wilton, Connecticut, provides the Company with the leading-edge technology in the photolithography equipment market through Perkin-Elmer's step-and-scan lithography tools.

SVG markets and sells its products as part of new wafer fabrication lines and in connection with the expansion and upgrading of existing fabrication lines. SVG's major customers include IBM, Intel, Motorola, Philips AG, Samsung Electronics, SGS-Thompson, and Texas Instruments. Dataquest ranks SVG as the tenth largest manufacturer of semiconductor wafer fab equipment in 1989, based on estimated equipment sales of $127 million* worldwide.

Total revenue increased by 168 percent to $131.0 million in fiscal 1989 from $9.0 million in fiscal 1988. Net income increased 116 percent to $9.6 million in fiscal 1989 from $4.4 million in fiscal 1988. Domestic sales represented approximately 59 percent of sales for the year. The foreign sales figure of 41 percent was up from 32 percent in the previous year.

R&D expenditure totaled $15.2 million in fiscal 1989, representing 11.6 percent of revenue. Capital spending totaled $1.8 million in fiscal 1989, or 1.4 percent of revenue. Silicon Valley Group employs 1,500 people worldwide (including SVGL employees).

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 backgrounder.

BUSINESS SEGMENT STRATEGIC DIRECTION

Track Systems Division

SVG's Track Systems Division designs, manufactures, markets, and services processing equipment that performs the wafer cleaning, adhesion promotion,

*All dollar amounts are in US dollars.

coating, developing, and baking steps in the photolithographic stage of semiconductor production. The division's products include photolithography processing systems, wafer cleaning systems, and lithography automation systems.

All of the Track Systems Division's products are available in fully automated, cassette-to-cassette configurations. The products can be configured as standalone processing stations or as in-line integrated manufacturing systems that incorporate a selected assortment of the photolithography processing products offered by SVG. The equipment is modular in design to allow many different system combinations and individual product replacements or additions to existing fabrication operations.

SVG offers four product lines of photolithography processing equipment: the 8800 Series, the 8600 Series, the 8100 Series, and the new 90 Series, which was introduced in May 1990.

Thermco Systems Division

SVG's Thermco Systems Division designs, manufactures, and markets LPCVD and oxidation/diffusion processing equipment. These products include horizontal thermal systems, the Company's Vertical Thermal Reactor (VTR), the Anicon Cross Flow Reactor, and LPCVD systems.

The horizontal thermal systems include furnaces, systems for LPCVD, systems for high-temperature processing, automated load stations, lab furnaces, boatloaders, multiaccess elevators, wafer transfer stations, cassette managers, and host computer interfaces and software.

SVG Lithography Systems, Inc. (SVGL)

SVGL offers the Micrascan generation of systems, originally developed by Perkin-Elmer's optical lithography unit and introduced in 1989. Micrascan merges the optical advantages of scanning aligner technology with the registration advantages of step-and-repeat technology. SVGL believes the result to be a system capable of delivering high-resolution, local alignment and leveling while maintaining high throughput, large image field size, and low distortion.

SVGL products include the Micrascan step-and-scan system, the Micrascan projection aligner, and X-ray step-and-repeat systems.

Further Information

For more information about the Company's business segments, please contact the appropriate Dataquest industry service.

Table 1
Five-Year Corporate Highlights
(Thousands of US Dollars)

	1985	1986	1987*	1988*	1989*
Five-Year Revenue	$36,864.0	$27,842.0	$39,300.0	$48,969.0	$131,080.0
Percent Change	-	(24.47)	41.15	24.60	167.68
Capital Expenditure	0	$1,914.0	$625.0	$1,740.0	$1,837.0
Percent of Revenue	0	6.87	1.59	3.55	1.40
R&D Expenditure	$4,660.0	$4,686.0	$5,808.0	$7,006.0	$15,177.0
Percent of Revenue	12.64	16.83	14.78	14.31	11.58
Number of Employees	297	268	344	382	932
Revenue ($K)/Employee	$12,412.12	$10,388.81	$11,424.42	$12,819.11	$14,064.38
Net Income	$5,734.0	$2,646.0	$3,148.0	$4,440.0	$9,612.0
Percent Change	-	(53.85)	18.97	41.04	116.49

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	$18,940.00	$35,455.00	$37,421.00	$39,264.00
Quarterly Profit	$1,483.00	$2,527.00	$2,828.00	$2,774.00

*Figures for 1987 through 1989 have been restated to reflect acquisitions.

Source: Silicon Valley Group, Inc.
Annual Reports and Forms 10-K
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	NA	NA	63.00	68.00	59.00
International	NA	NA	37.00	32.00	41.00
Europe	NA	NA	21.00	17.00	18.00
Asia/Pacific	NA	NA	7.00	10.00	22.00
ROW	NA	NA	9.00	5.00	1.00

NA = Not available

Source: Silicon Valley Group, Inc.
Annual Reports and Forms 10-K
Dataquest (1990)

Table 3
Revenue by Distribution Channel (Percent)

Channel	1988	1989
Direct Sales	80.00	80.00
Indirect Sales	20.00	20.00
Distributors	10.00	10.00
Manufacturers' Representatives	10.00	10.00

Source: Dataquest (1990)

1990 SALES OFFICE LOCATIONS

North America—18
Europe—14
Asia/Pacific—9
ROW—2

MANUFACTURING LOCATIONS

North America

Track Systems Division—San Jose, California
Manufacturing activities include photoresist processing equipment; brush scrubbers; high-pressure cleaners; vacuum bake vapor prime; chill plates; coaters; developers; interfaces to steppers, etchers, inspection systems, and host computers; hotplate ovens; and multiple hotplate ovens.

Thermco Systems Division—Orange and San Jose, California
Manufacturing activities include horizontal thermal systems, the Vertical Thermal Reactor (VTR), and CVD systems.

SVG Lithography Systems—Wilton, Connecticut
Manufacturing activities include step-and-scan lithography equipment, projection aligners, and X-ray step-and-repeat systems.

SUBSIDIARIES

North America

Silicon Valley Group International Inc. (United States)
SVG International Service (United States)
SVG Lithography Systems, Inc. (United States)
Thermco Systems Inc. (United States)

Europe

SVG Europe Ltd. (England)
SVG France S.A.R.L. (France)
SVG Halbleiter Anlagen GmbH (Germany)
SVG Lithography Europe B.V. (Netherlands)
SVG Lithography GmbH (Germany)
SVG Lithography S.A.R.L. (France)
Thermco Products GmbH (Germany)
Thermco Semiconductor Equipment Ltd. (England)

Asia/Pacific

Silicon Valley Group K.K. (Japan)
SVG Lithography (Japan)
Thermco Systems (Far East) Ltd. (Hong Kong)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

Information is not available.

MERGERS AND ACQUISITIONS

1990

Perkin-Elmer Corporation
SVG acquired a controlling interest in Perkin-Elmer Corporation's Optical Lithography Operation in a complex deal worth $40 million. The new company, known as SVG Lithography Systems, Inc. (SVGL), will run the operation; approximately two-thirds of its stock will be owned by SVG.

1988

Thermco Systems
Silicon Valley Group acquired Thermco Systems, a manufacturer of oxidation/diffusion furnaces and LPCVD systems, for approximately $22.7 million.

1987

Anicon
SVG acquired Anicon, a manufacturer of CVD equipment, for $6.9 million.

KEY OFFICERS

Gerald M. Starek
Chairman of the board

Papken S. Der Torossian
President and chief executive officer

Vahe A. Sarkissian
President and chief executive officer, SVG Lithography Systems, and vice president, Silicon Valley Group

Nicholas E. Miller
President, Thermco Systems Division, and vice president, Silicon Valley Group

H. F. Ken Machado
President, Track Systems Division, and vice president, Silicon Valley Group

Patrick O'Conner
Vice president, Corporate Planning

Russell G. Weinstock
Vice president, Finance, and chief financial officer

Charles Desmond
Vice president, Corporate Sales

PRINCIPAL INVESTORS

Prudential Insurance Co. of America—7.9 percent
Brinson Partners—7.7 percent

FOUNDERS

Information is not available.

Table 4
Comprehensive Financial Statement
Fiscal Year Ending September
(Thousands of US Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987*	1988*	1989*
Total Current Assets	$36,698.0	$38,677.9	$46,165.0	$51,504.0	$66,886.0
Cash	23,637.0	1,636.4	3,209.0	13,127.0	10,396.0
Receivables	5,629.0	24,018.7	9,730.0	12,794.0	29,370.0
Marketable Securities	0	6,619.2	26,259.0	14,384.0	1,400.0
Inventory	6,855.0	5,980.8	6,243.0	9,140.0	21,592.0
Other Current Assets	577.0	422.8	724.0	2,059.0	4,128.0
Net Property, Plants	$1,750.0	$3,171.8	$4,942.0	$5,027.0	$7,860.0
Other Assets	$233.0	$262.8	$3,636.0	$3,221.0	$10,165.0
Total Assets	$38,681.0	$42,112.5	$54,743.0	$59,752.0	$84,911.0
Total Current Liabilities	$3,938.0	$4,319.4	$8,901.0	$8,912.0	$22,687.0
Long-Term Debt	0	0	$544.0	$169.0	0
Other Liabilities	$364.0	$408.1	$1,018.0	$1,154.0	$1,632.0
Total Liabilities	$4,302.0	$4,727.5	$10,463.0	$10,235.0	$24,319.0
Total Shareholders' Equity	$34,380.3	$37,385.0	$44,280.0	$49,517.0	$60,592.0
Common Stock	15,748.7	16,107.1	19,854.0	20,651.0	24,328.0
Other Equity	0	0	0	0	(2,214.0)
Retained Earnings	18,631.6	21,277.9	24,426.0	28,866.0	38,478.0
Total Liabilities and Shareholders' Equity	$38,682.3	$42,112.5	$54,743.0	$59,752.0	$84,911.0
Income Statement	**1985**	**1986**	**1987***	**1988***	**1989***
Revenue	$36,864.0	$27,842.0	$39,300.0	$48,969.0	$131,080.0
US Revenue	NA	NA	24,759.0	33,299.0	77,337.0
Non-US Revenue	NA	NA	14,541.0	15,670.0	53,743.0
Cost of Sales	$15,130.0	$12,378.0	$18,160.0	$22,169.0	$71,546.0
R&D Expense	$4,660.0	$4,686.0	$5,808.0	$7,006.0	$15,177.0
SG&A Expense	$7,945.0	$8,036.0	$11,813.0	$14,877.0	$28,951.0
Capital Expense	NA	$1,914.0	$625.0	$1,740.0	$1,837.0
Pretax Income	$10,823.0	$4,739.0	$5,293.0	$6,628.0	$15,758.0
Pretax Margin (%)	29.36	17.02	13.47	13.54	12.02
Effective Tax Rate (%)	47.00	44.20	40.50	33.00	39.00
Net Income	$5,734.0	$2,646.0	$3,148.0	$4,440.0	$9,612.0
Shares Outstanding, Thousands	8,764.0	8,876.0	9,892.0	9,879.0	10,196.0
Per Share Data					
Earnings	$0.65	$0.30	$0.32	$0.45	$0.94
Dividend	0	0	0	0	0
Book Value	$3.92	$4.21	$4.48	$5.01	$5.94

Table 4 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending September
(Thousands of US Dollars, except Per Share Data)

Key Financial Ratios	1985	1986	1987*	1988*	1989*
Liquidity					
Current (Times)	9.32	8.95	5.19	5.78	2.95
Quick (Times)	7.58	7.57	4.49	4.75	2.00
Fixed Assets/Equity (%)	5.09	8.48	11.16	10.15	12.97
Current Liabilities/Equity (%)	11.45	11.55	20.10	18.00	37.44
Total Liabilities/Equity (%)	12.51	12.65	23.63	20.67	40.14
Profitability (%)					
Return on Assets	-	6.55	6.50	7.76	13.29
Return on Equity	-	7.37	7.71	9.47	17.46
Profit Margin	15.55	9.50	8.01	9.07	7.33
Other Key Ratios					
R&D Spending % of Revenue	12.64	16.83	14.78	14.31	11.58
Capital Spending % of Revenue	0	6.87	1.59	3.55	1.40
Employees	297	268	344	382	932
Revenue ($K)/Employee	$12,412.12	$10,388.81	$11,424.42	$12,819.11	$14,064.38
Capital Spending % of Assets	0	4.54	1.14	2.91	2.16

*Figures for 1987 through 1989 have been restated to reflect acquisitions.
NA = Not available

Source: Silicon Valley Group, Inc.
Annual Reports and Forms 10-K
Dataquest (1990)

Tokyo Electron Ltd.

2-30-7, Sumiyoshi-cho
Fuchu City, Tokyo, Japan
Telephone: 0423-33-8111
Fax: 0423-33-8480
Telex: 2832475
Dun's Number: 69-054-9777

Date Founded: 1963

CORPORATE STRATEGIC DIRECTION

Tokyo Electron Ltd. (TEL) was founded in 1963 as an electronic products distributor. Currently, TEL manufactures semiconductor manufacturing equipment and measuring instruments as well as pursuing its original trade. Sales for fiscal year ended September 1990 grew rapidly, led by semiconductor manufacturing equipment.

TEL has three divisions: Semiconductor Equipment, Computer Systems, and Electronic Parts and Components. The Company has formed strategic joint ventures in all three divisions that allow it to trade technologies and products.

Revenue for year ended September 1990 totaled ¥190.0 billion (US$1.3 billion), an increase of 9.7 percent over the previous year's total of ¥173.2 billion (US$1.4 billion). (Percentage changes refer only to ¥ amounts; US$ percentage changes will differ because of fluctuations in Dataquest exchange rates.) Net income for year ended September 1990 totaled ¥11.0 billion (US$77.2 million), an increase of 21.7 percent over the previous year's figure of ¥9.0 billion (US$70.5 million). Sixty-five percent of sales were of semiconductor manufacturing equipment, 22 percent were of electronic components, and the remaining 13 percent were of computer systems. Tokyo Electron's export sales accounted for 52 percent of revenue for fiscal year ended September 1990.

R&D expenditure totaled ¥4.8 billion (US$33.7 million) for year ended September 1990, an increase of 55 percent over the previous year's figure of ¥3.1 billion (US$24.2 million). Capital expenditure for year ended September 1990 totaled ¥6.1 billion (US$42.8 million), an increase of nearly 30 percent over the previous year's figure of ¥4.7 billion (US$36.6 million). Tokyo Electron employed 1,819 people the end of September 1990.

Due to the lack of complete financial information, no financial statements are included in this backgrounder.

BUSINESS SEGMENT STRATEGIC DIRECTION

Semiconductor Equipment

Because the introduction of highly integrated semiconductors requires rapid technological progress, success depends on the timely introduction of advanced processing technology into the market. The Company's strategy is to apply its skills as a trading enterprise with an extensive information network to identify the trends and seize the major portion of the market through the timely introduction of international products. Secondly, the Company plans to improve products to meet user specifications and back them up with reliable after-sales service.

Products in the Semiconductor Equipment division include photolithography/clean, doping/thermal processing, deposition, inspection/measurement/repair, and test equipment produced with various manufacturers through joint ventures.

Computer Systems

TEL offers complete systems of factory automation equipment used in the design, production, and inspection stages of semiconductor manufacturing, printed circuit boards, and machinery/equipment. Products in the Computer Systems Division include mechanical CAE/CAD/CAM/CAT systems, specified application equipment, scientific and technical computers, and electrical CAE/CAD/CAM/CAT systems.

Electronic Parts and Components

Products in the Electronic Parts and Components Division include semiconductors, integrated circuits, discrete devices, and electronic components such as connectors, IC sockets, and switching power supplies.

Manufacturers of the mentioned electronic components include Advanced Micro Devices, Fujitsu, Western Digital, Winchester Electronics, and VLSI Technology, to name a few.

Further Information

For further information about the Company's business segments, please contact the appropriate Dataquest industry service.

1990 SALES OFFICE LOCATIONS

North America—1
Europe—1
Asia/Pacific—9

MANUFACTURING LOCATIONS

Asia/Pacific

TEL Kyushu Ltd., Japan
  Semiconductor production equipment, including coaters/developers and LCD production equipment
TEL Sagami Ltd., Japan
  Oxidation/diffusion furnace systems and LP-CVD systems
TEL Tohoku Ltd., Japan
  Various semiconductor equipment
TEL Yamanashi Ltd., Japan
  Semiconductor production equipment including wafer probers, coater/developers, plasma-etching equipment, and ozone strip equipment

SUBSIDIARIES

North America

TEL America Inc. (United States)

Europe

TEL Service Europe B.V. (Netherlands)

Asia/Pacific

TEL Kyushu Ltd. (Japan)
TEL Sagami Ltd. (Japan)
TEL Tohoku Ltd. (Japan)
TEL Tokyo Electron FE (Japan)
TEL Yamanashi Ltd. (Japan)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

ITR Corporation
  TEL is marketing test equipment manufactured by ITR. The CXI-5400 is an automatic system for testing assembled surface-mount technology (SMT)-type printed circuit boards.

Ultra Network Technologies Inc.
  TEL will distribute Ultra Network Technologies networking systems to Fujitsu, which will support Ultra's gigabit-per-second network on its M-series mainframes and VP-series supercomputers.

Structural Dynamics Research Corporation
  TEL began marketing I-DEAS Level V, an enhanced version of the I-DEAS CAE software, from Structural Dynamics Research.

MERGERS AND ACQUISITIONS

Information is not available.

KEY OFFICERS

Tokuo Kubo
Chairman of the board

Toshio Kodaka
President

Noboru Fuse
Senior managing director

Zenju Kasama
Senior managing director

Akira Inoue
Senior managing director

PRINCIPAL INVESTORS

Information is not available.

FOUNDERS

Information is not available.

Tokyo Ohka Kogyo Co., Ltd.

1-403, Kosugi-cho, Nakahara-ku
Kawasaki City, Kanagawa Prefecture, Japan
Telephone: (044) 722-7181
Fax: (044) 733-0398
Dun's Number: Not Available

Date Founded: 1940

CORPORATE STRATEGIC DIRECTION

Established in 1940, Tokyo Ohka Kogyo Co., Ltd., offers a wide range of products including electronics materials, chemical products, synthetics, photopolymer printing plates, offset printing plates, and related processing equipment. Tokyo Ohka's consolidated revenue was ¥43,914 million (US$342.4 million) for fiscal year ended March 31, 1989. Consolidated net income totaled ¥5,357 million (US$41.8 million) for fiscal 1989. Photoresists accounted for 35 percent of sales, chemical products 28 percent, processing equipment 14 percent, printing materials 14 percent, and other products 9 percent. Expenditure for R&D totaled ¥1,377 million (US$10.7 million) for fiscal 1989.

No financial statements are included in this backgrounder.

BUSINESS SEGMENT STRATEGIC DIRECTION

In 1968, Tokyo Ohka developed the OMR81, the first negative semiconductor photoresist made in Japan. The Company later developed the positive photoresist OFPR series, the electron-beam photoresist OEBR series for VLSI manufacturing, and the ODUR series for deep ultraviolet (UV) irradiation. Currently, Tokyo Ohka offers a full line of negative and positive photoresists for diverse applications. In addition to photoresists, the Company provides developers, strippers, and rinsing solutions as well as processing equipment, which includes etching machines, ashing machines, and photoresist coating machines. Tokyo Ohka developed a fully automatic single-wafer processing plasma etching machine in 1977 and followed this with a full line of semiconductor processing equipment. The Company also offers a wide array of photoresists for use in printed circuit board (PCB) manufacturing and chemical milling applications.

Further Information

For further information about the Company's business segments, please contact the appropriate Dataquest industry service.

1989 SALES OFFICE LOCATIONS

Information is not available.

MANUFACTURING LOCATIONS

Asia/Pacific

Kumagaya Ohka Co., Ltd., Japan
  Chemicals
Sudama Denshi Kogyo Co., Ltd., Japan
  Materials for the electronics industry
Tokyo Alumetal Kogyo Co., Ltd., Japan
  Plates for offset printing
Yamanashi Photopoly Ohka Co., Ltd., Japan
  Photopolymer printing plates

SUBSIDIARIES

North America

Ohka America, Inc. (United States)

Europe

Ohka (UK), Ltd. (United Kingdom)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

Information is not available.

MERGERS AND ACQUISITIONS

Information is not available.

KEY OFFICERS

Takeo Ito
Chairman of the board of directors and president

Dr. Hisashi Nakane
Vice president

Hatsuo Matsumoto
Executive director

PRINCIPAL INVESTORS

Information is not available.

FOUNDERS

Information is not available.

Union Carbide Corporation

39 Old Ridgebury Road
Danbury, Connecticut 06817-0001
Telephone: (203) 794-6440
Fax: (203) 794-2826
Dun's Number: 00-128-9008

Date Founded: 1917

CORPORATE STRATEGIC DIRECTION

Incorporated in 1917, Union Carbide Corporation is a worldwide leader in industrial technology and is one of the 50 largest US industrial corporations. The Company designs, manufactures, and markets chemicals and plastics, industrial gases and related products, metals and carbons, batteries, home and automotive products, and specialty products. Union Carbide is divided into three specific business groups: Union Carbide Chemicals and Plastics Company Inc., representing 66 percent of total sales; Union Carbide Industrial Gases Inc., representing 25 percent of total sales; and UCAR Carbon Company, Inc., representing 9 percent of total sales. Seventy-five percent of UCAR's business and 17 percent of Industrial Gases' business is dependent upon the steel industry.

Total revenue for fiscal year 1989 grew 5.1 percent to $8.7 billion* from $8.3 billion in fiscal year 1988. Net income decreased 13.4 percent to $573.0 million for fiscal year 1989 from $662.0 million for fiscal year 1988. Union Carbide employs 45,987 people worldwide.

Union Carbide sales are produced principally through its direct sales force. Although domestic sales dominate the percentage of total revenue generated, international sales have slowly been increasing at a constant pace of 2 to 3 percent over the past five years. In fiscal year 1989, domestic sales accounted for 66.2 percent and international sales accounted for 33.8 percent of total revenue. Europe represented 12.0 percent and Latin America 11.0 percent of international sales. Union Carbide is currently focusing and building on trading and sales activities abroad.

In fiscal years 1989, 1988, and 1987, Union Carbide respectively spent $181.0 million, $159.0 million, and $159.0 million on R&D. These figures respectively total 2.0 percent, 1.9 percent, and 2.3 percent of total revenue. Sponsored primarily by Union Carbide, R&D activities are conducted to develop new products, processes, or services, and improve existing ones. The Chemicals and Plastics group has eight facilities within the United States and four internationally. The Industrial Gases group has five domestic facilities and two internationally. The UCAR Carbon Company's R&D activities are carried on primarily in Parma, Ohio.

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 backgrounder.

*All dollar amounts are US dollars.

BUSINESS SEGMENT STRATEGIC DIRECTION

Chemicals and Plastics

Union Carbide was one of the founders of the US petrochemical industry when it started to manufacture ethylene and other coproducts and derivatives. Since then, Union Carbide Chemicals and Plastics Company Inc. has branched out into developing numerous other chemicals and plastics. It is the world's largest producer of ethylene oxide/glycol. Its UNIPOL process is the lowest-cost process for polyethylene production and is widely licensed throughout the world. Union Carbide is also the largest producer of oxygenated solvents in the United States and is the leader in oxo-alcohols process technology. Union Carbide produces the following product groups: ethylene oxide and derivatives, polyethylene, solvents and coatings materials, and other specialty chemicals. The ethylene oxide and derivatives group consists of ethylene glycol for antifreeze, polyester fiber and PET resins, surfactants for detergents, ethanolamines, and ethyleneamines. This group also produces both high-volume and specialty polyethylene resins for many plastic products: film and wrap, bags, pipes, containers and drums, wire and cable insulation, and a variety of molded products. Solvents and coatings materials consist of alcohols, acetates, acrylates, latex, coatings resins, and glycol ethers. Other specialty chemicals produced by Union Carbide are water-soluble polymers for personal care, silicones, polyvinyl acetate for additives to plastics, UCON fluids for hydraulic and heat transfer fluids and for lubricants, acrolein, and gluteraldehyde for biocide and custom intermediates.

Industrial Gases

Union Carbide Industrial Gases Inc. is the largest producer of oxygen, nitrogen, argon, hydrogen, helium, and specialty gases in the United States, Canada, and Brazil, as well as one of the three largest producers throughout the world. Numerous areas utilize industrial gases: chemicals, steel and aluminum production, electronics, food freezing, rubber and plastic production, metalworking and welding, medicine, oil and gas extraction, pulp and paper, glass production, aerospace, and environmental cleanup.

Carbon Products

UCAR Carbon Company accounts for the smallest portion of Union Carbide Corporation's business; however, within its field, UCAR is the world's largest producer of graphite electrodes and other carbon and graphite products for the basic metals industries.

Further Information

For more information on Union Carbide's business segments, please contact Dataquest's Semiconductor Equipment and Materials Service.

Table 1
Five-Year Corporate Highlights (Millions of US Dollars)

	1985	1986	1987	1988	1989
Five-Year Revenue	$6,390.0	$6,343.0	$6,914.0	$8,324.0	$8,744.0
Percent Change	-	(0.74)	9.00	20.39	5.05
Capital Expenditure	$501.0	$524.0	$502.0	$671.0	NA
Percent of Revenue	7.84	8.26	7.26	8.06	NA
R&D Expenditure	$181.0	$148.0	$159.0	$159.0	$181.0
Percent of Revenue	2.83	2.33	2.30	1.91	2.07
Number of Employees	52,117	50,292	43,119	43,992	45,987
Revenue ($K)/Employee	$122.61	$126.12	$160.35	$189.22	$190.14
Net Income	($581.0)	$496.0	$232.0	$662.0	$573.0
Percent Change	-	185.37	(53.23)	185.34	(13.44)

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	$2,241.00	$2,277.00	$2,141.00	$2,085.00
Quarterly Profit	$201.00	$186.00	$139.00	$47.00

NA = Not available

Source: Union Carbide Corporation
Annual Reports and Forms 10-K
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	73.41	71.81	69.11	69.17	66.25
International	26.59	28.19	30.89	30.83	33.75
Canada	4.90	3.80	4.30	5.15	5.30
Europe	10.11	11.78	12.67	11.16	12.04
Latin America	7.45	8.18	9.23	9.33	10.99
Others	4.13	4.43	4.69	5.19	5.42

Source: Union Carbide Corporation
Annual Reports and Forms 10-K
Dataquest (1990)

Table 3
Revenue by Distribution Channel (Percent)

Channel	1988	1989
Direct Sales	100.00	100.00
Indirect Sales	0	0

Source: Dataquest (1990)

1990 SALES OFFICE LOCATIONS

Information is not available.

MANUFACTURING LOCATIONS

Chemical and Plastics Manufacturing

North America

Acushnet, Massachusetts
Precision coating equipment
Alsip, Illinois
Latexes
Bensenville, Illinois
Printed circuit chemicals
Bound Brook, New Jersey
Coatings resins, phenolic resins, phenoxy resins, polyethylene compounding, synthetic thickeners
Clear Lake, Wisconsin
Conformal coating services
Cowansville, Quebec, Canada
Polyethylene film
Edison, New Jersey
Lanolin derivatives
Garland, Texas
Latexes
Henderson, Kentucky
Dielectric fluid
Indianapolis, Indiana
Coating and bonding systems
Institute, West Virginia
Carbowax polyethylene glycol, hydroxethyl cellulose, polyethyleneoxide, ketones, tergitol surfactants
Mamaroneck, New York
Lanolin derivatives
Montreal East, Quebec, Canada
Chemicals
Moses Lake, Washington
Polycrystalline silicon
Prentiss, Canada
Ethylene oxide and glycol
Seadrift, Texas
Alkanolamines, ethylene oxide and glycol, glycol ethers, olefins, polyethylene, polypropylene, tergitol surfactants
Sistersville, West Virginia
Antifoams and emulsions, organofunctional silanes and silicone surfactants, silicone fluids
Somerset, New Jersey
Latexes
South Charleston, West Virginia
Alkylalkanolamines, brake fluids, ketones, miscellaneous specialty products, niax polyols and catalysts, propylene glycol, coatings resins, ucon fluids
Sunnyvale, California
Photoresists
Taft (Star Plant), Louisiana
Polyethylene
Taft, Louisiana
Acrolein and derivatives, acrylic monomers, ultraviolet curing equipment, alkylene amines, cycloaliphatic epoxides, ethylene oxide and glycol, glycol ethers, olefins
Texas City, Texas
Olefins, organic acids and esters, alcohols, tergitol surfactants, vinyl acetate, coatings resins
Torrance, California
Latexes
Tucker, Georgia
Latexes
Washougal, Washington
Crystal products

Europe

Northhampton, United Kingdom
Conformal coatings
Solingen, Germany
Photoresists
Termoli, Italy
Organofunctional silanes
Vilvoorde, Belgium
Lanolin derivatives

Asia/Pacific

Ekala, Sri Lanka
Latex
Jakarta, Indonesia
Latex
Jurong, Singapore
Latex
Kowloon, Hong Kong
Latex silicones
Nonthaburi, Thailand
Latex
Seoul, South Korea
Photoresists
Seremban, Malaysia
Latex, silicones

ROW

Aratu, Brazil
Hydroxyethyl cellulose
Barranquilla, Colombia
Silicones
Bayamon, Puerto Rico
Latexes
Buenos Aires, Argentina
Silicones
Cubatao, Brazil
Polyethylene
Guayaquil, Ecuador
Latexes
Sao Paulo, Brazil
Silicones

Industrial Gases Manufacturing

Domestic facilities for the manufacturing of industrial gases are spread over 100 plants, some of which are located at customer facilities throughout the United States. The following are principal manufacturing facilities for products other than oxygen, nitrogen, and argon.

North America

Bushton, Kansas
Gaseous and liquid helium
East Chicago, Indiana
Specialty gases
Fort Saskatchewan, Alberta, Canada
Industrial gases
Houston, Texas
Specialized industrial services
Indianapolis, Indiana
Coatings service
Kansas City, Missouri
Coatings service
Kearney, New Jersey
Specialty gases
Montreal, Quebec, Canada
Industrial gases
Niagara Falls, New York
Gaseous and liquid hydrogen
North Haven, Connecticut
Coatings service
Norwood, Massachusetts
Membrane systems
Oakville, Ontario, Canada
Industrial gases
Ontario, California
Gaseous and liquid hydrogen
Prentiss, Canada
Industrial gases
Sarnia, Ontario, Canada
Industrial gases
Sault Ste. Marie, Ontario, Canada
Industrial gases
Selkirk, Manitoba, Canada
Industrial gases
Tonawanda, New York
Air separation equipment
Torrance, California
Specialty gases
Tracy, Canada
Industrial gases
Ulysses, Kansas
Gaseous and liquid helium

Europe

Antwerp, Belgium
Industrial gases
Biebesheim, Germany
Industrial gases
Creil, France
Industrial gases
Geneva, Switzerland
Coatings service
Gijon, Spain
Industrial gases
Navarro, Italy
Coatings service
Oevel, Belgium
Industrial gases
Ratigen, Germany
Coatings service
Southam, United Kingdom
Coatings service
St. Etienne, France
Coatings service
Swindon, United Kingdom
Coatings service

Asia/Pacific

Changwon City, South Korea
Industrial gases and coatings service
Gibeugn, South Korea
Industrial gases
Kozuki-Cho, Japan
Coatings service
Okegawa, Japan
Coatings service

ROW

Brazil
Industrial gases, air separation equipment, welding, and related products

Carbon Manufacturing

North America

Clarksburg, West Virginia
Graphite specialties
Clarksville, Tennessee
Graphite electrodes
Cleveland, Ohio
Specialty inorganic materials
Columbia, Tennessee
Graphite electrodes
Irving, California
Graphite tooling
Lawrenceburg, Tennessee
Carbon and graphite products
Niagara Falls, New York
Calcined coal
Robinson, Illinois
Calcined petroleum coke
Welland, Ontario, Canada
Graphite electrodes
Yabucoa, Puerto Rico
Graphite electrodes

Europe

Aigueblanche, France
Graphite electrodes
Calais, France
Graphite electrodes
Caserta, Italy
Graphite electrodes
Forno Allione, Italy
Graphite electrodes
Pamplona, Spain
Graphite electrodes
Sheffield, United Kingdom
Graphite electrodes and graphite products

Asia/Pacific

Kozuki-Cho, Japan
Specialty inorganic materials

ROW

Candeias, Brazil
Carbon cathodes, graphite electrodes

SUBSIDIARIES

North America

Union Carbide Canada Ltd. (Canada)
Union Carbide Caribe Inc. (United States)
Union Carbide Communications Co. Inc. (United States)
Union Carbide Eastern Inc. (United States)
Union Carbide Engineering and Hydrocarbons Service Co. Inc. (United States)
Union Carbide Engineering and Technology Services (Africa and Middle East) Inc. (United States)
Union Carbide Ethylene Oxide/Glycol Co. (United States)
Union Carbide Europe Inc. (United States)
Union Carbide Finance Corp. (United States)
Union Carbide Foreign Sales Corp., Virgin Islands (United States)
Union Carbide Grafito Inc. (United States)
Union Carbide Imaging Systems Inc. (United States)
Union Carbide Industrial Services Co. (United States)
Union Carbide Inter-America Inc., Delaware (United States)
Union Carbide Inter-America Inc., New Jersey (United States)
Union Carbide International Capital Corp. (United States)
Union Carbide International Sales Corp. (United States)
Union Carbide Middle East Ltd. (United States)
Union Carbide Pan America Inc. (United States)
Union Carbide Petrochemical International (FCS) Corp., Virgin Islands (United States)
Union Carbide Polyolefins Development Co. Inc. (United States)
Union Carbide Puerto Rico Inc. (Puerto Rico)
Union Carbide Southern Africa (USA) Inc. (United States)
Union Carbide Subsidiary C Inc. (United States)
Union Carbide Turkey Inc. (United States)

Europe

Union Carbide Austria GmbH (Austria)
Union Carbide Benelux N.V. (Belgium)
Union Carbide Deutschland GmbH (Germany)
Union Carbide France S.A. (France)
Union Carbide Hellas Ltd. (Greece)
Union Carbide Iberica S.A. (Spain)
Union Carbide Italia S.p.A. (Italy)
Union Carbide M.S. S.p.A. (Italy)

Union Carbide Navarra S.A. (Spain)
Union Carbide Norden AB (Sweden)
Union Carbide Services Ltd. (United Kingdom)
Union Carbide U.K. Ltd. (United Kingdom)

Asia/Pacific

Union Carbide Asia Ltd. (Hong Kong)
Union Carbide Formosa Co. Ltd. (Taiwan)
Union Carbide India Ltd. (India)
Union Carbide Indonesia P.T. (Indonesia)
Union Carbide Japan K.K. (Japan)
Union Carbide Korea Ltd. (South Korea)
Union Carbide Pakistan Ltd. (Pakistan)
Union Carbide Philippines (Far East) Inc. (Philippines)
Union Carbide Services Eastern Ltd. (Hong Kong)
Union Carbide Thailand Ltd. (Thailand)

ROW

Union Carbide Agricultural Products Ltd. (Zimbabwe)
Union Carbide Argentina S.A.I.C.S. (Argentina)
Union Carbide Commercial Chile Ltda. (Chile)
Union Carbide Commercial Nicaragua S.A. (Nicaragua)
Union Carbide do Brasil Ltda. (Brazil)
Union Carbide Land & Investment Ltd. (Zimbabwe)
Union Carbide Management Services Ltd. (Zimbabwe)
Union Carbide Mexicana S.A. (Mexico)
Union Carbide Overseas Finance Corp. N.V. (Netherlands Antilles)
Union Carbide Ranches Ltd. (Zimbabwe)
Union Carbide South Africa Ltd. (South Africa)
Union Carbide Zimbabwe Ltd. (Zimbabwe)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1990

Guardsman Products
Guardsman Products was given the rights to develop, produce, and sell the UNICARB paint system from Union Carbide Chemicals and Plastics.

Elekeiroz do Nordeste Industrias Quimicas
A joint venture calls for production of 80,000 metric tons per year of butanol and 2-ethylhexanol in Brazil.

1989

Mitsubishi Petrochemical Company Limited
Under the agreement, Mitsubishi acquired a license to construct a worldscale polypropylene plant using the UNIPOL PP technology jointly developed by Union Carbide and Shell Chemical. Union Carbide acquired an option to obtain a license and sublicensing rights for the use of Mitsubishi's family of high-activity polypropylene catalysts.

Kanegafuchi Chemical Industry Co.
A joint venture calls for the production of silicon polymer.

Sekisui America
Union Carbide and Sekisui America jointly formed Hexatec Polymers to make toner resins for North and South American markets. Hexatec Polymers will supply custom styrene-acrylic resins for toners used in copying machines and laser printers.

Ivax
Union Carbide and Ivax jointly formed Baker Cummins Dermatologicals to manufacture and market dermatological products.

ENIQ
Union Carbide and ENIQ will construct an oxochemicals plant in Camacari, Brazil, to begin production of butanols and 2-ethylhexanol by 1992.

DNA Plant Technology
Union Carbide and DNA Plant Technology jointly formed Agri-Diagnostics Association to manufacture and market on-site test kits to detect diseases, contaminants, and pollutants in agricultural areas.

Wei T'o Associates
Wei T'o licensed its paper-preservation technology to Union Carbide.

Schenectady Chemicals
Union Carbide licensed its phenolic washed resins technology to Schenectady Chemicals, which will supply the resins to Union Carbide's customers after Union Carbide stops production of the resins in Bound Brook, New Jersey.

1988

UOP Inc.
A joint venture was established with UOP, Inc., a subsidiary of Allied-Signal Inc. The joint venture, called UOP, will help strengthen Union Carbide's position as a supplier of technology, products, and services to the petroleum refining, petrochemical, and gas-processing industries.

1987

Nan Ya Plastics
Nan Ya Plastics was licensed to use the low-pressure oxo technology Union Carbide jointly licensed with Davy-McKee and Johnson-Mathey for a new plant in Taiwan.

MERGERS AND ACQUISITIONS

1989

Argi-Diagnostic Associates
Union Carbide partly acquired Agri-Diagnostic, a developer and marketer of kits for detecting contaminants and agricultural pollutants.

BP Chemicals
BP Chemicals sold its silicone surfactant business to Union Carbide.

KEY OFFICERS

Robert D. Kennedy
Chairman, president and chief executive officer

Joseph E. Geoghan
Vice president and general counsel

John B. Powers
Vice president, Strategic Planning

Cornelius C. Smith, Jr.
Vice president, Community & Employee Health, Safety & Environmental Protection

J. Clayton Stephenson
Vice chairman, chief financial and administrative officer

H. William Lichtenberger
Vice president and president, Chemicals & Plastics Business Group

John R. MacLean
Vice president and president, Industrial Gases Business Group

Robert P. Krass
Vice president and president, Carbon Products Business Group

PRINCIPAL INVESTORS

Delaware Management Company Inc.—5.7 percent

FOUNDERS

Information is not available.

Table 4
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of US Dollars, except Per Share Data)

Balance Sheet	1985*	1986	1987	1988	1989
Total Current Assets	$4,426.0	$2,414.0	$2,555.0	$2,883.0	$2,787.0
Cash	24.0	38.0	201.0	146.0	142.0
Receivables	1,114.0	1,085.0	1,294.0	1,413.0	1,474.0
Marketable Securities	406.0	261.0	0	0	0
Inventory	831.0	746.0	827.0	1,032.0	932.0
Other Current Assets	2,051.0	284.0	233.0	292.0	239.0
Net Property, Plants	$4,527.0	$4,379.0	$4,344.0	$4,416.0	$4,584.0
Other Assets	$717.0	$778.0	$993.0	$1,142.0	$1,175.0
Total Assets	$9,670.0	$7,571.0	$7,892.0	$8,441.0	$8,546.0
Total Current Liabilities	$2,382.0	$1,881.0	$1,811.0	$2,455.0	$2,328.0
Long-Term Debt	$1,713.0	$3,057.0	$2,863.0	$2,295.0	$2,080.0
Other Liabilities	$1,556.0	$1,628.0	$1,971.0	$1,855.0	$1,755.0
Total Liabilities	$5,651.0	$6,566.0	$6,645.0	$6,605.0	$6,163.0
Total Shareholders' Equity	$4,019.0	$1,005.0	$1,247.0	$1,836.0	$2,383.0
Common Stock	212.0	205.0	209.0	214.0	142.0
Other Equity	199.0	961.0	1,140.0	1,216.0	(52.0)
Retained Earnings	3,774.0	2,061.0	2,098.0	2,605.0	2,293.0
Less: Treasury Stock	(166.0)	(2,222.0)	(2,200.0)	(2,199.0)	0
Total Liabilities and Shareholders' Equity	$9,670.0	$7,571.0	$7,892.0	$8,441.0	$8,546.0
Income Statement	**1985***	**1986**	**1987**	**1988**	**1989**
Revenue	$6,390.0	$6,343.0	$6,914.0	$8,324.0	$8,744.0
US Revenue	4,691.0	4,555.0	4,778.0	5,758.0	5,793.0
Non-US Revenue	1,699.0	1,788.0	2,136.0	2,566.0	2,951.0
Cost of Sales	$4,597.0	$4,343.0	$4,773.0	$5,465.0	$5,875.0
R&D Expense	$181.0	$148.0	$159.0	$159.0	$181.0
SG&A Expense	$735.0	$740.0	$779.0	$822.0	$924.0
Capital Expense	$501.0	$524.0	$502.0	$671.0	NA
Pretax Income	($906.0)	$212.0	$391.0	$1,128.0	$878.0
Pretax Margin (%)	-	3.34	5.66	13.55	10.04
Effective Tax Rate (%)	43.90	30.20	34.00	38.90	NA
Net Income	($581.0)	$496.0	$232.0	$662.0	$573.0
Shares Outstanding, Millions	202.8	127.7	132.2	137.6	141.6
Per Share Data					
Earnings	($2.78)	$4.78	$1.76	$4.88	$4.07
Dividend	$1.13	$1.50	$1.50	$1.15	NA
Book Value	$19.82	$7.87	$9.43	$13.34	$16.83

Table 4 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending December
(Millions of US Dollars, except Per Share Data)

Key Financial Ratios	1985*	1986	1987	1988	1989
Liquidity					
Current (Times)	1.28	1.41	1.41	1.17	1.20
Quick (Times)	0.89	0.95	0.95	0.75	0.80
Fixed Assets/Equity (%)	435.72	348.36	348.36	240.52	192.36
Current Liabilities/Equity (%)	187.16	145.23	145.23	133.71	97.69
Total Liabilities/Equity (%)	653.33	532.88	532.88	359.75	258.62
Profitability (%)					
Return on Assets	-	5.75	3.00	8.11	6.75
Return on Equity	-	19.75	20.60	42.95	27.16
Profit Margin	(9.09)	7.82	3.36	7.95	6.55
Other Key Ratios					
R&D Spending % of Revenue	2.83	2.33	2.30	1.91	2.07
Capital Spending % of Revenue	7.84	8.26	7.26	8.06	NA
Employees	52,117	50,292	43,119	43,992	45,987
Revenue ($K)/Employee	$122.61	$126.12	$160.35	$189.22	$190.14
Capital Spending % of Assets	6.62	6.64	6.36	7.95	NA

*1985 is restated. In addition, 1985 includes certain reclassifications to conform to the 1986 presentation. Amounts for 1985 were adjusted to reflect the stock dividend in March 1986.
NA = Not available

Source: Union Carbide Corporation Annual Reports and Forms 10-K
Dataquest (1990)

Varian Associates, Inc.

611 Hansen Way
Palo Alto, California 94303
Telephone: (415) 493-4000
Fax: (415) 493-0307
Dun's Number: 00-912-0817

Date Founded: 1948

CORPORATE STRATEGIC DIRECTION

Varian Associates, Inc., together with its subsidiaries, is engaged in the research, development, manufacture, and marketing of various products and services for the fields of communications, defense, industrial production, scientific and industrial research, health care, and environmental monitoring. The Company's principal lines of business are electron devices and systems and equipment including analytical instruments, semiconductor equipment, and medical and industrial products.

Varian's operations are grouped into two segments: Electron Devices and Systems and Equipment. The Electron Devices and Systems segment includes a broad line of electron devices and systems used in broadcasting, communications, and other commercial and military applications. The Equipment segment includes analytical instruments widely used in the fields of chemistry, physics, biology, life sciences, and metallurgy; semiconductor equipment used for semiconductor wafer fabrication; and medical and industrial products including linear accelerators used for cancer therapy and industrial testing and inspection, as well as vacuum pumps and systems, gauges, and leak detectors used in a variety of industrial applications.

Total revenue increased by 15 percent to $1.34 billion* in fiscal 1989 from $1.17 billion in fiscal 1988. Net earnings increased 14 percent to $31.5 million in fiscal 1989 from $27.8 million in fiscal 1988. Varian employs 12,100 people worldwide.

Research and development expenditure totaled $83 million in fiscal 1989, representing 6 percent of revenue.

*All dollar amounts are in US dollars.

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 distribution channels is not available. Table 3, a comprehensive financial statement, is at the end of this profile.

BUSINESS SEGMENT STRATEGIC DIRECTION

Electron Devices and Systems Segment

Varian's Electron Devices and Systems segment is organized around two major areas of activity, Electron Devices and Systems. Electron Devices, the larger of the two, holds world leadership positions in microwave, power grid, and special-purpose electron tubes, and has an expanding position in gallium arsenide (GaAs)-based solid-state components and night vision devices. The Systems area includes power amplifiers and other systems used in satellite communications, high-power transmitters for radar, radio and television broadcasting, and other communications applications, as well as electronic countermeasures and instrumentation. Approximately one-half of the segment's sales are for defense applications, including electronic countermeasures, radar, and missile guidance. About one-third of its sales are for communication applications, including radio and television broadcasting and satellite communications. Industrial and medical markets, such as X-ray generation and imaging, also are served.

Equipment Segment

The Company's largest business segment, Equipment, is organized around three major groups, Semiconductor Equipment, Analytical Instruments, and Medical and Industrial Products.

The Semiconductor Equipment Group manufactures process equipment used to make semiconductor devices such as integrated circuits. The major product lines are ion implantation and sputter deposition. Varian is a leader in the development, manufacture, and application of equipment utilizing ion implantation and sputter-coating in semiconductor wafer processing. Backlog for this business amounted to $125 million and $113 million in fiscal 1989 and 1988, respectively.

The Analytical Instruments Group manufactures, sells, and services a variety of scientific instruments for analyzing chemical substances. The substances analyzed include metals, inorganic materials, organic compounds, polymers, natural substances, and biochemicals. The products include liquid and gas chromatographs, nuclear magnetic resonance (NMR) spectrometers, ultraviolet visible and atomic absorption spectrophotometers, and associated data products. Typical applications are biochemical research, measurement of the chemical composition of mixtures, studies of the chemical structures of pure compounds, quality control of manufactured materials, chemical analysis of natural products, and the satisfaction of environmental and regulatory chemical measurement needs. The major markets served are the pharmaceutical and chemical industries, chemical and life science academic research, government laboratories, and specific areas of the health care industry. Backlog for this business amounted to $56 million and $49 million in fiscal 1989 and 1988, respectively.

The Medical and Industrial Products Group manufactures linear accelerators, simulators, supplies, and systems. Linear accelerators are used in cancer therapy and for industrial radiographic applications. Varian's leading CLINAC series of accelerators, marketed to hospitals and clinics worldwide, generate therapeutic X-rays and electron beams for cancer treatment. LINATRON linear accelerators are used in industrial applications for x ray examination of heavy metallic structures for quality control and materials irradiation for sterilization. Backlog for this business amounted to $236 million and $222 million in fiscal 1989 and 1988, respectively.

Further Information

For more information about the Company's business segments, please contact the appropriate industry service.

Table 1
Five-Year Corporate Highlights (Thousands of US Dollars)

	1985	1986	1987	1988	1989
Five-Year Revenue	$935,888.0	$891,139.0	$982,776.0	$1,170,558.0	$1,343,632.0
Percent Change	-	(4.78)	10.28	19.11	14.79
Capital Expenditure	-	-	-	-	-
Percent of Revenue	-	-	-	-	-
R&D Expenditure	$72,211.0	$82,290.0	$80,726.0	$80,222.0	$83,071.0
Percent of Revenue	7.72	9.23	8.21	6.85	6.18
Number of Employees	11,900	11,600	11,900	11,800	12,100
Revenue ($K)/Employee	$78.65	$76.82	$82.59	$99.20	$111.04
Net Income	$26,122.0	($14,870.0)	$21,365.0	$27,758.0	$31,519.0
Percent Change	-	(156.93)	(243.68)	29.92	13.55

1989 Calendar Year	Q1	Q2	Q3	Q4
Quarterly Revenue	$358.62	$333.50	$364.10	$317.70
Quarterly Profit	$12.03	$9.10	$10.00	$7.60

Source: Varian
Annual Reports and Forms 10-K
Dataquest (1990)

Table 2
Revenue by Geographic Region (Percent)

Region	1985	1986	1987	1988	1989
North America	80.14	77.20	76.42	75.35	77.40
International	19.86	22.80	23.58	24.65	22.60
Japan	6.00	4.00	4.00	6.00	6.00
Europe	9.00	12.00	14.00	12.00	10.00
Asia/Pacific	3.00	4.00	2.00	3.00	4.00
ROW	2.00	3.00	3.00	3.00	2.00

Source: Varian
Annual Reports and Forms 10-K
Dataquest (1990)

1989 SALES OFFICE LOCATIONS

Information is not available.

MANUFACTURING LOCATIONS

North America

Tempe, Arizona
Activities of the Tempe Electronics Division include printed circuit board assembly.

Fremont, Palo Alto, and Santa Clara, California
Thin Film Technology Division is located in each of these cities. Activities include the production of integrated processing systems, chemical vapor deposition (CVD) systems, sputtering systems, molecular beam epitaxy systems, and memory disk sputtering systems.

Palo Alto, California
The Microwave Power Division, Traveling-Wave Tube Division, Coupled Cavity Tube Division, Electro Optical Sensors Division, NMR Instrument Division, and Radiation Division are located in Palo Alto, California. Activities include the production of klystrons, gytrons, traveling-wave tubes, coupled cavity tubes, klystode tubes, night-vision devices, NMR spectrometers, and medical and industrial linear accelerators.

San Carlos, California
Activities of the Eimac, San Carlos Division include the production of power-grid tubes and ancillary hardware, and X-ray subsystems.

Santa Clara, California
The Solid State Microwave Division, III-V Device Center, Microwave Equipment Division, and Varian-TEL Ltd. are located in Santa Clara. Activities include the production of solid-state oscillators, amplifiers and subsystems, GaAs and indium-phosphide devices and integrated devices, GaAs foundry, power amplifiers and transmitters, power supplies, and semiconductor manufacturing equipment.

Sunnyvale and Walnut Creek, California
Activities of the Walnut Creek Instrument Division include the production of gas and liquid chromatographs, data systems, and laboratory information management systems.

Beverly, Massachusetts
Activities of the RF Subsystems Division include production of RF and IF/log amplifiers, microwave signal processing equipment and subsystems.

Beverly and Gloucester, Massachusetts
An Extron Division is located in both cities. Activities include the production of ion implantation equipment and rapid thermal processing equipment.

Georgetown, Ontario
The Canada Microwave Division's activities include the production of power supplies, klystrons, traveling-wave tubes, and millimeter-wave tubes.

Dallas, Texas
Activities of the Continental Electronics Division include the production of high-power transmitters and power amplifiers.

Salt Lake City, Utah
Activities of the Eimac, Salt Lake Division involve the production of power-grid tubes, cavity amplifiers, oscillators, and X-ray tubes.

Europe

Cambridge, England
Activities of Varian TVT Ltd. include the production of UHF, VHF, and FM transmitters and systems.

Crawley, England
Activities of Varian-TEM Ltd. include the production of cancer therapy planning simulators.

Asia/Pacific

Melbourne, Australia
Activities of the Varian Techtron Pty. Ltd. include the production of atomic absorption and UV-Vis spectrometers.

SUBSIDIARIES

North America

Analytichem International Inc. (United States)
Mansfield Insurance Co. (United States)
Varian Associates Ltd. (United States)
Varian Canada Inc. (Canada)
Varian China Ltd. (United States)
Varian Export Corp. (United States)

Varian Instruments Ltd. (United States)
Varian Instruments of Puerto Rico Inc. (United States)
Varian Investment Corp. (United States)
Varian Microwave Equipment Ltd. (United States)
Varian Pacific Inc. (United States)
Varian Realty Inc. (United States)
Varian Semiconductor Equipment Co. Inc. (United States)
Varian U.K. Ltd. (United States)

Europe

N.V. Varian Benelux S.A. (Belgium)
Varian AB (Sweden)
Varian AG (Switzerland)
Varian Benelux B.V. (The Netherlands)
Varian Electronics ApS (Denmark)
Varian FSC B.V. (The Netherlands)
Varian GmbH (Austria)
Varian GmbH (Germany)
Varian International AG (Switzerland)
Varian SA (France)
Varian S.p.A (Italy)
Varian-TEM Ltd. (United Kingdom)
Varian TVT Ltd. (United Kingdom)

Asia/Pacific

Varian Australia Pty. Ltd. (Australia)
Varian Pty. Ltd. (Australia)
Varian Taiwan Ltd. (Taiwan)
Varian Techtron Pty. Ltd. (Australia)

ROW

Varian Industria e Comercia Ltd. (Brazil)
Varian S.A. (Mexico)

ALLIANCES, JOINT VENTURES, AND LICENSING AGREEMENTS

1989

Tokyo Electron

Varian and Tokyo Electron (TEL) entered into a joint venture, a semiconductor equipment company called Varian-TEL, to produce a vertical diffusion furnace system. The system is focused on fabricating lines that produce products such as 4Mb dynamic random-access memory (DRAM) chips and 32-bit microprocessors.

ASEA Brown Boveri

Varian signed a letter of understanding with ASEA Brown Boveri AG (ABB) of Baden, Switzerland, under which Varian will assume installation and service responsibilities for ABB radiotherapy equipment. Under the arrangement, Varian would also purchase certain related ABB technology, including rights to its newly developed Dynaray-ID imaging system.

Finnigan Corporation

Varian and Finnigan Corporation entered into an agreement under which Varian will purchase from Finnigan the basic technology and knowledge to manufacture ion trap mass detectors used with Varian's gas chromatographs in varied analytical applications. Additionally, Varian will pay unspecified royalties on units manufactured under Finnigan patents. Varian will distribute worldwide a version of Finnigan's ITS 40 gas chromatograph/ion trap mass detection system, which is manufactured exclusively by Finnigan.

1988

Tokyo Electron (TEL)

Varian and TEL entered into an agreement under which Varian will exclusively distribute, sell, and service TEL's semiconductor products in the United Kingdom, the United States, and several European markets. In addition, Varian will distribute the TEL photoresist coater/developer, Clean Track Mark II, which is used for Mb DRAM production, and the TEL Diffusion Furnace/LPCVD System.

MERGERS AND ACQUISITIONS

1989

Watkins-Johnson

Varian acquired Watkins-Johnson's line of space communications equipment. Varian will merge the Watkins-Johnson traveling-wave tube, power supply, amplifier, and exploratory products into its Microwave Equipment Division product lines.

Machlett Laboratories

Varian acquired Machlett Laboratories, which makes X-ray and power grid tubes. Most of Machlett's equipment will be relocated to Varian's Eimac Division facilities in San Carlos, California, and Salt Lake City, Utah. Machlett was previously a subsidiary of Raytheon.

KEY OFFICERS

J. Tracy O'Rourke
Chairman of the board and chief executive officer

Allen J. Lauer
Senior vice president and president, Analytical Instruments

Al D. Wilunowski
Vice president and president, Electron Devices

Alan J. Bennet
Vice president, Research

Stanley Z. Cole
Vice president and director, Patents and Licensing

Richard M. Levy
Senior vice president and president, Semiconductor Equipment

John J. Cooper
Vice president and general counsel

Gary E. Simpson
Vice president, Corporate Communications

Ernest M. Felago
Vice president, Human Resources

PRINCIPAL INVESTORS

Battermarch Financial Management—9.4 percent
Neuberger and Berman—8.9 percent
Pioneering Management Corp.—7.0 percent
Prudential Insurance Co. of America—6.1 percent

Table 3
Comprehensive Financial Statement
Fiscal Year Ending September
(Thousands of US Dollars, except Per Share Data)

Balance Sheet	1985	1986	1987	1988	1989
Total Current Assets	$473,830.0	$505,420.0	$537,448.0	$589,922.0	$643,237.0
Cash	13,491.0	7,978.0	27,937.0	11,539.0	-
Receivables	188,474.0	190,403.0	205,242.0	252,469.0	263,738.0
Marketable Securities	-	-	-	-	-
Inventory	213,899.0	211,819.0	230,754.0	245,455.0	285,725.0
Other Current Assets	57,966.0	95,220.0	73,515.0	80,459.0	93,774.0
Net Property, Plants	$246,849.0	$254,272.0	$255,719.0	$241,660.0	$252,771.0
Other Assets	$24,127.0	$30,463.0	$36,437.0	$24,247.0	$35,273.0
Total Assets	$744,806.0	$790,155.0	$829,604.0	$855,829.0	$931,281.0
Total Current Liabilities	$247,133.0	$304,480.0	$327,568.0	$336,477.0	$414,201.0
Long-Term Debt	$46,188.0	$50,824.0	$3,814.0	$35,179.0	$54,914.0
Other Liabilities	$22,256.0	$23,921.0	$25,806.0	$33,171.0	$34,885.0
Total Liabilities	$315,577.0	$379,225.0	$357,188.0	$404,827.0	$1,129,799.0
Total Shareholders' Equity	$429,229.0	$410,930.0	$438,116.0	$451,002.0	$427,281.0
Converted Preferred Stock	-	-	-	-	-
Common Stock	21,313.0	21,448.0	21,966.0	21,674.0	19,896.0
Other Equity	155,488.0	157,476.0	168,437.0	159,537.0	111,356.0
Retained Earnings	252,428.0	232,006.0	247,713.0	269,791.0	296,029.0
Total Liabilities and Shareholders' Equity	$744,806.0	$790,155.0	$795,304.0	$855,829.0	$931,281.0

Income Statement	1985	1986	1987	1988	1989
Revenue	$935,888.0	$891,139.0	$982,776.0	$1,170,558.0	$1,343,632.0
U.S. Revenue	750,000.0	688,000.0	751,000.0	882,000.0	1,040,000.0
Non-U.S. Revenue	185,888.0	203,139.0	231,776.0	288,558.0	303,632.0
Cost of Sales	$643,209.0	$646,212.0	$676,382.0	$809,635.0	$961,728.0
R&D Expense	$72,211.0	$82,290.0	$80,726.0	$80,222.0	$83,071.0
SG&A Expense	$167,198.0	$181,463.0	$197,263.0	$211,032.0	$232,305.0
Capital Expense	-	-	-	-	-
Pretax Earnings	$54,137.0	($40,173.0)	$31,895.0	$43,378.0	$50,829.0
Pretax Margin (%)	5.78	(4.51)	3.25	3.71	3.78
Effective Tax Rate (%)	30.00	(63.00)	33.00	36.00	38.00
Net Earnings	$26,122.0	($14,870.0)	$21,365.0	$27,758.0	$31,519.0
Shares Outstanding, Millions	21.3	21.5	22.0	21.7	19.9
Per Share Data					
Earnings	$1.19	($0.70)	$0.98	$1.27	$1.53
Dividend	-	-	-	-	-
Book Value	$20.14	$19.12	$19.94	$20.81	$21.48

Table 3 (Continued)
Comprehensive Financial Statement
Fiscal Year Ending September
(Thousands of US Dollars, except Per Share Data)

Key Financial Ratios	1985	1986	1987	1988	1989
Liquidity					
Current (Times)	1.92	1.66	1.64	1.75	0.62
Quick (Times)	1.05	0.96	0.94	1.02	0.34
Fixed Assets/Equity (%)	57.51	61.88	58.37	53.58	59.16
Current Liabilities/Equity (%)	57.58	74.10	74.77	74.61	243.40
Total Liabilities/Equity (%)	73.52	92.28	81.53	89.76	264.42
Profitability (%)					
Return on Assets	-	(1.94)	2.64	3.29	3.53
Return on Equity	-	(3.54)	5.03	6.24	7.18
Profit Margin	2.79	(1.67)	2.17	2.37	2.35
Other Key Ratios					
R&D Spending % of Revenue	7.72	9.23	8.21	6.85	6.18
Capital Spending % of Revenue	0	0	0	0	0
Employees	11,900	11,600	11,900	11,800	12,100
Revenue ($K)/Employee	$78.65	$76.82	$82.59	$99.20	$111.04
Capital Spending % of Assets	0	0	0	0	0

Source: Varian
Annual Reports and Forms 10-K
Dataquest (1990)

Wafer Fab Equipment Market Share Estimates
1990

Source: Dataquest

Semiconductor Equipment, Manufacturing, and Materials

Dataquest

Wafer Fab Equipment Market Share Estimates 1990

Source: Dataquest

Dataquest

Semiconductor Equipment, Manufacturing, and Materials

Published by Dataquest Incorporated

Table of Contents

This booklet is divided into five major sections.

Chapter 1

Introduction to the Wafer Fab Equipment Database

Each year, Dataquest's Semiconductor Equipment, Manufacturing, and Materials Service (SEMMS) publishes its Wafer Fab Equipment Database. This database is the result of an extensive research project conducted by SEMMS whereby we contact the world's wafer fab equipment manufacturers to obtain detailed regional and company market share data.

Dataquest has organized the wafer fab equipment market into 10 major categories of front-end processing equipment. These categories, along with key subcategories, are shown in Table 1.1.

Capital spending by the world's merchant and captive semiconductor manufacturers consists of three components: spending for front-end, or wafer fab equipment; spending for back-end, or assembly and test equipment; and spending for property and plant. The total world market for the 10 categories of wafer fab equipment as defined in this database are equal to the total capital spending for front-end equipment by the world's semiconductor manufacturers.

Most of the equipment categories are self-explanatory; however, a few categories require further definition. The Other Process Control category represents a broad market that includes mask inspection and repair equipment, process monitoring equipment, surface analysis equipment, and analytical instrumentation. This market is a highly fragmented market with dozens of companies selling into a multitude of noncompetitive market niches.

Factory Automation includes CIM software for shop floor control, factory host computer systems, cell controllers and interface hardware, and wafer transport systems including automatic guided vehicles, robotics, and rail transport systems.

Other Equipment is a general, catch-all category that includes the other capital equipment

Table 1.1

Wafer Fab Equipment Categories

1. Lithography
   - Contact/Proximity
   - Projection Aligners
   - Steppers
   - Direct-Write Lithography
   - Maskmaking Lithography
   - X-Ray
2. Automatic Photoresist Processing Equipment
3. Etch and Clean
   - Wet Process
   - Dry Strip
   - Dry Etch
   - Ion Milling
4. Deposition
   - Chemical Vapor Deposition
   - Physical Vapor Deposition
   - Silicon Epitaxy
   - Metalorganic CVD
   - Molecular Beam Epitaxy
5. Diffusion
6. Rapid Thermal Processing
7. Ion Implantation
   - Medium Current
   - High Current
   - High Voltage
8. Process Control
   - Optical CD
   - CD SEM
   - Wafer Inspection
   - Other Process Control
9. Factory Automation
10. Other Equipment

Source: Dataquest (Aril 1991)

used throughout the fab but not classified with the other nine major types of wafer processing equipment. Included in this segment are decontamination systems, wafer markers, gas analyzers, storage stations, and other types of equipment.

CONVENTIONS

The data in the tables represent factory revenue for calendar year shipments, organized by company or by region. For companies with a different fiscal year, calendar year shipments have been estimated. Shipments do not include spare parts or service but do include retrofits and upgrades. Thus, for public companies, the sales reported here may be different from the sales reported in the annual reports. The compound annual growth rate (CAGR) is estimated over the years 1986 to 1990 for each major line item.

EXCHANGE RATES

Japanese-manufactured equipment sold in Japan is valued in dollars in the database tables at the average exchange rate for each year, as shown below:

Yen/Dollar Exchange Rate

1986	1987	1988	1989	1990
167	144	130	139	144

EQUIPMENT COMPANIES

Table 1.2 presents a list of the equipment companies found in the database tables by region of company ownership. (Please note that Table 1.2 includes companies that are currently active in the wafer fab equipment industry in addition to those companies that, for whatever reason, are no longer participants.) The database comprises a total of 100 U.S. equipment companies, 56 Japanese companies, 34 European companies, and 8 joint venture companies. These 198 companies account for virtually all of the world's wafer processing equipment for lithography, automatic photoresist processing, etch and clean, deposition, diffusion, rapid thermal processing, ion implantation, and optical CD/wafer inspection.

Table 1.3 presents a summary of recent mergers and acquisitions in the wafer fab equipment industry. Merger and acquisition activity is often accompanied by a change in company name. These changes have been incorporated in our market share tables. For example, Vickers Instruments was acquired by Biorad in early 1989. Thus, Vickers' sales of optical CD and CD SEM equipment in 1989 is found under the company's new name, Nanoquest; subsequently, estimates under the Vickers category drop to 0.

Table 1.2

Wafer Fab Equipment Companies

North American Companies

Advantage Production Technology	Gemini	Plasma-Therm
AG Associates	General Signal Thinfilm Company	Poly-Flow Engineering
Alameda Instruments	Genus	Process Products
American Semiconductor Equip. Tech.	Hampshire Instruments	Process Technology Ltd.
Amray	High Temperature Engineering	Pure Aire Corporation
Angstrom Measurements	Innotec	Rapro
Anicon	Insystems	Reichert-McBain
Applied Materials	Integrated Air Systems	S&K Products International
Ateq	Ion Tech	Santa Clara Plastics
Athens	IPEC	SCI Manufacturing
Biorad	IVS Inc.	Semiconductor Systems Inc.
Bjorne Enterprises	KLA Instruments	Semifab
Branson/IPC	Kurt J. Lesker	Semitherm
BTU International	Lam Research	Semitool
CFM Technology	LFE	Silicon Valley Group
CHA Industries	Machine Technology Inc.	SiScan Systems
CPA	Materials Research Corp.	Solitec
Crystal Specialties	Matrix	Spectrum CVD
CVC Products	Mattson Technologies	Spire
CVD Equipment	Metrologix	Sputtered Films
Denton Vacuum	Micronix	SubMicron Systems Inc.
Dexon	Moore	Tegal
Drytek	MR Semicon	Tempress
Eaton	MRL Industries	Thermco
Emcore	Nanometrics	Tylan
Epitaxy Inc.	Nanoquest	Ultratech
Estek	Nanosil	Universal Plastics
Etec	National Electrostatics	Varian
Focus Semiconductor	Novellus Systems Inc.	Veeco
FSI International	Optical Specialties Inc.	Verteq
Fusion Semiconductor Systems	Optical Specialties Inc.	Watkins-Johnson
Gasonics	Peak Systems	
GCA	Perkin-Elmer	

(Continued)

Table 1.2 (Continued)

Wafer Fab Equipment Companies

	Japanese Companies	
ABT Corporation	Holon	Samco
Advanced Film Technology Inc.	Japan Production Engineering	Sankyo Engineering
Amaya	JEOL	Seiden Sha
Anelva	Kaijo Denki	Seiko
Canon	Kokusai Electric	Shimada
Chemitronics	Koyo Lindberg	Sugai
Chlorine Engineering	Kuwano Electric	Sumitomo Metals
Dainippon Screen	Kyoritsu	Tazmo
Daiwa Semiconductor	Maruwa	Tohokasei
Dan Science Co. Ltd.	MRC (Sony)	Tokuda
Denko	Musashi	Tokyo Electron Ltd.
Disco	Nidek	Tokyo Ohka Kogyo
Eiko	Nikon	Toshiba
Elionix	Nippon EMC	Toyoko Chemical
Enya	Nippon Sanso	Ulvac
Ergo Plasma Systems	Nissin Electric	Ushio
ETE Company Ltd.	Plasma Systems	Yuasa
Fuji Electric	Ramco	
Hitachi	Ryokosha	
	European Companies	
AET	Helmut Seier	Sitesa
Aixtron	ISA Riber	Technics
ASM International	Jipelec	Temescal
ASM Lithography	Karl Suss	Thomas Schwonn
Balzers	Leica	VG Instruments
Cambridge Instruments	Leica Lasertechnik	Vickers Instruments
Centrotherm	Leybold-Heraeus	Wellman Furnaces
Convac	LPE	Wild Leitz
CVT	Micro-Controle	Wild Leitz Instruments
E.T. Electrotech	Plasma Technology	Zeiss
EEV	Pokorny	
Heidelberg Instruments	Semco Engineering	
	Joint Venture Companies	
Alcan Technology	TEL/LAM	Ulvac/BTU
BTU/Ulvac	TEL/Varian	Varian/TEL
Sumitomo/Eaton Nova		

Source: Dataquest (April 1991)

Table 1.3

Summary of Mergers and Acquisitions Incorporated in the Wafer Fab Equipment Database

Company	Action	Company	Now Identified As	First Year Change Noted In Database
ASM Lithography (e-beam lithography group)	acquired by	Cambridge Instruments	Leica	1990
Circuits Processing Apparatus (GSTC)	management buyout from	General Signal Thinfilm	CPA	1990
Materials Research Corp.	acquired by	Sony	Materials Research Corp.	1990
Nanoquest	name change to	-	Biorad Micromeasurements	1990
Perkin-Elmer (e-beam lithography group)	acquired by	industry consortium	Etec Systems, Inc.	1990
Perkin-Elmer (optical lithography group)	acquired by	Silicon Valley Group	SVG Lithography	1990
Wild Leitz	merged with	Cambridge Instruments	Leica	1990
Wild Leitz Instruments	name change to	-	Leica Lasertechnik	1990
ASM Lithography (50% of joint venture)	acquired by	Philips	ASM Lithography	1989
Cambridge Instruments (MOCVD group)	acquired by	MR Semicon	MR Semicon	1989
Estek (wet processing equipment group)	acquired by	Verteq	Verteq	1989
GCA Corporation	acquired by	General Signal	GCA Corporation	1989
Heidelberg Instruments	acquired by	Wild Leitz	Wild Leitz Instruments	1989
TEL/Thermco	acquired by	Tokyo Electron Ltd.	Tokyo Electron Ltd.	1989
Thermco	acquired by	Silicon Valley Group	Silicon Valley Group	1989
Tylan (diffusion and CVD group)	management buyout from	Tylan	Tystar	1989
Vickers Instruments	acquired by	Biorad	Nanoquest	1989
General Ionex	acquired by	Genus	Genus	1988
TEL/Lam	acquired by	Tokyo Electron Ltd.	Tokyo Electron Ltd.	1988
Tempress	merged with	Circuits Processing Apparatus	General Signal Thinfilm	1988
AET Addax (RTP group)	acquired by	Sitesa	Sitesa Addax	1987
Anicon	acquired by	Silicon Valley Group	Silicon Valley Group	1987
Gemini	acquired by	Lam Research	Lam Research	1987

Source: Dataquest (April 1991)

Chapter 2

Wafer Fab Equipment—Summary Data by Category

This section of the equipment database consists of two summary tables for the worldwide fab equipment market. Both tables present sales by equipment category for the years 1986 to 1990. In Table 2.1, the annual sales for each equipment category are organized by region of equipment sales; in Table 2.2, annual sales for each equipment category are organized by equipment vendor nationality (United States, Japan, and Europe). Joint venture equipment companies have their own listing.

For example, the total worldwide sales for contact/proximity aligners of $31.4 million in 1986 is the same in both Table 2.1 and Table 2.2; however, whereas Table 2.1 breaks the sales down by region, Table 2.2 breaks the sales down by nationality of the companies supplying the aligners.

In Table 2.2, the subtotal fab equipment line item designates that portion of the total worldwide fab equipment market for which detailed company data are available. For some of the categories in Table 2.2 (Ion Milling, Other Process Control, Factory Automation, and Other Equipment), detailed company data are not complete. For these categories, top-down estimates have been made and included in Tables 2.1 and 2.2 so that world fab equipment sales are consistent across all tables. Detailed company data are available for approximately 86 percent of the total worldwide wafer fab equipment market for 1990.

Table 2.1

Worldwide Wafer Fab Equipment Market
Regional Market Share By Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: All
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Fab Equipment Market	2,716.4	3,139.7	4,982.6	5,996.1	5,813.1	20.9
Lithography						
Contact/Proximity						
North American Market	11.1	10.0	8.9	7.3	6.4	-12.9
Japanese Market	9.1	5.2	4.0	5.7	4.5	-16.1
European Market	6.0	5.0	5.4	6.0	4.8	-5.4
Asia/Pacific-ROW Market	5.2	4.4	4.0	3.6	2.9	-13.6
Total Contact/Prox.	31.4	24.6	22.3	22.6	18.6	-12.3
Projection Aligners						
North American Market	98.4	66.4	60.7	22.4	24.8	-29.1
Japanese Market	38.4	36.7	63.3	43.9	28.0	-7.6
European Market	24.6	17.3	16.3	13.0	15.1	-11.5
Asia/Pacific-ROW Market	9.6	8.2	7.4	15.0	21.2	21.9
Total Projection	171.0	128.6	147.7	94.3	89.1	-15.0
Total Steppers						
North American Market	152.8	184.0	280.0	338.2	299.1	18.3
Japanese Market	139.1	212.8	436.6	532.4	539.1	40.3
European Market	45.7	58.5	90.0	110.6	132.1	30.4
Asia/Pacific-ROW Market	25.5	47.8	114.4	201.3	96.5	39.5
Total Steppers	363.1	503.1	921.0	1,182.5	1,066.8	30.9
Direct-Write Lithography						
North American Market	30.4	17.2	13.6	10.0	12.0	-20.7
Japanese Market	29.2	32.7	35.9	34.5	29.1	-.1
European Market	8.5	15.2	17.2	20.4	23.3	28.7
Asia/Pacific-ROW Market	.0	2.0	2.0	5.2	6.3	NM
Total Direct-Write	68.1	67.1	68.7	70.1	70.7	.9

(Continued)

Table 2.1 (Continued)

Worldwide Wafer Fab Equipment Market
Regional Market Share By Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Maskmaking Lithography						
North American Market	27.0	13.6	16.0	15.4	11.8	-18.7
Japanese Market	23.7	38.0	27.5	40.1	30.1	6.2
European Market	.0	13.0	7.6	8.2	3.0	NM
Asia/Pacific-ROW Market	.0	3.0	11.0	5.5	5.5	NM
Total Maskmaking	50.7	67.6	62.1	69.2	50.4	-.1
X-Ray						
North American Market	.0	.0	3.4	2.0	.0	NM
Japanese Market	.8	.0	1.6	.0	.0	-1.0
European Market	.0	.0	1.4	2.8	1.6	NM
Asia/Pacific-ROW Market	.0	.0	.0	.0	.0	NM
Total X-Ray	.8	.0	6.4	4.8	1.6	18.9
Total Lithography						
North American Market	319.7	291.2	382.6	395.3	354.1	2.6
Japanese Market	240.3	325.4	568.9	656.6	630.8	27.3
European Market	84.8	109.0	137.9	161.0	179.9	20.7
Asia/Pacific-ROW Market	40.3	65.4	138.8	230.6	132.4	34.6
Total Lithography	685.1	791.0	1,228.2	1,443.5	1,297.2	17.3
Automatic Photoresist Processing Equipment						
North American Market	59.0	60.9	78.0	91.1	95.6	12.8
Japanese Market	54.5	65.4	113.6	156.2	171.1	33.1
European Market	27.1	28.5	36.5	38.6	40.8	10.8
Asia/Pacific-ROW Market	8.2	12.9	25.3	47.7	30.7	39.1
Total Track	148.8	167.7	253.4	333.6	338.2	22.8
Etch and Clean						
Wet Process						
North American Market	63.3	65.6	83.3	84.4	71.8	3.2
Japanese Market	71.4	69.2	138.8	192.4	222.8	32.9
European Market	19.6	22.1	29.2	39.4	30.5	11.7
Asia/Pacific-ROW Market	6.4	10.3	25.6	38.4	25.2	40.9
Total Wet Process	160.7	167.2	276.9	354.6	350.3	21.5

(Continued)

Table 2.1 (Continued)

Worldwide Wafer Fab Equipment Market
Regional Market Share By Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Dry Strip						
North American Market	13.8	16.7	23.0	27.0	26.9	18.2
Japanese Market	15.6	33.7	64.2	75.9	80.6	50.8
European Market	4.0	2.9	5.9	6.9	10.1	26.1
Asia/Pacific-ROW Market	2.0	4.6	7.3	11.4	7.7	40.1
Total Dry Strip	35.4	57.9	100.4	121.2	125.3	37.2
Dry Etch						
North American Market	100.1	118.1	171.1	186.1	184.4	16.5
Japanese Market	82.3	113.0	240.1	329.4	359.7	44.6
European Market	39.7	58.3	72.9	74.5	95.3	24.5
Asia/Pacific-ROW Market	15.0	18.0	49.1	79.0	44.0	30.9
Total Dry Etch	237.1	307.4	533.2	669.0	683.4	30.3
Ion Milling						
North American Market	3.7	3.7	4.0	3.0	3.0	-5.1
Japanese Market	1.5	1.5	2.0	5.0	5.0	35.1
European Market	1.6	1.6	2.0	3.0	3.0	17.0
Asia/Pacific-ROW Market	1.0	1.0	1.5	1.5	2.0	NM
Total Ion Milling	7.8	7.8	9.5	12.5	13.0	13.6
Total Etch and Clean						
North American Market	180.9	204.1	281.4	300.5	286.1	12.1
Japanese Market	170.8	217.4	445.1	602.7	668.1	40.6
European Market	64.9	84.9	110.0	123.8	138.9	21.0
Asia/Pacific-ROW Market	24.4	33.9	83.5	130.3	78.9	34.1
Total Etch and Clean	441.0	540.3	920.0	1,157.3	1,172.0	27.7
Deposition						
CVD						
North American Market	62.8	91.3	150.3	192.7	222.1	37.1
Japanese Market	96.8	95.0	190.2	262.7	319.4	34.8
European Market	47.2	56.9	73.9	72.2	92.0	18.2
Asia/Pacific-ROW Market	14.6	16.0	48.2	81.8	55.0	39.3
Total CVD	221.4	259.2	462.6	609.4	688.5	32.8

(Continued)

Table 2.1 (Continued)

Worldwide Wafer Fab Equipment Market
Regional Market Share By Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
PVD						
North American Market	95.2	93.8	105.1	111.8	126.5	7.4
Japanese Market	76.5	99.8	138.1	175.0	197.6	26.8
European Market	48.2	40.7	36.0	45.0	56.3	4.0
Asia/Pacific-ROW Market	16.7	16.6	22.8	36.6	28.0	13.8
Total PVD	236.6	250.9	302.0	368.4	408.4	14.6
Silicon Epitaxy						
North American Market	16.2	13.4	43.0	31.7	35.7	21.8
Japanese Market	13.5	13.0	23.5	20.7	18.2	7.8
European Market	11.2	6.4	13.4	16.5	11.9	1.5
Asia/Pacific-ROW Market	5.4	2.7	5.6	6.1	2.4	-18.4
Total Silicon Epitaxy	46.3	35.5	85.5	75.0	68.2	10.2
Metalorganic CVD						
North American Market	9.3	11.0	13.8	14.9	13.9	10.6
Japanese Market	16.0	14.1	16.9	16.6	15.9	-.2
European Market	5.4	9.2	10.6	9.6	11.6	21.1
Asia/Pacific-ROW Market	.7	.3	.7	3.5	.9	6.5
Total MOCVD	31.4	34.6	42.0	44.6	42.3	7.7
Molecular Beam Epitaxy						
North American Market	24.3	19.7	21.3	20.8	9.3	-21.3
Japanese Market	23.3	32.6	36.3	20.5	22.5	-.9
European Market	16.4	11.7	19.0	23.7	12.2	-7.1
Asia/Pacific-ROW Market	1.8	4.0	4.3	7.2	10.5	55.4
Total MBE	65.8	68.0	80.9	72.2	54.5	-4.6
Total Deposition						
North American Market	207.8	229.2	333.5	371.9	407.5	18.3
Japanese Market	226.1	254.5	405.0	495.5	573.6	26.2
European Market	128.4	124.9	152.9	167.0	184.0	9.4
Asia/Pacific-ROW Market	39.2	39.6	81.6	135.2	96.8	25.4
Total Deposition	601.5	648.2	973.0	1,169.6	1,261.9	20.4

(Continued)

Table 2.1 (Continued)

Worldwide Wafer Fab Equipment Market
Regional Market Share By Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Diffusion						
North American Market	45.0	37.1	84.6	88.2	76.5	14.2
Japanese Market	74.2	59.1	105.4	128.2	172.8	23.5
European Market	31.2	39.2	46.1	45.2	40.1	6.5
Asia/Pacific-ROW Market	5.2	10.0	58.0	68.4	33.0	58.7
Total Diffusion	155.6	145.4	294.1	330.0	322.4	20.0
Rapid Thermal Processing						
North American Market	7.0	10.1	11.7	10.4	13.9	18.7
Japanese Market	4.9	4.5	6.2	10.0	12.4	26.1
European Market	2.6	2.7	3.2	4.1	3.8	10.0
Asia/Pacific-ROW Market	1.0	.9	1.2	3.6	2.8	29.4
Total RTP	15.5	18.2	22.3	28.1	32.9	20.7
Ion Implantation						
Medium Current						
North American Market	15.8	9.9	17.4	23.5	17.2	2.1
Japanese Market	22.4	29.6	64.1	76.8	72.5	34.1
European Market	10.4	15.1	17.9	8.7	3.8	-22.3
Asia/Pacific-ROW Market	5.9	6.4	18.5	22.3	17.6	31.4
Total Medium Current	54.5	61.0	117.9	131.3	111.1	19.5
High Current						
North American Market	12.8	27.6	44.5	59.3	58.4	46.2
Japanese Market	16.8	46.3	139.4	164.7	136.1	68.7
European Market	17.0	21.5	32.6	26.3	27.1	12.4
Asia/Pacific-ROW Market	7.9	11.5	24.6	50.4	27.9	37.1
Total High Current	54.5	106.9	241.1	300.7	249.5	46.3
High Voltage						
North American Market	8.4	8.1	6.2	7.4	2.5	-26.1
Japanese Market	1.1	5.9	8.1	15.5	2.5	22.8
European Market	.3	4.0	4.1	.0	.0	-100.0
Asia/Pacific-ROW Market	.0	.0	.0	1.7	.0	NM
Total High Voltage	9.8	18.0	18.4	24.6	5.0	-15.5

(Continued)

Table 2.1 (Continued)

Worldwide Wafer Fab Equipment Market
Regional Market Share By Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Total Implantation						
North American Market	37.0	45.6	68.1	90.2	78.1	20.5
Japanese Market	40.3	81.8	211.6	257.0	211.1	51.3
European Market	27.7	40.6	54.6	35.0	30.9	2.8
Asia/Pacific-ROW Market	13.8	17.9	43.1	74.4	45.5	34.8
Total Implantation	118.8	185.9	377.4	456.6	365.6	32.4
Optical CD						
North American Market	11.3	15.9	33.4	25.4	22.3	18.5
Japanese Market	10.5	15.0	27.6	20.5	16.2	11.5
European Market	4.1	8.0	12.8	12.9	16.7	42.1
Asia/Pacific-ROW Market	2.8	3.4	5.6	10.8	4.8	14.4
Total Optical CD	28.7	42.3	79.4	69.6	60.0	20.2
CD SEM						
North American Market	7.4	19.0	26.5	26.2	26.1	37.0
Japanese Market	7.2	22.7	37.7	41.4	54.5	65.9
European Market	.8	3.4	5.5	9.5	6.8	70.7
Asia/Pacific-ROW Market	.0	1.3	1.9	3.5	3.1	NM
Total CD SEM	15.4	46.4	71.6	80.6	90.5	55.7
Wafer Inspection						
North American Market	18.0	23.2	35.7	40.1	30.1	13.7
Japanese Market	15.8	21.8	39.3	42.9	43.7	29.0
European Market	6.4	8.5	12.9	23.4	19.3	31.8
Asia/Pacific-ROW Market	1.9	4.2	12.6	10.8	5.9	32.7
Total Wafer Inspection	42.1	57.7	100.5	117.2	99.0	23.8
Other Process Control						
North American Market	125.5	104.4	116.5	129.6	120.0	-1.1
Japanese Market	97.6	112.3	153.4	176.8	171.0	15.0
European Market	46.2	41.1	48.2	48.8	45.0	-.7
Asia/Pacific-ROW Market	18.0	27.9	37.3	49.2	32.0	15.5
Total Other Prc. Con.	287.3	285.7	355.4	404.4	368.0	6.4

(Continued)

Table 2.1 (Continued)

Worldwide Wafer Fab Equipment Market
Regional Market Share By Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Total Process Control						
North American Market	162.2	162.5	212.1	221.3	198.5	5.2
Japanese Market	131.1	171.8	258.0	281.6	285.4	21.5
European Market	57.5	61.0	79.4	94.6	87.8	11.2
Asia/Pacific-ROW Market	22.7	36.8	57.4	74.3	45.8	19.2
Total Process Control	373.5	432.1	606.9	671.8	617.5	13.4
Factory Automation						
North American Market	21.0	24.0	26.0	37.0	40.0	17.5
Japanese Market	43.0	54.0	76.0	112.0	121.0	29.5
European Market	14.0	17.0	17.0	25.0	27.0	17.8
Asia/Pacific-ROW Market	3.0	4.0	11.0	21.0	28.0	74.8
Total Automation	81.0	99.0	130.0	195.0	216.0	27.8
Other Equipment						
North American Market	38.0	39.7	55.1	58.4	50.8	7.5
Japanese Market	36.0	45.6	80.5	98.2	97.1	28.2
European Market	15.9	18.6	23.5	25.4	24.8	11.8
Asia/Pacific-ROW Market	5.7	8.0	18.2	28.6	16.7	30.8
Total Other Equipment	95.6	111.9	177.3	210.6	189.4	18.6
Total Wafer Fab Equipment						
North American Market	1,077.6	1,104.4	1,533.1	1,664.3	1,601.1 27%	10.4
Japanese Market	1,021.2	1,279.5	2,270.3	2,798.0	2,943.4 51%	30.3
European Market	454.1	526.4	661.1	719.7	758.0 13%	13.7
Asia/Pacific-ROW Market	163.5	229.4	518.1	814.1	510.6 9%	32.9
Total Fab Equipment	2,716.4	3,139.7	4,982.6	5,996.1	5,813.1	20.9

NM = Not Meaningful
Ref: SUMMREG

Source: Dataquest (April 1991)

Table 2.2
Worldwide Wafer Fab Equipment Market
Market Share by Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: All
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Fab Equipment Market	2,716.4	3,139.7	4,982.6	5,996.1	5,813.1	20.9
Lithography						
Contact/Proximity						
North American Companies	.0	.0	.0	.0	.0	NM
Japanese Companies	15.4	11.0	8.6	6.3	5.1	-24.1
European Companies	16.0	13.6	13.7	16.3	13.5	-4.2
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total Cont./Prox.	31.4	24.6	22.3	22.6	18.6	-12.3
Projection Aligners						
North American Companies	121.8	88.0	78.6	44.9	37.0	-25.8
Japanese Companies	49.2	40.6	69.1	49.4	52.1	1.4
European Companies	.0	.0	.0	.0	.0	NM
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total Projection	171.0	128.6	147.7	94.3	89.1	-15.0
Steppers						
North American Companies	154.2	124.5	198.0	147.2	152.6	-.3
Japanese Companies	199.8	341.9	664.4	912.1	823.2	42.5
European Companies	9.1	36.7	58.6	123.2	91.0	77.8
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total Steppers	363.1	503.1	921.0	1,182.5	1,066.8	30.9
Direct-Write Lithography						
North American Companies	6.4	9.6	12.8	9.9	11.8	16.5
Japanese Companies	41.2	39.5	40.7	41.0	43.7	1.5
European Companies	20.5	18.0	15.2	19.2	15.2	-7.2
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total Direct-Write	68.1	67.1	68.7	70.1	70.7	.9

(Continued)

Table 2.2 (Continued)
Worldwide Wafer Fab Equipment Market
Market Share by Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Maskmaking Lithography						
North American Companies	36.0	28.6	38.2	34.7	31.3	-3.4
Japanese Companies	14.7	35.0	16.5	29.6	16.6	3.1
European Companies	.0	4.0	7.4	4.9	2.5	NM
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total Maskmaking	50.7	67.6	62.1	69.2	50.4	NM
X-Ray						
North American Companies	.8	.0	1.8	2.0	.0	NM
Japanese Companies	.0	.0	.0	.0	.0	NM
European Companies	.0	.0	4.6	2.8	1.6	NM
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total X-Ray	.8	.0	6.4	4.8	1.6	18.9
Total Lithography						
North American Companies	319.2	250.7	329.4	238.7	232.7	-7.6
Japanese Companies	320.3	468.0	799.3	1,038.4	940.7	30.9
European Companies	45.6	72.3	99.5	166.4	123.8	28.4
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total Lithography	685.1	791.0	1,228.2	1,443.5	1,297.2	17.3
Automatic Photoresist Processing Equipment						
North American Companies	81.0	80.2	93.4	106.8	115.3	9.2
Japanese Companies	61.4	76.6	146.2	195.2	195.7	33.6
European Companies	6.4	10.9	13.8	12.2	13.4	20.3
Joint Venture Companies	.0	.0	.0	19.4	13.8	NM
Total Track	148.8	167.7	253.4	333.6	338.2	22.8
Wet Process						
North American Companies	89.7	95.2	106.5	114.5	96.1	1.7
Japanese Companies	67.9	67.7	165.7	231.9	252.0	38.8
European Companies	3.1	4.3	4.7	8.2	2.2	-8.2
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total Wet Process	160.7	167.2	276.9	354.6	350.3	21.5

59%   41%

(Continued)

Table 2.2 (Continued)
Worldwide Wafer Fab Equipment Market
Market Share by Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Dry Strip						
North American Companies	21.0	25.4	38.6	39.8	38.3	16.2
Japanese Companies	13.5	27.5	51.6	68.3	75.3	53.7
European Companies	.0	.0	.0	.0	.0	NM
Joint Venture Companies	.9	5.0	10.2	13.1	11.7	89.9
Total Dry Strip	35.4	57.9	100.4	121.2	125.3	37.2
Dry Etch						
North American Companies	176.1	210.3	364.0	385.8	335.2	17.5
Japanese Companies	50.0	72.5	153.5	260.0	314.2	58.3
European Companies	5.0	7.2	15.7	17.0	19.9	41.2
Joint Venture Companies	6.0	17.4	.0	6.2	14.1	23.8
Total Dry Etch	237.1	307.4	533.2	669.0	683.4	30.3
Deposition		528.3/790.2 = 41.5%		389.5/808.7 = 48%		Fog 7
CVD						
North American Companies	86.0	134.3	252.4	369.5	415.3	48.2
Japanese Companies	47.7	38.1	106.6	144.6	171.6	37.7
European Companies	80.1	78.0	100.1	91.3	80.7	.2
Joint Venture Companies	7.6	8.8	3.5	4.0	20.9	28.8
Total CVD	221.4	259.2	462.6	609.4	688.5	32.8
PVD						
North American Companies	113.5	102.0	132.4	157.7	123.0	2.0
Japanese Companies	75.2	102.7	129.7	161.1	236.0	33.1
European Companies	47.9	46.2	39.9	49.6	49.4	.8
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total PVD	236.6	250.9	302.0	368.4	408.4	14.6
Silicon Epitaxy						
North American Companies	42.7	33.4	67.2	46.9	36.8	-3.6
Japanese Companies	3.6	2.1	6.2	12.2	6.7	16.8
European Companies	.0	.0	12.1	15.9	24.7	NM
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total Silicon Epitaxy	46.3	35.5	85.5	75.0	68.2	10.2

(Continued)

Table 2.2 (Continued)
Worldwide Wafer Fab Equipment Market
Market Share by Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Metalorganic CVD						
North American Companies	8.9	10.2	13.1	15.7	15.3	14.5
Japanese Companies	12.1	10.5	13.7	14.5	10.9	-2.6
European Companies	7.4	11.0	13.5	14.4	16.1	21.5
Joint Venture Companies	3.0	2.9	1.7	.0	.0	NM
Total MOCVD	31.4	34.6	42.0	44.6	42.3	7.7
Molecular Beam Epitaxy						
North American Companies	18.0	17.1	20.3	17.2	4.7	-28.5
Japanese Companies	14.8	16.6	21.6	13.7	13.0	-3.2
European Companies	33.0	34.3	39.0	41.3	36.8	2.8
Joint Venture Companies	.0	.0	.0	.0	.0	NM
Total MBE	65.8	68.0	80.9	72.2	54.5	-4.6
Total Deposition						
North American Companies	269.1	297.0	485.4	607.0	595.1	21.9
Japanese Companies	153.4	170.0	277.8	346.1	438.2	30.0
European Companies	168.4	169.5	204.6	212.5	207.7	5.4
Joint Venture Companies	10.6	11.7	5.2	4.0	20.9	18.5
Total Deposition	601.5	648.2	973.0	1,169.6	1,261.9	20.4
Diffusion						
North American Companies	63.3	65.3	114.5	116.6	98.7	11.7
Japanese Companies	24.1	33.3	141.2	159.5	167.9	62.5
European Companies	18.8	21.5	26.9	35.3	33.0	15.1
Joint Venture Companies	49.4	25.3	11.5	18.6	22.8	-17.6
Total Diffusion	155.6	145.4	294.1	330.0	322.4	20.0
Rapid Thermal Processing						
North American Companies	11.9	16.3	19.3	21.2	25.0	20.4
Japanese Companies	2.1	1.2	1.8	5.4	6.2	31.1
European Companies	.7	.7	1.2	1.5	1.7	24.8
Joint Venture Companies	.8	.0	.0	.0	.0	NM
Total RTP	15.5	18.2	22.3	28.1	32.9	20.7

(Continued)

Table 2.2 (Continued)
Worldwide Wafer Fab Equipment Market
Market Share by Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990	
Ion Implantation							
North American Companies	82.5	107.0	197.6	223.7	197.9	24.5	
Japanese Companies	20.7	26.8	53.3	82.9	62.4	31.8	
European Companies	.0	2.8	4.2	1.6	.0	NM	
Joint Venture Companies	15.6	49.3	122.3	148.4	105.3	61.2	
Total Implantation	118.8	185.9	377.4	456.6	365.6	32.4	
Optical CD							
North American Companies	12.0	10.4	28.7	37.6	35.5	31.1	
Japanese Companies	11.2	15.1	27.7	19.1	11.8	1.3	
European Companies	5.5	16.8	23.0	12.9	12.7	23.3	
Joint Venture Companies	.0	.0	.0	.0	.0	NM	
Total Optical CD	28.7	42.3	79.4	69.6	60.0	20.2	
CD SEM							
North American Companies	3.6	3.9	6.4	16.0	14.4	41.4	
Japanese Companies	10.4	32.9	53.2	64.6	76.1	64.5	
European Companies	1.4	9.6	12.0	.0	.0	NM	
Joint Venture Companies	.0	.0	.0	.0	.0	NM	
Total CD SEM	15.4	46.4	71.6	80.6	90.5	55.7	
Wafer Inspection							
North American Companies	24.9	35.4	62.1	74.6	55.2	22.0	
Japanese Companies	10.9	15.5	26.1	28.8	30.5	29.3	
European Companies	6.3	6.8	12.3	13.8	13.3	20.5	
Joint Venture Companies	.0	.0	.0	.0	.0	NM	
Total Wafer Insp.	42.1	57.7	100.5	117.2	99.0	23.8	
Subtotal Fab Equipment*							w/o JV
North American Companies	1,154.3	1,197.1	1,845.9	1,982.3	1,839.4 38%	12.4	37%
Japanese Companies	745.9	1,007.1	1,897.4	2,500.2	2,571.0 53%	36.3	51%
European Companies	261.2	322.4	417.9	481.4	427.7 9%	13.1	8.6%
Joint Venture Companies	83.3	108.7	149.2	209.7	188.6	22.7	4%
Subtotal Fab Equipment	2,244.7	2,635.3	4,310.4	5,173.6	5,026.7	22.3	

(Continued)

Table 2.2 (Continued)
Worldwide Wafer Fab Equipment Market
Market Share by Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Ion Milling						
All Companies	7.8	7.8	9.5	12.5	13.0	13.6
Other Process Control						
All Companies	287.3	285.7	355.4	404.4	368.0	6.4
Factory Automation						
All Companies	81.0	99.0	130.0	195.0	216.0	27.8
Other Equipment						
All Companies	95.6	111.9	177.3	210.6	189.4	18.6
Total Fab Equip.	2,716.4	3,139.7	4,982.6	5,996.1	5,813.1	20.9

*Subtotal Fab Equipment does not include Ion Milling, Other Process Control, Factory Automation, and Other Equipment categories as detailed company data is not complete for these categories. Aggregate data for these categories are added to provide a consistent total for the worldwide wafer fab equipment market.

NM = Not Meaningful
Ref: SUMMSHR

Source: Dataquest (April 1991)

Chapter 3

Wafer Fab Equipment—Import/Export Data

This section of the equipment database consists of two summary tables that provide information on the import/export markets for the worldwide wafer fab equipment market. In both Table 3.1 and Table 3.2, the worldwide fab equipment market total in millions of U.S. dollars is listed at the beginning of the table and followed by the subtotal for fab equipment. The subtotal fab equipment line item includes all of the front-end equipment categories for which detailed company analysis has been made and accounts for 86 percent of all front-end equipment for 1990. For some equipment categories (Ion Milling, Process Control, Factory Automation, and Other Equipment), detailed company analysis is not yet complete. For these categories, which account for the remaining 14 percent of wafer fab equipment, a top-down estimate has been made and included in Tables 3.1 and 3.2 so that worldwide fab equipment sales are consistent across all tables.

The subtotal fab equipment market includes all of the major wafer fab equipment categories and accounts for the majority of all import/export activity in the worldwide fab equipment market. Relatively little import/export activity exists for the remaining 14 percent of wafer fab equipment for which detailed company data are not yet complete. These equipment markets are largely supplied by domestic suppliers. Significant import/export analysis of the fab equipment market can be done, however, with the aid of the data in Tables 3.1 and 3.2.

Table 3.1
Worldwide Wafer Fab Equipment Market
Import Data
(Revenue in Millions of U.S. Dollars)

Company: All
Product: All
Region of Consumption: All

	1986	1987	1988	1989	1990		CAGR (%) 1986-1990
World Fab Equipment Market	2716.4	3139.7	4982.6	5996.1	5813.1		20.9
Subtotal Fab Equip.*	2244.7	2635.3	4310.4	5173.6	5026.7		22.3
Subtotal Percent (%)	82.6	83.9	86.5	86.3	86.5		
Subtotal Fab Equipment							
North America							
N. American Co. Sales	719.8	696.2	997.6	1003.3	974.3	70.2	7.9
Japanese Co. Sales	81.2	123.7	177.1	229.2	249.9	18.0	32.5
European Co. Sales	88.4	112.7	156.8	178.4	146.6	10.6	13.5
Joint Venture Co. Sales	.0	.0	.0	25.4	16.5	1.2	NM
Total N. America Market	889.4	932.6	1331.5	1436.3	1387.3		11.8
Japan							
N. American Co. Sales	132.1	148.9	320.0	352.2	368.2	14.4	29.2
Japanese Co. Sales	589.8	770.7	1445.9	1832.6	1983.1	77.8	35.4
European Co. Sales	37.9	37.8	44.3	44.9	49.5	1.9	6.9
Joint Venture Co. Sales	83.3	108.7	148.2	176.3	148.5	5.8	15.6
Total Japan Market	843.1	1066.1	1958.4	2406.0	2549.3		31.9
Europe							
N. American Co. Sales	213.1	240.8	302.5	312.5	291.2	44.2	8.1
Japanese Co. Sales	41.0	54.5	82.4	99.0	164.0	24.9	41.4
European Co. Sales	122.3	152.8	184.5	198.0	179.4	27.3	10.1
Joint Venture Co. Sales	.0	.0	1.0	8.0	23.6	3.6	NM
Total Europe Market	376.4	448.1	570.4	617.5	658.2		15.0
Asia/Pacific-ROW							
N. American Co. Sales	89.3 65.8	111.2	225.8	314.3	205.7	47.6	23.2
Japanese Co. Sales	33.9 24.9	58.2	192.0	339.4	174.0	40.3	50.5
European Co. Sales	12.6 9.3	19.1	32.3	60.1	52.2	12.1	42.7
Joint Venture Co. Sales	.0	.0	.0	.0	.0		NM
Total A/P-ROW Market	135.8	188.5	450.1	713.8	431.9		33.5

(Continued)

Table 3.1 (Continued)
Worldwide Wafer Fab Equipment Market
Import Data
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Worldwide						
N. American Co. Sales	1154.3	1197.1	1845.9	1982.3	1839.4	12.4
Japanese Co. Sales	745.9	1007.1	1897.4	2500.2	2571.0	36.3
European Co. Sales	261.2	322.4	417.9	481.4	427.7	13.1
Joint Venture Co. Sales	83.3	108.7	149.2	209.7	188.6	22.7
Subtotal Fab Equip.	2244.7	2635.3	4310.4	5173.6	5026.7	22.3
Ion Milling						
All Companies	7.8	7.8	9.5	12.5	13.0	13.6
Other Process Control						
All Companies	287.3	285.7	355.4	404.4	368.0	6.4
Factory Automation						
All Companies	81.0	99.0	130.0	195.0	216.0	27.8
Other Equipment						
All Companies	95.6	111.9	177.3	210.6	189.4	18.6
Total Fab Equipment	2716.4	3139.7	4982.6	5996.1	5813.1	20.9

*Subtotal Fab Equipment does not include Ion Milling, Process Control, Factory Automation, and Other Equipment categories, as detailed company data are not complete for these categories. Aggregate data for these categories are added to provide a consistent total for the worldwide wafer fab equipment market.

NM = Not Meaningful
Ref: IMEXSHR

Source: Dataquest (April 1991)

Table 3.2
Worldwide Wafer Fab Equipment Market
Export Data
(Revenue in Millions of U.S. Dollars)

Company: All
Product: All
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Fab Equipment Market	2716.4	3139.7	4982.6	5996.1	5813.1	20.9
Subtotal Fab Equipment*	2244.7	2635.3	4310.4	5173.6	5026.7	22.3
Subtotal Percent (%)	82.6	83.9	86.5	86.3	86.5	
Subtotal Fab Equipment						
N. American Equipment Companies						
Sales in North America	719.8	696.2	997.6	1003.3	974.3	7.9
Sales in Japan	132.1	148.9	320.0	352.2	368.2	29.2
Sales in Europe	213.1	240.8	302.5	312.5	291.2	8.1
Sales in Asia/Pacific-ROW	89.3	111.2	225.8	314.3	205.7	23.2
Total N. American Companies	1154.3	1197.1	1845.9	1982.3	1839.4	12.4
Japanese Equipment Companies						
Sales in North America	81.2	123.7	177.1	229.2	249.9	32.5
Sales in Japan	589.8	770.7	1445.9	1832.6	1983.1	35.4
Sales in Europe	41.0	54.5	82.4	99.0	164.0	41.4
Sales in Asia/Pacific-ROW	33.9	58.2	192.0	339.4	174.0	50.5
Total Japanese Companies	745.9	1007.1	1897.4	2500.2	2571.0	36.3
European Equipment Companies						
Sales in North America	88.4	112.7	156.8	178.4	146.6	13.5
Sales in Japan	37.9	37.8	44.3	44.9	49.5	6.9
Sales in Europe	122.3	152.8	184.5	198.0	179.4	10.1
Sales in Asia/Pacific-ROW	12.6	19.1	32.3	60.1	52.2	42.7
Total European Companies	261.2	322.4	417.9	481.4	427.7	13.1
Joint Venture Equipment Companies						
Sales in North America	.0	.0	.0	25.4	16.5	NM
Sales in Japan	83.3	108.7	148.2	176.3	148.5	15.6
Sales in Europe	.0	.0	1.0	8.0	23.6	NM
Sales in Asia/Pacific-ROW	.0	.0	.0	.0	.0	NM
Total JV Companies	83.3	108.7	149.2	209.7	188.6	22.7
Subtotal Fab Equip.	2244.7	2635.3	4310.4	5173.6	5026.7	22.3

(Continued)

Table 3.2 (Continued)
Worldwide Wafer Fab Equipment Market
Export Data
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Ion Milling						
All Companies	7.8	7.8	9.5	12.5	13.0	13.6
Other Process Control						
All Companies	287.3	285.7	355.4	404.4	368.0	6.4
Factory Automation						
All Companies	81.0	99.0	130.0	195.0	216.0	27.8
Other Equipment						
All Companies	95.6	111.9	177.3	210.6	189.4	18.6
Total Fab Equip.	2716.4	3139.7	4982.6	5996.1	5813.1	20.9

*Subtotal Fab Equipment does not include Ion Milling, Other Process Control, Factory Automation, and Other Equipment categories as detailed company data is not complete for these categories. Aggregate data for these categories are added to provide a consistent total for the worldwide wafer fab equipment market.

NM = Not Meaningful
Ref: IMEXSHR

Source: Dataquest (April 1991)

Chapter 4

Wafer Fab Equipment—Company Shares by Category

This section of the equipment database contains detailed company market share data by region for the major front-end equipment categories as shown in Tables 4.1 through 4.63. All of the companies that participate in an equipment segment are listed for each region, regardless of whether or not they have sales in a particular region. Although this approach results in a large number of zeros in the tables, it also indicates that Dataquest has not recorded any sales for the company in that region. We believe that this format gives more positive information than eliminating a company with no sales in a given region.

At the beginning of each table, the total world market for a particular equipment category is presented. This total is the same for each category as the total listed in Tables 2.1 and 2.2 in Chapter 2 entitled "Wafer Fab Equipment—Summary Data by Category." Thus, all tables are completely consistent as one proceeds from the summary tables to the detailed tables presented here in this section.

Table 4.1
Worldwide Lithography Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Lithography
Region of Consumption: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Lithography Market	685.1	791.0	1228.2	1443.5	1297.2	17.3
Contact/Proximity						
Canon	15.4	11.0	8.6	6.3	5.1	
Karl Suss	16.0	13.6	13.7	16.3	13.5	
Total Cont./Prox.	31.4	24.6	22.3	22.6	18.6	-12.3
Projection Aligners						
Canon	49.2	40.6	69.1	49.4	52.1	
Perkin-Elmer	121.8	88.0	78.6	44.9	.0	
SVG Lithography	.0	.0	.0	.0	37.0	
Total Projection	171.0	128.6	147.7	94.3	89.1	-15.0
Steppers						
ASET	11.6	11.3	16.0	4.0	.0	
ASM Lithography	9.1	36.7	58.6	123.2	91.0	
Canon	63.2	89.8	125.0	182.9	202.2	
Eaton	2.1	.0	.0	.0	.0	
GCA	74.6	47.4	104.0	68.9	78.2	
Hitachi	8.2	33.3	49.2	75.5	102.6	
Nikon	128.4	218.8	490.2	653.7	518.4	
Perkin-Elmer	27.0	25.2	5.0	12.0	.0	
SVG Lithography	.0	.0	.0	.0	36.0	
Ultratech	38.9	40.6	73.0	62.3	38.4	
Total Steppers	363.1	503.1	921.0	1182.5	1066.8	30.9

(Continued)

Table 4.1 (Continued)
Worldwide Lithography Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Direct-Write Lithography						
ASM Lithography	6.0	8.0	7.2	7.2	.0	
Ateq	.0	.0	.0	.0	2.0	
Cambridge	14.5	10.0	8.0	12.0	.0	
Etec	.0	.0	.0	.0	9.8	
Hitachi	11.2	8.7	9.6	9.4	8.3	
JEOL	30.0	30.8	31.1	31.6	35.4	
Leica	.0	.0	.0	.0	15.2	
Perkin-Elmer	6.4	9.6	12.8	9.9	.0	
Toshiba	.0	.0	.0	.0	.0	
Varian	.0	.0	.0	.0	.0	
Total Direct-Write	68.1	67.1	68.7	70.1	70.7	.9
Maskmaking Lithography						
ASM Lithography	.0	4.0	2.4	2.4	.0	
Ateq	.0	1.6	11.2	13.7	10.3	
Cambridge	.0	.0	5.0	2.5	.0	
Etec	.0	.0	.0	.0	21.0	
Hitachi	.0	13.4	3.8	6.6	6.2	
JEOL	11.7	18.1	5.0	15.8	10.4	
Leica	.0	.0	.0	.0	2.5	
Perkin-Elmer	36.0	27.0	27.0	21.0	.0	
Toshiba	3.0	3.5	7.7	7.2	.0	
Varian	.0	.0	.0	.0	.0	
Total Maskmaking	50.7	67.6	62.1	69.2	50.4	-.1
X-Ray						
Hampshire Instruments	.0	.0	1.8	.0	.0	
Micronix	.8	.0	.0	.0	.0	
Perkin-Elmer	.0	.0	.0	2.0	.0	
Karl Suss	.0	.0	4.6	2.8	1.6	
Total X-Ray	.8	.0	6.4	4.8	1.6	18.9
Total Lithography	685.1	791.0	1228.2	1443.5	1297.2	17.3

Ref: LITHSHR

Source: Dataquest (April 1991)

Table 4.2
Worldwide Contact/Proximity Market Share
By Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Contact/Proximity
Region of Consumption: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Cont./Prox. Market	31.4	24.6	22.3	22.6	18.6	-12.3
North America						
Canon	5.6	4.5	3.0	1.4	1.3	
Karl Suss	5.5	5.5	5.9	5.9	5.1	
Total North America	11.1	10.0	8.9	7.3	6.4	-12.9
Japan						
Canon	5.2	3.6	2.7	2.7	2.1	
Karl Suss	3.9	1.6	1.3	3.0	2.4	
Total Japan	9.1	5.2	4.0	5.7	4.5	-16.1
Europe						
Canon	2.6	1.5	1.5	.8	.6	
Karl Suss	3.4	3.5	3.9	5.2	4.2	
Total Europe	6.0	5.0	5.4	6.0	4.8	-5.4
Asia-Pacific/ROW						
Canon	2.0	1.4	1.4	1.4	1.1	
Karl Suss	3.2	3.0	2.6	2.2	1.8	
Total A/P-ROW	5.2	4.4	4.0	3.6	2.9	-13.6
Worldwide						
Canon	15.4	11.0	8.6	6.3	5.1	
Karl Suss	16.0	13.6	13.7	16.3	13.5	
Total Worldwide	31.4	24.6	22.3	22.6	18.6	-12.3

Ref: CONTSHR

Source: Dataquest (April 1991)

Table 4.3
Worldwide Projection Aligner Market Share
By Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Projection Aligner
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Projection Market	171.0	128.6	147.7	94.3	89.1	-15.0
North America						
Canon	13.6	8.4	12.0	8.4	14.6	
Perkin-Elmer	84.8	58.0	48.7	14.0	.0	
SVG Lithography	.0	.0	.0	.0	10.2	
Total North America	98.4	66.4	60.7	22.4	24.8	-29.1
Japan						
Canon	25.4	21.7	52.3	36.0	18.8	
Perkin-Elmer	13.0	15.0	11.0	7.9	.0	
SVG Lithography	.0	.0	.0	.0	9.2	
Total Japan	38.4	36.7	63.3	43.9	28.0	-7.6
Europe						
Canon	6.4	6.3	3.2	2.5	4.9	
Perkin-Elmer	18.2	11.0	13.1	10.5	.0	
SVG Lithography	.0	.0	.0	.0	10.2	
Total Europe	24.6	17.3	16.3	13.0	15.1	-11.5
Asia-Pacific/ROW						
Canon	3.8	4.2	1.6	2.5	13.8	
Perkin-Elmer	5.8	4.0	5.8	12.5	.0	
SVG Lithography	.0	.0	.0	.0	7.4	
Total Rest of World	9.6	8.2	7.4	15.0	21.2	21.9
Worldwide						
Canon	49.2	40.6	69.1	49.4	52.1	
Perkin-Elmer	121.8	88.0	78.6	44.9	.0	
SVG Lithography	.0	.0	.0	.0	37.0	
Total Worldwide	171.0	128.6	147.7	94.3	89.1	-15.0

Ref: PROJSHR

Source: Dataquest (April 1991)

Table 4.4
Worldwide Stepper Market Share
By Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Steppers
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Stepper Market	363.1	503.1	921.0	1,182.5	1,066.8	30.9
North America						
ASET	11.6	10.4	14.0	4.0	.0	
ASM Lithography	5.8	19.6	39.0	82.6	49.7	
Canon	21.6	25.2	25.0	31.2	41.7	
Eaton	2.1	.0	.0	.0	.0	
GCA	46.4	36.7	80.6	53.0	68.2	
Hitachi	.0	.0	.0	.0	6.2	
Nikon	14.8	44.0	71.5	112.0	75.6	
Perkin-Elmer	23.1	18.0	5.0	12.0	.0	
SVG Lithography	.0	.0	.0	.0	36.0	
Ultratech	27.4	30.1	44.9	43.4	21.7	
Total North America	152.8	184.0	280.0	338.2	299.1	18.3
Japan						
ASET	.0	.0	.0	.0	.0	
ASM Lithography	.0	.0	.0	.0	.0	
Canon	20.9	24.1	45.0	64.7	92.4	
Eaton	.0	.0	.0	.0	.0	
GCA	9.6	4.4	3.9	.0	.0	
Hitachi	8.2	33.3	49.2	75.5	96.4	
Nikon	98.8	151.0	336.2	390.5	344.2	
Perkin-Elmer	.0	.0	.0	.0	.0	
SVG Lithography	.0	.0	.0	.0	.0	
Ultratech	1.6	.0	2.3	1.7	6.1	
Total Japan	139.1	212.8	436.6	532.4	539.1	40.3

(Continued)

Table 4.4 (Continued)
Worldwide Stepper Market Share
By Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Europe						
ASET	.0	.9	.0	.0	.0	
ASM Lithography	3.3	17.1	16.9	23.2	27.1	
Canon	15.3	18.0	20.0	37.5	41.7	
Eaton	.0	.0	.0	.0	.0	
GCA	16.7	6.3	18.2	15.9	4.5	
Hitachi	.0	.0	.0	.0	.0	
Nikon	3.7	6.2	22.0	25.2	54.0	
Perkin-Elmer	.0	2.7	.0	.0	.0	
SVG Lithography	.0	.0	.0	.0	.0	
Ultratech	6.7	7.3	12.9	8.8	4.8	
Total Europe	45.7	58.5	90.0	110.6	132.1	30.4
Asia/Pacific-ROW						
ASET	.0	.0	2.0	.0	.0	
ASM Lithography	.0	.0	2.7	17.4	14.2	
Canon	5.4	22.5	35.0	49.5	26.4	
Eaton	.0	.0	.0	.0	.0	
GCA	1.9	.0	1.3	.0	5.5	
Hitachi	.0	.0	.0	.0	.0	
Nikon	11.1	17.6	60.5	126.0	44.6	
Perkin-Elmer	3.9	4.5	.0	.0	.0	
SVG Lithography	.0	.0	.0	.0	.0	
Ultratech	3.2	3.2	12.9	8.4	5.8	
Total A/P-ROW	25.5	47.8	114.4	201.3	96.5	39.5
Worldwide						
ASET	11.6	11.3	16.0	4.0	.0	
ASM Lithography	9.1	36.7	58.6	123.2	91.0	
Canon	63.2	89.8	125.0	182.9	202.2	
Eaton	2.1	.0	.0	.0	.0	
GCA	74.6	47.4	104.0	68.9	78.2	
Hitachi	8.2	33.3	49.2	75.5	102.6	
Nikon	128.4	218.8	490.2	653.7	518.4	
Perkin-Elmer	27.0	25.2	5.0	12.0	.0	
SVG Lithography	.0	.0	.0	.0	36.0	
Ultratech	38.9	40.6	73.0	62.3	38.4	
Total Worldwide	363.1	503.1	921.0	1,182.5	1,066.8	30.9

Ref: STEPSHR

Source: Dataquest (April 1991)

Table 4.5
Worldwide Stepper Market Share
By Region
(Units)

Company: All
Product: Steppers
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Stepper Market	456	520	833	954	775	14.2
North America						
ASET	14	11	14	4	0	
ASM Lithography	7	16	30	57	33	
Canon	22	28	25	25	30	
Eaton	3	0	0	0	0	
GCA	72	41	62	40	44	
Hitachi	0	0	0	0	5	
Nikon	20	50	65	80	56	
Perkin-Elmer	24	20	5	3	0	
SVG Lithography	0	0	0	0	9	
Ultratech	44	37	41	45	21	
Total North America	206	203	242	254	198	-1.0
Japan						
ASET	0	0	0	0	0	
ASM Lithography	0	0	0	0	0	
Canon	20	20	45	60	70	
Eaton	0	0	0	0	0	
GCA	10	4	3	0	0	
Hitachi	9	30	40	70	78	
Nikon	110	148	310	325	255	
Perkin-Elmer	0	0	0	0	0	
SVG Lithography	0	0	0	0	0	
Ultratech	3	0	3	2	7	
Total Japan	152	202	401	457	410	28.2

(Continued)

Table 4.5 (Continued)
Worldwide Stepper Market Share
By Region
(Units)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Europe						
ASET	0	1	0	0	0	
ASM Lithography	4	14	13	16	15	
Canon	17	20	20	30	30	
Eaton	0	0	0	0	0	
GCA	26	7	14	12	4	
Hitachi	0	0	0	0	0	
Nikon	5	7	20	18	40	
Perkin-Elmer	0	3	0	0	0	
SVG Lithography	0	0	0	0	0	
Ultratech	12	9	14	10	5	
Total Europe	64	61	81	86	94	10.1
Asia/Pacific-ROW						
ASET	0	0	2	0	0	
ASM Lithography	0	0	2	12	10	
Canon	6	25	35	45	20	
Eaton	0	0	0	0	0	
GCA	3	0	1	0	4	
Hitachi	0	0	0	0	0	
Nikon	15	20	55	90	33	
Perkin-Elmer	4	5	0	0	0	
SVG Lithography	0	0	0	0	0	
Ultratech	6	4	14	10	6	
Total Asia/Pacific-ROW	34	54	109	157	73	21.0
Worldwide						
ASET	14	12	16	4	0	
ASM Lithography	11	30	45	85	58	
Canon	65	93	125	160	150	
Eaton	3	0	0	0	0	
GCA	111	52	80	52	52	
Hitachi	9	30	40	70	83	
Perkin-Elmer	28	28	5	3	0	
Nikon	150	225	450	513	384	
SVG Lithography	0	0	0	0	9	
Ultratech	65	50	72	67	39	
Total Worldwide	456	520	833	954	775	14.2

Ref: STEPUNIT

Source: Dataquest (April 1991)

Table 4.6
Worldwide Direct-Write Lithography Market Share
By Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Direct-Write Lithography
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Direct-Write Market	68.1	67.1	68.7	70.1	70.7	.9
North America						
ASM Lithography	4.0	4.0	2.4	.0	.0	
Ateq	.0	.0	.0	.0	.0	
Cambridge Instruments	10.0	4.0	2.0	4.0	.0	
Etec	.0	.0	.0	.0	.0	
Hitachi	.0	.0	.0	.0	.0	
JEOL	10.0	6.0	6.0	6.0	8.3	
Leica	.0	.0	.0	.0	3.7	
Perkin-Elmer	6.4	3.2	3.2	.0	.0	
Total North America	30.4	17.2	13.6	10.0	12.0	-20.7
Japan						
ASM Lithography	.0	.0	.0	.0	.0	
Ateq	.0	.0	.0	.0	2.0	
Cambridge Instruments	.0	.0	.0	.0	.0	
Etec	.0	.0	.0	.0	.0	
Hitachi	11.2	8.7	9.6	9.4	8.3	
Leica	.0	.0	.0	.0	.0	
JEOL	18.0	20.8	23.1	21.6	18.8	
Perkin-Elmer	.0	3.2	3.2	3.5	.0	
Total Japan	29.2	32.7	35.9	34.5	29.1	-.1
Europe						
ASM Lithography	2.0	4.0	4.8	7.2	.0	
Ateq	.0	.0	.0	.0	.0	
Cambridge Instruments	4.5	4.0	4.0	6.0	.0	
Etec	.0	.0	.0	.0	6.0	
Hitachi	.0	.0	.0	.0	.0	
JEOL	2.0	4.0	2.0	4.0	8.3	
Leica	.0	.0	.0	.0	9.0	
Perkin-Elmer	.0	3.2	6.4	3.2	.0	
Total Europe	8.5	15.2	17.2	20.4	23.3	28.7

(Continued)

Table 4.6 (Continued)
Worldwide Direct-Write Lithography Market Share
By Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Asia/Pacific-ROW						
ASM Lithography	.0	.0	.0	.0	.0	
Ateq	.0	.0	.0	.0	.0	
Cambridge Instruments	.0	2.0	2.0	2.0	.0	
Etec	.0	.0	.0	.0	3.8	
Hitachi	.0	.0	.0	.0	.0	
JEOL	.0	.0	.0	.0	.0	
Leica	.0	.0	.0	.0	2.5	
Perkin-Elmer	.0	.0	.0	3.2	.0	
Total Asia/Pacific-ROW	.0	2.0	2.0	5.2	6.3	NM
Worldwide						
ASM Lithography	6.0	8.0	7.2	7.2	.0	
Ateq	.0	.0	.0	.0	2.0	
Cambridge Instruments	14.5	10.0	8.0	12.0	.0	
Etec	.0	.0	.0	.0	9.8	
Hitachi	11.2	8.7	9.6	9.4	8.3	
JEOL	30.0	30.8	31.1	31.6	35.4	
Leica	.0	.0	.0	.0	15.2	
Perkin-Elmer	6.4	9.6	12.8	9.9	.0	
Total Worldwide	68.1	67.1	68.7	70.1	70.7	.9

NM = Not Meaningful
Ref: DWLTHSHR

Source: Dataquest (April 1991)

Table 4.7
Worldwide Maskmaking Lithography Market Share
By Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Maskmaking Lithography
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Maskmaking Market	50.7	67.6	62.1	69.2	50.4	-.1
North America						
ASM Lithography	.0	.0	2.4	2.4	.0	
Ateq	.0	1.6	1.6	4.0	8.8	
Cambridge Instruments	.0	.0	.0	.0	.0	
Etec Systems	.0	.0	.0	.0	3.0	
Hitachi	.0	.0	.0	.0	.0	
JEOL	.0	.0	.0	.0	.0	
Leica	.0	.0	.0	.0	.0	
Perkin-Elmer	27.0	12.0	12.0	9.0	.0	
Toshiba	.0	.0	.0	.0	.0	
Total North America	27.0	13.6	16.0	15.4	11.8	-18.7
Japan						
ASM Lithography	.0	.0	.0	.0	.0	
Ateq	.0	.0	8.0	7.5	1.5	
Cambridge Instruments	.0	.0	.0	.0	.0	
Etec Systems	.0	.0	.0	.0	12.0	
Hitachi	.0	10.4	3.8	6.6	6.2	
JEOL	11.7	18.1	5.0	15.8	10.4	
Leica	.0	.0	.0	.0	.0	
Perkin-Elmer	9.0	6.0	3.0	3.0	.0	
Toshiba	3.0	3.5	7.7	7.2	.0	
Total Japan	23.7	38.0	27.5	40.1	30.1	6.2
Europe						
ASM Lithography	.0	4.0	.0	.0	.0	
Ateq	.0	.0	1.6	2.2	.0	
Cambridge Instruments	.0	.0	.0	.0	.0	
Etec Systems	.0	.0	.0	.0	3.0	
Hitachi	.0	3.0	.0	.0	.0	
JEOL	.0	.0	.0	.0	.0	
Leica	.0	.0	.0	.0	.0	
Perkin-Elmer	.0	6.0	6.0	6.0	.0	
Toshiba	.0	.0	.0	.0	.0	
Total Europe	.0	13.0	7.6	8.2	3.0	NM

(Continued)

Table 4.7 (Continued)
Worldwide Maskmaking Lithography Market Share
By Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Asia/Pacific-ROW						
ASM Lithography	.0	.0	.0	.0	.0	
Ateq	.0	.0	.0	.0	.0	
Cambridge Instruments	.0	.0	5.0	2.5	.0	
Etec Systems	.0	.0	.0	.0	3.0	
Hitachi	.0	.0	.0	.0	.0	
JEOL	.0	.0	.0	.0	.0	
Leica	.0	.0	.0	.0	2.5	
Perkin-Elmer	.0	3.0	6.0	3.0	.0	
Toshiba	.0	.0	.0	.0	.0	
Total Asia/Pacific-ROW	.0	3.0	11.0	5.5	5.5	NM
Worldwide						
ASM Lithography	.0	4.0	2.4	2.4	.0	
Ateq	.0	1.6	11.2	13.7	10.3	
Cambridge Instruments	.0	.0	5.0	2.5	.0	
Etec Systems	.0	.0	.0	.0	21.0	
Hitachi	.0	13.4	3.8	6.6	6.2	
JEOL	11.7	18.1	5.0	15.8	10.4	
Leica	.0	.0	.0	.0	2.5	
Perkin-Elmer	36.0	27.0	27.0	21.0	.0	
Toshiba	3.0	3.5	7.7	7.2	.0	
Total Worldwide	50.7	67.6	62.1	69.2	50.4	-.1

NM = Not Meaningful
Ref: MMLITHSHR

Source: Dataquest (April 1991)

Table 4.8
Worldwide Direct-Write and Maskmaking Lithography Market Share
By Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Direct-Write and Maskmaking Lithography
Region of Consumption: All

World Direct-Write and Maskmaking Lithography Market	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Lithography Market	118.8	134.7	130.8	139.3	121.1	.5
North America						
ASM Lithography	4.0	4.0	4.8	2.4	.0	
Ateq	.0	1.6	1.6	4.0	8.8	
Cambridge Instruments	10.0	4.0	2.0	4.0	.0	
Etec	.0	.0	.0	.0	3.0	
Hitachi	.0	.0	.0	.0	.0	
JEOL	10.0	6.0	6.0	6.0	8.3	
Leica	.0	.0	.0	.0	3.7	
Perkin-Elmer	33.4	15.2	15.2	9.0	.0	
Toshiba	.0	.0	.0	.0	.0	
Total North America	57.4	30.8	29.6	25.4	23.8	-19.8
Japan						
ASM Lithography	.0	.0	.0	.0	.0	
Ateq	.0	.0	8.0	7.5	3.5	
Cambridge Instruments	.0	.0	.0	.0	.0	
Etec	.0	.0	.0	.0	12.0	
Hitachi	11.2	19.1	13.4	16.0	14.5	
JEOL	29.7	38.9	28.1	37.4	29.2	
Leica	.0	.0	.0	.0	.0	
Perkin-Elmer	9.0	9.2	6.2	6.5	.0	
Toshiba	3.0	3.5	7.7	7.2	.0	
Total Japan	52.9	70.7	63.4	74.6	59.2	2.9

(Continued)

Table 4.8 (Continued)
Worldwide Direct-Write and Maskmaking Lithography Market Share
By Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Europe						
ASM Lithography	2.0	8.0	4.8	7.2	.0	
Ateq	.0	.0	1.6	2.2	.0	
Cambridge Instruments	4.5	4.0	4.0	6.0	.0	
Etec	.0	.0	.0	.0	9.0	
Hitachi	.0	3.0	.0	.0	.0	
JEOL	2.0	4.0	2.0	4.0	8.3	
Leica	.0	.0	.0	.0	9.0	
Perkin-Elmer	.0	9.2	12.4	9.2	.0	
Toshiba	.0	.0	.0	.0	.0	
Total Europe	8.5	28.2	24.8	28.6	26.3	32.6
Asia/Pacific-ROW						
ASM Lithography	.0	.0	.0	.0	.0	
Ateq	.0	.0	.0	.0	.0	
Cambridge Instruments	.0	2.0	7.0	4.5	.0	
Etec	.0	.0	.0	.0	6.8	
Hitachi	.0	.0	.0	.0	.0	
JEOL	.0	.0	.0	.0	.0	
Leica	.0	.0	.0	.0	5.0	
Perkin-Elmer	.0	3.0	6.0	6.2	.0	
Toshiba	.0	.0	.0	.0	.0	
Total Asia/Pacific-ROW	.0	5.0	13.0	10.7	11.8	NM
Worldwide						
ASM Lithography	6.0	12.0	9.6	9.6	.0	
Ateq	.0	1.6	11.2	13.7	12.3	
Cambridge Instruments	14.5	10.0	13.0	14.5	.0	
Etec	.0	.0	.0	.0	30.8	
Hitachi	11.2	22.1	13.4	16.0	14.5	
JEOL	41.7	48.9	36.1	47.4	45.8	
Leica	.0	.0	.0	.0	17.7	
Perkin-Elmer	42.4	36.6	39.8	30.9	.0	
Toshiba	3.0	3.5	7.7	7.2	.0	
Total Worldwide	118.8	134.7	130.8	139.3	121.1	.5

NM = Not Meaningful
Ref: DWMMSHR

Source: Dataquest (April 1991)

Table 4.9
Worldwide X-Ray Aligner Market Share
By Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: X-Ray Aligner
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World X-Ray Market	.8	.0	6.4	4.8	1.6	18.9
North America						
Hampshire Instruments	.0	.0	1.8	.0	.0	
Micronix	.0	.0	.0	.0	.0	
Perkin-Elmer	.0	.0	.0	2.0	.0	
Karl Suss	.0	.0	1.6	.0	.0	
Total North America	.0	.0	3.4	2.0	.0	NM
Japan						
Hampshire Instruments	.0	.0	.0	.0	.0	
Micronix	.8	.0	.0	.0	.0	
Perkin-Elmer	.0	.0	.0	.0	.0	
Karl Suss	.0	.0	1.6	.0	.0	
Total Japan	.8	.0	1.6	.0	.0	NM
Europe						
Hampshire Instruments	.0	.0	.0	.0	.0	
Micronix	.0	.0	.0	.0	.0	
Perkin-Elmer	.0	.0	.0	.0	.0	
Kark Suss	.0	.0	1.4	2.8	1.6	
Total Europe	.0	.0	1.4	2.8	1.6	NM
Asia/Pacific-ROW						
Hampshire Instruments	.0	.0	.0	.0	.0	
Micronix	.0	.0	.0	.0	.0	
Perkin-Elmer	.0	.0	.0	.0	.0	
Karl Suss	.0	.0	.0	.0	.0	
Total Asia/Pacific-ROW	.0	.0	.0	.0	.0	NM

(Continued)

Table 4.9 (Continued)
Worldwide X-Ray Aligner Market Share
By Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Worldwide						
Hampshire Instruments	.0	.0	1.8	.0	.0	
Micronix	.8	.0	.0	.0	.0	
Perkin-Elmer	.0	.0	.0	2.0	.0	
Karl Suss	.0	.0	4.6	2.8	1.6	
Total Worldwide	.8	.0	6.4	4.8	1.6	18.9

NM = Not Meaningful
Ref: XRAYSHR

Source: Dataquest (April 1991)

Table 4.10
Worldwide Automatic Photoresist Processing Equipment (Track) Market Share
By Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Track
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Track Market	148.8	167.7	253.4	333.6	338.2	22.8
North America						
Canon	.0	.0	.0	.0	1.1	
Convac	2.0	4.0	5.9	6.4	6.3	
Dainippon Screen	.2	.5	3.1	5.7	6.2	
Eaton	5.0	3.7	1.1	1.0	1.5	
FSI International	.0	.0	.0	.0	.0	
GCA	6.5	2.8	2.2	.0	.0	
Machine Technology	11.3	10.1	7.9	10.0	17.5	
Semiconductor Systems	7.9	9.6	19.8	18.7	20.0	
Silicon Valley Group	15.5	20.8	25.4	27.0	29.7	
Solitec	6.3	5.3	5.6	7.0	5.0	
Tazmo	.5	2.0	2.0	1.7	1.4	
Tokyo Electron Ltd	.9	2.1	5.0	.0	.0	
Varian/TEL	.0	.0	.0	13.6	6.9	
Veeco	2.9	.0	.0	.0	.0	
Yuasa	.0	.0	.0	.0	.0	
Total North America	59.0	60.9	78.0	91.1	95.6	28% 12.8
Japan						
Canon	.2	.7	3.8	10.1	6.2	
Convac	.0	.0	.0	.0	.0	
Dainippon Screen	27.4	27.8	31.7	51.8	48.1	
Eaton	.0	.0	.0	.0	.0	
FSI International	.0	.0	.0	.0	.0	
GCA	.8	.3	.2	.0	.0	
Machine Technology	.1	.3	.5	.5	.0	
Semiconductor Systems	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.0	.5	.5	
Solitec	.0	.0	.0	.0	.0	
Tazmo	1.6	2.1	2.9	6.8	15.0	
Tokyo Electron Ltd	21.4	30.6	68.5	77.7	95.5	
Varian/TEL	.0	.0	.0	.0	.0	
Veeco	.0	.0	.0	.0	.0	
Yuasa	3.0	3.6	6.0	8.8	5.8	
Total Japan	54.5	65.4	113.6	156.2	171.1	57% 33.1

(Continued)

Table 4.10 (Continued)
Worldwide Automatic Photoresist Processing Equipment (Track) Market Share By Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Europe						
Canon	.3	.3	.0	.0	.0	
Convac	4.4	6.9	7.9	5.8	7.1	
Dainippon Screen	1.2	1.9	2.7	5.1	2.1	
Eaton	6.0	5.2	6.6	6.3	6.8	
FSI International	.0	.0	.0	.0	.0	
GCA	4.0	3.2	2.5	.0	.0	
Machine Technology	1.3	1.0	1.3	.6	3.5	
Semiconductor Systems	.9	1.2	2.2	3.3	3.0	
Silicon Valley Group	7.0	6.9	6.4	10.8	11.0	
Solitec	.2	.1	.4	.5	.4	
Tazmo	.3	.3	.3	.4	.0	
Tokyo Electron Ltd	1.5	1.5	6.2	.0	.0	
Varian/TEL	.0	.0	.0	5.8	6.9	
Veeco	.0	.0	.0	.0	.0	
Yuasa	.0	.0	.0	.0	.0	
Total Europe	27.1	28.5	36.5	38.6	40.8	12% 10.8
Asia/Pacific-ROW						
Canon	.0	.0	.0	.0	1.1	
Convac	.0	.0	.0	.0	.0	
Dainippon Screen	1.0	1.0	2.7	5.1	2.8	
Eaton	1.0	1.6	3.3	3.2	2.2	
FSI International	.0	.0	.0	.0	.0	
GCA	1.0	.7	.6	.0	.0	
Machine Technology	.2	1.3	.3	.2	.0	
Semiconductor Systems	.0	.0	.0	.0	.0	
Silicon Valley Group	3.1	5.3	5.6	15.7	13.8	
Solitec	.0	.8	1.5	1.5	.4	
Tazmo	.1	.2	.5	.4	.0	
Tokyo Electron Ltd	1.8	2.0	10.8	21.6	10.4	
Varian/TEL	.0	.0	.0	.0	.0	
Veeco	.0	.0	.0	.0	.0	
Yuasa	.0	.0	.0	.0	.0	
Total Asia/Pacific-ROW	8.2	12.9	25.3	47.7	30.7	9% 39.1

(Continued)

Table 4.10 (Continued)
Worldwide Automatic Photoresist Processing Equipment (Track) Market Share
By Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990	
Worldwide							
Canon	.5	1.0	3.8	10.1	8.4		62
Convac	6.4	10.9	13.8	12.2	13.4		
Dainippon Screen	29.8	31.2	40.2	67.7	59.2		41 /
Eaton	12.0	10.5	11.0	10.5	10.5		
FSI International	.0	.0	.0	.0	.0		
GCA	12.3	7.0	5.5	.0	.0		
Machine Technology	12.9	12.7	10.0	11.3	21.0		
Semiconductor Systems	8.8	10.8	22.0	22.0	23.0		
Silicon Valley Group	25.6	33.0	37.4	54.0	55.0		
Solitec	6.5	6.2	7.5	9.0	5.8		
Tazmo	2.5	4.6	5.7	9.3	16.4		15
Tokyo Electron Ltd	25.6	36.2	90.5	99.3	105.9		95.5
Varian/TEL	.0	.0	.0	19.4	13.8		13.8
Veeco	2.9	.0	.0	.0	.0		
Yuasa	3.0	3.6	6.0	8.8	5.8		5.8
Total Worldwide	148.8	167.7	253.4	333.6	338.2	22.8	

Ref: TRACKSHR

Source: Dataquest (April 1991)

170.6

209.5 38.9

European 4%
U.S. 34%
Japanese 62%

W/W
U.S. Track 115.3
N.A 73.7
Export

Table 4.11
Wet Process Market Share
North American Market
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Wet Process
Region of Consumption: North American Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Wet Process Market	160.7	167.2	276.9	354.6	350.3	21.5
Integrated Wet Systems						
Dainippon Screen	.0	.0	2.2	4.3	.0	
Dalton Corporation	.0	.0	.0	.0	.0	
Dan Science Co., Ltd.	.0	.0	.0	.0	.0	
Dexon	.0	.7	3.1	4.1	.5	
ETE Company, Ltd.	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	.0	
Fuji Electric	.0	.0	.0	.0	.0	
Integrated Air Systems	1.4	2.3	1.8	.0	.0	
Kaijo Denki	1.5	.6	3.1	3.0	.0	
Kuwano Electric	.0	.0	.9	2.1	2.0	
Maruwa	.0	.0	.0	.0	.0	
Musashi	.0	.0	.0	.0	.0	
Pokorny	.0	.0	.0	.0	.0	
Poly-Flow Engineering	.1	.1	.0	.0	.0	
Pure-Aire	1.0	1.5	1.7	2.5	1.0	
Sankyo Engineering	.5	1.2	.0	.0	.0	
Santa Clara Plastics	8.0	6.0	6.0	7.2	5.8	
Sci Manufacturing	.0	2.8	1.0	1.1	.4	
Semifab	1.0	2.6	5.0	6.2	3.5	
Shimada	.0	.0	.0	.0	.0	
Submicron Systems, Inc.	.0	.0	.0	2.0	10.0	
Sugai	.0	.0	.0	.0	.0	
S&K Products Internat.	1.0	1.5	2.0	4.2	1.0	
Tohokasei	.0	.0	.0	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.0	
Universal Plastics	.3	1.6	3.1	5.5	4.5	
Verteq	3.0	.8	1.8	.9	1.1	
Other Companies	.0	.0	.0	.0	.0	
Total Integr. Systems	17.8	21.7	31.7	43.1	29.8	13.7

(Continued)

Table 4.11 (Continued)
Wet Process Market Share
North American Market
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Manual Wet Benches						
Dainippon Screen	.0	.0	.4	.5	.0	
Dan Science Co., Ltd.	.0	.0	.0	.0	.0	
Dexon	1.8	2.1	2.3	1.6	.5	
Dalton Corporation	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	.0	
ETE Company, Ltd.	.0	.0	.0	.0	.0	
Integrated Air Systems	2.6	.7	.2	.0	.0	
Kaijo Denki	.0	.0	.0	.0	.0	
Kyoritsu	.0	.0	.0	.0	.0	
Maruwa	.0	.0	.0	.0	.0	
Musashi	.0	.0	.0	.0	.0	
Porkorny	.0	.0	.0	.0	.0	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Pure-Aire	.6	.6	.5	.2	.1	
Sankyo Engineering	.0	.0	.0	.7	.0	
Santa Clara Plastics	5.0	3.0	1.8	1.2	.6	
Sci Manufacturing	.0	1.7	.9	1.3	.0	
Semifab	4.7	4.3	1.2	.9	2.0	
Shimada	.0	.0	.0	.0	.0	
Sugai	.0	.0	.0	.0	.0	
Tohokasei	.0	.0	.0	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.0	
Universal Plastics	1.2	1.9	4.6	3.0	3.0	
Verteq	.1	.0	.4	.0	.0	
Other Companies	.0	.0	.0	.0	.0	
Total Man. Benches	16.0	14.3	12.3	9.4	6.2	-21.1
Rinsers/Dryers						
Dainippon Screen	.0	.0	.8	.7	.0	
Dan Science Co., Ltd.	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	.0	
Estek	.0	.8	.8	.0	.0	
FSI International	.8	.7	1.1	.7	1.1	
Kaijo Denki	.0	.0	.3	.2	.1	
Kuwano	.0	.0	.2	.0	.0	
Poly-Flow Engineering	.2	.2	.1	.2	.0	
Sankyo Engineering	.0	.0	.2	.1	.0	
Semitool	9.0	10.9	9.7	4.6	5.8	
Shimada	.0	.0	.0	.0	.0	
S&K Products Internat.	.4	.6	.9	2.2	4.0	
Sugai	.0	.0	.0	.0	.0	
Tohokasei	.0	.0	.0	.0	.0	

(Continued)

Table 4.11 (Continued)
Wet Process Market Share
North American Market
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Verteq	3.0	2.7	4.0	4.1	3.9	
Other Companies	.0	.0	.0	.0	.0	
Total Rinser/Dryers	13.4	15.9	18.1	12.8	14.9	2.7
Acid Processors						
Advantage Production Technology	.0	.0	.0	.0	.0	
Alameda Instruments	.0	.0	.0	.0	1.2	
Athens	.0	1.0	4.0	2.0	4.0	
CFM Technology	.0	.0	1.0	.3	2.1	
FSI International	10.9	7.5	8.8	10.7	7.4	
Poly-Flow Engineering	.1	.1	.0	.0	.1	
Semitool	2.7	2.2	2.9	1.3	1.6	
Total Acid Process.	13.7	10.8	16.7	14.3	16.4	4.6
Megasonic Cleaners						
FSI International	1.2	1.2	1.3	.9	1.0	
Kaijo Denki	.0	.0	.0	.0	.0	
Verteq	1.2	1.7	3.2	3.9	3.5	
Total Megasonics	2.4	2.9	4.5	4.8	4.5	17.0
Total N.A. Wet Process	63.3	65.6	83.3	84.4	71.8	3.2

Ref: WETSHR

Source: Dataquest (April 1991)

Table 4.12
Wet Process Market Share
Japanese Market
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Wet Process
Region of Consumption: Japanese Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Wet Process Market	160.7	167.2	276.9	354.6	350.3	21.5
Integrated Wet Systems						
Dainippon Screen	18.0	18.7	25.7	28.9	41.3	
Dalton Corporation	.0	.0	.0	1.7	1.7	
Dan Science Co., Ltd.	.0	.0	.9	1.2	1.1	
Dexon	.0	.0	.0	.0	.0	
ETE Company, Ltd.	.0	.0	1.5	2.9	5.9	
Enya	7.8	4.9	5.4	6.5	5.6	
Fuji Electric	.0	.0	2.6	2.4	2.0	
Integrated Air Systems	.0	.0	.0	.0	.0	
Kaijo Denki	10.8	6.2	7.7	19.4	27.3	
Kuwano Electric	3.3	5.6	8.5	4.0	5.6	
Maruwa	.0	.0	1.8	4.0	5.9	
Musashi	.0	.0	.0	1.2	3.9	
Pokorny	.0	.0	.0	.0	.0	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Pure-Aire	.0	.0	.0	.0	.0	
Sankyo Engineering	4.8	3.1	5.3	25.1	25.1	
Santa Clara Plastics	.0	.0	.0	.0	.0	
Sci Manufacturing	.0	.0	.0	.0	.0	
Semifab	.0	.0	.0	.0	.0	
Shimada	.0	3.4	4.9	8.6	14.0	
Submicron Systems, Inc.	.0	.0	.0	.0	.0	
Sugai	2.2	2.8	15.0	24.4	28.0	
S&K Products Internat.	1.5	2.0	.0	.0	.0	
Tohokasei	.0	.0	1.8	2.0	3.4	
Toyoko Chemical	.0	.0	1.2	1.7	3.8	
Universal Plastics	.0	.0	.0	.0	.0	
Verteq	.0	.0	.0	.0	.0	
Other Companies	6.0	4.2	6.2	8.2	.0	
Total Integr. Systems	54.4	50.9	88.5	142.2	174.6	33.8

(Continued)

Table 4.12 (Continued)
Wet Process Market Share
Japanese Market
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Manual Wet Benches						
Dainippon Screen	1.6	1.8	2.7	1.1	.0	
Dan Science Co., Ltd.	.0	.0	1.5	2.2	2.8	
Dexon	.0	.0	.0	.0	.0	
Dalton Corporation	.0	.0	.0	.9	.9	
Enya	.8	.8	1.3	4.0	2.6	
ETE Company, Ltd.	.0	.0	.5	1.1	2.1	
Integrated Air Systems	.0	.0	.0	.0	.0	
Kaijo Denki	.7	.8	1.9	1.1	1.6	
Kyoritsu	.0	.0	2.7	2.5	3.1	
Maruwa	.0	.0	1.8	1.4	6.4	
Musashi	.0	.0	.5	.7	.9	
Porkorny	.0	.0	.0	.0	.0	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Pure-Aire	.0	.0	.0	.0	.0	
Sankyo Engineering	.8	.9	1.9	2.3	3.4	
Santa Clara Plastics	.0	.0	.0	.0	.0	
Sci Manufacturing	.0	.0	.0	.0	.0	
Semifab	.0	.0	.0	.0	.0	
Shimada	.3	.3	.4	.0	.0	
Sugai	.3	.3	.9	1.1	1.4	
Tohokasei	.0	.0	1.1	1.1	1.4	
Toyoko Chemical	.0	.0	1.2	1.1	1.3	
Universal Plastics	.0	.0	.0	.0	.0	
Verteq	.0	.0	.0	.0	.0	
Other Companies	2.1	2.4	3.7	4.5	.0	
Total Man. Benches	6.6	7.3	22.1	25.1	27.9	43.4
Rinsers/Dryers						
Dainippon Screen	1.0	1.2	13.1	14.4	8.4	
Dan Science Co., Ltd.	.0	.0	.5	.5	.7	
Enya	1.0	.5	.9	1.1	.0	
FSI International	.0	.0	.0	.0	.0	
Kaijo Denki	.5	.6	1.3	1.4	2.4	
Kuwano	.6	.7	.8	.0	.0	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Sankyo Engineering	.8	.6	1.2	1.8	1.5	
Semitool	.0	.0	.4	.4	.4	
Shimada	.3	.2	.2	.0	.0	
S&K Products Internat.	3.3	3.8	4.5	1.2	.0	
Sugai	1.2	1.4	1.9	.0	.0	

(Continued)

Table 4.12 (Continued)
Wet Process Market Share
Japanese Market
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Tohokasei	.0	.0	.4	.4	.5	
Other Companies	.5	.3	.5	.5	.0	
Total Rinser/Dryers	9.3	9.4	26.1	23.3	15.8	14.2
Acid Processors						
Advantage Production Technology	.0	.0	.0	.0	.0	
Athens	.0	.0	.0	.0	1.6	
FSI International	.9	1.2	1.3	1.1	.5	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Semitool	.0	.0	.3	.4	.2	
Total Acid Process.	.9	1.2	1.6	1.5	2.3	26.4
Megasonic Cleaners						
FSI International	.2	.2	.1	.1	.0	
Kaijo Denki	.0	.1	.1	.1	2.1	
Verteq	.0	.1	.3	.1	.1	
Total Megasonics	.2	.4	.5	.3	2.2	82.1
Total Japan Wet Process	71.4	69.2	138.8	192.4	222.8	32.9

Ref: WETSHR

Source: Dataquest (April 1991)

Table 4.13
Wet Process Market Share
European Market
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Wet Process
Region of Consumption: European Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Wet Process Market	160.7	167.2	276.9	354.6	350.3	21.5
Integrated Wet Systems						
Dainippon Screen	.0	.0	.0	.0	.7	
Dalton Corporation	.0	.0	.0	.0	.0	
Dan Science Co., Ltd.	.0	.0	.0	.0	.0	
Dexon	.0	.0	.0	.0	.0	
ETE Company, Ltd.	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	.0	
Fuji Electric	.0	.0	.0	.0	.0	
Integrated Air Systems	.0	.0	.0	.0	.0	
Kaijo Denki	.0	1.8	.0	.0	3.6	
Kuwano Electric	.0	.0	2.3	1.0	.0	
Maruwa	.0	.0	.0	.0	.0	
Musashi	.0	.0	.0	.0	.0	
Pokorny	1.2	2.3	2.5	4.7	1.2	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Pure-Aire	.0	.0	.0	.0	.0	
Sankyo Engineering	.0	1.2	3.1	2.2	7.0	
Santa Clara Plastics	3.0	3.0	3.0	4.2	1.4	
Sci Manufacturing	.0	.0	.0	.0	.0	
Semifab	.0	.0	.0	.0	.0	
Shimada	.0	.0	.0	.0	.0	
Submicron Systems, Inc.	.0	.0	.0	.0	.0	
Sugai	.0	.0	.0	.0	.0	
S&K Products Internat.	.0	.0	1.5	3.5	2.0	
Tohokasei	.0	.0	.0	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.0	
Universal Plastics	.0	.0	.0	.0	.0	
Verteq	.0	.0	.0	.0	.0	
Other Companies	.0	.0	.0	.0	.0	
Total Integr. Systems	4.2	8.3	12.4	15.6	15.9	39.5

(Continued)

Table 4.13 (Continued)
Wet Process Market Share
European Market
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Manual Wet Benches						
Dainippon Screen	.0	.0	.4	.5	.0	
Dan Science Co., Ltd.	.0	.0	.0	.0	.0	
Dexon	1.3	.3	.1	.4	.0	
Dalton Corporation	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	2.6	
ETE Company, Ltd.	.0	.0	.0	.0	.0	
Integrated Air Systems	.0	.0	.0	.0	.0	
Kaijo Denki	.0	.0	.0	.0	.0	
Kyoritsu	.0	.0	.0	.0	.0	
Maruwa	.0	.0	.0	.0	.0	
Musashi	.0	.0	.0	.0	.0	
Porkorny	1.9	2.0	2.2	3.5	1.0	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Pure-Aire	.0	.0	.0	.0	.0	
Sankyo Engineering	.0	.0	3.2	.0	.0	
Santa Clara Plastics	2.0	1.0	.8	.6	.1	
Sci Manufacturing	.0	.0	.0	.0	.0	
Semifab	.1	.1	.0	.0	.0	
Shimada	.0	.0	.0	.0	.0	
Sugai	.0	.0	.0	.0	.0	
Tohokasei	.0	.0	.0	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.0	
Universal Plastics	.1	.1	.0	.0	.0	
Verteq	.0	.0	.0	.0	.0	
Other Companies	.0	.0	.0	.0	.0	
Total Man. Benches	5.4	3.5	6.7	5.0	3.7	-9.0
Rinsers/Dryers						
Dainippon Screen	.0	.0	.8	.7	1.4	
Dan Science Co., Ltd.	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	.0	
FSI International	.4	.2	.4	.2	.3	
Kaijo Denki	.0	.0	.2	.0	.0	
Kuwano	.0	.0	.0	.0	.0	
Poly-Flow Engineering	.0	.0	.0	.1	.2	
Sankyo Engineering	.0	.0	.2	.2	.0	
Semitool	2.0	2.1	1.6	2.5	2.1	
Shimada	.0	.0	.0	.0	.0	
S&K Products Internat.	.7	.6	.5	.5	.5	

(Continued)

Table 4.13 (Continued)
Wet Process Market Share
European Market
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Sugai	.0	.0	.0	.0	.0	
Tohokasei	.0	.0	.0	.0	.0	
Other Companies	.0	.0	.0	.0	.0	
Total Rinser/Dryers	3.3	3.6	4.5	4.8	5.4	13.1
Acid Processors						
Advantage Production Technology	.0	.0	.0	.0	.0	
Athens	.0	.0	.0	.0	.0	
FSI International	5.8	5.1	4.2	7.4	3.3	
Poly-Flow Engineering	.0	.0	.1	4.1	.2	
Semitool	.5	.8	.4	1.5	1.1	
Total Acid Process.	6.3	5.9	4.7	13.0	4.6	-7.6
Megasonic Cleaners						
FSI International	.3	.5	.4	.2	.5	
Kaijo Denki	.0	.0	.0	.0	.0	
Verteq	.1	.3	.5	.8	.4	
Total Megasonics	.4	.8	.9	1.0	.9	22.5
Total Europe Wet Process	19.6	22.1	29.2	39.4	30.5	11.7

Ref: WETSHR

Source: Dataquest (April 1991)

Table 4.14
Wet Process Market Share
Asia/Pacific-ROW Market
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Wet Process
Region of Consumption: Asia/Pacific-ROW Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Wet Process Market	160.7	167.2	276.9	354.6	350.3	21.5
Integrated Wet Systems						
Dainippon Screen	.0	.0	2.2	8.6	1.4	
Dalton Corporation	.0	.0	.0	.0	.0	
Dan Science Co., Ltd.	.0	.0	.0	.0	.0	
Dexon	.0	.0	.0	.3	.0	
ETE Company, Ltd.	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	.0	
Fuji Electric	.0	.0	.0	8.3	.0	
Integrated Air Systems	.0	.0	.0	.0	.0	
Kaijo Denki	.0	.0	.0	.0	.0	
Kuwano Electric	.0	.0	.9	2.3	2.0	
Maruwa	.0	.0	.0	.0	.0	
Musashi	.0	.0	.0	.0	2.0	
Pokorny	.0	.0	.0	.0	.0	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Pure-Aire	.1	.2	.2	.1	.1	
Sankyo Engineering	.5	1.1	1.8	2.4	1.7	
Santa Clara Plastics	1.0	2.0	2.0	2.9	2.0	
Sci Manufacturing	.0	.0	.0	.0	.0	
Semifab	.0	.1	.0	.0	.0	
Shimada	.0	.0	.0	.0	2.4	
Submicron Systems, Inc.	.0	.0	.0	.0	.0	
Sugai	.0	.0	2.9	5.4	6.3	
S&K Products Internat.	.0	.0	.0	.0	.0	
Tohokasei	.0	.0	.0	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.0	
Universal Plastics	.0	.0	.0	.0	.0	
Verteq	.5	.0	.2	.2	.0	
Other Companies	.0	.0	.0	.0	.0	
Total Integr. Systems	2.1	3.4	10.2	30.5	17.9	70.9

(Continued)

Table 4.14 (Continued)
Wet Process Market Share
Asia/Pacific-ROW Market
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Manual Wet Benches						
Dainippon Screen	.0	.0	.4	.2	.0	
Dan Science Co., Ltd.	.0	.0	.0	.0	.0	
Dexon	.0	.0	.0	.0	.0	
Dalton Corporation	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	.0	
ETE Company, Ltd.	.0	.0	.0	.0	.0	
Integrated Air Systems	.0	.0	.0	.0	.0	
Kaijo Denki	.0	.0	.0	.0	.0	
Kyoritsu	.0	.0	.0	.0	.0	
Maruwa	.0	.0	.0	.0	.0	
Musashi	.0	.0	.0	.0	.0	
Porkorny	.0	.0	.0	.0	.0	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Pure-Aire	.1	.1	.4	.2	.1	
Sankyo Engineering	.0	.0	6.5	.0	.0	
Santa Clara Plastics	1.0	1.0	1.0	.5	.2	
Sci Manufacturing	.0	.0	.0	.0	.0	
Semifab	.6	.6	.8	.5	1.0	
Shimada	.0	.0	.0	.0	.0	
Sugai	.0	.0	.0	.0	.0	
Tohokasei	.0	.0	.0	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.0	
Universal Plastics	.0	.1	.8	.9	.5	
Verteq	.0	.2	.1	.0	.0	
Other Companies	.0	.0	.0	.0	.0	
Total Man. Benches	1.7	2.0	10.0	2.3	1.8	1.4
Rinsers/Dryers						
Dainippon Screen	.0	.0	.8	.7	.7	
Dan Science Co., Ltd.	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	.0	
FSI International	.1	.3	.3	.3	.2	
Kaijo Denki	.0	.0	.0	.0	.0	
Kuwano	.0	.0	.0	.0	.0	
Poly-Flow Engineering	.1	.1	.0	.0	.0	
Sankyo Engineering	.0	.0	.4	.3	.0	
Semitool	1.6	2.5	.1	.2	.3	
Shimada	.0	.0	.0	.0	.0	
S&K Products Internat.	.0	.0	.0	.0	.5	

(Continued)

Table 4.14 (Continued)
Wet Process Market Share
Asia/Pacific-ROW Market
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Sugai	.0	.0	.0	.0	.0	
Tohokasei	.0	.0	.0	.0	.0	
Other Companies	.0	.0	.0	.0	.0	
Total Rinser/Dryers	1.9	3.1	2.0	1.8	2.0	1.3
Acid Processors						
Advantage Production Technology	.0	.0	.0	.0	.0	
Athens	.0	.0	.0	.0	.8	
FSI International	.5	1.2	2.9	3.3	1.5	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Semitool	.1	.3	.0	.0	.0	
Total Acid Process.	.6	1.5	2.9	3.3	2.3	39.9
Megasonic Cleaners						
FSI International	.1	.2	.5	.3	.4	
Kaijo Denki	.0	.0	.0	.0	.0	
Verteq	.0	.1	.0	.2	.8	
Total Megasonics	.1	.3	.5	.5	1.2	86.1
Total A/P-ROW Wet Process	6.4	10.3	25.6	38.4	25.2	40.9

Ref: WETSHR

Source: Dataquest (April 1991)

Table 4.15
Wet Process Market Share
Worldwide Market
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Wet Process
Region of Consumption: Worldwide Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Wet Process Market	160.7	167.2	276.9	354.6	350.3	21.5
Integrated Wet Systems						
Dainippon Screen	18.0	18.7	30.1	41.8	43.4	
Dalton Corporation	.0	.0	.0	1.7	1.7	
Dan Science Co., Ltd.	.0	.0	.9	1.2	1.1	
Dexon	.0	.7	3.1	4.4	.5	
ETE Company, Ltd.	.0	.0	1.5	2.9	5.9	
Enya	7.8	4.9	5.4	6.5	5.6	
Fuji Electric	.0	.0	2.6	10.7	2.0	
Integrated Air Systems	1.4	2.3	1.8	.0	.0	
Kaijo Denki	12.3	8.6	10.8	22.4	30.9	
Kuwano Electric	3.3	5.6	12.6	9.4	9.6	
Maruwa	.0	.0	1.8	4.0	5.9	
Musashi	.0	.0	.0	1.2	5.9	
Pokorny	1.2	2.3	2.5	4.7	1.2	
Poly-Flow Engineering	.1	.1	.0	.0	.0	
Pure-Aire	1.1	1.7	1.9	2.6	1.1	
Sankyo Engineering	5.8	6.6	10.2	29.7	33.8	
Santa Clara Plastics	12.0	11.0	11.0	14.3	9.2	
Sci Manufacturing	.0	2.8	1.0	1.1	.4	
Semifab	1.0	2.7	5.0	6.2	3.5	
Shimada	.0	3.4	4.9	8.6	16.4	
Submicron Systems, Inc.	.0	.0	.0	2.0	10.0	
Sugai	2.2	2.8	17.9	29.8	34.3	
S&K Products Internat.	2.5	3.5	3.5	7.7	3.0	
Tohokasei	.0	.0	1.8	2.0	3.4	
Toyoko Chemical	.0	.0	1.2	1.7	3.8	
Universal Plastics	.3	1.6	3.1	5.5	4.5	
Verteq	3.5	.8	2.0	1.1	1.1	
Other Companies	6.0	4.2	6.2	8.2	.0	
Total Integr. Systems	78.5	84.3	142.8	231.4	238.2	32.0

(Continued)

Table 4.15 (Continued)
Wet Process Market Share
Worldwide Market
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Manual Wet Benches						
Dainippon Screen	1.6	1.8	3.9	2.3	.0	
Dan Science Co., Ltd.	.0	.0	1.5	2.2	2.8	
Dexon	3.1	2.4	2.4	2.0	.5	
Dalton Corporation	.0	.0	.0	.9	.9	
Enya	.8	.8	1.3	4.0	5.2	
ETE Company, Ltd.	.0	.0	.5	1.1	2.1	
Integrated Air Systems	2.6	.7	.2	.0	.0	
Kaijo Denki	.7	.8	1.9	1.1	1.6	
Kyoritsu	.0	.0	2.7	2.5	3.1	
Maruwa	.0	.0	1.8	1.4	6.4	
Musashi	.0	.0	.5	.7	.9	
Porkorny	1.9	2.0	2.2	3.5	1.0	
Poly-Flow Engineering	.0	.0	.0	.0	.0	
Pure-Aire	.7	.7	.9	.4	.2	
Sankyo Engineering	.8	.9	11.6	3.0	3.4	
Santa Clara Plastics	8.0	5.0	3.6	2.3	.9	
Sci Manufacturing	.0	1.7	.9	1.3	.0	
Semifab	5.4	5.0	2.0	1.4	3.0	
Shimada	.3	.3	.4	.0	.0	
Sugai	.3	.3	.9	1.1	1.4	
Tohokasei	.0	.0	1.1	1.1	1.4	
Toyoko Chemical	.0	.0	1.2	1.1	1.3	
Universal Plastics	1.3	2.1	5.4	3.9	3.5	
Verteq	.1	.2	.5	.0	.0	
Other Companies	2.1	2.4	3.7	4.5	.0	
Total Man. Benches	29.7	27.1	51.1	41.8	39.6	7.5

(Continued)

Table 4.15 (Continued)
Wet Process Market Share
Worldwide Market
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Rinsers/Dryers						
Dainippon Screen	1.0	1.2	15.5	16.5	10.5	
Dan Science Co., Ltd.	.0	.0	.5	.5	.7	
Enya	1.0	.5	.9	1.1	.0	
FSI International	1.3	1.2	1.8	1.2	1.6	
Kaijo Denki	.5	.6	1.8	1.6	2.5	
Kuwano	.6	.7	1.0	.0	.0	
Poly-Flow Engineering	.3	.3	.1	.3	.2	
Sankyo Engineering	.8	.6	2.0	2.4	1.5	
Semitool	12.6	15.5	11.8	7.7	8.6	
Shimada	.3	.2	.2	.0	.0	
S&K Products Internat.	4.4	5.0	5.9	3.9	5.0	
Sugai	1.2	1.4	1.9	.0	.0	
Tohokasei	.0	.0	.4	.4	.5	
Other Companies	.5	.3	.5	.5	.0	
Total Rinser/Dryers	27.9	32.0	50.7	42.7	38.1	8.1
Acid Processors						
Advantage Production Technology	.0	.0	.0	.0	.0	
Athens	.0	1.0	4.0	2.0	6.4	
FSI International	18.1	15.0	17.2	22.5	12.7	
Poly-Flow Engineering	.1	.1	.1	4.1	.3	
Semitool	3.3	3.3	3.6	3.2	2.9	
Total Acid Process.	21.5	19.4	25.9	32.1	25.6	4.5
Megasonic Cleaners						
FSI International	1.8	2.1	2.3	1.5	1.9	
Kaijo Denki	.0	.1	.1	.1	2.1	
Verteq	1.3	2.2	4.0	5.0	4.8	
Total Megasonics	3.1	4.4	6.4	6.6	8.8	29.8
Total W.W. Wet Process	160.7	167.2	276.9	354.6	350.3	21.5

Ref: WETSHR

Source: Dataquest (April 1991)

Table 4.16
North American Dry Strip Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Dry Strip
Region of Consumption: North American Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Dry Strip Market	35.4	57.9	100.4	121.2	125.3	37.2
North America						
Alcan Tech	.0	.0	.0	.0	.0	
Bjorne Enterprises	.0	.0	.0	.0	.5	
Branson/IPC	5.0	3.8	8.0	6.4	6.0	
Chemitronics	.0	.0	.0	.0	.0	
Chlorine Engineering	.0	.0	.0	.0	.0	
Drytek	1.0	.8	.8	1.0	.0	
Fusion Semiconductor Systems	.0	.5	1.0	1.5	1.5	
Gasonics	.7	1.6	2.1	5.3	6.8	
Hitachi	.0	.0	.0	.0	.0	
LFE	1.0	1.0	.8	1.2	1.0	
Machine Technology	2.0	2.0	3.0	1.0	.0	
Matrix	2.1	4.5	4.7	5.5	6.0	
Mattson Technologies	.0	.0	.0	.0	.0	
Plasma Systems	.0	.0	.0	.0	1.1	
Plasma-Therm	.0	.0	.0	1.0	.0	
Ramco	.0	.0	.0	.0	.0	
Samco	.0	.0	.1	.1	.1	
Tegal	2.0	2.5	2.5	2.0	2.0	
Tokyo Ohka Kogyo	.0	.0	.0	2.0	1.9	
Ulvac	.0	.0	.0	.0	.0	
Total North America	13.8	16.7	23.0	27.0	26.9	18.2

Ref: DSTRPSHR

Source: Dataquest (April 1991)

Table 4.17
Japanese Dry Strip Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Dry Strip
Region of Consumption: Japanese Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Dry Strip Market	35.4	57.9	100.4	121.2	125.3	37.2
Japan						
Alcan Tech	.9	5.0	9.2	11.6	9.7	
Bjorne Enterprises	.0	.0	.0	.0	.0	
Branson/IPC	1.2	1.4	1.0	1.5	1.0	
Chemitronics	.0	.0	1.4	.0	.0	
Chlorine Engineering	.5	.6	.0	2.8	2.7	
Drytek	.0	.0	.0	.0	.0	
Fusion Semiconductor Systems	.0	.0	.0	.0	.0	
Gasonics	.0	.0	.0	.1	1.0	
Hitachi	.0	.0	4.6	5.0	2.7	
LFE	.0	.0	.0	.0	.0	
Machine Technology	.0	.7	1.5	.0	.0	
Matrix	.0	.2	.5	.5	1.0	
Mattson Technologies	.0	.0	.0	.0	.0	
Plasma Systems	3.3	4.3	10.4	15.0	21.0	
Plasma-Therm	.0	.0	.0	.0	.0	
Ramco	4.5	8.7	9.6	11.0	16.0	
Samco	.0	.0	.7	.9	.8	
Tegal	.0	.5	.5	.0	.0	
Tokyo Ohka Kogyo	5.2	8.7	19.9	22.0	20.5	
Ulvac	.0	3.6	4.9	5.5	4.2	
Total Japan	15.6	33.7	64.2	75.9	80.6	50.8

Ref: DSTRPSHR

Source: Dataquest (April 1991)

Table 4.18
European Dry Strip Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Dry Strip
Region of Consumption: European Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Dry Strip Market	35.4	57.9	100.4	121.2	125.3	37.2
Europe						
Alcan Tech	.0	.0	1.0	1.5	2.0	
Bjorne Enterprises	.0	.0	.0	.0	.0	
Branson/IPC	3.0	1.4	2.0	3.2	4.5	
Chemitronics	.0	.0	.0	.0	.0	
Chlorine Engineering	.0	.0	.0	.0	.0	
Drytek	.0	.0	.0	.0	.0	
Fusion Semiconductor Systems	.0	.0	.0	.0	.0	
Gasonics	.0	.4	.6	.1	.4	
Hitachi	.0	.0	.0	.0	.0	
LFE	.0	.0	.5	.1	.0	
Machine Technology	.0	.0	.0	.0	.2	
Matrix	.0	.1	.6	.5	1.5	
Mattson Technologies	.0	.0	.0	.0	.0	
Plasma Systems	.0	.0	.0	.0	.0	
Plasma-Therm	.0	.0	.0	.0	.0	
Ramco	.0	.0	.0	.0	.0	
Samco	.0	.0	.0	.0	.0	
Tegal	1.0	1.0	1.2	.5	.5	
Tokyo Ohka Kogyo	.0	.0	.0	1.0	1.0	
Ulvac	.0	.0	.0	.0	.0	
Total Europe	4.0	2.9	5.9	6.9	10.1	26.1

Ref: DSTRPSHR

Source: Dataquest (April 1991)

Table 4.19
Asia/Pacific-ROW Dry Strip Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Dry Strip
Region of Consumption: Asia/Pacific-ROW Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Dry Strip Market	35.4	57.9	100.4	121.2	125.3	37.2
Asia/Pacific-ROW						
Alcan Tech	.0	.0	.0	.0	.0	
Bjorne Enterprises	.0	.0	.0	.0	.0	
Branson/IPC	1.0	1.2	4.0	4.9	3.0	
Chemitronics	.0	.0	.0	.0	.0	
Chlorine Engineering	.0	.0	.0	.0	.0	
Drytek	1.0	.2	.4	.4	.0	
Fusion Semiconductor Systems	.0	.0	.0	.0	.0	
Gasonics	.0	.0	.3	.7	.0	
Hitachi	.0	.0	.0	.0	.0	
LFE	.0	.0	.2	.4	.4	
Machine Technology	.0	.0	.0	.5	.0	
Matrix	.0	.4	1.4	.5	.5	
Mattson Technologies	.0	.0	.0	.0	.0	
Plasma Systems	.0	1.1	.0	2.0	2.8	
Plasma-Therm	.0	.0	.0	.0	.0	
Ramco	.0	.0	.0	.0	.0	
Samco	.0	.0	.0	.0	.0	
Tegal	.0	1.2	1.0	1.0	.5	
Tokyo Ohka Kogyo	.0	.5	.0	1.0	.5	
Ulvac	.0	.0	.0	.0	.0	
Total A/P-ROW	2.0	4.6	7.3	11.4	7.7	40.1

Ref: DSTRPSHR

Source: Dataquest (April 1991)

Table 4.20
Worldwide Dry Strip Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Dry Strip
Region of Consumption: Worldwide Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Dry Strip Market	35.4	57.9	100.4	121.2	125.3	37.2
Worldwide						
Alcan Tech	.9	5.0	10.2	13.1	11.7	
Bjorne Enterprises	.0	.0	.0	.0	.5	
Branson/IPC	10.2	7.8	15.0	16.0	14.5	
Chemitronics	.0	.0	1.4	.0	.0	
Chlorine Engineering	.5	.6	.0	2.8	2.7	
Drytek	2.0	1.0	1.2	1.4	.0	
Fusion Semiconductor Systems	.0	.5	1.0	1.5	1.5	
Gasonics	.7	2.0	3.0	6.2	8.2	
Hitachi	.0	.0	4.6	5.0	2.7	
LFE	1.0	1.0	1.5	1.7	1.4	
Machine Technology	2.0	2.7	4.5	1.5	.2	
Matrix	2.1	5.2	7.2	7.0	9.0	
Mattson Technologies	.0	.0	.0	.0	.0	
Plasma Systems	3.3	5.4	10.4	17.0	24.9	
Plasma-Therm	.0	.0	.0	1.0	.0	
Ramco	4.5	8.7	9.6	11.0	16.0	
Samco	.0	.0	.8	1.0	.9	
Tegal	3.0	5.2	5.2	3.5	3.0	
Tokyo Ohka Kogyo	5.2	9.2	19.9	26.0	23.9	
Ulvac	.0	3.6	4.9	5.5	4.2	
Total Worldwide	35.4	57.9	100.4	121.2	125.3	37.2

Ref: DSTRPSHR

Source: Dataquest (April 1991)

Table 4.21
North American Dry Etch Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Dry Etch
Region of Consumption: North American Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Dry Etch Market	237.1	307.4	533.2	669.0	683.4	30.3
North America						
Alcan Technology	.0	.0	.0	.0	.0	
Anelva	.0	.0	.0	.0	.0	
Applied Materials	35.0	48.1	72.9	77.0	78.0	
Branson/IPC	.0	.0	.0	1.2	2.0	
Drytek	10.0	11.0	23.0	18.0	13.0	
Elionix	.0	.0	.0	.0	.0	
Ergo Plasma Systems	.0	.0	.0	.0	.0	
E.T. Electrotech	1.0	1.0	4.2	4.0	4.0	
GCA	1.2	3.0	4.0	.0	.0	
Hitachi	.0	.0	.0	.0	7.0	
Kokusai	.0	.0	.0	.0	.0	
Lam Research	16.0	20.0	29.0	44.0	48.7	
Materials Research	2.4	2.5	6.0	4.0	.0	
MRC (Sony)	.0	.0	.0	.0	.8	
Musashi	.0	.0	.0	.0	.0	
Perkin-Elmer	6.0	.0	.0	.0	.0	
Plasma Systems	.0	.0	.0	.0	.0	
Plasma Technology	.0	.0	.8	1.0	1.2	
Plasma-Therm	8.5	11.4	10.2	12.0	10.0	
Samco	.0	.0	.0	.0	.0	
Sumitomo Metals	.0	.0	.0	.0	.0	
Technics	.0	.0	.0	.0	.0	
Tegal	16.0	20.0	21.0	18.0	13.0	
Tokyo Electron	.0	.0	.0	.0	.0	
Tokuda	.0	1.1	.0	.7	.5	
Tokyo Ohka	.0	.0	.0	.0	1.5	
TEL/LAM	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian (Zylin)	4.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	6.2	4.7	
Total North America	100.1	118.1	171.1	186.1	184.4	16.5

Ref: DETCHSHR

Source: Dataquest (April 1991)

Table 4.22
Japanese Dry Etch Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Dry Etch
Region of Consumption: Japanese Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Dry Etch Market	237.1	307.4	533.2	669.0	683.4	30.3
Japan						
Alcan Technology	.0	.0	.0	.0	2.5	
Anelva	16.2	22.3	41.6	39.1	27.3	
Applied Materials	21.0	24.8	76.1	79.0	52.0	
Branson/IPC	1.2	.6	.0	.7	.0	
Drytek	.0	.0	.0	5.0	3.0	
Elionix	.2	.3	.3	.3	1.2	
Ergo Plasma Systems	.0	.0	.0	.0	.0	
E.T. Electrotech	.0	.0	1.5	1.5	2.5	
GCA	.0	.0	.0	.0	.0	
Hitachi	10.8	18.8	34.6	47.6	79.5	
Kokusai	3.3	1.4	1.5	1.0	1.1	
Lam Research	.0	.0	.0	.0	.0	
Materials Research	.8	1.0	5.0	2.2	.0	
MRC (Sony)	.0	.0	.0	.0	3.9	
Musashi	.0	.0	.0	.0	.0	
Perkin-Elmer	1.2	.0	.0	.0	.0	
Plasma Systems	1.7	1.9	3.2	3.3	1.7	
Plasma Technology	.0	.0	.0	.0	.0	
Plasma-Therm	1.5	1.2	1.2	1.6	5.0	
Samco	.0	.0	.0	2.2	2.8	
Sumitomo Metals	2.4	5.6	6.2	13.7	33.0	
Technics	.0	.0	.0	.0	.0	
Tegal	.6	.0	3.0	3.0	5.0	
Tokyo Electron	.0	.0	44.6	70.5	96.8	
Tokuda	4.3	5.0	3.2	28.3	22.3	
Tokyo Ohka	7.2	7.1	10.0	21.7	13.5	
TEL/LAM	6.0	17.4	.0	.0	.0	
Ulvac	3.9	5.6	8.1	8.7	6.6	
Varian (Zylin)	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.0	
Total Japan	82.3	113.0	240.1	329.4	359.7	44.6

Ref: DETCHSHR

Source: Dataquest (April 1991)

Table 4.23
European Dry Etch Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Dry Etch
Region of Consumption: European Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Dry Etch Market	237.1	307.4	533.2	669.0	683.4	30.3
Europe						
Alcan Technology	.0	.0	.0	.0	.0	
Anelva	.0	.0	.0	.0	.0	
Applied Materials	14.0	22.0	28.3	31.0	35.0	
Branson/IPC	2.0	.0	.0	.8	1.0	
Drytek	2.0	2.0	.0	3.0	4.0	
Elionix	.0	.0	.0	.0	.0	
Ergo Plasma Systems	.0	.0	.0	.0	.0	
E.T. Electrotech	4.0	6.2	7.7	8.0	10.0	
GCA	.8	1.0	1.0	.0	.0	
Hitachi	.0	.0	.0	.0	5.0	
Kokusai	.0	.0	.0	.0	.0	
Lam Research	5.0	7.0	13.0	11.0	17.0	
Materials Research	.9	.9	1.5	1.2	.0	
MRC (Sony)	.0	.0	.0	.0	.0	
Musashi	.0	.0	.0	.0	.0	
Perkin-Elmer	2.0	.0	.0	.0	.0	
Plasma Systems	.0	.0	.0	.0	.0	
Plasma Technology	.0	.0	.8	1.0	1.2	
Plasma-Therm	1.0	.8	1.2	1.2	2.0	
Samco	.0	.0	.0	.0	.0	
Sumitomo Metals	.0	.0	.0	.0	.0	
Technics	.0	.0	.0	.0	.0	
Tegal	8.0	15.6	19.4	16.0	11.0	
Tokyo Electron	.0	.0	.0	.0	.0	
Tokuda	.0	2.8	.0	1.3	.7	
Tokyo Ohka	.0	.0	.0	.0	1.5	
TEL/LAM	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian (Zylin)	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	6.9	
Total Europe	39.7	58.3	72.9	74.5	95.3	24.5

Ref: DETCHSER

Source: Dataquest (April 1991)

Table 4.24
Asia/Pacific-ROW Dry Etch Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Dry Etch
Region of Consumption: Asia/Pacific-ROW Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Dry Etch Market	237.1	307.4	533.2	669.0	683.4	30.3
Asia/Pacific-ROW						
Alcan Technology	.0	.0	.0	.0	.0	
Anelva	.0	.0	.0	9.4	2.1	
Applied Materials	4.0	7.1	19.4	21.0	10.0	
Branson/IPC	1.0	1.0	.0	.5	.5	
Drytek	4.0	4.0	2.0	4.0	2.0	
Elionix	.0	.0	.0	.0	.0	
Ergo Plasma Systems	.0	.0	.0	.0	.0	
E.T. Electrotech	.0	.0	.7	1.5	1.0	
GCA	.0	.0	.0	.0	.0	
Hitachi	.0	.0	.0	.0	.0	
Kokusai	.0	.0	.0	.0	.0	
Lam Research	5.0	5.0	23.0	26.0	20.0	
Materials Research	.0	.0	.5	.0	.0	
MRC (Sony)	.0	.0	.0	.0	.0	
Musashi	.0	.0	.0	.0	.0	
Perkin-Elmer	.0	.0	.0	.0	.0	
Plasma Systems	.0	.0	.0	.0	.0	
Plasma Technology	.0	.0	.0	.0	.0	
Plasma-Therm	.0	.3	.3	.4	1.0	
Samco	.0	.0	.0	.0	.0	
Sumitomo Metals	.0	.0	.0	.0	.0	
Technics	.0	.0	.0	.0	.0	
Tegal	1.0	.0	3.0	4.0	2.0	
Tokyo Electron	.0	.0	.0	10.1	2.4	
Tokuda	.0	.5	.0	2.1	.6	
Tokyo Ohka	.0	.0	.0	.0	2.4	
TEL/LAM	.0	.0	.0	.0	.0	
Ulvac	.0	.1	.2	.0	.0	
Varian (Zylin)	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.0	
Total A/P-ROW	15.0	18.0	49.1	79.0	44.0	30.9

Ref: DETCHSHR

Source: Dataquest (April 1991)

Table 4.25
Worldwide Dry Etch Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Dry Etch
Region of Consumption: Worldwide Market

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Dry Etch Market	237.1	307.4	533.2	669.0	683.4	30.3
Worldwide						
Alcan Technology	.0	.0	.0	.0	2.5	
Anelva	16.2	22.3	41.6	48.5	29.4	
Applied Materials	74.0	102.0	196.7	208.0	175.0	
Branson/IPC	4.2	1.6	.0	3.2	3.5	
Drytek	16.0	17.0	25.0	30.0	22.0	
Elionix	.2	.3	.3	.3	1.2	
Ergo Plasma Systems	.0	.0	.0	.0	.0	
E.T. Electrotech	5.0	7.2	14.1	15.0	17.5	
GCA	2.0	4.0	5.0	.0	.0	
Hitachi	10.8	18.8	34.6	47.6	91.5	
Kokusai	3.3	1.4	1.5	1.0	1.1	
Lam Research	26.0	32.0	65.0	81.0	85.7	
Materials Research	4.1	4.4	13.0	7.4	.0	
MRC (Sony)	.0	.0	.0	.0	4.7	
Musashi	.0	.0	.0	.0	.0	
Perkin-Elmer	9.2	.0	.0	.0	.0	
Plasma Systems	1.7	1.9	3.2	3.3	1.7	
Plasma Technology	.0	.0	1.6	2.0	2.4	
Plasma-Therm	11.0	13.7	12.9	15.2	18.0	
Samco	.0	.0	.0	2.2	2.8	
Sumitomo Metals	2.4	5.6	6.2	13.7	33.0	
Technics	.0	.0	.0	.0	.0	
Tegal	25.6	35.6	46.4	41.0	31.0	
Tokyo Electron	.0	.0	44.6	80.6	99.2	
Tokuda	4.3	9.4	3.2	32.4	24.1	
Tokyo Ohka	7.2	7.1	10.0	21.7	18.9	
TEL/LAM	6.0	17.4	.0	.0	.0	
Ulvac	3.9	5.7	8.3	8.7	6.6	
Varian (Zylin)	4.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	6.2	11.6	
Total Worldwide	237.1	307.4	533.2	669.0	683.4	30.3

Ref: DETCHSHR

Source: Dataquest (April 1991)

Table 4.26
North American Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Chemical Vapor Deposition
Region of Consumption: North America

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World CVD Market	221.4	259.2	462.6	609.4	688.5	32.8
Tube CVD						
Horizontal Tube LPCVD						
ASM International	1.2	1.7	2.6	2.0	2.5	
BTU International	2.7	3.4	7.4	9.0	4.0	
Centrotherm	.0	.0	.0	2.5	2.8	
Enya	.0	.0	.0	.0	.0	
GSTC	.0	.0	3.0	3.0	2.0	
Kokusai Electric	.0	.0	.8	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Pacific Western	.5	.0	.0	.0	.0	
Process Technology	4.5	3.8	4.0	2.2	2.5	
Silicon Valley Group	.0	.0	.0	7.0	6.0	
Solitec	4.1	2.0	4.8	4.0	4.0	
TEL/Thermco	.0	.0	.0	.0	.0	
Tempress	2.5	.0	.0	.0	.0	
Thermco	2.9	3.0	3.5	.0	.0	
Tokyo Electron Ltd.	.0	.0	.0	.0	.0	
Tylan	.4	1.0	1.5	.0	.0	
Tystar	.0	.0	.0	1.1	.2	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.0	
Wellman	.0	.0	.0	.0	.0	
Total Horizontal LPCVD	18.8	14.9	27.6	30.8	24.0	6.3
Vertical Tube LPCVD						
ASM International	.0	.0	.0	.6	1.2	
BTU International	.0	.0	.0	.0	2.0	
Denko	.0	.0	.0	.0	.0	
Disco	.0	.0	.0	.0	.0	
General Signal Thinfilm	.0	.0	.0	2.0	4.0	
Helmut Seier	.0	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	2.5	2.2	2.5	
Semitherm	.0	.0	.5	1.0	1.5	
Silicon Valley Group	.2	1.6	1.6	3.0	8.0	
TEL/Thermco	.0	.0	.0	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.0	

(Continued)

Table 4.26 (Continued)
North American Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Tokyo Electron Ltd.	.0	.0	.0	.0	.0	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	2.0	
Total Vertical LPCVD	.2	1.6	4.6	8.8	21.2	220.9
Horizontal Tube PECVD						
ASM International	14.9	23.1	20.6	16.0	16.0	
Pacific Western	2.9	3.7	2.7	1.8	1.5	
Total Horizontal PECVD	17.8	26.8	23.3	17.8	17.5	-.4
Total N.A. Tube CVD	36.8	43.3	55.5	57.4	62.7	14.2
Non-Tube CVD Reactors						
APCVD Reactors						
Alcan	.0	.0	.0	.0	.0	
Amaya	.0	.0	.0	.0	.0	
Applied Materials	1.2	3.0	3.0	2.0	.0	
General Signal Thinfilm	.0	.0	.5	.5	.5	
Hitachi	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Pacific Western	.4	.0	.0	.0	.0	
Tempress	1.3	.0	.0	.0	.0	
Toshiba Machine	.0	.0	.0	.0	.0	
Watkins-Johnson	5.6	7.3	10.5	10.0	10.0	
Total APCVD Reactors	8.5	10.3	14.0	12.5	10.5	5.4
LPCVD Reactors						
Anicon	3.3	.0	.0	.0	.0	
Anelva	.0	.0	.0	.0	.0	
Applied Materials	.0	.0	.0	.0	12.0	
BTU/Ulvac	.0	.0	.0	.0	.8	
Enya	.0	.0	.0	.0	.0	
Focus Semiconductor	.0	1.0	1.6	.0	.0	
Genus	4.2	7.1	11.7	22.0	14.0	
Kokusai Electric	.0	.0	.0	.0	.0	
LAM Research	.0	.0	.0	.0	1.3	
Silicon Valley Group	.0	1.4	1.5	.6	.6	
Spectrum CVD	.5	2.3	1.1	3.0	2.0	
Tokyo Electron, Ltd.	.0	.0	.0	.0	.0	

(Continued)

Table 4.26 (Continued)
North American Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Ulvac	.0	.0	.0	.0	.0	
Varian	1.1	2.5	2.0	.7	.0	
Total LPCVD Reactors	9.1	14.3	17.9	26.3	30.7	35.5
PECVD Reactors						
Anelva	.0	.0	.0	.0	.0	
Applied Materials	1.4	15.5	37.0	56.0	67.0	
Enya	.0	.0	.0	.0	.0	
E.T. Electrotech	4.0	1.0	4.2	2.5	3.5	
Japan Production	.0	.0	.0	.0	.0	
LAM Research	.0	.0	.0	.0	.0	
Novellus	.0	3.1	16.9	35.0	42.0	
Plasma-Therm	3.0	3.8	4.0	2.0	2.0	
Samco	.0	.0	.0	.0	.0	
Sumitomo Metals	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Total PECVD Reactors	8.4	23.4	62.1	95.5	114.5	92.1
ECR CVD						
Anelva	.0	.0	.0	.0	.0	
LAM Research	.0	.0	.0	.0	2.5	
Plasma Technology	.0	.0	.8	1.0	1.2	
Sumitomo Metals	.0	.0	.0	.0	.0	
Total ECR CVD	.0	.0	.8	1.0	3.7	
Total N.A. Non-Tube CVD	26.0	48.0	94.8	135.3	159.4	57.4
Total N.A. CVD	62.8	91.3	150.3	192.7	222.1	37.1

Ref: CVDSHR

Source: Dataquest (April 1991)

Table 4.27
Japanese Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Chemical Vapor Deposition
Region of Consumption: Japan

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World CVD Market	221.4	259.2	462.6	609.4	688.5	32.8
Tube CVD						
Horizontal Tube LPCVD						
ASM International	4.8	2.0	3.9	2.0	1.5	
BTU International	.0	.0	.0	.0	.0	
Centrotherm	.0	.0	.0	.0	.0	
Enya	1.0	.6	1.8	1.7	.0	
GSTC	.0	.0	.0	.0	.0	
Kokusai Electric	16.2	7.6	6.4	2.2	2.5	
Koyo Lindberg	1.8	1.0	1.8	3.0	1.0	
Pacific Western	.0	.0	.0	.0	.0	
Process Technology	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.0	.0	.0	
Solitec	.0	.0	.0	.0	.0	
TEL/Thermco	6.6	8.3	.0	.0	.0	
Tempress	.0	.0	.0	.0	.0	
Thermco	.0	.0	.0	.0	.0	
Tokyo Electron Ltd.	.0	.0	8.5	8.7	3.6	
Tylan	.0	.0	.0	.0	.0	
Tystar	.0	.0	.0	.0	.0	
Ulvac/BTU	.0	.5	3.5	4.0	6.2	
Varian/TEL	.0	.0	.0	.0	.0	
Wellman	.0	.0	.0	.0	.0	
Total Horizontal LPCVD	30.4	20.0	25.9	21.6	14.8	-16.5
Vertical Tube LPCVD						
ASM International	.5	.0	.0	.6	2.4	
BTU International	.0	.0	.0	.0	.0	
Denko	2.7	2.1	2.3	3.5	3.8	
Disco	.0	.0	.0	.0	.0	
General Signal Thinfilm	.0	.0	.0	.0	.0	
Helmut Seier	.0	.3	.3	.0	.0	
Koyo Lindberg	.4	1.0	2.7	1.1	2.1	
Kokusai Electric	1.4	2.8	12.3	23.6	39.2	
Semitherm	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.8	.0	.0	
TEL/Thermco	1.0	.0	.0	.0	.0	

(Continued)

Table 4.27 (Continued)
Japanese Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Toyoko Chemical	.0	.0	.0	5.8	5.2	
Tokyo Electron Ltd.	.0	.0	3.8	15.9	34.0	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.0	
Total Vertical LPCVD	6.0	6.2	22.2	50.5	86.7	95.0
Horizontal Tube PECVD						
ASM International	16.4	9.8	15.5	17.0	14.0	
Pacific Western	2.7	2.8	2.1	.0	.0	
Total Horizontal PECVD	19.1	12.6	17.6	17.0	14.0	-7.5
Total Japan Tube CVD	55.5	38.8	65.7	89.1	115.5	20.1
Non-Tube CVD Reactors						
APCVD Reactors						
Alcan	.0	.0	.0	.0	8.3	
Amaya	6.0	5.5	17.5	19.0	15.3	
Applied Materials	5.4	8.5	8.7	4.0	3.0	
General Signal Thinfilm	.0	.0	.5	.0	.0	
Hitachi	.4	.0	.5	1.1	.0	
Kokusai Electric	.7	.0	.7	.0	.0	
Koyo Lindberg	.4	.2	1.3	.6	.8	
Pacific Western	.4	.2	.0	.0	.0	
Tempress	.3	.0	.0	.0	.0	
Toshiba Machine	4.3	5.0	6.0	4.2	4.2	
Watkins-Johnson	.5	2.0	15.0	20.0	20.0	
Total APCVD Reactors	18.4	21.4	50.2	48.9	51.6	29.4
LPCVD Reactors						
Anicon	2.0	.0	.0	.0	.0	
Anelva	.0	.7	2.3	1.1	1.4	
Applied Materials	.0	.0	.0	.0	8.0	
BTU/Ulvac	.0	.0	.0	.0	.0	
Enya	.0	.0	1.8	1.7	3.5	
Focus Semiconductor	.0	.0	.9	.0	.0	
Genus	1.1	3.3	12.7	23.0	19.0	
Kokusai Electric	.0	.0	.0	.0	3.1	
LAM Research	.0	.0	.0	.0	1.4	
Silicon Valley Group	.0	.8	1.5	.7	.0	
Spectrum CVD	.0	.0	.3	.6	.6	
Tokyo Electron, Ltd.	.0	.0	.0	.0	4.9	

(Continued)

Table 4.27 (Continued)
Japanese Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Ulvac	1.2	1.4	3.8	4.2	5.2	
Varian	2.1	2.4	2.3	4.3	.0	
Total LPCVD Reactors	6.4	8.6	25.6	35.6	47.1	64.7
PECVD Reactors						
Anelva	.0	.0	1.4	.4	.0	
Applied Materials	3.4	10.0	25.0	59.0	70.0	
Enya	1.6	1.9	4.2	3.5	3.8	
E.T. Electrotech	.7	5.2	4.9	4.0	4.5	
Japan Production	6.0	4.5	6.5	7.0	8.0	
LAM Research	.0	.0	.0	.0	.0	
Novellus	.0	.5	3.4	5.6	11.0	
Plasma-Therm	1.2	.3	.5	.6	.5	
Samco	.0	.0	.0	1.0	2.3	
Sumitomo Metals	.0	.0	.0	.0	.0	
Ulvac	3.0	2.8	2.0	1.0	1.8	
Total PECVD Reactors	15.9	25.2	47.9	82.1	101.9	59.1
ECR CVD						
Anelva	.6	1.0	.8	1.0	.4	
LAM Research	.0	.0	.0	.0	.0	
Plasma Technology	.0	.0	.0	.0	.0	
Sumitomo Metals	.0	.0	.0	6.0	2.9	
Total ECR CVD	.6	1.0	.8	7.0	3.3	
Total Japan Non-Tube CVD	41.3	56.2	124.5	173.6	203.9	49.1
Total Japan CVD	96.8	95.0	190.2	262.7	319.4	34.8

Ref: CVDSHR

Source: Dataquest (April 1991)

Table 4.28
European Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Chemical Vapor Deposition
Region of Consumption: Europe

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World CVD Market	221.4	259.2	462.6	609.4	688.5	32.8
Tube CVD						
Horizontal Tube LPCVD						
ASM International	13.3	16.2	16.7	10.0	5.0	
BTU International	2.9	3.0	3.5	3.5	2.0	
Centrotherm	.0	.0	.0	2.0	2.0	
Enya	.0	.0	.0	.0	.0	
GSTC	.0	.0	.8	1.0	1.0	
Kokusai Electric	.0	.0	.0	.0	2.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Pacific Western	.0	.0	.0	.0	.0	
Process Technology	.7	.5	.0	.3	.5	
Silicon Valley Group	.0	.0	.0	1.0	2.0	
Solitec	.6	.3	.6	.0	.0	
TEL/Thermco	.0	.0	.0	.0	.0	
Tempress	.6	.0	.0	.0	.0	
Thermco	2.1	2.2	1.0	.0	.0	
Tokyo Electron Ltd.	.0	.0	2.3	.0	.0	
Tylan	.3	2.0	.0	.0	.0	
Tystar	.0	.0	.0	.0	.0	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	2.1	
Wellman	.0	.0	.5	.3	.0	
Total Horizontal LPCVD	20.5	24.2	25.4	18.1	16.6	-5.1
Vertical Tube LPCVD						
ASM International	.0	.0	.0	1.2	1.8	
BTU International	.0	.0	.0	.0	1.5	
Denko	.0	.0	.0	.0	.0	
Disco	.0	.0	.0	.0	.0	
General Signal Thinfilm	.0	.0	.0	.0	.0	
Helmut Seier	.0	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	.0	.3	.0	
Semitherm	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.8	.5	1.6	
TEL/Thermco	.0	.0	.0	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.7	

(Continued)

Table 4.28 (Continued)
European Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Tokyo Electron Ltd.	.0	.0	.0	.0	.0	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.7	
Total Vertical LPCVD	.0	.0	.8	2.0	6.3	NM
Horizontal Tube PECVD						
ASM International	9.8	5.8	10.3	9.0	5.0	
Pacific Western	1.3	1.4	.9	1.0	1.0	
Total Horizontal PECVD	11.1	7.2	11.2	10.0	6.0	-14.3
Total Europe Tube CVD	31.6	31.4	37.4	30.1	28.9	-2.2
Non-Tube CVD Reactors						
APCVD Reactors						
Alcan	.0	.0	.0	.0	.0	
Amaya	.0	.0	.0	.0	.0	
Applied Materials	.7	3.0	3.0	1.0	1.0	
General Signal Thinfilm	.0	.0	.3	.3	.3	
Hitachi	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Pacific Western	.4	.0	.0	.0	.0	
Tempress	.5	.0	.0	.0	.0	
Toshiba Machine	.0	.0	.0	.0	.0	
Watkins-Johnson	.4	6.7	6.0	5.0	8.0	
Total APCVD Reactors	2.0	9.7	9.3	6.3	9.3	46.8
LPCVD Reactors						
Anicon	2.5	.0	.0	.0	.0	
Anelva	.0	.0	.0	.0	.0	
Applied Materials	.0	.0	.0	.0	5.0	
BTU/Ulvac	.0	.0	.0	.0	.8	
Enya	.0	.0	.0	.0	.0	
Focus Semiconductor	.0	.0	.0	.0	.0	
Genus	1.1	1.7	3.7	7.0	7.0	
Kokusai Electric	.0	.0	.0	.0	.0	
LAM Research	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	1.1	.5	.7	.7	
Spectrum CVD	.0	.0	.0	.0	.6	
Tokyo Electron, Ltd.	.0	.0	.0	.0	.0	

(Continued)

Table 4.28 (Continued)
European Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Ulvac	.0	.0	.0	.0	.0	
Varian	.0	1.5	1.4	.0	.0	
Total LPCVD Reactors	3.6	4.3	5.6	7.7	14.1	40.7
PECVD Reactors						
Anelva	.0	.0	.0	.0	.0	
Applied Materials	.7	3.9	8.9	16.0	24.0	
Enya	.0	.0	.0	.0	.0	
E.T. Electrotech	8.5	7.1	9.8	7.0	8.0	
Japan Production	.0	.0	.0	.0	.0	
LAM Research	.0	.0	.0	.0	.0	
Novellus	.0	.0	1.1	3.7	6.0	
Plasma-Therm	.8	.5	1.0	.4	.5	
Samco	.0	.0	.0	.0	.0	
Sumitomo Metals	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Total PECVD Reactors	10.0	11.5	20.8	27.1	38.5	40.1
ECR CVD						
Anelva	.0	.0	.0	.0	.0	
LAM Research	.0	.0	.0	.0	.0	
Plasma Technology	.0	.0	.8	1.0	1.2	
Sumitomo Metals	.0	.0	.0	.0	.0	
Total ECR CVD	.0	.0	.8	1.0	1.2	
Total Europe Non-Tube CVD	15.6	25.5	36.5	42.1	63.1	41.8
Total Europe CVD	47.2	56.9	73.9	72.2	92.0	18.2

Ref: CVDSHR

Source: Dataquest (April 1991)

Table 4.29
Asia/Pacific-ROW Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Chemical Vapor Deposition
Region of Consumption: Asia/Pacific-Rest of World

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World CVD Market	221.4	259.2	462.6	609.4	688.5	32.8
Tube CVD						
Horizontal Tube LPCVD						
ASM International	.7	.0	2.6	1.0	1.0	
BTU International	.0	1.5	3.6	5.0	1.2	
Centrotherm	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	.0	
GSTC	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	2.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Pacific Western	.0	.0	.0	.0	.0	
Process Technology	.2	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.0	2.0	2.0	
Solitec	.6	1.3	.6	1.0	1.0	
TEL/Thermco	.0	.0	.0	.0	.0	
Tempress	.7	.0	.0	.0	.0	
Thermco	1.4	1.8	2.0	.0	.0	
Tokyo Electron Ltd.	.0	.0	3.8	6.0	3.3	
Tylan	.0	1.0	.0	.0	.0	
Tystar	.0	.0	.0	.2	.2	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.0	
Wellman	.0	.0	.0	.0	.0	
Total Horizontal LPCVD	3.6	5.6	14.6	15.2	8.7	24.7
Vertical Tube LPCVD						
ASM International	.0	.0	.0	.6	.6	
BTU International	.0	.0	.0	.0	1.5	
Denko	.0	.0	.0	.0	.0	
Disco	.0	.0	.0	.0	.0	
General Signal Thinfilm	.0	.0	.0	.0	.0	
Helmut Seier	.0	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	6.8	18.8	13.4	
Semitherm	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.4	.5	1.6	
TEL/Thermco	.0	.0	.0	.0	.0	

(Continued)

Table 4.29 (Continued)
Asia/Pacific-ROW Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Toyoko Chemical	.0	.0	.0	.0	.0	
Tokyo Electron Ltd.	.0	.0	.0	.0	.0	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.0	
Total Vertical LPCVD	.0	.0	7.2	19.9	17.1	NM
Horizontal Tube PECVD						
ASM International	3.3	5.8	5.2	9.0	5.0	
Pacific Western	.0	.0	.5	.0	.0	
Total Horizontal PECVD	3.3	5.8	5.7	9.0	5.0	10.9
Total A/P-ROW Tube CVD	6.9	11.4	27.5	44.1	30.8	45.4
Non-Tube CVD Reactors						
APCVD Reactors						
Alcan	.0	.0	.0	.0	.0	
Amaya	.0	.0	.0	.0	.7	
Applied Materials	.5	.0	1.0	2.0	1.0	
General Signal Thinfilm	.0	.0	.0	.0	.0	
Hitachi	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Pacific Western	.0	.0	.0	.0	.0	
Tempress	.1	.0	.0	.0	.0	
Toshiba Machine	.0	.0	.0	.0	.0	
Watkins-Johnson	1.6	.0	4.5	7.0	3.0	
Total APCVD Reactors	2.2	.0	5.5	9.0	4.7	20.9
LPCVD Reactors						
Anicon	1.0	.0	.0	.0	.0	
Anelva	.0	.0	.0	.0	.0	
Applied Materials	.0	.0	.0	.0	1.0	
BTU/Ulvac	.0	.0	.0	.0	.0	
Enya	.0	.0	.0	.0	.0	
Focus Semiconductor	.0	.0	.0	.0	.0	
Genus	1.1	1.1	5.3	10.0	4.0	
Kokusai Electric	.0	.0	.0	.0	.0	
LAM Research	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.4	.5	.0	.0	
Spectrum CVD	.0	.0	.0	.0	.0	
Tokyo Electron, Ltd.	.0	.0	.0	.0	.0	

(Continued)

Table 4.29 (Continued)
Asia/Pacific-ROW Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Ulvac	.0	.0	.0	.0	.0	
Varian	.0	1.5	.7	.0	.0	
Total LPCVD Reactors	2.1	3.0	6.5	10.0	5.0	24.2
PECVD Reactors						
Anelva	.0	.0	.0	.0	.0	
Applied Materials	.6	1.6	4.5	12.0	9.0	
Enya	.0	.0	.0	.0	.0	
E.T. Electrotech	2.0	.0	1.4	2.0	1.5	
Japan Production	.0	.0	.0	.0	.0	
LAM Research	.0	.0	.0	.0	.0	
Novellus	.0	.0	2.3	4.7	4.0	
Plasma-Therm	.8	.0	.5	.0	.0	
Samco	.0	.0	.0	.0	.0	
Sumitomo Metals	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Total PECVD Reactors	3.4	1.6	8.7	18.7	14.5	43.7
ECR CVD						
Anelva	.0	.0	.0	.0	.0	
LAM Research	.0	.0	.0	.0	.0	
Plasma Technology	.0	.0	.0	.0	.0	
Sumitomo Metals	.0	.0	.0	.0	.0	
Total ECR CVD	.0	.0	.0	.0	.0	
Total Non-Tube CVD	7.7	4.6	20.7	37.7	24.2	33.1
Total A/P-ROW CVD	14.6	16.0	48.2	81.8	55.0	39.3

Ref: CVDSHR

Source: Dataquest (April 1991)

Table 4.30
Worldwide Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Chemical Vapor Deposition
Region of Consumption: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World CVD Market	221.4	259.2	462.6	609.4	688.5	32.8
Tube CVD						
Horizontal Tube LPCVD						
ASM International	20.0	19.9	25.8	15.0	10.0	
BTU International	5.6	7.9	14.5	17.5	7.2	
Centrotherm	.0	.0	.0	4.5	4.8	
Enya	1.0	.6	1.8	1.7	.0	
GSTC	.0	.0	3.8	4.0	3.0	
Kokusai Electric	16.2	7.6	9.2	2.2	4.5	
Koyo Lindberg	1.8	1.0	1.8	3.0	1.0	
Pacific Western	.5	.0	.0	.0	.0	
Process Technology	5.4	4.3	4.0	2.5	3.0	
Silicon Valley Group	.0	.0	.0	10.0	10.0	
Solitec	5.3	3.6	6.0	5.0	5.0	
TEL/Thermco	6.6	8.3	.0	.0	.0	
Tempress	3.8	.0	.0	.0	.0	
Thermco	6.4	7.0	6.5	.0	.0	
Tokyo Electron Ltd.	.0	.0	14.6	14.7	6.9	
Tylan	.7	4.0	1.5	.0	.0	
Tystar	.0	.0	.0	1.3	.4	
Ulvac/BTU	.0	.5	3.5	4.0	6.2	
Varian/TEL	.0	.0	.0	.0	2.1	
Wellman	.0	.0	.5	.3	.0	
Total Horizontal LPCVD	73.3	64.7	93.5	85.7	64.1	-3.3
Vertical Tube LPCVD						
ASM International	.5	.0	.0	3.0	6.0	
BTU International	.0	.0	.0	.0	5.0	
Denko	2.7	2.1	2.3	3.5	3.8	
Disco	.0	.0	.0	.0	.0	
General Signal Thinfilm	.0	.0	.0	2.0	4.0	
Helmut Seier	.0	.3	.3	.0	.0	
Koyo Lindberg	.4	1.0	2.7	1.1	2.1	
Kokusai Electric	1.4	2.8	21.6	44.9	55.1	
Semitherm	.0	.0	.5	1.0	1.5	
Silicon Valley Group	.2	1.6	3.6	4.0	11.2	
TEL/Thermco	1.0	.0	.0	.0	.0	

(Continued)

Table 4.30 (Continued)
Worldwide Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Toyoko Chemical	.0	.0	.0	5.8	5.9	
Tokyo Electron Ltd.	.0	.0	3.8	15.9	34.0	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	2.7	
Total Vertical LPCVD	6.2	7.8	34.8	81.2	131.3	114.5
Horizontal Tube PECVD						
ASM International	44.4	44.5	51.6	51.0	40.0	
Pacific Western	6.9	7.9	6.2	2.8	2.5	
Total Horizontal PECVD	51.3	52.4	57.8	53.8	42.5	-4.6
Total W.W. Tube CVD	130.8	124.9	186.1	220.7	237.9	16.1
Non-Tube CVD Reactors						
APCVD Reactors						
Alcan	.0	.0	.0	.0	8.3	
Amaya	6.0	5.5	17.5	19.0	16.0	
Applied Materials	7.8	14.5	15.7	9.0	5.0	
General Signal Thinfilm	.0	.0	1.3	.8	.8	
Hitachi	.4	.0	.5	1.1	.0	
Kokusai Electric	.7	.0	.7	.0	.0	
Koyo Lindberg	.4	.2	1.3	.6	.8	
Pacific Western	1.2	.2	.0	.0	.0	
Tempress	2.2	.0	.0	.0	.0	
Toshiba Machine	4.3	5.0	6.0	4.2	4.2	
Watkins-Johnson	8.1	16.0	36.0	42.0	41.0	
Total APCVD Reactors	31.1	41.4	79.0	76.7	76.1	25.1
LPCVD Reactors						
Anicon	8.8	.0	.0	.0	.0	
Anelva	.0	.7	2.3	1.1	1.4	
Applied Materials	.0	.0	.0	.0	26.0	
BTU/Ulvac	.0	.0	.0	.0	1.6	
Enya	.0	.0	1.8	1.7	3.5	
Focus Semiconductor	.0	1.0	2.5	.0	.0	
Genus	7.5	13.2	33.4	62.0	44.0	
Kokusai Electric	.0	.0	.0	.0	3.1	
LAM Research	.0	.0	.0	.0	2.7	
Silicon Valley Group	.0	3.7	4.0	2.0	1.3	
Spectrum CVD	.5	2.3	1.4	3.6	3.2	
Tokyo Electron, Ltd.	.0	.0	.0	.0	4.9	

(Continued)

Table 4.30 (Continued)
Worldwide Chemical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Ulvac	1.2	1.4	3.8	4.2	5.2	
Varian	3.2	7.9	6.4	5.0	.0	
Total LPCVD Reactors	21.2	30.2	55.6	79.6	96.9	46.2
PECVD Reactors						
Anelva	.0	.0	1.4	.4	.0	
Applied Materials	6.1	31.0	75.4	143.0	170.0	
Enya	1.6	1.9	4.2	3.5	3.8	
E.T. Electrotech	15.2	13.3	20.3	15.5	17.5	
Japan Production	6.0	4.5	6.5	7.0	8.0	
LAM Research	.0	.0	.0	.0	.0	
Novellus	.0	3.6	23.7	49.0	63.0	
Plasma-Therm	5.8	4.6	6.0	3.0	3.0	
Samco	.0	.0	.0	1.0	2.3	
Sumitomo Metals	.0	.0	.0	.0	.0	
Ulvac	3.0	2.8	2.0	1.0	1.8	
Total PECVD Reactors	37.7	61.7	139.5	223.4	269.4	63.5
ECR CVD						
Anelva	.6	1.0	.8	1.0	.4	
LAM Research	.0	.0	.0	.0	2.5	
Plasma Technology	.0	.0	1.6	2.0	2.4	
Sumitomo Metals	.0	.0	.0	6.0	2.9	
Total ECR CVD	.6	1.0	2.4	9.0	8.2	
Total W.W. Non-Tube CVD	90.6	134.3	276.5	388.7	450.6	49.3
Total W.W. CVD	221.4	259.2	462.6	609.4	688.5	32.8

Ref: CVDSHR

Source: Dataquest (April 1991)

Table 4.31
North American Physical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Physical Vapor Deposition
Region of Consumption: North America

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World PVD Market	236.6	250.9	302.0	368.4	408.4	14.6
Sputtering						
Advanced Film Tech.	.0	.0	.0	.0	.0	
Anelva	2.6	10.0	10.0	10.8	17.8	
Applied Materials	.0	.0	.0	.0	6.5	
Balzers	5.6	5.0	5.0	4.0	2.0	
CHA Industries	.7	.3	.7	.1	.4	
Circuit Processing	2.0	2.0	.0	.0	.0	
CPA	.0	.0	.0	.0	1.0	
CVC Products	10.0	6.8	7.5	9.0	5.0	
E.T. Electrotech	1.3	1.4	1.8	3.0	3.0	
GSTC	.0	.0	2.6	2.0	.0	
Innotec	1.8	2.4	4.2	.5	.3	
Ion Tech	.5	.7	.5	.1	.1	
Kurt J. Lesker	.8	.8	.8	.8	1.0	
Leybold-Heraeus	2.8	3.0	3.0	2.0	2.0	
Materials Research	15.0	13.0	15.0	24.0	.0	
MRC Sony	.0	.0	.0	.0	25.0	
Perkin-Elmer	3.3	2.1	.9	1.0	.0	
Sputtered Films	1.3	1.0	.6	1.2	1.0	
Temescal	1.3	.0	.0	.1	.1	
Tokuda	.0	.0	.0	.0	.0	
Ulvac	1.5	6.3	6.4	6.2	6.9	
Varian	25.6	21.3	24.6	28.0	36.0	
Others	1.0	3.1	5.1	1.9	1.3	
Total Sputtering	77.1	79.2	88.7	94.7	109.4	9.1

(Continued)

Table 4.31 (Continued)
North American Physical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Evaporation						
Anelva	2.3	.0	.0	.0	.0	
Balzers	1.8	1.1	1.1	1.5	2.0	
CHA Industries	5.6	6.0	6.3	5.6	2.8	
CVC Products	.0	.0	1.0	1.0	1.5	
Innotec	.2	.0	1.0	.0	.0	
Kurt J. Lesker	.3	.3	.3	.4	.6	
Leybold-Heraeus	1.0	.5	.5	.8	.0	
Temescal	5.7	5.1	4.5	5.0	6.0	
Ulvac	1.0	1.4	1.5	1.6	1.5	
Others	.2	.2	.2	1.2	2.7	
Total Evaporation	18.1	14.6	16.4	17.1	17.1	-1.4
Total North America	95.2	93.8	105.1	111.8	126.5	7.4

Ref: PVDSHR

Source: Dataquest (April 1991)

Table 4.32
Japanese Physical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Physical Vapor Deposition
Region of Consumption: Japan

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World PVD Market	236.6	250.9	302.0	368.4	408.4	14.6
Sputtering						
Advanced Film Tech.	.0	.0	.0	.0	.7	
Anelva	18.0	34.7	43.8	65.0	64.5	
Applied Materials	.0	.0	.0	.0	6.5	
Balzers	.0	.0	.0	.0	.0	
CHA Industries	.0	.0	.0	.0	.0	
Circuit Processing	.9	1.0	.0	.0	.0	
CPA	.0	.0	.0	.0	.0	
CVC Products	.0	.0	.3	.0	.0	
E.T. Electrotech	.5	.6	.6	1.6	1.0	
GSTC	.0	.0	.0	.0	.0	
Innotec	.0	.0	.0	.0	.0	
Ion Tech	.2	.0	.0	.0	.0	
Kurt J. Lesker	.0	.0	.0	.0	.0	
Leybold-Heraeus	.0	.0	.0	.0	.0	
Materials Research	.9	1.9	7.5	13.0	.0	
MRC Sony	.0	.0	.0	.0	27.0	
Perkin-Elmer	.0	.0	.0	.0	.0	
Sputtered Films	.0	.0	.0	.0	.0	
Temescal	.0	.0	.0	.0	.0	
Tokuda	3.3	11.1	7.0	5.6	5.8	
Ulvac	14.7	24.7	40.1	43.6	46.0	
Varian	16.8	12.6	18.7	24.0	26.0	
Others	.0	.0	.0	.0	.0	
Total Sputtering	55.3	86.6	118.0	152.8	177.5	33.8

(Continued)

Table 4.32 (Continued)
Japanese Physical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Evaporation						
Anelva	.0	4.9	6.2	4.3	4.1	
Balzers	.4	.0	.0	1.4	2.0	
CHA Industries	.0	.0	.0	.0	.0	
CVC Products	.0	.0	.0	.0	.0	
Innotec	.0	.0	.0	.0	.0	
Kurt J. Lesker	.0	.0	.0	.0	.0	
Leybold-Heraeus	.0	.0	.0	.0	.0	
Temescal	1.8	2.4	2.4	3.5	2.0	
Ulvac	19.0	5.9	11.5	13.0	12.0	
Others	.0	.0	.0	.0	.0	
Total Evaporation	21.2	13.2	20.1	22.2	20.1	-1.3
Total Japan	76.5	99.8	138.1	175.0	197.6	26.8

Ref: PVDSHR

Source: Dataquest (April 1991)

Table 4.33
European Physical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Physical Vapor Deposition
Region of Consumption: Europe

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World PVD Market	236.6	250.9	302.0	368.4	408.4	14.6
Sputtering						
Advanced Film Tech.	.0	.0	.0	.0	.0	
Anelva	.0	.0	.0	1.5	5.0	
Applied Materials	.0	.0	.0	.0	2.0	
Balzers	7.6	8.9	6.0	4.2	5.0	
CHA Industries	.0	.0	.0	.0	.0	
Circuit Processing	.0	.0	.0	.0	.0	
CPA	.0	.0	.0	.0	.0	
CVC Products	3.5	2.9	3.5	2.0	1.5	
E.T. Electrotech	3.5	4.0	6.0	8.0	8.0	
GSTC	.0	.0	.0	.0	.0	
Innotec	.0	.0	.0	.0	.0	
Ion Tech	.0	.0	.0	.0	.0	
Kurt J. Lesker	.0	.0	.0	.0	.0	
Leybold-Heraeus	6.0	7.0	4.8	6.0	5.0	
Materials Research	3.5	4.0	4.0	5.0	.0	
MRC Sony	.0	.0	.0	.0	7.0	
Perkin-Elmer	1.0	.3	.0	.0	.0	
Sputtered Films	.0	.0	.0	.0	.0	
Temescal	.0	.0	.0	.0	.0	
Tokuda	.0	.0	.0	.0	.0	
Ulvac	4.6	2.0	1.2	5.9	5.6	
Varian	8.3	6.3	6.0	7.0	10.0	
Others	.0	.0	.0	.0	.0	
Total Sputtering	38.0	35.4	31.5	39.6	49.1	6.6

(Continued)

Table 4.33 (Continued)
European Physical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Evaporation						
Anelva	.0	.0	.0	.0	.0	
Balzers	2.8	1.8	1.8	1.5	2.0	
CHA Industries	.0	.0	.0	.0	.0	
CVC Products	.0	.0	.6	.6	.8	
Innotec	.0	.0	.0	.2	.4	
Kurt J. Lesker	.0	.0	.0	.0	.0	
Leybold-Heraeus	2.0	1.0	.0	1.0	1.0	
Temescal	3.0	2.4	1.8	2.1	3.0	
Ulvac	2.4	.1	.3	.0	.0	
Others	.0	.0	.0	.0	.0	
Total Evaporation	10.2	5.3	4.5	5.4	7.2	-8.3
Total Europe	48.2	40.7	36.0	45.0	56.3	4.0

Ref: PVDSHR

Source: Dataquest (April 1991)

Table 4.34
Asia-Pacific/ROW Physical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Physical Vapor Deposition
Region of Consumption: Asia/Pacific-ROW

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World PVD Market	236.6	250.9	302.0	368.4	408.4	14.6
Sputtering						
Advanced Film Tech.	.0	.0	.0	.0	.0	
Anelva	1.2	.0	.0	3.6	3.5	*
Applied Materials	.0	.0	.0	.0	.0	
Balzers	.0	.0	.0	.0	.0	
CHA Industries	.0	.0	.0	.0	.0	
Circuit Processing	.0	.0	.0	.0	.0	
CPA	.0	.0	.0	.0	.0	
CVC Products	.0	.0	1.0	1.0	1.0	
E.T. Electrotech	.0	.0	.6	1.5	1.5	
GSTC	.0	.0	.0	.0	.0	
Innotec	.0	.0	.0	.0	.5	
Ion Tech	.0	.0	.0	.0	.0	
Kurt J. Lesker	.0	.0	.0	.0	.0	
Leybold-Heraeus	.8	2.0	.0	.8	.8	
Materials Research	2.5	4.2	7.5	12.0	.0	
MRC Sony	.0	.0	.0	.0	3.6	
Perkin-Elmer	1.3	.7	.0	.0	.0	
Sputtered Films	.3	.0	.0	.0	.0	
Temescal	.0	.0	.0	.0	.0	
Tokuda	.0	.0	.0	.0	.0	
Ulvac	4.6	1.0	1.0	.0	.0	
Varian	6.0	8.1	12.0	14.0	12.0	
Others	.0	.0	.0	.0	.2	
Total Sputtering	16.7	16.0	22.1	32.9	23.1	8.4

(Continued)

Table 4.34 (Continued)
Asia-Pacific/ROW Physical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Evaporation						
Anelva	.0	.0	.0	.0	.0	
Balzers	.0	.0	.0	1.0	.5	
CHA Industries	.0	.0	.0	1.5	1.2	
CVC Products	.0	.0	.0	.4	.4	
Innotec	.0	.0	.0	.0	.0	
Kurt J. Lesker	.0	.0	.0	.2	.0	
Leybold-Heraeus	.0	.0	.0	.0	.5	
Temescal	.0	.0	.0	.6	2.0	
Ulvac	.0	.6	.7	.0	.0	
Others	.0	.0	.0	.0	.3	
Total Evaporation	.0	.6	.7	3.7	4.9	NM
Total A/P-ROW	16.7	16.6	22.8	36.6	28.0	13.8

Ref: PVDSHR

Source: Dataquest (April 1991)

Table 4.35
Worldwide Physical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Physical Vapor Deposition
Region of Consumption: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World PVD Market	236.6	250.9	302.0	368.4	408.4	14.6
Sputtering						
Advanced Film Tech.	.0	.0	.0	.0	.7	
Anelva	21.8	44.7	53.8	80.9	90.8	
Applied Materials	.0	.0	.0	.0	15.0	
Balzers	13.2	13.9	11.0	8.2	7.0	
CHA Industries	.7	.3	.7	.1	.4	
Circuit Processing	2.9	3.0	.0	.0	.0	
CPA	.0	.0	.0	.0	1.0	
CVC Products	13.5	9.7	12.3	12.0	7.5	
E.T. Electrotech	5.3	6.0	9.0	14.1	13.5	
GSTC	.0	.0	2.6	2.0	.0	
Innotec	1.8	2.4	4.2	.5	.8	
Ion Tech	.7	.7	.5	.1	.1	
Kurt J. Lesker	.8	.8	.8	.8	1.0	
Leybold-Heraeus	9.6	12.0	7.8	8.8	7.8	
Materials Research	21.9	23.1	34.0	54.0	.0	
MRC Sony	.0	.0	.0	.0	62.6	
Perkin-Elmer	5.6	3.1	.9	1.0	.0	
Sputtered Films	1.6	1.0	.6	1.2	1.0	
Temescal	1.3	.0	.0	.1	.1	
Tokuda	3.3	11.1	7.0	5.6	5.8	
Ulvac	25.4	34.0	48.7	55.7	58.5	
Varian	56.7	48.3	61.3	73.0	84.0	
Others	1.0	3.1	5.1	1.9	1.5	
Total Sputtering	187.1	217.2	260.3	320.0	359.1	17.7

(Continued)

Table 4.35 (Continued)
Worldwide Physical Vapor Deposition Market Share
By Company
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Evaporation						
Anelva	2.3	4.9	6.2	4.3	4.1	
Balzers	5.0	2.9	2.9	5.4	6.5	
CHA Industries	5.6	6.0	6.3	7.1	4.0	
CVC Products	.0	.0	1.6	2.0	2.7	
Innotec	.2	.0	1.0	.2	.4	
Kurt J. Lesker	.3	.3	.3	.6	.6	
Leybold-Heraeus	3.0	1.5	.5	1.8	1.5	
Temescal	10.5	9.9	8.7	11.2	13.0	
Ulvac	22.4	8.0	14.0	14.6	13.5	
Others	.2	.2	.2	1.2	3.0	
Total Evaporation	49.5	33.7	41.7	48.4	49.3	-.1
Total Worldwide	236.6	250.9	302.0	368.4	408.4	14.6

Ref: PVDSHR

Source: Dataquest (April 1991)

Table 4.36
Worldwide Silicon Epitaxy Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Silicon Epitaxy
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Total Epitaxy Market	46.3	35.5	85.5	75.0	68.2	10.2
North America						
Applied Materials	12.2	6.4	25.5	13.0	12.5	
ASM Epitaxy	.0	.0	1.5	3.8	12.6	
Kokusai Electric	.0	.0	.0	.0	.0	
Lam Research	4.0	7.0	15.0	12.8	7.9	
LPE	.0	.0	.0	.0	.0	
Moore	.0	.0	1.0	1.2	1.8	
Rapro	.0	.0	.0	.9	.9	
Shimada	.0	.0	.0	.0	.0	
Sitesa	.0	.0	.0	.0	.0	
Toshiba Machine	.0	.0	.0	.0	.0	
Total North America	16.2	13.4	43.0	31.7	35.7	21.8
Japan						
Applied Materials	8.1	8.0	16.5	5.4	8.5	
ASM Epitaxy	.0	.0	.8	.0	3.0	
Kokusai Electric	2.1	1.5	4.2	5.7	2.2	
Lam Research	1.8	2.9	.0	3.1	.0	
LPE	.0	.0	.0	.0	.0	
Moore	.0	.0	.0	.0	.0	
Rapro	.0	.0	.0	.0	.0	
Shimada	.5	.0	.0	.0	.0	
Sitesa	.0	.0	.0	.0	.0	
Toshiba Machine	1.0	.6	2.0	6.5	4.5	
Total Japan	13.5	13.0	23.5	20.7	18.2	7.8

(Continued)

Table 4.36 (Continued)
Worldwide Silicon Epitaxy Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Europe						
Applied Materials	8.0	3.6	4.4	3.0	3.1	
ASM Epitaxy	.0	.0	.8	2.4	3.6	
Kokusai Electric	.0	.0	.0	.0	.0	
Lam Research	3.2	2.8	1.0	2.8	.0	
LPE	.0	.0	2.7	3.0	4.0	
Moore	.0	.0	.0	.4	1.2	
Rapro	.0	.0	.0	.0	.0	
Shimada	.0	.0	.0	.0	.0	
Sitesa	.0	.0	4.5	4.9	.0	
Toshiba Machine	.0	.0	.0	.0	.0	
Total Europe	11.2	6.4	13.4	16.5	11.9	1.5
Asia/Pacific-ROW						
Applied Materials	3.0	.6	.8	.8	.9	
ASM Epitaxy	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	.0	.0	.0	
Lam Research	2.4	2.1	3.0	3.5	.0	
LPE	.0	.0	1.8	1.8	1.5	
Moore	.0	.0	.0	.0	.0	
Rapro	.0	.0	.0	.0	.0	
Shimada	.0	.0	.0	.0	.0	
Sitesa	.0	.0	.0	.0	.0	
Toshiba Machine	.0	.0	.0	.0	.0	
Total A/P-ROW	5.4	2.7	5.6	6.1	2.4	-18.4
Worldwide						
Applied Materials	31.3	18.6	47.2	22.2	25.0	
ASM Epitaxy	.0	.0	3.1	6.2	19.2	
Kokusai Electric	2.1	1.5	4.2	5.7	2.2	
Lam Research	11.4	14.8	19.0	22.2	7.9	
LPE	.0	.0	4.5	4.8	5.5	
Moore	.0	.0	1.0	1.6	3.0	
Rapro	.0	.0	.0	.9	.9	
Shimada	.5	.0	.0	.0	.0	
Sitesa	.0	.0	4.5	4.9	.0	
Toshiba Machine	1.0	.6	2.0	6.5	4.5	
Total Worldwide	46.3	35.5	85.5	75.0	68.2	10.2

Ref: EPISHR

Source: Dataquest (April 1991)

Table 4.37
North American Metalorganic CVD Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Metalorganic CVD
Region of Consumption: North America

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World MOCVD Market	31.4	34.6	42.0	44.6	42.3	7.7
North America						
Aixtron	.0	.0	.8	3.5	4.8	
Cambridge Instruments	1.1	1.5	1.3	.0	.0	
Crystal Specialties	2.2	1.7	2.3	.0	.0	
CVD Equipment	.6	1.2	1.0	1.0	.7	
CVT	.0	.0	.0	.0	.0	
Daiwa Semiconductor	.0	.0	.0	.0	.0	
EEV	.2	.0	.0	.0	.0	
Emcore	2.3	5.1	6.5	7.5	5.4	
MR Semicon	.0	.0	.0	1.2	1.3	
Nippon EMC	.0	.0	.0	.0	.0	
Nippon Sanso	.0	.2	.0	.0	.0	
Samco	.0	.0	.0	.0	.0	
Seiden	.0	.0	.0	.0	.0	
Semco Engineering	.0	.0	.0	.0	.0	
Shimada Rika	.0	.0	.0	.0	.0	
Spire	2.9	1.3	1.5	1.7	1.7	
TEL	.0	.0	.0	.0	.0	
TEL/Thermco	.0	.0	.0	.0	.0	
Thomas Schwonn	.0	.0	.4	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Total North America	9.3	11.0	13.8	14.9	13.9	10.6

Ref: MOCVDSHR

Source: Dataquest (April 1991)

Table 4.38
Japanese Metalorganic CVD Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Metalorganic CVD
Region of Consumption: Japan

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World MOCVD Market	31.4	34.6	42.0	44.6	42.3	7.7
Japan						
Aixtron	.0	.0	.0	.0	.0	
Cambridge Instruments	.4	.0	.0	.0	.0	
Crystal Specialties	.5	.9	.4	.0	.0	
CVD Equipment	.0	.0	.0	.0	.0	
CVT	.0	.0	.0	.0	.0	
Daiwa Semiconductor	.4	.4	.5	.0	.0	
EEV	.0	.0	.0	.0	.0	
Emcore	.0	.0	.5	2.5	5.0	
MR Semicon	.0	.0	.0	.0	.0	
Nippon EMC	1.5	1.4	1.9	2.2	1.7	
Nippon Sanso	4.6	4.7	6.3	5.7	5.6	
Samco	.7	.6	1.0	.6	1.2	
Seiden	1.3	.6	.6	.0	.0	
Semco Engineering	.0	.0	.0	.0	.0	
Shimada Rika	.3	.0	.0	.0	.0	
Spire	.0	.0	.6	.7	.0	
TEL	.0	.0	.0	2.9	.0	
TEL/Thermco	3.0	2.9	1.7	.0	.0	
Thomas Schwonn	.0	.0	.0	.0	.0	
Toyoko Chemical	1.0	.7	1.2	.0	.0	
Ulvac	2.3	1.9	2.2	2.0	2.4	
Total Japan	16.0	14.1	16.9	16.6	15.9	-.2

Ref: MOCVDSHR

Source: Dataquest (April 1991)

Table 4.39
European Metalorganic CVD Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Metalorganic CVD
Region of Consumption: Europe

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World MOCVD Market	31.4	34.6	42.0	44.6	42.3	7.7
Europe						
Aixtron	1.7	4.9	6.7	6.7	8.2	
Cambridge Instruments	1.4	1.5	1.0	.0	.0	
Crystal Specialties	.0	.0	.0	.0	.0	
CVD Equipment	.0	.0	.0	.0	.0	
CVT	.4	1.1	1.6	1.1	2.2	
Daiwa Semiconductor	.0	.0	.0	.0	.0	
EEV	1.2	.7	.0	.0	.0	
Emcore	.0	.0	.0	.0	1.2	
MR Semicon	.0	.0	.0	.8	.0	
Nippon EMC	.0	.0	.0	.0	.0	
Nippon Sanso	.0	.0	.0	.0	.0	
Samco	.0	.0	.0	.0	.0	
Seiden	.0	.0	.0	.0	.0	
Semco Engineering	.0	.3	.9	1.0	.0	
Shimada Rika	.0	.0	.0	.0	.0	
Spire	.4	.0	.0	.0	.0	
TEL	.0	.0	.0	.0	.0	
TEL/Thermco	.0	.0	.0	.0	.0	
Thomas Schwonn	.3	.7	.4	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Total Europe	5.4	9.2	10.6	9.6	11.6	21.1

Ref: MOCVDSHR

Source: Dataquest (April 1991)

Table 4.40
Asia/Pacific-ROW Metalorganic CVD Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Metalorganic CVD
Region of Consumption: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World MOCVD Market	31.4	34.6	42.0	44.6	42.3	7.7
Asia/Pacific-ROW						
Aixtron	.0	.0	.0	1.2	.9	
Cambridge Instruments	.7	.3	.4	.0	.0	
Crystal Specialties	.0	.0	.0	.0	.0	
CVD Equipment	.0	.0	.3	.3	.0	
CVT	.0	.0	.0	.9	.0	
Daiwa Semiconductor	.0	.0	.0	.0	.0	
EEV	.0	.0	.0	.0	.0	
Emcore	.0	.0	.0	.0	.0	
MR Semicon	.0	.0	.0	.0	.0	
Nippon EMC	.0	.0	.0	.0	.0	
Nippon Sanso	.0	.0	.0	1.1	.0	
Samco	.0	.0	.0	.0	.0	
Seiden	.0	.0	.0	.0	.0	
Semco Engineering	.0	.0	.0	.0	.0	
Shimada Rika	.0	.0	.0	.0	.0	
Spire	.0	.0	.0	.0	.0	
TEL	.0	.0	.0	.0	.0	
TEL/Thermco	.0	.0	.0	.0	.0	
Thomas Schwonn	.0	.0	.0	.0	.0	
Toyoko Chemical	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Total A/P-ROW	.7	.3	.7	3.5	.9	6.5

Ref: MOCVDSHR

Source: Dataquest (April 1991)

Table 4.41
Worldwide Metalorganic CVD Market Share
By Company
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Metalorganic CVD
Region of Consumption: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World MOCVD Market	31.4	34.6	42.0	44.6	42.3	7.7
Worldwide						
Aixtron	1.7	4.9	7.5	11.4	13.9	
Cambridge Instruments	3.6	3.3	2.7	.0	.0	
Crystal Specialties	2.7	2.6	2.7	.0	.0	
CVD Equipment	.6	1.2	1.3	1.3	.7	
CVT	.4	1.1	1.6	2.0	2.2	
Daiwa Semiconductor	.4	.4	.5	.0	.0	
EEV	1.4	.7	.0	.0	.0	
Emcore	2.3	5.1	7.0	10.0	11.6	
MR Semicon	.0	.0	.0	2.0	1.3	
Nippon EMC	1.5	1.4	1.9	2.2	1.7	
Nippon Sanso	4.6	4.9	6.3	6.8	5.6	
Samco	.7	.6	1.0	.6	1.2	
Seiden	1.3	.6	.6	.0	.0	
Semco Engineering	.0	.3	.9	1.0	.0	
Shimada Rika	.3	.0	.0	.0	.0	
Spire	3.3	1.3	2.1	2.4	1.7	
TEL	.0	.0	.0	2.9	.0	
TEL/Thermco	3.0	2.9	1.7	.0	.0	
Thomas Schwonn	.3	.7	.8	.0	.0	
Toyoko Chemical	1.0	.7	1.2	.0	.0	
Ulvac	2.3	1.9	2.2	2.0	2.4	
Total Worldwide	31.4	34.6	42.0	44.6	42.3	7.7

Ref: MOCVDSHR

Source: Dataquest (April 1991)

Table 4.42
Worldwide Molecular Beam Epitaxy Market Share
By Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Molecular Beam Epitaxy
Region of Consumption: All

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World MBE Market	65.8	68.0	80.9	72.2	54.5	-4.6
North America						
Anelva	.0	.0	.0	.0	.0	
Eiko	.0	.0	.0	.0	.0	
Emcore	.0	.0	.0	.0	1.0	
ISA Riber	5.4	7.0	8.0	6.5	3.6	
Perkin-Elmer	7.2	5.0	2.8	.0	.0	
Seiko	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian	6.3	5.2	5.4	7.8	2.1	
VG Instruments	5.4	2.5	5.1	6.5	2.6	
Total North America	24.3	19.7	21.3	20.8	9.3	-21.3
Japan						
Anelva	7.2	9.7	11.5	6.8	6.2	
Eiko	1.2	1.4	1.2	2.9	2.6	
Emcore	.0	.0	.0	.0	.0	
ISA Riber	3.5	6.0	3.9	1.4	2.7	
Perkin-Elmer	.0	.0	.0	.0	.0	
Seiko	2.0	1.2	1.4	.0	.0	
Ulvac	4.4	4.3	7.5	4.0	4.2	
Varian	.8	1.9	5.2	.5	.7	
VG Instruments	4.2	8.1	5.6	4.9	6.1	
Total Japan	23.3	32.6	36.3	20.5	22.5	-.9
Europe						
Anelva	.0	.0	.0	.0	.0	
Eiko	.0	.0	.0	.0	.0	
Emcore	.0	.0	.0	.0	.0	
ISA Riber	4.7	4.9	6.9	8.0	9.6	
Perkin-Elmer	.0	.0	.0	.0	.0	
Seiko	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian	3.0	4.4	6.3	8.9	.0	
VG Instruments	8.7	2.4	5.8	6.8	2.6	
Total Europe	16.4	11.7	19.0	23.7	12.2	-7.1

(Continued)

Table 4.42 (Continued)
Worldwide Molecular Beam Epitaxy Market Share
By Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Asia/Pacific-ROW						
Anelva	.0	.0	.0	.0	.0	
Eiko	.0	.0	.0	.0	.0	
Emcore	.0	.0	.0	.0	.0	
ISA Riber	.0	1.4	3.7	6.4	3.5	
Perkin-Elmer	.0	.0	.0	.0	.0	
Seiko	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian	.7	.6	.6	.0	.9	
VG Instruments	1.1	2.0	.0	.8	6.1	
Total A/P-ROW	1.8	4.0	4.3	7.2	10.5	55.4
Worldwide						
Anelva	7.2	9.7	11.5	6.8	6.2	
Eiko	1.2	1.4	1.2	2.9	2.6	
Emcore	.0	.0	.0	.0	1.0	
ISA Riber	13.6	19.3	22.5	22.3	19.4	
Perkin-Elmer	7.2	5.0	2.8	.0	.0	
Seiko	2.0	1.2	1.4	.0	.0	
Ulvac	4.4	4.3	7.5	4.0	4.2	
Varian	10.8	12.1	17.5	17.2	3.7	
VG Instruments	19.4	15.0	16.5	19.0	17.4	
Total Worldwide	65.8	68.0	80.9	72.2	54.5	-4.6

Ref: MBESHR

Source: Dataquest (April 1991)

Table 4.43
North American Diffusion Furnace Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Diffusion Furnaces
Region: North America

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Diffusion Market	155.6	145.4	294.1	330.0	322.4	20.0
Horizontal Tube						
ASM International	3.3	2.3	3.4	2.5	3.5	
BTU International	18.3	8.3	17.3	18.0	10.0	
Denko	.0	.0	.0	.0	.0	
Gasonics	6.1	7.5	9.0	8.0	6.0	
GSTC	.0	.0	3.0	4.0	3.0	
Kokusai Electric	.0	.0	1.2	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Pacific Western	.6	.0	.0	.0	.0	
Process Technology	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.0	34.0	24.0	
Solitec	.2	.0	.0	.0	.0	
TEL/Thermco	.0	.0	.0	.0	.0	
Tempress	2.0	.5	.0	.0	.0	
Thermco	12.4	15.7	42.0	.0	.0	
Tokyo Electron Ltd	.0	.0	.0	.0	.0	
Tylan	1.7	2.0	2.5	.0	.0	
Tystar	.0	.0	.0	1.6	.3	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.0	
Others	.0	.0	.0	1.3	1.9	
Total N.A. Horizontal	44.6	36.3	78.4	69.4	48.7	2.2
Vertical Tube						
ASM International	.0	.0	.0	1.0	2.0	
BTU International	.0	.0	1.0	.0	3.0	
Denko	.0	.0	.0	.0	.0	
Disco	.0	.0	.0	.0	.0	
GSTC	.0	.0	.0	3.0	5.0	
Helmut Seier	.2	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	2.7	4.2	1.7	
Semitherm	.0	.0	.5	2.0	4.0	
Silicon Valley Group	.2	.8	2.0	3.0	10.0	

(Continued)

Table 4.43 (Continued)
North American Diffusion Furnace Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
TEL/Thermco	.0	.0	.0	.0	.0	
Tokyo Electron Ltd.	.0	.0	.0	.0	.0	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	5.6	2.1	
Total N.A. Vertical	.4	.8	6.2	18.8	27.8	188.7
Total North America	45.0	37.1	84.6	88.2	76.5	14.2

Ref: DIFFSHR

Source: Dataquest (April 1991)

Table 4.44
Japanese Diffusion Furnace Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Diffusion Furnaces
Region: Japan

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Diffusion Market	155.6	145.4	294.1	330.0	322.4	20.0
Horizontal Tube						
ASM International	.0	.0	.0	2.0	2.6	
BTU International	.4	.0	.0	.0	.0	
Denko	.6	.8	.9	.0	.0	
Gasonics	.0	.0	.0	.0	1.0	
GSTC	.0	.0	.5	.0	.0	
Kokusai Electric	12.0	16.7	13.4	10.8	4.8	
Koyo Lindberg	6.0	2.6	3.3	5.0	4.5	
Pacific Western	.0	.0	.0	.0	.0	
Process Technology	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.0	.0	.0	
Solitec	.0	.0	.0	.0	.0	
TEL/Thermco	49.0	22.9	.0	.0	.0	
Tempress	.0	.0	.0	.0	.0	
Thermco	.0	.0	.0	.0	.0	
Tokyo Electron Ltd	.0	.0	44.6	52.0	38.0	
Tylan	.0	.0	.0	.0	.0	
Tystar	.0	.0	.0	.0	.0	
Ulvac/BTU	.4	1.7	9.2	10.0	13.2	
Varian/TEL	.0	.0	.0	.0	.0	
Others	.0	.0	.0	.0	.0	
Total Japan Horizontal	68.4	44.7	71.9	79.8	64.1	-1.6
Vertical Tube						
ASM International	.0	.0	.0	2.0	2.8	
BTU International	.0	.0	.0	.0	.0	
Denko	1.2	1.2	1.8	4.0	6.9	
Disco	.7	1.5	2.9	3.6	5.8	
GSTC	.0	.0	.0	.0	.0	
Helmut Seier	.3	.5	.7	.0	.0	
Koyo Lindberg	1.8	3.1	3.5	3.1	7.6	
Kokusai Electric	1.8	7.3	13.5	16.5	34.3	
Semitherm	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.8	.0	.0	

(Continued)

Table 4.44 (Continued)
Japanese Diffusion Furnace Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
TEL/Thermco	.0	.7	.0	.0	.0	
Tokyo Electron Ltd.	.0	.1	8.0	16.9	48.0	
Ulvac/BTU	.0	.0	2.3	2.3	3.3	
Varian/TEL	.0	.0	.0	.0	.0	
Total Japan Vertical	5.8	14.4	33.5	48.4	108.7	108.1
Total Japan	74.2	59.1	105.4	128.2	172.8	23.5

Ref: DIFFSHR

Source: Dataquest (April 1991)

Table 4.45
European Diffusion Furnace Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Diffusion Furnaces
Region: Europe

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Diffusion Market	155.6	145.4	294.1	330.0	322.4	20.0
Horizontal Tube						
ASM International	13.3	16.2	19.3	16.0	8.0	
BTU International	4.2	7.3	8.2	9.0	5.0	
Denko	.0	.0	.0	.0	.0	
Gasonics	.0	.0	.0	.0	.0	
GSTC	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Pacific Western	.0	.0	.0	.0	.0	
Process Technology	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.0	12.0	10.0	
Solitec	.0	.0	.0	.0	.0	
TEL/Thermco	.0	.0	.0	.0	.0	
Tempress	.0	.0	.0	.0	.0	
Thermco	11.2	13.2	12.0	.0	.0	
Tokyo Electron Ltd	.0	.0	2.3	.0	.0	
Tylan	.8	.0	.0	.0	.0	
Tystar	.0	.0	.0	.0	.0	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.7	4.2	
Others	1.7	2.5	3.5	3.5	5.2	
Total Europe Horizontal	31.2	39.2	45.3	41.2	32.4	.9
Vertical Tube						
ASM International	.0	.0	.0	3.0	3.0	
BTU International	.0	.0	.0	.0	1.5	
Denko	.0	.0	.0	.0	.0	
Disco	.0	.0	.0	.0	.0	
GSTC	.0	.0	.0	.0	.0	
Helmut Seier	.0	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	.0	.0	.0	
Semitherm	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.8	1.0	3.2	

(Continued)

Table 4.45 (Continued)
European Diffusion Furnace Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
TEL/Thermco	.0	.0	.0	.0	.0	
Tokyo Electron Ltd.	.0	.0	.0	.0	.0	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.0	
Total Europe Vertical	.0	.0	.8	4.0	7.7	NM
Total Europe	31.2	39.2	46.1	45.2	40.1	6.5

Ref: DIFFSHR

Source: Dataquest (April 1991)

Table 4.46
Asia/Pacific-ROW Diffusion Furnace Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Diffusion Furnaces
Region: Asia/Pacific-ROW

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Diffusion Market	155.6	145.4	294.1	330.0	322.4	20.0
Horizontal Tube						
ASM International	.0	.0	.0	1.5	1.5	
BTU International	1.1	3.7	8.5	14.0	3.0	
Denko	.0	.0	.0	.0	.0	
Gasonics	.0	.0	.0	.0	1.0	
GSTC	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	4.6	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Pacific Western	.0	.0	.0	.0	.0	
Process Technology	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.0	6.0	4.0	
Solitec	.1	.0	.0	.0	.0	
TEL/Thermco	.0	.0	.0	.0	.0	
Tempress	.0	.0	.0	.0	.0	
Thermco	4.0	6.0	6.0	.0	.0	
Tokyo Electron Ltd	.0	.0	27.7	21.0	6.2	
Tylan	.0	.0	.0	.0	.0	
Tystar	.0	.0	.0	.0	.2	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.0	
Others	.0	.0	.0	1.5	1.5	
Total A/P-ROW Horizontal	5.2	9.7	46.8	44.0	17.4	35.2
Vertical Tube						
ASM International	.0	.0	.0	1.0	1.0	
BTU International	.0	.0	.0	.0	1.5	
Denko	.0	.0	.0	.0	.0	
Disco	.0	.0	.0	.0	.0	
GSTC	.0	.0	.0	.0	.0	
Helmut Seier	.0	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Kokusai Electric	.0	.0	10.8	22.4	10.1	
Semitherm	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.3	.4	1.0	3.0	

(Continued)

Table 4.46 (Continued)
Asia/Pacific-ROW Diffusion Furnace Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
TEL/Thermco	.0	.0	.0	.0	.0	
Tokyo Electron Ltd.	.0	.0	.0	.0	.0	
Ulvac/BTU	.0	.0	.0	.0	.0	
Varian/TEL	.0	.0	.0	.0	.0	
Total A/P-ROW Vertical	.0	.3	11.2	24.4	15.6	NM
Total A/P-ROW	5.2	10.0	58.0	68.4	33.0	58.7

Ref: DIFFSHR

Source: Dataquest (April 1991)

Table 4.47
Worldwide Diffusion Furnace Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Diffusion Furnaces
Region: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Diffusion Market	155.6	145.4	294.1	330.0	322.4	20.0
Horizontal Tube						
ASM International	16.6	18.5	22.7	22.0	15.6	
BTU International	24.0	19.3	34.0	41.0	18.0	
Denko	.6	.8	.9	.0	.0	
Gasonics	6.1	7.5	9.0	8.0	8.0	
GSTC	.0	.0	3.5	4.0	3.0	
Kokusai Electric	12.0	16.7	19.2	10.8	4.8	
Koyo Lindberg	6.0	2.6	3.3	5.0	4.5	
Pacific Western	.6	.0	.0	.0	.0	
Process Technology	.0	.0	.0	.0	.0	
Silicon Valley Group	.0	.0	.0	52.0	38.0	
Solitec	.3	.0	.0	.0	.0	
TEL/Thermco	49.0	22.9	.0	.0	.0	
Tempress	2.0	.5	.0	.0	.0	
Thermco	27.6	34.9	60.0	.0	.0	
Tokyo Electron Ltd	.0	.0	74.6	73.0	44.2	
Tylan	2.5	2.0	2.5	.0	.0	
Tystar	.0	.0	.0	1.6	.5	
Ulvac/BTU	.4	1.7	9.2	10.0	13.2	
Varian/TEL	.0	.0	.0	.7	4.2	
Others	1.7	2.5	3.5	6.3	8.6	
Total W.W. Horizontal	149.4	129.9	242.4	234.4	162.6	2.1
Vertical Tube						
ASM International	.0	.0	.0	7.0	8.8	
BTU International	.0	.0	1.0	.0	6.0	
Denko	1.2	1.2	1.8	4.0	6.9	
Disco	.7	1.5	2.9	3.6	5.8	
GSTC	.0	.0	.0	3.0	5.0	
Helmut Seier	.5	.5	.7	.0	.0	
Koyo Lindberg	1.8	3.1	3.5	3.1	7.6	
Kokusai Electric	1.8	7.3	27.0	43.1	46.1	
Semitherm	.0	.0	.5	2.0	4.0	
Silicon Valley Group	.2	1.1	4.0	5.0	16.2	

(Continued)

Table 4.47 (Continued)
Worldwide Diffusion Furnace Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
TEL/Thermco	.0	.7	.0	.0	.0	
Tokyo Electron Ltd.	.0	.1	8.0	16.9	48.0	
Ulvac/BTU	.0	.0	2.3	2.3	3.3	
Varian/TEL	.0	.0	.0	5.6	2.1	
Total Worldwide Vertical	6.2	15.5	51.7	95.6	159.8	125.3
Total W.W.	155.6	145.4	294.1	330.0	322.4	20.0

Ref: DIFFSHR

Source: Dataquest (April 1991)

Table 4.48
Worldwide Rapid Thermal Processing
By Region
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Rapid Thermal Processing
Region of Consumption: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World RTP Market	15.5	18.2	22.3	28.1	32.9	20.7
North America						
AG Associates	5.4	5.9	6.0	6.0	9.2	
Dainippon Screen	.0	.0	.0	.0	.0	
Eaton	.2	.2	.2	.0	.0	
High Temperature Eng.	.0	.0	.0	.0	.3	
Jipelec	.0	.0	.0	.0	.0	
Koyo Lindberg	.0	.0	.0	.0	.0	
Nanosil	.0	.3	.3	.4	.4	
Peak Systems	.7	2.7	4.2	3.0	3.3	
Process Products	.5	.6	.8	1.0	.7	
Sitesa Addax	.0	.2	.0	.0	.0	
TEL/Thermco	.0	.0	.0	.0	.0	
TEL/Varian	.0	.0	.0	.0	.0	
Ushio	.0	.0	.0	.0	.0	
Varian	.2	.2	.2	.0	.0	
Total North America	7.0	10.1	11.7	10.4	13.9	18.7
Japan						
AG Associates	1.6	1.9	2.0	2.0	4.0	
Dainippon Screen	1.8	1.0	1.2	1.8	2.3	
Eaton	.2	.0	.2	.0	.0	
High Temperature Eng.	.0	.0	.0	.0	.0	
Jipelec	.0	.0	.0	.0	.0	
Koyo-Lindberg	.3	.2	.6	.6	.7	
Nanosil	.0	.0	.0	.0	.1	
Peak Systems	.0	.7	2.0	2.5	2.1	
Process Products	.0	.0	.0	.1	.0	
Sitesa Addax	.0	.0	.0	.0	.0	
TEL/Thermco	.4	.0	.0	.0	.0	
TEL/Varian	.4	.0	.0	.0	.0	
Ushio	.0	.0	.0	3.0	3.2	
Varian	.2	.7	.2	.0	.0	
Total Japan	4.9	4.5	6.2	10.0	12.4	26.1

(Continued)

Table 4.48 (Continued)
Worldwide Rapid Thermal Processing
By Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Europe						
AG Associates	1.6	2.1	1.6	1.5	.8	
Dainippon Screen	.0	.0	.0	.0	.0	
Eaton	.3	.0	.0	.0	.0	
High Temperature Eng.	.0	.0	.0	.0	.0	
Jipelec	.0	.0	.0	.0	.7	
Koyo-Lindberg	.0	.0	.0	.0	.0	
Nanosil	.0	.0	.0	.0	.0	
Peak Systems	.0	.0	.2	1.0	.9	
Process Products	.0	.1	.2	.1	.4	
Sitesa Addax	.7	.5	1.2	1.5	1.0	
TEL/Thermco	.0	.0	.0	.0	.0	
TEL/Varian	.0	.0	.0	.0	.0	
Ushio	.0	.0	.0	.0	.0	
Varian	.0	.0	.0	.0	.0	
Total Europe	2.6	2.7	3.2	4.1	3.8	10.0
Asia/Pacific-ROW						
AG Associates	1.0	.9	1.0	1.5	.6	
Dainippon Screen	.0	.0	.0	.0	.0	
Eaton	.0	.0	.0	.0	.0	
High Temperature Eng.	.0	.0	.0	.0	.0	
Jipelec	.0	.0	.0	.0	.0	
Koyo-Lindberg	.0	.0	.0	.0	.0	
Nanosil	.0	.0	.0	.0	.0	
Peak Systems	.0	.0	.2	2.0	2.1	
Process Products	.0	.0	.0	.1	.1	
Sitesa Addax	.0	.0	.0	.0	.0	
TEL/Thermco	.0	.0	.0	.0	.0	
TEL/Varian	.0	.0	.0	.0	.0	
Ushio	.0	.0	.0	.0	.0	
Varian	.0	.0	.0	.0	.0	
Total A/P-ROW	1.0	.9	1.2	3.6	2.8	29.4

(Continued)

Table 4.48 (Continued)
Worldwide Rapid Thermal Processing
By Region
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Worldwide						
AG Associates	9.6	10.8	10.6	11.0	14.6	
Dainippon Screen	1.8	1.0	1.2	1.8	2.3	
Eaton	.7	.2	.4	.0	.0	
High Temperature Eng.	.0	.0	.0	.0	.3	
Jipelec	.0	.0	.0	.0	.7	
Koyo-Lindberg	.3	.2	.6	.6	.7	
Nanosil	.0	.3	.3	.4	.5	
Peak Systems	.7	3.4	6.6	8.5	8.4	
Process Products	.5	.7	1.0	1.3	1.2	
Sitesa Addax	.7	.7	1.2	1.5	1.0	
TEL/Thermco	.4	.0	.0	.0	.0	
TEL/Varian	.4	.0	.0	.0	.0	
Ushio	.0	.0	.0	3.0	3.2	
Varian	.4	.9	.4	.0	.0	
Total Worldwide	15.5	18.2	22.3	28.1	32.9	20.7

Ref: RTPSHR

Source: Dataquest (April 1991)

Table 4.49
North American Ion Implantation Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Ion Implantation
Region of Consumption: North America

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Implanter Market	118.8	185.9	377.4	456.6	365.6	32.4
Medium Current						
Balzers	.0	.0	.0	.0	.0	
Eaton	6.6	4.0	10.0	9.0	5.7	
Nissin	.0	.0	1.2	1.3	1.9	
Sumitomo/Eaton Nova	.0	.0	.0	.0	.0	
TEL/Varian	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian	9.2	5.9	6.2	13.2	9.6	
Total Medium Current	15.8	9.9	17.4	23.5	17.2	2.1
High Current						
Applied Materials	.0	4.0	9.1	18.4	24.2	
Eaton	8.8	17.0	27.0	19.0	19.5	
Hitachi	.0	.0	.0	.0	.0	
Nissin	.0	.0	.0	2.1	1.7	
Sumitomo/Eaton Nova	.0	.0	.0	.0	.0	
TEL/Varian	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian	4.0	6.6	8.4	19.8	13.0	
Total High Current	12.8	27.6	44.5	59.3	58.4	46.2
High Voltage						
Eaton	2.0	4.5	.0	.0	.0	
Genus	.0	.0	3.2	3.4	2.5	
National Electrostatics	2.5	1.8	1.2	4.0	.0	
Nissin	.0	.0	.0	.0	.0	
Sumitomo Eaton Nova	.0	.0	.0	.0	.0	
Varian	3.9	1.8	1.8	.0	.0	
Total High Voltage	8.4	8.1	6.2	7.4	2.5	-26.1
Total North America	37.0	45.6	68.1	90.2	78.1	20.5

Ref: IMPLSHR

Source: Dataquest (April 1991)

Table 4.50
Japanese Ion Implantation Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Ion Implantation
Region of Consumption: Japan

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Implanter Market	118.8	185.9	377.4	456.6	365.6	32.4
Medium Current						
Balzers	.0	.0	.0	.0	.0	
Eaton	.0	.0	.0	.0	.0	
Nissin	10.2	11.1	26.2	34.1	30.4	
Sumitomo/Eaton Nova	1.5	2.6	2.9	.9	.0	
TEL/Varian	5.2	8.4	24.1	28.0	20.4	
Ulvac	4.8	5.2	7.5	13.8	9.7	
Varian	.7	2.3	3.4	.0	12.0	
Total Medium Current	22.4	29.6	64.1	76.8	72.5	34.1
High Current						
Applied Materials	2.2	2.0	8.6	16.5	12.1	
Eaton	.0	.0	.0	.0	.0	
Hitachi	3.2	3.8	9.6	14.4	11.2	
Nissin	1.6	1.8	4.1	14.3	7.5	
Sumitomo/Eaton Nova	3.9	18.4	42.8	47.5	51.6	
TEL/Varian	5.0	16.8	52.5	72.0	33.3	
Ulvac	.9	2.1	3.8	.0	.0	
Varian	.0	1.4	18.0	.0	20.4	
Total High Current	16.8	46.3	139.4	164.7	136.1	68.7
High Voltage						
Eaton	.0	.0	.0	.0	.0	
Genus	.0	.0	8.1	12.6	2.5	
National Electrostatics	1.1	.0	.0	.0	.0	
Nissin	.0	2.8	.0	2.9	.0	
Sumitomo Eaton Nova	.0	3.1	.0	.0	.0	
Varian	.0	.0	.0	.0	.0	
Total High Voltage	1.1	5.9	8.1	15.5	2.5	22.8
Total Japan	40.3	81.8	211.6	257.0	211.1	51.3

Ref: IMPLSHR

Source: Dataquest (April 1991)

Table 4.51
European Ion Implantation Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Ion Implantation
Region of Consumption: Europe

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Implanter Market	118.8	185.9	377.4	456.6	365.6	32.4
Medium Current						
Balzers	.0	1.4	2.1	.8	.0	
Eaton	3.5	7.0	11.0	3.5	2.6	
Nissin	.0	.0	.9	.0	.0	
Sumitomo/Eaton Nova	.0	.0	.0	.0	.0	
TEL/Varian	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian	6.9	6.7	3.9	4.4	1.2	
Total Medium Current	10.4	15.1	17.9	8.7	3.8	-22.3
High Current						
Applied Materials	2.2	4.0	7.2	14.5	9.7	
Eaton	11.8	12.0	23.0	8.2	11.9	
Hitachi	.0	.0	.0	.0	.0	
Nissin	.0	.0	.0	.0	.0	
Sumitomo/Eaton Nova	.0	.0	.0	.0	.0	
TEL/Varian	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian	3.0	5.5	2.4	3.6	5.5	
Total High Current	17.0	21.5	32.6	26.3	27.1	12.4
High Voltage						
Eaton	.0	2.2	2.5	.0	.0	
Genus	.0	.0	1.6	.0	.0	
National Electrostatics	.3	.0	.0	.0	.0	
Nissin	.0	.0	.0	.0	.0	
Sumitomo Eaton Nova	.0	.0	.0	.0	.0	
Varian	.0	1.8	.0	.0	.0	
Total High Voltage	.3	4.0	4.1	.0	.0	NM
Total Europe	27.7	40.6	54.6	35.0	30.9	2.8

Ref: IMPLSHR

Source: Dataquest (April 1991)

Table 4.52
Asia/Pacific-ROW Ion Implantation Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Ion Implantation
Region of Consumption: Asia/Pacific-ROW

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Implanter Market	118.8	185.9	377.4	456.6	365.6	32.4
Medium Current						
Balzers	.0	1.4	2.1	.8	.0	
Eaton	1.9	2.0	7.0	10.5	9.2	
Nissin	.0	.0	.0	.0	.0	
Sumitomo/Eaton Nova	.0	.0	.0	.0	.0	
TEL/Varian	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian	4.0	3.0	9.4	11.0	8.4	
Total Medium Current	5.9	6.4	18.5	22.3	17.6	31.4
High Current						
Applied Materials	.0	.0	.0	.0	.0	
Eaton	5.9	6.0	9.0	28.8	18.7	
Hitachi	.0	.0	.0	.0	.0	
Nissin	.0	.0	.0	.0	.0	
Sumitomo/Eaton Nova	.0	.0	.0	.0	.0	
TEL/Varian	.0	.0	.0	.0	.0	
Ulvac	.0	.0	.0	.0	.0	
Varian	2.0	5.5	15.6	21.6	9.2	
Total High Current	7.9	11.5	24.6	50.4	27.9	37.1
High Voltage						
Eaton	.0	.0	.0	.0	.0	
Genus	.0	.0	.0	1.7	.0	
National Electrostatics	.0	.0	.0	.0	.0	
Nissin	.0	.0	.0	.0	.0	
Sumitomo Eaton Nova	.0	.0	.0	.0	.0	
Varian	.0	.0	.0	.0	.0	
Total High Voltage	.0	.0	.0	1.7	.0	NM
Total A/P-ROW	13.8	17.9	43.1	74.4	45.5	34.8

Ref: IMPLSHR

Source: Dataquest (April 1991)

Table 4.53
Worldwide Ion Implantation Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Ion Implantation
Region of Consumption: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Implanter Market	118.8	185.9	377.4	456.6	365.6	32.4
Medium Current						
Balzers	.0	2.8	4.2	1.6	.0	
Eaton	12.0	13.0	28.0	23.0	17.5	
Nissin	10.2	11.1	28.3	35.4	32.3	
Sumitomo/Eaton Nova	1.5	2.6	2.9	.9	.0	
TEL/Varian	5.2	8.4	24.1	28.0	20.4	
Ulvac	4.8	5.2	7.5	13.8	9.7	
Varian	20.8	17.9	22.9	28.6	31.2	
Total Medium Current	54.5	61.0	117.9	131.3	111.1	19.5
High Current						
Applied Materials	4.4	10.0	24.9	49.4	46.0	
Eaton	26.5	35.0	59.0	56.0	50.1	
Hitachi	3.2	3.8	9.6	14.4	11.2	
Nissin	1.6	1.8	4.1	16.4	9.2	
Sumitomo/Eaton Nova	3.9	18.4	42.8	47.5	51.6	
TEL/Varian	5.0	16.8	52.5	72.0	33.3	
Ulvac	.9	2.1	3.8	.0	.0	
Varian	9.0	19.0	44.4	45.0	48.1	
Total High Current	54.5	106.9	241.1	300.7	249.5	46.3
High Voltage						
Eaton	2.0	6.7	2.5	.0	.0	
Genus	.0	.0	12.9	17.7	5.0	
National Electrostatics	3.9	1.8	1.2	4.0	.0	
Nissin	.0	2.8	.0	2.9	.0	
Sumitomo Eaton Nova	.0	3.1	.0	.0	.0	
Varian	3.9	3.6	1.8	.0	.0	
Total High Voltage	9.8	18.0	18.4	24.6	5.0	-15.5
Total Worldwide	118.8	185.9	377.4	456.6	365.6	32.4

Ref: IMPLSHR

Source: Dataquest (April 1991)

Table 4.54
North American Optical CD & CD SEM Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Optical CD & CD SEM
Region: North America

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Optical CD & CD SEM Market	44.1	88.7	151.0	150.2	150.5	35.9
Optical Critical Dimension						
Biorad	.0	.0	.0	.0	6.5	
Heidelberg Instruments	.0	.7	1.7	.0	.0	
Hitachi	.0	.0	.0	.3	.3	
IVS, Inc.	.5	1.4	6.4	5.2	8.0	
KLA Instruments	.0	.0	2.8	3.8	3.4	
Leica	.0	.0	.0	.0	1.5	
Leica Lasertechnik	.0	.0	.0	.0	.3	
Micro-Controle	.0	.0	.0	.0	.0	
Nanometrics	.9	1.1	1.4	.5	.4	
Nanoquest	.0	.0	.0	5.8	.0	
Nidek	.0	.0	.0	.0	.0	
Nikon	.2	.3	.5	.0	.0	
Optical Specialties	1.8	1.1	1.0	1.8	.3	
Perkin-Elmer	.0	.0	2.3	1.4	.0	
Reichert-McBain	2.7	.3	.0	.0	.0	
Ryokosha	.1	.0	.3	.0	.0	
SiScan Systems	1.7	2.3	4.9	1.9	.4	
Vickers Instruments	.0	4.9	7.0	.0	.0	
Wild Leitz	1.5	2.3	3.3	1.9	.0	
Wild Leitz Instruments	.0	.0	.0	1.4	.0	
Other CD Companies	1.9	1.5	1.8	1.4	1.2	
Total Optical CD	11.3	15.9	33.4	25.4	22.3	18.5
CD SEM						
ABT Corporation	.0	.0	.0	.0	.0	
Amray	.7	1.4	2.6	1.3	1.1	
Angstrom Measurements	.0	.0	.0	.3	.3	
Biorad	.0	.0	.0	.0	6.9	
Hitachi	2.7	7.0	10.8	15.1	13.9	
Holon	.0	.0	.0	.0	.0	
JEOL	.0	.0	.0	.0	.0	
Metrologix	.0	.0	.0	.0	.0	
Nanometrics	2.9	2.1	1.7	1.6	3.1	

(Continued)

Table 4.54 (Continued)
North American Optical CD & CD SEM Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Nanoquest	.0	.0	.0	6.5	.0	
Opal	.0	.0	1.3	1.4	.8	
Vickers	1.1	8.5	10.1	.0	.0	
Total CD SEM	7.4	19.0	26.5	26.2	26.1	37.0
Total N.A. Optical CD & CD SEM	18.7	34.9	59.9	51.6	48.4	26.8

Ref: CDSHR

Source: Dataquest (April 1991)

Table 4.55
Japanese Optical CD & CD SEM Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Optical CD & CD SEM
Region: Japan

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Optical CD & CD SEM Market	44.1	88.7	151.0	150.2	150.5	35.9
Optical Critical Dimension						
Biorad	.0	.0	.0	.0	.0	
Heidelberg Instruments	.0	.0	.4	.0	.0	
Hitachi	4.1	6.0	7.1	6.3	5.1	
IVS, Inc.	.0	.0	.0	.0	.0	
KLA Instruments	.0	.0	1.5	1.1	3.3	
Leica	.0	.0	.0	.0	.0	
Leica Lasertechnik	.0	.0	.0	.0	.0	
Micro-Controle	.0	.0	.0	.0	.0	
Nanometrics	.3	.1	.4	.0	.0	
Nanoquest	.0	.0	.0	.0	.0	
Nidek	.0	.0	.5	.3	.0	
Nikon	1.7	4.5	12.9	7.0	3.8	
Optical Specialties	.2	.0	.7	.6	.9	
Perkin-Elmer	.0	.0	.2	.0	.0	
Reichert-McBain	.0	.0	.0	.0	.0	
Ryokosha	1.4	1.4	1.7	1.4	1.0	
SiScan Systems	.2	.2	.0	2.2	.9	
Vickers Instruments	.0	.8	.0	.0	.0	
Wild Leitz	.3	.5	.2	.0	.0	
Wild Leitz Instruments	.0	.0	.0	.0	.0	
Other CD Companies	2.3	1.5	2.0	1.6	1.2	
Total Optical CD	10.5	15.0	27.6	20.5	16.2	11.5
CD SEM						
ABT Corporation	1.4	1.2	2.4	1.5	5.2	
Amray	.0	.0	.0	.0	.0	
Angstrom Measurements	.0	.0	.0	.0	.0	
Biorad	.0	.0	.0	.0	.0	
Hitachi	5.4	18.6	26.9	33.5	38.8	
Holon	.0	.8	4.8	6.1	8.9	
JEOL	.4	2.1	2.9	.0	.0	
Metrologix	.0	.0	.0	.0	.0	
Nanometrics	.0	.0	.0	.0	.0	
Nanoquest	.0	.0	.0	.3	.0	

(Continued)

Table 4.55 (Continued)
Japanese Optical CD & CD SEM Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Opal	.0	.0	.0	.0	1.6	
Vickers	.0	.0	.7	.0	.0	
Total CD SEM	7.2	22.7	37.7	41.4	54.5	65.9
Total Japan Optical CD & CD SEM	17.7	37.7	65.3	61.9	70.7	41.4

Ref: CDSHR

Source: Dataquest (April 1991)

Table 4.56
European Optical CD & CD SEM Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Optical CD & CD SEM
Region: Europe

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Optical CD & CD SEM Market	44.1	88.7	151.0	150.2	150.5	35.9
Optical Critical Dimension						
Biorad	.0	.0	.0	.0	10.1	
Heidelberg Instruments	.0	1.6	3.5	.0	.0	
Hitachi	4.1	6.0	7.1	6.6	5.4	
IVS, Inc.	.5	1.5	6.4	7.2	10.8	
KLA Instruments	.0	.0	6.2	6.5	8.6	
Leica	.0	.0	.0	.0	6.5	
Leica Lasertechnik	.0	.0	.0	.0	1.0	
Micro-Controle	.0	.0	.0	2.2	4.4	
Nanometrics	1.5	1.7	2.3	.9	.8	
Nanoquest	.0	.0	.0	9.0	.0	
Nidek	.0	.0	.5	.3	.0	
Nikon	2.3	5.2	14.3	8.0	3.8	
Optical Specialties	2.2	1.3	2.3	4.7	1.9	
Perkin-Elmer	.0	.0	2.9	1.4	.0	
Reichert-McBain	3.0	.3	.0	.0	.0	
Ryokosha	1.5	1.4	2.5	1.4	1.0	
SiScan Systems	1.9	3.0	4.9	5.0	1.3	
Vickers Instruments	.0	8.3	9.0	.0	.0	
Wild Leitz	4.8	6.4	9.8	7.9	.0	
Wild Leitz Instruments	.0	.0	.0	2.0	.0	
Other CD Companies	6.9	5.6	7.7	6.5	4.4	
Total Optical CD	28.7	42.3	79.4	69.6	60.0	20.2
CD SEM						
ABT Corporation	1.4	1.2	2.4	1.5	5.2	
Amray	.7	1.4	2.6	2.1	1.7	
Angstrom Measurements	.0	.0	.0	.3	.3	
Biorad	.0	.0	.0	.0	6.9	
Hitachi	8.6	28.8	43.1	57.0	62.0	
Holon	.0	.8	4.8	6.1	8.9	
JEOL	.4	2.1	2.9	.0	.0	
Metrologix	.0	.0	.0	.0	.0	
Nanometrics	2.9	2.5	2.5	2.3	3.1	
Nanoquest	.0	.0	.0	8.5	.0	

(Continued)

Table 4.56 (Continued)
European Optical CD & CD SEM Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Opal	.0	.0	1.3	2.8	2.4	
Vickers	1.4	9.6	12.0	.0	.0	
Total CD SEM	15.4	46.4	71.6	80.6	90.5	55.7
Total Europe Optical CD & CD SEM	44.1	88.7	151.0	150.2	150.5	35.9

Ref: CDSHR

Source: Dataquest (April 1991)

Table 4.57
Asia/Pacific-ROW Optical CD & CD SEM Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Optical CD & CD SEM
Region: Asia/Pacific-ROW

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Optical CD & CD SEM Market	44.1	88.7	151.0	150.2	150.5	35.9
Optical Critical Dimension						
Biorad	.0	.0	.0	.0	10.1	
Heidelberg Instruments	.0	1.6	3.5	.0	.0	
Hitachi	4.1	6.0	7.1	6.6	5.4	
IVS, Inc.	.5	1.5	6.4	7.2	10.8	
KLA Instruments	.0	.0	6.2	6.5	8.6	
Leica	.0	.0	.0	.0	6.5	
Leica Lasertechnik	.0	.0	.0	.0	1.0	
Micro-Controle	.0	.0	.0	2.2	4.4	
Nanometrics	1.5	1.7	2.3	.9	.8	
Nanoquest	.0	.0	.0	9.0	.0	
Nidek	.0	.0	.5	.3	.0	
Nikon	2.3	5.2	14.3	8.0	3.8	
Optical Specialties	2.2	1.3	2.3	4.7	1.9	
Perkin-Elmer	.0	.0	2.9	1.4	.0	
Reichert-McBain	3.0	.3	.0	.0	.0	
Ryokosha	1.5	1.4	2.5	1.4	1.0	
SiScan Systems	1.9	3.0	4.9	5.0	1.3	
Vickers Instruments	.0	8.3	9.0	.0	.0	
Wild Leitz	4.8	6.4	9.8	7.9	.0	
Wild Leitz Instruments	.0	.0	.0	2.0	.0	
Other CD Companies	6.9	5.6	7.7	6.5	4.4	
Total Optical CD	28.7	42.3	79.4	69.6	60.0	20.2
CD SEM						
ABT Corporation	1.4	1.2	2.4	1.5	5.2	
Amray	.7	1.4	2.6	2.1	1.7	
Angstrom Measurements	.0	.0	.0	.3	.3	
Biorad	.0	.0	.0	.0	6.9	
Hitachi	8.6	28.8	43.1	57.0	62.0	
Holon	.0	.8	4.8	6.1	8.9	
JEOL	.4	2.1	2.9	.0	.0	
Metrologix	.0	.0	.0	.0	.0	
Nanometrics	2.9	2.5	2.5	2.3	3.1	
Nanoquest	.0	.0	.0	8.5	.0	

(Continued)

Table 4.57 (Continued)
Asia/Pacific-ROW Optical CD & CD SEM Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Opal	.0	.0	1.3	2.8	2.4	
Vickers	1.4	9.6	12.0	.0	.0	
Total CD SEM	15.4	46.4	71.6	80.6	90.5	55.7
Total A/P-ROW Optical CD & CD SEM	44.1	88.7	151.0	150.2	150.5	35.9

Ref: CDSHR

Source: Dataquest (April 1991)

Table 4.58
Worldwide Optical CD & CD SEM Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Optical CD & CD SEM
Region: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Optical CD & CD SEM Market	44.1	88.7	151.0	150.2	150.5	35.9
Optical Critical Dimension						
Biorad	.0	.0	.0	.0	10.1	
Heidelberg Instruments	.0	1.6	3.5	.0	.0	
Hitachi	4.1	6.0	7.1	6.6	5.4	
IVS, Inc.	.5	1.5	6.4	7.2	10.8	
KLA Instruments	.0	.0	6.2	6.5	8.6	
Leica	.0	.0	.0	.0	6.5	
Leica Lasertechnik	.0	.0	.0	.0	1.0	
Micro-Controle	.0	.0	.0	2.2	4.4	
Nanometrics	1.5	1.7	2.3	.9	.8	
Nanoquest	.0	.0	.0	9.0	.0	
Nidek	.0	.0	.5	.3	.0	
Nikon	2.3	5.2	14.3	8.0	3.8	
Optical Specialties	2.2	1.3	2.3	4.7	1.9	
Perkin-Elmer	.0	.0	2.9	1.4	.0	
Reichert-McBain	3.0	.3	.0	.0	.0	
Ryokosha	1.5	1.4	2.5	1.4	1.0	
SiScan Systems	1.9	3.0	4.9	5.0	1.3	
Vickers Instruments	.0	8.3	9.0	.0	.0	
Wild Leitz	4.8	6.4	9.8	7.9	.0	
Wild Leitz Instruments	.0	.0	.0	2.0	.0	
Other CD Companies	6.9	5.6	7.7	6.5	4.4	
Total Optical CD	28.7	42.3	79.4	69.6	60.0	20.2
CD SEM						
ABT Corporation	1.4	1.2	2.4	1.5	5.2	
Amray	.7	1.4	2.6	2.1	1.7	
Angstrom Measurements	.0	.0	.0	.3	.3	
Biorad	.0	.0	.0	.0	6.9	
Hitachi	8.6	28.8	43.1	57.0	62.0	
Holon	.0	.8	4.8	6.1	8.9	
JEOL	.4	2.1	2.9	.0	.0	
Metrologix	.0	.0	.0	.0	.0	
Nanometrics	2.9	2.5	2.5	2.3	3.1	
Nanoquest	.0	.0	.0	8.5	.0	

(Continued)

Table 4.58 (Continued)
Worldwide Optical CD & CD SEM Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
Opal	.0	.0	1.3	2.8	2.4	
Vickers	1.4	9.6	12.0	.0	.0	
Total CD SEM	15.4	46.4	71.6	80.6	90.5	55.7
Total W.W. Optical CD & CD SEM	44.1	88.7	151.0	150.2	150.5	35.9

Ref: CDSHR

Source: Dataquest (April 1991)

Table 4.59
North American Wafer Inspection Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Wafer Inspection
Region: North America

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Wafer Inspection Market	42.1	57.7	100.5	117.2	99.0	23.8
Wafer Inspection						
Canon	.0	.0	.0	.0	.0	
Estek	.2	.1	.2	.0	.0	
Insystems	.0	1.1	6.4	7.1	7.4	
KLA Instruments	8.8	11.6	16.8	23.4	14.9	
Leica	.0	.0	.0	.0	.8	
Micro-Controle	.0	.0	.0	.0	.0	
Nidek	.0	.0	.0	.2	.8	
Nikon	1.6	2.9	3.4	4.4	4.5	
Optical Specialties	3.9	3.6	1.8	1.3	.1	
Wild Leitz	1.3	2.2	5.0	1.8	.0	
Carl Zeiss	1.0	.6	.9	.9	.7	
Other Inspection Companies	1.2	1.1	1.2	1.0	.9	
Total N.A. Wafer Inspection	18.0	23.2	35.7	40.1	30.1	13.7

Ref: INSPSHR

Source: Dataquest (April 1991)

Table 4.60
Japanese Wafer Inspection Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Wafer Inspection
Region: Japan

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Wafer Inspection Market	42.1	57.7	100.5	117.2	99.0	23.8
Wafer Inspection						
Canon	1.4	2.0	3.0	3.5	3.8	
Estek	.0	.0	.0	.0	.0	
Insystems	.0	1.1	3.4	4.2	7.0	
KLA Instruments	6.9	11.5	18.4	20.0	16.1	
Leica	.0	.0	.0	.0	.0	
Micro-Controle	.0	.0	.0	.0	.0	
Nidek	2.2	2.3	5.0	4.5	5.7	
Nikon	4.1	4.4	8.8	10.0	10.6	
Optical Specialties	.6	.0	.0	.0	.0	
Wild Leitz	.2	.0	.0	.0	.0	
Carl Zeiss	.0	.0	.0	.0	.0	
Other Inspection Companies	.4	.5	.7	.7	.5	
Total Japan Wafer Inspection	15.8	21.8	39.3	42.9	43.7	29.0

Ref: INSPSHR

Source: Dataquest (April 1991)

Table 4.61
European Wafer Inspection Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Wafer Inspection
Region: Europe

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Wafer Inspection Market	42.1	57.7	100.5	117.2	99.0	23.8
Wafer Inspection						
Canon	.0	.0	.0	.0	.0	
Estek	.0	.0	.0	.0	.0	
Insystems	.0	.0	.0	3.0	1.2	
KLA Instruments	2.4	3.6	4.8	7.0	4.7	
Leica	.0	.0	.0	.0	5.2	
Micro-Controle	.0	.0	.0	3.1	5.0	
Nidek	.0	.0	.4	.3	.2	
Nikon	.0	1.1	2.0	2.5	2.2	
Optical Specialties	.5	.2	.2	.0	.0	
Wild Leitz	1.7	2.1	4.5	6.5	.0	
Carl Zeiss	1.4	1.2	.9	.9	.7	
Other Inspection Companies	.4	.3	.1	.1	.1	
Total Europe Wafer Inspection	6.4	8.5	12.9	23.4	19.3	31.8

Ref: INSPSHR

Source: Dataquest (April 1991)

Table 4.62
Asia/Pacific-ROW Wafer Inspection Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Wafer Inspection
Region: Asia/Pacific-ROW

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Wafer Inspection Market	42.1	57.7	100.5	117.2	99.0	23.8
Wafer Inspection						
Canon	.0	.0	.0	.0	.0	
Estek	.0	.0	.0	.0	.0	
Insystems	.0	.0	.0	.0	1.2	
KLA Instruments	.0	.9	8.0	6.7	1.3	
Leica	.0	.0	.0	.0	.8	
Micro-Controle	.0	.0	.0	.0	.0	
Nidek	.0	.8	.8	.3	.0	
Nikon	.7	1.1	1.6	2.2	2.0	
Optical Specialties	.0	.2	.5	.7	.2	
Wild Leitz	.3	.4	.9	.5	.0	
Carl Zeiss	.0	.0	.0	.0	.0	
Other Inspection Companies	.9	.8	.8	.4	.4	
Total A/P-ROW Wafer Inspection	1.9	4.2	12.6	10.8	5.9	32.7

Ref: INSPSHR

Source: Dataquest (April 1991)

Table 4.63
Worldwide Wafer Inspection Market Share
By Equipment Category
(Revenue in Millions of U.S. Dollars)

Company: All
Product: Wafer Inspection
Region: Worldwide

	1986	1987	1988	1989	1990	CAGR (%) 1986-1990
World Wafer Inspection Market	42.1	57.7	100.5	117.2	99.0	23.8
Wafer Inspection						
Canon	1.4	2.0	3.0	3.5	3.8	
Estek	.2	.1	.2	.0	.0	
Insystems	.0	2.2	9.8	14.3	16.8	
KLA Instruments	18.1	27.6	48.0	57.1	37.0	
Leica	.0	.0	.0	.0	6.8	
Micro-Controle	.0	.0	.0	3.1	5.0	
Nidek	2.2	3.1	6.2	5.3	6.7	
Nikon	6.4	9.5	15.8	19.1	19.3	
Optical Specialties	5.0	4.0	2.5	2.0	.3	
Wild Leitz	3.5	4.7	10.4	8.8	.0	
Carl Zeiss	2.4	1.8	1.8	1.8	1.4	
Other Inspection Companies	2.9	2.7	2.8	2.2	1.9	
Total W.W. Wafer Inspection	42.1	57.7	100.5	117.2	99.0	23.8

Ref: INSPSHR

Source: Dataquest (April 1991)

Chapter 5

Wafer Fab Equipment—Company Rankings

This section of the wafer fab equipment database presents the ranking of wafer fab equipment manufacturers by 1990 revenue, as shown in Table 5.1. Line 1 in the table shows the total worldwide wafer fab equipment market. Individual company data shown in the table represent 86 percent of the 1990 total wafer fab equipment market of approximately $5,813 million. The companies listed here represent virtually all worldwide industry sales in the key front-end equipment categories of lithography, automatic photoresist processing, etch and clean, deposition, diffusion, ion implantation, and CD/wafer inspection. The remaining 14 percent of the total worldwide wafer fab equipment includes other process control, factory automation, and other front-end equipment. Company sales for these categories are not included in the table.

Table 5.1 includes only company sales of front-end equipment; it does not include company sales of assembly and test equipment. For instance, back-end equipment sales by General Signal or ASM International are not included. Likewise, KLA's CD/wafer inspection equipment sales only are included; KLA's sales of mask inspection equipment (part of the Other Process Control Equipment category) are not.

The revenue reported in Table 5.1 is for the calendar year and includes system sales, upgrades, and retrofits, but it does not include service and spare parts. Thus, the revenue reported here will differ from each company's sales as reported in its financial statements.

Some companies, such as Silicon Valley Group, have experienced significant growth as a result of mergers and acquisitions. Please refer to Table 1.3 in Chapter 1 for a summary of merger and acquisition activities in the wafer fab equipment industry.

Several companies are denoted as being involved in wafer fab equipment joint venture activities. The entries for these companies do not include the revenue of the joint ventures. Instead, the reader should refer to the individual entry for the joint venture equipment company. For example, the estimated revenue of the TEL/Varian or Varian/TEL joint ventures is listed separately from Tokyo Electron Ltd. and Varian Associates.

Table 5.1
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

Company: All
Product: All
Region of Consumption: All

	1986	1987	1988	1989	1990	1990 Rank
World Fab Equipment Market	2,716.4	3,139.7	4,982.6	5,996.1	5,813.1	
Nikon						1
Steppers	128.4	218.8	490.2	653.7	518.4	
Critical Dimension	2.3	5.2	14.3	8.0	3.8	
Wafer Inspection	6.4	9.5	15.8	19.1	19.3	
Total	137.1	233.5	520.3	680.8	541.5	
Applied Materials						2
Dry Etch	74.0	102.0	196.7	208.0	175.0	
APCVD	7.8	14.5	15.7	9.0	5.0	
LPCVD	.0	.0	.0	.0	26.0	
PECVD	6.1	31.0	75.4	143.0	170.0	
Sputtering	.0	.0	.0	.0	15.0	
Silicon Epitaxy	31.3	18.6	47.2	22.2	25.0	
Ion Implantation	4.4	10.0	24.9	49.4	46.0	
Total	123.6	176.1	359.9	431.6	462.0	
Tokyo Electron Ltd.						3
Resist Processing Equip.	25.6	36.2	90.5	99.3	105.9	
Dry Etch	.0	.0	44.6	80.6	99.2	
LPCVD	.0	.0	18.4	30.6	45.8	
MOCVD	.0	.0	.0	2.9	.0	
Diffusion	.0	.1	82.6	89.9	92.2	
Total	25.6	36.3	236.1	303.3	343.1	

Wafer fab equipment joint venture activity: TEL/Varian, Varian/TEL (not included here; please refer to individual entries)

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Hitachi						4
Direct Write	11.2	8.7	9.6	9.4	8.3	
Maskmaking	.0	13.4	3.8	6.6	6.2	
Steppers	8.2	33.3	49.2	75.5	102.6	
Dry Strip	.0	.0	4.6	5.0	2.7	
Dry Etch	3.6	2.1	2.3	2.3	4.5	
ECR Etch	7.2	16.7	32.3	45.3	87.0	
APCVD	.4	.0	.5	1.1	.0	
Ion Implantation	3.2	3.8	9.6	14.4	11.2	
Critical Dimension	12.7	34.8	50.2	63.6	67.4	
Total	46.5	112.8	162.1	223.2	289.9	
Canon						5
Contact Proximity	15.4	11.0	8.6	6.3	5.1	
Projection Aligners	49.2	40.6	69.1	49.4	52.1	
Steppers	63.2	89.8	125.0	182.9	202.2	
Resist Processing Equip.	.5	1.0	3.8	10.1	8.4	
Wafer Inspection	1.4	2.0	3.0	3.5	3.8	
Total	129.7	144.4	209.5	252.2	271.6	

Wafer fab equipment joint venture activity: Alcan (not included here; please refer to individual entry)

	1986	1987	1988	1989	1990	1990 Rank
Silicon Valley Group						6
Projection Aligners	.0	.0	.0	.0	37.0	
Steppers	.0	.0	.0	.0	36.0	
Resist Processing Equip.	25.6	33.0	37.4	54.0	55.0	
LPCVD	.2	5.3	7.6	16.0	22.5	
Diffusion	.2	1.1	4.0	57.0	54.2	
Total	26.0	39.4	49.0	127.0	204.7	
General Signal Companies						7
Ultratech						
Steppers	38.9	40.6	73.0	62.3	38.4	
	38.9	40.6	73.0	62.3	38.4	
Drytek						
Dry Strip	2.0	1.0	1.2	1.4	.0	
Dry Etch	16.0	17.0	25.0	30.0	22.0	
Total	18.0	18.0	26.2	31.4	22.0	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Semiconductor Systems, Inc.						
Resist Processing Equip.	8.8	10.8	22.0	22.0	23.0	
General Signal Thinfilm						
Diffusion	.0	.0	3.5	7.0	8.0	
LPCVD	.0	.0	3.8	6.0	7.0	
APCVD	.0	.0	1.3	.8	.8	
Sputtering	.0	.0	2.6	2.0	.0	
Total	.0	.0	11.2	15.8	15.8	
Circuits Proc. Apparatus						
Sputtering	2.9	3.0	.0	.0	.0	
Tempress						
Deposition	6.0	.0	.0	.0	.0	
Diffusion	2.0	.5	.0	.0	.0	
Total	8.0	.5	.0	.0	.0	
GCA						
Resist Processing Eqp.	.0	.0	.0	.0	.0	
Steppers	.0	.0	.0	68.9	78.2	
Dry Etch	.0	.0	.0	.0	.0	
Total	.0	.0	.0	68.9	78.2	
Total General Signal Cos.	76.6	72.9	132.4	200.4	177.4	
Varian Associates						8
Dry Etch	4.0	.0	.0	.0	.0	
LPCVD	3.2	7.9	6.4	5.0	.0	
Sputtering	56.7	48.3	61.3	73.0	84.0	
Molecular Beam Epitaxy	10.8	12.1	17.5	17.2	3.7	
Rapid Thermal Processing	.4	.9	.4	.0	.0	
Ion Implantation	33.7	40.5	69.1	73.6	79.3	
Total	108.8	109.7	154.7	168.8	167.0	

Wafer fab equipment joint venture activity: TEL/Varian, Varian/TEL (not included here; please refer to individual entries)

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Anelva						9
Dry Etch	10.8	18.1	38.5	45.6	23.8	
ECR Etch	5.4	4.2	3.1	2.9	5.6	
ECR CVD	.6	1.0	.8	1.0	.4	
LPCVD	.0	.7	2.3	1.1	1.4	
PECVD	.0	.0	1.4	.4	.0	
Sputtering	21.8	44.7	53.8	80.9	90.8	
Evaporation	2.3	4.9	6.2	4.3	4.1	
Molecular Beam Epitaxy	7.2	9.7	11.5	6.8	6.2	
Total	48.1	83.3	117.6	143.0	132.3	
Kokusai Electric						10
LPCVD	17.6	10.4	30.8	47.1	62.7	
Diffusion	13.8	24.0	46.2	53.9	50.9	
Dry Etch	3.3	1.4	1.5	1.0	1.1	
Silicon Epitaxy	2.1	1.5	4.2	5.7	2.2	
APCVD	.7	.0	.7	.0	.0	
Total	37.5	37.3	83.4	107.7	116.9	
Dainippon Screen						11
Resist Processing Equip.	29.8	31.2	40.2	67.7	59.2	
Wet Process	20.6	21.7	49.5	60.6	53.9	
Rapid Thermal Processing	1.8	1.0	1.2	1.8	2.3	
Total	52.2	53.9	90.9	130.1	115.4	
Ulvac						12
Dry Strip	.0	3.6	4.9	5.5	4.2	
Dry Etch	3.0	3.6	6.0	8.7	6.6	
ECR Etch	.9	2.1	2.3	.0	.0	
PECVD	3.0	2.8	2.0	1.0	1.8	
LPCVD	1.2	1.4	3.8	4.2	5.2	
Sputtering	25.4	34.0	48.7	55.7	58.5	
Evaporation	22.4	8.0	14.0	14.6	13.5	
Molecular Beam Epitaxy	4.4	4.3	7.5	4.0	4.2	
MOCVD	2.3	1.9	2.2	2.0	2.4	
Ion Implantation	5.7	7.3	11.3	13.8	9.7	
Total	68.3	69.0	102.7	109.5	106.1	

Wafer fab joint venture activity: BTU/Ulvac, Ulvac/BTU (not included here; please refer to individual entries)

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
ASM International						13
Diffusion	16.6	18.5	22.7	29.0	24.4	
PECVD	44.4	44.5	51.6	51.0	40.0	
LPCVD	20.5	19.9	25.8	18.0	16.0	
Silicon Epitaxy	.0	.0	3.1	6.2	19.2	
Total	81.5	82.9	103.2	104.2	99.6	
LAM Research						14
Dry Etch	26.0	32.0	65.0	81.0	85.0	
ECR Etch	.0	.0	.0	.0	.7	
ECR CVD	.0	.0	.0	.0	2.5	
LPCVD	.0	.0	.0	.0	2.7	
Silicon Eiptaxy	.0	14.8	19.0	22.2	7.9	
Total	26.0	46.8	84.0	103.2	98.8	
ASM Lithography						15
Steppers	9.1	36.7	58.6	123.2	91.0	
Direct Write	6.0	8.0	7.2	7.2	.0	
Maskmaking	.0	4.0	2.4	2.4	.0	
Total	15.1	48.7	68.2	132.8	91.0	
Eaton						16
Ion Implantation	40.5	54.7	89.5	79.0	67.6	
Resist Processing Equip.	12.0	10.5	11.0	10.5	10.5	
Steppers	2.1	.0	.0	.0	.0	
Rapid Thermal Processing	.7	.2	.4	.0	.0	
Total	55.3	65.4	100.9	89.5	78.1	

Wafer fab equipment joint venture activity: Sumitomo/Eaton Nova (not included here; please refer to individual entry)

	1986	1987	1988	1989	1990	1990 Rank
Materials Research Corp. (Sony)						17
Dry Etch	.0	.0	.0	.0	4.7	
Sputtering	.0	.0	.0	.0	62.6	
Total	.0	.0	.0	.0	67.3	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Novellus Systems, Inc.						18
PECVD	.0	3.6	23.7	49.0	63.0	
TEL/Varian						19
Ion Implantation	10.2	25.2	76.6	100.0	53.7	
Sumitomo/Eaton Nova						
Ion Implantation	5.4	24.1	45.7	48.4	51.6	
Genus						20
LPCVD	7.5	13.2	33.4	62.0	44.0	
Ion Implantation	.0	.0	12.9	17.7	5.0	
Total	7.5	13.2	46.3	79.7	49.0	
E.T. Electrotech						21
PECVD	15.2	13.3	20.3	15.5	17.5	
Dry Strip	.0	.0	.0	.0	.0	
Dry Etch	5.0	7.2	14.1	15.0	17.5	
Sputtering	5.3	6.0	9.0	14.1	13.5	
Total	25.5	26.5	43.4	44.6	48.5	
JEOL						22
Direct Write	30.0	30.8	31.1	31.6	35.4	
Maskmaking	11.7	18.1	5.0	15.8	10.4	
Total	41.7	48.9	36.1	47.4	45.8	
KLA Instruments						23
Critical Dimension	.0	.0	6.2	6.5	8.6	
Wafer Inspection	18.1	27.6	48.0	57.1	37.0	
Total	18.1	27.6	54.2	63.6	45.6	
Tokyo Ohka Kogyo						24
Dry Strip	5.2	9.2	19.9	26.0	23.9	
Dry Etch	7.2	7.1	10.0	21.7	18.9	
Total	12.4	16.3	29.9	47.7	42.8	
Nissin Electric						25
Ion Implantation	11.8	15.7	32.4	54.7	41.5	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Watkins-Johnson						26
APCVD	8.1	16.0	36.0	42.0	41.0	
Sanyko Engineering						27
Wet Process	7.4	8.1	23.8	35.1	38.7	
Kaijo Denki						28
Wet Process	13.5	10.1	14.6	25.2	37.1	
Varian/TEL						29
Resist Processing Equip.	.0	.0	.0	19.4	13.8	
Dry Etch	.0	.0	.0	6.2	11.6	
LPCVD	.0	.0	.0	.0	4.8	
Diffusion	.0	.0	.0	6.3	6.3	
Total	.0	.0	.0	31.9	36.5	
BTU International						30
LPCVD	5.6	7.9	14.5	17.5	12.2	
Diffusion	24.0	19.3	35.0	41.0	24.0	
Total	29.6	27.2	49.5	58.5	36.2	

Wafer fab joint venture activity: BTU/Ulvac, Ulvac/BTU (not included here; please refer to individual entries)

	1986	1987	1988	1989	1990	1990 Rank
Sumitomo Metals						31
Dry Etch	.0	.0	.0	1.7	18.0	
ECR Etch	2.4	5.6	6.2	12.0	15.0	
ECR CVD	.0	.0	.0	6.0	2.9	
Total	2.4	5.6	6.2	19.7	35.9	
Sugai						32
Wet Process	3.7	4.5	20.7	30.9	35.7	
Tegal						33
Dry Strip	3.0	5.2	5.2	3.5	3.0	
Dry Etch	25.6	35.6	46.4	41.0	31.0	
Total	28.6	40.8	51.6	44.5	34.0	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Leica and Leica Lasertechnik						34
Direct Write	.0	.0	.0	.0	15.2	
Maskmaking	.0	.0	.0	.0	2.5	
Critical Dimension	.0	.0	.0	.0	7.5	
Wafer Inspection	.0	.0	.0	.0	6.8	
Total	.0	.0	.0	.0	32.0	
Etec						35
Direct Write	.0	.0	.0	.0	9.8	
Maskmaking	.0	.0	.0	.0	21.0	
Total	.0	.0	.0	.0	30.8	
Tokuda						36
Dry Etch	4.3	9.4	3.2	32.4	24.1	
Sputtering	3.3	11.1	7.0	5.6	5.8	
Total	7.6	20.5	10.2	38.0	29.9	
Plasma Systems						37
Dry Strip	3.3	5.4	10.4	17.0	24.9	
Dry Etch	1.7	1.9	3.2	3.3	1.7	
Total	5.0	7.3	13.6	20.3	26.6	
Ulvac/BTU						38
LPCVD	.0	.5	3.5	4.0	6.2	
Diffusion	.4	1.7	11.5	12.3	16.5	
Total	.4	2.2	15.0	16.3	22.7	
Alcan Technology						39
Dry Strip	.9	5.0	10.2	13.1	11.7	
Dry Etch	.0	.0	.0	.0	2.5	
APCVD	.0	.0	.0	.0	8.3	
Total	.9	5.0	10.2	13.1	22.5	
Machine Technology, Inc.						40
Resist Processing Equip.	12.9	12.7	10.0	11.3	21.0	
Dry Strip	2.0	2.7	4.5	1.5	.2	
Sputtering	.9	3.0	5.0	1.0	.0	
Total	15.8	18.4	19.5	13.8	21.2	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Plasma-Therm						41
Dry Etch	11.0	13.7	12.9	15.2	18.0	
PECVD	5.8	4.6	6.0	3.0	3.0	
Total	16.8	18.3	18.9	18.2	21.0	
ISA Riber						42
Molecular Beam Epitaxy	13.6	19.3	22.5	22.3	19.4	
Enya						43
Wet Process	9.6	6.2	7.6	11.6	10.8	
LPCVD	1.0	.6	3.6	3.4	3.5	
PECVD	1.6	1.9	4.2	3.5	3.8	
Total	12.2	8.7	15.4	18.5	18.1	
Branson/IPC						44
Dry Strip	10.2	7.8	15.0	16.0	14.5	
Dry Etch	4.2	1.6	.0	3.2	3.5	
Total	14.4	9.4	15.0	19.2	18.0	
VG Instruments						45
Molecular Beam Epitaxy	19.4	15.0	16.5	19.0	17.4	
Biorad						46
Critical Dimension	.0	.0	.0	.0	17.0	
Semitool and Semitherm						47
Wet Process	15.9	18.8	15.4	10.9	11.5	
Diffusion	.0	.0	.5	2.0	4.0	
LPCVD	.0	.0	.5	1.0	1.5	
Total	15.9	18.8	16.4	13.9	17.0	
Insystems						48
Wafer Inspection	.0	2.2	9.8	14.3	16.8	
Koyo Lindberg						49
APCVD	.4	.2	1.3	.6	.8	
LPCVD	2.2	2.0	4.5	4.1	3.1	
Diffusion	7.8	5.7	6.8	8.1	12.1	
Rapid Thermal Processing	.3	.2	.6	.6	.7	
Total	10.7	8.1	13.2	13.4	16.7	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Shimada						50
Wet Process	.6	3.9	5.5	8.6	16.4	
MOCVD	.3	.0	.0	.0	.0	
Silicon Epitaxy	.5	.0	.0	.0	.0	
Total	1.4	3.9	5.5	8.6	16.4	
Tazmo						51
Resist Processing Equip.	2.5	4.6	5.7	9.3	16.4	
FSI International						52
Wet Process	21.2	18.3	21.3	25.2	16.2	
Gasonics						53
Dry Strip	.7	2.0	3.0	6.2	8.2	
Diffusion	6.1	7.5	9.0	8.0	8.0	
Total	6.8	9.5	12.0	14.2	16.2	
Amaya						54
APCVD	6.0	5.5	17.5	19.0	16.0	
Ramco						55
Dry Strip	4.5	8.7	9.6	11.0	16.0	
Karl Suss						56
Contact Proximity	16.0	13.6	13.7	16.3	13.5	
X-Ray Aligners	.0	.0	4.6	2.8	1.6	
Total	16.0	13.6	18.3	19.1	15.1	
AG Associates						57
Rapid Thermal Processing	9.6	10.8	10.6	11.0	14.6	
Axitron						58
MOCVD	1.7	4.9	7.5	11.4	13.9	
Balzers						59
Sputtering	13.2	13.9	11.0	8.2	7.0	
Evaporation	5.0	2.9	2.9	5.4	6.5	
Total	18.2	16.8	13.9	13.6	13.5	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Convac						60
Resist Processing Equip.	6.4	10.9	13.8	12.2	13.4	
Centrotherm						61
Diffusion	.2	.5	1.0	5.8	8.4	
LPCVD	.0	.0	.0	4.5	4.8	
Total	.2	.5	1.0	10.3	13.2	
Temescal						62
Sputtering	1.3	.0	.0	.1	.1	
Evaporation	10.5	9.9	8.7	11.2	13.0	
Total	11.8	9.9	8.7	11.3	13.1	
Verteq						63
Wet Process	8.3	6.5	11.8	12.7	12.9	
Emcore						64
Molecular Beam Epitaxy	.0	.0	.0	.0	1.0	
MOCVD	2.3	5.1	7.0	10.0	11.6	
Total	2.3	5.1	7.0	10.0	12.6	
Ateq						65
Direct Write	.0	.0	.0	.0	2.0	
Maskmaking	.0	1.6	11.2	13.7	10.3	
Total	.0	1.6	11.2	13.7	12.3	
Maruwa						66
Wet Process	.0	.0	3.6	5.4	12.3	
Toyoko Chemical						67
Wet Process	.0	.0	2.4	2.8	5.1	
LPCVD	.0	.0	.0	5.8	5.9	
MOCVD	1.0	.7	1.2	.0	.0	
Diffusion	.0	.0	.0	.0	.0	
Total	1.0	.7	3.6	8.6	11.0	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
IVS, Inc.						68
Critical Dimension	.5	1.5	6.4	7.2	10.8	
Solitec						69
Resist Processing Equip.	6.5	6.2	7.5	9.0	5.8	
LPCVD	5.3	3.6	6.0	5.0	5.0	
Diffusion	.3	.0	.0	.0	.0	
Total	12.1	9.8	13.5	14.0	10.8	
Denko						70
LPCVD	2.7	2.1	2.3	3.5	3.8	
Diffusion	1.8	2.0	2.7	4.0	6.9	
Total	4.5	4.1	5.0	7.5	10.7	
CVC Products						71
Sputtering	13.5	9.7	12.3	12.0	7.5	
Evaporation	.0	.0	1.6	2.0	2.7	
Total	13.5	9.7	13.9	14.0	10.2	
Santa Clara Plastics						72
Wet Process	20.0	16.0	14.6	16.6	10.1	
SubMicron Systems, Inc.						73
Wet Process	.0	.0	.0	2.0	10.0	
Kuwano Electric						74
Wet Process	3.9	6.3	13.6	9.4	9.6	
Micro-Controle						75
Critical Dimension	.0	.0	.0	2.2	4.4	
Wafer Inspection	.0	.0	.0	3.1	5.0	
Total	.0	.0	.0	5.3	9.4	
Leybold-Heraeus						76
Sputtering	9.6	12.0	7.8	8.8	7.8	
Evaporation	3.0	1.5	.5	1.8	1.5	
Total	12.6	13.5	8.3	10.6	9.3	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies Ranked by Worldwide Sales (Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Matrix						77
Dry Strip	2.1	5.2	7.2	7.0	9.0	
Holon						78
Critical Dimension	.0	.8	4.8	6.1	8.9	
Toshiba						79
Maskmaking	3.0	3.5	7.7	7.2	.0	
APCVD	4.3	5.0	6.0	4.2	4.2	
Silicon Epitaxy	1.0	.6	2.0	6.5	4.5	
Total	8.3	9.1	15.7	17.9	8.7	
Peak Systems						80
Rapid Thermal Processing	.7	3.4	6.6	8.5	8.4	
ETE Company, Inc.						81
Wet Process	.0	.0	2.0	4.0	8.0	
Japan Production Engineering						82
PECVD	6.0	4.5	6.5	7.0	8.0	
S&K Products International						83
Wet Process	6.9	8.5	9.4	11.6	8.0	
Universal Plastics						84
Wet Process	1.6	3.7	8.5	9.4	8.0	
Samco						85
Dry Strip	.0	.0	.8	1.0	.9	
Dry Etch	.0	.0	.0	2.2	2.8	
PECVD	.0	.0	.0	1.0	2.3	
MOCVD	.7	.6	1.0	.6	1.2	
Total	.7	.6	1.8	4.8	7.2	
Musashi						86
Wet Process	.0	.0	.5	1.9	6.8	
Nidek						87
Critical Dimension	.0	.0	.5	.3	.0	
Wafer Inspection	2.2	3.1	6.2	5.3	6.7	
Total	2.2	3.1	6.7	5.6	6.7	

1990
(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Semifab						88
Wet Process	6.4	7.7	7.0	7.6	6.5	
Athens						89
Wet Process	.0	1.0	4.0	2.0	6.4	
Disco						90
Diffusion	.7	1.5	2.9	3.6	5.8	
Yuasa						91
Resist Processing Equip.	3.0	3.6	6.0	8.8	5.8	
Nippon Sanso						92
MOCVD	4.6	4.9	6.3	6.8	5.6	
LPE						93
Silicon Epitaxy	.0	.0	4.5	4.8	5.5	
Tohokasei						94
Wet Process	.0	.0	3.3	3.5	5.3	
ABT Corporation						95
Critical Dimension	1.4	1.2	2.4	1.5	5.2	
Plasma Technology						96
ECR Etch	.0	.0	1.6	2.0	2.4	
ECR CVD	.0	.0	1.6	2.0	2.4	
Total	.0	.0	3.2	4.0	4.8	
Dan Science Co., Ltd.						97
Wet Process	.0	.0	2.9	3.9	4.6	
Denton Vacuum						98
Sputtering	.1	.1	.1	.9	1.5	
Evaporation	.2	.2	.2	1.2	3.0	
Total	.3	.3	.3	2.1	4.5	
CHA Industries						99
Sputtering	.7	.3	.7	.1	.4	
Evaporation	5.6	6.0	6.3	7.1	4.0	
Total	6.3	6.3	7.0	7.2	4.4	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	Rank
Nanometrics						100
Critical Dimension	4.4	4.2	4.8	3.2	3.9	
Spectrum CVD						101
LPCVD	.5	2.3	1.4	3.6	3.2	
Ushio						102
Rapid Thermal Processing	.0	.0	.0	3.0	3.2	
Kyoritsu						103
Wet Process	.0	.0	2.7	2.5	3.1	
Moore						104
Silicon Epitaxy	.0	.0	1.0	1.6	3.0	
Process Technology, Ltd.						105
LPCVD	5.4	4.3	4.0	2.5	3.0	
Chlorine Engineering						106
Dry Strip	.5	.6	.0	2.8	2.7	
Dalton Corporation						107
Wet Process	.0	.0	.0	2.6	2.6	
Eiko						108
Molecular Beam Epitaxy	1.2	1.4	1.2	2.9	2.6	
Pacific Western						109
LPCVD	.5	.0	.0	.0	.0	
PECVD	6.9	7.9	6.2	2.8	2.5	
APCVD	1.2	.2	.0	.0	.0	
Diffusion	.6	.0	.0	.0	.0	
Total	9.2	8.1	6.2	2.8	2.5	
Opal						110
Critical Dimension	.0	.0	1.3	2.8	2.4	
CVT						111
MOCVD	.4	1.1	1.6	2.0	2.2	
Optical Specialties, Inc.						112
Critical Dimension	2.2	1.3	2.3	4.7	1.9	
Wafer Inspection	5.0	4.0	2.5	2.0	.3	
Total	7.2	5.3	4.8	6.7	2.2	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Pokorny						113
Wet Process	3.1	4.3	4.7	8.2	2.2	
CFM Technology						114
Wet Process	.0	.0	1.0	.3	2.1	
Fuji Electric						115
Wet Process	.0	.0	2.6	10.7	2.0	
Amray						116
Critical Dimension	.7	1.4	2.6	2.1	1.7	
Nippon EMC						117
MOCVD	1.5	1.4	1.9	2.2	1.7	
Spire						118
MOCVD	3.3	1.3	2.1	2.4	1.7	
BTU/Ulvac						119
LPCVD	.0	.0	.0	.0	1.6	
Kurt J. Lesker						120
Sputtering	.8	.8	.8	.8	1.0	
Evaporation	.3	.3	.3	.6	.6	
Total	1.1	1.1	1.1	1.4	1.6	
Fusion Semiconductor Systems						121
Dry Strip	.0	.5	1.0	1.5	1.5	
LFE						122
Dry Strip	1.0	1.0	1.5	1.7	1.4	
Carl Zeiss						123
Wafer Inspection	2.4	1.8	1.8	1.8	1.4	
MR Semicon						124
MOCVD	.0	.0	.0	2.0	1.3	
Pure Aire Corporation						125
Wet Process	1.8	2.4	2.8	3.0	1.3	
SiScan Systems						126
Critical Dimension	1.9	3.0	4.9	5.0	1.3	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Alameda Instruments						127
Wet Process	.0	.0	.0	.0	1.2	
Elionix						128
ECR Etch	.2	.3	.3	.3	1.2	
Innotec						129
Sputtering	1.8	2.4	4.2	.5	.8	
Evaporation	.2	.0	1.0	.2	.4	
Total	2.0	2.4	5.2	.7	1.2	
Process Products						130
Rapid Thermal Processing	.5	.7	1.0	1.3	1.2	
CPA						131
Sputter	.0	.0	.0	.0	1.0	
Dexon						132
Wet Process	3.1	3.1	5.5	6.4	1.0	
Ryokosha						133
Critical Dimension	1.5	1.4	2.5	1.4	1.0	
Sitesa						134
Rapid Thermal Processing	.0	.7	1.2	1.5	1.0	
Sputtered Films						135
Sputtering	1.6	1.0	.6	1.2	1.0	
Rapro						136
Silicon Epitaxy	.0	.0	.0	.9	.9	
Tystar						137
LPCVD	.0	.0	.0	1.3	.4	
Diffusion	.0	.0	.0	1.6	.5	
Total	.0	.0	.0	2.9	.9	
Adv. Film Technology, Inc.						138
Sputter	.0	.0	.0	.0	.7	
CVD Equipment						139
MOCVD	.6	1.2	1.3	1.3	.7	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Jipelec						140
RTP	.0	.0	.0	.0	.7	
Bjorne Enterprises						141
Dry Strip	.0	.0	.0	.0	.5	
Nanosil						142
RTP	.0	.3	.3	.4	.5	
Poly-Flow Engineering						143
Wet Process	.5	.5	.2	4.4	.5	
SCI Manufacturing						144
Wet Process	.0	4.5	1.9	2.4	.4	
Angstrom Measurements						145
Critical Dimension	.0	.0	.0	.3	.3	
High Temperature Engineering						146
RTP	.0	.0	.0	.0	.3	
Wellman Furnaces						147
LPCVD	.0	.0	.5	.3	.0	
Diffusion	1.5	2.0	2.5	.5	.2	
Total	1.5	2.0	3.0	.8	.2	
Ion Tech						148
Sputter	.7	.7	.5	.1	.1	
AET Addax						
RTP	.7	.0	.0	.0	.0	
American Semiconductor Equipment Technology						
Steppers	11.6	11.3	16.0	4.0	.0	
Anicon						
LPCVD	8.8	.0	.0	.0	.0	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Cambridge Instruments						
Direct Write	14.5	10.0	8.0	12.0	.0	
Maskmaking	.0	.0	5.0	2.5	.0	
MOCVD	3.6	3.3	2.7	.0	.0	
Total	18.1	13.3	15.7	14.5	.0	
Chemitronics						
Dry Strip	.0	.0	1.4	.0	.0	
Crystal Specialties						
MOCVD	2.7	2.6	2.7	.0	.0	
Daiwa Semiconductor						
MOCVD	.4	.4	.5	.0	.0	
EEV						
MOCVD	1.4	.7	.0	.0	.0	
Epitaxy, Inc.						
Silicon Epitaxy	.0	.0	.0	.0	.0	
Ergo Plasma Systems						
Dry Etch	.0	.0	.0	.0	.0	
Estek						
Wet Process	.0	1.2	1.1	.0	.0	
Wafer Inspection	.2	.1	.2	.0	.0	
Total	.2	1.3	1.3	.0	.0	
Focus Semiconductor						
LPCVD	.0	1.0	2.5	.0	.0	
GCA						
Resist Processing Eqp.	12.3	7.0	5.5	.0	.0	
Steppers	74.6	47.4	104.0	.0	.0	
Dry Etch	2.0	4.0	5.0	.0	.0	
Total	88.9	58.4	114.5	.0	.0	
Gemini						
Silicon Epitaxy	11.4	.0	.0	.0	.0	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Hampshire Instruments						
X-Ray	.0	.0	1.8	.0	.0	
Heidelberg Instruments						
Critical Dimension	.0	1.6	3.5	.0	.0	
Helmut Seier						
LPCVD	.0	.3	.3	.0	.0	
Diffusion	.5	.5	.7	.0	.0	
Total	.5	.8	1.0	.0	.0	
Integrated Air Systems						
Wet Process	4.0	3.0	2.0	.0	.0	
Materials Research Corp.						
Dry Etch	4.1	4.4	13.0	7.4	.0	
Sputter	21.9	23.1	34.0	54.0	.0	
Total	26.0	27.5	47.0	61.4	.0	
Micronix						
X-Ray	.8	.0	.0	.0	.0	
Nanoquest						
Critical Dimension	.0	.0	.0	17.5	.0	
National Electrostatics						
Ion Implantation	3.9	1.8	1.2	4.0	.0	
Perkin-Elmer						
Projection	121.8	88.0	78.6	44.9	.0	
Steppers	27.0	25.2	5.0	12.0	.0	
Direct Write	6.4	9.6	12.8	9.9	.0	
Maskmaking	36.0	27.0	27.0	21.0	.0	
X-Ray	.0	.0	.0	2.0	.0	
Dry Etch	9.2	.0	.0	.0	.0	
MBE	7.2	5.0	2.8	.0	.0	
Sputter	5.6	3.1	.9	1.0	.0	
Critical Dimension	.0	.0	2.9	1.4	.0	
Total	213.2	157.9	130.0	92.2	.0	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Reichert-McBain						
Critical Dimension	3.0	.3	.0	.0	.0	
Seiden Sha						
MOCVD	1.3	.6	.6	.0	.0	
Seiko						
MBE	2.0	1.2	1.4	.0	.0	
Semco Engineering						
MOCVD	.0	.3	.9	1.0	.0	
TEL/Lam						
Dry Etch	6.0	17.4	.0	.0	.0	
TEL/Thermco						
LPCVD	7.6	8.3	.0	.0	.0	
MOCVD	3.0	2.9	1.7	.0	.0	
Diffusion	49.0	23.6	.0	.0	.0	
RTP	.4	.0	.0	.0	.0	
Total	60.0	34.8	1.7	.0	.0	
Thermco						
LPCVD	6.4	7.0	6.5	.0	.0	
Diffusion	27.6	34.9	60.0	.0	.0	
Total	34.0	41.9	66.5	.0	.0	
Thomas Schwonn						
MOCVD	.3	.7	.8	.0	.0	
Tylan						
LPCVD	.7	4.0	1.5	.0	.0	
Diffusion	2.5	2.0	2.5	.0	.0	
Total	3.2	6.0	4.0	.0	.0	
Wild Leitz and Wild Leitz Instruments						
Critical Dimension	4.8	6.4	9.8	9.9	.0	
Wafer Inspection	3.5	4.7	10.4	8.8	.0	
Total	8.3	11.1	20.2	18.7	.0	

(Continued)

Table 5.1 (Continued)
Semiconductor Wafer Fab Equipment Companies
Ranked by Worldwide Sales
(Revenue in Millions of U.S. Dollars)

	1986	1987	1988	1989	1990	1990 Rank
Veeco						
Track	2.9	.0	.0	.0	.0	
Vickers Instruments						
Critical Dimension	1.4	17.9	21.0	.0	.0	

Ref: CMPRNK90

Source: Dataquest (April 1991)

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Semiconductor Equipment, Manufacturing, and Materials Forecast

November 1991

Source: Dataquest

Market Statistics

Semiconductor Equipment, Manufacturing, and Materials

Dataquest

Semiconductor Equipment, Manufacturing, and Materials Forecast

November 1991

Source: Dataquest

Market Statistics

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Table of Contents

This booklet is divided into five major sections.

Chapter 1

Semiconductor Consumption Forecast

Introduction

This section presents data on the worldwide semiconductor market by region. The regional semiconductor market, or regional semiconductor consumption, deals with where chips are consumed; this contrasts with regional semiconductor production, which deals with where chips are made. The data presented here are for the merchant market and do not include the value of chips made by captive semiconductor manufacturers for internal use.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Semiconductor Consumption

Table 1.1 shows the historical regional semiconductor consumption for the years 1985 through 1990; it also breaks down the merchant market by nationality of the merchant semiconductor companies. Table 1.2 shows forecast semiconductor consumption by region for the period from 1990 through 1995. Figures 1.1 and 1.2 graphically illustrate the data from Tables 1.1 and 1.2. Figure 1.3 depicts the share of the worldwide market by nationality of semiconductor company for the period from 1985 through 1990. Figure 1.4 illustrates worldwide market share by nationality of producer, covering the years 1985 and 1990.

Table 1.1
Worldwide Semiconductor Consumption by Region
Merchant Semiconductor Company in the Region—Historical
(In Millions of U.S. Dollars)

	1985	1986	1987	1988	1989	1990	Market Share (%) 1990
North America							
North American Companies	7,380	8,566	9,671	11,146	11,715	11,942	68.7
Japanese Companies	1,279	1,434	2,110	3,277	4,574	3,777	21.7
European Companies	731	751	913	1,006	1,025	1,074	6.2
Asia/Pacific-ROW Companies	28	93	164	415	623	593	3.4
Total North American Market	9,418	10,844	12,858	15,844	17,937	17,386	100.0
Japan							
North American Companies	695	933	1,249	1,965	2,162	2,402	10.7
Japanese Companies	7,387	10,851	13,588	18,630	20,628	19,825	88.1
European Companies	60	63	70	115	130	164	.7
Asia/Pacific-ROW Companies	7	8	20	62	77	117	.5
Total Japanese Market	8,149	11,855	14,927	20,772	22,997	22,508	100.0
Europe							
North American Companies	2,428	2,580	2,845	3,664	4,032	4,492	42.1
Japanese Companies	549	715	900	1,466	1,924	1,814	17.0
European Companies	1,806	2,282	2,714	3,196	3,562	4,117	38.6
Asia/Pacific-ROW Companies	12	10	39	165	237	238	2.2
Total European Market	4,795	5,587	6,498	8,491	9,755	10,661	100.0
Asia/Pacific-ROW							
North American Companies	548	730	1,165	1,811	2,069	2,701	35.2
Japanese Companies	929	1,160	1,852	2,569	2,683	2,961	38.6
European Companies	254	347	503	600	726	851	11.1
Asia/Pacific-ROW Companies	248	311	448	772	1,046	1,157	15.1
Total Asia/Pacific-ROW Market	1,979	2,548	3,968	5,752	6,524	7,670	100.0
Worldwide							
North American Companies	11,051	12,809	14,930	18,586	19,978	21,537	37.0
Japanese Companies	10,144	14,160	18,450	25,942	29,809	28,377	48.7
European Companies	2,851	3,443	4,200	4,917	5,443	6,206	10.7
Asia/Pacific-ROW Companies	295	422	671	1,414	1,983	2,105	3.6
Total Worldwide Market	24,341	30,834	38,251	50,859	57,213	58,225	100.0
Percent Growth	-16	27	24	33	12	2	

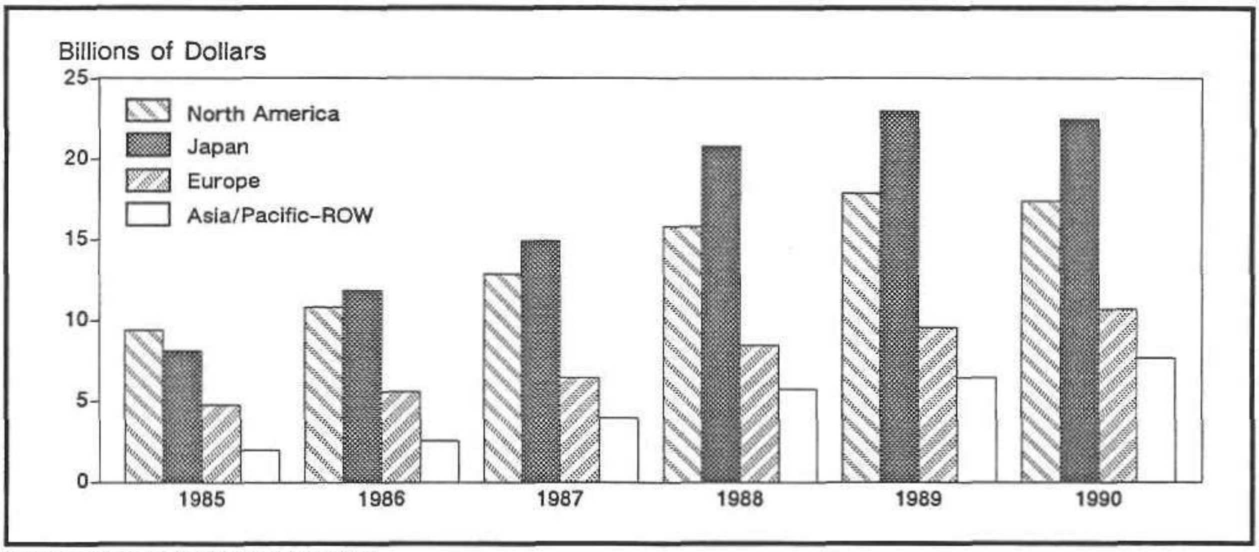
Source: Dataquest (November 1991)

Table 1.2
Worldwide Semiconductor Consumption by Region
Merchant Semiconductor Company Sales Only—Forecast
(In Millions of U.S. Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America	17,386	18,483	20,728	23,888	26,758	28,816	11
Percent Growth	-3.1	6.3	12.1	15.2	12.0	7.7	
Japan	22,508	25,544	29,524	33,341	37,208	40,232	12
Percent Growth	-2.1	13.5	15.6	12.9	11.6	8.1	
Europe	10,661	10,828	11,556	13,777	15,335	16,368	9
Percent Growth	9.3	1.6	6.7	19.2	11.3	6.7	
Asia/Pacific-ROW	7,670	8,792	10,405	12,532	14,486	16,246	16
Percent Growth	17.6	14.6	18.3	20.4	15.6	12.1	
Total Worldwide Market	58,225	63,647	72,213	83,538	93,787	101,662	12
Percent Growth	1.8	9.3	13.5	15.7	12.3	8.4	

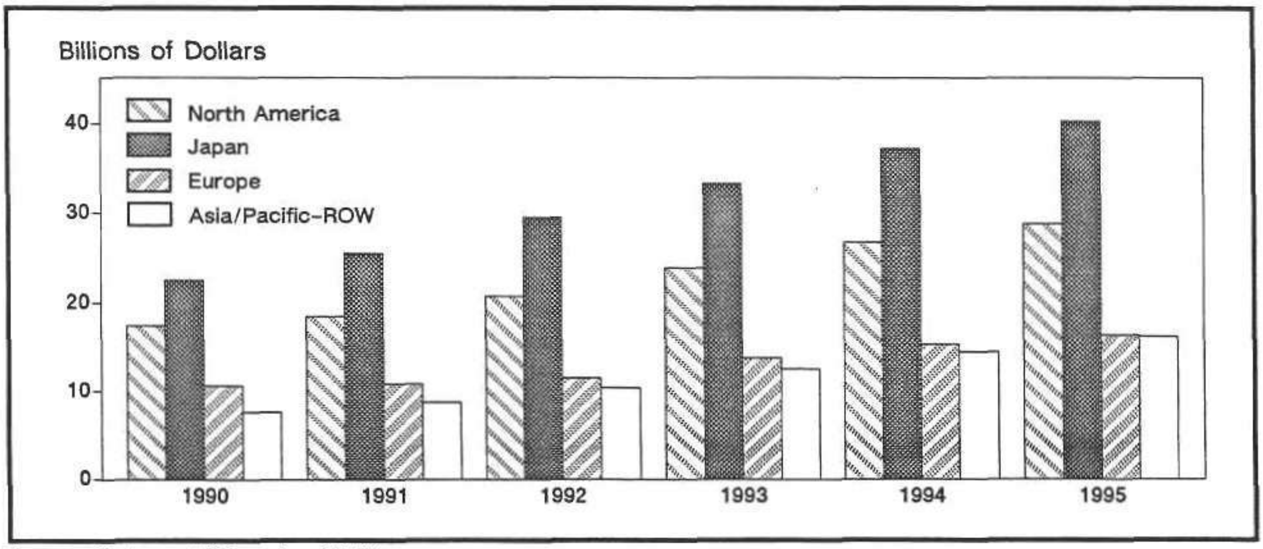
Source: Dataquest (November 1991)

Figure 1.1
Worldwide Semiconductor Consumption
Merchant Market—Historical



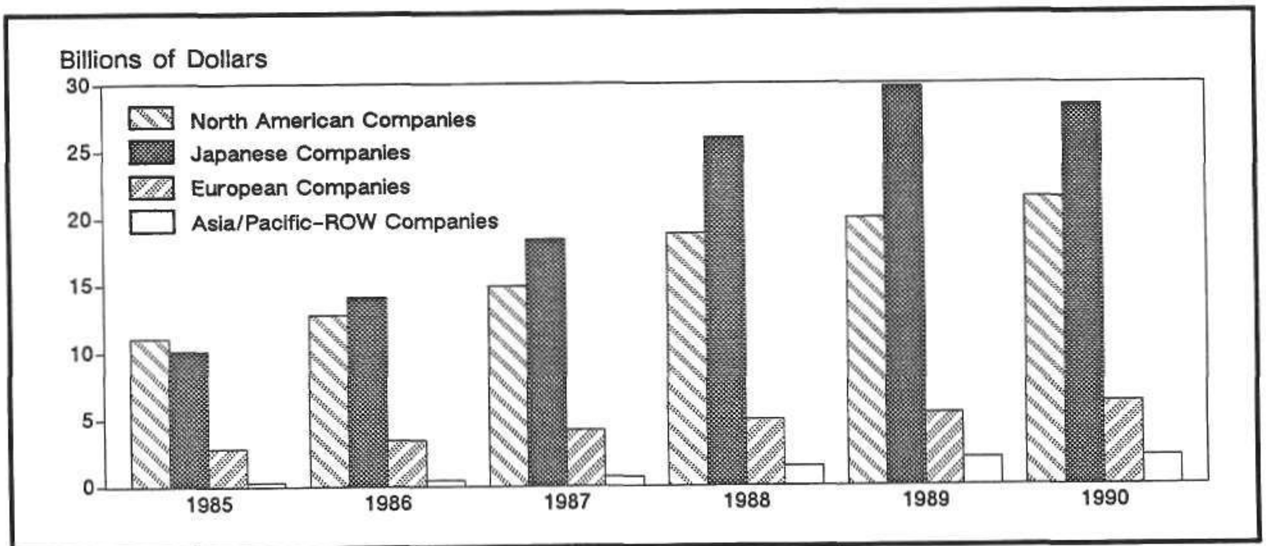
Source: Dataquest (November 1991)

Figure 1.2
Worldwide Semiconductor Consumption
Merchant Market—Forecast



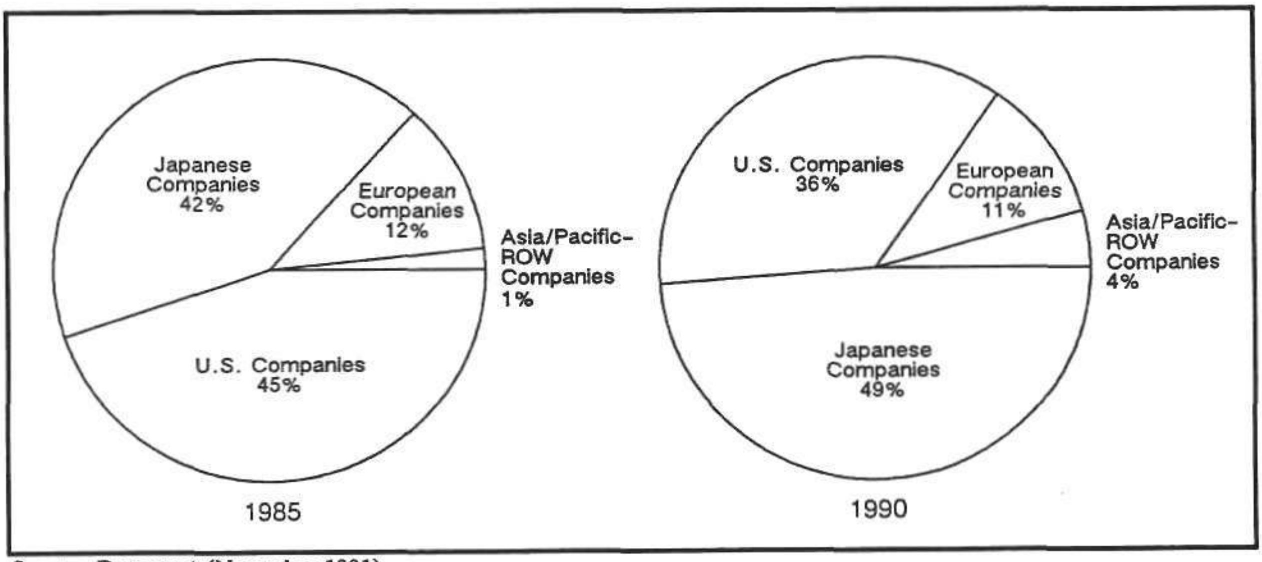
Source: Dataquest (November 1991)

Figure 1.3
Merchant Semiconductor Company Sales
Worldwide Market Share—Historical



Source: Dataquest (November 1991)

Figure 1.4
Merchant Semiconductor Company Sales
Worldwide Market Share



Source: Dataquest (November 1991)

Chapter 2

Semiconductor Production Forecast

Introduction

This section presents data on worldwide semiconductor production by region. Semiconductor production is defined by the place where the wafers are fabricated, and regional semiconductor production includes all production in the region including merchant and captive producers and all foreign producers. For instance, North American semiconductor production includes IBM and Delco fabs as well as Japanese and European fabs in the United States.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Semiconductor Production

Table 2.1 shows historical semiconductor production for the years 1985 through 1990, and Table 2.2 shows forecast production for the period from 1990 through 1995. Figures 2.1 and 2.2 illustrate the same data. Figure 2.3 depicts the five-year trend for regional production; it shows percent production by region in 1985 and in 1990.

Table 2.1
Worldwide Semiconductor Production by Region—Historical
Merchant and Captive Semiconductor Manufacturers
(Millions of U.S. Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
North America							
Merchant	10,411	12,129	14,116	17,326	18,480	19,621	13.5
Captive	2,243	2,327	2,596	2,845	3,244	3,458	9.0
Total North America	12,654	14,456	16,712	20,171	21,724	23,078	12.8
Japan							
Merchant	10,500	14,524	18,824	26,388	30,000	28,698	22.3
Captive	151	162	180	305	440	523	28.2
Total Japan	10,651	14,686	19,004	26,693	30,440	29,221	22.4
Europe							
Merchant	3,024	3,426	4,223	5,277	5,995	7,000	18.3
Captive	379	405	451	512	557	566	8.4
Total Europe	3,403	3,831	4,674	5,789	6,552	7,566	17.3
Asia/Pacific-ROW							
Merchant	406	756	1,088	1,868	2,738	2,906	48.2
Captive	0	0	0	0	0	0	
Total A/P-ROW	406	756	1,088	1,868	2,738	2,906	48.2
Total Worldwide							
Merchant	24,341	30,834	38,251	50,859	57,213	58,225	19.1
Captive	2,773	2,894	3,227	3,662	4,241	4,547	10.4
Total Production	27,114	33,728	41,478	54,521	61,454	62,771	18.3
Percent Growth	-16	24	23	31	13	2	

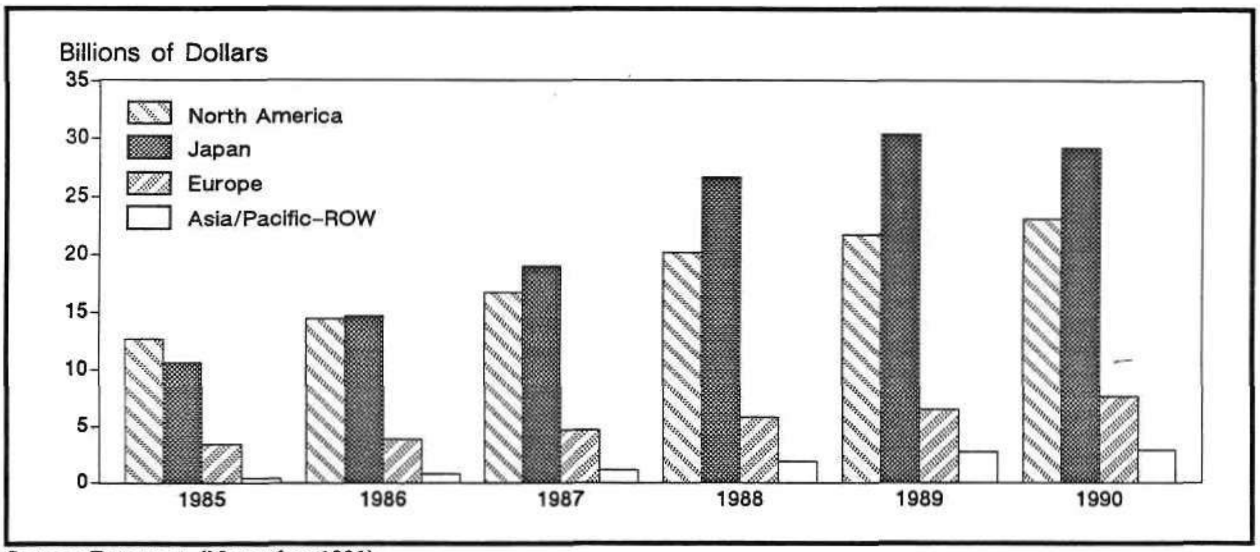
Source: Dataquest (November 1991)

Table 2.2
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Forecast
(Millions of U.S. Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America							
Merchant	19,621	21,268	24,113	27,919	30,769	33,238	11.1
Captive	3,458	4,157	4,849	5,532	6,217	6,447	13.3
Total North America	23,078	25,425	28,962	33,451	36,986	39,685	11.5
Japan							
Merchant	28,698	31,319	35,373	40,602	45,658	49,104	11.3
Captive	523	671	818	931	1,008	1,025	14.4
Total Japan	29,221	31,990	36,191	41,534	46,666	50,128	11.4
Europe							
Merchant	7,000	7,747	8,759	10,233	11,686	12,937	13.1
Captive	566	756	889	1,054	1,182	1,218	16.6
Total Europe	7,566	8,503	9,648	11,288	12,868	14,155	13.3
Asia/Pacific-ROW							
Merchant	2,906	3,312	3,968	4,783	5,674	6,384	17.0
Captive	0	0	0	0	0	0	
Total A/P-ROW	2,906	3,312	3,968	4,783	5,674	6,384	17.0
Total Worldwide							
Merchant	58,225	63,647	72,213	83,538	93,787	101,662	11.8
Captive	4,547	5,584	6,556	7,518	8,407	8,691	13.8
Total Production	62,771	69,231	78,769	91,056	102,194	110,353	11.9
Percent Growth	2	10	14	16	12	8	

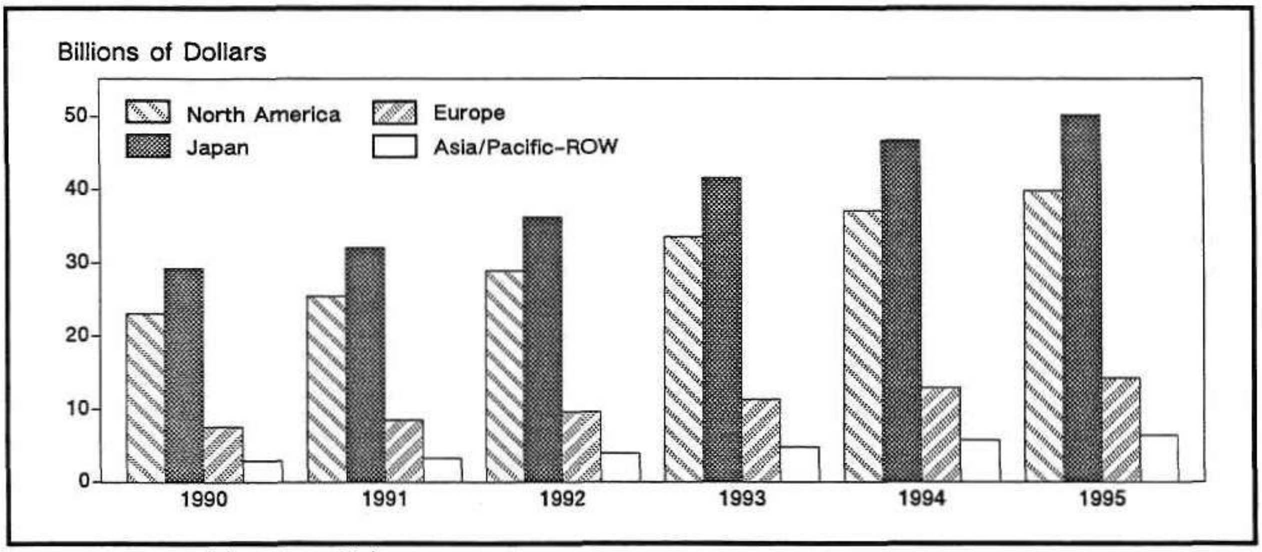
Source: Dataquest (November 1991)

Figure 2.1
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Historical



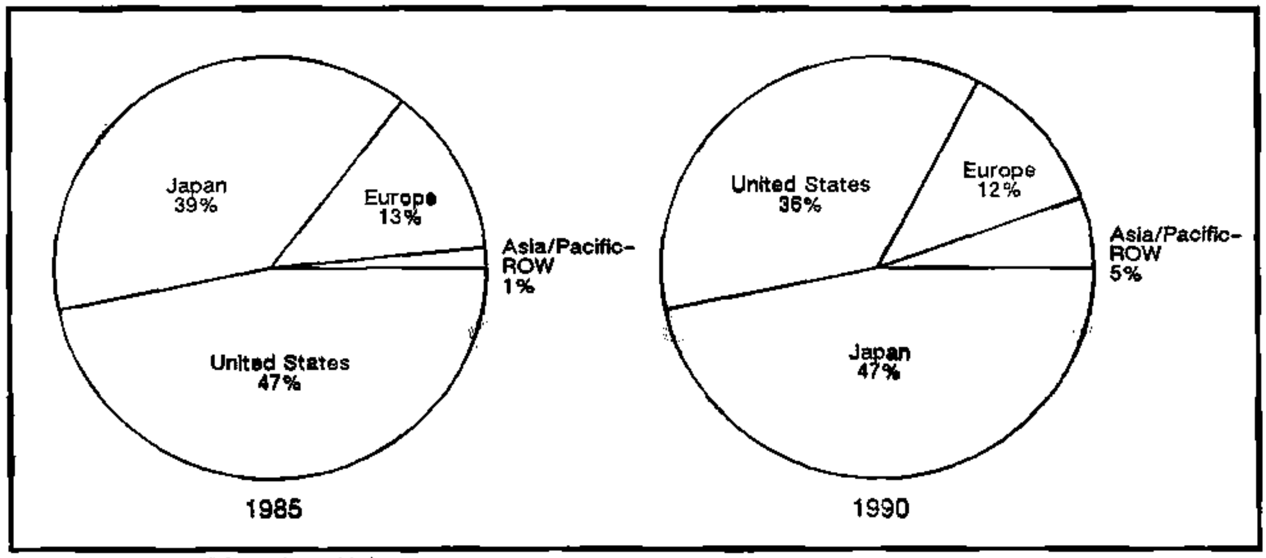
Source: Dataquest (November 1991)

Figure 2.2
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Forecast



Source: Dataquest (November 1991)

Figure 2.3
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers



Source: Dataquest (November 1991)

Chapter 3

Capital Spending Forecast

Introduction

This section presents data on worldwide semiconductor capital spending by region. Capital spending in a region includes spending by all semiconductor producers in that region, including spending by merchant and captive producers as well as foreign producers. For instance, capital spending in North America includes spending by Delco, IBM, and Japanese and European semiconductor companies building wafer fabrication, assembly, and test facilities in the United States.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Capital Spending Forecast

Table 3.1 shows historical capital spending for the years 1985 through 1990, and Table 3.2 shows forecast spending for the period from 1990 through 1995. Figures 3.1 and 3.2 illustrate the same data graphically. Figure 3.3 depicts the five-year trend for regional capital spending; it shows percentage of spending by region in 1985 and in 1990.

Table 3.1
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Companies—Historical
(Millions of U.S. Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
North America							
Merchant	1,957	1,438	1,911	2,649	3,004	3,208	10.4
Captive	672	644	683	785	871	880	5.5
Total North America	2,629	2,082	2,594	3,434	3,875	4,088	9.2
Japan							
Merchant	3,292	1,802	2,345	4,440	5,363	5,271	9.9
Captive	44	43	87	170	110	154	28.5
Total Japan	3,336	1,845	2,432	4,610	5,473	5,425	10.2
Europe							
Merchant	711	653	796	864	1,053	1,412	14.7
Captive	89	112	79	120	158	100	2.4
Total Europe	800	765	875	984	1,211	1,512	13.6
Asia/Pacific-ROW							
Merchant	534	437	534	1,060	1,905	1,495	22.9
Captive	0	0	0	0	0	0	
Total A/P-ROW	534	437	534	1,060	1,905	1,495	22.9
Total Worldwide							
Merchant	6,494	4,330	5,586	9,013	11,324	11,385	11.9
Captive	805	799	849	1,075	1,139	1,134	7.1
Total Capital Spending	7,299	5,129	6,435	10,088	12,463	12,519	11.4
Percent Growth	-17	-30	25	57	24	0	

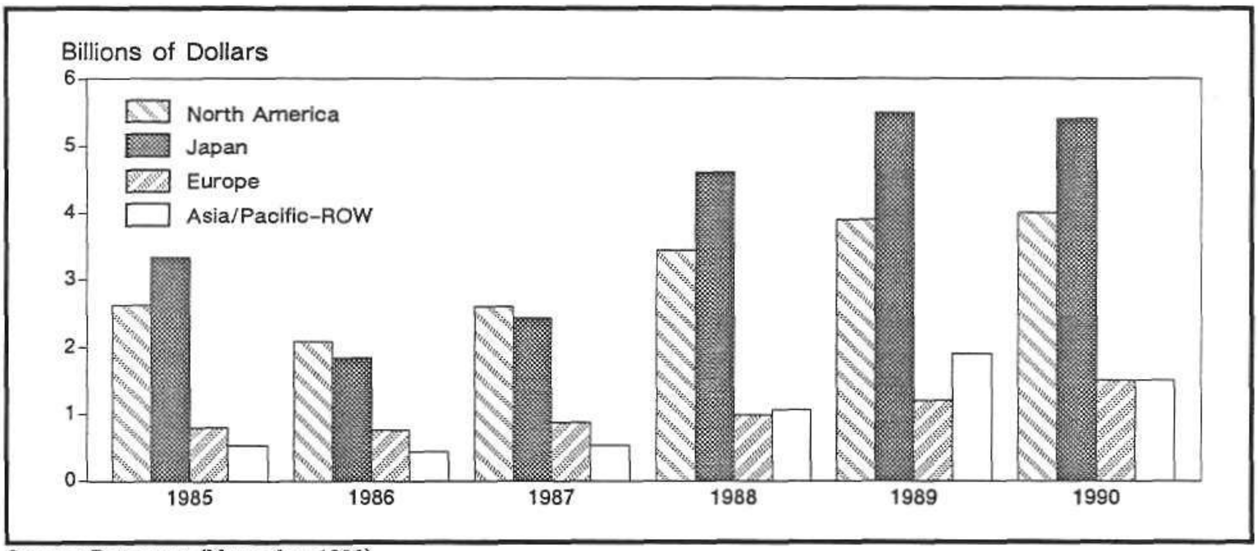
Source: Dataquest (November 1991)

Table 3.2
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Companies—Forecast
(Millions of U.S. Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America							
Merchant	3,208	3,164	2,896	3,292	3,572	3,937	4.2
Captive	880	933	925	1,060	1,215	1,280	7.8
Total North America	4,088	4,097	3,821	4,352	4,787	5,217	5.0
Japan							
Merchant	5,271	6,238	5,670	6,426	7,245	7,509	7.3
Captive	154	144	158	160	197	235	8.8
Total Japan	5,425	6,382	5,828	6,586	7,442	7,744	7.4
Europe							
Merchant	1,412	1,473	1,536	1,809	2,111	2,314	10.4
Captive	100	158	152	175	211	240	19.1
Total Europe	1,512	1,631	1,688	1,984	2,322	2,554	11.1
Asia/Pacific-ROW							
Merchant	1,495	2,084	2,543	2,825	3,248	3,573	19.0
Captive	0	0	0	0	0	0	
Total A/P-ROW	1,495	2,084	2,543	2,825	3,248	3,573	19.0
Total Worldwide							
Merchant	11,385	12,959	12,645	14,352	16,175	17,334	8.8
Captive	1,134	1,235	1,234	1,395	1,624	1,756	9.1
Total Capital Spending	12,519	14,194	13,879	15,747	17,799	19,090	8.8
Percent Growth	0	13	-2	13	13	7	

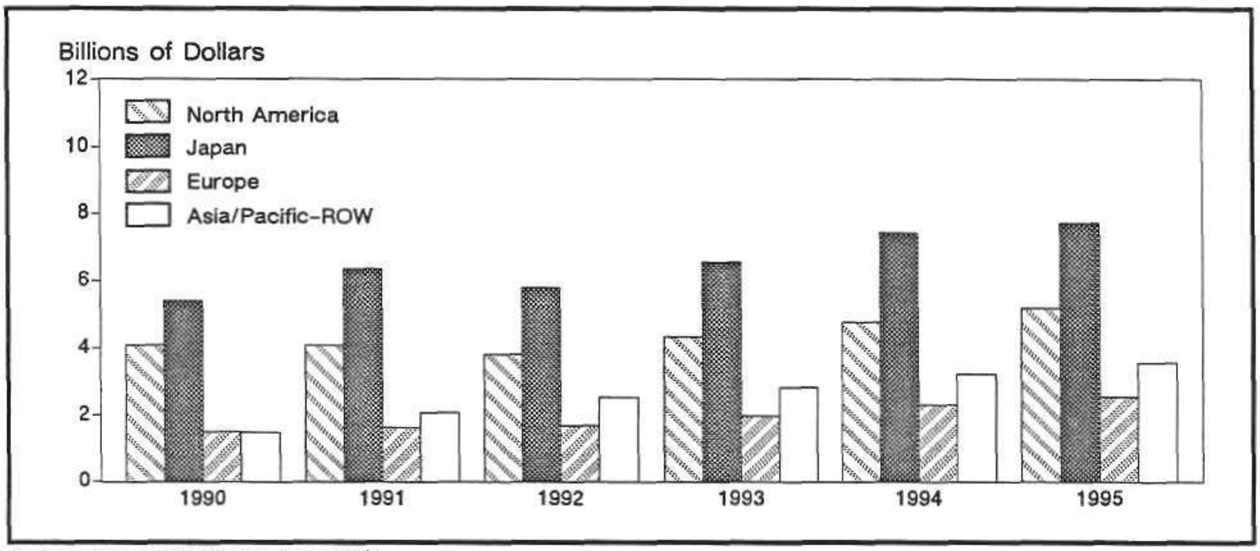
Source: Dataquest (November 1991)

Figure 3.1
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers—Historical



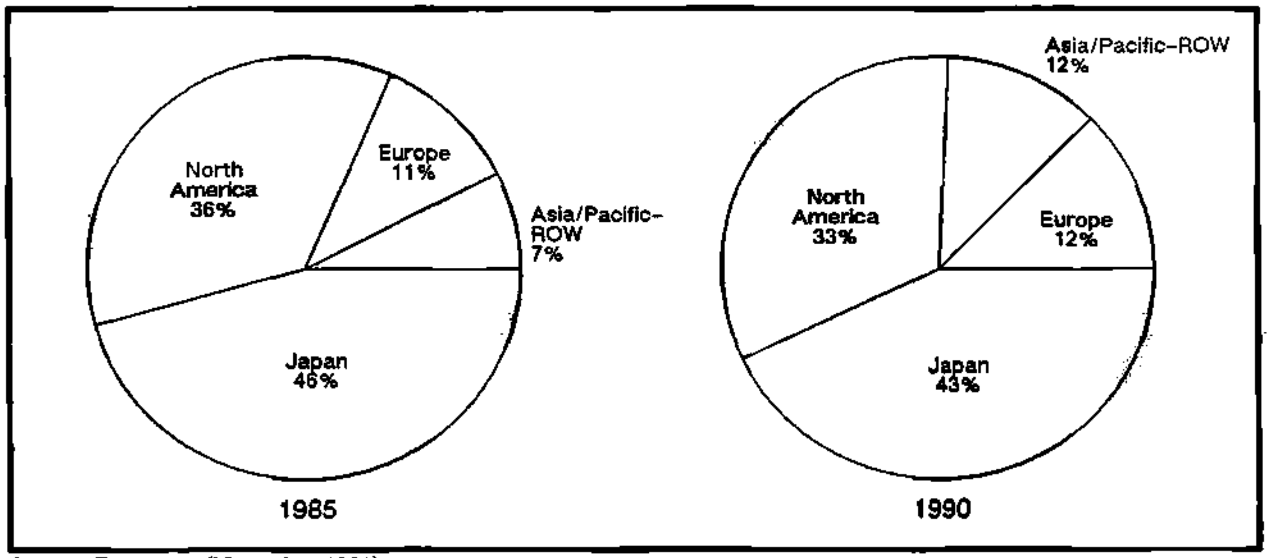
Source: Dataquest (November 1991)

Figure 3.2
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers—Forecast



Source: Dataquest (November 1991)

Figure 3.3
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers



Source: Dataquest (November 1991)

Chapter 4

Wafer Fab Equipment Forecast

Introduction

This section presents historical and forecast data on the worldwide wafer fabrication equipment market. Table 4.1 presents the historical data by equipment category for the years 1985 through 1990, and Table 4.2 shows forecast data by category for the years 1990 through 1995.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Production versus Spending

Table 4.3 summarizes the historical worldwide semiconductor production, capital spending, and wafer fab equipment expenditure for the years 1985 through 1990. Table 4.4 presents Dataquest's forecast regarding these items for the years 1990 through 1995.

Market Growth

Figure 4.1 shows year-to-year growth for semiconductor production and wafer fab equipment for the 10-year period from 1985 through 1995. Table 4.5 shows the compound annual growth rate (CAGR) forecast for semiconductor production, capital spending, and wafer fab equipment.

Table 4.1
Worldwide Wafer Fab Equipment Market—Historical
(Millions of U.S. Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1990-1995
World Fab Equipment Market	3,353	2,716	3,140	4,983	5,996	5,818	11.7
Lithography							
Contact/Proximity	48	31	25	22	23	19	-17.2
Projection Aligners	266	171	129	148	94	89	-19.7
Steppers	430	363	503	921	1,183	1,067	19.9
Direct-Write Lithography	31	68	67	69	70	71	18.2
Maskmaking Lithography	81	51	68	62	69	50	-9.1
X-Ray	2	1	0	6	5	2	-2.3
Total	858	685	791	1,228	1,444	1,297	8.6
Automatic Photoresist Processing Equipment	161	149	168	253	334	338	16.0
Etch and Clean							
Wet Process	157	161	167	277	355	350	17.4
Dry Strip	40	35	58	100	121	125	25.9
Dry Etch	300	237	307	533	669	683	17.9
Ion Milling	7	8	8	10	13	13	14.9
Total	503	441	540	920	1,157	1,172	18.4
Deposition							
Chemical Vapor Deposition	247	221	259	463	609	689	22.8
Physical Vapor Deposition	263	237	251	302	368	408	9.2
Silicon Epitaxy	72	46	36	86	75	68	-.9
Metalorganic CVD	25	31	35	42	45	42	11.3
Molecular Beam Epitaxy	53	66	68	81	72	55	.7
Total	658	602	648	973	1,170	1,262	13.9
Diffusion	207	156	145	294	330	322	9.2
Rapid Thermal Processing	15	16	18	22	28	33	17.5
Ion Implantation							
Medium Current	125	55	61	118	131	116	-1.4
High Current	167	55	107	241	301	250	8.4
High Voltage	2	10	18	18	25	5	18.9
Total	293	119	186	377	457	371	4.8
Process Control							
CD (Optical & SEM)	20	44	89	151	150	151	49.6
Wafer Inspection	34	42	58	101	117	99	23.5
Other Process Control	360	287	286	355	404	368	.4
Total	415	374	432	607	672	618	8.3
Factory Automation	125	81	99	130	195	216	11.6
Other Equipment	118	96	112	177	211	189	10.0
Total World Fab Equipment	3,353	2,716	3,140	4,983	5,996	5,818	11.7
Percent Change	-5	-19	16	59	20	-3	

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (November 1991)

Table 4.2
Worldwide Wafer Fab Equipment Market—Forecast
(Millions of U.S. Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
World Fab Equipment Market	5,818	6,026	5,568	6,450	7,885	8,833	8.7
Lithography							
Contact/Proximity	19	17	17	16	16	15	-4.2
Projection Aligners	89	76	65	69	76	78	-2.6
Steppers	1,067	1,042	955	1,113	1,404	1,610	8.6
Direct-Write Lithography	50	55	63	75	85	88	11.9
Maskmaking Lithography	71	72	76	89	112	126	12.3
X-Ray	2	8	12	25	38	55	102.7
Total	1,297	1,270	1,188	1,387	1,730	1,972	8.7
Automatic Photoresist Processing Equipment	338	350	315	356	428	483	7.4
Etch and Clean							
Wet Process	350	370	361	408	477	525	8.4
Dry Strip	125	130	120	145	180	200	9.8
Dry Etch	683	715	650	775	950	1,050	9.0
Ion Milling	13	15	12	15	18	20	9.0
Total	1,172	1,230	1,143	1,343	1,625	1,795	8.9
Deposition							
Chemical Vapor Deposition	689	735	675	775	950	1,075	9.3
Physical Vapor Deposition	408	435	400	450	550	625	8.9
Silicon Epitaxy	68	75	58	53	71	61	-2.2
Metalorganic CVD	42	44	42	49	61	66	9.2
Molecular Beam Epitaxy	55	53	50	57	66	71	5.5
Total	1,262	1,342	1,225	1,384	1,698	1,898	8.5
Diffusion	322	325	270	330	400	475	8.1
Rapid Thermal Processing	33	40	45	65	80	100	24.9
Ion Implatation							
Medium Current	116	123	106	116	144	153	5.6
High Current	250	266	238	272	338	373	8.4
High Voltage	5	15	18	30	38	42	53.4
Total	371	405	362	418	520	568	8.9
Process Control							
CD (Optical & SEM)	151	160	150	175	210	241	9.9
Wafer Inspection	99	71	74	87	103	116	3.2
Other Process Control	368	398	380	432	520	567	9.0
Total	618	629	603	694	833	924	8.4
Factory Automation	216	232	234	266	319	335	9.2
Other Equipment	189	204	183	206	252	282	8.3
Total World Fab Equipment	5,818	6,026	5,568	6,450	7,885	8,833	8.7
Percent Change	-3	4	-8	16	22	12	

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (November 1991)

Table 4.3
Worldwide Semiconductor Production, Capital Spending, and Wafer Fab Equipment—Historical, 1985-1990 (Millions of U.S. Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
Semiconductor Production*	27,114	33,728	41,478	54,521	61,453	62,771	18.3
Capital Spending	7,299	5,129	6,435	10,088	12,463	12,519	11.4
Wafer Fab Equipment	3,353	2,716	3,140	4,983	5,996	5,818	11.7

*Semiconductor production includes worldwide merchant and captive production.
Source: Dataquest (November 1991)

Table 4.4
Worldwide Semiconductor Production, Capital Spending, and Wafer Fab Equipment—Forecast (Millions of U.S. Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Semiconductor Production*	62,771	69,231	78,769	91,056	102,194	110,353	11.9
Capital Spending	12,519	14,194	13,879	15,747	17,799	19,090	8.8
Wafer Fab Equipment	5,818	6,026	5,568	6,450	7,885	8,833	8.7

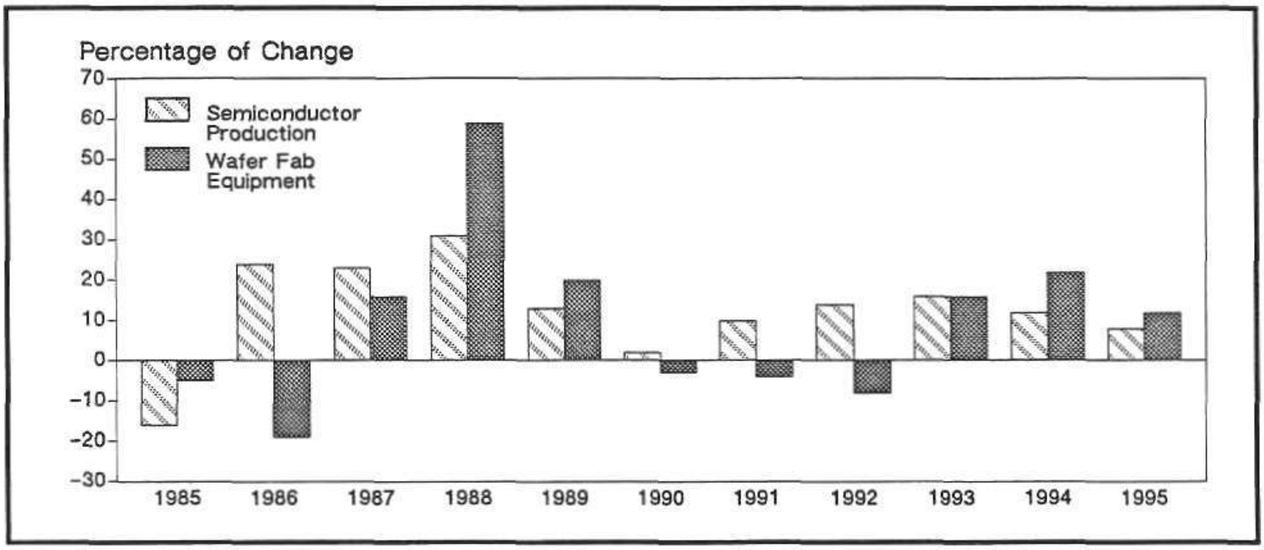
*Semiconductor production includes worldwide merchant and captive production.
Source: Dataquest (November 1991)

Table 4.5
Estimated 10-Year CAGR, 1985-1995

	CAGR (%) 1985-1995
Semiconductor Production	15.1
Capital Spending	10.2
Wafer Fab Equipment	10.2

Source: Dataquest (November 1991)

Figure 4.1
Estimated Semiconductor Production and Wafer Fab Equipment
10-Year Growth Pattern, 1985-1995



Source: Dataquest (November 1991)

Chapter 5

Silicon Wafer Forecast

Tables 5.1 and 5.2 present the historical and forecast consumption of silicon in millions of square inches by region. Tables 5.3 and 5.4 present historical and forecast information on merchant epitaxial wafer consumption by region.

Table 5.1
Silicon and Epitaxial Wafer Consumption by Region—Historical
(Millions of Square Inches)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
North America	398	405	442	546	582	648	10.2
Percent Growth	-43.7	1.9	8.9	23.7	6.5	11.4	
Japan	588	642	670	777	923	1,017	11.6
Percent Growth	-11.0	9.1	4.4	16.0	18.8	10.1	
Europe	148	155	172	196	231	227	8.9
Percent Growth	-7.5	4.6	10.8	14.1	17.8	-1.7	
Asia/Pacific-ROW	43	64	70	84	114	145	27.5
Percent Growth	-15.7	47.9	9.3	20.6	35.9	27.0	
Worldwide	1,177	1,266	1,353	1,604	1,851	2,037	11.6
Percent Growth	-25.5	7.5	6.9	18.5	15.4	10.1	

Source: Dataquest (November 1991)

Table 5.2
Silicon and Epitaxial Wafer Consumption by Region—Forecast
(Millions of Square Inches)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America	648	645	665	705	769	810	4.6
Percent Growth	11.4	-.5	3.1	6.0	9.1	5.3	
Japan	1,017	1,102	1,175	1,258	1,367	1,480	7.8
Percent Growth	10.1	8.4	6.6	7.1	8.7	8.3	
Europe	227	218	212	225	257	292	6.1
Percent Growth	-1.7	-4.0	-2.8	6.1	14.2	13.6	
Asia/Pacific-ROW	145	168	185	213	247	281	14.2
Percent Growth	27.0	16.1	10.1	15.1	16.0	13.8	
Worldwide	2,037	2,133	2,237	2,401	2,640	2,863	7.0
Percent Growth	10.1	4.7	4.9	7.3	10.0	8.4	

Source: Dataquest (November 1991)

Table 5.3
Merchant Epitaxial Wafer Consumption by Region—Historical
(Millions of Square Inches)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
North America	25	29	42	56	82	97	31.1
Percent Growth	-43.7	16.0	44.8	33.3	46.4	18.3	
Japan	49	65	71	75	83	93	13.7
Percent Growth	-11.0	32.7	9.2	5.6	10.7	12.0	
Europe	6	9	12	15	18	19	25.9
Percent Growth	-7.5	50.0	33.3	25.0	20.0	5.6	
Asia/Pacific-ROW	2	2	3	4	5	5	20.1
Percent Growth	-15.7	0	50.0	33.3	25.0	0	
Worldwide	82	105	128	150	188	214	21.1
Percent Growth	-25.5	28.0	21.9	17.2	25.3	13.8	

Source: Dataquest (November 1991)

Table 5.4
Merchant Epitaxial Wafer Consumption by Region—Forecast
(Millions of Square Inches)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America	97	105	110	123	137	145	8.4
Percent Growth	18.3	8.2	4.8	11.8	11.4	5.8	
Japan	93	97	104	116	122	125	6.1
Percent Growth	12.0	4.3	7.2	11.5	5.2	2.5	
Europe	19	18	18	22	26	26	6.2
Percent Growth	5.6	-3.2	-1.6	21.5	16.4	.4	
Asia/Pacific-ROW	5	6	7	8	9	11	17.1
Percent Growth	0	12.0	17.9	16.7	11.7	27.9	
Worldwide	214	226	239	269	293	307	7.5
Percent Growth	13.2	5.6	5.6	12.6	9.1	4.6	

Source: Dataquest (November 1991)

Appendix

Exchange Rates

Table A.1 lists the exchange rates per dollar for Japanese yen and European currency units (ECUs) for the period from 1985 to 1991. Exchange rate variations should be kept in mind when interpreting yearly changes in the 1985 to 1991 data presented in this booklet. However, the forecast years (1992 to 1995) are assumed to have constant exchange rates.

Table A.1
Exchange Rates per Dollar for Japanese Yen and ECU: 1985-1991

	1985	1986	1987	1988	1989	1990	1991 3Q
Yen/$	238	167	144	130	138	144	136
Percent Change		-30	-14	-10	6	4	-6
ECU/$	1.31	1.02	0.87	0.84	0.92	0.79	0.85
Percent Change		-22	-15	-3	10	-14	8

Source: Dataquest (November 1991)

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European Fab Database
November 1991

Source:
Dataquest

Semiconductor Equipment, Manufacturing,
and Materials

Dataquest

European Fab Database

November 1991

Source: Dataquest

Dataquest

Semiconductor Equipment, Manufacturing, and Materials

Published by Dataquest Incorporated

*E*uropean Fab Database

Background

The material in this booklet applies to the European portions of Dataquest's Semiconductors Equipment, Manufacturing, and Materials service Wafer Fab Database. The Wafer Fab Database is updated on an ongoing basis, employing both primary and secondary research methodologies. The tables included in this booklet highlight both production and pilot line wafer fabs.

General Definitions

A *fab line* is a processing line in a clean room that is equipped to do all front-end wafer processing. Occasionally there are two separate product-specific fab lines or two different wafer sizes in a clean room. In this situation, a clean room will be documented as two fab lines if the equipment is dedicated to each wafer size or product line. There can be many fab lines at one location.

Front-end wafer processing is defined as all steps involved with semiconductor processing, beginning with initial oxide and ending at wafer probe.

A *production fab* is defined as a wafer fab capable of front-end processing more than 1,250 wafers per week (type = F).

A *pilot fab* is defined as a wafer fab capable of front-end processing 1,250 wafers or less per week (type = P).

Definitions of Table Columns

The *Products Produced* column contains product information for seven product categories. The information in this column can be very detailed, depending on the information's availability. The nomenclature used within the seven product groups of the fab database is as follows, with definitions where warranted:

- Analog
  - LIN—Linear/analog devices
  - A/D D/A—Analog-to-digital, digital-to-analog converters
  - AUTOMOTIVE—Dedicated to automobile applications
  - CODEC—Coder/decoder
  - INTERFACE—Interface IC
  - MESFET (GaAs)—Metal Schottky field-effect transistor
  - MODFET (GaAs)
  - MDIODE (GaAs)—Microwave diode
  - MFET (GaAs)—Microwave field-effect transistor
  - MODEM—Modulator/demodulator
  - MMIC—Monolithic microwave IC
  - OP AMP—Operational amplifier
  - PWR IC—Power IC
  - REG—Voltage regulator
  - SMART PWR—Smart power
  - SWITCHES—Switching device
  - TELECOM—Telecommunications chips
- Memory
  - MEM—Memory
  - RAM—Random-access memory
  - DRAM—Dynamic RAM
  - SRAM 4 TR.—Static RAM uses a 4-transistor cell design
  - SRAM 6 TR.—Static RAM uses a 6-transistor cell design
  - VRAM—Video RAM
  - ROM—Read-only memory
  - PROM—Programmable ROM
  - EPROM—Ultraviolet erasable PROM
  - EEPROM or E2—Electrically erasable PROM
  - FERRAM—Ferroelectric RAM
  - NVMEM—Nonvolatile memory (ROM, PROM, EPROM, EEPROM, FERRAM)
  - FIFO—First-in, first-out memory
  - SPMEM—Other specialty memory (dual port, shift-register, color look-up, etc.)
- Micrologic
  - ASSP—Application-specific standard product
  - BIT—Bit slice (subset of MPU functions)
  - DSP—Digital signal processor
  - MCU—Microcontroller unit

- MPR—Microperipheral
- MPRCOM—MPR digital communications (ISDN, LAN, UART, modem)
- MPU—Microprocessor unit
- LISP—32-bit list instruction set processor for AI applications
- RISC—Reduced-instruction-set computation 32-bit MPU

• Standard logic

- LOG—Standard logic

• ASIC logic

- ASIC—Application-specific IC
- ARRAYS—Gate arrays
- CBIC—Cell-based IC
- CUSTOM—Full-custom IC (single user)
- PLD—Programmable logic device

• Discrete

- DIS—Discrete
- DIODE
- FET—Field-effect transistor
- GTO—Gate turn-off thyristor
- HEMT (GaAs)—High-electron-mobility transistor
- MOSFET—MOS-based field-effect transistor
- PWR TRAN—Power transistor
- RECTIFIER
- RF—Radio frequency
- SCR—Schottky rectifier
- SENSORS
- SST—Small-signal transistor
- THYRISTOR
- TRAN—Transistor
- ZENER DIODE

• Optoelectronic

- OPTO—Optoelectronic
- CCD—Charge-coupled device (imaging)
- COUPLERS—Photocouplers
- IED—Infrared-emitting diode
- IMAGE SENSOR
- LASER (GaP)—Semiconductor laser or laser IC
- LED—Light-emitting diode
- PDIODE—Photo diode
- PTRAN—Photo transistor
- SAW—Surface acoustic wave device
- SIT IMAGE SENSOR—Static induction transistor image sensor

The *Process Technology* column lists four major types of technologies. This column also lists a few uncommon technologies along with information on levels of metal, type of well, and logic structure, when available. Definitions of the nomenclature used in the Process Technology column are as follows:

• MOS (silicon-based)

- CMOS—Complementary metal-oxide semiconductor
- MOS—n-channel metal-oxide semiconductor (NMOS) and p-channel metal-oxide semiconductor (PMOS) (More than 90 percent of the MOS fabs use n-channel MOS.)
- M1—Single-level metal
- M2—Double-level metal
- M3—Triple-level metal
- N-WELL
- P-WELL
- POLY1—Single-level polysilicon
- POLY2—Double-level polysilicon
- POLY3—Triple-level polysilicon

• BiCMOS (silicon-based)

- BICMOS—Bipolar and CMOS combined on a chip
- BIMOS—Bipolar and MOS combined on a chip
- ECL I/O—ECL input/output
- TTL I/O—TTL input/output

• Bipolar (silicon-based)

- BIP—Bipolar
- ECL—Emitter-coupled logic
- TTL—Transistor-transistor logic
- STTL—Schottky TTL

• Gallium arsenide and other compound semiconductor materials

- GaAs—Gallium arsenide
- GaAlAs—Gallium aluminum arsenide
- GaAs on Si—Gallium arsenide on silicon
- GaP—Gallium phosphide

- HgCdTe—Mercuric cadmium telluride
- InAs—Indium arsenide
- InP—Indium phosphide
- InSb—Indium antimony
- LiNbO3—Lithium niobate
- SOS—Silicon on sapphire

The number in the *Minimum Linewidth* column represents the minimum linewidth at the critical mask layers as drawn. This number is stated in microns and is defined in Dataquest's fab survey as being available in production volumes.

The *Wafer Size* column represents the wafer diameter expressed colloquially in inches. However, for wafers greater than 3 inches in diameter, the colloquial expression is inaccurate. When calculating square inches, the following approximations are used:

Wafer-Start Capacity is defined in the fab survey as the equipment-limited wafer-start capacity per four-week period. Start capacity is not limited by current staffing or the number of shifts operating; it is limited only by the installed equipment in the fab and the complexity of the process it runs. Start capacity in square inches is calculated using the approximate diameter and the wafer-start capacity.

The *Clean Room Class* column represents the level of cleanliness in the cleanest part of the clean room. This area represents the true environment to which the wafer is exposed.

The *Origin of Owner* column represents the country where the parent company is headquartered.

The *Merchant or Captive* column categorizes each fab line on the tables as one of these two types. Definitions of the various categories are as follows:

- A *Merchant* fab line is a fab line that produces devices that end up available on the merchant market.
- A *Captive* fab line does not sell any of its devices on the merchant market. All production is consumed by the owner of the fab line.

Table 1
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
ABB-HAFO AB	JARFALLA	SWEDEN	N/A	DIS OPTO	BIP CMOS SOS	1.50	4	5,000	60,850	6,000	1/10	SWITZ/SWEDEN	M
ABB-IXYS	LAMPERTHEIM	GERMANY	N/A	PWR DIS LIN	BIP	5.00	[redacted]	16,000	113,120	0	100	SWITZ/SWEDEN	M
AEG AG (DAIMLER BENZ)	[redacted]	[redacted]	ULM RSCH	3D ICs mm-WAVE OPTO	GaAs MOS	[redacted]	0	0	0	0	N/A	GERMANY	M
ANALOG DEVICES	LIMERICK	[redacted]	[redacted]	LIN AD/DA TELECOM	CMOS BICMOS	1.00	4	15,000	182,550	10,000	10	U.S.A.	M
ANALOG DEVICES	LIMERICK	[redacted]	[redacted]	LIN AD/DA TELECOM	BIP BICMOS	1.20	[redacted]	20,000	547,600	0	N/A	U.S.A.	M
ANSALDO TRASPORTI	[redacted]	[redacted]	[redacted]	PWR DIS	BIP 1M	2.00	[redacted]	6,000	73,020	0	10	ITALY	M
ASCOM FAVAG	[redacted]	SWITZERLAND	N/A	ARRAYS CUSTOM	BIP	3.00	[redacted]	1,000	12,170	0	100	SWITZERLAND	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
AT&T MICROELECTRONICS	MADRID	SPAIN	N/A	CBIC CUSTOM	CMOS M2	1.25	6	14,000	383,320	25,000	1	U.S.A.	M
ATMEL	N/A	NETHERLANDS	N/A	EPROM EEPROM ARRAYS	CMOS	[illegible]	[illegible]	5,000	243,350	0	N/A	U.S.A.	
AUSTRIA MIKROSYSTEME GMBH	GRAZ	AUSTRIA	N/A	ARRAYS	NMOS CMOS BICMOS	1.00	4	25,000	304,250	10,000	10	AUSTRIA	M
DIGITAL EQUIPMENT	SOUTH QUEENSFERRY	SCOTLAND	N/A	MPU FPU LOG	CMOS	0.70	[illegible]	3,000	82,140	28,000	1	U.S.A.	C
ELMOS GMBH	DORTMUND	GERMANY	N/A	LIN CUSTOM	CMOS	1.50	4	4,166	50,700	0	10	GERMANY	M
[illegible]	ERFURT	GERMANY	N/A	N/A	CMOS	1.60	5	0	0	0	N/A	GERMANY	M
ES2 EUROPEAN SILICON STRUCTURES	ROUSSET CEDEX	FRANCE	ROUSSET	CBIC ARRAYS CUSTOM MIL	CMOS M2	[illegible]	[illegible]	1,000	19,020	0	10/1	FRANCE	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
				STD 883									
FUJITSU	NEWTON AYCLIFFE	ENGLAND	PHASE 1	4Mb DRAM ASIC	CMOS	1.00	6	25,000	684,500	0	N/A	JAPAN	M
GEC PLESSEY S/C	LINCOLN	ENGLAND	N/A	LIN MPU ARRAYS SRAM CUST	CMOS MOS	1.50	4	13,000	158,210	12,000	10	ENGLAND	M
GEC PLESSEY S/C	PLYMPTON	ENGLAND	N/A	N/A	MOS	3.00	4	15,000	182,550	0	N/A	ENGLAND	M
GEC PLESSEY S/C	ROBOROUGH	ENGLAND	N/A	ASIC DSP TELECOM	CMOS NMOS M3	0.70	6	6,000	164,280	19,906	1	ENGLAND	M
GEC PLESSEY S/C	SWINDON	ENGLAND	N/A	DIODES DIS LIN	BIP	5.00	5	12,000	228,240	29,000	N/A	ENGLAND	M
GEC PLESSEY S/C	SWINDON	ENGLAND	N/A	LIN	BIP	3.00	4	14,000	170,380	0	N/A	ENGLAND	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
EMT	BRUGG	SWITZERLAND	N/A	CONSUMER ICs	MOS	0.00	3	15,000	106,050	15,000	N/A	SWITZERLAND	M
HUGHES MICROELEC.	GLENROTHES	SCOTLAND	N/A	ARRAYS CBIC EPROM CUSTOM	CMOS MOS	3.00	4	6,400	77,888	28,000	100	U.S.A.	M
IBM	BOEBLINGEN	GERMANY	N/A	PWR DIS HYBRID	BIP	0.00	4	20,000	243,400	0	N/A	U.S.A.	C
IBM	CORBEIL-ESSONNES	FRANCE	N/A	ARRAYS LIN CUSTOM	BIP	2.00	5	40,000	760,800	50,000	N/A	U.S.A.	C
IBM	CORBEIL-ESSONNES	FRANCE	N/A	256K DRAM 64K SRAM	CMOS MOS	1.00	5	25,000	475,500	25,000	N/A	U.S.A.	C
IBM	CORBEIL-ESSONNES	FRANCE	N/A	1Mb DRAM	CMOS	0.00	8	7,000	340,690	0	N/A	U.S.A.	C
IBM	HANNOVER	GERMANY	N/A	DIS	BIP	0.00	4	20,000	243,400	0	N/A	U.S.A.	C

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
IBM	SINDELFINGEN	GERMANY	N/A	ARRAYS	BIP	2.00	5	15,000	285,300	20,000	N/A	U.S.A.	C
IBM	SINDELFINGEN	GERMANY	N/A	1Mb DRAM 4Mb DRAM	CMOS	0.80	8	20,000	973,400	45,000	N/A	U.S.A.	C
IBM	SINDELFINGEN	GERMANY	N/A	256K DRAM SRAM DSP MPU	MOS	1.50	5	25,000	475,500	20,000	N/A	U.S.A.	C
IBM	SINDELFINGEN	GERMANY	N/A	CUSTOM	BIP	1.50	5	15,000	285,300	20,000	N/A	U.S.A.	C
IBM	SINDELFINGEN	GERMANY	N/A	4Mb DRAM	CMOS	0.80	8	30,000	1,460,100	45,000	N/A	U.S.A.	C
ICL	N/A	BULGARIA	N/A	16K DRAM, 64K DRAM		0.00	0	0	0	0	N/A	U.K.	M
INST. SCIENCE & TECH.	TRENTO	ITALY	N/A	CCD	CMOS	0.00	4	10,000	121,700	0	N/A	ITALY	R

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
INTL. RECTIFIER	TURIN	ITALY	BORGARO	RECTIFIER THYRISTOR	N/A	0.00	4	15,000	182,550	13,000	100	U.S.A.	M
INTL. RECTIFIER	TURIN	ITALY	VENARIA	RECTIFIER THYRISTOR	N/A	0.00	4	10,000	121,700	0	N/A	U.S.A.	M
ISKRA	TRBOVLJE	YUGOSLAVIA	N/A	DIS	BIP	0.00	3	5,000	35,350	0	N/A	YUGOSLAVIA	M
ISOCOM	HARTLEPOOL	ENGLAND	N/A	OPTO	GaAs	0.00	0	0	0	0	N/A	ENGLAND	M
ITALTEL	ROME	ITALY	N/A	N/A	GaAs	0.00	0	0	0	0	N/A	ITALY	M
ITT	FREIBURG	GERMANY	N/A	PWR TRAN DIS	BIP MOS	5.00	4	42,000	511,140	0	1000	U.S.A.	M
ITT	FREIBURG	GERMANY	N/A	DSP NVMEM CUSTOM	CMOS MOS	1.20	5	21,500	408,930	0	10	U.S.A.	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
ITT	FREIBURG	GERMANY	N/A	DIS CUSTOM	BIP	5.00	4	16,500	200,805	0	10	U.S.A.	M
LUCAS	SUTTON COLDFIELD	ENGLAND	N/A	PWR DIS	GaAs	0.00	0	0	0	54,000	N/A	ENGLAND	M
MATRA MHS	NANTES	FRANCE	N/A	256K SRAM MCU ASIC LIN	CMOS BiCMOS M2	0.70	5	10,000	190,200	21,500	10	FRANCE/U.S.	M
MATRA MHS/CYPRESS	N/A	FRANCE	N/A	N/A	N/A	0.00	0	0	0	0	N/A	FRANCE/U.S.	M
MICORELECT.-MARIN	MARIN	SWITZERLAND	N/A	CUSTOM	N/A	0.00	4	10,000	121,700	0	N/A	SWITZERLAND	M
MICROELECT.-MARIN	MARIN	SWITZERLAND	N/A	ARRAYS LIN CUSTOM	CMOS	3.00	4	10,000	121,700	0	10	SWITZERLAND	M
MICRONAS, INC.	ESPOO	FINLAND	N/A	LIN CBIC CUSTOM	CMOS M2	2.00	4	4,000	48,680	12,912	100	FINLAND	C

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
MIETEC ALCATEL	OUDENAARDE	BELGIUM	FAB 1	CUSTOM CBIC ANA	MOS CMOS BICMOS	1.00	4	15,000	162,550	21,520	10	BELGIUM	M
MOTOROLA	EAST KILBRIDE	SCOTLAND	MOS-1	MCU MEM LOG	CMOS MOS ML	3.00	4	20,000	243,400	25,600	100	U.S.A.	M
MOTOROLA	EAST KILBRIDE	SCOTLAND	MOS-4	MCU MEM LOG	CMOS MOS	2.00	5	45,000	855,900	35,000	N/A	U.S.A.	M
MOTOROLA	EAST KILBRIDE	SCOTLAND	MOS-9	SRAM 1Mb DRAM 68040 MPU	CMOS TOSHIBA	1.00	6	25,000	684,500	34,000	10	U.S.A.	M
MOTOROLA	TOULOUSE	FRANCE	BIP PWR	PWR TRAN	BIP	10.00	5	12,000	228,240	8,700	100	U.S.A.	M
MOTOROLA	TOULOUSE	FRANCE	BP-4	TELECOM OP AMP REG AUTO	BIP	2.00	4	25,000	304,250	22,000	100	U.S.A.	M
MOTOROLA	TOULOUSE	FRANCE	N/A	DIS	BIP	0.00	4	14,000	170,380	5,800	N/A	U.S.A.	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
NATIONAL S/C	GREENOCK	SCOTLAND	BIP 4	LOG	BIP	5.00	4	40,000	486,800	10,000	100	U.S.A.	M
NATIONAL S/C	GREENOCK	SCOTLAND	LOGIC	LOG	N/A	0.00	5	15,000	265,300	15,000	N/A	U.S.A.	M
NATIONAL S/C	GREENOCK	SCOTLAND	UK 6"	LOG CUSTOM ARRAYS	BIP	1.50	6	7,000	191,660	10,000	10	U.S.A.	M
NEC	LIVINGSTON, WEST LOTHIAN	SCOTLAND	PHASE 1	1Mb DRAM 4Mb DRAM	CMOS M2 M3	0.70	[illegible]	9,000	171,180	19,500	1	JAPAN	M
NEC	LIVINGSTON, WEST LOTHIAN	SCOTLAND	PHASE 2	4Mb DRAM 256K SRAM MPU	CMOS	0.00	6	9,000	246,420	19,500	N/A	JAPAN	M
NEWMARKET MICROSYS,	NEWMARKET	ENGLAND	N/A	LIN DIS	BIP	0.00	4	10,000	121,700	0	N/A	ENGLAND	M
NUOVA MISTRAL S.P.A.	SERMONETA	ITALY	N/A	ZENER DIODE DIODES	N/A	3.00	3	15,000	106,050	10,760	1000	ITALY	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
PHILIPS	CAEN	FRANCE	N/A	CONSUMER ICS	BIPOLAR M2 M3	1.50	5	18,000	342,360	0	100	NETHERLANDS	
PHILIPS	HAMBURG	GERMANY	CONSUMER	CON	BIP M2	1.20	5	18,000	342,360	16,140	100	NETHERLANDS	M
PHILIPS	HAMBURG	GERMANY	DISCRETE	DIS	BIP M1	2.00	4	22,000	267,740	0	1K/10	NETHERLANDS	M
PHILIPS	HAMBURG	GERMANY	N/A	8-BIT MCU 16-BIT MCU EEPROM ASIC	CMOS MOS M1 M2	1.00	5	12,500	237,750	32,280	10K/1	NETHERLANDS	M
PHILIPS	HAZELGROVE, STOCKPORT CHESHIRE	ENGLAND	BIPOLAR	TRAN DIODE RECTIFIER	BIP	10.00	4	45,000	547,650	19,368	100	NETHERLANDS	
PHILIPS	HAZELGROVE, STOCKPORT CHESHIRE	ENGLAND	POWERMOS	DIODE SMART PWR	MOS 1M	3.00	4	10,000	121,700	11,836	10	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETHERLANDS	N/A	N/A	MOS 1M	3.00	4	26,000	316,420	23,456	100	NETHERLANDS	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
PHILIPS	NIJMEGEN	NETHERLANDS	N/A	SRAM CON	CMOS NMOS M2	0.80	6	8,400	229,992	0	1	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETHERLANDS	N/A	DIS	MOS BICMOS BIP	1.50	5	20,000	380,400	39,338	100	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETHERLANDS	N/A	PWR DIS DIODES	N/A	0.70	4	0	0	12,912	10000	NETHERLANDS	M
PHILIPS	STADSKANAAL	NETHERLANDS	N/A	RECTIFIER	BIP M3	0.00	3	70,000	494,900	0	N/A	NETHERLANDS	M
PHILIPS RTC	CAEN	FRANCE	N/A	TRAN		5.00	5	12,000	228,240	12,569	10	FRANCE	M
PHILIPS/FASELEC	[illegible]	SWITZERLAND	N/A	N/A	CMOS 1M	2.00	4	12,000	146,040	21,520	100	NETHERLANDS	M
[illegible]	GRANOLLERS	SPAIN	N/A	DIS LIN	BIP	0.00	3	10,000	70,700	13,000	N/A	SPAIN	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
RACAL	READING	ENGLAND	N/A	N/A	MOS	0.00	3	10,000	70,700	0	N/A	ENGLAND	M
RIFA AB	KALMAR	SWEDEN	N/A	PWR DIS	BIP	0.00	4	25,000	304,250	92,000	N/A	SWEDEN	M
RIFA AB	[illegible]	[illegible]	N/A	N/A	BIP [illegible]	0.00	4	10,000	121,700	0	N/A	SWEDEN	M
ROBERT BOSCH	REUTLINGEN	GERMANY	RtN/FAW	LIN DIS CUSTOM	BIP BICMOS	3.00	4	20,000	243,400	0	100	GERMANY	C
SEAGATE MICROELECT.	LIVINGSTON	SCOTLAND	N/A	LIN	BIP M2	3.00	4	5,000	60,850	16,140	100	U.S.A.	C
[illegible]	GLENROTHES	SCOTLAND	N/A	LIN DIS OPTO	BIP CMOS MOS	4.00	[illegible]	2,000	24,340	0	10	SCOTLAND	M
SEMITRON	CRICKLADE	ENGLAND	N/A	DIS	BIP	0.00	4	10,000	121,700	0	N/A	GERMANY	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
SEMITRON	NURNBERG	GERMANY	N/A	DIS	BIP	0.00	4	10,000	121,700	0	N/A	GERMANY	M
SGS-THOMSON	35041 RENNES	FRANCE	N/A	LIN	BIP MG	0.00	5	16,000	304,320	0	10	ITALY	M
SGS-THOMSON	AGRATE	ITALY	MMD	LIN ARRAYS LOGIC	BIP BICMOS	4.00	5	16,000	304,320	22,000	10	ITALY	M
SGS-THOMSON	AGRATE (MILAN)	ITALY	FAB 9	64K 256K 1Mb EPROM PLD LIN ARRAYS	CMOS	0.70	6	28,000	766,640	22,000	10/1	ITALY	M
SGS-THOMSON	CATANIA	ITALY	N/A	DIS	N/A	3.00	5	34,000	646,680	0	100	ITALY	M
SGS-THOMSON	CATANIA	ITALY	N/A	LOG LIN CUSTOM	CMOS	3.00	4	21,000	255,570	0	100	ITALY	M
SGS-THOMSON	COSTALETTO		N/A	MPU	CMOS	0.00	5	0	0	0	N/A	ITALY	

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
SGS-THOMSON	GRENOBLE	FRANCE	N/A	LIN PWR IC CUSTOM	BIP CMOS	1.50	4	20,000	243,400	14,000	100	ITALY	M
SGS-THOMSON	ROUSSET	FRANCE	MODULE 4	MPU LIN	CMOS MOS	2.00	4	22,000	267,740	0	10	ITALY	M
SGS-THOMSON	ROUSSET	FRANCE	MODULE 5	NVMEM MPU	CMOS MOS	1.50	5	16,000	304,320	0	1	ITALY	M
SGS-THOMSON	TOURS	FRANCE	[illegible]	DIS	N/A	5.00	3	70,000	494,900	0	100	ITALY	M
SGS-THOMSON	TOURS	FRANCE	PLANAR	DIS	N/A	5.00	4	20,000	243,400	0	100	ITALY	M
SIEMENS	MUNICH	GERMANY	BALANSTRAS	ASIC CUSTOM LIN	BIP	2.00	5	15,000	285,300	0	N/A	GERMANY	M
SIEMENS	MUNICH	GERMANY	BALANSTRAS	ASIC CUSTOM	CMOS MOS	1.50	5	15,000	285,300	0	N/A	GERMANY	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
SIEMENS	REGENSBURG	GERMANY	MEGA 1	1Mb DRAM 4Mb DRAM	CMOS	0.80	6	20,800	569,504	0	N/A	GERMANY	M
SIEMENS	REGENSBURG	GERMANY	MEGA 2	4Mb DRAM	CMOS	0.80	6	16,000	438,080	0	N/A	GERMANY	M
SIEMENS	REGENSBURG	GERMANY	N/A	OPTO	N/A	0.00	6	10,000	121,700	0	N/A	GERMANY	M
SIEMENS	VILLACH	AUSTRIA	FAB 1	64K DRAM LOG	MOS	2.00	4	40,000	486,800	0	N/A	GERMANY	M
SIEMENS	VILLACH	AUSTRIA	FAB 2	256K DRAM	MOS	1.20	5	40,000	760,800	0	N/A	GERMANY	M
TAG	ZURICH	SWITZERLAND	N/A	DIS	N/A	0.00	6	10,000	121,700	0	N/A	SWITZERLAND	M
TELEFUNKEN	[illegible]	GERMANY	N/A	LOG MPU MCU ARRAYS	CMOS	3.00	4	24,000	292,080	3,000	100	GERMANY	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
				CUST									
TELEFUNKEN ELECT.	HEILBRONN	GERMANY	N/A	CUSTOM LIN DIS MCU	BIP MOS CMOS	1.00	4	20,000	243,400	0	1	GERMANY	M
TELEFUNKEN ELECT.	HEILBRONN	GERMANY	N/A	OPTO HIGH FREQUENCY	BIP	1.00	3	5,000	35,350	0	N/A	GERMANY	M
TELEFUNKEN ELECT.	HEILBRONN	GERMANY	N/A	OPTO	GaAs	1.00	2	3,000	9,420	0	N/A	GERMANY	M
[illegible]	NICE	FRANCE	N/A	DIS	N/A	0.80	4	10,000	121,700	25,000	N/A	FRANCE	M
TI	AVEZZANO	ITALY	PHASE 1	4Mb DRAM ASSP CBIC	CMOS	0.80	6	23,740	650,001	46,000	1	U.S.A.	M
TI	BEDFORD	ENGLAND	PWR FAB	PWR DIS	BIP	[illegible]	4	14,379	174,992	9,000	100	U.S.A.	M
TI	FREISING	GERMANY	N/A	LIN ASSP	BIP CMOS BICMOS	0.80	5	9,463	179,986	10,000	100	U.S.A.	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
TI	FREISING	GERMANY	N/A	CBIC LIN ASSP	CMOS BICMOS	0.80	5	10,515	199,995	17,000	10	U.S.A.	M
VAISALA	VANTAA	FINLAND	N/A	LIN	CMOS	5.00	3	200	1,414	0	100	FINLAND	M
VEB GLEICHRICHTERWERK	STAHNSDORF	GERMANY	N/A	PWR DIS	N/A	0.00	0	0	0	0	N/A	GERMANY	C
VEB HALBLEITERWERK	FRANKFURT (ODER)	GERMANY	N/A	LIN	BIP	0.00	0	0	0	0	N/A	GERMANY	C
VEB KOMBINAT MIKROELEKTRONIK	ERFURT	GERMANY	N/A	N/A	CMOS MOS	0.00	0	0	0	0	N/A	GERMANY	C
VEB ROEHRENWERK	NEUHAUS AM RENNWEG	GERMANY	N/A	TRAN	N/A	0.00	0	0	0	0	N/A	GERMANY	C
VEB WERK FUER FERNSEHELEKTRONIK	BERLIN-OBERSCHOENE WEIDE	GERMANY	N/A	SENSOR CCD	N/A	0.00	0	0	0	0	N/A	GERMANY	C

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
WESTCODE S/C	CHIPPENHAM	ENGLAND	N/A	DIS	N/A	0.00	4	10,000	121,700	0	N/A	ENGLAND	C
ZETEX	OLDHAM	ENGLAND	N/A	CUSTOM	BIP MOS	1.50	5	10,000	190,200	26,000	N/A	ENGLAND	M

NA = Not Available
Source: Dataquest (November 1991)

Table 2
European Future Pilot and Production Fab Lines
(Planned Facilities Going into Production by Year)

Company	City	Country	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Feet)
Production Begins: 1992												
HITACHI	LANDSHUT	GERMANY	N/A	4Mb DRAM 256K 1Mb SRAM	N/A	F	01/01/92	0.80	8	16,000	778,720	0
MITSUBISHI	ALSDORF	GERMANY	N/A	4Mb DRAM MPU 1Mb DRAM	CMOS	FAT	03/01/92	0.80	6	22,000	602,360	25,000
TI	AVEZZANO	ITALY	PHASE 2	16Mb DRAM	CMOS	F	02/01/92	0.60	8	20,000	973,400	30,000
Production Begins: 1993												
FUJITSU	NEWTON AYCLIFFE	ENGLAND	PHASE 2	4Mb DRAM ASIC	CMOS	F	/ /	0.80	6	45,000	1,232,100	0
INTEL	LEIXLIP, KILDARE	IRELAND	FAB 10	386 486 586 MPU LOG	CMOS	F	06/01/93	0.80	8	18,000	876,060	30,000
MIETEC ALCATEL	OUDENAARDE	BELGIUM	FAB 2	ASIC	CMOS M2 POLY2	FAT	07/01/93	0.50	6	5,000	136,900	12,917
Production Begins: 1994												
FUJITSU	NEWTON AYCLIFFE	ENGLAND	PHASE 3	16Mb DRAM	CMOS	F	/ /	0.60	8	30,000	1,460,100	0

Dataquest (October 1991)

Dataquest

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European Fab Database

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Background

The material in this booklet applies to the European portions of Dataquest's Semiconductors Equipment, Manufacturing, and Materials service Wafer Fab Database. The Wafer Fab Database is updated on an ongoing basis, employing both primary and secondary research methodologies. The tables included in this booklet highlight both production and pilot line wafer fabs.

General Definitions

A *fab line* is a processing line in a clean room that is equipped to do all front-end wafer processing. Occasionally there are two separate product-specific fab lines or two different wafer sizes in a clean room. In this situation, a clean room will be documented as two fab lines if the equipment is dedicated to each wafer size or product line. There can be many fab lines at one location.

Front-end wafer processing is defined as all steps involved with semiconductor processing, beginning with initial oxide and ending at wafer probe.

A *production fab* is defined as a wafer fab capable of front-end processing more than 1,250 wafers per week (type = F).

A *pilot fab* is defined as a wafer fab capable of front-end processing 1,250 wafers or less per week (type = P).

Definitions of Table Columns

The *Products Produced* column contains product information for seven product categories. The information in this column can be very detailed, depending on the information's availability. The nomenclature used within the seven product groups of the fab database is as follows, with definitions where warranted:

- Analog
  - LIN—Linear/analog devices
  - A/D D/A—Analog-to-digital, digital-to-analog converters
  - AUTOMOTIVE—Dedicated to automobile applications
  - CODEC—Coder/decoder
  - INTERFACE—Interface IC
  - MESFET (GaAs)—Metal Schottky field-effect transistor
  - MODFET (GaAs)
  - MDIODE (GaAs)—Microwave diode
  - MFET (GaAs)—Microwave field-effect transistor
  - MODEM—Modulator/demodulator
  - MMIC—Monolithic microwave IC
  - OP AMP—Operational amplifier
  - PWR IC—Power IC
  - REG—Voltage regulator
  - SMART PWR—Smart power
  - SWITCHES—Switching device
  - TELECOM—Telecommunications chips
- Memory
  - MEM—Memory
  - RAM—Random-access memory
  - DRAM—Dynamic RAM
  - SRAM 4 TR.—Static RAM uses a 4-transistor cell design
  - SRAM 6 TR.—Static RAM uses a 6-transistor cell design
  - VRAM—Video RAM
  - ROM—Read-only memory
  - PROM—Programmable ROM
  - EPROM—Ultraviolet erasable PROM
  - EEPROM or E2—Electrically erasable PROM
  - FERRAM—Ferroelectric RAM
  - NVMEM—Nonvolatile memory (ROM, PROM, EPROM, EEPROM, FERRAM)
  - FIFO—First-in, first-out memory
  - SPMEM—Other specialty memory (dual port, shift-register, color look-up, etc.)
- Micrologic
  - ASSP—Application-specific standard product
  - BIT—Bit slice (subset of MPU functions)
  - DSP—Digital signal processor
  - MCU—Microcontroller unit

- MPR—Microperipheral
- MPRCOM—MPR digital communications (ISDN, LAN, UART, modem)
- MPU—Microprocessor unit
- LISP—32-bit list instruction set processor for AI applications
- RISC—Reduced-instruction-set computation 32-bit MPU

• Standard logic

- LOG—Standard logic

• ASIC logic

- ASIC—Application-specific IC
- ARRAYS—Gate arrays
- CBIC—Cell-based IC
- CUSTOM—Full-custom IC (single user)
- PLD—Programmable logic device

• Discrete

- DIS—Discrete
- DIODE
- FET—Field-effect transistor
- GTO—Gate turn-off thyristor
- HEMT (GaAs)—High-electron-mobility transistor
- MOSFET—MOS-based field-effect transistor
- PWR TRAN—Power transistor
- RECTIFIER
- RF—Radio frequency
- SCR—Schottky rectifier
- SENSORS
- SST—Small-signal transistor
- THYRISTOR
- TRAN—Transistor
- ZENER DIODE

• Optoelectronic

- OPTO—Optoelectronic
- CCD—Charge-coupled device (imaging)
- COUPLERS—Photocouplers
- IED—Infrared-emitting diode
- IMAGE SENSOR
- LASER (GaP)—Semiconductor laser or laser IC
- LED—Light-emitting diode
- PDIODE—Photo diode
- PTRAN—Photo transistor
- SAW—Surface acoustic wave device
- SIT IMAGE SENSOR—Static induction transistor image sensor

The *Process Technology* column lists four major types of technologies. This column also lists a few uncommon technologies along with information on levels of metal, type of well, and logic structure, when available. Definitions of the nomenclature used in the Process Technology column are as follows:

• MOS (silicon-based)

- CMOS—Complementary metal-oxide semiconductor
- MOS—n-channel metal-oxide semiconductor (NMOS) and p-channel metal-oxide semiconductor (PMOS) (More than 90 percent of the MOS fabs use n-channel MOS.)
- M1—Single-level metal
- M2—Double-level metal
- M3—Triple-level metal
- N-WELL
- P-WELL
- POLY1—Single-level polysilicon
- POLY2—Double-level polysilicon
- POLY3—Triple-level polysilicon

• BiCMOS (silicon-based)

- BICMOS—Bipolar and CMOS combined on a chip
- BIMOS—Bipolar and MOS combined on a chip
- ECL I/O—ECL input/output
- TTL I/O—TTL input/output

• Bipolar (silicon-based)

- BIP—Bipolar
- ECL—Emitter-coupled logic
- TTL—Transistor-transistor logic
- STTL—Schottky TTL

• Gallium arsenide and other compound semiconductor materials

- GaAs—Gallium arsenide
- GaAlAs—Gallium aluminum arsenide
- GaAs on Si—Gallium arsenide on silicon
- GaP—Gallium phosphide

- HgCdTe—Mercuric cadmium telluride
- InAs—Indium arsenide
- InP—Indium phosphide
- InSb—Indium antimony
- LiNbO3—Lithium niobate
- SOS—Silicon on sapphire

The number in the *Minimum Linewidth* column represents the minimum linewidth at the critical mask layers as drawn. This number is stated in microns and is defined in Dataquest's fab survey as being available in production volumes.

The *Wafer Size* column represents the wafer diameter expressed colloquially in inches. However, for wafers greater than 3 inches in diameter, the colloquial expression is inaccurate. When calculating square inches, the following approximations are used:

Wafer-Start Capacity is defined in the fab survey as the equipment-limited wafer-start capacity per four-week period. Start capacity is not limited by current staffing or the number of shifts operating; it is limited only by the installed equipment in the fab and the complexity of the process it runs. Start capacity in square inches is calculated using the approximate diameter and the wafer-start capacity.

The *Clean Room Class* column represents the level of cleanliness in the cleanest part of the clean room. This area represents the true environment to which the wafer is exposed.

The *Origin of Owner* column represents the country where the parent company is headquartered.

The *Merchant or Captive* column categorizes each fab line on the tables as one of these two types. Definitions of the various categories are as follows:

- A *Merchant* fab line is a fab line that produces devices that end up available on the merchant market.
- A *Captive* fab line does not sell any of its devices on the merchant market. All production is consumed by the owner of the fab line.

Table 1
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
ABB-HAFO AB	JARFALLA	SWEDEN	N/A	DIS OPTO	BIP CMOS SOS	1.50	4	5,000	60,850	6,000	1/10	SWITZ/SWEDEN	M
ABB-IXYS	LAMPERTHEIM	GERMANY	N/A	PWR DIS LIN	BIP	5.00	3	16,000	113,120	0	100	SWITZ/SWEDEN	M
AEG AG (DAIMLER BENZ)	ULM	GERMANY	ULM RSCH	3D ICs mm-WAVE OPTO	GaAs MOS	0.00	0	0	0	0	N/A	GERMANY	M
ANALOG DEVICES	LIMERICK	IRELAND	N/A	LIN AD/DA TELECOM	CMOS BICMOS	1.00	4	15,000	182,550	10,000	10	U.S.A.	M
ANALOG DEVICES	LIMERICK	IRELAND	N/A	LIN AD/DA TELECOM	BIP BICMOS	1.20	6	20,000	547,600	0	N/A	U.S.A.	M
ANSALDO TRASPORTI	GENOA	ITALY	LINITA	PWR DIS	BIP 1M	2.00	4	6,000	73,020	0	10	ITALY	M
ASCOM FAVAG	[illegible]	SWITZERLAND	N/A	ARRAYS CUSTOM	BIP	3.00	4	1,000	12,170	0	100	SWITZERLAND	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
AT&T MICROELECTRONICS	MADRID	SPAIN	N/A	CBIC CUSTOM	CMOS M2	1.25	6	14,000	383,320	25,000	1	U.S.A.	M
ATMEL	N/A	NETHERLANDS	N/A	EPROM EEPROM ARRAYS	CMOS	0.60	[illegible]	5,000	243,350	0	N/A	U.S.A.	
AUSTRIA MIKROSYSTEME GMBH	GRAZ	AUSTRIA	N/A	ARRAYS	NMOS CMOS BICMOS	1.00	4	25,000	304,250	10,000	10	AUSTRIA	M
DIGITAL EQUIPMENT	SOUTH QUEENSFERRY	SCOTLAND	N/A	MPU FPU LOG	CMOS	0.70	6	3,000	82,140	20,000	1	U.S.A.	C
ELMOS GMBH	DORTMUND	GERMANY	N/A	LIN CUSTOM	CMOS	1.50	4	4,166	50,700	0	10	GERMANY	M
[illegible]	ERFURT	GERMANY	N/A	N/A	CMOS	1.60	5	0	0	0	N/A	GERMANY	M
ES2 EUROPEAN SILICON STRUCTURES	ROUSSET CEDEX	FRANCE	ROUSSET	CBIC ARRAYS CUSTOM MIL	CMOS M2	[illegible]	5	1,000	19,020	0	10/1	FRANCE	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
				STD 883									
FUJITSU	NEWTON AYCLIFFE	ENGLAND	PHASE 1	4Mb DRAM ASIC	CMOS	1.00	6	25,000	664,500	0	N/A	JAPAN	M
GEC PLESSEY S/C	LINCOLN	ENGLAND	N/A	LIN MPU ARRAYS SRAM CUST	CMOS MOS	1.50	4	13,000	158,210	12,000	10	ENGLAND	M
GEC PLESSEY S/C	PLYMPTON	ENGLAND	N/A	N/A	MOS	3.00	4	15,000	182,550	0	N/A	ENGLAND	M
GEC PLESSEY S/C	ROBOROUGH	ENGLAND	N/A	ASIC DSP TELECOM	CMOS NMOS M3	0.70	6	6,000	164,280	19,906	1	ENGLAND	M
GEC PLESSEY S/C	SWINDON	ENGLAND	N/A	DIODES DIS LIN	BIP	5.00	5	12,000	228,240	29,000	N/A	ENGLAND	M
GEC PLESSEY S/C	SWINDON	ENGLAND	N/A	LIN	BIP	[illegible]	4	14,000	170,360	0	N/A	ENGLAND	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
HMT	BRUGG	SWITZERLAND	N/A	CONSUMER ICs	MOS	0.00	3	15,000	106,050	15,000	N/A	SWITZERLAND	M
HUGHES MICROELECT.	GLENROTHES	SCOTLAND	N/A	ARRAYS CBIC EPROM CUSTOM	CMOS MOS	[illegible]	4	6,400	77,880	20,000	100	U.S.A.	M
IBM	BOEBLINGEN	GERMANY	N/A	PWR DIS HYBRID	BIP	0.00	4	20,000	243,400	0	N/A	U.S.A.	C
IBM	CORBEIL-ESSONNES	FRANCE	N/A	ARRAYS LIN CUSTOM	BIP	2.00	5	40,000	760,800	50,000	N/A	U.S.A.	C
IBM	CORBEIL-ESSONNES	FRANCE	N/A	256K DRAM 64K SRAM	CMOS MOS	1.00	5	25,000	475,500	25,000	N/A	U.S.A.	C
IBM	CORBEIL-ESSONNES	FRANCE	N/A	1Mb DRAM	CMOS	0.00	8	7,000	340,690	0	N/A	U.S.A.	C
IBM	HANNOVER	GERMANY	N/A	BIP	BIP	0.00	4	20,000	243,400	0	N/A	U.S.A.	C

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
IBM	SINDELFINGEN	GERMANY	N/A	ARRAYS	BIP	2.00	5	15,000	285,300	20,000	N/A	U.S.A.	C
IBM	SINDELFINGEN	GERMANY	N/A	1Mb DRAM 4Mb DRAM	CMOS	0.80	8	20,000	973,400	45,000	N/A	U.S.A.	C
IBM	SINDELFINGEN	GERMANY	N/A	256K DRAM SRAM DSP MPU	MOS	1.50	5	25,000	475,500	20,000	N/A	U.S.A.	C
IBM	SINDELFINGEN	GERMANY	N/A	CUSTOM	BIP	1.50	5	15,000	285,300	20,000	N/A	U.S.A.	C
IBM	SINDELFINGEN	GERMANY	N/A	4Mb DRAM	CMOS	0.80	8	30,000	1,460,100	45,000	N/A	U.S.A.	C
ICL	N/A	BULGARIA	N/A	16K DRAM, 64K DRAM		0.00	0	0	0	0	N/A	U.K.	M
INST. SCIENCE & TECH.	TRENTO	ITALY	N/A	CCD	CMOS	0.00	4	10,000	121,700	0	N/A	ITALY	R

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
INTL. RECTIFIER	TURIN	ITALY	BORGARO	RECTIFIER THYRISTOR	N/A	0.00	4	15,000	182,550	13,000	100	U.S.A.	M
INTL. RECTIFIER	[illegible]	ITALY	VENARIA	RECTIFIER THYRISTOR	N/A	0.00	4	10,000	121,700	0	N/A	U.S.A.	M
ISKRA	TRBOVLJE	YUGOSLAVIA	N/A	DIS	BIP	0.00	3	5,000	35,350	0	N/A	YUGOSLAVIA	M
ISOCOM	HARTLEPOOL	ENGLAND	N/A	OPTO	GaAs	0.00	0	0	0	0	N/A	ENGLAND	M
[illegible]	[illegible]	ITALY	N/A	N/A	GaAs	0.00	0	0	0	0	N/A	ITALY	M
ITT	FREIBURG	GERMANY	N/A	PWR TRAN DIS	BIP MOS	5.00	4	42,000	511,140	0	1000	U.S.A.	M
ITT	FREIBURG	GERMANY	N/A	DSP NVMEM CUSTOM	CMOS MOS	1.20	5	21,500	408,930	0	10	U.S.A.	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
ITT	FREIBURG	GERMANY	N/A	DIS CUSTOM	BIP	5.00	4	16,500	200,805	0	10	U.S.A.	M
LUCAS	SUTTON COLDFIELD	ENGLAND	N/A	PWR DIS	GaAs	0.00	0	0	0	54,000	N/A	ENGLAND	M
MATRA MHS	NANTES	FRANCE	N/A	256K SRAM MCU ASIC LIN	CMOS BiCMOS M2	0.70	[illegible]	10,000	190,200	21,500	10	FRANCE/U.S.	M
MATRA MHS/CYPRESS	N/A	FRANCE	N/A	N/A	N/A	0.00	0	0	0	0	N/A	FRANCE/U.S.	M
MICROELECT.-MARIN	MARIN	SWITZERLAND	N/A	CUSTOM	N/A	0.00	4	10,000	121,700	0	N/A	SWITZERLAND	M
MICROELECT.-MARIN	MARIN	SWITZERLAND	N/A	ARRAYS LIN CUSTOM	CMOS	3.00	4	10,000	121,700	0	10	SWITZERLAND	M
MICRONAS, INC.	ESPOO	FINLAND	N/A	LIN CBIC CUSTOM	CMOS M2	2.00	4	4,000	48,680	12,912	100	FINLAND	C

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
MIETEC ALCATEL	OUDENAARDE	BELGIUM	FAB 1	CUSTOM CBIC ANA	MOS CMOS BICMOS	1.00	4	15,000	182,550	21,520	10	BELGIUM	M
MOTOROLA	EAST KILBRIDE	SCOTLAND	MOS-1	MCU MEM LOG	CMOS MOS M1	3.00	4	20,000	243,400	25,600	100	U.S.A.	M
MOTOROLA	EAST KILBRIDE	SCOTLAND	MOS-[illegible]	MCU MEM LOG	CMOS MOS	[illegible]	5	45,000	855,900	35,000	N/A	U.S.A.	M
MOTOROLA	EAST KILBRIDE	SCOTLAND	MOS-9	SRAM 1Mb DRAM 68040 MPU	CMOS TOSHIBA	1.00	6	25,000	684,500	34,000	10	U.S.A.	M
MOTOROLA	TOULOUSE	FRANCE	BIP PWR	PWR TRAN	BIP	10.00	5	12,000	228,240	8,700	100	U.S.A.	M
MOTOROLA	TOULOUSE	FRANCE	[illegible]	TELECOM OP AMP REG AUTO	BIP	2.00	4	25,000	304,250	22,000	100	U.S.A.	M
MOTOROLA	TOULOUSE	FRANCE	N/A	DIS	BIP	0.00	4	14,000	170,380	5,800	N/A	U.S.A.	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
NATIONAL S/C	GREENOCK	SCOTLAND	BIP 4	LOG	BIP	5.00	4	40,000	486,800	10,000	100	U.S.A.	M
NATIONAL S/C	GREENOCK	SCOTLAND	LOGIC	LOG	N/A	0.00	5	15,000	285,300	15,000	N/A	U.S.A.	M
NATIONAL S/C	GREENOCK	SCOTLAND	UK 6"	LOG CUSTOM ARRAYS	BIP	1.50	6	7,000	191,660	10,000	10	U.S.A.	M
NEC	LIVINGSTON, WEST LOTHIAN	SCOTLAND	PHASE 1	1Mb DRAM 4Mb DRAM	CMOS M2 M3	0.70	5	9,000	171,180	19,500	1	JAPAN	M
NEC	LIVINGSTON, WEST LOTHIAN	SCOTLAND	PHASE 2	4Mb DRAM 256K SRAM MPU	CMOS	0.00	6	9,000	246,420	19,500	N/A	JAPAN	M
NEWMARKET MICROSYS.	NEWMARKET	ENGLAND	N/A	LIN DIS	BIP	0.00	4	10,000	121,700	0	N/A	ENGLAND	M
NUOVA MISTRAL S.P.A.	SERMONETA	ITALY	N/A	ZENER DIODE DIODES	N/A	3.00	3	15,000	106,050	10,760	1000	ITALY	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
PHILIPS	CAEN	FRANCE	N/A	CONSUMER ICS	BIPOLAR M2 M3	1.50	5	18,000	342,360	0	100	NETHERLANDS	
PHILIPS	HAMBURG	GERMANY	CONSUMER	CON	BIP M2	1.20	5	18,000	342,360	16,140	100	NETHERLANDS	M
PHILIPS	HAMBURG	GERMANY	DISCRETE	DIS	BIP M1	2.00	4	22,000	267,740	0	1K/10	NETHERLANDS	M
PHILIPS	HAMBURG	GERMANY	N/A	8-BIT MCU 16-BIT MCU EEPROM ASIC	CMOS MOS M1 M2	1.00	6	12,500	237,750	32,280	10K/1	NETHERLANDS	M
PHILIPS	HAZELGROVE, STOCKPORT CHESHIRE	ENGLAND	BIPOLAR	TRAN DIODE RECTIFIER	BIP	10.00	4	45,000	547,650	19,368	100	NETHERLANDS	
PHILIPS	HAZELGROVE, STOCKPORT CHESHIRE	ENGLAND	POWERMOS	DIODE SMART PWR	MOS 1M	[illegible]	[illegible]	10,000	121,700	11,836	10	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETHERLANDS	N/A	N/A	MOS 1M	[illegible]	4	26,000	316,420	23,456	100	NETHERLANDS	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
PHILIPS	NIJMEGEN	NETHERLANDS	N/A	SRAM CON	CMOS NMOS M2	0.80	6	8,400	229,992	0	1	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETHERLANDS	N/A	DIS	MOS BICMOS BIP	1.50	[illegible]	20,000	380,400	39,339	100	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETHERLANDS	N/A	PWR DIS DIODES	N/A	0.70	4	0	0	12,912	10000	NETHERLANDS	M
PHILIPS	STADSKANAAL	NETHERLANDS	N/A	RECTIFIER	BIP M3	0.00	3	70,000	494,900	0	N/A	NETHERLANDS	M
PHILIPS RTC	CAEN	FRANCE	N/A	[illegible]		[illegible]	5	12,000	228,240	12,589	10	FRANCE	M
PHILIPS/FASELEC	ZURICH	SWITZERLAND	N/A	N/A	CMOS 1M	2.00	4	12,000	146,040	21,520	100	NETHERLANDS	M
PIHER	GRANOLLERS	SPAIN	N/A	DIS LIN	BIP	0.00	3	10,000	70,700	13,000	N/A	SPAIN	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
RACAL	READING	ENGLAND	N/A	N/A	MOS	0.00	3	10,000	70,700	0	N/A	ENGLAND	M
RIFA AB	KALMAR	SWEDEN	N/A	PWR DIS	BIP	0.00	4	25,000	304,250	92,000	N/A	SWEDEN	M
RIFA AB	KISTA	SWEDEN	N/A	N/A	BIP MOS	0.00	4	10,000	121,700	0	N/A	SWEDEN	M
ROBERT BOSCH	REUTLINGEN	GERMANY	RtW/FAN	LIN DIS CUSTOM	BIP BICMOS	3.00	4	20,000	243,400	0	100	GERMANY	C
SEAGATE MICROELECT.	LIVINGSTON	SCOTLAND	N/A	LIN	BIP M2	3.00	4	5,000	60,850	16,140	100	U.S.A.	C
[illegible]	GLENROTHES	SCOTLAND	N/A	LIN DIS OPTO	BIP CMOS MOS	4.00	4	2,000	24,340	0	10	SCOTLAND	M
SEMITRON	CRICKLADE	ENGLAND	N/A	DIS	BIP	0.00	4	10,000	121,700	0	N/A	GERMANY	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
SEMITRON	NURNBERG	GERMANY	N/A	DIS	BIP	0.00	4	10,000	121,700	0	N/A	GERMANY	M
SGS-THOMSON	35041 RENNES	FRANCE	N/A	LIN	BIP M2	5.00	5	16,000	304,320	0	10	ITALY	M
SGS-THOMSON	AGRATE	ITALY	MOD	LIN ARRAYS LOGIC	BIP BICMOS	4.00	5	16,000	304,320	22,000	10	ITALY	M
SGS-THOMSON	AGRATE (MILAN)	ITALY	FAB 8	64K 256K 1Mb EPROM PLD LIN ARRAYS	CMOS	0.70	6	28,000	766,640	22,000	10/1	ITALY	M
SGS-THOMSON	CATANIA	ITALY	N/A	DIS	N/A	3.00	5	34,000	646,680	0	100	ITALY	M
SGS-THOMSON	CATANIA	ITALY	N/A	LOG LIN CUSTOM	CMOS	3.00	4	21,000	255,570	0	100	ITALY	M
SGS-THOMSON	COSTALETTO		N/A	MPU	CMOS	0.00	5	0	0	0	N/A	ITALY	

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
SGS-THOMSON	GRENOBLE	FRANCE	N/A	LIN PWR IC CUSTOM	BIP CMOS	1.50	4	20,000	243,400	14,000	100	ITALY	M
SGS-THOMSON	ROUSSET	FRANCE	MODULE 4	MPU LIN	CMOS MOS	2.00	4	22,000	267,740	0	10	ITALY	M
SGS-THOMSON	ROUSSET	FRANCE	MODULE 5	NVMEM MPU	CMOS MOS	1.50	5	16,000	304,320	0	1	ITALY	M
SGS-THOMSON	TOURS	FRANCE	MESA	DIS	N/A	5.00	3	70,000	494,900	0	100	ITALY	M
SGS-THOMSON	TOURS	FRANCE	PLANAR	DIS	N/A	5.00	4	20,000	243,400	0	100	ITALY	M
SIEMENS	MUNICH	GERMANY	BALANSTRAS	ASIC CUSTOM LIN	BIP	2.00	5	15,000	285,300	0	N/A	GERMANY	M
SIEMENS	MUNICH	GERMANY	BALANSTRAS	ASIC CUSTOM	CMOS MOS	1.20	5	15,000	285,300	0	N/A	GERMANY	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
SIEMENS	REGENSBURG	GERMANY	MEGA 1	1Mb DRAM 4Mb DRAM	CMOS	0.80	6	20,800	569,504	0	N/A	GERMANY	M
SIEMENS	REGENSBURG	GERMANY	MEGA 2	4Mb DRAM	CMOS	0.80	6	16,000	438,080	0	N/A	GERMANY	M
SIEMENS	REGENSBURG	GERMANY	N/A	OPTO	N/A	0.00	4	10,000	121,700	0	N/A	GERMANY	M
SIEMENS	VILLACH	AUSTRIA	FAB 1	64K DRAM LOG	MOS	2.00	4	40,000	486,800	0	N/A	GERMANY	M
SIEMENS	VILLACH	AUSTRIA	FAB 2	256K DRAM	MOS	1.20	5	40,000	760,800	0	N/A	GERMANY	M
TAG	ZURICH	SWITZERLAND	N/A	DIS	N/A	0.00	4	10,000	121,700	0	N/A	SWITZERLAND	M
TELEFUNKEN	ECHING	GERMANY	N/A	LOG MPU MCU ARRAYS	CMOS	3.00	4	24,000	292,080	3,000	100	GERMANY	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
				CUST									
TELEFUNKEN ELECT.	HEILBRONN	GERMANY	N/A	CUSTOM LIN DIS MCU	BIP MOS CMOS	1.00	4	20,000	243,400	0	1	GERMANY	M
TELEFUNKEN ELECT.	HEILBRONN	GERMANY	N/A	OPTO HIGH FREQUENCY	BIP	1.00	3	5,000	35,350	0	N/A	GERMANY	M
TELEFUNKEN ELECT.	HEILBRONN	GERMANY	N/A	OPTO	GaAs	1.00	2	3,000	9,420	0	N/A	GERMANY	M
TEXET	NICE	FRANCE	N/A	DIS	N/A	0.00	4	10,000	121,700	25,000	N/A	FRANCE	M
TI	AVEZZANO	ITALY	PHASE 1	4Mb DRAM ASSP CBIC	CMOS	0.80	6	23,740	650,001	46,000	1	U.S.A.	M
TI	BEDFORD	ENGLAND	PWR FAB	PWR DIS	BIP	0.00	4	14,379	174,992	9,000	100	U.S.A.	M
TI	FREISING	GERMANY	N/A	LIN ASSP	BIP CMOS BICMOS	[illegible]	5	9,463	179,986	10,000	100	U.S.A.	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
TI	FREISING	GERMANY	N/A	CBIC LIN ASSP	CMOS BICMOS	0.80	5	10,515	199,995	17,000	10	U.S.A.	M
VAISALA	VANTAA	FINLAND	N/A	LIN	CMOS	5.00	3	200	1,414	0	100	FINLAND	M
VEB GLEICHRICHTERWERK	STAHNSDORF	GERMANY	N/A	PWR DIS	N/A	0.00	0	0	0	0	N/A	GERMANY	C
VEB HALBLEITERWERK	FRANKFURT (ODER)	GERMANY	N/A	LIN	BIP	0.00	0	0	0	0	N/A	GERMANY	C
VEB KOMBINAT MIKROELEKTRONIK	ERFURT	GERMANY	N/A	N/A	CMOS MOS	0.00	0	0	0	0	N/A	GERMANY	C
VEB ROEHRENWERK	NEUHAUS AM RENNWEG	GERMANY	N/A	TRAN	N/A	0.00	0	0	0	0	N/A	GERMANY	C
VEB WERK FUER FERNSEHELEKTRONIK	BERLIN-OBERSCHOENEWEIDE	GERMANY	N/A	SENSOR CCD	N/A	0.00	0	0	0	0	N/A	GERMANY	C

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1992)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
WESTCODE S/C	CHIPPENHAM	ENGLAND	N/A	DIS	N/A	0.00	4	10,000	121,700	0	N/A	ENGLAND	C
ZETEX	OLDHAM	ENGLAND	N/A	CUSTOM	BIP MOS	1.50	5	10,000	190,200	26,000	N/A	ENGLAND	M

NA = Not Available
Source: Dataquest (November 1991)

Table 2
European Future Pilot and Production Fab Lines
(Planned Facilities Going into Production by Year)

Company	City	Country	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Feet)
Production Begins: 1992												
HITACHI	LANDSHUT	GERMANY	N/A	4Mb DRAM 256K 1Mb SRAM	N/A	F	01/01/92	0.80	8	16,000	778,720	0
MITSUBISHI	ALSDORF	GERMANY	N/A	4Mb DRAM MPU 1Mb DRAM	CMOS	FAT	03/01/92	0.80	6	22,000	602,360	25,000
TI	AVEZZANO	[illegible]	PHASE 2	16Mb DRAM	CMOS	F	02/01/92	0.60	8	20,000	973,400	30,000
Production Begins: 1993												
FUJITSU	NEWTON AYCLIFFE	ENGLAND	PHASE 2	4Mb DRAM ASIC	CMOS	F	/ /	0.80	6	45,000	1,232,100	0
INTEL	LEIXLIP, KILDARE	IRELAND	FAB 10	386 486 586 MPU LOG	CMOS	F	06/01/93	0.80	8	18,000	876,060	30,000
MIETEC ALCATEL	OUDENAARDE	BELGIUM	FAB 2	ASIC	CMOS M2 POLY2	FAT	07/01/93	0.50	6	5,000	136,900	12,917
Production Begins: 1994												
FUJITSU	NEWTON AYCLIFFE	ENGLAND	PHASE 3	16Mb DRAM	CMOS	F	/ /	0.60	8	30,000	1,460,100	0

Dataquest (October 1991)

Dataquest

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European Fab Database

BACKGROUND

The material in this booklet applies to the European portion of Dataquest's Semiconductor Equipment, Manufacturing, and Materials service Wafer Fab Database. The Wafer Fab Database is updated on an ongoing basis, employing both primary and secondary research methodologies. The tables included in this booklet highlight both production and pilot line wafer fabs.

GENERAL DEFINITIONS

A *fab line* is a processing line in a clean room that is equipped to do all front-end wafer processing. Occasionally there are two separate product-specific fab lines or two different wafer sizes in a clean room. In this situation, a clean room will be documented as two fab lines if the equipment is dedicated to each wafer size or product line. There can be many fab lines at one location.

Front-end wafer processing is defined as all steps involved with semiconductor processing, beginning with initial oxide and ending at wafer probe.

A *production fab* is defined as a wafer fab capable of front-end processing more than 1,250 wafers per week.

A *pilot fab* is defined as a wafer fab capable of front-end processing 1,250 wafers or less per week.

DEFINITIONS OF TABLE COLUMNS

The *Products Produced* column contains product information for seven product categories. The information in this column can be very detailed, depending on the information's availability. The nomenclature used within the seven product groups of the fab database is as follows, with definitions where warranted:

- Analog
  - LIN—Linear/analog devices
  - A/D D/A—Analog-to-digital, digital-to-analog converters
  - AUTOMOTIVE—Dedicated to automobile applications
  - CODEC—Coder/decoder
  - INTERFACE—Interface IC
  - MESFET (GaAs)—Metal Schottky field-effect transistor
  - MODFET (GaAs)
  - MDIODE (GaAs)—Microwave diode
  - MFET (GaAs)—Microwave field-effect transistor
  - MODEM—Modulator/demodulator
  - MMIC—Monolithic microwave IC
  - OP AMP—Operational amplifier
  - PWR IC—Power IC
  - REG—Voltage regulator
  - SMART PWR—Smart power
  - SWITCHES—Switching device
  - TELECOM—Telecommunications chips
- Memory
  - MEM—Memory
  - RAM—Random-access memory
  - DRAM—Dynamic RAM
  - SRAM 4 TR.—Static RAM uses a 4-transistor cell design
  - SRAM 6 TR.—Static RAM uses a 6-transistor cell design
  - VRAM—Video RAM
  - ROM—Read-only memory
  - PROM—Programmable ROM
  - EPROM—Ultraviolet erasable PROM
  - EEPROM or E2—Electrically erasable PROM
  - FERRAM—Ferroelectric RAM
  - NVMEM—Nonvolatile memory (ROM, PROM, EPROM, EEPROM, FERRAM)
  - FIFO—First-in, first-out memory
  - SPMEM—Other specialty memory (dual port, shift-register, color look-up, etc.)
- Micrologic
  - ASSP—Application-specific standard product
  - BIT—Bit slice (subset of MPU functions)
  - DSP—Digital signal processor

- MCU—Microcontroller unit
- MPR—Microperipheral
- MPRCOM—MPR digital communications (ISDN, LAN, UART, modem)
- MPU—Microprocessor unit
- LISP—32-bit list instruction set processor for AI applications
- RISC—Reduced-instruction-set computation 32-bit MPU

• Standard logic

- LOG—Standard logic

• ASIC logic

- ASIC—Application-specific IC
- ARRAYS—Gate arrays
- CBIC—Cell-based IC
- CUSTOM—Full-custom IC (single user)
- PLD—Programmable logic device

• Discrete

- DIS—Discrete
- DIODE
- FET—Field-effect transistor
- GTO—Gate turn-off thyristor
- HEMT (GaAs)—High-electron-mobility transistor
- MOSFET—MOS-based field-effect transistor
- PWR TRAN—Power transistor
- RECTIFIER
- RF—Radio frequency
- SCR—Schottky rectifier
- SENSORS
- SST—Small-signal transistor
- THYRISTOR
- TRAN—Transistor
- ZENER DIODE

• Optoelectronic

- OPTO—Optoelectronic
- CCD—Charge-coupled device (imaging)
- COUPLERS—Photocouplers
- IED—Infrared-emitting diode
- IMAGE SENSOR
- LASER (GaP)—Semiconductor laser or laser IC
- LED—Light-emitting diode
- PDIODE—Photo diode
- PTRAN—Photo transistor
- SAW—Surface acoustic wave device
- SIT IMAGE SENSOR—Static induction transistor image sensor

The *Process Technology* column lists four major types of technologies. This column also lists a few uncommon technologies along with information on levels of metal, type of well, and logic structure, when available. Definitions of the nomenclature used in the Process Technology column are as follows:

• MOS (silicon-based)

- CMOS—Complementary metal-oxide semiconductor
- MOS—n-channel metal-oxide semiconductor (NMOS) and p-channel metal-oxide semiconductor (PMOS) (More than 90 percent of the MOS fabs use n-channel MOS.)
- M1—Single-level metal
- M2—Double-level metal
- M3—Triple-level metal
- N-WELL
- P-WELL
- POLY1—Single-level polysilicon
- POLY2—Double-level polysilicon
- POLY3—Triple-level polysilicon

• BiCMOS (silicon-based)

- BICMOS—Bipolar and CMOS combined on a chip
- BIMOS—Bipolar and MOS combined on a chip
- ECL I/O—ECL input/output
- TTL I/O—TTL input/output

• Bipolar (silicon-based)

- BIP—Bipolar
- ECL—Emitter-coupled logic
- TTL—Transistor-transistor logic
- STTL—Schottky TTL

• Gallium arsenide and other compound semiconductor materials

- GaAs—Gallium arsenide
- GaAlAs—Gallium aluminum arsenide

- GaAs on Si—Gallium arsenide on silicon
- GaP—Gallium phosphide
- HgCdTe—Mercuric cadmium telluride
- InAs—Indium arsenide
- InP—Indium phosphide
- InSb—Indium antimony
- LiNbO3—Lithium niobate
- SOS—Silicon on sapphire

The number in the *Minimum Linewidth* column represents the minimum linewidth at the critical mask layers as drawn. This number is stated in microns and is defined in Dataquest's fab survey as being available in production volumes.

The *Wafer Size* column represents the wafer diameter expressed colloquially in inches. However, for wafers greater than 3 inches in diameter, the colloquial expression is inaccurate. When calculating square inches, the following approximations are used:

Stated Diameter	Approximate Diameter
4 inches (100mm)	3.938 inches
5 inches (125mm)	4.922 inches
6 inches (150mm)	5.906 inches
8 inches (200mm)	7.87 inches

Wafer-Start Capacity is defined in the fab survey as the equipment-limited wafer-start capacity per four-week period. Start capacity is not limited by current staffing or the number of shifts operating; it is limited only by the installed equipment in the fab and the complexity of the process it runs. Start capacity in square inches is calculated using the approximate diameter and the wafer-start capacity.

The *Clean Room Class* column represents the level of cleanliness in the cleanest part of the clean room. This area represents the true environment to which the wafer is exposed.

The *Origin of Owner* column represents the country where the parent company is headquartered.

The *Merchant or Captive* column categorizes each fab line on the tables as one of these two types. Definitions of the various categories are as follows:

- A *Merchant* fab line is a fab line that produces devices that end up available on the merchant market.
- A *Captive* fab line does no sell any of its devices on the merchant market. All production is consumed by the owner of the fab line.

Table 1
European Existing Pilot and Production Fab Lines (Including Fabs Going Into Production During 1991)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
ABB-HAFO	JARFALLA	SWEDEN	N/A	DIS OPTO	BIP CMOS	1.50	4	5,000	60,868	6,000	0	SWITZ/SWEDEN	M
ABB-IXYS	LAMPERTHEIM	GERMANY	N/A	PWR DIS LIN	BIP	5.00	3	16,000	113,040	0	100	SWISS/SWEDISH	M
ACRIAN	BRIDGEND	WALES	N/A	MICROWAVE	BIP	1.20	4	5,000	60,868	0	0	U.S.	M
AMS	GRAZ	AUSTRIA	N/A	N/A	MOS	0.00	5	20,000	380,350	28,000	0	GERMANY/JAPAN	M
AMS	UNTERPREMSTATTEN	AUSTRIA	N/A	ARRAYS CBIC CUSTOM	CMOS	1.20	4	5,000	60,868	0	0	AUSTRIA	M
ANALOG DEVICES	LIMERICK	IRELAND	N/A	LIN AD/DA TELECOM	BIP BICMOS	2.00	4	10,000	121,737	10,000	10	U.S.	M
ANALOG DEVICES	LIMERICK	IRELAND	N/A	LIN AD/DA TELECOM	BIP BICMOS	1.20	6	20,000	547,629	0	0	U.S.	M
ANSALDO TRASPORTI	GENOA	ITALY	LINITA	PWR DIS	BIP	5.00	4	10,000	121,737	0	100	ITALY	M
ASCOM FAVAG	BEVAIX	SWITZERLAND	N/A	ARRAYS CUSTOM	BIP	3.00	4	1,000	12,174	0	100	SWITZERLAND	M
AT&T MICROELECT.	MADRID	SPAIN	N/A	CBIC CUSTOM	CMOS M2	1.25	6	14,000	383,340	25,000	1	SPAIN/U.S.	M
ATMEL	N/A	NETH.	N/A	EPROM EEPROM ARRAYS	CMOS	0.60	8	5,000	243,102	0	0	U.S.	
BURR-BROWN	LIVINGSTON	SCOT.	N/A	LIN CUSTOM	BIP CMOS	0.00	3	7,000	49,455	0	0	U.S.	M
DIGITAL EQUIPMENT	SOUTH QUEENSFERRY	SCOT.	N/A	DRAM MCU CPU	CMOS	0.70	6	3,000	82,144	28,000	1	U.S.	C
ELMOS	DORTMUND	GERMANY	N/A	LIN CUSTOM	CMOS	3.00	4	4,000	48,695	0	10	N/A	M
ERMIC	ERFURT	GERMANY	N/A	N/A	CMOS	1.60	5	0	0	0	0	GERMANY	M
ES2	AIX-EN-PROVENCE	FRANCE	N/A	CBIC ARRAYS CUSTOM	CMOS M2	2.00	5	5,000	95,087	0	0	FRANCE	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
FUJITSU	NEWTON AYCLIFFE	ENGLAND	PHASE 1	1Mb DRAM 4Mb DRAM ASIC	CMOS	1.00	6	25,000	684,536	0	0	JAPAN	M
GEC PLESSEY S/C	SWINDON	ENGLAND	N/A	DIODES DIS LIN	BIP	5.00	5	12,000	228,210	29,000	0	ENGLAND	M
GEC PLESSEY S/C	SWINDON	ENGLAND	N/A	LIN	BIP	3.00	4	14,000	170,431	0	0	ENGLAND	M
GEC PLESSEY S/C	PLYMPTON	ENGLAND	N/A	N/A	MOS	3.00	4	15,000	182,605	0	0	ENGLAND	M
GEC PLESSEY S/C	ROBOROUGH	ENGLAND	N/A	ARRAYS CUSTOM BIT VHPIC	CMOS M2	1.00	6	6,000	164,289	0	10	ENGLAND	M
GEC PLESSEY S/C	ROBOROUGH	ENGLAND	N/A	LIN LOG	MOS	2.00	4	2,000	24,347	0	100	ENGLAND	M
GEC PLESSEY SEMICOND.	LINCOLN	ENGLAND	N/A	LIN MPU ARRAYS SRAM CUST	CMOS MOS	1.50	4	13,000	158,258	12,000	10	ENGLAND	M
HITACHI	LANDSHUT	GERMANY	N/A	4Mb DRAM 256K 1Mb SRAM	N/A	0.80	6	16,000	438,103	0	0	JAPAN	M
HMT	BRUGG	SWITZERLAND	N/A	CONSUMER ICs	MOS	0.00	3	15,000	105,975	15,000	0	SWITZERLAND	M
HUGHES MICROELECT.	GLENROTHES	SCOT.	N/A	ARRAYS CBIC EPROM CUSTOM	CMOS NMOS	3.00	4	6,400	77,911	28,000	100	U.S.	M
IBM	CORBEIL-ESSONNES	FRANCE	N/A	ARRAYS LIN CUSTOM	BIP	2.00	5	40,000	760,699	50,000	0	U.S.	C
IBM	BOEBLINGEN	GERMANY	N/A	PWR DIS HYBRID	BIP	0.00	4	20,000	243,473	0	0	U.S.	C
IBM	HANNOVER	GERMANY	N/A	DIS	BIP	0.00	4	20,000	243,473	0	0	U.S.	C

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
IBM	SINDELFINGEN	GERMANY	N/A	ARRAYS	BIP	2.00	5	15,000	285,262	20,000	0	U.S.	C
IBM	CORBEIL-ESSONNES	FRANCE	N/A	288K DRAM 64K SRAM	CMOS MOS	1.00	5	25,000	475,437	25,000	0	U.S.	C
IBM	SINDELFINGEN	GERMANY	N/A	1Mb DRAM 4Mb DRAM	CMOS	0.80	8	20,000	972,409	45,000	0	U.S.	C
IBM	SINDELFINGEN	GERMANY	N/A	288K DRAM SRAM DSP MPU	MOS	1.50	5	25,000	475,437	20,000	0	U.S.	C
IBM	SINDELFINGEN	GERMANY	N/A	CUSTOM	BIP	1.50	5	15,000	285,262	20,000	0	U.S.	C
IBM	SINDELFINGEN	GERMANY	N/A	4Mb DRAM	CMOS	0.80	8	30,000	1,458,614	45,000	0	U.S.	C
IBM	CORBEIL-ESSONNES	FRANCE	N/A	1Mb DRAM	CMOS	0.00	8	7,000	340,343	0	0	U.S.	C
INST. SCIENCE & TECH.	TRENTO	ITALY	N/A	CCD	CMOS	0.00	4	10,000	121,737	0	0	ITALY	R
INTL. RECTIFIER	BORGARA TORINES	ITALY	N/A	DIS	N/A	0.00	4	15,000	182,605	13,000	0	U.S.	M
INTL. RECTIFIER	BORGARA TORINES	ITALY	N/A	DIS	N/A	0.00	4	10,000	121,737	0	0	U.S.	M
ISKRA	TRBOVLJE	YUGOSLAVIA	N/A	DIS	BIP	0.00	3	5,000	35,325	0	0	YUGOSLAVIA	M
ISOCOM	HARTLEPOOL	ENGLAND	N/A	OPTO	GaAs	0.00	0	0	0	0	0	ENGLAND	M
ITALTEL	ROME	ITALY	N/A	N/A	GaAs	0.00	0	0	0	0	0	ITALY	M
ITT	FREIBURG	GERMANY	N/A	PWR TRAN DIS	BIP MOS	5.00	4	42,000	511,294	0	1,000	GERMANY	M
ITT	FREIBURG	GERMANY	N/A	DSP NVMEM CUSTOM	CMOS MOS	1.20	5	21,500	408,876	0	10	GERMANY	M
ITT	FREIBURG	GERMANY	N/A	DSP	CMOS	0.80	6	12,000	328,577	0	0	GERMANY	M
ITT	FREIBURG	GERMANY	N/A	DIS CUSTOM	BIP	5.00	4	16,500	200,865	0	10	FRANCE	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
LSI LOGIC	SIDCUP, KENT	ENGLAND	N/A	ARRAYS LIN DRAM SRAM CUST	CMOS BIP MOS	2.00	4	3,000	36,521	0	10	ENGLAND/U.S.	M
LSI LOGIC	FOOTSCRAY	ENGLAND	PHASE 1	ARRAYS CBIC LIN MPU	CMOS BICMOS	1.20	6	2,500	68,454	13,000	10	U.S.	M
LUCAS	SUTTON COLDFIELD	ENGLAND	N/A	PWR DIS	GaAs	0.00	0	0	0	54,000	0	ENGLAND	M
MATRA MHS	NANTES	FRANCE	N/A	256K SRAM MCU ARRAYS LIN	CMOS MOS M2	1.00	5	9,000	171,157	0	10	FRANCE/U.S.	M
MATRA MHS	NANTES	FRANCE	N/A	LIN	BIP MOS	0.00	3	15,000	105,975	0	0	FRANCE	M
MATRA MHS/CYPRESS	N/A	FRANCE	N/A	N/A	N/A	0.00	0	0	0	0	0	FRANCE/U.S.	M
MICORELECT.-MARIN	MARIN	SWITZERLAND	N/A	CUSTOM	N/A	0.00	4	10,000	121,737	0	0	SWITZERLAND	M
MICROELECT.-MARIN	MARIN	SWITZERLAND	N/A	ARRAYS LIN CUSTOM	CMOS	3.00	4	10,000	121,737	0	10	SWITZERLAND	M
MICRONAS	ESPOO	FINLAND	N/A	LIN CBIC CUSTOM	BICMOS CMOS	2.50	4	2,000	24,347	0	10	FINLAND	C
MIETEC	OUDENAARDE	BELGIUM	N/A	CUSTOM	MOS	0.00	3	10,000	70,650	0	0	BELGIUM	M
MIETEC	OUDENAARDE	BELGIUM	N/A	ASIC	BIMOS CMOS	2.40	4	55,385	674,238	0	10	BELGIUM	M
MISTRAL	SERMONETA	ITALY	N/A	DIS	N/A	0.00	3	10,000	70,650	0	0	ITALY	M
MITEL	NEWPORT	WALES	N/A	LIN OPTO CUSTOM	BIP	0.00	3	20,000	141,300	28,000	0	WALES	M
MITEL	NEWPORT	WALES	N/A	CUSTOM	N/A	0.00	4	10,000	121,737	0	0	ENGLAND	M
MOTOROLA	TOULOUSE	FRANCE	BP-4	TELECOM OP AMP REG AUTO	BIP	2.00	4	25,000	304,341	22,000	100	U.S.	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
MOTOROLA	EAST KILBRIDE	SCOT.	MOS-4	MCU MEM LOG	CMOS MOS	2.00	5	45,000	855,786	35,000	0	U.S.	M
MOTOROLA	TOULOUSE	FRANCE	BIP PWR	PWR TRAN	BIP	10.00	5	12,000	228,210	8,700	100	U.S.	M
MOTOROLA	TOULOUSE	FRANCE	N/A	DIS	BIP	0.00	4	14,000	170,431	5,800	0	U.S.	M
MOTOROLA	EAST KILBRIDE	SCOT.	N/A	FET AMPS LED MMIC	GaAs	0.00	0	0	0	0	0	U.S.	M
MOTOROLA	EAST KILBRIDE	SCOT.	MOS-9	SRAM 1Mb DRAM 68040 MPU	CMOS TOSHIBA	1.00	6	25,000	684,536	34,000	10	U.S.	M
MOTOROLA	EAST KILBRIDE	SCOT.	MOS-1	MCU MEM LOG	CMOS MOS M1	3.00	4	20,000	243,473	25,600	100	U.S.	M
NATIONAL S/C	GREENOCK	SCOT.	UK 6"	LOG CUSTOM ARRAYS	BIP	1.50	6	7,000	191,670	10,000	10	U.S.	M
NATIONAL S/C	GREENOCK	SCOT.	LOGIC	LOG	N/A	0.00	5	15,000	285,262	15,000	0	U.S.	M
NATIONAL S/C	GREENOCK	SCOT.	BIP 4	LOG	BIP	5.00	4	40,000	486,946	10,000	100	U.S.	M
NEC	LIVINGSTON	SCOT.	PHASE 2	4Mb DRAM 256K SRAM MPU	CMOS	0.00	6	9,000	246,433	19,500	0	JAPAN	M
NEC	LIVINGSTON	SCOT.	PHASE 1	256K 1Mb DRAM SAMPLE 4Mb	CMOS	0.80	6	9,000	246,433	19,500	1	JAPAN	M
NEWMARKET MICROSYS.	NEWMARKET	ENGLAND	N/A	LIN DIS	BIP	0.00	4	10,000	121,737	0	0	ENGLAND	M
PHILIPS	HAMBURG	GERMANY	N/A	1Mb DRAM	CMOS	1.20	6	20,000	547,629	0	0	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETH.	MOS 3	256K SRAM 1Mb DEVELOP	CMOS	1.00	6	17,500	479,175	30,000	0	NETHERLANDS	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
PHILIPS	STOCKPORT	ENGLAND	PWR LABS	DIS	MOS	4.00	4	8,000	97,389	0	10	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETH.	FAB C	LOGIC	CMOS	1.50	5	10,000	190,175	0	0	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETH.	FAB D	PWR DIS	BIP	0.00	4	20,000	243,473	0	0	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETH.	FAB E	DIS	BIP	0.00	3	15,000	105,975	0	0	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETH.	FAB A	LIN	BIP	3.00	4	25,000	304,341	28,000	0	NETHERLANDS	M
PHILIPS	STADSKANAAL	NETH.	N/A	OPTO CUSTOM	GaAs MOS	0.00	0	0	0	0	0	NETHERLANDS	M
PHILIPS	HAMBURG	GERMANY	DIS.	DIS	BIP	2.00	3	20,000	141,300	0	100	NETHERLANDS	M
PHILIPS	NIJMEGEN	NETH.	FAB B	64K 256K SRAM	CMOS	0.80	5	10,000	190,175	0	0	NETHERLANDS	M
PHILIPS NATL. LABS	EINDHOVEN	NETH.	MOS 1	4Mb DRAM 16Mb DRAM DEVELO	CMOS MOS	0.80	6	6,400	175,241	0	0	NETHERLANDS	R
PHILIPS/FASELEC	ZURICH	SWITZERLAND	N/A	LOG MCU CUSTOM	CMOS	2.00	4	14,000	170,431	5,000	10	NETHERLANDS	M
PIHER	GRANOLLERS	SPAIN	N/A	DIS LIN	BIP	0.00	3	10,000	70,650	13,000	0	SPAIN	M
RACAL	READING	ENGLAND	N/A	N/A	MOS	0.00	3	10,000	70,650	0	0	ENGLAND	M
RIFA	KALMAR	SWEDEN	N/A	PWR DIS	BIP	0.00	4	25,000	304,341	92,000	0	SWEDEN	M
RIFA	KISTA	SWEDEN	N/A	N/A	BIP MOS	0.00	4	10,000	121,737	0	0	SWEDEN	M
ROBERT BOSCH	REUTLINGEN	GERMANY	RtW/FAW	LIN DIS CUSTOM	BIP BICMOS	3.00	4	20,000	243,473	0	100	GERMANY	C
SEAGATE MICROELECT.	LIVINGSTON	SCOT.	N/A	LIN	BIP	6.00	4	4,500	54,781	0	100	U.S.	C
SEMEFAB	GLENROTHES	SCOT.	N/A	LIN DIS OPTO	BIP CMOS MOS	4.00	4	2,000	24,347	0	10	SCOTLAND	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
SEMITRON	CRICKLADE	ENGLAND	N/A	DIS	BIP	0.00	4	10,000	121,737	0	0	GERMANY	M
SEMITRON	NURNBERG	GERMANY	N/A	DIS	BIP	0.00	4	10,000	121,737	0	0	GERMANY	M
SGS-THOMSON	ROUSSET	FRANCE	MOD 5	NVMEM MPU	CMOS MOS	1.50	5	16,000	304,280	0	1	ITALY	M
SGS-THOMSON	TOURS	FRANCE	MESA	DIS	N/A	5.00	3	70,000	494,550	0	100	ITALY	M
SGS-THOMSON	GRENOBLE	FRANCE	N/A	LIN PWR IC CUSTOM	BIP CMOS	2.00	4	21,000	255,647	0	10	ITALY	M
SGS-THOMSON	AGRATE	ITALY	MMD	LIN ARRAYS LOGIC	BIP BICMOS	4.00	5	16,000	304,280	22,000	10	ITALY	M
SGS-THOMSON	CATANIA	ITALY	N/A	DIS	N/A	3.00	5	34,000	646,594	0	100	ITALY	M
SGS-THOMSON	ROUSSET	FRANCE	MOD 4	MPU LIN	CMOS MOS	2.00	4	22,000	267,820	0	10	ITALY	M
SGS-THOMSON	CATANIA	ITALY	N/A	LOG LIN CUSTOM	CMOS	3.00	4	21,000	255,647	0	100	ITALY	M
SGS-THOMSON	TOURS	FRANCE	PLANAR	DIS	N/A	5.00	4	20,000	243,473	0	100	ITALY	M
SGS-THOMSON	AGRATE	ITALY	N/A	64K 256K 1Mb EPROM	CMOS	1.20	6	10,000	273,815	22,000	0	ITALY	M
SGS-THOMSON	RENNES	FRANCE	N/A	LIN	BIP	5.00	5	12,000	228,210	0	10	ITALY	M
SGS-THOMSON	COSTALETTO			MPU	CMOS	0.00	5	0	0	0	0	ITALY	
SGS-THOMSON/INMOS	NEWPORT	WALES	F21	SRAM LIN MPU DRAM MPR DSP	CMOS MOS OKI	0.00	4	20,000	243,473	0	1	ITALY	M
SIEMENS	VILLACH	AUSTRIA	FAB 2	256K DRAM	MOS	1.20	5	40,000	760,699	0	0	GERMANY	M
SIEMENS	MUNICH	GERMANY	BALANSTR.	ASIC CUSTOM LIN	BIP	2.00	5	15,000	285,262	0	0	GERMANY	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
SIEMENS	REGENSBURG	GERMANY	MEGA 1	1Mb DRAM 4Mb DRAM DEVELOP	CMOS TOSHIBA	0.80	6	20,800	569,534	0	0	GERMANY	M
SIEMENS	MUNICH	GERMANY	BALANSTR.	ASIC CUSTOM	CMOS MOS	1.50	5	15,000	285,262	0	0	GERMANY	M
SIEMENS	VILLACH	AUSTRIA	FAB 1	64K DRAM LOG	MOS	2.00	4	40,000	486,946	0	0	GERMANY	M
SIEMENS	REGENSBURG	GERMANY	MEGA 2	4Mb DRAM	CMOS TOSHIBA	0.80	6	16,000	438,103	0	0	GERMANY	M
SIEMENS	CRICKLADE	ENGLAND	N/A	DIS	N/A	0.00	5	15,000	285,262	0	0	GERMANY	M
SIEMENS	REGENSBURG	GERMANY	N/A	DIS OPTO	N/A	0.00	4	10,000	121,737	0	0	GERMANY	M
SIEMENS	MUNICH	GERMANY	PERLACH	4Mb 16Mb DRAM PROTO	CMOS	0.60	8	1,600	77,793	0	0	GERMANY	M
SIEMENS	MUNICH	GERMANY	PERLACH	N/A	BIP	1.50	4	12,000	146,084	0	0	GERMANY	M
SIEMENS	MUNICH	GERMANY	PERLACH	4Mb DRAM	CMOS	0.80	6	16,000	438,103	0	0	GERMANY	M
STANDARD ELECTRICA	CASCAIS	PORTUGAL	N/A	DIS	N/A	0.00	3	10,000	70,650	0	0	PORTUGAL	M
TAG	ZURICH	SWITZERLAND	N/A	DIS	N/A	0.00	4	10,000	121,737	0	0	SWITZERLAND	M
TELEFUNKEN	ECHING	GERMANY	N/A	LOG MPU MCU ARRAYS CUST	CMOS	3.00	4	24,000	292,168	3,000	100	GERMANY	M
TELEFUNKEN ELECT.	HEILBRONN	GERMANY	N/A	CUSTOM LIN DIS MCU	BIP MOS CMOS	1.00	4	20,000	243,473	0	1	GERMANY	M
TELEFUNKEN ELECT.	HEILBRONN	GERMANY	N/A	OPTO HIGH FREQUENCY	BIP	1.00	3	5,000	35,325	0	0	GERMANY	M
TELEFUNKEN ELECT.	HEILBRONN	GERMANY	N/A	OPTO	GaAs	1.00	2	3,000	9,420	0	0	GERMANY	M
TEXET	NICE	FRANCE	N/A	DIS	N/A	0.00	4	10,000	121,737	25,000	0	FRANCE	M

(Continued)

Table 1 (Continued)
European Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	Country	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Max. W/Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Mercant or Captive
TI	FREISING	GERMANY	N/A	LOG LIN	BIP	0.00	5	15,000	285,262	13,000	100	U.S.	M
TI	BEDFORD	ENGLAND	PWR FAB	PWR DIS	BIP	0.00	4	20,000	243,473	25,000	100	U.S.	M
TI	AVEZZANO	ITALY	PHASE 1	4Mb DRAM	CMOS	0.80	6	11,000	301,196	30,000	0	U.S.	M
TI	FREISING	GERMANY	N/A	LOG	CMOS	0.80	6	3,000	82,144	0	0	U.S.	M
VAISALA	VANTAA	FINLAND	N/A	LIN	CMOS	5.00	3	200	1,413	0	100	FINLAND	M
VEB CARL ZEISS JENA	N/A	GERMANY	N/A	256K DRAM	CMOS	1.50	4	10,000	121,737	0	0	GERMANY	R
VEB CARL ZEISS JENA	N/A	GERMANY	N/A	N/A	N/A	3.00	4	20,000	243,473	0	0	GERMANY	R
VEB GLEICHRICHTERWERK	STAHNSDORF	GERMANY	N/A	PWR DIS	N/A	0.00	0	0	0	0	0	GERMANY	C
VEB HALBLEITERWERK	FRANKFURT	GERMANY	N/A	LIN	BIP	0.00	0	0	0	0	0	GERMANY	C
VEB MICROELECT.	ERFURT	GERMANY	N/A	N/A	CMOS MOS	0.00	0	0	0	0	0	GERMANY	C
VEB ROHRENWERK	NEUHAUS	GERMANY	N/A	TRAN	N/A	0.00	0	0	0	0	0	GERMANY	C
VEB WERK FUR FERNSEH.	BERLIN	GERMANY	N/A	SENSOR CCD	N/A	0.00	0	0	0	0	0	GERMANY	C
WESTCODE S/C	CHIPPENHAM	ENGLAND	N/A	DIS	N/A	0.00	4	10,000	121,737	0	0	ENGLAND	C
ZETEX	OLDHAM	ENGLAND	N/A	CUSTOM	BIP MOS	1.50	5	10,000	190,175	26,000	0	ENGLAND	M

Source: Dataquest (May 1991)

Table 2
European Future Pilot and Production Fab Lines
Planned Facilities Going Into Production by Year

Company	City	Country	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Feet)
Production Begins: 1992												
ATMEL	N/A	NETH.	N/A	EPROM EEPROM ARRAYS	CMOS	P	12/01/92	0.60	8	5,000	243,102	0
MITSUBISHI	ALSDORF	GERMANY	N/A	4Mb DRAM MPU 1Mb DRAM	CMOS	FAT	03/01/92	0.80	6	22,000	602,392	25,000
TI	AVEZZANO	ITALY	PHASE 2	16Mb DRAM	CMOS	F	02/01/92	0.60	8	20,000	972,409	30,000
TOSHIBA	BRAUNSCHWEIG	GERMANY	N/A	DRAM SRAM	CMOS	FAT	/ /	0.00	6	14,000	383,340	0
Production Begins: 1993												
FUJITSU	NEWTON AYCLIFFE	ENGLAND	PHASE 2	4Mb DRAM ASIC	CMOS	F	/ /	0.80	6	45,000	1,232,166	0
INTEL	LEIXLIP, KILDARE	IRELAND	FAB 11	386 486 586 MPU	CMOS	F	06/01/93	0.60	8	18,000	875,168	30,000
INTERBIP		HUNGARY		ANALOG LOGIC	BIPOLAR	F	/ /	5.00	4	6,000	0	4,000
MATRA MHS/CYPRESS	N/A	FRANCE	N/A	N/A	N/A	P	/ /	0.00	0	0	0	0
Production Begins: 1994												
FUJITSU	NEWTON AYCLIFFE	ENGLAND	PHASE 3	16Mb DRAM	CMOS	F	/ /	0.60	8	30,000	1,458,614	0

Source: Dataquest (May 1991)

Dataquest

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Japanese Fab Database

Background

The material in this booklet applies to the Japanese portion of Dataquest's Semiconductors *Japan* service Wafer Fab Database. The Wafer Fab Database is updated on an ongoing basis, employing both primary and secondary research methodologies. The tables included in this booklet highlight both production and pilot line wafer fabs.

General Definitions

A *fab line* is a processing line in a clean room that is equipped to do all front-end wafer processing. Occasionally there are two separate product-specific fab lines or two different wafer sizes in a clean room. In this situation, a clean room will be documented as two fab lines if the equipment is dedicated to each wafer size or product line. There can be many fab lines at one location.

Front-end wafer processing is defined as all steps involved with semiconductor processing, beginning with initial oxide and ending at wafer probe.

A *production fab* is defined as a wafer fab capable of front-end processing more than 1,250 wafers per week (type = F).

A *pilot fab* is defined as a wafer fab capable of front-end processing 1,250 wafers or less per week (type = P).

Definitions of Table Columns

The *Products Produced* column contains product information for seven product categories. The information in this column can be very detailed, depending on the information's availability. The nomenclature used within the seven product groups of the fab database is as follows, with definitions where warranted:

- Analog
  - LIN—Linear/analog devices
  - A/D D/A—Analog-to-digital, digital-to-analog converters
  - AUTOMOTIVE—Dedicated to automobile applications
  - CODEC—Coder/decoder
  - INTERFACE—Interface IC
  - MESFET (GaAs)—Metal Schottky field-effect transistor
  - MODFET (GaAs)
  - MDIODE (GaAs)—Microwave diode
  - MFET (GaAs)—Microwave field-effect transistor
  - MODEM—Modulator/demodulator
  - MMIC—Monolithic microwave IC
  - OP AMP—Operational amplifier
  - PWR IC—Power IC
  - REG—Voltage regulator
  - SMART PWR—Smart power
  - SWITCHES—Switching device
  - TELECOM—Telecommunications chips
- Memory
  - MEM—Memory
  - RAM—Random-access memory
  - DRAM—Dynamic RAM
  - SRAM 4 TR.—Static RAM uses a 4-transistor cell design
  - SRAM 6 TR.—Static RAM uses a 6-transistor cell design
  - VRAM—Video RAM
  - ROM—Read-only memory
  - PROM—Programmable ROM
  - EPROM—Ultraviolet erasable PROM
  - EEPROM or E2—Electrically erasable PROM
  - FERRAM—Ferroelectric RAM
  - NVMEM—Nonvolatile memory (ROM, PROM, EPROM, EEPROM, FERRAM)
  - FIFO—First-in, first-out memory
  - SPMEM—Other specialty memory (dual port, shift-register, color look-up, etc.)
- Micrologic
  - ASSP—Application-specific standard product
  - BIT—Bit slice (subset of MPU functions)
  - DSP—Digital signal processor
  - MCU—Microcontroller unit

- MPR—Microperipheral
- MPRCOM—MPR digital communications (ISDN, LAN, UART, modem)
- MPU—Microprocessor unit
- LISP—32-bit list instruction set processor for AI applications
- RISC—Reduced-instruction-set computation 32-bit MPU

• Standard logic

- LOG—Standard logic

• ASIC logic

- ASIC—Application-specific IC
- ARRAYS—Gate arrays
- CBIC—Cell-based IC
- CUSTOM—Full-custom IC (single user)
- PLD—Programmable logic device

• Discrete

- DIS—Discrete
- DIODE
- FET—Field-effect transistor
- GTO—Gate turn-off thyristor
- HEMT (GaAs)—High-electron-mobility transistor
- MOSFET—MOS-based field-effect transistor
- PWR TRAN—Power transistor
- RECTIFIER
- RF—Radio frequency
- SCR—Schottky rectifier
- SENSORS
- SST—Small-signal transistor
- THYRISTOR
- TRAN—Transistor
- ZENER DIODE

• Optoelectronic

- OPTO—Optoelectronic
- CCD—Charge-coupled device (imaging)
- COUPLERS—Photocouplers
- IED—Infrared-emitting diode
- IMAGE SENSOR
- LASER (GaP)—Semiconductor laser or laser IC
- LED—Light-emitting diode
- PDIODE—Photo diode
- PTRAN—Photo transistor
- SAW—Surface acoustic wave device
- SIT IMAGE SENSOR—Static induction transistor image sensor

The *Process Technology* column lists four major types of technologies. This column also lists a few uncommon technologies along with information on levels of metal, type of well, and logic structure, when available. Definitions of the nomenclature used in the Process Technology column are as follows:

• MOS (silicon-based)

- CMOS—Complementary metal-oxide semiconductor
- MOS—n-channel metal-oxide semiconductor (NMOS) and p-channel metal-oxide semiconductor (PMOS) (More than 90 percent of the MOS fabs use n-channel MOS.)
- M1—Single-level metal
- M2—Double-level metal
- M3—Triple-level metal
- N-WELL
- P-WELL
- POLY1—Single-level polysilicon
- POLY2—Double-level polysilicon
- POLY3—Triple-level polysilicon

• BiCMOS (silicon-based)

- BICMOS—Bipolar and CMOS combined on a chip
- BIMOS—Bipolar and MOS combined on a chip
- ECL I/O—ECL input/output
- TTL I/O—TTL input/output

• Bipolar (silicon-based)

- BIP—Bipolar
- ECL—Emitter-coupled logic
- TTL—Transistor-transistor logic
- STTL—Schottky TTL

• Gallium arsenide and other compound semiconductor materials

- GaAs—Gallium arsenide
- GaAlAs—Gallium aluminum arsenide

- GaAs on Si—Gallium arsenide on silicon
- GaP—Gallium phosphide
- HgCdTe—Mercuric cadmium telluride
- InAs—Indium arsenide
- InP—Indium phosphide
- InSb—Indium antimony
- LiNbO3—Lithium niobate
- SOS—Silicon on sapphire

The number in the ***Minimum Linewidth*** column represents the minimum linewidth at the critical mask layers as drawn. This number is stated in microns and is defined in Dataquest's fab survey as being available in production volumes.

The ***Wafer Size*** column represents the wafer diameter expressed colloquially in inches. However, for wafers greater than 3 inches in diameter, the colloquial expression is inaccurate. When calculating square inches, the following approximations are used:

Wafer-Start Capacity is defined in the fab survey as the equipment-limited wafer-start capacity per four-week period. Start capacity is not limited by current staffing or the number of shifts operating; it is limited only by the installed equipment in the fab and the complexity of the process it runs. Start capacity in square inches is calculated using the approximate diameter and the wafer-start capacity.

The ***Clean Room Class*** column represents the level of cleanliness in the cleanest part of the clean room. This area represents the true environment to which the wafer is exposed.

The ***Origin of Owner*** column represents the country where the parent company is headquartered.

The ***Merchant or Captive*** column categorizes each fab line on the tables as one of these two types. Definitions of the various categories are as follows:

- A ***Merchant*** fab line is a fab line that produces devices that end up available on the merchant market.
- A ***Captive*** fab line does not sell any of its devices on the merchant market. All production is consumed by the owner of the fab line.

Table 1
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
CANON	KANAGAWA	R&D CENTER	N/A	AMORPHOUS IMAGE SENSORS	GaAs	0.00	3	0	0	0	N/A	JAPAN	C
CANON	SHIGA	NAGAHAMA WORKS	N/A	AMORPHOUS IMAGE SENSORS	GaAs	0.00	3	0	0	0	N/A	JAPAN	C
CANON DENSHI	SAITAMA	N/A	N/A	CCD	MOS	3.00	5	5,000	95,100	0	N/A	JAPAN	C
CASIO	TOKYO	N/A	N/A	ASIC	N/A	0.00	4	11,000	133,870	0	N/A	JAPAN	C
CLARION	FUKUSHIMA	S/C LAB	N/A	SAN CONVERTER CUSTOM	N/A	0.00	4	5,000	60,850	0	N/A	JAPAN	C
FUJI ELECTRIC	YAMANASHI	YAMANASHI	N/A	LOG ASSP	CMOS	0.00	6	15,000	410,700	0	N/A	JAPAN	C
FUJI ELECTRIC	NAGANO	MATSUMOTO	N/A	DIODE PWR TRAN PWR MOSFET	MOS	2.00	5	20,000	380,400	0	N/A	JAPAN	C
FUJI ELECTRIC	NAGANO	MATSUMOTO	N/A	LOG CUSTOM ASSP	CMOS MOS	2.00	5	10,000	190,200	0	100	JAPAN	C
FUJI ELECTRIC	TOYAMA	MAIN OFFICE	N/A	DIODE	N/A	0.00	4	10,000	121,700	0	N/A	JAPAN	C
FUJI XEROX	MIE	SUZUKA FUJI/XER	N/A	PWR ICs IMAGE SENSOR LOG	CMOS	3.00	5	3,000	57,060	0	N/A	JAPAN	C
FUJITSU	YAMANASHI	YAMANASHI ELECT	N/A	FET LIN OPTO HEMT	GaAs	0.00	3	0	0	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines (Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
FUJITSU	IWATE	IWATE	NO. 3	256K DRAM 1Mb DRAM SRAM ROM	CMOS MOS P3	1.00	6	30,000	821,400	0	N/A	JAPAN	M
FUJITSU	FUKUSHIMA	AIZU	VLSI 3	1Mb DRAM SRAM ROM	CMOS MOS	1 00	6	20,000	547,600	0	10	JAPAN	M
FUJITSU	IWATE	IWATE	NO. 4	4Mb DRAM 16Mb DRAM SRAM A	CMOS MOS P3	0.80	6	13,000	355,940	0	1	JAPAN	M
FUJITSU	FUKUSHIMA	WAKAMATSU	BLDG. 1 #2	ARRAYS LOG	CMOS	1.20	6	16,000	438,080	0	N/A	JAPAN	M
FUJITSU	FUKUSHIMA	WAKAMATSU	BLDG. 2 #1	ARRAYS CBIC 32-bit MCU	CMOS	0.70	6	15,000	410,700	5,250	N/A	JAPAN	M
FUJITSU	YAMANASHI	YAMANASHI ELECT	N/A	FET LIN OPTO HEMT	GaAs	0.00	4	0	0	0	10	JAPAN	M
FUJITSU	FUKUSHIMA	AIZU	VLSI 2	256K DRAM SRAM EPROM MPU	MOS CMOS	1.50	5	40,000	760,800	0	N/A	JAPAN	M
FUJITSU	FUKUSHIMA	AIZU	VLSI 1	DIS A/D D/A	BIP	2.00	5	30,000	570,600	0	N/A	JAPAN	M
FUJITSU	FUKUSHIMA	WAKAMATSU	BLDG. 1 #1	ARRAYS LOG	CMOS	1.50	5	38,000	722,760	0	N/A	JAPAN	M
FUJITSU	IWATE	IWATE	NO. 1	ARRAYS	BIP	1.20	6	15,000	410,700	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
FUJITSU	IWATE	IWATE	NO. 2	ROM EPROM	MOS	1.50	5	32,000	608,640	0	N/A	JAPAN	M
FUJITSU	MIE	MIE	NO. 1	ARRAYS	CMOS MOS	1.00	6	10,000	273,800	0	10	JAPAN	M
FUJITSU	MIE	MIE	NO. 3	4Mb DRAM 16Mb DRAM	CMOS	0.80	8	500	24,335	0	N/A	JAPAN	M
FUJITSU	KANAGAWA	N/A	N/A	3D ICs JOSEPHSON JUNCTION	N/A	0.00	5	15,000	285,300	0	N/A	JAPAN	M
FUJITSU	MIYAGI	MIYAGI	N/A	ASIC	CMOS	1.20	6	10,000	273,800	0	N/A	JAPAN	M
FUJITSU	MIE	MIE	NO. 2	LOG ARRAYS 4Mb DRAM PROTO	CMOS BIP	0.80	6	10,000	273,800	0	N/A	JAPAN	M
FUJITSU	GIFU	FUJITSU VLSI	MINOKAMO	PROTOTYPE ICs	CMOS	1.00	6	5,000	136,900	0	10	JAPAN	M
HAMAMATSU PHOTONICS	SHIZUOKA	N/A	N/A	OPTO	N/A	0.00	3	15,000	106,050	0	N/A	JAPAN	C
HITACHI	CHIBA	MOBARA WORKS	D1	ASIC MCU EPROM	MOS CMOS	1.50	5	30,000	570,600	4,180	N/A	JAPAN	M
HITACHI	CHIBA	MOBARA WORKS	D3	1Mb DRAM 4Mb DRAM	CMOS M2	0.80	6	30,000	821,400	4,180	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
HITACHI	IBARAGI	NAKA WORKS	N/A	1Mb DRAM SAMPLE 4Mb DRAM	CMOS	0.80	6	20,000	547,600	1,858	N/A	JAPAN	M
HITACHI	GUNMA	TAKASAKI WORKS	N/A	LIN EPROM PWR MOSFET SRAM	BIP MOS CMOS	2.00	5	20,000	380,400	0	N/A	JAPAN	M
HITACHI	YAMANASHI	KOFU WORKS	NO. K4-1	MEM MPU LOG	MOS	2.00	5	20,000	380,400	0	N/A	JAPAN	M
HITACHI	YAMANASHI	KOFU WORKS	NO. K3	64K SRAM	MOS	1.50	5	15,000	285,300	3,995	N/A	JAPAN	M
HITACHI	HOKKAIDO	HOKKAI S/C	CHITOSE	256K SRAM 1Mb DRAM MPU	CMOS	1.00	6	15,000	410,700	1,858	N/A	JAPAN	M
HITACHI	YAMANASHI	KOFU WORKS	NO. K4-3	4Mb DRAM 1Mb SRAM EPROM	CMOS MOS	0.80	6	10,000	273,800	0	100	JAPAN	M
HITACHI	GUNMA	TAKASAKI WORKS	KOMORO	LASER TELECOM 8-bit MCU	CMOS GaAs	1.50	3	15,000	106,050	1,858	N/A	JAPAN	M
HITACHI	CHIBA	MOBARA WORKS	D2	1Mb DRAM	CMOS MOS	1.20	5	30,000	570,600	4,180	N/A	JAPAN	M
HITACHI	IBARAGI	HITACHI WORKS	N/A	PWR GTO THYRISTERS	BIP STTL	4.00	5	20,000	380,400	0	N/A	JAPAN	M
HITACHI	IBARAGI	NAKA WORKS	N1-1	4Mb DRAM 1Mb SRAM	CMOS	0.80	6	15,000	410,700	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
HITACHI	YAMANASHI	KOFU WORKS	INASUNA	4Mb DRAM 16Mb PROTO SRAM 4Mb SRAM	CMOS	0.60	6	25,000	684,500	0	N/A	JAPAN	M
HITACHI	TOKYO	MUSASHI WORKS	DDC	LOG LIN	BIP	2.00	4	15,000	182,550	0	N/A	JAPAN	M
HITACHI	TOKYO	MUSASHI WORKS	N/A	4-Bit MPU 8-Bit MCU	MOS	2.00	4	20,000	243,400	0	N/A	JAPAN	M
HITACHI	TOKYO	MUSASHI WORKS	N/A	4-bit 8-bit MCU	MOS	1.50	5	30,000	570,600	0	N/A	JAPAN	M
HITACHI	YAMANASHI	KOFU WORKS	NO. K4-2	1Mb DRAM	CMOS	1.00	6	20,000	547,600	0	N/A	JAPAN	M
HITACHI	YAMANASHI	KOFU WORKS	NO. K2-1	N/A	N/A	2.00	4	15,000	182,550	0	N/A	JAPAN	M
HITACHI	YAMANASHI	KOFU WORKS	NO. K2-2	N/A	MOS	2.00	6	20,000	380,400	0	N/A	JAPAN	M
HITACHI	GUNMA	TAKASAKI WORKS	N/A	256K SRAM 4Mb DRAM MCU	CMOS BICMOS	0.80	6	20,000	547,600	0	N/A	JAPAN	M
HITACHI	HOKKAIDO	HOKKAI S/C	CHITOSE	4Mb DRAM 1Mb SRAM ROM E2	CMOS	0.80	0	0	0	0	N/A	JAPAN	M
HITACHI	YAMANASHI	KOFU WORKS	LSI	N/A	MOS	3.00	4	30,000	365,100	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
HITACHI	TOKYO	MUSASHI WORKS	R&D	MPU SRAM DRAM ARRAYS CBIC	CMOS M2	1.30	6	15,000	410,700	0	N/A	JAPAN	M
HITACHI	TOKYO	MUSASHI WORKS	R&D	MPU MEM CBIC	CMOS M2	1.20	5	15,000	285,300	0	10	JAPAN	M
HITACHI	TOKYO	MUSASHI WORKS	N/A	4Mb DRAM 16Mb PROTO MCU	CMOS	0.80	8	8,000	389,360	0	N/A	JAPAN	M
HITACHI		N/A	N/A	4Mb DRAM 16Mb DRAM	CMOS	0.50	8	8,000	389,360	0	N/A	JAPAN	M
HITACHI	GUNMA	TAKASAKI WORKS	N/A	16Mb DRAM ASIC RISC MPU	CMOS BICMOS	0.50	8	0	0	0	N/A	JAPAN	M
HITACHI		N/A	N/A	4Mb DRAM 16Mb DRAM	CMOS	0.00	4	2,000	97,340	0	N/A	JAPAN	M
HONDA	TOCHIGI	CENTRAL RSCH.	N/A	ENG. CONTROL SENSORS MMIC	GaAs	0.00	3	0	0	0	N/A	JAPAN	C
IBM	SHIGA	YASU WORKS	N/A	1Mb DRAM MPU ROM	MOS CMOS	1.00	5	30,000	570,600	4,645	N/A	U.S.	C
IBM	SHIGA	N/A	N/A	4Mb DRAM SRAM 250K ARRAYS	CMOS	0.80	8	15,000	730,050	3,716	N/A	U.S.	C
IBM	SHIGA	S/C RSRCH CTR	N/A	16Mb DRAM 250K ARRAYS	CMOS	0.60	8	5,000	243,350	1,858	N/A	U.S.	C

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
INTL. RECTIFIER	KANAGAWA	HQ	N/A	MOSFET DIODE RECTIFIER	BIP	0.00	3	20,000	141,400	0	N/A	U.S.	M
INTL. RECTIFIER	AKITA	AKITA	N/A	DIS	N/A	0.00	0	0	0	0	N/A	U.S.	M
IWATSU	TOKYO	HACHIOJI BLDG	N/A	N/A	CMOS	1.50	5	6,000	114,120	0	N/A	JAPAN	M
JVC	KANAGAWA	CENTRAL LAB	N/A	1K ARRAYS DSP CUSTOM	CMOS	3.00	5	9,000	63,630	0	N/A	JAPAN	C
KAWASAKI STEEL	TOCHIGI	PHASE 1	N/A	256K SRAM CBIC ARRAYS	CMOS NTT	0.80	6	10,000	273,800	0	N/A	JAPAN	M
KAWASAKI STEEL	TOCHIGI	LSI RSCH.	PROTOTYPE	SRAM CBIC ARRAYS	CMOS NTT	0.80	5	7,000	133,140	0	N/A	JAPAN	M
KODAK	KANAGAWA	MIDORI-KU	N/A	N/A	N/A	0.00	3	14,000	98,980	0	N/A	U.S.	C
KODENSHI	KYOTO-FU	N/A	PLANT 3	DIS DIODE TRAN	GaAs GaP	0.00	0	0	0	0	N/A	JAPAN	M
KYOTO S/C	KYOTO-FU	N/A	N/A	LED TRAN IMAGE SENSOR	GaAs GaP	0.00	0	0	0	0	10000	JAPAN	M
MATSUSHITA	NIIGATA	ARAI	FAB B-3	64K DRAM SRAM MPU	MOS	2.00	5	45,000	855,900	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
MATSUSHITA	NIIGATA	ARAI	FAB D	LOG LIN CCD	BIP	3.00	5	20,000	380,400	0	100	JAPAN	M
MATSUSHITA	TOYAMA	UOZU	FAB C-1	1Mb DRAM 4Mb DRAM	CMOS	0.80	6	20,000	547,600	0	10	JAPAN	M
MATSUSHITA	TOYAMA	UOZU	FAB B	1Mb DRAM 256K SRAM	CMOS	1.00	6	25,000	684,500	0	10	JAPAN	M
MATSUSHITA	TOYAMA	UOZU	FAB A-1	16-bit MPU ARRAYS CCD	CMOS	2.00	5	15,000	285,300	0	100	JAPAN	M
MATSUSHITA	KYOTO-FU	NAGAOKA	IC	MEM MPU ARRAYS CBIC	MOS	2.00	4	15,000	182,550	0	1000	JAPAN	M
MATSUSHITA	KAGOSHIMA	KAGOSHIMA	N/A	OPTO S/C LASERS LED HEMT	GaP MOS	0.00	0	0	0	0	10000	JAPAN	M
MATSUSHITA	KYOTO-FU	TOYO DEMPA LTD.	N/A	PWR TRAN	MOS	0.00	5	18,000	342,360	0	N/A	JAPAN	M
MATSUSHITA	KYOTO-FU	NAGAOKA	LSI	LOG	CMOS	2.00	4	15,000	182,550	0	N/A	JAPAN	M
MATSUSHITA	KYOTO-FU	NAGAOKA	VLSI	CCD FET	MOS GaAs	1.50	4	10,000	121,700	0	N/A	JAPAN	M
MATSUSHITA	TOYAMA	UOZU	FAB A-2	MPU ROM EPROM EEPROM	MOS	1.50	5	15,000	285,300	0	N/A	JAPAN	M
MATSUSHITA	TOYAMA	UOZU	FAB C-2	4Mb DRAM 256K SRAM	CMOS	0.80	6	20,000	547,600	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
MATSUSHITA	NIIGATA	ARAI	FAB D	ROM EPROM EEPROM	MOS	1.50	5	20,000	380,400	0	N/A	JAPAN	M
MATSUSHITA	NIIGATA	ARAI	FAB C-2	256K DRAM SRAM MPU ROM	MOS	1.50	5	35,000	665,700	0	100	JAPAN	M
MATSUSHITA	KYOTO-FU	NAGAOKA	N/A	TTL LOG PWR TRAN CUSTOM	BIP	3.00	4	20,000	243,400	0	10000	JAPAN	M
MATSUSHITA	NIIGATA	ARAI	FAB C-1	MPU	MOS	1.50	4	15,000	182,550	0	N/A	JAPAN	M
MATSUSHITA	KYOTO-FU	NAGAOKA	N/A	CCD	MOS	2.00	4	8,000	97,360	0	1000	JAPAN	M
MATSUSHITA	OSAKA	S/C RSCH. CTR.	PROTOTYPE	16Mb DRAM 64-bit MPU	CMOS	0.60	6	8,000	219,040	0	N/A	JAPAN	M
MATSUSHITA	TOCHIGI	APPL. LAB	N/A	SST VARIABLE CAPAC. DIODE	MOS	0.00	3	8,000	56,560	0	N/A	JAPAN	M
MEIDENSHA	SHIZUOKA	N/A	N/A	GTO THYRISTOR	N/A	0.00	5	7,000	133,140	0	N/A	JAPAN	M
MITSUBISHI	KUMAMOTO	KUMAMOTO WORKS	C-2F	1Mb SRAM 1Mb ROM ARRAYS	MOS CMOS	0.80	5	25,000	475,500	0	N/A	JAPAN	M
MITSUBISHI	FUKUOKA	FUKUOKA	#2	LOG LIN A/D D/A DIS	BIP	3.00	4	25,000	304,250	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
MITSUBISHI	KUMAMOTO	KUMAMOTO WORKS	B-1F	EPROM	CMOS	1.50	5	30,000	570,600	0	N/A	JAPAN	M
MITSUBISHI	KUMAMOTO	KUMAMOTO WORKS	B-2F	ARRAYS	CMOS	2.00	4	42,000	511,140	0	N/A	JAPAN	M
MITSUBISHI	KUMAMOTO	KUMAMOTO WORKS	C-1F	EPROM	CMOS	1.50	5	25,000	475,500	0	N/A	JAPAN	M
MITSUBISHI	KOCHI	KOCHI	TA-1F	4Mb DRAM SRAM ASIC MCU	CMOS	1.00	6	25,000	684,500	0	N/A	JAPAN	M
MITSUBISHI	EHIME	SAIJO A	A-2F	4Mb DRAM SAMPLE 16Mb	CMOS M2	0.50	6	20,000	547,600	5,574	N/A	JAPAN	M
MITSUBISHI	HYOGO	KITAITAMI WORKS	N/A	N/A	N/A	0.00	4	25,000	304,250	0	N/A	JAPAN	M
MITSUBISHI	FUKUOKA	FUKUOKA	#3	100K 200K ARRAYS	CMOS BICMOS	0.80	0	0	0	0	N/A	JAPAN	M
MITSUBISHI	HYOGO	KITAITAMI WORKS	N/A	ARRAYS OPTO LASER	CMOS MOS	2.00	5	28,000	532,560	650	10	JAPAN	M
MITSUBISHI	EHIME	SAIJO C	C	8-BIT MCU	CMOS M2	0.80	5	38,000	722,760	4,000	10	JAPAN	M
MITSUBISHI	FUKUOKA	FUKUOKA	#1	PWR TRN DIODE	BIP	4.00	4	40,000	486,800	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
MITSUBISHI	EHIME	SAIJO B	B	ASIC MCU	CMOS M2	1.20	5	38,000	722,760	4,000	N/A	JAPAN	M
MITSUBISHI	HYOGO	KITAITAMI WORKS	N/A	FET OPTO HEMT	GaAs	0.00	3	0	0	0	N/A	JAPAN	M
MITSUBISHI	KOCHI	KOCHI	N/A	1Mb DRAM 8-bit MCU 16-bit MCU ASIC	CMOS	1.00	6	10,000	273,800	0	10	JAPAN	M
MITSUBISHI	OSAKA	ULSI	N/A	64Mb DRAM 256Mb DRAM	CMOS	0.35	8	0	0	0		JAPAN	M
MITSUMI	KANAGAWA	ATSUGI	N/A	LOG DIS	BIP	0.00	4	30,000	365,100	0	100	JAPAN	M
MORIRICA	KANAGAWA	HEADQUARTER	N/A	OPTO	GaP	0.00	0	0	0	0	N/A	JAPAN	M
MOTOROLA	FUKUSHIMA	AIZU WORKS	N/A	LOG	BIP	3.00	4	30,000	365,100	0	N/A	U.S.	M
MOTOROLA	FUKUSHIMA	AIZU WORKS	MOS-7	CBIC MCU SRAM ROM PWR ICs	CMOS MOS M1	1.80	4	25,000	304,250	2,211	100	U.S.	M
MURATA MFG.	N/A	N/A	N/A	FET MMIC	GaAs	0.80	0	0	0	0	N/A	JAPAN	C
NEC	KUMAMOTO	KYUSHU	FAB 3	CCD	MOS	3.00	4	60,000	730,200	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
NEC	YAMAGUCHI	YAMAGUCHI LTD	PHASE 1	1Mb DRAM SRAM MPU	CMOS MOS	1.00	6	25,000	684,500	0	10	JAPAN	M
NEC	SHIGA	KANSAI LTD	NO. 3	ARRAYS SRAM 8-bit MPU	CMOS MOS	2.00	4	20,000	243,400	0	N/A	JAPAN	M
NEC	KUMAMOTO	KYUSHU	FAB 6	1Mb DRAM MPU ARRAYS	MOS POLY2	1.00	6	45,000	1,232.100	4,645	100	JAPAN	M
NEC	SHIGA	KANSAI LTD	YOKAICHI P	ZENER DIODE	BIP	5.00	4	20,000	243,400	0	1000	JAPAN	M
NEC	YAMANASHI	OTSUKI WORKS	N/A	N/A	N/A	2.00	5	30,000	570,600	0	100	JAPAN	M
NEC	KUMAMOTO	KYUSHU	FAB 7	MCU 1Mb DRAM ARRAYS EPROM	CMOS BICMOS	1.00	4	30,000	821,400	2,787	10	JAPAN	M
NEC	KUMAMOTO	KYUSHU	FAB 4	ASIC EPROM MCU MPU	CMOS MOS	1.40	5	20,000	380,400	4,180	100	JAPAN	M
NEC	SHIGA	KANSAI LTD	NO. 2	LIN CCD	MOS	3.00	4	20,000	243,400	0	1000	JAPAN	M
NEC	YAMAGATA	YAMAGATA LTD	TSURUOKA N	LOG LIN	BIP	2.00	5	40,000	760,800	0	N/A	JAPAN	M
NEC	KANAGAWA	SAGAMIHARA	BLDG. B FLOOR 1	ARRAYS CBIC	MOS	2.00	5	28,000	532,560	5,400	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
NEC	YAMAGUCHI	YAMAGUCHI LTD	PHASE 2	1Mb DRAM 4Mb DRAM 1Mb SRAM	CMOS BICMOS	0.80	6	20,000	547,600	2,300	10	JAPAN	M
NEC	YAMAGATA	YAMAGATA LTD	TSURUOKA W	LOG LIN DIS	BIP	3.00	4	20,000	243,400	0	N/A	JAPAN	M
NEC	SHIGA	KANSAI LTD	NO. 1	PWR TRAN DIS CCD	BIP	4.00	4	15,000	182,550	0	1000	JAPAN	M
NEC	KANAGAWA	SAGAMIHARA	BLDG. B FLOOR 2	ARRAYS CBIC SRAM EPROM	CMOS	1.25	5	12,000	228,240	5,400	N/A	JAPAN	M
NEC	SHIGA	KANSAI LTD	NO. 4	ARRAYS MCU SRAM 4Mb DRAM	CMOS	0.80	6	20,000	547,600	0	100	JAPAN	M
NEC	HIROSHIMA	CHUGOKU	PHASE 1	4Mb DRAM SRAM MPU 4Mb ROM	CMOS	0.80	6	27,000	739,260	3,600	N/A	JAPAN	M
NEC	KANAGAWA	TAMAGAWA WORKS	N/A	ASIC EPROM MCU MPU	CMOS MOS	1.40	5	20,000	380,400	0	N/A	JAPAN	M
NEC	YAMAGATA	YAMAGATA LTD	TSURUOKA W	64K SRAM	MOS	2.00	4	20,000	243,400	0	N/A	JAPAN	M
NEC	KAGOSHIMA	KAGOSHIMA	N/A	LIN TELECOM LASER	BIP GaAs Si	0.78	4	4,200	51,114	0	N/A	JAPAN	M
NEC	SHIGA	KANSAI LTD.	N/A	N/A	GaAs	0.00	3	0	0	0	N/A	JAPAN	M
NEC	KANAGAWA	SAGAMIHARA	BLDG. G FLR 3	4Mb DRAM ASIC MPU 4Mb ROM	CMOS BICMOS	0.80	6	10,000	273,800	4,300	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
NEC	KANAGAWA	SAGAMIHARA	G-2	16Mb DRAM	CMOS	0.55	6	500	13,690	3,500	1	JAPAN	M
NEW JAPAN RADIO	SAITAMA	KAWAGOE WORKS	N/A	IED FET DIODE	GaAs GaAlAs	1.50	3	2,800	19,796	0	N/A	JAPAN	M
NEW JAPAN RADIO	SAITAMA	KAWAGOE WORKS	N/A	OP AMP	BIP	0.00	3	25,000	176,750	0	N/A	JAPAN	M
NEW JAPAN RADIO	SAITAMA	KAWAGOE WORKS	N/A	OP AMP	BIP	0.00	3	25,000	176,750	0	N/A	JAPAN	M
NEW JAPAN RADIO	SAITAMA	KAWAGOE WORKS	N/A	CUSTOM LOG A/D D/A OPTO	CMOS	1.20	5	20,000	380,400	0	10	JAPAN	M
NEW JAPAN RADIO	SAITAMA	KAWAGOE WORKS	N/A	OP AMP A/D D/A REG	BIP	0.00	4	17,000	206,890	0	1000	JAPAN	M
NIKON S/C	IBARAGI	N/A	PHASE 1	ARRAYS CBIC MPU 64K SRAM	CMOS	1.50	6	20,000	547,600	0	1	JAPAN	M
NIPPON DENSO	AICHI	HQ	N/A	DIODE LOG CUSTOM MCU	BIP MOS	3.00	4	20,000	243,400	0	N/A	JAPAN	C
NIPPON DENSO	AICHI	HQ	N/A	CUSTOM	BIP	5.00	3	5,000	35,350	0	N/A	JAPAN	C
NIPPON DENSO	AICHI	KODA WORKS	BLDG. 1	LOG CUSTOM MCU OPTO	MOS	1.50	5	2,000	38,040	0	N/A	JAPAN	C

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
NIPPON DENSO	AICHI	KODA WORKS	BLDG. 2	MCU CUSTOM	MOS	0.00	6	10,000	273,800	0	N/A	JAPAN	C
NIPPON PRECISION CIRC.	TOCHIGI	N/A	N/A	LOG LIN A/D D/A MODEM	CMOS	2.00	5	13,000	247,260	3,000	1000	JAPAN	C
NIPPON PRECISION CIRC.	TOCHIGI	SHIOBARA	N/A	A/D D/A DSP LOG ASSP	CMOS	0.80	6	20,000	547,600	2,000	1	JAPAN	C
NIPPON STEEL	KANAGAWA	ELECT. LAB	N/A	ASIC	N/A	0.80	6	15,000	410,700	0	N/A	JAPAN	M
NISSAN	KANAGAWA	CENTRAL RSCH.	N/A	MCU CUSTOM	CMOS	2.00	5	500	9,510	1,500	10	JAPAN	C
NKK	KANAGAWA	N/A	EDRL	1Mb SRAM 4Mb SRAM MASK ROM RISC MPU ASIC	N/A	0.80	8	5,000	243,350	0	1	JAPAN	M
NMB S/C	CHIBA	N/A	N3	4Mb DRAM SAMPLE 16Mb	CMOS	0.80	6	20,000	547,600	0	1	JAPAN	M
NMB S/C	CHIBA	N/A	N1	256K DRAM 64K SRAM ASIC	CMOS	1.20	5	20,000	380,400	3,994	1	JAPAN	M
NMB S/C	CHIBA	N/A	N2	1Mb DRAM	CMOS N1	0.80	6	20,000	547,600	3,994	1	JAPAN	M
OKI	MIYAZAKI	MIYAZAKI OKI	M3	4Mb DRAM 90K ARRAYS	CMOS	0.50	6	30,000	821,400	9,000	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
OKI	MIYAGI	MIYAGI OKI	N/A	4Mb DRAM VRAM 1Mb SRAM	CMOS	0.80	6	20,000	547,600	0	N/A	JAPAN	M
OKI	MIYAZAKI	MIYAZAKI OKI	M1	256K DRAM SRAM ARRAYS MPU	CMOS	1.50	5	50,000	951,000	0	100	JAPAN	M
OKI	MIYAGI	MIYAGI OKI	N/A	ARRAYS 1Mb DRAM VRAM LOG	CMOS	0.80	6	20,000	547,600	0	10	JAPAN	M
OKI	MIYAZAKI	MIYAZAKI OKI	M2	256K DRAM 1Mb DRAM EEPROM	CMOS	1.30	5	30,000	570,600	2,400	10	JAPAN	M
OKI	TOKYO	HACHIOJI	V-4	16Mb DRAM 64Mb DRAM	CMOS BICMOS	0.30	8	500	24,335	2,600	N/A	JAPAN	M
OLYMPUS	NAGANO	TATSUNO WORKS	N/A	SIT IMAGE SENSOR	CMOS	3.00	5	5,000	95,100	0	N/A	JAPAN	C
OMRON TATEISHI	SHIGA	MINAKUCHI	N/A	OPTO IMAGE SENSOR	BIP GaP	0.00	4	20,000	243,400	4,620	N/A	JAPAN	M
OMRON TATEISHI	SHIGA	MINAKUCHI	N/A	OPTO IMAGE SENSOR	BIP GaP	3.00	4	1,000	12,170	1,320	N/A	JAPAN	M
ORIGIN ELECT.	TOCHIGI	N/A	N/A	TRAN DIODE DIS	BIP	0.00	4	17,000	206,890	0	N/A	JAPAN	M
PIONEER VIDEO CORP.	YAMANASHI	N/A	N/A	ARRAYS LOG SAN CCD	CMOS	3.00	5	8,000	152,160	0	N/A	JAPAN	C
RICOH	OSAKA	N/A	N/A	ARRAYS	CMOS	1.00	6	10,000	273,800	0	N/A	JAPAN	C

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
RICOH	OSAKA	N/A	N/A	ARRAYS ROM PLD LOG	BICMOS CMOS	2.00	4	15,000	182,550	1,420	100	JAPAN	C
RICOH	OSAKA	N/A	N/A	256K ROM ARRAYS CBIC	CMOS NMOS	1.30	6	7,000	191,660	0	100	JAPAN	C
ROHM	KYOTO-FU	LSI RSCH.	N/A	256K SRAM ASIC MCU EEPROM	CMOS BICMOS	1.20	6	15,000	410,700	2,100	10	JAPAN	M
ROHM	OKAYAMA	SHINKO ELECTRIC	N/A	TRAN DIODE	BIP	0.00	3	23,000	162,610	0	1000	JAPAN	M
ROHM	FUKUOKA	N/A	N/A	PWR ICs MPU MODEM	BIP	3.00	4	20,000	243,400	0	N/A	JAPAN	M
ROHM	FUKUOKA	N/A	N/A	TRAN DIS	BIP	0.00	4	20,000	243,400	0	N/A	JAPAN	M
ROHM	KYOTO-FU	MAIN OFFICE	N/A	MPU LASER MODEM TRAN LED	BIP GaAs	0.00	4	25,000	304,250	0	N/A	JAPAN	M
SANKEN	SAITAMA	HQ	N/A	PWR TRAN DIODE LED	N/A	0.00	3	15,000	106,050	0	1000	JAPAN	
SANKEN	YAMAGATA	YAMAGATA SANKEN	N/A	PWR TRAN DIODE LED	N/A	0.00	5	10,000	190,200	0	1000	JAPAN	
SANKEN	SAITAMA	S/C TECH. CTR.	N/A	PWR TRAN DIODE LED	N/A	0.00	5	6,000	114,120	0	N/A	JAPAN	

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
SANSHA	OKAYAMA	OKAYAMA	N/A	PWR TRAN PWR DIODE	BIP	0.00	5	15,000	285,300	0	N/A	JAPAN	
SANYO	NIIGATA	NIIGATA SANYO	BLDG. 2 CMOS	ASIC PLD 1Mb DRAM 4Mb DRAM	BICMOS CMOS	1.00	4	16,000	430,080	0	N/A	JAPAN	M
SANYO	GUNMA	S/C DIV.	N/A	N/A	BIP	2.00	4	30,000	365,100	4,645	10	JAPAN	M
SANYO	GUNMA	S/C DIV.	N/A	SRAM	MOS	1.20	4	25,000	304,250	0	N/A	JAPAN	M
SANYO	NIIGATA	NIIGATA SANYO	BLDG. 3 #4	16-BIT MCU DSP	CMOS	1.00	6	20,000	547,600	0	N/A	JAPAN	M
SANYO	GIFU	VLSI DIV.	N/A	256K SRAM 4Mb ROM 8Mb ROM	N/A	0.80	6	17,000	465,460	0	N/A	JAPAN	M
SANYO	TOTTORI	TOTTORI SANYO	N/A	LASER LED	GaAs GaP	5.00	3	20,000	141,400	3,000	1000	JAPAN	M
SANYO	GUNMA	S/C DIV.	N/A	TRAN DIODE	N/A	4.00	4	40,000	486,800	4,180	1000	JAPAN	M
SANYO	GIFU	VLSI DIV.	BLDG. G	CCD ARRAY CBIC	CMOS	1.50	5	15,000	285,300	0	10	JAPAN	M
SANYO	NIIGATA	NIIGATA SANYO	BLDG. 1	64K 256K DRAM 8-bit MPU	CMOS	1.20	5	30,000	570,600	0	10	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
SANYO	NIIGATA	NIIGATA SANYO	BLDG. 2 BIP	LIN	BIP	2.00	5	25,000	475,500	3,500	1000	JAPAN	M
SANYO	GIFU	VLSI DIV.	BLDG. F	CCD SRAM ARRAYS CBIC ROM	CMOS	2.00	4	25,000	304,250	0	100	JAPAN	M
SANYO		N/A	N/A	16Mb DRAM 64Mb DRAM		0.00	8	0	0	0		JAPAN	M
SEIKO INSTRUMENT	CHIBA	TAKATSUKA	BLDG. B	TELECOM	CMOS	2.00	5	10,000	190,200	0	N/A	JAPAN	C
SEIKO INSTRUMENT	CHIBA	TAKATSUKA	N/A	SRAM ARRAYS CBIC EEPROM	CMOS	1.25	6	3,000	82,140	0	10	JAPAN	C
SEIKO-EPSON	NAGANO	FUJIMI	BLDG. D	1Mb SRAM ASIC	CMOS BICMOS	0.80	6	25,000	684,500	0	N/A	JAPAN	M
SEIKO-EPSON	NAGANO	FUJIMI	BLDG. A	ARRAYS 256K SRAM EPROM	CMOS	1.50	5	30,000	570,600	0	100	JAPAN	M
SEIKO-EPSON	NAGANO	FUJIMI	BLDG. B	ARRAYS CBIC SRAM EEPROM	CMOS NMOS	2.00	4	40,000	486,800	0	100	JAPAN	M
SEIKO-EPSON	YAMAGATA	TOHOKU EPSON	N/A	256K ARRAYS CBIC 1Mb SRAM	CMOS BICMOS	0.80	6	20,000	547,600	0	10	JAPAN	M
SHARP	HIROSHIMA	FUKUYAMA	BLDG. 2 #2	4Mb DRAM 16Mb ROM ASIC	CMOS	0.80	6	24,000	657,120	0	N/A	JAPAN	M
SHARP	NARA	NARA	N/A	LASER LED OPTO	GaAs	0.00	3	22,000	155,540	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
SHARP	NARA	TENRI	NO. 2	OPTO	CMOS MOS	2.00	4	20,000	243,400	0	N/A	JAPAN	M
SHARP	HIROSHIMA	FUKUYAMA	BLDG. 1	1Mb DRAM SRAM ARRAYS ROM	MOS	1.00	5	35,000	665,700	3,500	10	JAPAN	M
SHARP	NARA	TENRI	NO. 4	N/A	MOS	1.50	5	10,000	190,200	0	N/A	JAPAN	M
SHARP	NARA	SHINJO	N/A	DIODE TRAN COUPLERS	N/A	0.00	4	25,000	304,250	0	N/A	JAPAN	M
SHARP	NARA	TENRI	NO. 3	ARRAYS CBIC	CMOS MOS BIP	1.20	5	20,000	380,400	0	N/A	JAPAN	M
SHARP	HIROSHIMA	FUKUYAMA	BLDG. 2 #1	1Mb DRAM SRAM ROM ASIC	CMOS	0.80	6	24,000	657,120	0	1	JAPAN	M
SHARP	NARA	TENRI	NO. 1	LOG LIN	BIP	3.00	4	20,000	243,400	0	N/A	JAPAN	M
SHARP	NARA	IC TECH. CTR.	TRIAL LINE	ARRAYS	CMOS	0.80	6	1,650	45,177	0	10	JAPAN	M
SHINDENGEN	SAITAMA	N/A	N/A	PWR MOSFET LIN LOG	MOS BIP	2.00	5	22,000	418,440	1,860	100	JAPAN	C
SHINDENGEN	AKITA	AKITA DIV.	BLDG. 2	DIODE VARISTER THYRISTOR	BIP	0.00	5	30,000	570,600	1,800	N/A	JAPAN	C

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
SHINDENGEN	YAMAGATA	HIGASHINE DIV.	BLDG. 1	TRAN DIODE	N/A	0.00	4	15,000	182,550	0	1000	JAPAN	C
SHINDENGEN	YAMAGATA	HIGASHINE DIV.	BLDG. 2 DIS.	TRAN DIODE LIN	BIP	0.00	5	30,000	570,600	2,537	N/A	JAPAN	C
SHINDENGEN	YAMAGATA	HIGASHINE DIV.	BLDG. 2 MOS	CUSTOM	CMOS MOS	2.00	5	25,000	475,500	2,537	N/A	JAPAN	C
SHINDENGEN	YAMAGATA	HIGASHINE DIV.	BLDG. 3	CUSTOM	CMOS MOS	0.00	5	10,000	190,200	0	N/A	JAPAN	C
SHINDENGEN	AKITA	AKITA DIV.	BLDG. 1	DIODE THYRISTOR VARISTER	BIP	0.00	4	20,000	243,400	0	N/A	JAPAN	C
SHINDENGEN	SAITAMA	N/A	N/A	DIS LIN	BIP	0.00	4	10,000	121,700	0	1000	JAPAN	C
SHOWA DENKO	TOKYO	N/A	N/A	N/A	GaAs	0.00	0	0	0	0	N/A	JAPAN	M
SONY	NAGASAKI	SONY NAGASAKI	1G	256K SRAM CCD	CMOS	1.00	6	20,000	547,600	2,322	10	JAPAN	M
SONY	KANAGAWA	ATSUGI	N/A	ROM 2.4Mb VRAM 4Mb SRAM	CMOS	0.80	6	12,000	328,560	0	100	JAPAN	M
SONY	KAGOSHIMA	SONY KOKUBU	#3	LIN A/D D/A	BIP	2.00	4	25,000	304,250	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
SONY	KAGOSHIMA	SONY KOKUBU	CCD	CCD	MOS	1.50	4	20,000	243,400	0	N/A	JAPAN	M
SONY	KAGOSHIMA	SONY KOKUBU	#2	DIS	N/A	3.00	4	15,000	182,550	0	N/A	JAPAN	M
SONY	KAGOSHIMA	SONY KOKUBU	#1	DIS	N/A	4.00	4	15,000	182,550	0	N/A	JAPAN	M
SONY	KANAGAWA	ATSUGI	N/A	LIN	BIP	2.00	4	24,000	292,080	0	N/A	JAPAN	M
SONY	NAGASAKI	SONY NAGASAKI	3G	1Mb SRAM 4Mb VRAM CDD	CMOS	0.80	6	40,000	1,095,200	0	N/A	JAPAN	M
SONY	NAGASAKI	SONY NAGASAKI	2G	CCD 256K SRAM SAMPLE 1Mb	CMOS	0.80	6	20,000	547,600	0	N/A	JAPAN	M
SONY	KAGOSHIMA	SONY KOKUBU	#4	SRAM MPU CCD	BICMOS CMOS	1.30	5	30,000	570,600	0	10	JAPAN	M
SONY	KANAGAWA	ATSUGI	N/A	MEM LIN OPTO DIS HEMT	GaAs CMOS	0.00	0	0	0	0	N/A	JAPAN	M
SONY	KANAGAWA	ATSUGI	N/A	FET LASER CCD HEMT	GaAs	0.00	3	0	0	0	N/A	JAPAN	C
STANLEY	YAMAGATA	TSURUOKA WORKS	N/A	LED	N/A	0.00	3	12,000	84,840	0	N/A	JAPAN	C
STANLEY	KANAGAWA	STANLEY ELECT.	N/A	LASER LED	N/A	0.00	4	10,000	121,700	0	N/A	JAPAN	C

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
SUMITOMO METAL MINING	OSAKA	OSAKA WORKS	N/A	LED DIODE	GaAs	0.00	3	1,000	7,070	0	N/A	JAPAN	M
SUMITOMO METAL MINING	OITA	N/A	N/A	N/A	N/A	0.00	5	3,000	57,060	464	N/A	JAPAN	M
SUMITOMO METAL MINING	HYOGO	FUTURE TECH LAB	N/A	4Mb DRAM	N/A	0.80	0	0	0	0	N/A	JAPAN	M
TATEISHI ELECTRIC	N/A	MINAKUCHI	N/A	OPTO CUSTOM	BIP	0.00	6	10,000	273,900	1,306	10	JAPAN	C
TDK/SILICON SYSTEMS	IBARAGI	N/A	N/A	ASIC MPR LOG A/D D/A	CMOS BIP	0.00	0	0	0	0	N/A	JAPAN	M
TI	IBARAGI	MIHO	MIHO 5	ASSP ASIC MCU DSP CBIC	MOS	1.00	5	25,466	484,363	2,322	1	U.S.	M
TI	OITA	HIJI	HIJI 1	LOG LIN ARRAYS	BIP	1.20	5	10,976	208,764	0	100	U.S.	M
TI	SAITAMA	HATOGAYA	N/A	MCU DSP CBIC ARRAYS	CMOS MOS	2.00	5	15,000	285,300	0	100	U.S.	M
TI	IBARAGI	MIHO	MIHO 6	1Mb DRAM 4Mb DRAM ASSP RISC	CMOS BICMOS	0.75	6	21,221	581,031	2,787	1	U.S.	M
TI	OITA	HIJI	MOS 8	SRAM 16Mb DRAM	CMOS BICMOS	0.50	8	2,706	131,701	2,500	1	U.S.	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
TOHOKU S/C	MIYAGI	SENDAI	PHASE 2	4Mb DRAM SRAM MPU ARRAYS	CMOS	0.70	6	20,000	547,600	0	100	JAPAN/U.S.	M
TOHOKU S/C	MIYAGI	SENDAI	PHASE 1	1Mb DRAM 256K SRAM MPU	CMOS	1.00	6	25,000	684,500	0	100	JAPAN	M
TOKIN	MIYAGI	SENDAI WORKS	N/A	POWER SIT	BIP	0.00	3	10,000	70,700	0	N/A	JAPAN	C
TOKO	SAITAMA	SAITAMA	N/A	N/A	MOS	3.00	5	15,000	265,300	0	N/A	JAPAN	M
TOKO	SAITAMA	SAITAMA	N/A	A/D D/A TELECOM DIODE	BIP	3.50	5	20,000	380,400	0	N/A	JAPAN	M
TOREX SEMICONDCUTOR	OKAYAMA	N/A	N/A	N/A		0.00	0	0	0	0		JAPAN	M
TOSHIBA	IWATE	IWATE TOSHIBA	BLDG. 2	4Mb ROM 4Mb EEPROM	CMOS	1.00	6	15,000	410,700	0	100	JAPAN	M
TOSHIBA	FUKUOKA	KITAKYUSHU	N/A	LIN	BIP	3.00	5	30,000	570,600	4,000	N/A	JAPAN	M
TOSHIBA	FUKUOKA	KITAKYUSHU	KUBIC 1	LASER LED	GaAs	2.00	3	25,000	176,750	1,600	N/A	JAPAN	M
TOSHIBA	CHIBA	KIMITSU	PHASE 2	DIODE RECTIFIER THYRISTOR	BIP	0.00	5	18,000	342,360	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
TOSHIBA	HYOGO	HIMEJI	N/A	TRAN DIODE	BIP	3.00	4	30,000	365,100	0	N/A	JAPAN	M
TOSHIBA	OITA	OITA BLDG #2	C-1	256K DRAM 1Mb DRAM	CMOS MOS	1.00	5	30,000	570,600	0	100	JAPAN	M
TOSHIBA	OITA	OITA BLDG #1	LSI 2	MPU LOG ROM EPROM	CMOS MOS	1.50	5	45,000	855,900	0	N/A	JAPAN	M
TOSHIBA	IWATE	IWATE TOSHIBA	BLDG. 3	4Mb EPROM ROM 172K ARRAYS	BICMOS CMOS	0.80	5	24,000	456,480	0	N/A	JAPAN	M
TOSHIBA	OITA	OITA BLDG #3	C-3 #1	1Mb DRAM	CMOS	1.00	6	14,000	383,320	0	N/A	JAPAN	M
TOSHIBA	OITA	OITA BLDG #3	C-3 #2	1Mb DRAM	CMOS	1.00	6	15,000	410,700	0	N/A	JAPAN	M
TOSHIBA	OITA	OITA BLDG #3	C-4 #2	4Mb DRAM	CMOS	0.80	6	15,000	410,700	0	N/A	JAPAN	M
TOSHIBA	OITA	OITA BLDG #1	LSI 1	MPU LOG 64K DRAM	MOS	2.00	4	20,000	243,400	0	N/A	JAPAN	M
TOSHIBA	OITA	OITA BLDG #2	C-2	1Mb DRAM	CMOS	1.00	5	30,000	570,600	0	N/A	JAPAN	M
TOSHIBA	KANAGAWA	TAMAGAWA	N/A	LOG LIN	BIP	2.00	5	15,000	285,300	0	N/A	JAPAN	M
TOSHIBA	OITA	OITA BLDG #4	#1	1Mb DRAM 4Mb DRAM ARRAYS CBIC	CMOS	0.80	6	30,000	821,400	3,716	10	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
TOSHIBA	OITA	OITA BLDG #4	#2	4Mb DRAM SAMPLE 16Mb	BICMOS CMOS	0.60	6	20,000	547,600	3,716	N/A	JAPAN	M
TOSHIBA	CHIBA	KIMITSU	PHASE 1	DIODE RECTIFIER THYRISTOR	BIP	0.00	4	20,000	243,400	0	N/A	JAPAN	M
TOSHIBA	FUKUOKA	NIPPO INDUST.	NAKAMA P	LED P_DIODE IMAGE SENSOR	N/A	0.00	4	30,000	365,100	0	N/A	JAPAN	M
TOSHIBA	OITA	OITA BLDG #3	C-4 #1	4Mb DRAM 256K SRAM ASIC	CMOS	0.80	6	15,000	410,700	0	N/A	JAPAN	M
TOSHIBA	HYOGO	HIMEJI	N/A	PWR FET GTO TRAN DIODE	CMOS BIP	1.00	5	45,000	855,900	0	N/A	JAPAN	M
TOSHIBA	IWATE	IWATE TOSHIBA	BLDG. 1	ARRAYS CBIC MPU CUSTOM	CMOS	1.50	5	20,000	380,400	0	100	JAPAN	M
TOSHIBA	IWATE	IWATE TOSHIBA	BLDG. 2	ARRAYS CCD	CMOS	1.50	5	20,000	380,400	0	N/A	JAPAN	M
TOSHIBA	FUKUOKA	KITAKYUSHU	KUBIC 2	ASIC OPTO LOG	BICMOS BIP	2.00	5	30,000	570,600	2,000	100	JAPAN	M
TOSHIBA	KANAGAWA	TAMAGAWA	N/A	1Mb DRAM SAMPLE 4Mb DRAM 16Mb DRAM	CMOS	0.80	6	10,000	273,800	0	N/A	JAPAN	M
TOSHIBA	OITA	OITA TECH. CTR.	N/A	4Mb DRAM 16Mb DRAM VRAM	N/A	0.50	0	0	0	0	N/A	JAPAN	M

(Continued)

Table 1 (Continued)
Japanese Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	Prefect.	Plant Name	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square meters)	Clean Room Class	Origin of Owner	Merchant or Captive
TOSHIBA		N/A	N/A	4Mb DRAM 16Mb DRAM	CMOS	0.00	8	800	24,335	0		JAPAN	
TOSHIBA	IWATE	IWATE TOSHIBA	BLDG. 3	ARRAYS CBIC	CMOS BICMOS	0.70	6	10,000	273,800	0	N/A	JAPAN	M
TOYO	KANAGAWA	TECHNICAL LAB	N/A	STATIC INDUCT. THYRISTOR	N/A	0.00	5	5,000	95,100	0	10	JAPAN	C
TOYOTA	AICHI	CENTRAL LAB	N/A	MCU PWR ICs CUSTOM	CMOS BIP	2.00	5	500	9,510	0	100	JAPAN	C
UNIZON	HYOGO	ITAMI	N/A	ZENER DIODE REG ARRAYS	BIP	0.00	5	15,000	285,300	0	N/A	JAPAN	M
YAMAHA	KAGOSHIMA	KAGOSHIMA	N/A	LIN ROM CBIC ASSP MPR	CMOS MOS	1.20	5	20,000	380,400	0	N/A	JAPAN	M
YAMAHA	KAGOSHIMA	KAGOSHIMA	N/A	ROM CBIC ASSP	CMOS	0.80	6	14,000	383,320	0	N/A	JAPAN	M
YAMAHA	SHIZUOKA	TOYOOKA WORKS	EE DEV CTR	CBIC LOG	CMOS	1.00	6	6,000	164,280	0	10	JAPAN	M
YAMAHA	SHIZUOKA	TOYOOKA WORKS	N/A	CBIC LOG	CMOS	1.50	4	10,000	121,700	0	N/A	JAPAN	M
YOKOGAWA HOKUSHIN	TOKYO	N/A	N/A	CUSTOM	BIP	0.00	4	17,000	206,890	3,000	N/A	JAPAN	M
YOKOGAWA INT	NAGANO	N/A	N/A	TRAN DIODE OPTO	N/A	0.00	4	2,800	34,076	0	N/A	JAPAN	M

NA = Not available

Source: Dataquest (October 1991)

Table 2
Japanese Future Pilot and Production Fab Lines
Planned Facilities Going Into Production By Year

Company	Prefect.	Plant Name	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Meters)
Production Begins: 1991												
KAWASAKI STEEL	TOCHIGI	PHASE 1	N/A	256K SRAM CBIC ARRAYS	CMOS NTT	NP	09/01/91	0.80	6	10,000	273,800	0
MATSUSHITA	OSAKA	S/C RSCH. CTR.	PROTOTYPE	16Mb DRAM 64-bit MPU	CMOS	P	02/01/91	0.60	6	8,000	219,040	0
NIPPON STEEL	KANAGAWA	ELECT. LAB	N/A	ASIC	N/A	DP	09/01/91	0.80	6	15,000	410,700	0
OKI	TOKYO	HACHIOJI	V-4	16Mb DRAM 64Mb DRAM	CMOS BICMOS	PR	11/01/91	0.30	8	500	24,335	2,600
SONY	KANAGAWA	ATSUGI	N/A	MEM LIN OPTO DIS HEMT	GaAs CMOS	P		0.00	0	0	0	0
SUMITOMO METAL MINING	HYOGO	FUTURE TECH LAB	N/A	4Mb DRAM	N/A	P	03/01/91	0.80	0	0		0
TOSHIBA	IWATE	IWATE TOSHIBA	BLDG. 3	ARRAYS CBIC	CMOS BICMOS	PAT	04/01/91	0.70	6	10,000	273,800	0
Production Begins: 1992												
FUJITSU	IWATE	IWATE	NO. 5	16Mb DRAM	CMOS	P		0.60	6	13,000	355,940	0
FUJITSU	MIE	N/A	N/A	16Mb DRAM		P	09/01/92	0.00	8	14,000	681,380	0
HITACHI	YAMANASHI	N/A	N/A	4Mb DRAM	CMOS	P	01/01/92	0.00	8	10,000	486,700	0

(Continued)

Table 2 (Continued)
Japanese Future Pilot and Production Fab Lines
Planned Facilities Going Into Production By Year

Company	Prefect.	Plant Name	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Meters)
				16Mb DRAM								
KTI SEMICONDUCTOR	HYOGO	N/A	N/A	LOG ASIC	CMOS	F	08/01/92	0.80	8	9,000	438,030	0
LSI LOGIC	IBARGI	N/A	FAB II	ASIC		F		0.00	6	12,500	342,250	0
MATSUSHITA	TOYAMA	N/A	NO 2.	16Mb DRAM 64Mb DRAM CCD MCU	CMOS	F	05/01/92	0.00	8	8,000	389,360	0
MITSUBISHI	KUMAMOTO	KUMAMOTO WORKS	D	ARRAYS CBIC ASSP MCU	N/A	F		0.00	0	0	0	0
MITSUBISHI	EHIME	SAIJO A	A-1F	16Mb DRAM	CMOS M2	F	01/01/92	0.50	8	20,000	973,400	0
MITSUBISHI	OSAKA	ULSI	N/A	64Mb DRAM 256Mb DRAM	CMOS	RP	12/31/92	0.35	8	0	0	0
NEC	KUMAMOTO	KYUSHU	FAB 8	4Mb SRAM RISC MPU 16Mb DRAM	CMOS BICMOS	F	07/01/92	0.50	8	20,000	973,400	3,716
NEW JAPAN RADIO	KUMAMOTO	KYUSHU	N/A	CUSTOM CONSUMER LOG	CMOS	F		1.00	6	20,000	547,600	0
NIHON S/C	IBARAGI	N/A	PHASE 2	ARRAYS CBIC MPU 1Mb SRAM	N/A	F	05/01/92	0.80	8	25,000	684,500	0

(Continued)

Table 2 (Continued)
Japanese Future Pilot and Production Fab Lines
Planned Facilities Going Into Production By Year

Company	Prefect.	Plant Name	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Meters)
NIPPON DENSO	AICHI	KODA WORKS	BLDG. 2	MCU CUSTOM	MOS	P		0.00	6	10,000	273,800	0
NKK	KANAGAWA	N/A	EDRL	1Mb SRAM 4Mb SRAM MASK ROM RISC MPU ASIC	N/A	P	10/01/92	0.80	8	5,000	243,350	0
NMB S/C	CHIBA	N/A	M4	4Mb DRAM 16Mb DRAM	BICMOS CMOS	OF		0.60	0	20,000	0	0
SANYO	NIIGATA	NIIGATA SANYO	BLDG. 3 #5	4Mb DRAM	CMOS	F	06/01/92	0.80	6	20,000	547,600	0
SHARP	HIROSHIMA	FUKUYAMA	BLDG. 3	4Mb DRAM 16Mb DRAM 4Mb SRAM 32 Mb ROM	CMOS	F		0.00	8	24,000	1,168,080	0
SONY	KAGOSHIMA	SONY KOKUBU	#5	LOG MEM MPU LIN DIS OPTO	BIP CMOS MOS	FAT		0.80	6	0	0	0
SONY	MIYAGI	N/A	N/A			FA		0.00	0	0	0	0
TDK/SILICON SYSTEMS	IBARAGI	N/A	N/A	ASIC MPR LOG A/D D/A	CMOS BIP	P		0.00	0	0	0	0
TI	OITA	HIJI	BLDG. 3	4Mb SRAM 16Mb DRAM	CMOS BICMOS	F		0.60	8	20,000	973,400	0

(Continued)

Table 2 (Continued)
Japanese Future Pilot and Production Fab Lines
Planned Facilities Going Into Production By Year

Company	Prefect.	Plant Name	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Meters)
TOSHIBA	MIE	N/A	PHASE 1	4Mb DRAM SAMPLE 16Mb DRAM	CMOS	F	04/01/92	0.60	8	20,000	973,400	3,716
TOSHIBA	OITA	OITA BLDG #4	#3	4Mb DRAM 16Mb DRAM	CMOS	F		0.80	6	20,000	547,600	3,716
TOSHIBA	ISHIKAWA	KAGA	N/A	DIS	N/A	FAT		0.00	5	80,000	1,521,600	15,000
TOSHIBA	OITA	OITA TECH. CTR.	N/A	4Mb DRAM 16Mb DRAM VRAM	N/A	P		0.50	0	0	0	0
Production Begins: 1993												
ASAHI KASEI (CHEMICAL)	MIYAZAKI	N/A	N/A	ASIC SRAM	CMOS HITACHI	F	12/31/93	0.80	6	16,500	451,770	4,500
FUJITSU	FUKUSHIMA	WAKAMATSU	BLDG. 2 #2	ARRAYS CBIC 32-bit MCUs	CMOS	F		0.70	6	15,000	410,700	5,250
NEC	HIROSHIMA	CHUGOKU	PHASE 2	EPROM 4Mb DRAM SAMPLE 16Mb DRAM	CMOS	F	12/31/93	0.60	8	30,000	1,460,100	0
NEC	YAMAGATA	TSURUOKA	N/A	ASIC MCU	CMOS	F	04/01/93	0.80	6	20,000	547,600	21,000
NEC	YAMAGUCHI	YAMAGUCHI LTD.	N/A	16Mb DRAM	CMOS	F		0.50	8	0	0	0
OKI	MIYAZAKI	MIYAZAKI OKI	M4	16Mb DRAM	CMOS	F	03/31/93	0.50	8	20,000	973,400	6,400

(Continued)

Table 2 (Continued)
Japanese Future Pilot and Production Fab Lines
Planned Facilities Going Into Production By Year

Company	Prefect.	Plant Name	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Meters)
SEIKO-EPSON	NAGANO	FUJIMI	BLDG. E	SRAM ARRAYS	CMOS BICMOS	NFAT		0.00	0	0		0
SGS THOMPSON	N/A	N/A	N/A	CONSUMER LOG DRAM	N/A	F		0.00	0	0		0
TOHOKU S/C	MIYAGI	SENDAI	PHASE 3	16Mb DRAM	CMOS TOSHIBA	F		0.60	8	20,000	973,400	0
TOSHIBA	MIE	N/A	PHASE 2	16Mb DRAM 4 Mb DRAM	CMOS	F		0.50	8	20,000		3,716
TOSHIBA	OITA	OITA BLDG #4	#4	16Mb DRAM	BICMOS CMOS	F		0.60	6	20,000	547,600	3,716
Production Begins: 1994												
MOTOROLA	MIYAGI	SENDAI	MOS-10	4Mb DRAM MPU CUSTOM	CMOS	F	04/01/94	0.80	6	25,000	684,500	2,322
NEC	HIROSHIMA	CHUGOKU	PHASE 3	16Mb DRAM MPU EPROM	CMOS	F		0.60	8	22,000	1,070,740	0
NIHON S/C	IBARAGI	N/A	PHASE 3	ASIC CBIC MPU SRAM MPR	CMOS BICMOS	F		0.50	8	20,000	973,400	0
Production Begins: 1995												
KAWASAKI STEEL	TOCHIGI	PHASE 2	N/A	SRAM DRAM ARRAYS	CMOS NTT	F		0.00	6	15,000	410,700	0

(Continued)

Table 2 (Continued)
Japanese Future Pilot and Production Fab Lines
Planned Facilities Going Into Production By Year

Company	Prefect.	Plant Name	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Meters)
NEC	HIROSHIMA	CHUGOKU	PHASE 4	16Mb DRAM MPU EPROM	CMOS	F		0.60	8	22,000	1,070,740	0
NISSAN	N/A	N/A	N/A	CUSTOM	N/A	FAT		0.00	0	0	0	0
Production Begins: 1996												
TOSHIBA	MIE	N/A	PHASE 3	16Mb DRAM	CMOS	F		0.50	8	25,000	1,216,750	3,716
Production Begins: 1998												
KAWASAKI STEEL	TOCHIGI	PHASE 3	N/A	16Mb DRAM SRAM ARRAYS	CMOS NTT	F		0.00	6	15,000	410,700	0

NA = Not available

Source: Dataquest (October 1991)

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Asia/Pacific and Rest of World Fab Database

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Asia/Pacific and Rest of World Fab Database

Background

The material in this booklet applies to the Asia/Pacific and Rest of World (ROW) portions of Dataquest's Semiconductors *Asia* service Wafer Fab Database. The Wafer Fab Database is updated on an ongoing basis, employing both primary and secondary research methodologies. The tables included in this booklet highlight both production and pilot line wafer fabs.

General Definitions

A *fab line* is a processing line in a clean room that is equipped to do all front-end wafer processing. Occasionally there are two separate product-specific fab lines or two different wafer sizes in a clean room. In this situation, a clean room will be documented as two fab lines if the equipment is dedicated to each wafer size or product line. There can be many fab lines at one location.

Front-end wafer processing is defined as all steps involved with semiconductor processing, beginning with initial oxide and ending at wafer probe.

A *production fab* is defined as a wafer fab capable of front-end processing more than 1,250 wafers per week (type = F).

A *pilot fab* is defined as a wafer fab capable of front-end processing 1,250 wafers or less per week (type = P).

Definitions of Table Columns

The *Products Produced* column contains product information for seven product categories. The information in this column can be very detailed, depending on the information's availability. The nomenclature used within the seven product groups of the fab database is as follows, with definitions where warranted:

- Analog
  - LIN—Linear/analog devices
  - A/D D/A—Analog-to-digital, digital-to-analog converters
  - AUTOMOTIVE—Dedicated to automobile applications
  - CODEC—Coder/decoder
  - INTERFACE—Interface IC
  - MESFET (GaAs)—Metal Schottky field-effect transistor
  - MODFET (GaAs)
  - MDIODE (GaAs)—Microwave diode
  - MFET (GaAs)—Microwave field-effect transistor
  - MODEM—Modulator/demodulator
  - MMIC—Monolithic microwave IC
  - OP AMP—Operational amplifier
  - PWR IC—Power IC
  - REG—Voltage regulator
  - SMART PWR—Smart power
  - SWITCHES—Switching device
  - TELECOM—Telecommunications chips
- Memory
  - MEM—Memory
  - RAM—Random-access memory
  - DRAM—Dynamic RAM
  - SRAM 4 TR.—Static RAM uses a 4-transistor cell design
  - SRAM 6 TR.—Static RAM uses a 6-transistor cell design
  - VRAM—Video RAM
  - ROM—Read-only memory
  - PROM—Programmable ROM
  - EPROM—Ultraviolet erasable PROM
  - EEPROM or E2—Electrically erasable PROM
  - FERRAM—Ferroelectric RAM
  - NVMEM—Nonvolatile memory (ROM, PROM, EPROM, EEPROM, FERRAM)
  - FIFO—First-in, first-out memory
  - SPMEM—Other specialty memory (dual port, shift-register, color look-up, etc.)
- Micrologic
  - ASSP—Application-specific standard product
  - BIT—Bit slice (subset of MPU functions)

- DSP—Digital signal processor
- MCU—Microcontroller unit
- MPR—Microperipheral
- MPRCOM—MPR digital communications (ISDN, LAN, UART, modem)
- MPU—Microprocessor unit
- LISP—32-bit list instruction set processor for AI applications
- RISC—Reduced-instruction-set computation 32-bit MPU

- Standard logic
  - LOG—Standard logic

- ASIC logic
  - ASIC—Application-specific IC
  - ARRAYS—Gate arrays
  - CBIC—Cell-based IC
  - CUSTOM—Full-custom IC (single user)
  - PLD—Programmable logic device

- Discrete
  - DIS—Discrete
  - DIODE
  - FET—Field-effect transistor
  - GTO—Gate turn-off thyristor
  - HEMT (GaAs)—High-electron-mobility transistor
  - MOSFET—MOS-based field-effect transistor
  - PWR TRAN—Power transistor
  - RECTIFIER
  - RF—Radio frequency
  - SCR—Schottky rectifier
  - SENSORS
  - SST—Small-signal transistor
  - THYRISTOR
  - TRAN—Transistor
  - ZENER DIODE

- Optoelectronic
  - OPTO—Optoelectronic
  - CCD—Charge-coupled device (imaging)
  - COUPLERS—Photocouplers
  - IED—Infrared-emitting diode
  - IMAGE SENSOR
  - LASER (GaP)—Semiconductor laser or laser IC
  - LED—Light-emitting diode
  - PDIODE—Photo diode
  - PTRAN—Photo transistor
  - SAW—Surface acoustic wave device
  - SIT IMAGE SENSOR—Static induction transistor image sensor

The *Process Technology* column lists four major types of technologies. This column also lists a few uncommon technologies along with information on levels of metal, type of well, and logic structure, when available. Definitions of the nomenclature used in the Process Technology column are as follows:

- MOS (silicon-based)
  - CMOS—Complementary metal-oxide semiconductor
  - MOS—n-channel metal-oxide semiconductor (NMOS) and p-channel metal-oxide semiconductor (PMOS) (More than 90 percent of the MOS fabs use n-channel MOS.)
  - M1—Single-level metal
  - M2—Double-level metal
  - M3—Triple-level metal
  - N-WELL
  - P-WELL
  - POLY1—Single-level polysilicon
  - POLY2—Double-level polysilicon
  - POLY3—Triple-level polysilicon

- BiCMOS (silicon-based)
  - BICMOS—Bipolar and CMOS combined on a chip
  - BIMOS—Bipolar and MOS combined on a chip
  - ECL I/O—ECL input/output
  - TTL I/O—TTL input/output

- Bipolar (silicon-based)
  - BIP—Bipolar
  - ECL—Emitter-coupled logic
  - TTL—Transistor-transistor logic
  - STTL—Schottky TTL

- Gallium arsenide and other compound semiconductor materials
  - GaAs—Gallium arsenide
  - GaAlAs—Gallium aluminum arsenide

- GaAs on Si—Gallium arsenide on silicon
- GaP—Gallium phosphide
- HgCdTe—Mercuric cadmium telluride
- InAs—Indium arsenide
- InP—Indium phosphide
- InSb—Indium antimony
- LiNbO3—Lithium niobate
- SOS—Silicon on sapphire

The number in the *Minimum Linewidth* column represents the minimum linewidth at the critical mask layers as drawn. This number is stated in microns and is defined in Dataquest's fab survey as being available in production volumes.

The *Wafer Size* column represents the wafer diameter expressed colloquially in inches. However, for wafers greater than 3 inches in diameter, the colloquial expression is inaccurate. When calculating square inches, the following approximations are used:

Wafer-Start Capacity is defined in the fab survey as the equipment-limited wafer-start capacity per four-week period. Start capacity is not limited by current staffing or the number of shifts operating; it is limited only by the installed equipment in the fab and the complexity of the process it runs. Start capacity in square inches is calculated using the approximate diameter and the wafer-start capacity.

The *Clean Room Class* column represents the level of cleanliness in the cleanest part of the clean room. This area represents the true environment to which the wafer is exposed.

The *Merchant or Captive* column categorizes each fab line on the tables as one of these two types. Definitions of the various categories are as follows:

- A *Merchant* fab line is a fab line that produces devices that end up available on the merchant market.
- A *Captive* fab line does not sell any of its devices on the merchant market. All production is consumed by the owner of the fab line.

Table 1
Asia/Pacific-ROW Existing Pilot and Production Fab Lines (Including Fabs Going Into Production During 1991)

Company	City or District	Country or Territory	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Merchant or Captive
AMALGAMATED WIRELESS	SYDNEY	AUSTRALIA	N/A	ASIC	CMOS	1.50	6	7,000	191,660	0	N/A	M
AMPI	HSINCHU	TAIWAN	FAB 1	PWR ICs DIS	MOS BIP	2.00	4	15,000	182,550	0	N/A	M
ATMOS/[illegible]	WARSAW	POLAND	N/A	ASIC	N/A	2.00	4	0	0	0		M
BEIJING NO.2	BEIJING	CHINA	N/A	INTERFACE IC	BIP TTL	5.00	3	10,000	70,700	0	N/A	C
BEIJING NO.3	BEIJING	CHINA	N/A	LOG TRANS LIN MEM	CMOS MOS	5.00	3	15,000	106,050	0	N/A	C
BEIJING NO.5	BEIJING	CHINA	N/A	OP AMP LOG PWR TRAN	N/A	5.00	3	10,000	70,700	0	N/A	C
BEIJING NO.878	BEIJING	CHINA	N/A	DIS	N/A	5.00	3	8,000	56,560	0	N/A	C
BEIJING TUBE FACTORY	BEIJING	CHINA	N/A	DIS	N/A	5.00	4	10,000	121,700	0	N/A	C
BEL	BANGALORE	INDIA	N/A	DIS	N/A	4.00	4	10,000	121,700	0	N/A	M
BELLING IC CO.	N/A	CHINA	N/A	DIS	N/A	0.00	0	0	0	0	N/A	C
BHARAT ELECTRONICS	BANGALORE	INDIA	N/A			0.00	0	0	0	0	N/A	M

(Continued)

Table 1 (Continued)
Asia/Pacific-ROW Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City or District	Country or Territory	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Merchant or Captive
CHARTERED S/C	N/A	SINGAPORE	N/A	ASIC LIN EEPROM	CMOS MOS	1.20	6	12,000	328,560	20,000	10	M
CONTINENTAL DEVICES	DELHI	INDIA	N/A	DIS DIODE TRAN PWR SCR	N/A	0.00	3	10,000	70,700	0	N/A	M
DAEWOO	GURO-DONG, SEOUL	S. KOREA	BIPOLAR LINE	CUSTOM AUTOMOTIVE AUDIO	BIP	3.00	4	9,000	109,530	0	N/A	M
DAEWOO	GURO-DONG, SEOUL	S. KOREA	MOS LINE	ARRAYS	CMOS	2.00	4	9,000	109,530	0	N/A	M
DONG GUANG PLANT	BEIJING	CHINA	N/A	LOG MPU	BIP TTL	5.00	3	5,000	35,350	0	N/A	C
ELECT. COMPONENTS INDIA	HYDERABAD	INDIA	N/A	DIS CONSUMER ICs	BIP	0.00	3	15,000	106,050	0	N/A	M
FINE MICROELECT.	HSINCHU	TAIWAN	N/A	OPTO TRAN	N/A	0.00	3	10,000	70,700	0	N/A	M
FUCHOU	FUCHOU	CHINA	N/A	N/A	N/A	5.00	3	4,000	28,280	0	N/A	M
GENERAL INST.	N/A	TAIWAN	N/A	PWR DIS	BIP	0.00	3	12,000	84,840	0	N/A	M
GOLDSTAR	WOOMYUN-DONG, SEOUL	S. KOREA	N/A	256K DRAM	CMOS HITACHI	1.20	6	10,000	273,800	0	N/A	M

(Continued)

Table 1 (Continued)
Asia/Pacific-ROW Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City or District	Country or Territory	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Merchant or Captive
GOLDSTAR	CHONGJU-CITY, CHOONGBUK	S. KOREA	PHASE 1	1Mb DRAM 4Mb DRAM	CMOS HITACHI	0.08	6	30,000	821,400	0	N/A	M
GOLDSTAR	CHONGJU-CITY, CHOONGBUK	S. KOREA	PHASE 2	4Mb DRAM	CMOS HITACHI	0.70	6	20,000	547,600	0	N/A	M
GOLDSTAR	GUMI-CITY, KYUNGBUK	S. KOREA	PLANT 1	LIN	BIP TTL	0.00	4	25,000	304,250	0	N/A	M
GOLDSTAR	GUMI-CITY, KYUNGBUK	S. KOREA	PLANT 2	64K SRAM ROM ARRAYS	CMOS MOS	0.00	5	15,000	285,300	0	N/A	M
GOLDSTAR	ANYANG	S. KOREA	N/A	MPU ASIC 64K SRAM	CMOS	0.00	5	10,000	190,200	0	N/A	M
GOLDSTAR	WOOMYUN-DONG, SEOUL	S. KOREA	N/A	LOG LIN DIS CONSUMER	BIP	3.00	5	4,500	85,590	0	N/A	M
HANILL	SIHEUNG	S. KOREA	N/A	N/A	GaAs	0.00	2	0	0	0	N/A	M
HARBIN FACTORY	HARBIN	CHINA	N/A	TRAN	N/A	5.00	3	10,000	70,700	0	N/A	C
HOLTEK	HSINCHU	TAIWAN	N/A	ASIC LIN	N/A	2.00	5	10,000	190,200	0	N/A	M
HUA KO ELECTRONICS	TAI PO	HONG KONG	N/A	MPU LIN ASIC LOG SRAM ROM	CMOS MOS	0.00	4	8,000	97,360	0	N/A	M
HUALON MICROELECT.	HSINCHU	TAIWAN	FAB 1	SRAM ROM TELECOM CONSUMER	CMOS POLY2 M2	1.20	5	30,000	570,600	0	N/A	M

(Continued)

Table 1 (Continued)
Asia/Pacific-ROW Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City or District	Country or Territory	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Merchant or Captive
HUALON MICROELECT.	HSINCHU	TAIWAN	FAB 2	CCD	CMOS BICMOS	1.20	6	30,000	821,400	0	N/A	M
HYUNDAI	ICHUN, KYUNGKI-DO	S. KOREA	FAB I-B	256K SRAM	CMOS	1.00	5	8,000	152,160	0	N/A	M
HYUNDAI	ICHUN, KYUNGKI-DO	S. KOREA	FAB III - 1	1Mb DRAM	CMOS	0.80	6	30,000	821,400	0	N/A	M
HYUNDAI	ICHUN, KYUNGKI-DO	S. KOREA	FAB II	64K DRAM 256K DRAM	CMOS TI	1.00	6	25,000	684,500	0	N/A	M
HYUNDAI	ICHUN, KYUNGKI-DO	S. KOREA	FAB I-A	16K SRAM PLD EEPROM EPROM	CMOS MOS	1.20	5	15,000	285,300	0	N/A	M
ICCE	BANEASA	ROMANIA	N/A	OPTO LIN	BIP	0.00	0	0	0	0	N/A	
INDIAN TELEPHONE	BANGALORE	INDIA	N/A	DIS	BIP	0.00	3	12,000	84,840	0	N/A	C
INTEL	JERUSALEM	ISRAEL	FAB 8	386 MPU 286 MPU	CMOS	1.50	6	21,000	574,980	24,000	10	M
IPRS	BANEASA	ROMANIA	N/A	THYRISTOR DIODE LIN	BIPOLAR	0.00	0	0	0	0	N/A	M
JINAN NO.1	JINAN	CHINA	N/A	LOG OP AMP	N/A	5.00	3	10,000	70,700	0	N/A	C

(Continued)

Table 1 (Continued)
Asia/Pacific-ROW Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City or District	Country or Territory	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Merchant or Captive
JINAN NO.2	JINAN	CHINA	N/A	1K SRAM 4K DRAM	MOS	5.00	3	8,000	56,560	0	N/A	C
KOREAN ELECTRONIC CO.	GUMI-CITY, KYUNGBUK	S. KOREA	4" LINE	LIN OPTO	BIP	2.50	4	20,000	243,400	0	N/A	M
LIAONING FACTORY	JINZHOU	CHINA	N/A	TRAN	N/A	5.00	3	12,000	84,840	0	N/A	C
MACRONIX	HSIN CHU	TAIWAN	FAB 1	EPROM	MOS	1.00	6	30,000	821,400	0	N/A	M
MICROELECTRONICA	BANEASA	ROMANIA	N/A	MPU 16K DRAM	MOS	0.00	0	0	0	0	N/A	M
MIN MACHINERY INDUSTRY	N/A	CHINA	N/A	LOG PWR TRAN	MOS GE	5.00	3	5,000	35,350	0	N/A	C
MOTOROLA	SEREMBAN	MALAYSIA	N/A	PWR TRAN DIS SST	N/A	0.00	4	8,000	97,360	6,000	N/A	M
NAINA SEMICONDUCTORS	HALDWANI	INDIA	N/A	DIODES	N/A	0.00	0	0	0	0	N/A	M
NATIONAL S/C	PENANG	MALAYSIA	N/A	LOG	N/A	0.00	4	13,000	158,210	0	N/A	M
NATIONAL S/C	HA-EMEK	ISRAEL	N/A	32-bit MPU	CMOS	1.20	6	6,400	175,232	18,000	10	M
PHOTRONICS	N/A	TAIWAN	N/A	OPTO	N/A	0.00	3	10,000	70,700	0	N/A	M

(Continued)

Table 1 (Continued)
Asia/Pacific-ROW Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City or District	Country or Territory	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Merchant or Captive
QIANMEN S/C FACTORY	BEIJING	CHINA	N/A	DIG WATCH IC	N/A	5.00	3	10,000	70,700	0	N/A	C
RAMAX	MELBOURNE	AUSTRALIA	N/A	FERRAM	CMOS GaAs	0.00	0	0	0	0	N/A	M
RCL S/C	TAI PO	HONG KONG	N/A	MEM MPU LOG LIN TRAN	CMOS	0.00	4	4,000	48,680	0	N/A	M
RECTRON LTD.	TAIPEI	TAIWAN	NO. 1	DIS	N/A	0.00	2	90,000	282,600	0	N/A	M
ROHM	SEOUL	S. KOREA	N/A	DIS OPTO	N/A	0.00	4	15,000	182,550	0	N/A	M
S. AFRICAN MICROELECT.	PRETORIA	SOUTH AFRICA	N/A	A/D D/A TELECOM	BIP	5.00	3	10,000	70,700	0	N/A	M
S. AFRICAN MICROELECT.	PRETORIA	SOUTH AFRICA	N/A	A/D D/A TELECOM	CMOS	3.00	4	10,000	121,700	0	N/A	M
SAMMI	N/A	S. KOREA	N/A	LASER DIODE	GaAs	0.00	2	0	0	0	N/A	M
SAMSUNG	KIHEUNG-UP, KYUNGKI-DO	S. KOREA	LINE 3	1Mb DRAM	CMOS	0.80	6	35,000	958,300	0	N/A	M
SAMSUNG	KIHEUNG-UP, KYUNGKI-DO	S. KOREA	FAB 5	4Mb DRAM	N/A	0.70	8	20,000	973,400	0	N/A	M

(Continued)

Table 1 (Continued)
Asia/Pacific-ROW Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City or District	Country or Territory	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Merchant or Captive
SAMSUNG	KIHEUNG-UP, KYUNGKI-DO	S. KOREA	LINE 1	64K DRAM	MOS	1.50	4	35,000	425,950	0	N/A	M
SAMSUNG	KIHEUNG-UP, KYUNGKI-DO	S. KOREA	LINE 2	256K DRAM	MOS	1.20	6	35,000	958,300	0	N/A	M
SAMSUNG	KIHEUNG-UP, KYUNGKI-DO	S. KOREA	LINE 4	4Mb DRAM	CMOS	0.50	6	30,000	821,400	0	N/A	M
SAMSUNG	BUCHON-CITY, KYUNGKI-DO	S. KOREA	BIPOLAR LINE	LIN	BIP	3.00	4	25,000	304,250	0	N/A	M
SAMSUNG	BUCHON-CITY, KYUNGKI-DO	S. KOREA	MOS LINE	MPU MCU LOG	CMOS MOS	2.00	5	20,000	380,400	0	N/A	M
SGS-THOMSON	ANG MO KIO	SINGAPORE	N/A	PWR TRAN LIN	BIP MOS	0.00	5	25,000	475,500	14,000	10	M
SHANGHAI NO.5	SHANGHAI	CHINA	N/A	8080 MPU LOG MEM LIN DIS	CMOS	5.00	3	10,000	70,700	0	N/A	C
SHANGHAI NO.[illegible]1	SHANGHAI	CHINA	N/A	OP AMP PWR TRAN	BIP TTL	5.00	3	4,000	28,280	0	N/A	C
SHANGHAI PHILIPS NO.7	SHANGHAI	CHINA	N/A	OP AMP PWR TRAN DIS	BIP TTL CMOS	5.00	3	10,000	70,700	5,380	100	M
SHINDENGEN	N/A	THAILAND	N/A	TRAN DIODES	N/A	0.00	0	0	0	0	N/A	M
SID MICROELECT.	CONTAGEM	BRAZIL	N/A	LIN PWR TRAN SST PWR ICs	BIP	30.00	3	12,000	84,840	15,000	100	M

(Continued)

Table 1 (Continued)
Asia/Pacific-ROW Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1991)

Company	City or District	Country or Territory	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Merchant or Captive
SID MICROELECT.	CONTAGEM	BRAZIL	N/A	PWR ICs	CMOS	2.00	4	13,000	158,210	15,000	N/A	M
SPIC ELECTRONICS	MADRAS	INDIA	N/A	PHOTO VOLTAIC DIS	N/A	3.00	3	15,000	106,050	0	N/A	M
SUZHOU PLANT	SUZHOU	CHINA	N/A	LOG OPTO CONSUMER	BIP TTL MOS	0.00	3	0	0	0	N/A	C
TI/ACER	HSINCHU	TAIWAN	FAB 1	4Mb DRAM	CMOS	0.80	6	25,000	684,500	45,000	N/A	M
TIAN GUANG FACTORY	SHAOXING	CHINA	N/A	LOG	BIP ECL TTL	5.00	4	14,000	170,380	0	N/A	C
TIANJIN NO.1	TIANJIN	CHINA	N/A	AUDIO IC	CMOS FUJI	5.00	3	10,000	70,700	0	N/A	C
TOMI	TORUN	POLAND	N/A	DIS	N/A	0.00	0	0	0	0		M
TSMC	HSINCHU	TAIWAN	FAB 1	LOG ASIC ROM MPR MCU DRAM	MOS CMOS	1.20	6	14,000	383,320	7,637	10	M
TSMC	HSINCHU	TAIWAN	FAB 2-A	SRAM ROM DRAM LOG CUSTOM	CMOS	1.00	6	20,000	547,600	40,000	1	M
U.S.S.R.	N/A	U.S.S.R.	N/A	64K 256K DRAM	N/A	2.00	0	0	0	0	N/A	C

(Continued)

Table 1 (Continued)
Asia/Pacific-ROW Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City or District	Country or Territory	Fab Name	Products Produced	Process Technology	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Merchant or Captive
UNITED MICROELECT.	HSINCHU	TAIWAN	FAB 2A	256K SRAM ROM EPROM ASIC	CMOS NMOS M2	1.00	6	30,000	821,400	30,000	N/A	M
UNITED MICROELECT.	HSINCHU	TAIWAN	FAB 2B	1Mb SRAM	CMOS	0.80	6	10,000	273,800	15,000	N/A	M
UNITED MICROELECT.	HSINCHU	TAIWAN	FAB 1	64K SRAM CUSTOM LIN MCU	CMOS NMOS M2	1.50	4	45,000	547,650	0	N/A	M
UTIC	HSINSHU	TAIWAN	N/A	DIS LIN	BIP	2.00	5	8,000	152,160	0	N/A	M
VITELIC CORPORATION	TAI PO	HONG KONG	N/A	ROM 256K DRAM SRAM LIN ASIC	CMOS	0.80	5	2,000	38,040	0	10	M
WINBOND	HSINCHU	TAIWAN	FAB 1	SRAM ROM ASIC MPR TELECOM	CMOS NMOS ERSO	1.20	5	20,000	380,400	0	10	M
WUXI FACTORY	WUXI	CHINA	N/A	TRAN DIODES LIN LOG MEM	MOS TOSHIBA	5.00	4	15,000	182,550	0	N/A	M
YANHE RADIO FACTORY	XIAN	CHINA	N/A	LIN LOG	N/A	5.00	3	7,000	49,490	0	N/A	C

NA = Not available

Source: Dataquest (October 1991)

Table 2
Asia/Pacific-ROW Future Pilot and Production Fab Lines
Planned Facilities Going Into Production by Year

Company	City or District	Country or Territory	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Feet)
Production Begins: 1992												
HYUNDAI	ICHON, KYUNGKI-DO	S. KOREA	FAB III - 2	4Mb DRAM	CMOS	F	01/01/92	1.00	0	30,000	1,460,100	0
TSMC	HSINCHU	TAIWAN	FAB 2-B	SRAM ROM DRAM LOG CUSTOM	CMOS	CF	12/01/92	0.80	6	20,000	547,600	40,000
VITELIC CORPORATION	HSINCHU	TAIWAN	MODULE 1	256K 1Mb DRAM SRAM	CMOS OKI	F	12/31/92	1.00	6	10,000	273,800	22,000
WINBOND	HSINCHU	TAIWAN	FAB 2A	SRAM ASIC EPROM	CMOS M2	F	11/01/91	1.00	6	15,000	410,700	0
XICOR	N/A	ISRAEL	N/A	EPROM	CMOS	F		0.80	6	0	0	0
Production Begins: 1993												
INTERBIP	N/A	HUNGARY	N/A	LIN LOG	BIPOLAR	F		5.00	4	6,000	73,020	4,000
MOSEL	HSINCHU	TAIWAN	FAB 1	256K SRAM ROM	CMOS M2	FRNAT	07/15/93	0.80	6	15,000	410,700	30,000
NEC CHINA	BEIJING	CHINA	N/A	64K DRAM	CMOS	F		1.50	4	0	0	0
SAMSUNG	KIHEUNG-UP, KYUNGKI-DO	S. KOREA	FAB 6	4Mb 16Mb DRAM	N/A	F	06/01/93	0.60	8	20,000	973,400	0
WUXI	WUXI	CHINA	N/A	TELECOM ICS	MOS TOSHIBA	F	02/01/91	3.00	5	25,000	475,500	0
Production Begins: 1994												
SEMICONDUCTOR COMPLEX	MOHALI/CHANDIGARH	INDIA	N/A	LSI	BICMOS	F		1.00	6	0	0	0
SYNTEK	HSIN-CHU	TAIWAN	N/A	N/A	N/A	F		0.00	6	10,000	273,800	0
TECH S/C SINGAPORE LTD.	N/A	SINGAPORE	N/A	4Mb DRAM	CMOS	F		0.60	8	0	0	0

(Continued)

Table 2 (Continued)
Asia/Pacific-ROW Future Pilot and Production Fab Lines
Planned Facilities Going Into Production by Year

Company	City or District	Country or Territory	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Est. Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Feet)
UNITED MICROELECT.	HSINCHU	TAIWAN	FAB 3	SRAM	N/A	F		0.00	8	30,000	1,460,100	0
Production Begins: 1995												
MOTOROLA	TIANJIN	CHINA	N/A	LOG DIS TELECOM	BIP MOS	F		0.00	6	10,000	273,800	0
SAMSUNG	KIHEUNG-UP, KYUNGKI-DO	S. KOREA	FAB 7	16Mb DRAM SAMPLE 64Mb	N/A	F		0.50	8	20,000	973,400	0
Production Begins: 1997												
SAMSUNG	KIHEUNG-UP, KYUNGKI-DO	S. KOREA	FAB 8	64Mb DRAM	N/A	F		0.35	8	0	0	0

NA = Not available

Source: Dataquest (October 1991)

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North American Fab Database

BACKGROUND

The material in this booklet applies to the entire Semiconductor Equipment, Manufacturing, and Materials (SEMM) Wafer Fab Database. The Wafer Fab Database is updated on an ongoing basis, employing both primary and secondary research methodologies. The tables included in this booklet highlight both production and pilot line wafer fabs.

GENERAL DEFINITIONS

A *fab line* is a processing line in a clean room that is equipped to do all front-end wafer processing. Occasionally there are two separate product-specific fab lines or two different wafer sizes in a clean room. In this situation, a clean room will be documented as two fab lines if the equipment is dedicated to each wafer size or product line. There can be many fab lines at one location.

Front-end wafer processing is defined as all steps involved with semiconductor processing, beginning with initial oxide and ending at wafer probe.

A *production fab* is defined as a wafer fab capable of front-end processing more than 1,250 wafers per week.

A *pilot fab* is defined as a wafer fab capable of front-end processing 1,250 wafers or less per week.

DEFINITIONS OF TABLE COLUMNS

The *Products Produced* column contains product information for seven product categories. The information in this column can be very detailed, depending on the information's availability. The nomenclature used within the seven product groups of the fab database is as follows, with definitions where warranted:

- Analog
  - LIN—Linear/analog devices
  - A/D D/A—Analog-to-digital, digital-to-analog converters
  - AUTOMOTIVE—Dedicated to automobile applications
  - CODEC—Coder/decoder
  - INTERFACE—Interface IC
  - MESFET (GaAs)—Metal Schottky field-effect transistor
  - MODFET (GaAs)
  - MDIODE (GaAs)—Microwave diode
  - MFET (GaAs)—Microwave field-effect transistor
  - MODEM—Modulator/demodulator
  - MMIC—Monolithic microwave IC
  - OP AMP—Operational amplifier
  - PWR IC—Power IC
  - REG—Voltage regulator
  - SMART PWR—Smart power
  - SWITCHES—Switching device
  - TELECOM—Telecommunications chips
- Memory
  - MEM—Memory
  - RAM—Random-access memory
  - DRAM—Dynamic RAM
  - SRAM 4 TR.—Static RAM uses a 4-transistor cell design
  - SRAM 6 TR.—Static RAM uses a 6-transistor cell design
  - VRAM—Video RAM
  - ROM—Read-only memory
  - PROM—Programmable ROM
  - EPROM—Ultraviolet erasable PROM
  - EEPROM or E2—Electrically erasable PROM
  - FERRAM—Ferroelectric RAM
  - NVMEM—Nonvolatile memory (ROM, PROM, EPROM, EEPROM, FERRAM)
  - FIFO—First-in, first-out memory
  - SPMEM—Other specialty memory (dual port, shift-register, color look-up, etc.)
- Micrologic
  - ASSP—Application-specific standard product
  - BIT—Bit slice (subset of MPU functions)
  - DSP—Digital signal processor

- MCU—Microcontroller unit
- MPR—Microperipheral
- MPRCOM—MPR digital communications (ISDN, LAN, UART, modem)
- MPU—Microprocessor unit
- LISP—32-bit list instruction set processor for AI applications
- RISC—Reduced-instruction-set computation 32-bit MPU

• Standard logic

- LOG—Standard logic

• ASIC logic

- ASIC—Application-specific IC
- ARRAYS—Gate arrays
- CBIC—Cell-based IC
- CUSTOM—Full-custom IC (single user)
- PLD—Programmable logic device

• Discrete

- DIS—Discrete
- DIODE
- FET—Field-effect transistor
- GTO—Gate turn-off thyristor
- HEMT (GaAs)—High-electron-mobility transistor
- MOSFET—MOS-based field-effect transistor
- PWR TRAN—Power transistor
- RECTIFIER
- RF—Radio frequency
- SCR—Schottky rectifier
- SENSORS
- SST—Small-signal transistor
- THYRISTOR
- TRAN—Transistor
- ZENER DIODE

• Optoelectronic

- OPTO—Optoelectronic
- CCD—Charge-coupled device (imaging)
- COUPLERS—Photocouplers
- IED—Infrared-emitting diode
- IMAGE SENSOR
- LASER (GaP)—Semiconductor laser or laser IC
- LED—Light-emitting diode
- PDIODE—Photo diode
- PTRAN—Photo transistor
- SAW—Surface acoustic wave device
- SIT IMAGE SENSOR—Static induction transistor image sensor

The *Process Technology* column lists four major types of technologies. This column also lists a few uncommon technologies along with information on levels of metal, type of well, and logic structure, when available. Definitions of the nomenclature used in the Process Technology column are as follows:

• MOS (silicon-based)

- CMOS—Complementary metal-oxide semiconductor
- MOS—n-channel metal-oxide semiconductor (NMOS) and p-channel metal-oxide semiconductor (PMOS) (More than 90 percent of the MOS fabs use n-channel MOS.)
- M1—Single-level metal
- M2—Double-level metal
- M3—Triple-level metal
- N-WELL
- P-WELL
- POLY1—Single-level polysilicon
- POLY2—Double-level polysilicon
- POLY3—Triple-level polysilicon

• BiCMOS (silicon-based)

- BICMOS—Bipolar and CMOS combined on a chip
- BIMOS—Bipolar and MOS combined on a chip
- ECL I/O—ECL input/output
- TTL I/O—TTL input/output

• Bipolar (silicon-based)

- BIP—Bipolar
- ECL—Emitter-coupled logic
- TTL—Transistor-transistor logic
- STTL—Schottky TTL

• Gallium arsenide and other compound semiconductor materials

- GaAs—Gallium arsenide
- GaAlAs—Gallium aluminum arsenide

- GaAs on Si—Gallium arsenide on silicon
- GaP—Gallium phosphide
- HgCdTe—Mercuric cadmium telluride
- InAs—Indium arsenide
- InP—Indium phosphide
- InSb—Indium antimony
- LiNbO3—Lithium niobate
- SOS—Silicon on sapphire

The number in the *Minimum Linewidth* column represents the minimum linewidth at the critical mask layers as drawn. This number is stated in microns and is defined in Dataquest's fab survey as being available in production volumes.

The *Wafer Size* column represents the wafer diameter expressed colloquially in inches. However, for wafers greater than 3 inches in diameter the colloquial expression is inaccurate. When calculating square inches, the following approximations are used:

Stated Diameter	Approximate Diameter
4 inches (100mm)	3.938 inches
5 inches (125mm)	4.922 inches
6 inches (150mm)	5.906 inches
8 inches (200mm)	7.87 inches

Wafer-Start Capacity is defined in the fab survey as the equipment-limited wafer-start capacity per four-week period. Start capacity is not limited by current staffing or the number of shifts operating; it is limited only by the installed equipment in the fab and the complexity of the process it runs. Start capacity in square inches is calculated using the approximate diameter and the wafer-start capacity.

The *Clean Room Class* column represents the level of cleanliness in the cleanest part of the clean room. This area represents the true environment to which the wafer is exposed.

The *Origin of Owner* column represents the country where the parent company is headquartered.

The *Merchant or Captive* column categorizes each fab line on the tables as one of these two types. Definitions of the various categories are as follows:

- A *Merchant* fab line is a fab line that produces devices that end up available on the merchant market.
- A *Captive* fab line does not sell any of its devices on the merchant market. All production is consumed by the owner of the fab line.

Table 1
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
ACRIAN INC.	SAN JOSE	CA	N/A	PWR DIS	BIP MOS	0.00	3	2,400	16,956	7,000	1,000	U.S.	M
ADAMS-RUSSELL CO.	BURLINGTON	MA	N/A	MESFET MMIC RAD-HARD	GaAs	0.50	3	400	2,826	2,500	10	U.S.	M
ADVANCED POWER TECH.	BEND	OR	N/A	POWER MOSFET A/D D/A	MOS	5.00	4	1,400	17,043	5,000	10	U.S.	M
ALLIED SIGNAL AEROSPACE	COLUMBIA	MD	MICRO CENTR	ASIC	CMOS	1.25	4	1,600	19,478	10,000	1	U.S.	C
ALPHA INDUSTRIES	WOBURN	MA	N/A	RF TRAN LIN	GaAs	0.50	2	200	628	10,000	100	U.S.	C
AMCC	SAN DIEGO	CA	N/A	ARRAYS CBIC	BIP	1.00	6	8,000	219,052	15,000	10	U.S.	M
AMCC	SAN DIEGO	CA	N/A	ARRAYS CBIC MEM	BIP BICMOS	2.00	4	6,400	77,911	3,000	100	U.S.	M
AMD	AUSTIN	TX	FAB 14	512K 1Mb 2Mb EPROM PLD	CMOS MOS	1.30	6	21,600	591,439	17,000	10	U.S.	M
AMD	AUSTIN	TX	FAB 10	286 MPU PLD SRAM	CMOS MOS	1.20	5	20,400	387,957	13,500	100	U.S.	M
AMD	SANTA CLARA	CA	FAB 5	PROM PLD	BIP	1.50	4	20,800	253,212	20,800	10	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines (Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
AMD	AUSTIN	TX	FAB 15	286 MPU SRAM RISC 29K MPU	BICMOS CMOS M2	0.80	6	17,200	470,961	17,200	10	U.S.	M
AMD	SUNNYVALE	CA	SDC	N/A	N/A	0.80	6	6,800	186,194	35,000	1	U.S.	M
ANADIGICS INC.	WARREN	NJ	N/A	OP AMP MMIC	GaAs	0.50	3	1,200	8,478	6,400	100	U.S.	M
ANALOG DEVICES	WILMINGTON	MA	MODULE B	LIN LOG OP AMP A/D D/A	BIP BICMOS	4.00	4	7,040	85,703	8,000	100	U.S.	M
ANALOG DEVICES	SANTA CLARA	CA		LOGIC ANALOG	NMOS CMOS BIP	3.00	4	6,800	82,781	14,000	10	U.S.	M
ANALOG DEVICES	WILMINGTON	MA	MODULE C	MEM LOG ASIC	BIP MOS	1.00	4	2,400	29,217	10,000	10	U.S.	M
ARMY ETDL	FORT MONMOUTH	NJ	N/A	N/A	N/A	0.00	5	5,000	95,087	0	0	U.S.	C
AT&T	ALLENTOWN	PA	BIP 2	LOG	BIP	4.00	4	8,500	103,476	20,000	0	U.S.	C
AT&T	LEE'S SUMMIT	MO	KANSAS	SST DIODE HYBRID	BIP	4.00	4	8,000	97,389	8,000	10,000	U.S.	C
AT&T	ALLENTOWN	PA	MOS 1	LOG 4-bit MCU	MOS	4.00	5	20,000	380,350	0	0	U.S.	C
AT&T	ALLENTOWN	PA	MOS 5	256K SRAM	CMOS MOS M2	1.25	5	16,560	314,929	30,000	10	U.S.	C

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
				MPU ASIC									
AT&T	ALLENTOWN	PA	MOS 2	ASIC LOG	MOS	1.75	4	8,500	103,476	20,000	0	U.S.	C
AT&T	ORLANDO	FL	OR2	256K 1Mb SRAM	CMOS	0.80	6	22,400	613,345	25,000	10	U.S.	M
AT&T	ORLANDO	FL	OR1	MPR SRAM CBIC ARRAYS DRAM	CMOS M2	1.25	5	22,400	425,991	25,000	10	U.S.	C
AT&T	READING	PA	N/A	INTERFACE TELECOM	BIP	3.50	4	1,600	19,478	6,000	0	U.S.	C
AT&T	READING	PA	N/A	OP AMP A/D D/A	BIP	4.00	5	1,600	30,428	5,000	0	U.S.	C
AT&T BELL LABS	READING	PA	COMPOUN D ST	MIL STD LOG MEM LIN	GaAs	0.70	3	1,200	8,478	10,000	1	U.S.	C
ATMEL	COLORADO SPRINGS	CO	FAB 1	PRESURE SENSORS LIN	BIP	3.00	3	800	5,652	13,900	100	U.S.	M
ATMEL	COLORADO SPRINGS	CO	FAB 3	256K EPROM ARRAYS MPU	CMOS	1.00	6	3,150	86,252	7,000	10	U.S.	M
ATMEL	COLORADO SPRINGS	CO	FAB 2	CBIC CUSTOM OPTO LOG	CMOS	1.25	4	4,300	52,347	10,000	50	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines (Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
AVANTEK	SANTA CLARA	CA	N/A	MMIC	BIP	0.00	4	5,000	60,868	10,000	10	U.S.	M
AVANTEK	NEWARK	CA	N/A	MMIC FET DIS	GaAs	0.00	3	900	6,359	17,000	10	U.S.	M
BALL AEROSPACE	BOULDER	CO	N/A	N/A	N/A	1.20	6	3,000	82,144	3,000	0	U.S.	C
BALL AEROSPACE	BOULDER	CO	N/A	MIL STD AEROSPACE ICs	N/A	0.00	4	5,000	60,868	0	0	U.S.	C
BIT	BEAVERTON	OR	N/A	DSP	BIP	2.00	4	800	9,739	2,000	10	U.S.	M
BURR-BROWN	TUCSON	AZ	N/A	HYBRID LIN A/D D/A ASIC	BIP	4.00	4	12,000	146,084	10,000	0	U.S.	M
CALIF. MICRODEV.	TEMPE	AZ	MICRO DIV	PWR LIN MPU ASIC	BICMOS BIP CMOS	1.60	5	4,000	76,070	17,400	100	U.S.	M
CALOGIC	FREMONT	CA	N/A	A/D D/A	BIP MOS	3.00	4	3,600	43,825	5,000	100	U.S.	M
CELERITEK INC.	SAN JOSE	CA	N/A	FET AMP	GaAs	0.00	3	0	0	1,000	100	U.S.	M
CHERRY S/C	EAST GREENWICH	RI	BIPOLAR	ARRAYS DIS CUSTOM LIN	BIP	3.00	3	6,400	45,216	75,000	100	U.S.	M
COMMODORE	NORRISTOWN	PA	FAB 2	ASIC	CMOS	2.00	5	10,000	190,175	0	0	U.S.	C

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines (Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
COMMODORE	NORRISTOWN	PA	FAB 1	ASIC MEM	CMOS MOS	2.00	5	8,000	152,140	11,000	50	U.S.	C
COMPENSATED DEVICES	MELROSE	MA	N/A	DIODE ZENER DIODE	BIP	0.00	4	10,000	121,737	0	0	U.S.	M
CRAY RESEARCH	COLORADO SPRINGS	CO		ASIC CUSTOM LOG	GaAs	0.00	4	700	8,522	10,500	100	U.S.	M
CYPRESS MINNESOTA INC.	BLOOMINGTON	MN	FAB 3	SRAM	CMOS	0.65	6	1,200	32,858	20,000	1	U.S.	M
CYPRESS S/C	SAN JOSE	CA	FAB 1	64K SRAM LOG MPU MPR BIT	BIP CMOS	1.20	5	4,000	76,070	6,000	10	U.S.	M
CYPRESS S/C TEXAS INC.	ROUNDROCK	TX	FAB 3	N/A	CMOS	0.70	6	8,000	219,052	0	1	U.S.	M
CYPRESS S/C TEXAS INC.	ROUNDROCK	TX	FAB 2	SRAM PLD RISC MPU	CMOS	1.20	6	4,400	120,478	20,000	1	U.S.	M
DALLAS S/C	DALLAS	TX	FAB 2	SRAM CCD	CMOS	1.00	6	12,000	328,577	20,000	10	U.S.	M
DALLAS S/C	DALLAS	TX	FAB 1	SRAM CCD	CMOS	1.50	6	6,800	186,194	15,000	10	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
DATA LINEAR	MILPITAS	CA	FAB 1	OP AMP CBIC CUSTOM	CMOS	4.00	4	1,600	19,478	3,500	100	U.S.	M
DAVID SARNOFF LABS	PRINCETON	NJ	Si IC CENTR	ASIC ANALOG	BICMOS	0.90	4	800	9,739	5,000	100	U.S.	C
DELCO	KOKOMO	IN	FAB 2	MCU MPU LOGIC DISCRETE	CMOS NMOS BICMOS	2.00	5	7,800	148,336	17,000	10	U.S.	C
DELCO	KOKOMO	IN	FAB 1	LOG DISCRETE	BIP	3.00	4	30,000	365,210	43,000	1,000	U.S.	C
DELCO	KOKOMO	IN	FAB 3	ASIC MPU LINEAR	CMOS BIP	1.30	5	10,000	190,175	30,000	10	U.S.	C
DIELECTRIC S/C	SAN JOSE	CA	N/A	ASIC	BIP	5.00	4	4,000	48,695	4,000	1,000	U.S.	M
DIGITAL EQUIPMENT	TEMPE	AZ	TEMPE 3	MPU LOG	CMOS	1.20	5	19,200	365,136	22,000	10	U.S.	C
DIGITAL EQUIPMENT	HUDSON	MA	FAB 3	MPU MPR CBIC CUSTOM	CMOS MOS	1.20	5	6,300	119,810	11,000	100	U.S.	C
DIGITAL EQUIPMENT	HUDSON	MA	PILOT	MPU MCU MPR CBIC CUSTOM	CMOS	1.50	6	1,600	43,810	6,000	0	U.S.	C

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
DIGITAL EQUIPMENT	SAN JOSE	CA	N/A	N/A	N/A	0.80	6	3,200	87,621	10,000	0	U.S.	C
DIGITAL EQUIPMENT	HUDSON	MA	FAB 1	ARRAYS CUSTOM MPU LOG	BIP MOS TTL	2.50	4	4,480	54,538	8,000	10,000	U.S.	C
DIGITAL EQUIPMENT	HUDSON	MA	FAB 2	CUSTOM	CMOS M2	1.20	5	2,700	51,347	6,000	1,000	U.S.	C
DIONICS	WESTBURY	NY	N/A	PWR DIS OPTO HYBRID	BIP	2.00	4	1,600	19,478	4,000	10,000	U.S.	M
ECI S/C	SANTA CLARA	CA	N/A	ARRAYS CBIC CUST LIN DIS	BIP CMOS BICMOS	3.00	4	8,000	97,389	6,500	1,000	U.S.	M
EG&G RETICON	SUNNYVALE	CA	N/A	IMAGE SENSOR A/D D/A	CMOS MOS	2.50	4	3,200	38,956	4,600	15	U.S.	M
EG&G VACTEC	ST. LOUIS	MO	N/A	PDIODE PTRAN	BIP	6.00	4	16,000	113,040	10,000	1,000	U.S.	M
ELANTEC	MILPITAS	CA	N/A	OP AMP	BIP	5.00	3	960	6,782	1,800	100	U.S.	M
ELECTRONIC DECISIONS	URBANA	IL	N/A	MONOLITHIC ICs HYBRID	GaAs	0.70	3	300	2,120	2,400	10	U.S.	M
EXAR	SUNNYVALE	CA	KIFER PLANT	ASIC	BIP	3.00	4	14,500	176,518	15,000	100	U.S./JAPAN	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines (Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
EXEL	SAN JOSE	CA		64K EEPROM PLD SRAM	CMOS BIP	1.30	5	10,000	190,175	19,000	2	U.S.	M
FEI MICROWAVE	SUNNYVALE	CA	1	DIODE OPTO RAD-HARD	GaAs	1.00	2	200	628	3,000	100	U.S.	M
FOXBORO ICT	SAN JOSE	CA	N/A	DIS PRESSURE SENSORS	BIP	3.00	3	24,000	169,560	10,000	1,000	U.S.	C
FREQUENCY SOURCES	CHELMSFORD	MA	N/A	DIODE MMIC	BIP	0.00	3	15,000	105,975	0	0	U.S.	M
FUJITSU	GRESHAM	OR	N/A	1Mb DRAM	CMOS	1.20	6	13,000	355,959	17,500	0	JAPAN	M
GAIN ELECT.	SOMERVILLE	NJ	N/A	LOG 4K SRAM ARRAYS CUSTOM	GaAs	1.00	3	800	5,652	7,000	10	U.S.	M
GE	UTICA	NY	N/A	LIN	GaAs	0.00	3	300	2,120	10,000	0	U.S.	C
GE ELECT. LAB	SYRACUSE	NY	MATERIA L	N/A	N/A	0.00	4	2,000	24,347	2,700	0	U.S.	C
GE ELECT. LAB	SYRACUSE	NY	MMIC FAB	MMIC	GaAs	0.50	3	100	707	5,000	10	U.S.	C
GENERAL DYNAMICS	FORT WORTH	TX	N/A	N/A	MOS	0.00	4	7,000	85,216	0	0	U.S.	C

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
GENERAL S/C	TEMPE	AZ	N/A	DIODE	BIP	25.00	3	19,200	135,648	15,000	100	U.S.	M
GENESIS MICROCHIP	MARKHAM, ONTARIO	CN	N/A	PLD ARRAYS CBIC CUSTOM	CMOS M2	1.00	6	8,000	219,052	12,000	10	CANADA/U.S.	M
GENNUM CORP.	BURLINGTON,ONTA RIO	CN	N/A	OP AMP INTERFACE	BIP	6.00	3	2,000	14,130	1,750	100	CANADA	M
GERMANIUM POWER DEVICES	ANDOVER	MA	N/A	OPTO DIS	N/A	0.00	3	10,000	70,650	0	0	U.S.	M
GI	HICKSVILLE	NY	N/A	PWR SCR	BIP	0.00	4	4,800	58,434	0	0	U.S.	M
GI QUALITY TECH. CORP.	PALO ALTO	CA	N/A	OPTO	GaAs	5.00	2	0	0	6,000	10,000	U.S.	M
GI QUALITY TECH. CORP.	PALO ALTO	CA	N/A	OPTO COUPLERS	MOS	0.00	2	4,800	15,072	6,000	10,000	U.S.	M
GIGABIT LOGIC	NEWBURY PARK	CA	N/A	CBIC 4K SRAM ROM CUSTOM	GaAs	1.50	4	2,000	24,347	5,000	10	U.S.	M
GOULD	POCATELLO	ID	N/A	ARRAYS CBIC EEPROM LIN	CMOS BICMOS M2	1.50	5	14,400	273,852	20,000	10	JAPAN	M
HANSCORN AFB	LEXINGTON	MA	N/A	CUSTOM MIL	BIP CMOS	0.00	4	8,000	97,389	0	0	U.S.	C

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
				STD	MOS								
HARRIS CORP.	MELBOURNE	FL	VHSIC	64K SRAM 256K SRAM	CMOS	0.80	4	5,000	60,868	0	0	U.S.	C
HARRIS MICROWAVE	MILPITAS	CA	MILPITAS	MOSFET CBIC LIN LOG	GaAs	0.50	3	0	0	7,500	100	U.S.	M
HARRIS S/C	MOUNTAINTOP	PA	N/A	ASIC PWR ICs AUTOMOTIVE	BICMOS CMOS	0.00	6	8,500	232,742	0	0	U.S.	M
HARRIS S/C	MELBOURNE	FL	N/A	N/A	N/A	0.00	6	20,000	547,629	0	0	U.S.	M
HARRIS S/C	MOUNTAINTOP	PA	BIP/DISC	PWR TRAN OPTO DIS	BIP	3.00	4	30,000	365,210	36,000	100	U.S.	M
HARRIS S/C	MOUNTAINTOP	PA	PWR CMOS	PWR DIS OP AMP MOSFET	BIMOS CMOS	3.00	5	6,400	121,712	7,000	10	U.S.	M
HARRIS S/C	FINDLAY	OH	FAB 3&4	DSP LOG LIN MEM MIL STD	BIMOS CMOS MOS	1.50	4	28,900	351,819	31,000	100	U.S.	M
HARRIS S/C	MELBOURNE	FL	FAB C	286 MPU CBIC SRAM PROM	CMOS	2.00	4	11,250	136,954	12,000	100	U.S.	M
HARRIS S/C	MELBOURNE	FL	FAB A	SRAM PROM LIN ALL ASIC	BIP CMOS BICMOS	3.00	4	7,225	87,955	6,000	100	U.S.	M

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Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
HARRIS S/C	FINDLAY	OH	FAB 5	DSP MPR ASIC MIL STD	CMOS N-WELL M2	1.20	5	17,000	323,297	12,000	10	U.S.	M
HARRIS S/C	FINDLAY	OH	FAB 1&2	16K SRAM LOG	CMOS SOS	3.00	4	27,200	331,123	22,000	1,000	U.S.	M
HARRIS S/C	MELBOURNE	FL	FAB D	LIN OP AMP REG TELECOM	BIP MOS BICMOS	5.00	4	4,500	54,781	8,000	100	U.S.	M
HARRIS S/C	MELBOURNE	FL	FAB D	LIN OP AMP REG TELECOM	BIP MOS BICMOS	5.00	3	4,000	28,260	7,750	100	U.S.	M
HARRIS S/C	MELBOURNE	FL	FAB B	64K SRAM MPU CBIC MPR DSP	CMOS	1.50	5	2,500	47,544	10,800	10	U.S.	M
HARRIS S/C	SANTA CLARA	CA	SCOTT 1	DSP MIL STD	CMOS	1.50	4	1,600	19,478	4,000	1,000	U.S.	M
HARRIS S/C	RESEARCH TRIANGLE	NC	N/A	ARRAYS CBIC CUSTOM	CMOS P-WELL SOS	1.25	4	6,400	77,911	20,000	10	U.S.	C
HITACHI	IRVING	TX	PHASE 1	MPU,MCU, 256K SRAM, 1Mb SRAM, 1Mb DRAM	CMOS	0.80	6	16,000	438,103	25,000	10	JAPAN	M
HOLT	IRVINE	CA	N/A	OP AMP EEPROM LOG ASIC	CMOS MOS	3.00	4	10,000	121,737	0	0	U.S.	M
HONEYWELL MICROSWITCH	FREEPORT	IL	N/A	DIS	BIP	3.00	4	16,000	194,779	10,000	0	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
HONEYWELL MICROSWITCH	RICHARDSON	TX	N/A	ANALOG OPTO GaAs	BIP GaAs	3.00	4	4,000	48,695	7,000	10	U.S.	M
HONEYWELL OPTO DIV.	RICHARDSON	TX	OPTO	OPTO PRESSURE SENSORS	BIP GaAs	5.00	3	4,000	28,260	7,000	10	U.S.	M
HONEYWELL SOLID STATE	PLYMOUTH	MN	VHSIC	MIL STD CUSTOM	BIP CMOS	1.25	4	5,000	60,868	10,000	0	U.S.	C
HP	CORVALLIS	OR	4-INCH	CBIC	CMOS MOS	1.20	4	16,000	194,779	19,000	10	U.S.	M
HP	SANTA ROSA	CA	N/A	DISC ASIC	GaAs	0.00	2	0	0	3,000	1,000	U.S.	C
HP	PALO ALTO	CA	HSDL	ASIC OPTO	GaAs	0.00	2	0	0	0	0	U.S.	M
HP	CORVALLIS	OR	N/A	ASIC MPR DSP	N/A	0.00	6	15,000	410,722	20,000	0	U.S.	
HP	SANTA CLARA	CA	N/A	LOG ASIC	BIP	1.50	3	1,600	11,304	8,000	100	U.S.	C
HP	FORT COLLINS	CO	N/A	RISC MPU ASIC MIL STD	MOS	0.90	4	1,600	19,478	20,000	100	U.S.	C
HP	SAN JOSE	CA	DIODE	DIODE	BIP	3.00	2	2,400	7,536	12,500	1,000	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines (Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
HP	SANTA ROSA	CA	N/A	DIS COUPLERS	BIP	0.00	2	4,000	12,560	2,500	1,000	U.S.	C
HP	SAN JOSE	CA	BPOL TRN	TRAN	GaAs	0.50	2	200	628	4,500	100	U.S.	M
HP	SAN JOSE	CA	OED	OPTO	GaAs	5.00	3	2,050	14,483	25,000	100	U.S.	M
HP	PALO ALTO	CA	D. CREEK	ASIC SRAM	CMOS	0.50	3	800	5,652	8,000	100	U.S.	C
HUGHES	NEWPORT BEACH	CA	FAB 3	ASIC	CMOS	2.00	4	2,240	27,269	5,000	100	U.S.	M
HUGHES	NEWPORT BEACH	CA	FAB 2	ASIC LIN	CMOS	3.00	4	4,000	48,695	3,000	10	U.S.	M
HUGHES	CARLSBAD	CA	HTC	MIL STD OPTO ASIC LIN	BICMOS CMOS MOS	1.50	4	8,800	107,128	6,000	10	U.S.	C
HUGHES	TORRANCE	CA	N/A	DIS	GaAs	0.00	2	500	1,570	2,250	100	U.S.	C
HUGHES	TORRANCE	CA	N/A	MMIC	GaAs	0.50	3	500	3,533	12,000	100	U.S.	C
HUGHES	TORRANCE	CA	GaAs	MONOLITHIC ICs	GaAs	0.10	2	45	141	3,000	100	U.S.	C

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Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
IBM	ESSEX JUNCTION	VT	BLDG 963	ARRAYS	CMOS	1.00	5	36,000	684,629	60,000	1	U.S.	C
IBM	EAST FISHKILL	NY	N/A	DSP MPU MPR MCU	BIP	2.00	4	32,000	389,557	45,000	10	U.S.	C
IBM	MANASSAS	VA	VHSIC	1Mb DRAM 4Mb DRAM MPU MIL	MOS	0.50	5	12,000	228,210	25,000	10	U.S.	C
IBM	ESSEX JUNCTION	VT	BLDG 963	1Mb DRAM	CMOS	1.00	8	16,000	777,927	35,000	10	U.S.	C
IBM	ESSEX JUNCTION	VT	BLDG 970	1Mb SRAM ARRAYS	MOS	1.20	5	24,000	456,419	30,000	10	U.S.	C
IBM	ESSEX JUNCTION	VT	BLDG 973	1Mb DRAM	CMOS	1.00	8	20,000	972,409	40,000	10	U.S.	C
IBM	HOPEWELL JUNCTION	NY	BLDG 323	ARRAYS LOG	BIP	1.50	5	32,000	608,559	50,000	10	U.S.	C
IBM	HOPEWELL JUNCTION	NY	BLDG 323	CPU CUSTOM	BIP	1.50	5	32,000	608,559	50,000	10	U.S.	C
IBM	HOPEWELL JUNCTION	NY	BLDG 323	ARRAYS LOG	BIP	1.50	5	32,000	608,559	50,000	0	U.S.	C
IBM	ESSEX JUNCTION	VT	BLDG 963	4Mb DRAM	CMOS M2	0.60	8	16,000	777,927	25,000	1	U.S.	C
IBM	ESSEX JUNCTION	VT	BLDG 973	4Mb DRAM 250K	CMOS	0.80	8	20,000	972,409	40,000	1	U.S.	C

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
				ARRAYS									
IBM	ESSEX JUNCTION	VT	BLDG 973	4Mb DRAM 250K ARRAYS	CMOS M2	0.80	8	20,000	972,409	40,000	1	U.S.	C
IBM	ESSEX JUNCTION	VT	BLDG 970	LOG	BIP	0.00	5	24,000	456,419	30,000	0	U.S.	C
IBM	HOPEWELL JUNCTION	NY	ASTC/MEM	MEM PROCESS VERIFICATION	CMOS	0.80	8	10,000	496,205	20,000	1	U.S.	C
IBM	HOPEWELL JUNCTION	NY	ASTC/LOG	LOG PROCESS VERIFICATION	BIP CMOS	0.80	8	10,000	486,205	20,000	1	U.S.	C
IC SENSORS	MILPITAS	CA	N/A	DIS	BIP	3.00	4	17,600	214,256	6,000	0	U.S.	M
IDT	SANTA CLARA	CA	FAB 3	MEM MPU LOG	BICMOS CMOS	0.50	6	18,000	492,866	25,000	0	U.S.	M
IDT	SANTA CLARA	CA	FAB 1	LOG FIFO DSP 16K EEPROM	BICMOS CMOS M2	1.20	4	7,200	87,650	6,000	10	U.S.	M
IDT	SALINAS	CA	FAB 2	FAST 16K 64K 256K SRAM	CMOS	1.00	5	13,500	256,736	14,000	3	U.S.	M
IDT	SANTA CLARA	CA	N/A	N/A	CMOS	0.00	5	800	15,214	8,000	10	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
IMP	SAN JOSE	CA	N/A	CBIC CUSTOM LIN	BICMOS CMOS MOS	1.20	5	14,400	273,852	12,000	10	U.S.	M
INST. FOR TECH. DVLPMNT	KANSAS CITY	MO	N/A	N/A	N/A	0.00	5	5,000	95,087	0	0	U.S.	C
INTEL	ALOHA	OR	FAB 4	HIGH VOL. COMMODITY & LOG	CMOS MOS	2.00	4	31,500	383,470	16,000	100	U.S.	M
INTEL	RIO RANCHO	NM	FAB 9.2	486 MPU EPROM	CMOS	1.00	6	13,600	372,388	25,000	1	U.S.	M
INTEL	CHANDLER	AZ	FAB 6	MCU 286 MPU	CMOS MOS	1.50	6	31,000	848,825	38,000	100	U.S.	M
INTEL	ALOHA	OR	FAB 5	386 486 MPU LOG 64K SRAM	CMOS M2	1.00	6	11,200	306,672	22,000	10	U.S.	M
INTEL	RIO RANCHO	NM	FAB 7	512K EPROM MCU MIL STD	CMOS MOS	1.00	6	31,500	862,516	36,000	10	U.S.	M
INTEL	RIO RANCHO	NM	FAB 9.1	64K SRAM 486 860 MPU MPR	CMOS	1.00	6	13,600	372,388	25,000	10	U.S.	M
INTEL	SANTA CLARA	CA	D2	EPROM NVMEM TECH. DEV.	CMOS	0.80	6	3,000	82,144	16,000	1	U.S.	M
INTEL	SANTA CLARA	CA	PED	N/A	CMOS	1.00	6	3,200	87,621	5,000	10	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
INTL. RECTIFIER	RANCHO CALIFORNIA	CA	HEXFET	PWR ICs MOSFET	CMOS MOS	5.00	5	24,000	456,419	12,800	10	U.S.	M
INTL. RECTIFIER	EL SEGUNDO	CA		PWR ICs MOSFET	CMOS MOS	5.00	4	24,000	292,168	6,000	100	U.S.	M
ITT	SHELTON	CT	N/A	CUSTOM	CMOS MOS	1.50	4	7,200	87,650	14,400	10	EUROPE	C
ITT	ROANOKE	VA	DARPA	LIN DIS MIL STD	GaAs	0.00	3	0	0	4,000	0	EUROPE	C
JOHN FLUKE MFG.	EVERETT	WA	N/A	ASIC	CMOS BICMOS	2.00	4	1,400	17,043	9,500	10	U.S.	C
KODAK	ROCHESTER	NY	N/A	IMAGING ARRAYS CBIC CUST.	BIP CMOS MOS	1.50	4	5,000	60,868	25,000	0	U.S.	C
KULITE	LEONIA	NJ	N/A	DIS	BIP	3.00	4	24,000	292,168	10,000	0	U.S.	M
LAWRENCE LIVERMORE LABS	LIVERMORE	CA	N/A	N/A	N/A	0.25	6	5,000	136,907	0	0	U.S.	C
LINEAR TECHNOLOGY	MILPITAS	CA	FAB 2	LIN	BIP CMOS	2.00	5	6,400	121,712	6,000	10	U.S.	M
LINEAR TECHNOLOGY	MILPITAS	CA	FAB 1	LIN INTERFACE	BIP CMOS BICMOS	5.00	4	6,400	77,911	6,000	100	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
				A/D D/A									
LITTON MICROWAVE	SAN JOSE	CA	N/A	FET AMP	GaAs	0.00	3	0	0	0	0	U.S.	C
LOCKHEED	SUNNYVALE	CA	113	ASIC MIL STD RAD-HARD	CMOS	1.50	5	640	12,171	3,000	1	U.S.	C
LSI LOGIC	MILPITAS	CA	METAL	ARRAY CBIC MCU MPU SRAM	BICMOS CMOS	1.25	6	17,000	465,485	17,000	10	U.S.	M
M/A-COM	BURLINGTON	MA	N/A	MMIC DIODE TRAN	GaAs MOS	0.30	3	4,000	28,260	22,000	10	U.S.	M
M/A-COM	LOWELL	MA	ADV. S/C	MMIC	GaAs	0.25	3	800	5,652	15,000	10	U.S.	M
M/A-COM PHI, INC.	TORRANCE	CA	N/A	PWR TRAN	BIP	0.00	4	10,000	121,737	0	0	U.S.	M
MAGNOVOX	FORT WAYNE	IN	N/A	ARRAYS CBIC HYBRID	CMOS	5.00	3	400	2,826	2,000	100	U.S.	C
MARTIN MARIETTA	ORLANDO	FL	N/A	LIN	GaAs	0.00	3	0	0	0	0	U.S.	C
MARTIN MARIETTA	ORLANDO	FL	VLSI PLT	AEROSPACE CBIC ARRAYS	CMOS	1.25	5	800	15,214	7,000	10	U.S.	C

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
MATSUSHITA	PUYALLUP	WA	BIPOLAR 2	1Mb SRAM ARRAYS PLD	BICMOS BIP ECL	0.80	6	12,000	328,577	40,000	5	JPN	M
MATSUSHITA	PUYALLUP	WA	BIPOLAR 1	ARRAYS	BIP	2.50	4	8,000	97,389	20,000	10	JPN	M
MATSUSHITA	PUYALLUP	WA	N/A	64K 256K FAST SRAM	BICMOS M2 ECL	1.00	5	4,000	76,070	40,000	10	JPN	M
MAXIM INTEGRATED PROD.	SUNNYVALE	CA	N/A	OP AMPS A/D D/A	BIP CMOS	2.00	0	0	0	0	0	U.S.	M
MAXIM INTEGRATED PROD.	SUNNYVALE	CA	N/A	OP AMPS A/D D/A	CMOS	3.00	4	4,000	48,695	13,500	10	U.S.	M
MCDONNELL DOUGLAS	HUNTINGTON BEACH	CA	3''PILOT	4K 16K SRAM 6K ARRAY MPU	GaAs	1.00	3	400	2,826	6,000	100	U.S.	C
MCDONNELL DOUGLAS	HUNTINGTON BEACH	CA	DVLPMNT	MPU LOG ASIC DIS	GaAs	1.00	3	0	0	4,000	100	U.S.	C
MICREL	SUNNYVALE	CA	N/A	MPU LOG ARRAYS PWR ICs	CMOS MOS	3.00	4	9,600	116,867	19,000	100	U.S.	M
MICRO POWER SYSTEMS	SANTA CLARA	CA	N/A	LIN CUSTOM	BICMOS CMOS BIP	4.00	3	15,000	105,975	0	0	U.S./JAPAN	M
MICRO-CIRCUIT ENG	WEST PALM BEACH	FL	N/A	CUSTOM	MOS	4.00	4	12,000	146,084	30,000	0	U.S.	M
MICRO-REL	TEMPE	AZ	N/A	ASIC	BIP CMOS	3.00	4	3,600	43,825	10,000	20	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
				HI-REL									
MICROCHIP TECHNOLOGY	CHANDLER	AZ	FAB E	16-bit MPU EEPROM DSP ROM	CMOS MOS	2.50	4	24,000	292,168	35,000	100	U.S.	M
MICROCHIP TECHNOLOGY	CHANDLER	AZ	FAB C	MPU 512K PROM 256K EEPROM	CMOS MOS	1.20	5	10,000	190,175	15,000	100	U.S.	M
MICROCHIP TECHNOLOGY	CHANDLER	AZ	FAB B	EEPROM 8-bit MPU	MOS	5.00	3	16,000	113,040	0	1,000	U.S.	M
MICRON TECHNOLOGY	BOISE	ID	FAB 2	1Mb DRAM 256K SRAM VRAM	CMOS	1.00	6	14,400	394,293	35,000	1	U.S.	M
MICRON TECHNOLOGY	BOISE	ID	FAB 1	256K 1Mb DRAM 256K SRAM	CMOS MOS	1.20	5	32,400	616,166	36,000	10	U.S.	M
MICRON TECHNOLOGY	BOISE	ID	FAB 3	1Mb DRAM	CMOS	0.80	6	20,000	547,629	0	1	U.S.	M
MICROPAC INDUSTRIES	GARLAND	TX	N/A	MIL STD OPTO HYBRID	N/A	0.00	4	3,000	36,521	3,000	0	U.S.	M
MICROSEMI CORP.	BROOMFIELD	CO	N/A	SCHOTTKY DIODE RECTIFER	MOS	5.00	4	8,800	107,128	2,400	2,000	U.S.	M
MICROWAVE ASSOC.	BURLINGTON	MA	N/A	N/A	N/A	0.00	4	10,000	121,737	0	0	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
MICROWAVE MONOLITHICS	SIMI VALLEY	CA	R&D	CUSTOM MMIC	GaAs	0.50	3	0	0	1,500	100	U.S.	M
MICROWAVE TECH.	FREMONT	CA	N/A	MMIC AMP FET	GaAs	0.50	2	0	0	7,000	1,000	U.S.	M
MITEL S/C	BROMONT, QUEBEC	CN	FAB 1	TELECOM A/D D/A	CMOS	1.20	4	6,400	77,911	10,000	100	U.K./CANADA	M
MITSUBISHI	DURHAM	NC	N/A	1Mb DRAM ARRAYS MCU	CMOS	1.00	6	8,500	232,742	11,000	0	JAPAN	M
MOTOROLA	AUSTIN	TX	MOS-2	ARRAYS CBIC CUSTOM LOG	CMOS	2.00	5	21,600	410,777	22,000	100	U.S.	M
MOTOROLA	PHOENIX	AZ	TMOS	MOSFET SMART PWR	BIP	3.00	6	21,250	581,656	15,000	100	U.S.	M
MOTOROLA	CHANDLER	AZ	BP-6	ECL 50K ARRAYS	BIP BICMOS	1.00	6	20,000	547,629	25,000	0	U.S.	M
MOTOROLA	MESA	AZ	BP-2	FAST PROM LOG STTL	BIP ECL TTL	2.50	4	25,500	310,428	30,500	100	U.S.	M
MOTOROLA	MESA	AZ	BP-3	ARRAYS FAST PROM STTL	BIP BICMOS M3	1.25	4	25,500	310,428	24,600	10	U.S.	M
MOTOROLA	MESA	AZ	MOS-5	MCU 68040 MPU CUSTOM LIN	CMOS MOS	1.00	5	16,875	320,920	23,700	100	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines (Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
MOTOROLA	AUSTIN	TX	APRDL	MPU ASIC MEM	CMOS MOS	1.00	5	36,550	695,089	26,600	10	U.S.	M
MOTOROLA	PHOENIX	AZ	STD RECT	LOW-COST RECTIFIER	MOS	0.00	4	6,400	77,911	12,000	10,000	U.S.	M
MOTOROLA	PHOENIX	AZ	RF POWER	PWR SST MOSFET	BIP	1.25	4	21,250	258,690	13,000	100	U.S.	M
MOTOROLA	PHOENIX	AZ	THYRIST	SST THYRISTOR PWR	BIP	10.00	4	15,200	185,040	11,000	100	U.S.	M
MOTOROLA	AUSTIN	TX	MOS-8	68040 MPU SRAM DSP LIN	CMOS M2	1.20	5	13,050	248,178	26,600	10	U.S.	M
MOTOROLA	MESA	AZ	MOS-6	1Mb DRAM 256K SRAM	CMOS M2	1.00	6	33,600	920,017	23,000	100	U.S.	M
MOTOROLA	OAK HILL	TX	MOS-11	4Mb DRAM MCU MPU RISC	CMOS	0.80	8	17,000	826,548	35,000	0	U.S.	M
MOTOROLA	PHOENIX	AZ	BIP PWR	PWR TRAN	BIP	10.00	5	20,000	380,350	22,000	100	U.S.	M
MOTOROLA	PHOENIX	AZ	SST&SEN	SST SENSORS	BIP	5.00	4	20,000	243,473	30,000	100	U.S.	M
MOTOROLA	PHOENIX	AZ	ZEN/REC T	ZENER DIODE RECTIFIER	BIP	10.00	4	25,000	304,341	25,000	100	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
MOTOROLA	AUSTIN	TX	MOS 11	SRAM, MPU, MCU	CMOS	0.00	8	0	0	0	0	U.S.	C
MOTOROLA	MESA	AZ	BP-1	TELECOM OP AMP AUTOMOTIVE	BIP BICMOS	3.00	4	31,350	381,644	33,700	100	U.S.	M
MOTOROLA	AUSTIN	TX	MOS-3	MCU EPROM ROM CUSTOM	CMOS MOS	2.00	4	26,100	317,732	14,900	100	U.S.	M
MOTOROLA	MESA	AZ	BTC	VHSIC ASIC SRAM MPR	BIP BICMOS	0.50	4	16,640	202,570	25,000	10	U.S.	M
MOTOROLA	TEMPE	AZ	MICARL	CUSTOM INTERNAL & MIL STD	BIP CMOS	1.25	4	20,000	243,473	20,000	10	U.S.	C
MOTOROLA	PHOENIX	AZ	OPTO	MMIC MESFET MODFET LED	GaAs	0.70	3	400	2,826	4,000	100	U.S.	M
MOTOROLA	LAWNDALE	CA	RF POWER	RF MMIC PWR TRAN	BIP	1.25	3	5,000	35,325	0	100	U.S.	M
MOTOROLA	SCHAUMBERG	IL	N/A	SMARTPOWER	BIP	5.00	4	10,000	121,737	10,000	100	U.S.	M
N-CHIP	SAN JOSE	CA	N/A	TRAN	CMOS MOS	3.00	5	1,000	19,017	6,000	100	U.S.	M
NATIONAL S/C	SOUTH PORTLAND	ME	PORTLAND	LOG PLD	BIP TTL ECL	3.00	4	31,200	379,818	25,000	10	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
NATIONAL S/C	ARLINGTON	TX	CMOS 1	ARRAYS MPR MPU ADV LOG	CMOS	1.50	6	18,000	492,866	25,000	10	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	ALICCLI C	ADV & COMMERCIAL LIN	BIP M2	7.00	5	8,000	152,140	17,000	1,000	U.S.	M
NATIONAL S/C	WEST JORDAN	UT	MOS 2	TELECOM MPU	CMOS M2 POLY2	2.00	5	17,920	340,793	30,000	50	U.S.	M
NATIONAL S/C	WEST JORDAN	UT	MOS 1	LOG MPU MCU SRAM	CMOS	1.60	4	12,000	146,084	20,000	100	U.S.	M
NATIONAL S/C	WEST JORDAN	UT	MOS 3	1Mb EPROM MPU SRAM ARRAYS	CMOS	0.80	6	13,000	355,959	30,000	5	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	BIPLOG 4	LOG	BIP	2.00	4	7,200	87,650	7,000	1,000	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	PROLOG 4	PLD	BIP CMOS	2.00	4	13,500	164,344	17,000	0	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	BIPLOG 5	LOG	BIP	2.00	5	7,200	136,926	7,000	1,000	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	PROLOG 5	PLD	BIP CMOS	2.00	5	8,000	152,140	8,000	0	U.S.	M
NATIONAL S/C	ARLINGTON	TX	CMOS 2	N/A	CMOS	1.20	6	18,000	492,866	25,000	10	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
NATIONAL S/C	SANTA CLARA	CA	SLIC	LIN	BIP	7.00	5	9,000	171,157	9,000	0	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	VHSIC	VHSIC 10K ARRAYS	MOS	1.00	4	1,200	14,608	4,000	10	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	E2 PROM	EEPROM	CMOS	2.00	5	4,000	76,070	5,000	100	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	ABL	ARRAYS MEM DEVELOP	BIP	1.20	5	4,000	76,070	5,000	100	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	CLD 5''	LIN ARRAYS	BIP	1.00	5	4,500	85,579	7,000	100	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	BLDG E	ASIC FERRAM	CMOS	0.80	6	2,000	54,763	10,000	10	U.S.	M
NATIONAL S/C	SOUTH PORTLAND	ME	CMOS	LOG ARRAYS	CMOS M2 P-WELL	1.50	5	3,325	63,233	5,000	10	U.S.	M
NATIONAL S/C	SANTA CLARA	CA	BLDG E	CUSTOM LOGIC	CMOS	0.00	6	4,000	109,526	10,000	0	U.S.	M
NATL. SECURITY ADMIN.	FORT MEADE	MD	N/A	CUSTOM MIL STD	BIP CMOS MOS	1.00	6	10,000	273,815	0	10	U.S.	C
NATL. SECURITY ADMIN.	FORT MEADE	MD	N/A	MIL STD	N/A	0.80	6	5,000	136,907	0	0	U.S.	C

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Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
NAVAL OCEAN SYS. CTR.	SAN DIEGO	CA	N/A	N/A	N/A	0.00	4	5,000	60,868	0	0	U.S.	C
NCR	COLORADO SPRINGS	CO	FAB 2	CBIC MPU LOG MEM	CMOS	0.95	5	6,400	121,712	11,000	10	U.S.	M
NCR	FORT COLLINS	CO	FT COLL.	MPU LOG ASIC	CMOS MOS	1.50	4	10,240	124,658	15,000	1,000	U.S.	M
NCR	COLORADO SPRINGS	CO	FAB 1	ASIC	CMOS	2.00	4	8,000	97,389	9,600	10	U.S.	M
NEC	ROSEVILLE	CA	K-LINE	256K SRAM 256K DRAM ASIC MCU	NMOS CMOS	1.00	5	27,900	530,588	40,000	100	JAPAN	M
NEC	ROSEVILLE	CA	M-LINE	4Mb DRAM 16Mb DRAM	CMOS	0.60	8	30,000	1,458,614	150,000	1	JAPAN	M
NORTHERN TELECOM	RANCHO BERNARDO	CA	N/A	LOG	CMOS	3.00	4	14,500	176,518	10,000	100	CANADA	C
NORTHERN TELECOM	OTTAWA, ONTARIO	CN	N/A	LIN TELECOM	MOS	0.00	6	10,000	273,815	0	0	CANADA	C
NORTHERN TELECOM	OTTAWA, ONTARIO	CN	N/A	LIN TELECOM	MOS	1.25	6	12,500	342,268	0	0	CANADA	C
NORTHRUP	PALOS VERDES	CA	N/A	INFRARED	MOS HgCdTe	0.00	3	0	0	0	0	U.S.	C

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Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
NOVA SENSORS	FREMONT	CA	N/A	SI BASED PRESSURE SENSORS	BIP	3.00	4	24,000	292,168	0	0	U.S.	M
OKI	TUALATIN	OR	N/A	ARRAYS 256K SRAM 4Mb DRAM	CMOS	1.00	6	5,000	136,907	6,000	0	JAPAN	M
OPTEK	CARROLLTON	TX	FAB 1	MIL STD PWR ICs	MOS	0.00	4	15,000	182,605	0	0	U.S.	M
OPTEK	CARROLLTON	TX	FAB 2	MIL STD PWR ICs	MOS	0.00	5	15,000	285,262	0	0	U.S.	M
OPTO DIODE	NEWBURY PARK	CA	N/A	OPTO DIODE	GaAs	0.00	0	0	0	0	0	U.S.	M
ORBIT S/C	SUNNYVALE	CA	N/A	LOGIC ARRAYS	CMOS MOS	1.30	4	8,000	97,389	8,000	10	U.S.	M
PARADIGM TECH.	SAN JOSE	CA	N/A	256K SRAM	CMOS	1.00	5	1,280	24,342	6,000	0	U.S.	M
PARADIGM TECH.	SAN JOSE	CA	N/A	256K 1Mb SRAM	CMOS M2 POLY 2	1.00	5	2,500	47,544	4,000	0	U.S.	M
PERFORMANCE S/C	SUNNYVALE	CA	FAB 1	SRAM ARRAYS MIPS RISC MPU	CMOS	1.00	6	5,600	153,336	3,000	10	U.S.	M
PERFORMANCE S/C	SUNNYVALE	CA	FAB 2	SRAM MPU ASIC	BICMOS CMOS	0.80	6	7,000	191,670	0	0	U.S.	

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Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
POLYCORE ELECT.	NEWBURY PARK	CA	N/A	DIS PWR LIN MIL STD	BIP CMOS MOS	7.00	4	1,200	14,608	3,000	0	SINGAPORE	M
POWER TECH. COMPONENTS	TORRANCE	CA	N/A	MIL STD DIS	BIP	12.00	3	4,800	33,912	4,200	1,000	U.S.	M
POWEREX	AUBURN	NY	N/A	DIS SCR DIODE THYRISTOR	BIP	10.00	3	24,000	169,560	35,000	1,000	U.S./JAPAN	M
POWEREX	AUBURN	NY	N/A	DIS SCR DIODE THYRISTOR	BIP	10.00	3	24,000	169,560	25,000	10	U.S./JAPAN	M
POWEREX	YOUNGWOOD	PA	POW BIPO	DIODE PWR TRAN THYRISTOR	BIP	0.00	3	10,000	70,650	0	0	U.S./JAPAN	M
PRECISION MONO.	SANTA CLARA	CA	FAB 2	CUSTOM	BIP	2.50	4	3,200	38,956	3,500	100	U.S.	M
PRECISION MONO.	SANTA CLARA	CA	FAB 1	ASIC	CMOS	3.00	4	1,600	19,478	4,000	100	U.S.	M
RAMTRON	COLORADO SPRINGS	CO	N/A	256K FRAM 4Mb DRAM DEV.	CMOS N2	1.00	6	2,700	73,930	11,500	1	U.S.	M
RAYTHEON	MOUNTAIN VIEW	CA	LSI ARAY	20K ARRAYS	BIP CMOS	1.00	4	10,000	121,737	0	0	U.S.	M
RAYTHEON	MOUNTAIN VIEW	CA	LINEAR	LIN ASIC	BIP	5.00	4	6,400	77,911	7,000	1,000	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
RAYTHEON	WALTHAM	MA	N/A	MMIC	GaAs	0.00	3	400	2,826	11,000	0	U.S.	C
RAYTHEON	MOUNTAIN VIEW	CA	DIS TRAN	DIS TRAN SST	BIP	5.00	4	2,400	29,217	6,000	100	U.S.	M
RAYTHEON MICROELECT.	ANDOVER	MA	GaAs	N/A	GaAs	0.50	3	800	5,652	0	10	U.S.	M
RAYTHEON MICROELECT.	ANDOVER	MA	N/A	ASIC	CMOS	1.25	5	3,500	66,561	15,000	10	U.S.	C
RAYTHEON SMDO	NORTHBOROUGH	MA	N/A	MMIC PWR MESFET	GaAs	0.50	3	250	1,766	5,000	1,000	U.S.	C
ROCKWELL	NEWPORT BEACH	CA	FAB 1	MODEM TELECOM	CMOS MOS	2.00	4	20,400	248,343	14,000	100	U.S.	M
ROCKWELL	NEWPORT BEACH	CA	FAB 4	TELECOM INTERFACE	CMOS MOS	2.00	4	20,000	243,473	24,000	10	U.S.	M
ROCKWELL	NEWBURY PARK	CA	DARPA	MEM ASIC CBIC	GaAs SOS	1.00	3	3,000	21,195	4,500	10	U.S.	C
ROCKWELL	NEWPORT BEACH	CA	SOS	N/A	SOS	1.00	5	0	0	0	0	U.S.	
ROHM	SUNNYVALE	CA	PILOT	LIN ARRAYS	BIP	0.00	4	17,000	206,952	14,000	10	JAPAN	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
SAMSUNG S/C	SAN JOSE	CA	N/A	DRAM EEPROM SRAM MPU PLD	CMOS	1.00	5	8,000	152,140	15,000	1	KOREA	M
SANDERS ASSOCIATES	NASHUA	NH	GaAs	LIN MMIC	GaAs	0.50	3	400	2,826	7,000	10	U.S.	C
SANDIA NATIONAL LABS	ALBUQUERQUE	NM	RMIC-I	MPU LOG SRAM ASIC	CMOS	1.50	4	1,200	14,608	6,000	100	U.S.	C
SANTA BARBARA RSCH.	GOLETA	CA	SBRC	MIL STD INFRARED DETECTOR	HgCdTe InSb	0.00	4	1,000	12,174	200	10	U.S.	C
SEMICOA	COSTA MESA	CA	N/A	CUSTOM HI-REL PWR PHOTO	BIP	7.00	3	12,000	84,780	10,000	0	U.S.	M
SEMTECH	NEWBURY PARK	CA	N/A	RECTIFIER ZENER DIODE	BIP	0.00	2	9,600	30,144	5,000	10,000	U.S.	M
SEMTECH	CORPUS CHRISTI	TX		ANALOG	BIPOLAR	3.00	4	0	0	13,000	10	U.S.	M
SENSOR SOLID STATE	QUAKERTOWN	PA	N/A	CUSTOM DIS SENSORS	MOS	4.00	3	480	3,391	2,000	1,000	U.S.	M
SENSYM	SUNNYVALE	CA	N/A	Si CUSTOM LIN SENSORS	BIP CMOS	3.00	4	2,000	24,347	1,500	100	U.S.	C

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
SGS-THOMSON	CARROLLTON	TX	FAB 4	ARRAYS CBIC SRAM MCU MPR	CMOS MOS M2	2.00	4	22,400	272,690	20,000	100	ITALY	M
SGS-THOMSON	CARROLLTON	TX	FAB 6	1Mb SRAM ARRAYS 256K DRAM	CMOS M2	0.70	6	14,400	394,293	20,000	10	ITALY	M
SGS-THOMSON	PHILADELPHIA	PA	N/A	DIS RF	MOS	0.00	4	5,000	60,868	0	0	ITALY	M
SHARP MICROELECT.	VANCOUVER	WA	R&D CTR.	256K 1Mb SRAM ROM FIFO	N/A	0.80	6	8,500	232,742	20,000	0	JAPAN	C
SI-FAB	SCOTTS VALLEY	CA	N/A	16K RAM MIL STD SUNSET	CMOS MOS	2.00	6	6,300	172,503	10,000	100	U.S.	M
SIEMENS	CUPERTINO	CA	N/A	LED COUPLERS OPTO	GaAs MOS	0.00	0	0	0	0	0	GERMANY	M
SIERRA S/C	SANTA CLARA	CA	N/A	CBIC CUSTOM LIN	CMOS	1.50	5	1,600	30,428	3,000	10	U.S.	M
SIGNETICS	OREM	UT	FAB 9	N/A	BIP TTL ECL	4.00	4	27,000	328,689	22,000	1,000	NETHERLANDS	M
SIGNETICS	ALBUQUERQUE	NM	FAB 22	EPROM MPU MCU CBIC PLD	CMOS	1.50	4	20,900	254,429	10,000	10	NETHERLANDS	M
SIGNETICS	SUNNYVALE	CA	FAB 15	MPU LOG	CMOS	1.50	4	9,600	116,867	12,500	100	NETHERLANDS	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
SIGNETICS	SUNNYVALE	CA	FAB 1	LIN SMART PWR	BIP	4.00	4	14,000	170,431	14,000	30	NETHERLANDS	M
SIGNETICS	OREM	UT	FAB 21	PROM PLD ARRAYS CUSTOM	BIP	2.00	4	24,000	292,168	25,000	100	NETHERLANDS	M
SIGNETICS	ALBUQUERQUE	NM	FAB 23	256K 1Mb EPROM 8-bit MCU	CMOS BICMOS	1.25	6	14,000	383,340	10,000	10	NETHERLANDS	M
SIGNETICS	OREM	UT	FAB 18	N/A	BIP	1.00	6	12,000	328,577	20,000	0	NETHERLANDS	M
SIGNETICS	ALBUQUERQUE	NM	FAB 24	N/A	N/A	1.00	6	8,000	219,052	15,000	0	NETHERLANDS	M
SILICON GENERAL	GARDEN GROVE	CA	N/A	LIN ASIC	BIP BICMOS	4.00	4	6,800	82,761	9,000	100	U.S.	M
SILICON SYSTEMS (TDK)	SANTA CRUZ	CA	IIA	ASIC TELECOM	BIP CMOS	2.00	4	8,000	97,389	14,000	100	JAPAN	M
SILICON SYSTEMS (TDK)	TUSTIN	CA	FAB 1	MPR CBIC DIS TELECOM	BIP CMOS	2.00	4	9,600	116,867	22,000	10	JAPAN	M
SILICON TRANSISTOR	CHELMSFORD	MA	N/A	MIL STD DIS PWR	BIP	10.00	4	4,000	48,695	2,000	10,000	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
SILICONIX	SANTA CLARA	CA	FAB 2	SMART PWR A/D D/A	CMOS	3.00	4	8,000	97,389	13,000	100	U.S.	M
SILICONIX	SANTA CLARA	CA	FAB 3	PWR DIS SMART PWR	CMOS	1.50	6	4,000	109,526	10,400	1	U.S.	M
SIMTEK	COLORADO SPRINGS	CO	N/A	ADV. MEM EEPROM	CMOS	1.00	6	800	21,905	2,000	0	U.S.	M
SOLID POWER CO.	FARMINGDALE	NY	N/A	PWR TRAN	BIP	20.00	2	24,000	75,360	15,000	0	U.S.	M
SOLID STATE DEVICES	LA MIRADA	CA	N/A	HI-REL CUSTOM	BIP	0.00	4	4,000	48,695	10,000	0	U.S.	M
SOLITRON	RIVIERA BEACH	FL	N/A	PWR FET HYBRID	BIP	0.00	4	10,000	121,737	0	0	U.S.	M
SONY	SAN ANTONIO	TX	FAB 11	PLD PROM	BIP CMOS	1.50	5	16,000	304,280	14,000	10	JAPAN	M
SPECTRA DIODE LABS	SAN JOSE	CA	N/A	LASER DIODE	GaAs GaAlAs	0.00	3	0	0	0	0	U.S.	C
SPECTRO LABS (HUGHES)	SYLMAR	CA	N/A	SOLAR CELL ARRAYS	N/A	0.00	4	24,000	292,168	10,000	100	U.S.	M
SPRAGUE TECH.	WORCESTER	MA	N/A	CUSTOM DIS	BICMOS BIP	4.00	4	19,200	233,734	25,000	100	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
SPRAGUE TECH.	WILLOW GROVE	PA	N/A	SRAM ROM PROM	CMOS	2.20	4	12,800	155,823	25,000	100	U.S.	M
STANDARD MICROSYSTEMS	HAUPPAUGE	NY	N/A	CUSTOM CBIC	CMOS MOS	2.00	4	19,200	233,734	30,000	100	U.S.	M
SUPERTEX	SUNNYVALE	CA	N/A	PWR FET A/D D/A CUSTOM	CMOS MOS	5.00	4	2,400	29,217	10,000	0	U.S.	M
SYNERGY S/C	SANTA CLARA	CA	FAB 1	VERY FAST 4K 16K SRAM	BIP ECL	1.50	4	1,920	23,373	5,000	10	U.S.	M
TANDEM	CUPERTINO	CA	MOS 1 LAB	ASIC ARRAYS	BIP CMOS	1.10	4	80	974	2,500	10	U.S.	C
TECCOR ELECT	IRVING	TX	N/A	LOG	BIP	5.00	3	16,000	113,040	15,000	0	U.S.	M
TEKTRONIX	BEAVERTON	OR	BIPOLAR	OP AMP A/D ARRAYS CUSTOM	BIP	1.50	4	4,000	48,695	17,500	10	U.S.	C
TEKTRONIX	BEAVERTON	OR	CCD	CCD A/D D/A	CMOS	1.50	4	3,200	38,956	6,000	10	U.S.	C
TELCOM DEVICES	NEWBURY PARK	CA	N/A	PDIODE LED	GaAs	0.00	1	0	0	2,500	10,000	U.S.	M
TELEDYNE CRYSTALONICS	CAMBRIDGE	MA	N/A	CAP REG DIODE HYBRID	BIP CMOS	3.00	4	2,000	24,347	3,000	100	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines (Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
TELEDYNE MICROELECT.	LOS ANGELES	CA	N/A	HI-REL HYBRID & A/D D/A	BIP	0.00	4	5,000	60,868	0	0	U.S.	M
TELEDYNE MICROWAVE	MOUNTAIN VIEW	CA	GaAs	FET	GaAs	0.50	3	80	565	6,000	10	U.S.	M
TELEDYNE S/C	MOUNTAIN VIEW	CA	N/A	POWER ICs POWER MOSFET	BIP BICMOS CMOS	0.00	4	5,000	60,868	0	0	U.S.	M
TI	LUBBOCK	TX	LMOS	EPROM LOGIC	MOS	1.50	5	25,000	475,437	30,000	100	U.S.	M
TI	SHERMAN	TX	S BIP 1	LOG MPR	BIP TTL	4.00	4	17,000	206,952	20,000	100	U.S.	M
TI	SHERMAN	TX	S BIP 2	ADV SCHOTTKY	BIP	2.00	4	16,000	194,779	20,000	100	U.S.	M
TI	DALLAS	TX	DLOGIC 1	LOG ASIC 9K ARRAY	BIP MOS CMOS	1.00	4	19,000	231,299	30,000	100	U.S.	M
TI	DALLAS	TX	DLIN2	LIN	CMOS	2.00	4	22,500	273,907	25,000	100	U.S.	M
TI	HOUSTON	TX	BIP 4	16K 64K SRAM	BIP BICMOS	1.50	4	17,000	206,952	15,000	100	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
TI	DALLAS	TX	DMOS 4.1	256K 1Mb DRAM SRAM DSP	CMOS	1.00	6	23,750	650,310	30,000	5	U.S.	M
TI	DALLAS	TX	DMOS 4.2	1Mb DRAM 4Mb DRAM 256K SR	CMOS BICMOS	0.80	6	17,000	465,485	20,000	5	U.S.	M
TI	DALLAS	TX	N/A	LIN	BIP CMOS	1.50	6	12,000	328,577	0	0	U.S.	M
TI	DALLAS	TX	CHD	4K ARRAYS 1K SRAM 14K MPU	GaAs M2	0.25	3	120	848	5,000	100	U.S.	M
TI	DALLAS	TX	FPAT	OPTO	N/A	4.00	4	4,000	48,695	5,000	100	U.S.	C
TI	DALLAS	TX	GEFE	VHSIC MPU AI ICs	BIP	1.20	4	6,400	77,911	30,000	10	U.S.	M
TI	DALLAS	TX	IRDL	OPTO	N/A	2.00	4	1,600	19,478	5,000	10	U.S.	M
TI	DALLAS	TX	DMOS 4.2	4Mb DRAM 16Mb RISC MPU	CMOS	0.60	8	7,000	340,343	10,000	0	U.S.	M
TI	DALLAS	TX	MMST	ASIC	CMOS	0.50	6	800	21,905	0	0	U.S.	C
TRIQUINT S/C	BEAVERTON	OR	N/A	MMIC LIN OPTO CBIC ARRAYS	GaAs	0.50	4	2,300	27,999	12,000	50	U.S.	M
TRW	REDONDO BEACH	CA	D1	VHSIC MIL STD FERRAM	CMOS MOS	0.50	4	6,400	77,911	15,000	10	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
TRW	REDONDO BEACH	CA	N/A	RF PWR	GaAs	0.50	3	200	1,413	0	0	U.S.	M
TRW	MANHATTAN BEACH	CA	N/A	LIN TRAN PWR TRAN HYBRD	MOS	0.00	4	5,000	60,868	0	0	U.S.	M
TRW	REDONDO BEACH	CA	D1	LIN TRAN PWR TRAN HYBRD	BIP CMOS	1.50	4	1,600	19,478	13,000	10	U.S.	C
TRW SYSTEMS	LA JOLLA	CA	N/A	A/D D/A MULTIPLIER S	CMOS BIP	0.00	4	5,000	60,868	8,000	0	U.S.	M
UNION CARBIDE	SHELBY	NC	N/A	CAP	BIP	0.00	4	10,000	121,737	0	0	U.S.	M
UNISYS COMPONENTS GROUP	RANCHO BERNARDO	CA	N/A	CBIC ARRAYS CUSTOM	BIP MOS	1.50	4	20,000	243,473	0	100	U.S.	C
UNITED Si STRUCTURES	N/A	N/A	N/A	CBIC ARRAYS CUSTOM	N/A	0.00	0	0	0	0	0	FRANCE	
UNITRODE	WATERTOWN	MA	N/A	HYBRID DIS	BIP	0.00	4	10,000	121,737	0	0	U.S.	M
UNITRODE	MERRIMACK	NH	N/A	LIN SMART PWR CUSTOM	BIP	5.00	4	4,000	48,695	4,000	100	U.S.	M
UNIVERSAL S/C	SAN JOSE	CA	N/A	LIN ARRAYS RAM EPROM	CMOS MOS	1.50	4	850	10,348	3,000	10	U.S.	M

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
UTMC	COLORADO SPRINGS	CO	UTMC	RISC MPU ARRAYS MIL STD	BIP CMOS	1.20	5	3,200	60,856	6,000	10	U.S.	C
VARIAN	SANTA CLARA	CA	N/A	MMIC CCD	GaAs	0.50	3	100	707	7,000	100	U.S.	C
VARO QUALITY S/C	GARLAND	TX	N/A	RECTIFIER MULTIPLIER	BIP	0.00	4	10,000	121,737	47,800	0	U.S.	M
VITESSE ELECT.	CAMARILLO	CA	N/A	4.5K ARRAYS 4K SRAM MPU	GaAs	1.00	3	3,000	21,195	6,000	10	U.S.	M
VLSI TECHNOLOGY	SAN ANTONIO	TX	MODULE A	ARRAYS CBIC SRAM MPU E2	CMOS	1.00	6	6,400	175,241	7,000	1	U.S.	M
VLSI TECHNOLOGY	SAN ANTONIO	TX	MODULE B	ARRAYS CBIC SRAM MPU E2	CMOS M3	0.80	6	6,400	175,241	7,000	1	U.S.	M
VLSI TECHNOLOGY	SAN ANTONIO	TX	MODULE C	ARRAYS CBIC SRAM MPU E2	CMOS M3	0.80	6	6,400	175,241	7,000	1	U.S.	M
VLSI TECHNOLOGY	SAN JOSE	CA	SAN JOSE	PLD ARRAYS CBIC SRAM ROM	CMOS MOS	1.00	5	13,600	258,638	11,000	10	U.S.	M
WATKINS-JOHNSON	PALO ALTO	CA	N/A	MMIC ICs FET DIODE	GaAs	0.25	2	300	942	11,000	10	U.S.	C

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Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
WESTERN DIGITAL	COSTA MESA	CA	DVLPMNT	CUSTOM	CMOS M2	1.25	6	6,400	175,241	12,000	1	U.S.	M
WESTERN DIGITAL	COSTA MESA	CA	PROTO.	ARRAYS CUSTOM	CMOS M2	1.25	4	800	9,739	3,000	10	U.S.	M
WESTINGHOUSE	BALTIMORE	MD	GaAs	MMIC	GaAs	0.00	3	720	5,087	7,000	100	U.S.	C
WESTINGHOUSE	CHURCHILL	PA	R&D CTR.	N/A	GaAs	0.00	0	0	0	0	0	U.S.	C
WESTINGHOUSE	BALTIMORE	MD	VLSI	ASIC OPTO LIN MIL STD	BIP CMOS MOS	1.00	4	8,000	97,389	15,000	10	U.S.	C
WESTINGHOUSE	BALTIMORE	MD	LSI	ASIC OPTO LIN MIL STD	BIP CMOS MOS	3.00	4	8,000	97,389	20,000	100	U.S.	C
XEROX	EL SEGUNDO	CA	N/A	ASIC	CMOS NMOS	2.00	4	4,000	48,695	10,000	0	U.S.	C
XEROX	EL SEGUNDO	CA	N/A	ASIC LIN	CMOS MOS	2.00	4	4,800	58,434	7,500	10	U.S.	C
XICOR	MILPITAS	CA	PHASE 2	1Mb DRAM 4Mb EEPROM	CMOS M2 POLY3	0.80	6	12,000	328,577	25,000	1	U.S.	M
XICOR	MILPITAS	CA	PHASE 1	256K EEPROM 4K NVRAM	CMOS MOS M1 P3	2.00	4	8,000	97,389	20,000	10	U.S.	M
ZENITH MICROCIRC.	ELK GROVE	IL	HVSR	HIGH-VOLT	BIP	20.00	2	16,000	50,240	1,000	10,000	U.S.	C

(Continued)

Table 1 (Continued)
North American Existing Pilot and Production Fab Lines
(Including Fabs Going Into Production During 1991)

Company	City	St.	Fab Name	Products Produced	Process Technology	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (square feet)	Clean Room Class	Origin of Owner	Merchant or Captive
				DIODE TRIODE									
ZILOG	NAMPA	ID	MOD 3	N/A	N/A	1.00	6	8,000	219,052	12,000	0	U.S.	M
ZILOG	NAMPA	ID	MOD 2	Z80,000 MPU MCU CUSTOM	CMOS	1.50	5	10,200	193,978	19,000	10	U.S.	M
ZILOG	NAMPA	ID	MOD 1	Z80 Z8000 16-bit MPU	MOS	1.50	4	17,000	206,952	13,000	100	U.S.	M

Source: Dataquest (March 1991)

Table 2
North American Future Pilot and Production Fab Lines
Planned Facilities Going Into Production by Year

Company	City	St.	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Feet)
Production Begins: 1991												
DIGITAL EQUIPMENT	SAN JOSE	CA	N/A	N/A	N/A	P	/ /	0.80	6	3,200	87,621	10,000
MICRON TECHNOLOGY	BOISE	ID	FAB 3	1Mb DRAM	CMOS	P	02/08/91	0.80	6	20,000	547,629	0
UNITED Si STRUCTURES	N/A	N/A	N/A	CBIC ARRAYS CUSTOM	N/A	P	/ /	0.00	0	0	0	0
Production Begins: 1992												
ACTEL	N/A	N/A	N/A	PROGRAMABLE ARRAYS	CMOS	P	/ /	0.00	0	0	0	0
EXAR	FREMONT	CA	N/A	LIN DSP MPU	CMOS	P	/ /	1.00	6	0	0	0
IDT	SALINAS	CA	FAB 4	SRAM LOG DSP FIFO	CMOS	P	/ /	0.70	6	10,800	295,720	14,000
INTEL	RIO RANCHO	NM	FAB 9.3	586 MPU EPROM	CMOS	P	/ /	0.80	6	24,000	657,155	25,000
MITSUBISHI	DURHAM	NC	N/A	16Mb DRAM	N/A	P	11/02/92	0.60	8	14,000	680,687	0
NATIONAL S/C	ARLINGTON	TX	CMOS 3	N/A	CMOS	P	/ /	0.80	6	14,400	394,293	25,000
SGS-THOMSON	SCOTTSDALE	AZ	N/A	1Mb EPROM	CMOS	P	/ /	1.00	6	12,000	328,577	22,000

(Continued)

Table 2 (Continued)
North American Future Pilot and Production Fab Lines
Planned Facilities Going Into Production by Year

Company	City	St.	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Feet)
SIERRA S/C	SAN JOSE	CA	N/A	N/A	N/A	F	/ /	0.80	6	0	0	0
SILICON SYSTEMS (TDK)	SANTA CRUZ	CA	IIB	MPR ASIC A/D D/A	CMOS	F	04/01/92	1.50	6	18,000	492,866	28,000
SONY	SAN ANTONIO	TX	FAB 12	1Mb SRAM	CMOS BICMOS	F	/ /	0.80	6	12,800	350,483	17,500
TI	DALLAS	TX	DMOS 5.1	16Mb DRAM	CMOS	F	06/01/92	0.80	8	16,000	777,927	25,000
TOSHIBA	PORTLAND	OR	N/A	4Mb DRAM SRAM MPU ASIC	CMOS	F	/ /	0.80	6	17,000	465,485	40,000
VLSI TECHNOLOGY	SAN ANTONIO	TX	MODULE D	ARRAYS CBIC SRAM MPU E2	CMOS M3	F	11/01/92	0.60	6	6,400	175,241	7,000
Production Begins: 1993												
HITACHI	IRVING	TX	PHASE 2	16Mb DRAM 4Mb SRAM CBIC	CMOS BICMOS	F	/ /	0.60	8	0	0	0
HP	CORVALLIS	OR	N/A	ASIC	N/A	F	/ /	0.00	6	0	0	20,000
INTEL	ALOHA	OR	FAB 10	586 MPU	CMOS	F	/ /	0.00	8	21,250	1,033,185	35,000
MICRON TECHNOLOGY	N/A	N/A	FAB 4	4Mb DRAM	CMOS	F	02/01/93	0.80	0	0	0	0
MITEL S/C	BROMONT, QUEBEC	CN	FAB 2	TELECOM A/D	CMOS	F	/ /	1.00	6	9,000	246,433	12,000

(Continued)

Table 2 (Continued)
North American Future Pilot and Production Fab Lines
Planned Facilities Going Into Production by Year

Company	City	St.	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Feet)
				D/A								
TI	DALLAS	TX	MMST	ASIC	CMOS	P	/ /	0.50	6	800	21,905	0
Production Begins: 1994												
AMD	AUSTIN	TX	FAB 25	N/A	N/A	F	/ /	0.80	8	15,000	729,307	0
CYPRESS S/C TEXAS INC.	ROUNDROCK	TX	FAB 4	N/A	CMOS	F	/ /	0.55	6	8,000	219,052	0
INTEL	RIO RANCHO	NM	FAB 9.4	N/A	CMOS	F	/ /	0.70	8	17,000	826,548	25,000
LSI LOGIC	MILPITAS	CA	N/A	ASIC	BICMOS CMOS	F	/ /	0.50	0	0	0	0
MATSUSHITA	FORT WORTH	TX	N/A	N/A	N/A	F	/ /	0.00	0	0	0	0
MOTOROLA	OAK HILL	TX	N/A	N/A	N/A	F	06/01/94	0.60	8	15,000	729,307	0
OKI	TUALATIN	OR	N/A	ASIC DRAM	N/A	F	/ /	0.00	8	15,000	729,307	0
TI	DALLAS	TX	DMOS 5.2	16Mb DRAM	CMOS	F	/ /	0.00	8	16,000	777,927	25,000
Production Begins: 1995												
CRYSTAL S/C	AUSTIN	TX	N/A	LIN A/D D/A	MOS	F	/ /	1.20	0	0	0	0

(Continued)

Table 2 (Continued)
North American Future Pilot and Production Fab Lines
Planned Facilities Going Into Production by Year

Company	City	St.	Fab Name	Products	Process Technology	Fab Type	Target Date Prod. Begins	Min. Line-width	Waf. Size	Wafer Start Capacity (4 wks.)	Sq. In. Start Capacity (4 wks.)	Clean Room (Square Feet)
MAXIM INTEGRATED PROD.	SUNNYVALE	CA	N/A	OP AMPS A/D D/A	BIP CMOS	P	/ /	2.00	0	0	0	0
Production Begins: 1996												
NEC	HILLSBORO	OR	PHASE 3	16Mb DRAM	CMOS	FAT	/ /	0.60	8	20,000	972,409	90,000
SONY	SAN ANTONIO	TX	N/A	SRAM	CMOS	F	/ /	0.60	8	0	0	0
Production Begins: 1997												
MATSUSHITA	FORT WORTH	TX	N/A	N/A	N/A	F	/ /	0.00	0	0	0	0

Source: Dataquest (March 1991)

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Silicon Wafer Market Statistics
1990

Source:
Dataquest

Dataquest

Semiconductor Equipment, Manufacturing, and Materials

Silicon Wafer Market Statistics
1990

Source:
Dataquest

Dataquest

Semiconductor Equipment, Manufacturing,
and Materials

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Table of Contents

This booklet is divided into seven sections.

Chapter 1

Introduction to the Silicon Wafer Market

Introduction

Dataquest's Semiconductor Equipment, Manufacturing, and Materials service tracks the silicon wafer industry by examining the merchant silicon and epitaxial wafer market, captive silicon production, wafer price trends, and silicon square-inch consumption.

The information in this document is focused on the silicon and epitaxial wafers used in the manufacturing of integrated circuits.

Definitions and Conventions

The calendar year sales of merchant silicon and epitaxial wafer suppliers are estimated in U.S. dollars and converted to millions of square inches using an average selling price for each region. Currency fluctuations over the last several years affects the dollar value of wafer sales of Japanese and European companies. Dataquest uses average exchange rates supplied by the International Monetary Fund (IMF) to convert from local currency to U.S. dollars. The average exchange rates for the Japanese yen and German deutsche mark for 1985 through 1990 are shown in Table 1.

Please note the convention that the regional designation "United States" includes Canadian semiconductor manufacturing activities.

Silicon Products

The merchant silicon wafer market is categorized into two product segments—silicon wafers and silicon epitaxial wafers. Silicon wafers include prime, test, and monitor wafers grown by both Czochralski and float zone methods. In the silicon database, Dataquest does not include sales of polysilicon, single-crystal silicon ingots (unless noted), silicon materials used in solar applications, or compound semiconductor material substrates such as gallium arsenide.

Table 1.1
Japanese and German Exchange Rates

	1985	1986	1987	1988	1989	1990
Yen/Dollar	238	167	144	128	138	144
Deutsche Mark/ Dollar	2.94	2.17	1.80	1.78	1.88	1.62

Source: IMF

Silicon Producers

Companies that produce silicon and epitaxial wafers are defined as either merchant silicon companies or captive silicon producers. Merchant silicon companies are suppliers such as Shin-Etsu Handotai (SEH) of Japan and Wacker of Germany.

Silicon also is produced, to a lesser extent, by both merchant and captive semiconductor manufacturers. These semiconductor manufacturers collectively are referred to as captive silicon producers because they grow single-crystal silicon to produce wafers for their own internal consumption. Examples of captive producers with significant internal silicon production include Motorola and Texas Instruments in the United States and Hitachi in Japan.

Merchant or Captive?

Some captive silicon producers have sold small amounts of materials on the merchant silicon market. These producers have sold wafers to ensure that internal production methods continue to produce material of competitive quality and cost. Dataquest estimates that merchant sales for these companies historically have represented a small percentage of their total captive silicon production, and thus these companies are identified as captive rather than merchant silicon producers.

Dataquest identifies Toshiba Ceramics, a subsidiary of Toshiba Corporation, as a merchant silicon company even though a substantial amount of its silicon production is consumed by its semiconductor parent. However, because Toshiba Ceramics is actively marketing its material on the merchant market, Toshiba Ceramics is considered a merchant rather than a captive silicon producer. Toshiba Corporation is considered a customer of Toshiba Ceramics.

Merchant Silicon and Epitaxial Wafer Suppliers

Table 2 contains a list of merchant silicon manufacturers that were active in the worldwide market in 1990. This table, organized by region of corporate ownership, summarizes whether a company offers silicon and/or epitaxial wafers.

Table 2
Worldwide Merchant Silicon and Epitaxial Companies, 1990

	Silicon Wafers	Epitaxial Wafers
U.S. Companies		
Crysteco Inc.	X	
Epitaxy Inc.		X
General Instrument		
Power Semiconductor Division		X
M/A-COM Semiconductor Products		X
Pensilco	X	
Recticon (closed 1991)	X	
Spire Corporation		X
Virginia Semiconductor	X	
Japanese Companies		
Kawasaki Steel		
Kawatec	X	X
Komatsu Electronic Metals	X	X
Mitsubishi Material		
Japan Silicon	X	X
Siltec Corporation	X	X
Nittetsu Denshi	X	X
Osaka Titanium Company	X	X
Cincinnati Semiconductor	X	X
U.S. Semiconductor		X
Shin-Etsu Handotai	X	X
Showa Denko	X	X
Toshiba Ceramics	X	X
European Companies		
Hüls		
MEMC Electronic Materials	X	X
Okmetic	X	
Siltronix SA	X	
Topsil Semiconductor Materials A/S	X	
Wacker	X	X
Rest of World Companies		
Korea		
Posco-Hüls	X	X
Oriental Electronic Metals	X	X
Lucky Advanced Materials Inc.	X	
Taiwan		
Hermes Epitaxy		X
Sino-America	X	
Tatung Company	X	

Source: Dataquest (July 1991)

Chapter 2

Forecast of Silicon and Epitaxial Wafers

The tables in this chapter are organized as follows:

- Table 2.1—Forecast of Silicon and Epitaxial Wafer Consumption, 1990-1995
  - Includes consumption of merchant and captive silicon.
  - Products include prime, test, monitor, and epitaxial wafers.
- Table 2.2—Forecast of Merchant Epitaxial Wafer Consumption, 1990-1995
  - Does not include captive epitaxial wafer consumption.

Table 2.1
Forecast of Silicon and Epitaxial Wafer Consumption by Region, 1990-1995
(Millions of Square Inches)

	1990	1991	1992	1993	1994	1995
United States	648	687	731	807	894	921
Percent Growth	11.4	6.0	6.4	10.4	10.8	3.0
Japan	1,017	1,102	1,230	1,389	1,498	1,572
Percent Growth	10.1	8.4	11.6	12.9	7.8	4.9
Europe	227	224	244	272	312	343
Percent Growth	-1.7	-1.4	8.9	11.5	14.7	9.9
Asia/Pacific-ROW	145	168	196	231	271	295
Percent Growth	27.0	16.1	16.7	17.9	17.3	8.9
Total	2,037	2,181	2,401	2,699	2,975	3,131

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Table 2.2
Forecast of Merchant Epitaxial Wafer Consumption, 1990-1995
(Millions of Square Inches)

Region	1990	1991	1992	1993	1994	1995
United States	97	105	117	133	137	138
Japan	93	97	104	116	114	114
Europe	19	18	18	20	23	24
Asia/Pacific-ROW	5	6	7	9	10	11
Total	214	225	247	277	283	287

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Chapter 3

Historical Unit Data in Millions of Square Inches

The tables in this chapter are organized as follows:

- Table 3.1—Merchant Silicon and Epitaxial Wafer Consumption, 1985-1990
  - Merchant silicon includes prime, test, and monitor wafers.
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  - Total merchant
- Table 3.2—Captive Silicon Wafer Consumption, 1985-1990
  - By company and region
- Table 3.3—Merchant and Captive Silicon Wafer Consumption, 1985-1990
- Table 3.4—Asia/Pacific-ROW Silicon Wafer Consumption, 1987-1990

Table 3.1
Merchant Silicon and Epitaxial Wafer Consumption, 1985-1990
(Millions of Square Inches)

	1985	1986	1987	1988	1989	1990
Merchant Silicon Wafers						
United States	281	296	325	404	418	471
Japan	515	548	565	666	803	878
Europe	134	138	155	174	209	200
Asia/Pacific-ROW	41	62	67	80	109	140
Total	972	1,044	1,112	1,324	1,540	1,690
Merchant Epitaxial Wafers						
United States	25	29	42	56	82	97
Japan	49	65	71	75	83	93
Europe	6	9	12	15	18	19
Asia/Pacific-ROW	2	2	3	4	5	5
Total	82	104	127	150	187	214
Total Merchant Wafers						
United States	307	324	367	459	500	568
Japan	564	613	636	741	886	971
Europe	140	147	166	189	226	219
Asia/Pacific-ROW	43	64	70	84	114	145
Total	1,054	1,148	1,238	1,474	1,727	1,903

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Chapter 3 Historical Unit Data in Millions of Square Inches 3-3

Table 3.2
Captive Silicon Wafer Consumption, 1985-1990
(Millions of Square Inches)

	1985	1986	1987	1988	1989	1990
Total Captive Silicon Production						
AT&T	15	15	17	18	18	25
Delco	3	1	0	0	0	0
Fairchild	3	0	0	0	0	0
Hitachi	18	18	18	18	18	18
IBM	18	18	18	20	12	0
Motorola	15	15	15	18	18	20
Philips	6	5	2	2	0	0
Texas Instruments	45	46	45	54	58	71
Total—Worldwide	123	118	115	130	124	134
Regional Consumption of Captive Silicon Production						
United States						
AT&T	15	15	17	18	18	22
Delco	3	1	0	0	0	0
Fairchild	3	0	0	0	0	0
IBM	18	18	18	20	12	0
Motorola	15	15	15	18	18	20
Texas Instruments	37	32	25	31	34	38
Total—United States	91	81	75	87	82	80
Japan						
Hitachi	18	18	18	18	18	18
Texas Instruments	6	11	16	18	19	28
Total—Japan	24	29	34	36	37	46
Europe						
Philips	6	5	2	2	0	0
Texas Instruments	2	3	4	5	5	5
Total—Europe	8	8	6	7	5	5

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Table 3.3
Merchant and Captive Silicon Wafer Consumption, 1985-1990
(Millions of Square Inches)

	1985	1986	1987	1988	1989	1990
Merchant Silicon						
United States	307	324	367	459	500	568
Japan	564	613	636	741	886	971
Europe	140	147	166	189	226	219
Asia/Pacific-ROW	43	64	70	84	114	145
Total	1,054	1,148	1,239	1,474	1,727	1,903
Captive Silicon						
United States	91	81	75	87	82	80
Japan	24	29	34	36	37	46
Europe	8	8	6	7	5	8
Asia/Pacific-ROW	0	0	0	0	0	0
Total	123	118	115	130	124	134
Merchant and Captive Silicon						
United States	398	405	442	546	582	648
Percent Growth		1.9	8.9	23.7	6.5	11.4
Japan	588	642	670	777	923	1,017
Percent Growth		9.1	4.4	16.0	18.8	10.1
Europe	148	155	172	196	231	227
Percent Growth		4.6	10.9	14.0	17.8	-1.7
Asia/Pacific-ROW	43	64	70	84	114	145
Percent Growth		47.9	9.3	20.6	35.9	27.0
Total	1,177	1,266	1,354	1,604	1,851	2,037

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Table 3.4
Asia/Pacific-ROW Silicon Wafer Consumption
(Millions of Square Inches)

Region	1987	1988	1989	1990
Silicon Wafers	67	80	109	140
Korea	46	55	68	81
Taiwan	18	22	29	37
ROW	3	3	12	22
Epitaxial Wafers	3.0	4.0	5.0	5.4
Korea	2.7	3.3	4.2	4.4
Taiwan	0.3	0.6	0.7	0.8
ROW	0	0.1	0.1	0.2
Total	70	84	114	145

Source: Dataquest (July 1991)

Chapter 4

Regional Wafer Size Distribution by Diameter

The tables in this chapter are organized as follows:

- Table 4.1—Worldwide Wafer Size Distribution by Diameter
  - Historical (1985-1990) and forecast (1991-1995)
- Table 4.2—U.S. Wafer Size Distribution by Diameter
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- Table 4.5—Asia/Pacific-ROW Wafer Size Distribution by Diameter
  - Historical (1985-1990) and forecast (1991-1995)

Table 4.1
Worldwide Wafer Size Distribution by Diameter

	Percentage of Square Inches										
									Forecast		
Size	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2"	0.9	0.8	0.5	0.4	0.2	0.2	0.2	0.1	0.1	0	0
3"	7.2	6.0	3.5	3.0	3.2	2.8	2.4	2.0	1.5	0.5	0.5
100mm	42.9	35.4	30.1	28.0	26.0	23.3	20.5	18.5	15.4	14.4	14.4
125mm	38.3	41.9	45.1	43.4	40.2	37.8	35.0	31.8	29.1	27.4	27.4
150mm	10.7	15.8	20.5	24.4	28.8	33.5	38.3	41.9	46.2	47.1	47.1
200mm	0	0	0.3	0.8	1.5	2.3	3.6	5.6	7.8	10.6	10.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total—Millions of Square Inches	1,177	1,266	1,353	1,604	1,851	2,037	2,181	2,401	2,738	3,038	3,249

	Millions of Wafer Starts										
									Forecast		
Size	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2"	3.4	3.4	2.3	2.3	1.4	1.3	1.2	1.0	0.6	0.4	0.1
3"	12.0	10.8	6.7	6.9	8.5	8.2	7.5	6.7	5.9	4.2	2.9
100mm	41.5	36.8	33.5	36.9	39.6	39.0	36.7	36.5	34.6	32.8	28.8
125mm	23.7	27.9	32.1	36.6	39.1	40.5	40.1	40.2	41.9	42.2	39.5
150mm	4.6	7.3	10.1	14.3	19.5	24.9	30.5	36.8	46.2	55.0	61.0
200mm	0	0	0.1	0.3	0.6	1.0	1.6	2.8	4.4	6.1	9.4
Total Wafers (M)	85.2	86.2	84.8	97.1	108.6	115.0	117.6	123.9	133.5	140.7	141.7
Average Wafer Diameter (")	4.2	4.3	4.5	4.6	4.7	4.8	4.9	5.0	5.1	5.2	5.4

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Table 4.2
United States Wafer Size Distribution by Diameter

	Percentage of Square Inches										
									Forecast		
Size	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
2"	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0
3"	6.8	5.9	3.3	2.2	2.0	1.8	1.5	1.3	1.1	0.8	0.5
100mm	55.3	44.9	36.3	33.4	31.5	28.8	26.8	26.3	22.1	19.8	19.7
125mm	29.9	33.9	40.1	41.9	36.7	35.4	32.5	28.4	25.9	23.4	21.6
150mm	7.5	14.9	19.4	20.7	26.3	28.7	31.9	34.9	40.0	43.2	39.5
200mm	0	0	0.7	1.7	3.4	5.3	7.2	9.0	10.9	12.8	18.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total—Millions of Square Inches	398	405	442	546	582	648	687	731	807	894	921
	Millions of Wafer Starts										
									Forecast		
Size	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**
2"	0.6	0.5	0.1	0.2	0.1	0.1	0.1	0.1	0	0.1	0
3"	3.8	3.4	2.1	1.7	1.6	1.6	1.5	1.3	1.2	1.0	0.7
100mm	18.1	15.0	13.2	15.0	15.1	15.3	15.1	15.8	14.7	14.5	14.9
125mm	6.3	7.2	9.3	12.0	11.2	12.1	11.7	10.9	11.0	11.0	10.5
150mm	1.1	2.2	3.1	4.1	5.6	6.8	8.0	9.3	11.8	14.1	13.3
200mm	0	0	0.1	0.2	0.4	0.7	1.0	1.4	1.8	2.4	3.5
Total Wafers (M)	29.9	28.3	27.9	33.2	34.1	36.7	37.5	38.8	40.4	43.1	42.8
Average Wafer Diameter (")	4.1	4.3	4.5	4.6	4.7	4.7	4.8	4.9	5.0	5.1	5.2

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Table 4.3
Japanese Wafer Size Distribution by Diameter

Size	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
					Percentage of Square Inches						
									Forecast		
2"	0.5	0.4	0.2	0.1	0.1	0.1	0.1	0	0	0	0
3"	6.8	5.9	2.8	2.8	2.6	2.3	2.0	1.7	1.4	1.1	0.7
100mm	31.0	25.0	22.4	21.4	20.2	17.9	15.6	13.2	10.9	8.6	5.4
125mm	47.4	51.0	53.0	48.1	46.5	42.9	39.3	35.7	32.1	28.4	24.5
150mm	14.3	17.7	21.5	27.4	30.3	36.4	41.6	45.3	48.5	52.0	56.5
200mm	0	0	0.1	0.2	0.3	0.5	1.5	4.1	7.1	9.9	12.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total—Millions of Square Inches	588	642	670	777	923	1,017	1,102	1,230	1,389	1,498	1,572
					Millions of Wafer Starts						
									Forecast		
Size	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2"	0.9	0.8	0.4	0.2	0.3	0.2	0.2	0.1	0.1	0	0
3"	5.7	5.4	2.7	3.1	3.3	3.3	3.1	2.9	2.7	2.3	1.6
100mm	15.0	13.2	12.3	13.7	15.3	14.9	14.1	13.4	12.4	10.6	7.0
125mm	14.7	17.2	18.7	19.7	22.6	22.9	22.8	23.1	23.4	22.4	20.2
150mm	3.1	4.1	5.3	7.8	10.2	13.5	16.7	20.4	24.6	28.4	32.4
200mm	0	0	0	0	0.1	0.1	0.3	1.0	2.0	3.0	4.2
Total Wafers (M)	39.3	40.7	39.4	44.5	51.8	55.0	57.2	60.9	65.3	66.8	65.4
Average Wafer Diameter (")	4.4	4.5	4.7	4.7	4.8	4.9	5.0	5.1	5.2	5.3	5.5

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Table 4.4
European Wafer Size Distribution by Diameter

	Percentage of Square Inches										
									Forecast		
Size	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2"	1.0	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.1
3"	10.0	6.8	5.9	5.0	4.3	3.7	3.1	2.5	1.9	1.2	0.8
100mm	60.0	55.3	44.9	40.1	35.9	32.5	29.1	25.7	22.3	19.0	15.3
125mm	25.0	29.9	33.9	34.3	33.0	31.9	30.8	29.7	28.7	27.6	23.0
150mm	4.0	7.5	14.9	19.5	24.4	28.3	32.3	36.2	40.2	44.1	47.9
200mm	0	0	0	0.7	2.1	3.3	4.4	5.6	6.7	7.9	12.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total—Millions of Square Inches	148	155	172	196	231	227	224	244	272	312	355

	Millions of Wafer Starts										
									Forecast		
Size	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995
2"	0.5	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1
3"	2.1	1.5	1.4	1.4	1.4	1.2	1.0	0.8	0.7	0.6	0.4
100mm	7.3	7.1	6.3	6.5	6.8	6.1	5.4	5.2	5.0	4.9	4.5
125mm	2.0	2.4	3.1	3.5	4.0	3.8	3.6	3.8	4.1	4.5	4.3
150mm	0.2	0.4	0.9	1.4	2.1	2.3	2.6	3.2	4.0	5.0	6.2
200mm	0	0	0	0	0.1	0.2	0.2	0.3	0.4	0.5	0.9
Total Wafers (M)	12.1	11.7	12.0	13.1	14.7	13.8	13.0	13.5	14.4	15.7	16.4
Average Wafer Diameter (")	4.0	4.1	4.3	4.4	4.5	4.6	4.7	4.8	4.9	5.0	5.2

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Table 4.5
Asia/Pacific-ROW Wafer Size Distribution by Diameter

Size	1985	1986	1987	1988	1989	1990	1991	1992	Forecast 1993	1994	1995
Percentage of Square Inches											
2"	10.0	9.0	7.0	6.0	2.0	1.6	1.2	0.8	0.4	0	0
3"	7.0	6.0	6.0	6.0	13.0	10.5	8.1	5.6	3.2	0.7	0.5
100mm	33.0	31.0	28.0	25.5	25.1	22.1	15.5	13.7	11.4	10.3	7.5
125mm	37.0	31.0	28.0	30.0	21.2	21.8	22.4	23.1	23.7	24.3	21.3
150mm	13.0	23.0	31.0	32.5	38.7	43.2	51.0	54.1	58.5	61.1	61.8
200mm	0	0	0	0	0	0.7	1.8	2.7	2.9	3.6	8.9
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total—Millions of Square Inches	43	64	70	84	114	145	168	196	270	334	401
Millions of Wafer Starts											
2"	1.4	1.8	1.5	1.6	0.7	0.7	0.6	0.5	0.4	0	0
3"	0.4	0.5	0.6	0.7	2.1	2.2	1.9	1.6	1.2	0.3	0.3
100mm	1.2	1.6	1.6	1.8	2.3	2.6	2.1	2.2	2.5	2.8	2.5
125mm	0.8	1.0	1.0	1.3	1.3	1.7	2.0	2.4	3.4	4.3	4.5
150mm	0.2	0.5	0.8	1.0	1.6	2.3	3.1	3.9	5.8	7.5	9.1
200mm	0	0	0	0	0	0	0.1	0.1	0.2	0.2	0.7
Total Wafers (M)	4.0	5.6	5.5	6.4	8.0	9.5	9.9	10.6	13.4	15.1	17.0
Average Wafer Diameter (")	3.7	3.8	4.0	4.1	4.2	4.4	4.7	4.8	5.1	5.3	5.5

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Chapter 5

Historical Revenue Data by Company

The tables in this chapter are organized as follows:

- Table 5.1—Worldwide Merchant Silicon and Epitaxial Sales by Company, 1985-1990
  - Revenue include prime, test, monitor, and epitaxial wafers
- Table 5.2—Worldwide Silicon and Epitaxial Sales by Company, 1990
  - Prime, test, and monitor wafers
  - Epitaxial wafers
- Table 5.3—U.S. Silicon and Epitaxial Sales by Company, 1990
  - Prime, test, and monitor wafers
  - Epitaxial wafers
- Table 5.4—Japanese Silicon and Epitaxial Sales by Company, 1990
  - Prime, test, and monitor wafers
  - Epitaxial wafers
- Table 5.5—European Silicon and Epitaxial Sales by Company, 1990
  - Prime, test, and monitor wafers
  - Epitaxial wafers
- Table 5.6—Asia/Pacific-ROW Silicon and Epitaxial Sales by Company, 1990
  - Prime, test, and monitor wafers
  - Epitaxial wafers

Table 5.1
Worldwide Merchant Silicon and Epitaxial Sales by Company, 1985 to 1990
(Millions of Dollars)

Company	1985	1986	1987	1988	1989	1990
U.S.-Based Companies						
Cincinnati Milacron	42.1	37.9	34.0	30.2	-	-
Crysteco	8.5	8.5	9.5	11.0	11.6	14.0
Epitaxy Inc.	6.0	6.2	7.0	7.5	9.6	10.7
Monsanto	137.0	154.0	185.0	254.0	-	-
NBK Corporation	7.0	-	-	-	-	-
Recticon	4.7	6.0	4.5	5.5	7.0	8.0
Siltec	24.8	21.3	-	-	-	-
UniSil Corp.	-	-	-	-	8.5	12.5
U.S. Semiconductor	3.0	4.0	-	-	-	-
Other U.S. Companies	16.8	14.0	12.4	11.2	11.9	14.6
Total	249.9	251.9	252.4	319.4	48.6	57.3
Japan-Based Companies						
Kawasaki Steel, NBK Corp.	-	7.1	7.0	11.0	8.0	11.0
Komatsu Electronic Metals	113.8	168.5	197.3	256.9	254.2	279.0
Mitsubishi Metal Corp.	123.2	195.0	241.3	300.2	303.4	317.4
Osaka Titanium Company[1]	132.3	197.6	235.5	281.6	317.4	346.0
Shin-Etsu Handotai	298.9	408.0	452.1	567.3	645.3	696.1
Toshiba Ceramics	35.1	61.0	78.9	94.5	112.0	129.7
Other Japanese Companies	0	0	11.4	23.8	31.3	42.2
Total	703.3	1,037.2	1,223.5	1,535.3	1,671.6	1,821.4
Europe-Based Companies						
DNS Electronic Materials	43.0	53.0	63.0	74.5	-	-
Hüls	-	-	-	-	358.5	403.7
Topsil	8.7	8.5	9.0	10.5	13.1	15.5
Wacker	160.4	162.1	177.0	253.8	312.8	338.6
Other European Companies	2.0	3.0	3.0	1.9	6.4	6.4
Total	214.1	226.6	252.0	340.7	690.8	764.2
Asia/Pacific-ROW-Based Companies						
Korsil[2]	0	0	5.0	25.0	15.0	0
Lucky Advanced Materials	0	0	0.7	7.6	14.5	26.2
Other Asia/Pacific-ROW Companies	0.5	1.3	2.2	3.3	4.3	13.0
Total	0.5	1.3	7.9	35.9	33.8	39.2
Total Sales—Worldwide	1,167.8	1,517.0	1,735.8	2,231.3	2,444.8	2,684.6

[1]Includes U.S. Semiconductor sales from 1987, Cincinnati Semiconductor from 1989.
[2]Korsil ended operations in May 1989.
Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Table 5.2
Worldwide Silicon and Epitaxial Sales by Company, 1990
(Millions of Dollars)

	Silicon Wafers		Epitaxial Wafers		Total	
Company	Sales	Share (%)	Sales	Share (%)	Sales	Share (%)
U.S.-Based Companies						
Crysteco	14.0	0.7	0	0	14.0	0.5
Epitaxy Inc.	0	0	10.7	1.5	10.7	0.4
Recticon	8.0	0.4	0	0	8.0	0.3
UniSil Corp.	12.5	0.5	0	0	12.5	0.4
Other U.S. Companies	6.1	0.3	8.5	1.2	14.6	0.5
Total	38.1	1.9	19.2	2.8	57.3	2.1
Japan-Based Companies						
Kawasaki Steel, NBK Corp.	10.7	0.5	0.3	0	11.0	0.4
Komatsu Electronic Metals	225.2	11.3	53.8	7.8	279.0	10.4
Mitsubishi Metal Corp.	227.2	11.4	90.2	13.0	317.4	11.8
Japan Silicon	180.2	-	83.2	-	263.4	-
Siltec	47.0	-	7.0	-	54.0	-
Osaka Titanium Company*	269.5	13.5	76.5	11.1	346.0	12.9
Shin-Etsu Handotai	504.5	25.3	191.6	27.7	696.1	26.0
Toshiba Ceramics	80.8	4.1	48.9	7.1	129.7	4.8
Other Japanese Companies	42.2	2.1	0	0	42.2	1.6
Total	1,360.1	68.3	461.3	66.7	1,821.4	67.9
Europe-Based Companies						
Hüls	313.7	15.8	90.0	13.0	403.7	15.1
Topsil	15.5	0.8	0	0	15.5	0.6
Wacker	220.3	11.1	118.3	17.1	338.6	12.6
Other European Companies	6.4	0.3	0	0	6.4	0.2
Total	555.9	27.9	208.3	30.1	764.2	28.5
Asia/Pacific-ROW-Based Companies						
Lucky Advanced Materials	26.2	1.3	0	0	26.2	1.0
Other Asia/Pacific-ROW Companies	10.0	0.5	3.0	0.4	13.0	0.5
Total	36.2	1.8	3.0	0.4	39.2	1.5
Total Sales—Worldwide	1,992.8	100.0	691.8	100.0	2,684.6	100.0

*Includes U.S. Semiconductor and Cincinnati Semiconductor sales
Source: Dataquest (July 1991)

Table 5.3
U.S. Silicon and Epitaxial Sales by Company, 1990
(Millions of Dollars)

	Silicon Wafers		Epitaxial Wafers		Total	
Company	Sales	Share (%)	Sales	Share (%)	Sales	Share (%)
U.S.-Based Companies						
Crysteco	12.8	3.0	0	0	12.8	1.8
Epitaxy Inc.	0	0	4.7	1.7	4.7	0.7
Recticon	8.0	1.9	0	0	8.0	1.1
UniSil Corp.	12.5	2.3	0	0	12.5	1.4
Other U.S. Companies	5.7	1.3	7.5	2.8	13.2	1.9
Total	36.5	8.5	12.2	4.5	48.7	6.9
Japan-Based Companies						
Kawasaki Steel, NBK Corp.	5.4	1.3	0.3	0.1	5.7	0.8
Komatsu Electronic Metals	5.6	1.3	1.4	0.5	7.0	1.0
Mitsubishi Metal Corp.	47.8	11.1	7.2	2.7	55.0	7.8
Japan Silicon	0.8	-	0.2	-	1.0	-
Siltec	47.0	-	7.0	-	54.0	-
Osaka Titanium Company*	18.0	4.2	48.9	18.1	66.9	9.5
Shin-Etsu Handotai	86.7	20.1	51.8	19.1	138.5	19.8
Toshiba Ceramics	0	0	0	0	0	0
Other Japanese Companies	0	0	0	0	0	0
Total	163.5	38.0	109.6	40.5	273.1	39.0
Europe-Based Companies						
Hüls	137.0	31.8	62.0	22.9	199.0	28.4
Topsil	2.8	0.7	0	0	2.8	0.4
Wacker	90.0	20.9	87.0	32.1	177.0	25.2
Other European Companies	0	0	0	0	0	0
Total	229.8	53.4	149.0	55.0	378.8	54.0
Asia/Pacific-ROW-Based Companies						
Lucky Advanced Materials	0.5	0.1	0	0	0.5	0.1
Other Asia/Pacific-ROW Companies	0	0	0	0	0	0
Total	0.5	0.1	0	0	0.5	0.1
Total Sales—United States	432.8	100.0	270.8	100.0	703.6	100.0

*Includes U.S. Semiconductor and Cincinnati Semiconductor sales
Source: Dataquest (July 1991)

Table 5.4
Japan Silicon and Epitaxial Sales by Company, 1990
(Millions of Dollars)

	Silicon Wafers		Epitaxial Wafers		Total	
Company	Sales	Share (%)	Sales	Share (%)	Sales	Share (%)
U.S.-Based Companies						
Crysteco	0.6	0	0	0	0.6	0
Epitaxy Inc.	0	0	0	0	0	0
Recticon	0	0	0	0	0	0
UniSil Corp.	0	0	0	0	0	0
Other U.S. Companies	0	0	0	0	0	0
Total	0.6	0	0	0	0.6	0
Japan-Based Companies						
Kawasaki Steel, NBK Corp.	2.1	0.2	0	0	2.1	0.1
Komatsu Electronic Metals	212.6	17.5	52.4	15.0	265.0	16.9
Mitsubishi Metal Corp.	176.0	14.5	82.0	23.5	258.0	16.5
Japan Silicon	176.0	-	82.0	-	258.0	-
Siltec	0	-	0	-	0	-
Osaka Titanium Company*	227.0	18.7	23.5	6.7	250.5	16.0
Shin-Etsu Handotai	390.5	32.2	137.0	39.2	527.5	33.7
Toshiba Ceramics	80.0	6.6	47.4	13.6	127.4	8.1
Other Japanese Companies	42.2	3.5	0	0	42.2	2.7
Total	1,130.4	93.1	342.3	98.0	1,472.7	94.2
Europe-Based Companies						
Hüls	51.5	4.2	2.9	0.8	54.4	3.5
Topsil	6.0	0.5	0	0	6.0	0.4
Wacker	25.8	2.1	4.2	1.2	30.0	1.9
Other European Companies	0	0	0	0	0	0
Total	83.3	6.9	7.1	2.0	90.4	5.8
Asia/Pacific-ROW-Based Companies						
Lucky Advanced Materials	0	0	0	0	0	0
Other Asia/Pacific-ROW Companies	0	0	0	0	0	0
Total	0	0	0	0	0	0
Total Sales—Japan	1,214.3	100.0	349.4	100.0	1,563.7	100.0

*Includes U.S. Semiconductor and Cincinnati Semiconductor sales
Source: Dataquest (July 1991)

Table 5.5
Europe Silicon and Epitaxial Sales by Company, 1990
(Millions of Dollars)

	Silicon Wafers		Epitaxial Wafers		Total	
Company	Sales	Share (%)	Sales	Share (%)	Sales	Share (%)
U.S.-Based Companies						
Crysteco	0.6	0.3	0	0	0.6	0.2
Epitaxy, Inc.	0	0	0.9	1.6	0.9	0.3
Recticon	0	0	0	0	0	0
UniSil Corp.	0	0	0	0	0	0
Other U.S. Companies	0.2	0.1	0.7	1.2	0.9	0.3
Total	0.8	0.4	1.6	2.8	2.4	0.9
Japan-Based Companies						
Kawasaki Steel, NBK Corp.	0	0	0	0	0	0
Komatsu Electronic Metals	7.0	3.2	0	0	7.0	2.6
Mitsubishi Metal Corp.	1.8	0.8	0.8	1.4	2.6	1.0
Japan Silicon	1.8	-	0.8	-	2.6	-
Siltec	0	-	0	-	0	-
Osaka Titanium Company*	22.0	10.2	2.3	4.0	24.3	8.9
Shin-Etsu Handotai	21.0	9.7	2.5	4.4	23.5	8.6
Toshiba Ceramics	0	0	0	0	0	0
Other Japanese Companies	0	0	0	0	0	0
Total	51.8	24.0	5.6	9.8	57.4	21.0
Europe-Based Companies						
Hüls	72.2	33.5	24.3	42.5	96.5	35.4
Topsil	5.2	2.4	0	0	5.2	1.9
Wacker	80.0	37.1	25.7	44.9	105.7	38.7
Other European Companies	5.7	2.6	0	0	5.7	2.1
Total	163.1	75.6	50.0	87.4	213.1	78.1
Asia/Pacific-ROW-Based Companies						
Lucky Advanced Materials	0	0	0	0	0	0
Other Asia/Pacific-ROW Companies	0	0	0	0	0	0
Total	0	0	0	0	0	0
Total Sales—Europe	215.7	100.0	57.2	100.0	272.9	100.0

*Includes U.S. Semiconductor and Cincinnati Semiconductor sales
Source: Dataquest (July 1991)

Table 5.6
Asia/Pacific-ROW Silicon and Epitaxial Sales by Company, 1990
(Millions of Dollars)

	Silicon Wafers		Epitaxial Wafers		Total	
Company	Sales	Share (%)	Sales	Share (%)	Sales	Share (%)
U.S.-Based Companies						
Crysteco	0	0	0	0	0	0
Epitaxy Inc.	0	0	5.1	35.4	5.1	3.5
Recticon	0	0	0	0	0	0
UniSil Corp.	0	0	0	0	0	0
Other U.S. Companies	0.2	0.2	0.3	2.1	0.5	0.3
Total	0.2	0.2	5.4	37.5	5.6	3.9
Japan-Based Companies						
Kawasaki Steel, NBK Corp.	3.2	2.5	0	0	3.2	2.2
Komatsu Electronic Metals	0	0	0	0	0	0
Mitsubishi Metal Corp.	1.6	1.2	0.2	1.4	1.8	1.2
Japan Silicon	1.6	-	0.2	-	1.8	-
Siltec	0	-	0	-	0	-
Osaka Titanium Company*	2.5	1.9	1.8	12.5	4.3	3.0
Shin-Etsu Handotai	6.3	4.8	0.3	2.1	6.6	4.6
Toshiba Ceramics	0.8	0.6	1.5	10.4	2.3	1.6
Other Japanese Companies	0	0	0	0	0	0
Total	14.4	11.1	3.8	26.4	18.2	12.6
Europe-Based Companies						
Hüls	53.0	40.8	0.8	5.6	53.8	37.3
Topsil	1.5	1.2	0	0	1.5	1.0
Wacker	24.5	18.8	1.4	9.7	25.9	17.9
Other European Companies	0.7	0.5	0	0	0.7	0.5
Total	79.7	61.3	2.2	15.3	81.9	56.7
Asia/Pacific-ROW-Based Companies						
Lucky Advanced Materials	25.7	19.8	0	0	25.7	17.8
Other Asia/Pacific-ROW Companies	10.0	7.7	3.0	20.8	13.0	9.0
Total	35.7	27.5	3.0	20.8	38.7	26.8
Total Sales—Rest of World	130.0	100.0	14.4	100.0	144.4	100.0

*Includes U.S. Semiconductor and Cincinnati Semiconductor sales
Source: Dataquest (July 1991)

Chapter 6

1990 *Average Selling Prices by Region*

The table in this chapter is organized as follows:

- Table 6.1—1990 Regional Average Selling Price (ASP)
  - The silicon wafer prices reflect the ASP for polished CZ wafers.
  - Epitaxial wafer prices can vary considerably, depending on the level of custom specifications and the thickness of the epitaxial layer.
  - The regional ASPs presented reflect a broad distribution in product specifications for each wafer size.

Table 6.1
1990 Regional Average Selling Price of Silicon and Epitaxial Wafers by Wafer Size

Wafer Diameter	3-inch	100mm	125mm	150mm	200mm
Wafer Area (Square Inches)	7.07	12.17	19.02	27.39	48.70
Per Wafer ($/Wafer)					
CZ Polished Wafers					
North America	7.25	9.98	18.75	31.50	121.05
Europe	8.05	11.75	19.03	32.45	123.39
Asia/Pacific-ROW	7.25	9.50	17.50	29.12	-
Japan	10.66	12.62	23.85	42.66	223.78
Japan* (¥/Wafer)	1,525	1,805	3,410	6,100	32,000
Epitaxial Wafers					
North America	24.39	32.30	51.50	83.25	-
Europe	25.01	35.07	57.02	88.31	-
Asia/Pacific-ROW	25.10	34.71	53.87	86.23	-
Japan	35.85	39.86	69.93	130.23	-
Japan* (¥/Wafer)	5127	5,700	10,000	18,754	-
Per Square Inch ($/SI)					
CZ Polished Wafers					
North America	1.03	0.82	0.99	1.15	2.49
Europe	1.14	0.97	1.00	1.18	2.53
Asia/Pacific-ROW	1.03	0.78	0.92	1.06	-
Japan	1.51	1.04	1.25	1.56	4.59
Japan* (¥/Wafer)	216	148	179	223	657
Epitaxial Wafers					
North America	3.45	2.65	2.71	3.04	-
Europe	3.54	2.88	3.00	3.22	-
Asia/Pacific-ROW	3.55	2.85	2.83	3.15	-
Japan	5.07	3.28	3.68	4.79	-
Japan* (¥/Wafer)	725	468	526	685	-

*US$1 = ¥143
Source: Dataquest (July 1991)

Chapter 7

Silicon Wafer Plant Expansions/ New Lines

The table in this chapter is organized as follows:

- Table 7.1—Silicon Wafer Plant Expansions/New Lines
  - Location
  - Status
  - Wafer diameter
  - Capacity
  - Start date
  - Capital investment

Table 7.1
Silicon Wafer Plant Expansions/New Lines

Company	Location	Status	Size	Capacity K/Month	Start	Capital Spending (US$M)	Capital Spending (¥M)
Shin-Etsu Handotai	Shirakawa	R&D			1990/3	14.3	2,000
	Isobe	Epi expand				14.3	2,000
	Nagano	Production line for 4Mb	6"		1991/2	25.0	3,500
	Naoetsu	Production line for 4Mb	6"		1991/3	32.1	4,500
	Mimasu	Polishing line for 4Mb	6"		1991/4	39.3	5,500
	Shirakawa	8" volume production	8"	30	1992/4	107.1	15,000
	Camus Or	8" volume production	8"	10	1991/2	7.1	1,000
	England	6" volume production	6"	200	1991/1Q	32.1	4,500
						271.4	38,000
Osaka Titanium	Imari	#3 volume production line	6", 8"	300	1991/1Q	8.6	1,200
	Mainville, Ohio	Expand			1992/1Q	7.1	1,000
						15.7	2,200
Mitsubishi Metal	Noda	Pilot line	8"	5	1990/9	28.6	4,000
	Yonezawa	Volume production	6"	250	1990	28.6	4,000
	Noda	R&D for 4Mb			1990/4	14.3	2,000
	Central Research	R&D for 16Mb	8"		1990	14.3	2,000
	Ikuno	8" volume production	8"	20	1991/1Q	53.6	7,500
	Chitose	Epi production line			1992/4Q	71.4	10,000
						210.7	29,500
Komatsu Electronic Metals	Nagasaki	Volume production line	6", 8"	200	1992/1Q	28.6	4,000
	Miyazaki	R&D				14.3	2,000
	Hiratsuka	Technical center			1991/3Q	14.3	2,000
	Portland, Oregon			1,000		7.1	1,000
						64.3	9,000
Toshiba Ceramics	Yamagata	Expand at Okuni plant	6"			28.6	4,000
	Central Research	Pilot line	8"		1990/9	3.6	500
	Niigata	Volume production line	8"	100	1993/1	158.6	22,210
	Tokuyama	Epi expansion	5"	90	1994	35.7	5,000
						226.5	31,710

(Continued)

Table 7.1 (Continued)
Silicon Wafer Plant Expansions/New Lines

Company	Location	Status	Size	Capacity K/Month	Start	Capital Spending (US$M)	Capital Spending (¥M)
Kawatec	Santa Clara, California	First expansion	5", 6", 8"	70	1990/7	44.3	6,200
		Second expansion	5", 6", 8"	80	1992/7	20.0	2,800
						64.3	9,000
Showa Denko	Chichibu	Expand	6", 8"	30	1990/4Q	14.3	2,000
Nittetsu	Hikari	Expand	8"		1991	21.4	3,000
MEMC/Hüls	St. Peters, Missouri	Expand	8"	30	1991/11	31.0	4,340
Posco-Hüls	Korea	Volume production line	6", 8"		1992/3	110.0	15,400
Oriental Electronic Metals	Korea	Volume production line	6", 8"		1992/2	35.0	4,900
Wacker-Chemitronic	Wasserburg	Expansion of epi	6"		1990/6	5.0	700
Total						1,069.6	149,750

Source: Dataquest (July 1991)

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Semiconductor Equipment, Manufacturing, and Materials Forecast

November 1991

Source: Dataquest

Market Statistics

Semiconductor Equipment, Manufacturing, and Materials

Dataquest

Semiconductor Equipment, Manufacturing, and Materials Forecast

November 1991

Source: Dataquest

Market Statistics

Published by Dataquest Incorporated

Table of Contents

This booklet is divided into five major sections.

Chapter 1

Semiconductor Consumption Forecast

Introduction

This section presents data on the worldwide semiconductor market by region. The regional semiconductor market, or regional semiconductor consumption, deals with where chips are consumed; this contrasts with regional semiconductor production, which deals with where chips are made. The data presented here are for the merchant market and do not include the value of chips made by captive semiconductor manufacturers for internal use.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Semiconductor Consumption

Table 1.1 shows the historical regional semiconductor consumption for the years 1985 through 1990; it also breaks down the merchant market by nationality of the merchant semiconductor companies. Table 1.2 shows forecast semiconductor consumption by region for the period from 1990 through 1995. Figures 1.1 and 1.2 graphically illustrate the data from Tables 1.1 and 1.2. Figure 1.3 depicts the share of the worldwide market by nationality of semiconductor company for the period from 1985 through 1990. Figure 1.4 illustrates worldwide market share by nationality of producer, covering the years 1985 and 1990.

Table 1.1
Worldwide Semiconductor Consumption by Region
Merchant Semiconductor Company in the Region—Historical
(In Millions of U.S. Dollars)

	1985	1986	1987	1988	1989	1990	Market Share (%) 1990
North America							
North American Companies	7,380	8,566	9,671	11,146	11,715	11,942	68.7
Japanese Companies	1,279	1,434	2,110	3,277	4,574	3,777	21.7
European Companies	731	751	913	1,006	1,025	1,074	6.2
Asia/Pacific-ROW Companies	28	93	164	415	623	593	3.4
Total North American Market	9,418	10,844	12,858	15,844	17,937	17,386	100.0
Japan							
North American Companies	695	933	1,249	1,965	2,162	2,402	10.7
Japanese Companies	7,387	10,851	13,588	18,630	20,628	19,825	88.1
European Companies	60	63	70	115	130	164	.7
Asia/Pacific-ROW Companies	7	8	20	62	77	117	.5
Total Japanese Market	8,149	11,855	14,927	20,772	22,997	22,508	100.0
Europe							
North American Companies	2,428	2,580	2,845	3,664	4,032	4,492	42.1
Japanese Companies	549	715	900	1,466	1,924	1,814	17.0
European Companies	1,806	2,282	2,714	3,196	3,562	4,117	38.6
Asia/Pacific-ROW Companies	12	10	39	165	237	238	2.2
Total European Market	4,795	5,587	6,498	8,491	9,755	10,661	100.0
Asia/Pacific-ROW							
North American Companies	548	730	1,165	1,811	2,069	2,701	35.2
Japanese Companies	929	1,160	1,852	2,569	2,683	2,961	38.6
European Companies	254	347	503	600	726	851	11.1
Asia/Pacific-ROW Companies	248	311	448	772	1,046	1,157	15.1
Total Asia/Pacific-ROW Market	1,979	2,548	3,968	5,752	6,524	7,670	100.0
Worldwide							
North American Companies	11,051	12,809	14,930	18,586	19,978	21,537	37.0
Japanese Companies	10,144	14,160	18,450	25,942	29,809	28,377	48.7
European Companies	2,851	3,443	4,200	4,917	5,443	6,206	10.7
Asia/Pacific-ROW Companies	295	422	671	1,414	1,983	2,105	3.6
Total Worldwide Market	24,341	30,834	38,251	50,859	57,213	58,225	100.0
Percent Growth	-16	27	24	33	12	2	

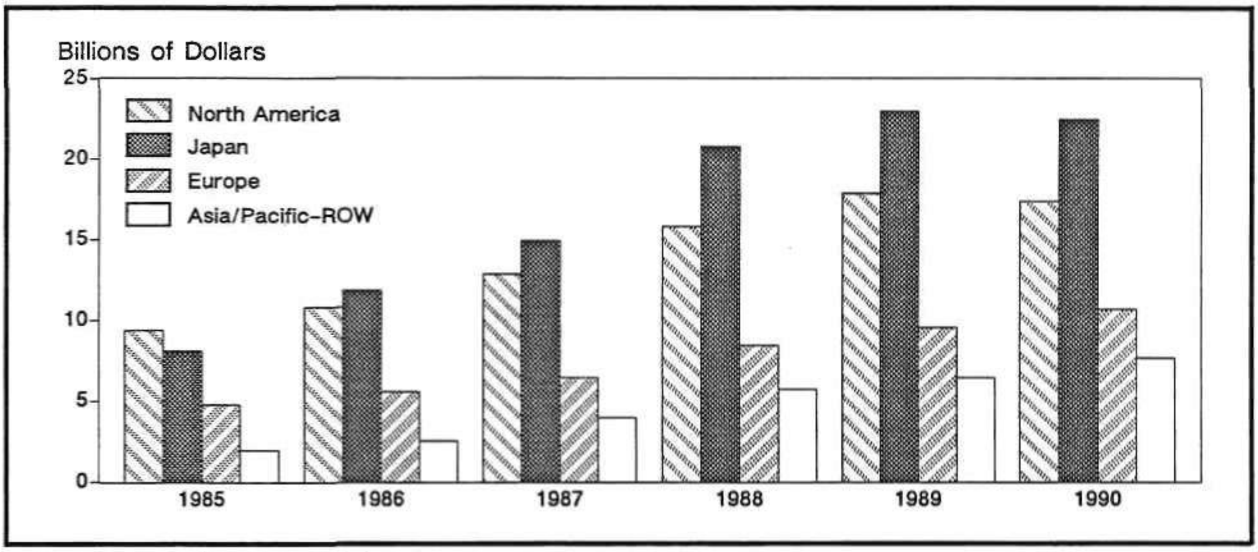
Source: Dataquest (November 1991)

Table 1.2
Worldwide Semiconductor Consumption by Region
Merchant Semiconductor Company Sales Only—Forecast
(In Millions of U.S. Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America	17,386	18,483	20,728	23,888	26,758	28,816	11
Percent Growth	-3.1	6.3	12.1	15.2	12.0	7.7	
Japan	22,508	25,544	29,524	33,341	37,208	40,232	12
Percent Growth	-2.1	13.5	15.6	12.9	11.6	8.1	
Europe	10,661	10,828	11,556	13,777	15,335	16,368	9
Percent Growth	9.3	1.6	6.7	19.2	11.3	6.7	
Asia/Pacific-ROW	7,670	8,792	10,405	12,532	14,486	16,246	16
Percent Growth	17.6	14.6	18.3	20.4	15.6	12.1	
Total Worldwide Market	58,225	63,647	72,213	83,538	93,787	101,662	12
Percent Growth	1.8	9.3	13.5	15.7	12.3	8.4	

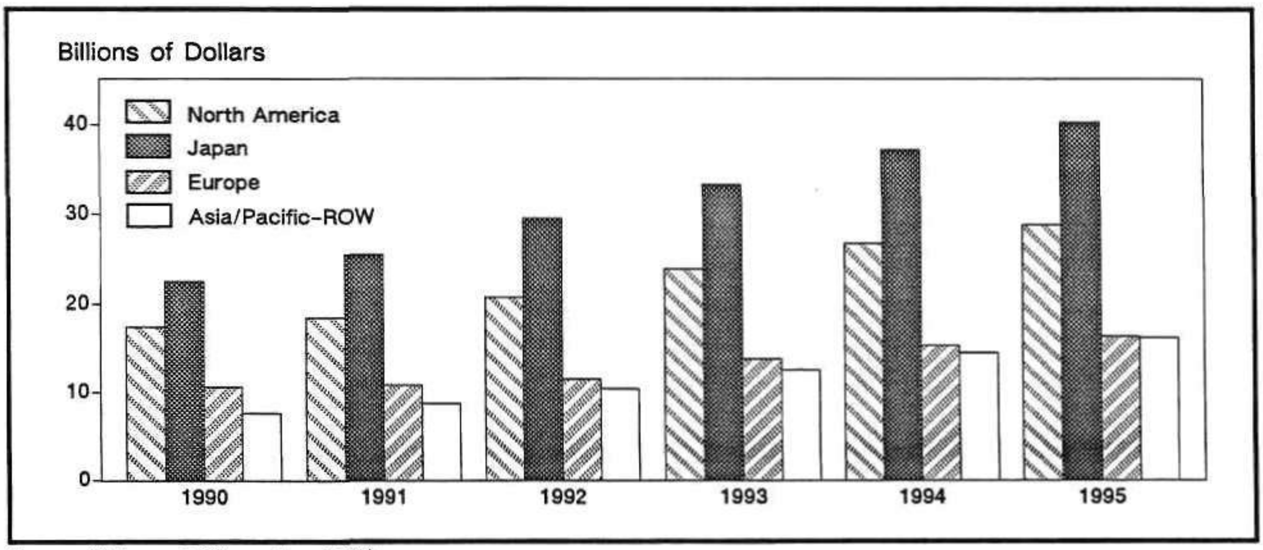
Source: Dataquest (November 1991)

Figure 1.1
Worldwide Semiconductor Consumption
Merchant Market—Historical



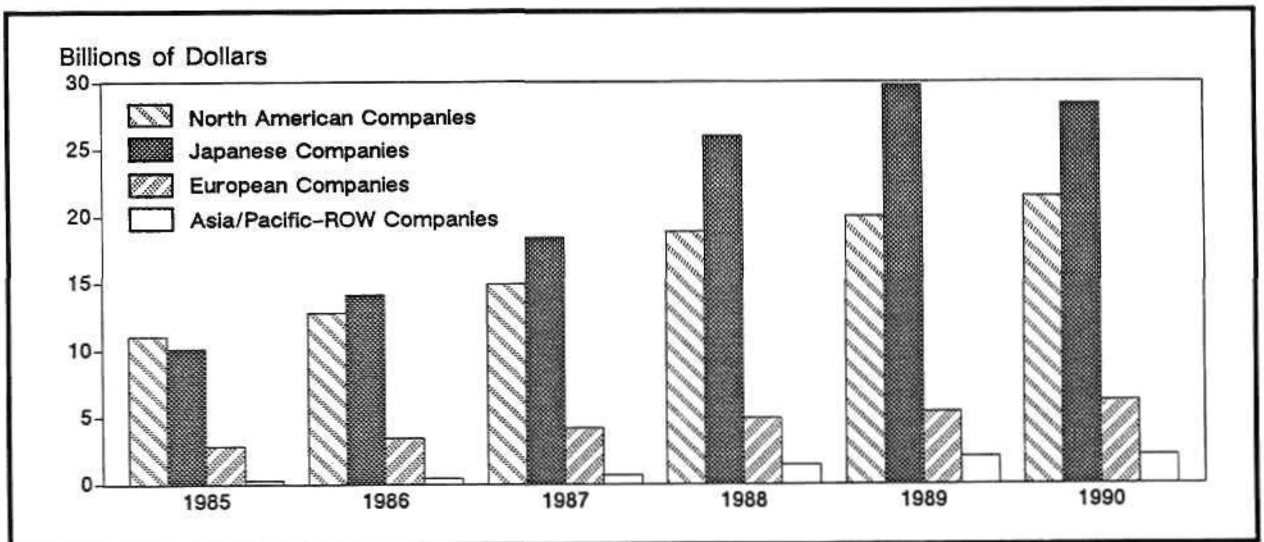
Source: Dataquest (November 1991)

Figure 1.2
Worldwide Semiconductor Consumption
Merchant Market—Forecast



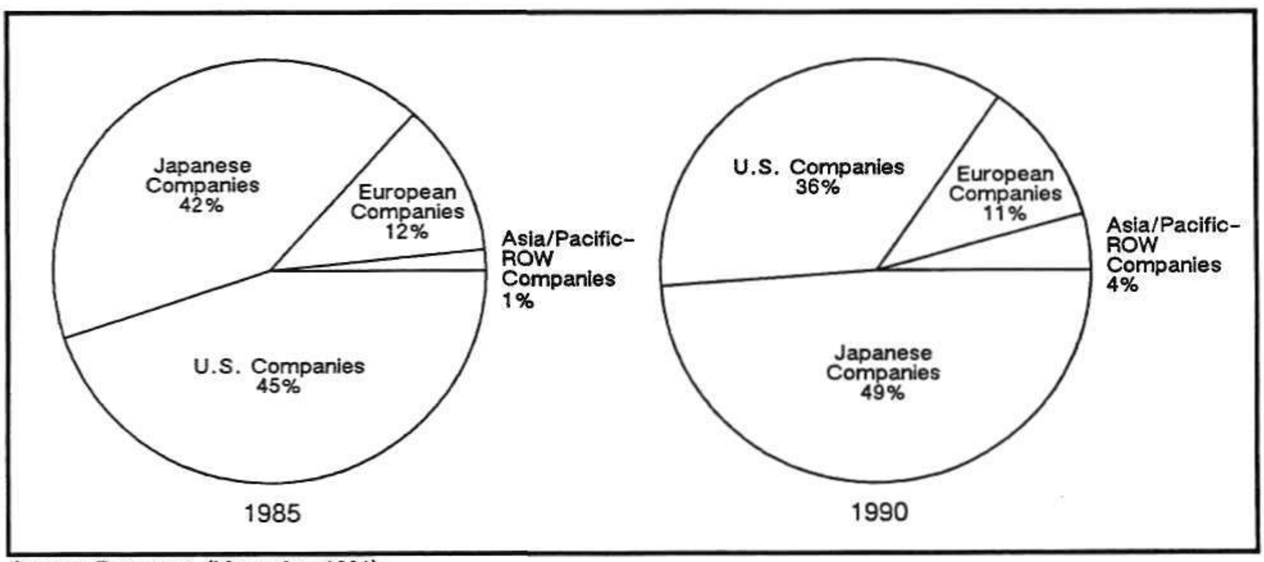
Source: Dataquest (November 1991)

Figure 1.3
Merchant Semiconductor Company Sales
Worldwide Market Share—Historical



Source: Dataquest (November 1991)

Figure 1.4
Merchant Semiconductor Company Sales
Worldwide Market Share



Source: Dataquest (November 1991)

Chapter 2

Semiconductor Production Forecast

Introduction

This section presents data on worldwide semiconductor production by region. Semiconductor production is defined by the place where the wafers are fabricated, and regional semiconductor production includes all production in the region including merchant and captive producers and all foreign producers. For instance, North American semiconductor production includes IBM and Delco fabs as well as Japanese and European fabs in the United States.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Semiconductor Production

Table 2.1 shows historical semiconductor production for the years 1985 through 1990, and Table 2.2 shows forecast production for the period from 1990 through 1995. Figures 2.1 and 2.2 illustrate the same data. Figure 2.3 depicts the five-year trend for regional production; it shows percent production by region in 1985 and in 1990.

Table 2.1
Worldwide Semiconductor Production by Region—Historical
Merchant and Captive Semiconductor Manufacturers
(Millions of U.S. Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
North America							
Merchant	10,411	12,129	14,116	17,326	18,480	19,621	13.5
Captive	2,243	2,327	2,596	2,845	3,244	3,458	9.0
Total North America	12,654	14,456	16,712	20,171	21,724	23,078	12.8
Japan							
Merchant	10,500	14,524	18,824	26,388	30,000	28,698	22.3
Captive	151	162	180	305	440	523	28.2
Total Japan	10,651	14,686	19,004	26,693	30,440	29,221	22.4
Europe							
Merchant	3,024	3,426	4,223	5,277	5,995	7,000	18.3
Captive	379	405	451	512	557	566	8.4
Total Europe	3,403	3,831	4,674	5,789	6,552	7,566	17.3
Asia/Pacific-ROW							
Merchant	406	756	1,088	1,868	2,738	2,906	48.2
Captive	0	0	0	0	0	0	
Total A/P-ROW	406	756	1,088	1,868	2,738	2,906	48.2
Total Worldwide							
Merchant	24,341	30,834	38,251	50,859	57,213	58,225	19.1
Captive	2,773	2,894	3,227	3,662	4,241	4,547	10.4
Total Production	27,114	33,728	41,478	54,521	61,454	62,771	18.3
Percent Growth	-16	24	23	31	13	2	

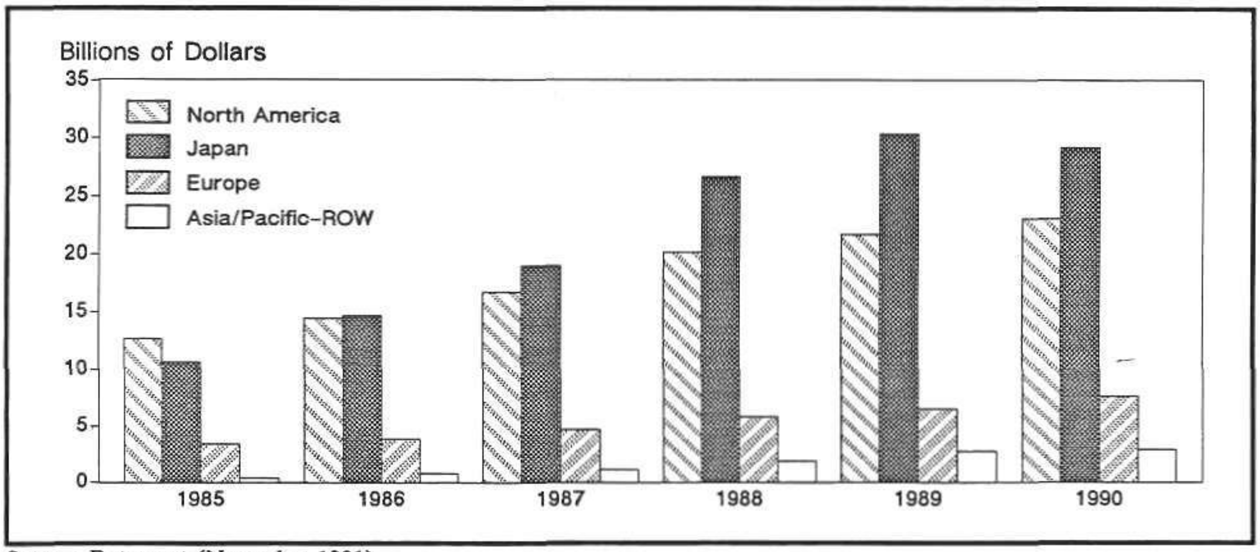
Source: Dataquest (November 1991)

Table 2.2
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Forecast
(Millions of U.S. Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America							
Merchant	19,621	21,268	24,113	27,919	30,769	33,238	11.1
Captive	3,458	4,157	4,849	5,532	6,217	6,447	13.3
Total North America	23,078	25,425	28,962	33,451	36,986	39,685	11.5
Japan							
Merchant	28,698	31,319	35,373	40,602	45,658	49,104	11.3
Captive	523	671	818	931	1,008	1,025	14.4
Total Japan	29,221	31,990	36,191	41,534	46,666	50,128	11.4
Europe							
Merchant	7,000	7,747	8,759	10,233	11,686	12,937	13.1
Captive	566	756	889	1,054	1,182	1,218	16.6
Total Europe	7,566	8,503	9,648	11,288	12,868	14,155	13.3
Asia/Pacific-ROW							
Merchant	2,906	3,312	3,968	4,783	5,674	6,384	17.0
Captive	0	0	0	0	0	0	
Total A/P-ROW	2,906	3,312	3,968	4,783	5,674	6,384	17.0
Total Worldwide							
Merchant	58,225	63,647	72,213	83,538	93,787	101,662	11.8
Captive	4,547	5,584	6,556	7,518	8,407	8,691	13.8
Total Production	62,771	69,231	78,769	91,056	102,194	110,353	11.9
Percent Growth	2	10	14	16	12	8	

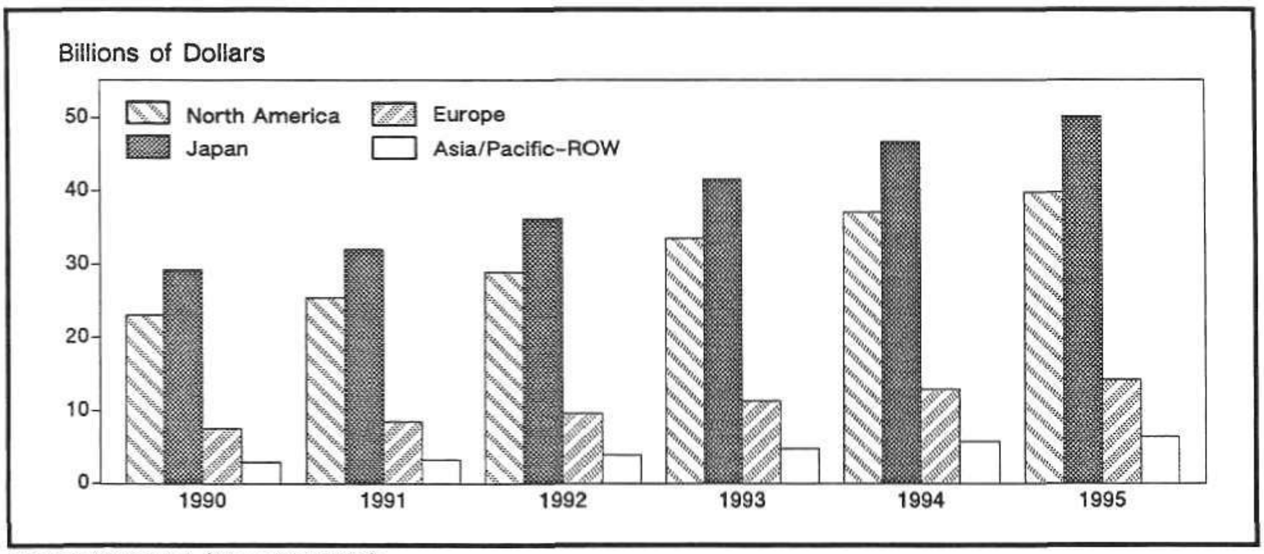
Source: Dataquest (November 1991)

Figure 2.1
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Historical



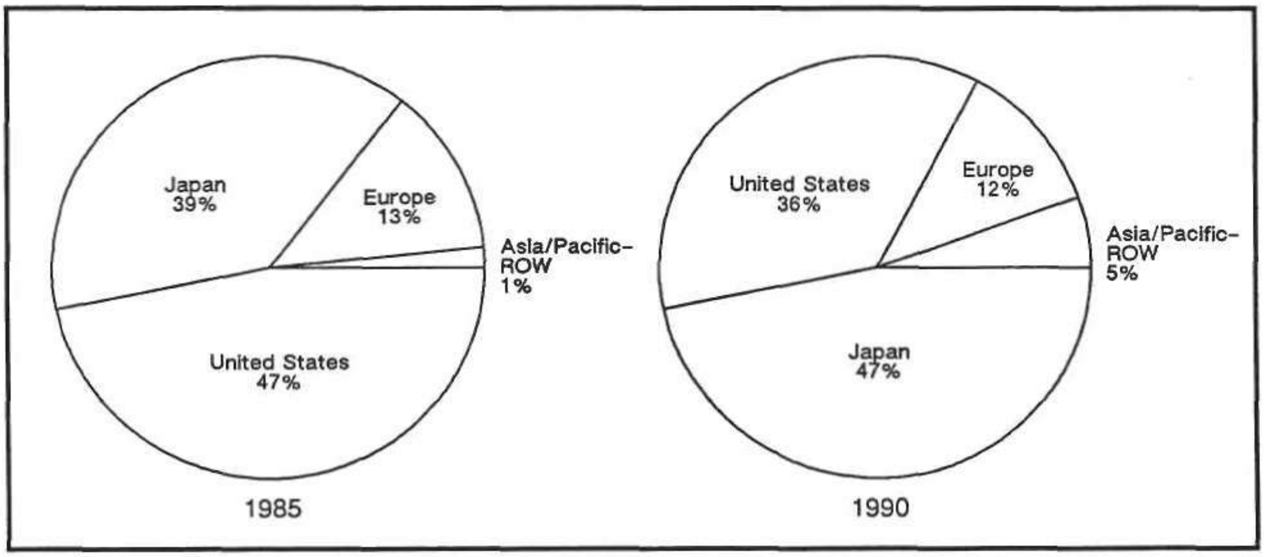
Source: Dataquest (November 1991)

Figure 2.2
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Forecast



Source: Dataquest (November 1991)

Figure 2.3
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers



Source: Dataquest (November 1991)

Chapter 3

Capital Spending Forecast

Introduction

This section presents data on worldwide semiconductor capital spending by region. Capital spending in a region includes spending by all semiconductor producers in that region, including spending by merchant and captive producers as well as foreign producers. For instance, capital spending in North America includes spending by Delco, IBM, and Japanese and European semiconductor companies building wafer fabrication, assembly, and test facilities in the United States.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Capital Spending Forecast

Table 3.1 shows historical capital spending for the years 1985 through 1990, and Table 3.2 shows forecast spending for the period from 1990 through 1995. Figures 3.1 and 3.2 illustrate the same data graphically. Figure 3.3 depicts the five-year trend for regional capital spending; it shows percentage of spending by region in 1985 and in 1990.

Table 3.1
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Companies—Historical
(Millions of U.S. Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
North America							
Merchant	1,957	1,438	1,911	2,649	3,004	3,208	10.4
Captive	672	644	683	785	871	880	5.5
Total North America	2,629	2,082	2,594	3,434	3,875	4,088	9.2
Japan							
Merchant	3,292	1,802	2,345	4,440	5,363	5,271	9.9
Captive	44	43	87	170	110	154	28.5
Total Japan	3,336	1,845	2,432	4,610	5,473	5,425	10.2
Europe							
Merchant	711	653	796	864	1,053	1,412	14.7
Captive	89	112	79	120	158	100	2.4
Total Europe	800	765	875	984	1,211	1,512	13.6
Asia/Pacific-ROW							
Merchant	534	437	534	1,060	1,905	1,495	22.9
Captive	0	0	0	0	0	0	
Total A/P-ROW	534	437	534	1,060	1,905	1,495	22.9
Total Worldwide							
Merchant	6,494	4,330	5,586	9,013	11,324	11,385	11.9
Captive	805	799	849	1,075	1,139	1,134	7.1
Total Capital Spending	7,299	5,129	6,435	10,088	12,463	12,519	11.4
Percent Growth	-17	-30	25	57	24	0	

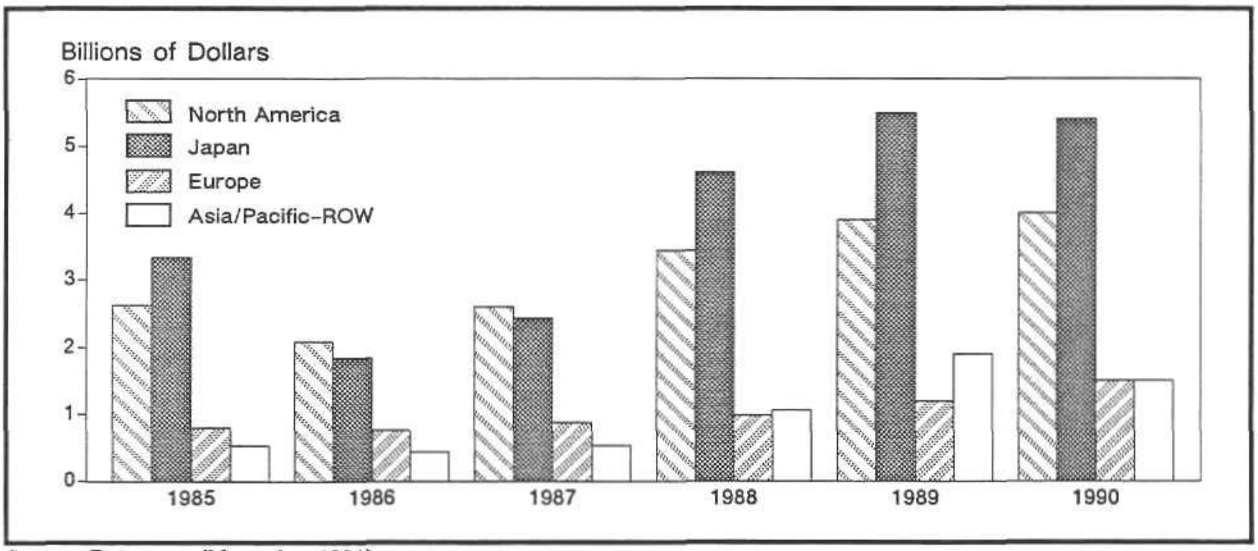
Source: Dataquest (November 1991)

Table 3.2
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Companies—Forecast
(Millions of U.S. Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America							
Merchant	3,208	3,164	2,896	3,292	3,572	3,937	4.2
Captive	880	933	925	1,060	1,215	1,280	7.8
Total North America	4,088	4,097	3,821	4,352	4,787	5,217	5.0
Japan							
Merchant	5,271	6,238	5,670	6,426	7,245	7,509	7.3
Captive	154	144	158	160	197	235	8.8
Total Japan	5,425	6,382	5,828	6,586	7,442	7,744	7.4
Europe							
Merchant	1,412	1,473	1,536	1,809	2,111	2,314	10.4
Captive	100	158	152	175	211	240	19.1
Total Europe	1,512	1,631	1,688	1,984	2,322	2,554	11.1
Asia/Pacific-ROW							
Merchant	1,495	2,084	2,543	2,825	3,248	3,573	19.0
Captive	0	0	0	0	0	0	
Total A/P-ROW	1,495	2,084	2,543	2,825	3,248	3,573	19.0
Total Worldwide							
Merchant	11,385	12,959	12,645	14,352	16,175	17,334	8.8
Captive	1,134	1,235	1,234	1,395	1,624	1,756	9.1
Total Capital Spending	12,519	14,194	13,879	15,747	17,799	19,090	8.8
Percent Growth	0	13	-2	13	13	7	

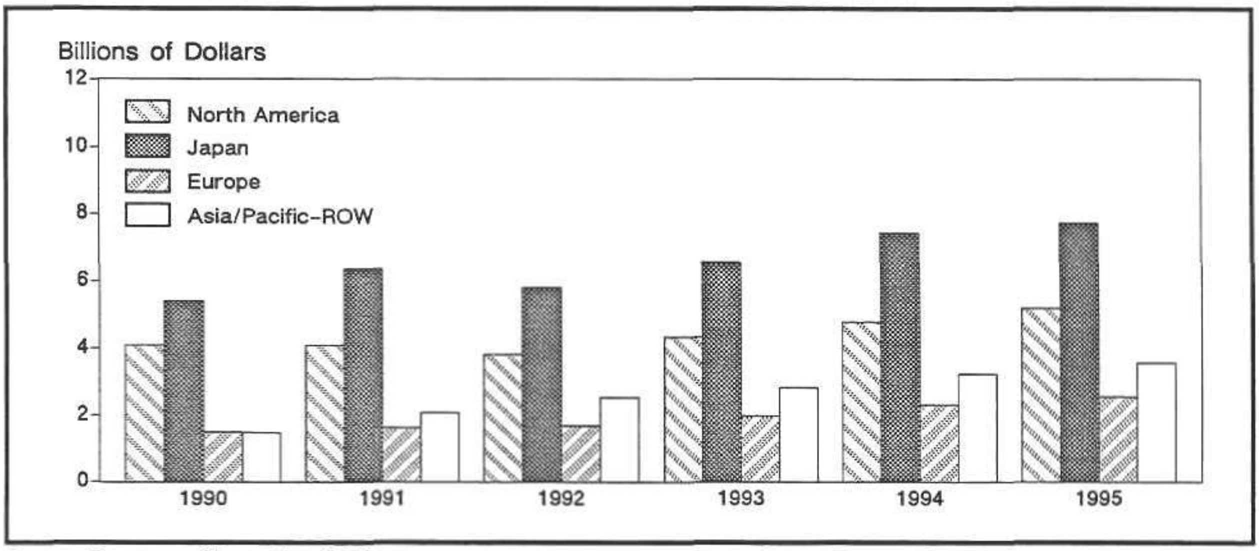
Source: Dataquest (November 1991)

Figure 3.1
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers—Historical



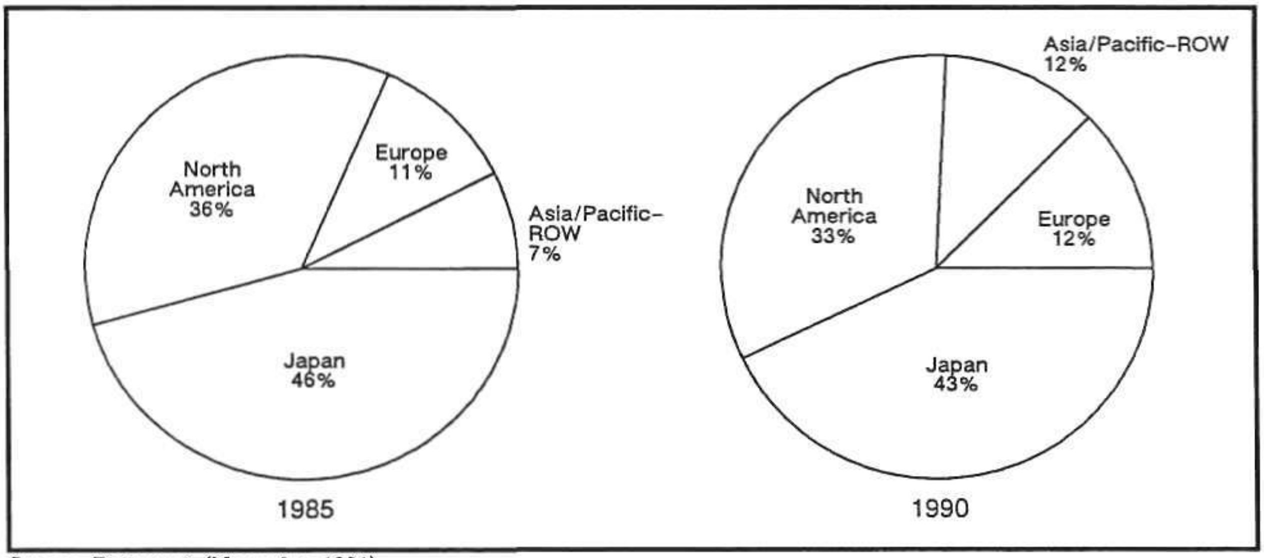
Source: Dataquest (November 1991)

Figure 3.2
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers—Forecast



Source: Dataquest (November 1991)

Figure 3.3
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers



Source: Dataquest (November 1991)

Chapter 4

Wafer Fab Equipment Forecast

Introduction

This section presents historical and forecast data on the worldwide wafer fabrication equipment market. Table 4.1 presents the historical data by equipment category for the years 1985 through 1990, and Table 4.2 shows forecast data by category for the years 1990 through 1995.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Production versus Spending

Table 4.3 summarizes the historical worldwide semiconductor production, capital spending, and wafer fab equipment expenditure for the years 1985 through 1990. Table 4.4 presents Dataquest's forecast regarding these items for the years 1990 through 1995.

Market Growth

Figure 4.1 shows year-to-year growth for semiconductor production and wafer fab equipment for the 10-year period from 1985 through 1995. Table 4.5 shows the compound annual growth rate (CAGR) forecast for semiconductor production, capital spending, and wafer fab equipment.

Table 4.1
Worldwide Wafer Fab Equipment Market—Historical
(Millions of U.S. Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1990-1995
World Fab Equipment Market	3,353	2,716	3,140	4,983	5,996	5,818	11.7
Lithography							
Contact/Proximity	48	31	25	22	23	19	-17.2
Projection Aligners	266	171	129	148	94	89	-19.7
Steppers	430	363	503	921	1,183	1,067	19.9
Direct-Write Lithography	31	68	67	69	70	71	18.2
Maskmaking Lithography	81	51	68	62	69	50	-9.1
X-Ray	2	1	0	6	5	2	-2.3
Total	858	685	791	1,228	1,444	1,297	8.6
Automatic Photoresist Processing Equipment	161	149	168	253	334	338	16.0
Etch and Clean							
Wet Process	157	161	167	277	355	350	17.4
Dry Strip	40	35	58	100	121	125	25.9
Dry Etch	300	237	307	533	669	683	17.9
Ion Milling	7	8	8	10	13	13	14.9
Total	503	441	540	920	1,157	1,172	18.4
Deposition							
Chemical Vapor Deposition	247	221	259	463	609	689	22.8
Physical Vapor Deposition	263	237	251	302	368	408	9.2
Silicon Epitaxy	72	46	36	86	75	68	-.9
Metalorganic CVD	25	31	35	42	45	42	11.3
Molecular Beam Epitaxy	53	66	68	81	72	55	.7
Total	658	602	648	973	1,170	1,262	13.9
Diffusion	207	156	145	294	330	322	9.2
Rapid Thermal Processing	15	16	18	22	28	33	17.5
Ion Implantation							
Medium Current	125	55	61	118	131	116	-1.4
High Current	167	55	107	241	301	250	8.4
High Voltage	2	10	18	18	25	5	18.9
Total	293	119	186	377	457	371	4.8
Process Control							
CD (Optical & SEM)	20	44	89	151	150	151	49.6
Wafer Inspection	34	42	58	101	117	99	23.5
Other Process Control	360	287	286	355	404	368	.4
Total	415	374	432	607	672	618	8.3
Factory Automation	125	81	99	130	195	216	11.6
Other Equipment	118	96	112	177	211	189	10.0
Total World Fab Equipment	3,353	2,716	3,140	4,983	5,996	5,818	11.7
Percent Change	-5	-19	16	59	20	-3	

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (November 1991)

Table 4.2
Worldwide Wafer Fab Equipment Market—Forecast
(Millions of U.S. Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
World Fab Equipment Market	5,818	6,026	5,568	6,450	7,885	8,833	8.7
Lithography							
Contact/Proximity	19	17	17	16	16	15	-4.2
Projection Aligners	89	76	65	69	76	78	-2.6
Steppers	1,067	1,042	955	1,113	1,404	1,610	8.6
Direct-Write Lithography	50	55	63	75	85	88	11.9
Maskmaking Lithography	71	72	76	89	112	126	12.3
X-Ray	2	8	12	25	38	55	102.7
Total	1,297	1,270	1,188	1,387	1,730	1,972	8.7
Automatic Photoresist Processing Equipment	338	350	315	356	428	483	7.4
Etch and Clean							
Wet Process	350	370	361	408	477	525	8.4
Dry Strip	125	130	120	145	180	200	9.8
Dry Etch	683	715	650	775	950	1,050	9.0
Ion Milling	13	15	12	15	18	20	9.0
Total	1,172	1,230	1,143	1,343	1,625	1,795	8.9
Deposition							
Chemical Vapor Deposition	689	735	675	775	950	1,075	9.3
Physical Vapor Deposition	408	435	400	450	550	625	8.9
Silicon Epitaxy	68	75	58	53	71	61	-2.2
Metalorganic CVD	42	44	42	49	61	66	9.2
Molecular Beam Epitaxy	55	53	50	57	66	71	5.5
Total	1,262	1,342	1,225	1,384	1,698	1,898	8.5
Diffusion	322	325	270	330	400	475	8.1
Rapid Thermal Processing	33	40	45	65	80	100	24.9
Ion Implatation							
Medium Current	116	123	106	116	144	153	5.6
High Current	250	266	238	272	338	373	8.4
High Voltage	5	15	18	30	38	42	53.4
Total	371	405	362	418	520	568	8.9
Process Control							
CD (Optical & SEM)	151	160	150	175	210	241	9.9
Wafer Inspection	99	71	74	87	103	116	3.2
Other Process Control	368	398	380	432	520	567	9.0
Total	618	629	603	694	833	924	8.4
Factory Automation	216	232	234	266	319	335	9.2
Other Equipment	189	204	183	206	252	282	8.3
Total World Fab Equipment	5,818	6,026	5,568	6,450	7,885	8,833	8.7
Percent Change	-3	4	-8	16	22	12	

Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (November 1991)

Table 4.3
Worldwide Semiconductor Production, Capital Spending, and Wafer Fab Equipment—Historical, 1985-1990 (Millions of U.S. Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
Semiconductor Production*	27,114	33,728	41,478	54,521	61,453	62,771	18.3
Capital Spending	7,299	5,129	6,435	10,088	12,463	12,519	11.4
Wafer Fab Equipment	3,353	2,716	3,140	4,983	5,996	5,818	11.7

*Semiconductor production includes worldwide merchant and captive production.
Source: Dataquest (November 1991)

Table 4.4
Worldwide Semiconductor Production, Capital Spending, and Wafer Fab Equipment—Forecast (Millions of U.S. Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Semiconductor Production*	62,771	69,231	78,769	91,056	102,194	110,353	11.9
Capital Spending	12,519	14,194	13,879	15,747	17,799	19,090	8.8
Wafer Fab Equipment	5,818	6,026	5,568	6,450	7,885	8,833	8.7

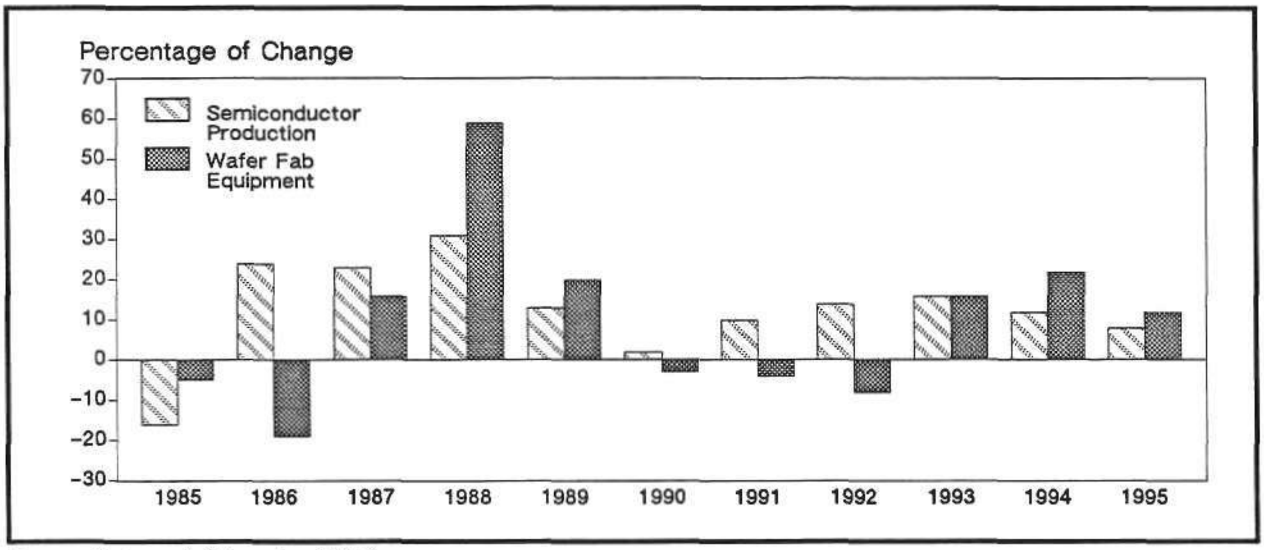
*Semiconductor production includes worldwide merchant and captive production.
Source: Dataquest (November 1991)

Table 4.5
Estimated 10-Year CAGR, 1985-1995

	CAGR (%) 1985-1995
Semiconductor Production	15.1
Capital Spending	10.2
Wafer Fab Equipment	10.2

Source: Dataquest (November 1991)

Figure 4.1
Estimated Semiconductor Production and Wafer Fab Equipment
10-Year Growth Pattern, 1985-1995



Source: Dataquest (November 1991)

Chapter 5

Silicon Wafer Forecast

Tables 5.1 and 5.2 present the historical and forecast consumption of silicon in millions of square inches by region. Tables 5.3 and 5.4 present historical and forecast information on merchant epitaxial wafer consumption by region.

Table 5.1
Silicon and Epitaxial Wafer Consumption by Region—Historical
(Millions of Square Inches)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
North America	398	405	442	546	582	648	10.2
Percent Growth	-43.7	1.9	8.9	23.7	6.5	11.4	
Japan	588	642	670	777	923	1,017	11.6
Percent Growth	-11.0	9.1	4.4	16.0	18.8	10.1	
Europe	148	155	172	196	231	227	8.9
Percent Growth	-7.5	4.6	10.8	14.1	17.8	-1.7	
Asia/Pacific-ROW	43	64	70	84	114	145	27.5
Percent Growth	-15.7	47.9	9.3	20.6	35.9	27.0	
Worldwide	1,177	1,266	1,353	1,604	1,851	2,037	11.6
Percent Growth	-25.5	7.5	6.9	18.5	15.4	10.1	

Source: Dataquest (November 1991)

Table 5.2
Silicon and Epitaxial Wafer Consumption by Region—Forecast
(Millions of Square Inches)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America	648	645	665	705	769	810	4.6
Percent Growth	11.4	-.5	3.1	6.0	9.1	5.3	
Japan	1,017	1,102	1,175	1,258	1,367	1,480	7.8
Percent Growth	10.1	8.4	6.6	7.1	8.7	8.3	
Europe	227	218	212	225	257	292	6.1
Percent Growth	-1.7	-4.0	-2.8	6.1	14.2	13.6	
Asia/Pacific-ROW	145	168	185	213	247	281	14.2
Percent Growth	27.0	16.1	10.1	15.1	16.0	13.8	
Worldwide	2,037	2,133	2,237	2,401	2,640	2,863	7.0
Percent Growth	10.1	4.7	4.9	7.3	10.0	8.4	

Source: Dataquest (November 1991)

Table 5.3
Merchant Epitaxial Wafer Consumption by Region—Historical
(Millions of Square Inches)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
North America	25	29	42	56	82	97	31.1
Percent Growth	-43.7	16.0	44.8	33.3	46.4	18.3	
Japan	49	65	71	75	83	93	13.7
Percent Growth	-11.0	32.7	9.2	5.6	10.7	12.0	
Europe	6	9	12	15	18	19	25.9
Percent Growth	-7.5	50.0	33.3	25.0	20.0	5.6	
Asia/Pacific-ROW	2	2	3	4	5	5	20.1
Percent Growth	-15.7	0	50.0	33.3	25.0	0	
Worldwide	82	105	128	150	188	214	21.1
Percent Growth	-25.5	28.0	21.9	17.2	25.3	13.8	

Source: Dataquest (November 1991)

Table 5.4
Merchant Epitaxial Wafer Consumption by Region—Forecast
(Millions of Square Inches)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America	97	105	110	123	137	145	8.4
Percent Growth	18.3	8.2	4.8	11.8	11.4	5.8	
Japan	93	97	104	116	122	125	6.1
Percent Growth	12.0	4.3	7.2	11.5	5.2	2.5	
Europe	19	18	18	22	26	26	6.2
Percent Growth	5.6	-3.2	-1.6	21.5	16.4	.4	
Asia/Pacific-ROW	5	6	7	8	9	11	17.1
Percent Growth	0	12.0	17.9	16.7	11.7	27.9	
Worldwide	214	226	239	269	293	307	7.5
Percent Growth	13.2	5.6	5.6	12.6	9.1	4.6	

Source: Dataquest (November 1991)

Appendix

Exchange Rates

Table A.1 lists the exchange rates per dollar for Japanese yen and European currency units (ECUs) for the period from 1985 to 1991. Exchange rate variations should be kept in mind when interpreting yearly changes in the 1985 to 1991 data presented in this booklet. However, the forecast years (1992 to 1995) are assumed to have constant exchange rates.

Table A.1
Exchange Rates per Dollar for Japanese Yen and ECU: 1985-1991

	1985	1986	1987	1988	1989	1990	1991 3Q
Yen/$	238	167	144	130	138	144	136
Percent Change		-30	-14	-10	6	4	-6
ECU/$	1.31	1.02	0.87	0.84	0.92	0.79	0.85
Percent Change		-22	-15	-3	10	-14	8

Source: Dataquest (November 1991)

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Semiconductor Equipment, Manufacturing, and Materials Forecast

July 1991

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Semiconductor Equipment, Manufacturing, and Materials

Semiconductor Equipment, Manufacturing, and Materials Forecast

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Source: Dataquest

Published by Dataquest Incorporated

Table of Contents

This booklet is divided into six major sections.

Chapter 1

Semiconductor Consumption Forecast

Introduction

This section presents data on the worldwide semiconductor market by region. The regional semiconductor market, or regional semiconductor consumption, deals with where chips are consumed; this contrasts with regional semiconductor production, which deals with where chips are made. The data presented here are for the merchant market and do not include the value of chips made by captive semiconductor manufacturers for internal use.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Semiconductor Consumption

Table 1.1 shows the historical regional semiconductor consumption for the years 1985 through 1990; it also breaks down the merchant market by nationality of the merchant semiconductor companies. Table 1.2 shows forecast semiconductor consumption by region for the period from 1990 through 1995. Figures 1.1 and 1.2 graphically illustrate the data from Tables 1.1 and 1.2. Figure 1.3 depicts the share of the worldwide market by nationality of semiconductor company for the period from 1985 through 1990. Figure 1.4 illustrates worldwide market share by nationality of producer, covering the years 1985 and 1990.

Table 1.1
Worldwide Semiconductor Consumption by Region
Sales by Merchant Semiconductor Companies in the Region—Historical
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990	Market Share (%) 1990
North America							
U.S. Companies	7,380	8,566	9,671	11,146	11,715	11,942	68.7
Japanese Companies	1,279	1,434	2,110	3,277	4,574	3,777	21.7
European Companies	731	751	913	1,006	1,025	1,074	6.2
Asia/Pacific Companies	28	93	164	415	623	593	3.4
Total North American Market	9,418	10,844	12,858	15,844	17,937	17,386	100.0
Japan							
U.S. Companies	695	933	1,249	1,965	2,162	2,402	10.7
Japanese Companies	7,387	10,851	13,588	18,630	20,628	19,825	88.1
European Companies	60	63	70	115	130	164	0.7
Asia/Pacific Companies	7	8	20	62	77	117	0.5
Total Japanese Market	8,149	11,855	14,927	20,772	22,997	22,508	100.0
Europe							
U.S. Companies	2,428	2,580	2,845	3,664	4,032	4,492	42.1
Japanese Companies	549	715	900	1,466	1,924	1,814	17.0
European Companies	1,806	2,282	2,714	3,196	3,562	4,117	38.6
Asia/Pacific Companies	12	10	39	165	237	238	2.2
Total European Market	4,795	5,587	6,498	8,491	9,755	10,661	100.0
Asia/Pacific-ROW							
U.S. Companies	548	730	1,165	1,811	2,069	2,701	35.2
Japanese Companies	929	1,160	1,852	2,569	2,683	2,961	38.6
European Companies	254	347	503	600	726	851	11.1
Asia/Pacific Companies	248	311	448	772	1,046	1,157	15.1
Total Asia/Pacific-ROW Market	1,979	2,548	3,968	5,752	6,524	7,670	100.0
Worldwide							
U.S. Companies	11,051	12,809	14,930	18,586	19,978	21,537	37.0
Japanese Companies	10,144	14,160	18,450	25,942	29,809	28,377	48.7
European Companies	2,851	3,443	4,200	4,917	5,443	6,206	10.7
Asia/Pacific Companies	295	422	671	1,414	1,983	2,105	3.6
Total Worldwide Market	24,341	30,834	38,251	50,859	57,213	58,225	100.0
Percent Growth	-16	27	24	33	12	2	

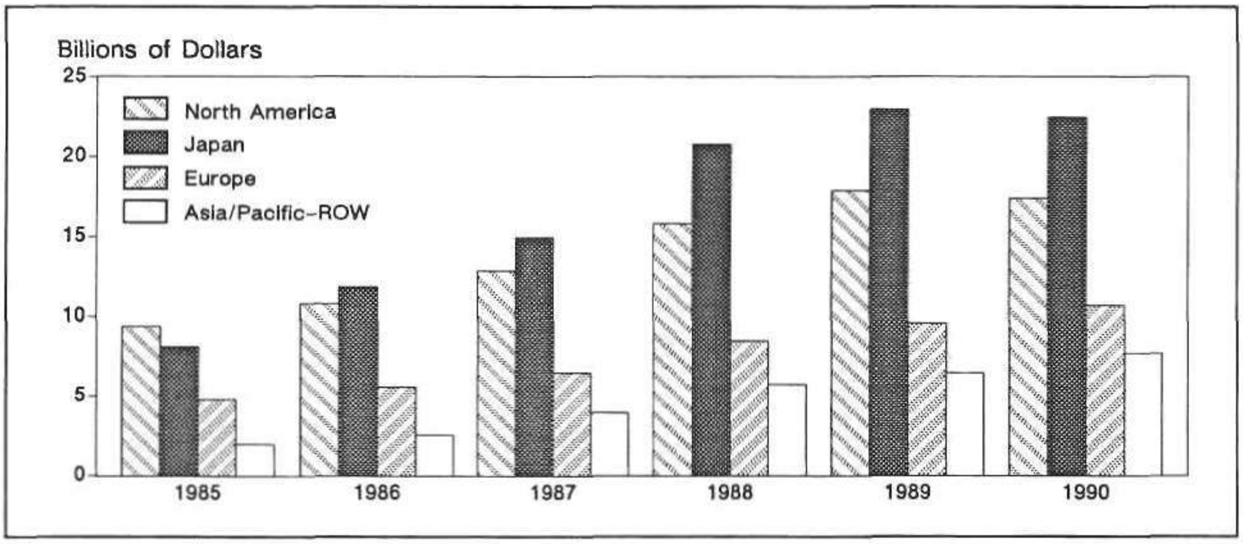
Source: Dataquest (July 1991)

Table 1.2
Worldwide Semiconductor Consumption by Region
Merchant Semiconductor Company Sales Only—Forecast
(Millions of Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America	17,386	18,761	21,386	24,810	26,895	28,001	10
Percent Growth	-3.1	7.9	14.0	16.0	8.4	4.1	
Japan	22,508	26,354	30,762	34,655	38,200	40,762	13
Percent Growth	-2.1	17.1	16.7	12.7	10.2	6.7	
Europe	10,661	12,274	14,416	17,313	19,326	20,764	14
Percent Growth	9.3	15.1	17.5	20.1	11.6	7.4	
Asia/Pacific	7,670	8,834	10,625	13,025	14,804	16,004	16
Percent Growth	17.6	15.2	20.3	22.6	13.7	8.1	
Total Worldwide Market	58,225	66,223	77,189	89,803	99,225	105,531	13
Percent Growth	1.8	13.7	16.6	16.3	10.5	6.4	

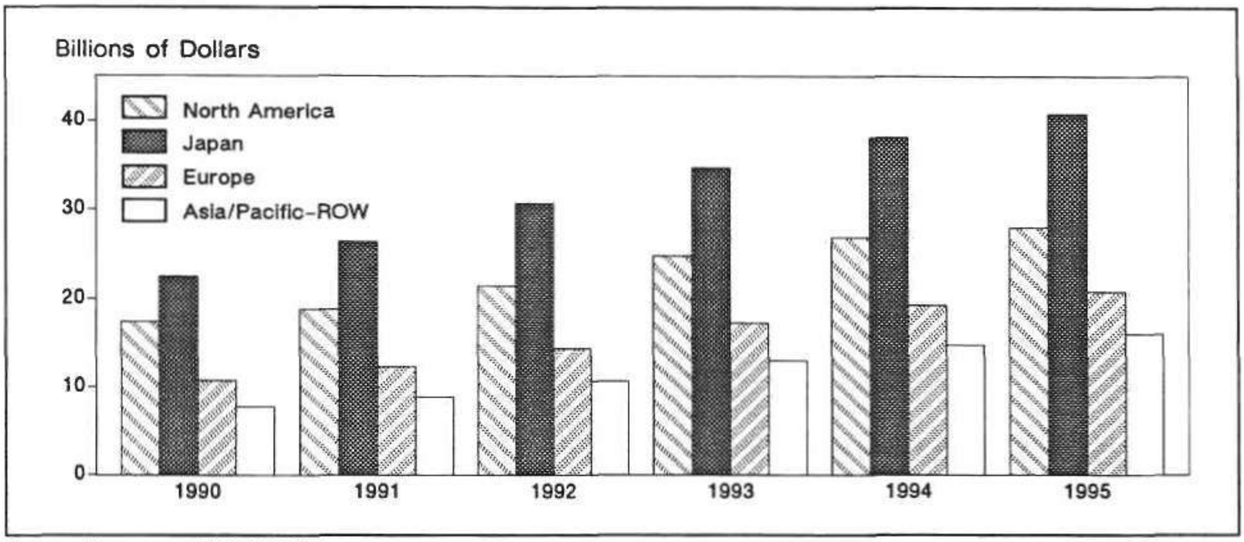
Source: Dataquest (July 1991)

Figure 1.1
Worldwide Semiconductor Consumption
Merchant Market—Historical



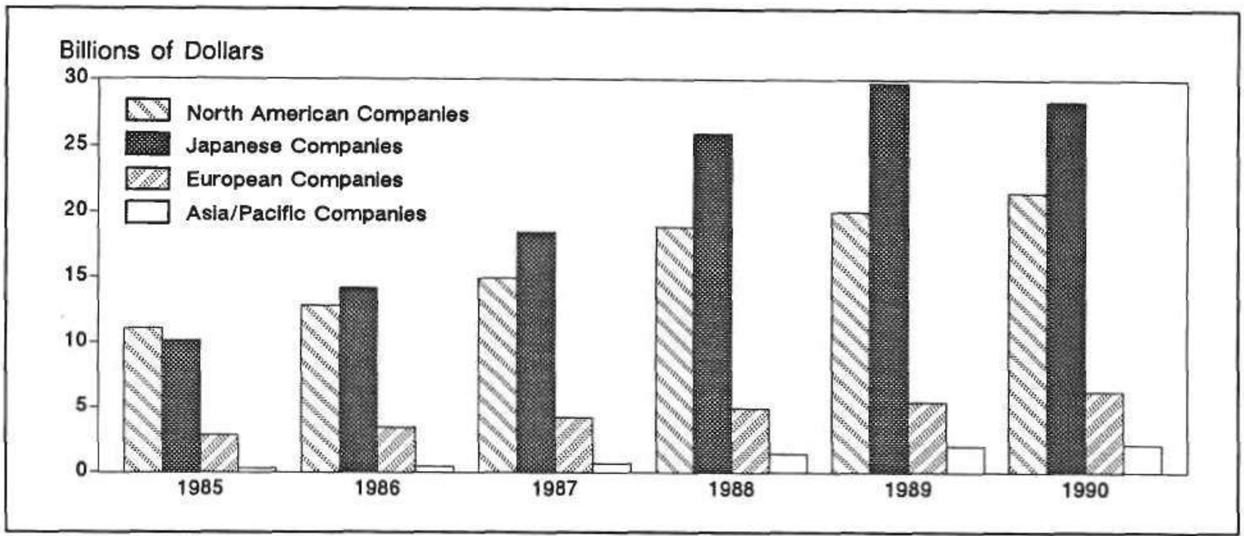
Source: Dataquest (July 1991)

Figure 1.2
Worldwide Semiconductor Consumption
Merchant Market—Forecast



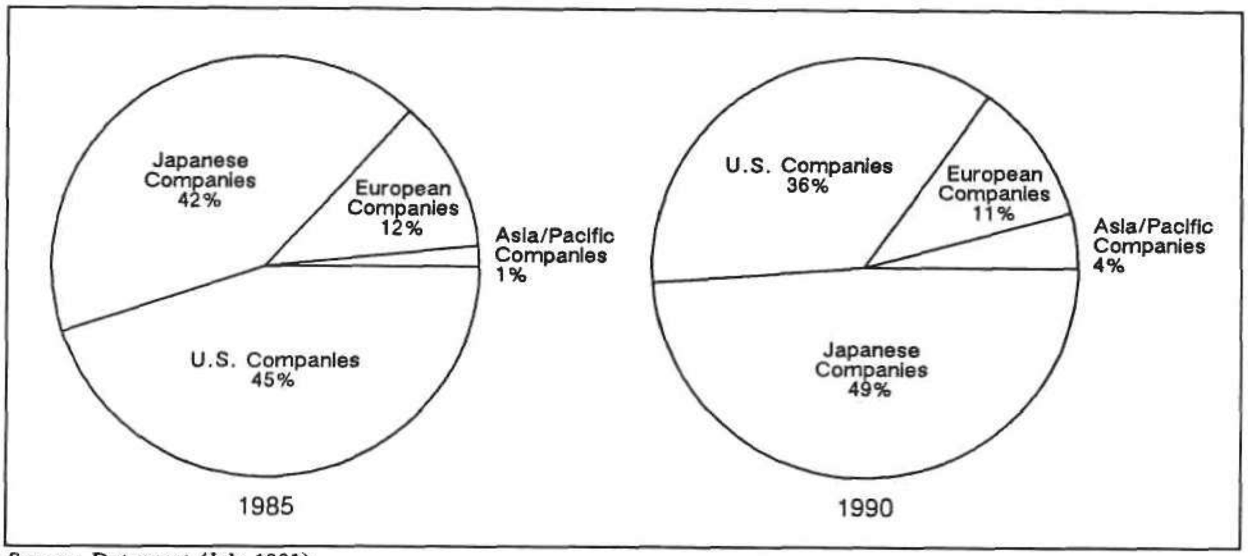
Source: Dataquest (July 1991)

Figure 1.3
Merchant Semiconductor Company Sales
Worldwide Market Share—Historical



Source: Dataquest (July 1991)

Figure 1.4
Merchant Semiconductor Company Sales
Worldwide Market Share



Source: Dataquest (July 1991)

Chapter 2

Semiconductor Production Forecast

Introduction

This section presents data on worldwide semiconductor production by region. Semiconductor production is defined by the place where the wafers are fabricated, and regional semiconductor production includes all production in the region including merchant and captive producers and all foreign producers. For instance, North American semiconductor production includes IBM and Delco fabs as well as Japanese and European fabs in the United States.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Semiconductor Production

Table 2.1 shows historical semiconductor production for the years 1985 through 1990, and Table 2.2 shows forecast production for the period from 1990 through 1995. Figures 2.1 and 2.2 illustrate the same data. Figure 2.3 depicts the five-year trend for regional production; it shows percent production by region in 1985 and in 1990.

Table 2.1
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Historical
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
North America							
Merchant	10,411	12,129	14,116	17,326	18,480	19,621	13.5
Captive	2,243	2,327	2,596	2,845	3,244	3,458	9.0
Total North America	12,654	14,456	16,712	20,171	21,724	23,078	12.8
Japan							
Merchant	10,500	14,524	18,824	26,388	30,000	28,698	22.3
Captive	151	162	180	305	440	523	28.2
Total Japan	10,651	14,686	19,004	26,693	30,440	29,221	22.4
Europe							
Merchant	3,024	3,426	4,223	5,277	5,995	7,000	18.3
Captive	379	405	451	512	557	566	8.4
Total Europe	3,403	3,831	4,674	5,789	6,552	7,566	17.3
Asia/Pacific-ROW							
Merchant	406	756	1,088	1,868	2,738	2,906	48.2
Captive	0	0	0	0	0	0	
Total Asia/Pacific-ROW	406	756	1,088	1,868	2,738	2,906	48.2
Total Worldwide							
Merchant	24,341	30,834	38,251	50,859	57,213	58,225	19.1
Captive	2,773	2,894	3,227	3,662	4,241	4,547	10.4
Total Production	27,114	33,728	41,478	54,521	61,454	62,771	18.3
Percent Growth	-16	24	23	31	13	2	

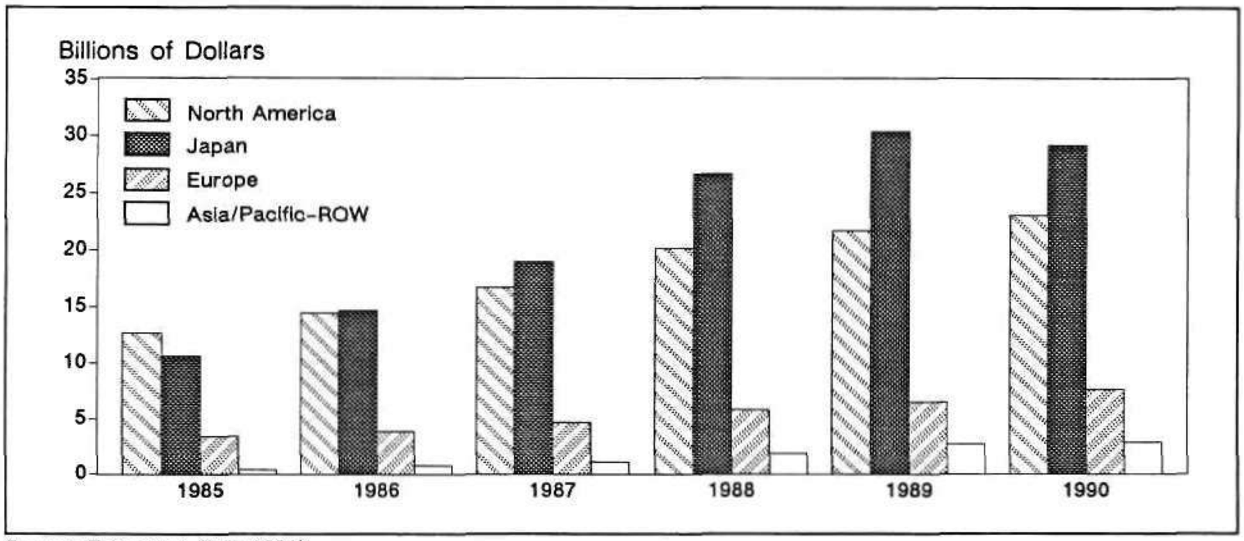
Source: Dataquest (July 1991)

Table 2.2
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Forecast
(Millions of Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America							
Merchant	19,621	22,098	26,033	30,149	32,823	34,479	11.9
Captive	3,458	4,157	4,849	5,532	6,217	6,447	13.3
Total North America	23,078	26,255	30,882	35,681	39,040	40,926	12.1
Japan							
Merchant	28,698	32,750	37,939	43,996	48,231	50,792	12.1
Captive	523	671	818	931	1,008	1,025	14.4
Total Japan	29,221	33,421	38,757	44,928	49,239	51,817	12.1
Europe							
Merchant	7,000	7,945	8,987	10,500	12,106	13,531	14.1
Captive	566	756	889	1,054	1,182	1,218	16.6
Total Europe	7,566	8,701	9,876	11,555	13,288	14,750	14.3
Asia/Pacific-ROW							
Merchant	2,906	3,430	4,230	5,157	6,065	6,729	18.3
Captive	0	0	0	0	0	0	
Total Asia/Pacific-ROW	2,906	3,430	4,230	5,157	6,065	6,729	18.3
Total Worldwide							
Merchant	58,225	66,223	77,189	89,803	99,225	105,531	12.6
Captive	4,547	5,584	6,556	7,518	8,407	8,691	13.8
Total Production	62,771	71,807	83,746	97,321	107,632	114,223	12.7
Percent Growth	2	14	17	16	11	6	

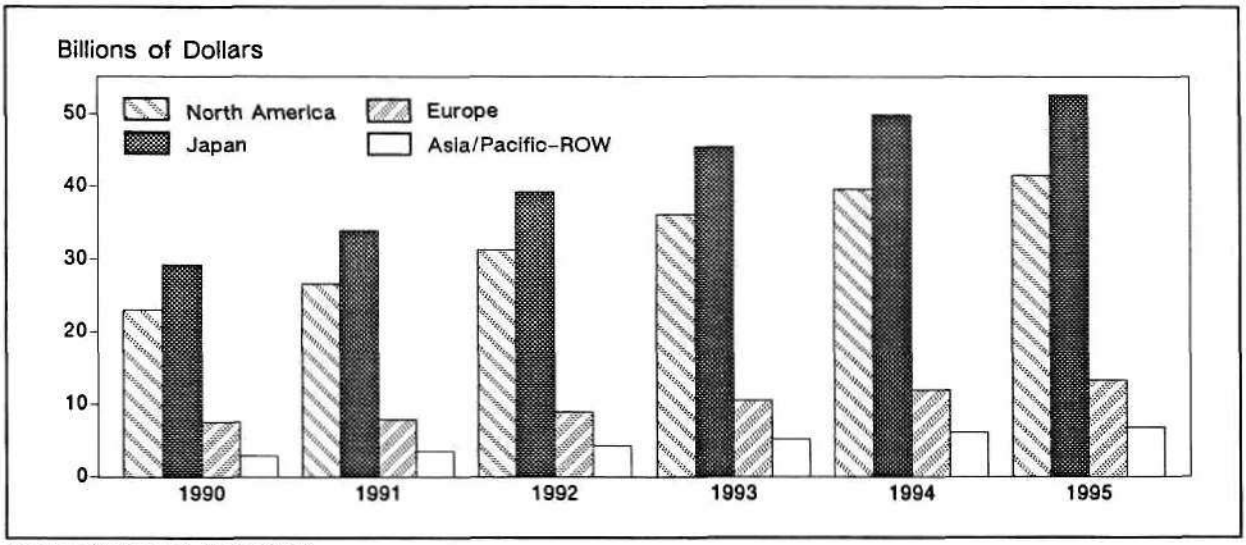
Source: Dataquest (July 1991)

Figure 2.1
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Historical



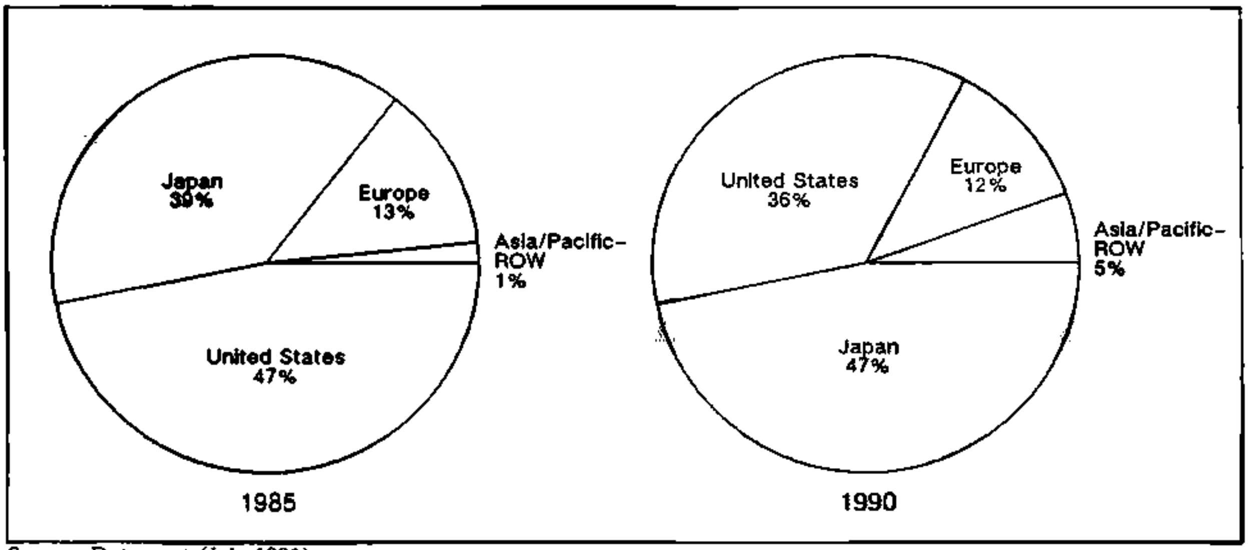
Source: Dataquest (July 1991)

Figure 2.2
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Forecast



Source: Dataquest (July 1991)

Figure 2.3
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers



Source: Dataquest (July 1991)

Chapter 3

Capital Spending Forecast

Introduction

This section presents data on worldwide semiconductor capital spending by region. Capital spending in a region includes spending by all semiconductor producers in that region, including spending by merchant and captive producers as well as foreign producers. For instance, capital spending in North America includes spending by Delco, IBM, and Japanese and European semiconductor companies building wafer fabrication, assembly, and test facilities in the United States.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Capital Spending Forecast

Table 3.1 shows historical capital spending for the years 1985 through 1990, and Table 3.2 shows forecast spending for the period from 1990 through 1995. Figures 3.1 and 3.2 illustrate the same data graphically. Figure 3.3 depicts the five-year trend for regional capital spending; it shows percentage of spending by region in 1985 and in 1990.

Table 3.1
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Companies—Historical
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
North America							
Merchant	1,957	1,438	1,911	2,649	3,004	3,208	10.4
Captive	672	644	683	785	871	880	5.5
Total North America	2,629	2,082	2,594	3,434	3,875	4,088	9.2
Japan							
Merchant	3,292	1,802	2,345	4,440	5,363	5,271	9.9
Captive	44	43	87	170	110	154	28.5
Total Japan	3,336	1,845	2,432	4,610	5,473	5,425	10.2
Europe							
Merchant	711	653	796	864	1,053	1,412	14.7
Captive	89	112	79	120	158	100	2.4
Total Europe	800	765	875	984	1,211	1,512	13.6
Asia/Pacific-ROW							
Merchant	534	437	534	1,060	1,905	1,495	22.9
Captive	0	0	0	0	0	0	
Total Asia/Pacific-ROW	534	437	534	1,060	1,905	1,495	22.9
Total Worldwide							
Merchant	6,494	4,330	5,586	9,013	11,324	11,385	11.9
Captive	805	799	849	1,075	1,139	1,134	7.1
Total Capital Spending	7,299	5,129	6,435	10,088	12,463	12,519	11.4
Percent Growth	-17	-30	25	57	24	0	

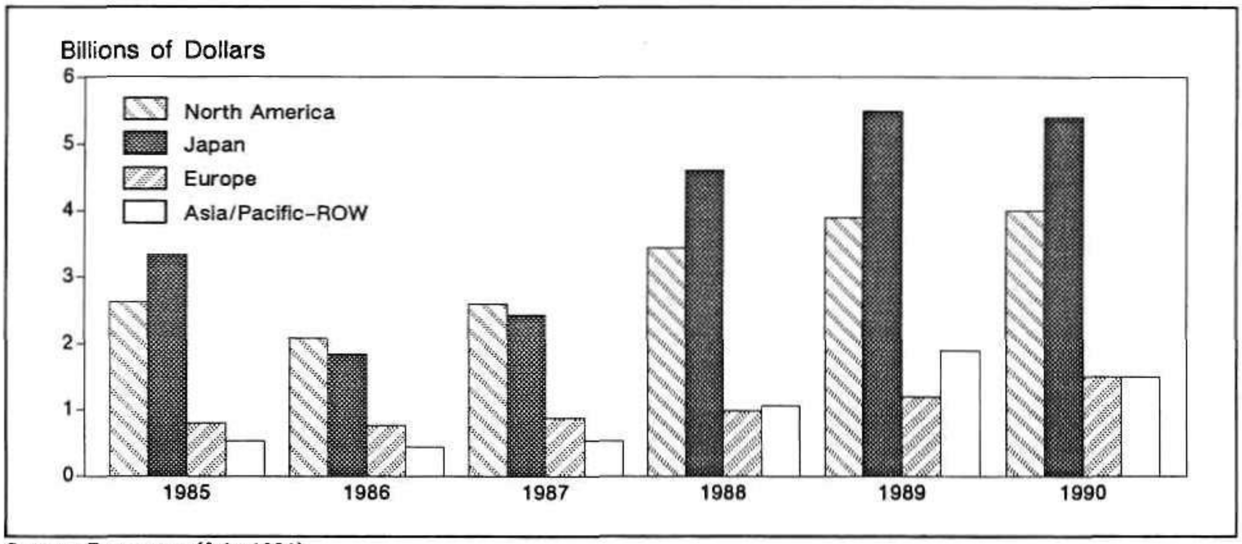
Source: Dataquest (July 1991)

Table 3.2
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Companies—Forecast
(Millions of Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America							
Merchant	3,208	3,261	4,021	5,066	5,375	5,804	12.6
Captive	880	933	1,054	1,212	1,285	1,349	8.9
Total North America	4,088	4,194	5,075	6,278	6,660	7,153	11.8
Japan							
Merchant	5,271	6,073	7,065	8,548	8,927	9,493	12.5
Captive	154	144	156	200	230	241	9.4
Total Japan	5,425	6,216	7,221	8,748	9,157	9,734	12.4
Europe							
Merchant	1,412	1,601	1,750	2,587	2,746	2,851	15.1
Captive	100	158	185	211	232	241	19.2
Total Europe	1,512	1,759	1,934	2,798	2,978	3,092	15.4
Asia/Pacific-ROW							
Merchant	1,495	1,954	2,564	3,312	3,741	3,849	20.8
Captive	0	0	0	0	0	0	
Total Asia/Pacific-ROW	1,495	1,954	2,564	3,312	3,741	3,849	20.8
Total Worldwide							
Merchant	11,385	12,888	15,399	19,513	20,790	21,997	14.1
Captive	1,134	1,235	1,394	1,623	1,748	1,833	10.1
Total Capital Spending	12,519	14,123	16,793	21,136	22,537	23,830	13.7
Percent Growth	0	13	19	26	7	6	

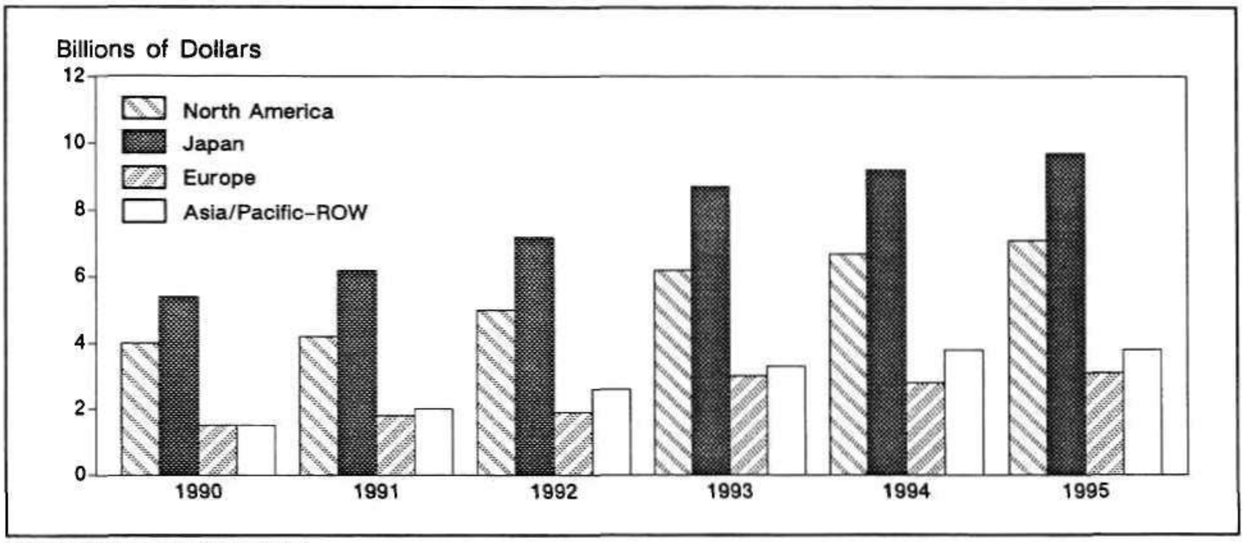
Source: Dataquest (July 1991)

Figure 3.1
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers
Historical



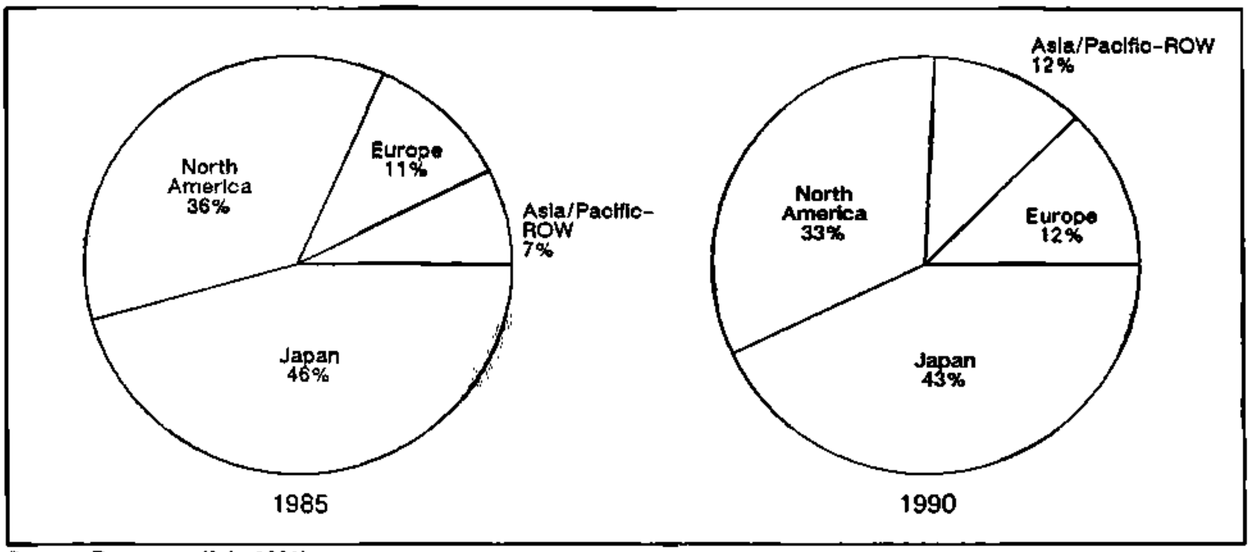
Source: Dataquest (July 1991)

Figure 3.2
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers
Forecast



Source: Dataquest (July 1991)

Figure 3.3
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers



Source: Dataquest (July 1991)

Chapter 4

Wafer Fab Equipment Forecast

Introduction

This section presents historical and forecast data on the worldwide wafer fabrication equipment market. Table 4.1 presents the historical data by equipment category for the years 1985 through 1990, and Table 4.2 shows forecast data by category for the years 1990 through 1995.

Yearly exchange rate variations can have a significant effect on the 1985 through 1991 data in the following tables. For more information about the exchange rates used and their effects, please refer to the appendix of this booklet.

Production versus Spending

Table 4.3 summarizes the historical worldwide semiconductor production, capital spending, and wafer fab equipment expenditure for the years 1985 through 1990. Table 4.4 presents Dataquest's forecast regarding these items for the years 1990 through 1995.

Market Growth

Figure 4.1 shows year-to-year growth for semiconductor production and wafer fab equipment for the 10-year period from 1985 through 1995. Table 4.5 shows the compound annual growth rate (CAGR) forecast for semiconductor production, capital spending, and wafer fab equipment.

Table 4.1
Worldwide Wafer Fab Equipment Market—Historical, 1985-1990
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
World Fab Equipment Market	3,353	2,716	3,140	4,983	5,996	5,818	11.7
Lithography							
Contact/Proximity	48	31	25	22	23	19	-17.2
Projection Aligners	266	171	129	148	94	89	-19.7
Steppers	430	363	503	921	1,183	1,067	19.9
Direct-Write Lithography	31	68	67	69	70	71	18.2
Maskmaking Lithography	81	51	68	62	69	50	-9.1
X-Ray	2	1	0	6	5	2	-2.3
Total	858	685	791	1,228	1,444	1,297	8.6
Automatic Photoresist Processing Equipment	161	149	168	253	334	338	16.0
Etch and Clean							
Wet Process	157	161	167	277	355	350	17.4
Dry Strip	40	35	58	100	121	125	25.9
Dry Etch*	306	245	315	543	682	696	17.9
Total	503	441	540	920	1,157	1,172	18.4
Deposition							
Chemical Vapor Deposition	247	221	259	463	609	689	22.8
Physical Vapor Deposition	263	237	251	302	368	408	9.2
Silicon Epitaxy	72	46	36	86	75	68	-.9
Metalorganic CVD	25	31	35	42	45	42	11.3
Molecular Beam Epitaxy	53	66	68	81	72	55	.7
Total	658	602	648	973	1,170	1,262	13.9
Diffusion	207	156	145	294	330	322	9.2
Rapid Thermal Processing	15	16	18	22	28	33	17.5
Ion Implantation							
Medium Current	125	55	61	118	131	116	-1.4
High Current	167	55	107	241	301	250	8.4
High Voltage	2	10	18	18	25	5	18.9
Total	293	119	186	377	457	371	4.8
Process Control							
CD (Optical and SEM)	20	44	89	151	150	151	49.6
Wafer Inspection	34	42	58	101	117	99	23.5
Other Process Control	360	287	286	355	404	368	.4
Total	415	374	432	607	672	618	8.3
Factory Automation	125	81	99	130	195	216	11.6
Other Equipment	118	96	112	177	211	189	10.0
Total World Fab Equipment	3,353	2,716	3,140	4,983	5,996	5,818	11.7
Percent Change	-5	-19	16	59	20	-3	

*Includes ion milling
Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Table 4.2
Worldwide Wafer Fab Equipment Market—Forecast, 1990-1995
(Millions of Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
World Fab Equipment Market	5,818	6,353	7,704	9,707	10,848	11,189	14.0
Lithography							
Contact/Proximity	19	17	17	16	16	15	-4.2
Projection Aligners	89	94	106	122	132	133	8.3
Steppers	1,067	1,200	1,470	1,877	2,079	2,146	15.0
Direct-Write Lithography	71	78	95	121	145	160	17.7
Maskmaking Lithography	50	62	77	99	115	118	18.5
X-Ray	2	8	12	25	38	55	102.7
Total	1,297	1,459	1,776	2,259	2,526	2,626	15.2
Automatic Photoresist							
Processing Equipment	338	370	443	556	616	631	13.3
Etch and Clean							
Wet Process	350	385	450	555	607	621	12.1
Dry Strip	125	134	164	212	238	245	14.4
Dry Etch*	696	761	922	1,190	1,338	1,396	14.9
Total	1,172	1,279	1,536	1,957	2,183	2,263	14.1
Deposition							
Chemical Vapor Deposition	689	760	915	1,177	1,322	1,385	15.0
Physical Vapor Deposition	408	444	532	665	733	765	13.4
Silicon Epitaxy	68	55	85	74	105	110	10.0
Metalorganic CVD	42	47	58	71	79	84	14.7
Molecular Beam Epitaxy	55	61	70	81	91	95	11.8
Total	1,262	1,369	1,659	2,068	2,329	2,439	14.1
Diffusion	322	347	412	526	588	605	13.4
Rapid Thermal Processing	33	37	52	70	83	94	23.3
Ion Implantation							
Medium Current	116	123	150	183	199	185	9.8
High Current	250	269	338	425	467	427	11.4
High Voltage	5	13	23	33	39	43	54.0
Total	371	405	511	642	705	656	12.1
Process Control							
CD (Optical and SEM)	151	165	201	249	279	283	13.4
Wafer Inspection	99	109	133	165	190	197	14.7
Other Process Control	368	382	463	561	616	631	11.4
Total	618	656	796	975	1,085	1,110	12.4
Factory Automation	216	232	278	350	393	413	13.8
Other Equipment	189	200	242	304	338	352	13.2
Total World Fab Equipment	5,818	6,353	7,704	9,707	10,848	11,189	14.0
Percent Change	-3	9	21	26	12	3	

*Includes ion milling
Note: Some columns do not add to totals shown because of rounding.
Source: Dataquest (July 1991)

Table 4.3
Worldwide Semiconductor Production, Capital Spending, and Wafer Fab Equipment—Historical, 1985-1990 (Millions of Dollars)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
Semiconductor Production*	27,114	33,728	41,478	54,521	61,453	62,771	18.3
Capital Spending	7,299	5,129	6,435	10,088	12,463	12,519	11.4
Wafer Fab Equipment	3,353	2,716	3,140	4,983	5,996	5,818	11.7

*Semiconductor production includes worldwide merchant and captive production.
Source: Dataquest (July 1991)

Table 4.4
Worldwide Semiconductor Production, Capital Spending, and Wafer Fab Equipment—Forecast, 1990-1995 (Millions of Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Semiconductor Production*	62,771	71,807	83,746	97,321	107,632	114,223	12.7
Capital Spending	12,519	14,123	16,793	21,136	22,537	23,830	13.7
Wafer Fab Equipment	5,818	6,353	7,704	9,707	10,848	11,189	14.0

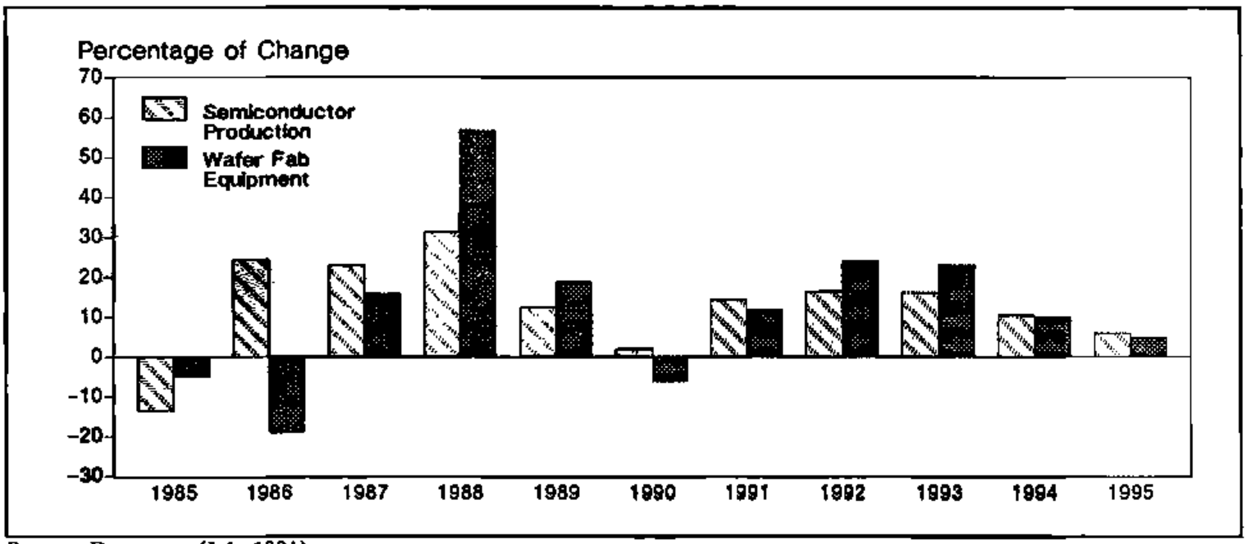
*Semiconductor production includes worldwide merchant and captive production.
Source: Dataquest (July 1991)

Table 4.5
Estimated 10-Year CAGR, 1985-1995

	CAGR (%) 1985-1995
Semiconductor Production	15.5
Capital Spending	12.6
Wafer Fab Equipment	12.8

Source: Dataquest (July 1991)

Figure 4.1
Estimated Semiconductor Production and Wafer Fab Equipment
10-Year Growth Pattern, 1985-1995



Source: Dataquest (July 1991)

Chapter 5

Silicon Wafer Forecast

Tables 5.1 and 5.2 present the historical and forecast consumption of silicon in millions of square inches by region. Tables 5.3 and 5.4 present historical and forecast information on merchant epitaxial wafer consumption by region.

Table 5.1
Silicon Consumption by Region—Historical, 1985-1990
(Millions of Square Inches)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
United States	398	405	442	546	582	648	10.2
Percent Growth	-43.7	1.9	8.9	23.7	6.5	11.4	
Japan	588	642	670	777	923	1,017	11.6
Percent Growth	-11.0	9.1	4.4	16.0	18.8	10.1	
Europe	148	155	172	196	231	227	8.9
Percent Growth	-7.5	4.6	10.9	14.0	17.8	-1.7	
Asia/Pacific-ROW	43	64	70	84	114	145	27.5
Percent Growth	-15.7	47.9	9.3	20.6	35.9	27.0	
Worldwide	1,177	1,266	1,354	1,604	1,851	2,037	
Percent Growth	-25.5	7.6	7.0	18.5	15.4	10.0	

Source: Dataquest (July 1991)

Table 5.2
Silicon Consumption by Region—Forecast, 1990-1995
(Millions of Square Inches)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
United States	648	687	731	807	894	921	7.3
Percent Growth	11.4	6.0	6.4	10.4	10.8	3.0	
Japan	1,017	1,102	1,230	1,389	1,498	1,572	9.1
Percent Growth	10.1	8.4	11.6	12.9	7.8	4.9	
Europe	227	224	244	272	312	343	8.6
Percent Growth	-1.7	-1.4	8.9	11.5	14.7	9.9	
Asia/Pacific-ROW	145	168	196	231	271	295	15.3
Percent Growth	27.0	16.1	16.7	17.9	17.3	8.9	
Worldwide	2,037	2,181	2,401	2,701	2,975	3,131	
Percent Growth	-25.5	7.1	10.1	12.5	10.1	5.2	

Source: Dataquest (July 1991)

Table 5.3
Merchant Epitaxial Wafer Consumption by Region—Historical, 1985-1990
(Millions of Square Inches)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
United States	25	29	42	56	82	97	31.1
Percent Growth	-43.7	16.0	44.8	33.3	46.4	18.3	
Japan	49	65	71	75	83	93	13.7
Percent Growth	-11.0	32.7	9.2	5.6	10.7	12.0	
Europe	6	9	12	15	18	19	25.9
Percent Growth	-7.5	50.0	33.3	25.0	20.0	5.6	
Asia/Pacific-ROW	2	2	3	4	5	5	20.1
Percent Growth	-15.7	.0	50.0	33.3	25.0	.0	
Worldwide	82	105	128	151	189	214	21.1
Percent Growth	-25.5	28.0	21.9	18.0	25.2	13.2	

Source: Dataquest (July 1991)

Table 5.4
Merchant Epitaxial Wafer Consumption by Region—Forecast, 1990-1995
(Millions of Square Inches)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
United States	97	105	117	133	137	138	7.3
Percent Growth	18.3	6.0	6.4	10.4	10.8	3.0	
Japan	93	97	104	116	114	114	4.2
Percent Growth	12.0	8.4	11.6	12.9	7.8	4.9	
Europe	19	18	18	20	23	24	4.8
Percent Growth	5.6	-1.4	8.9	11.5	14.7	9.9	
Asia/Pacific-ROW	5	6	7	9	10	11	17.1
Percent Growth	.0	16.1	16.7	17.9	17.3	8.9	
Worldwide	214	225	247	277	284	287	6.0
Percent Growth	13.2	5.1	9.8	12.1	2.5	1.1	

Source: Dataquest (July 1991)

Appendix

Exchange Rates

Table A.1 lists the exchange rates per dollar for Japanese yen and European currency units (ECUs) for the period from 1985 to 1991. Exchange rate variations should be kept in mind when interpreting yearly changes in the 1985 to 1991 data presented in this booklet. However, the forecast years (1992 to 1995) are assumed to have constant exchange rates.

Table A.1
Exchange Rates per Dollar for Japanese Yen and ECU: 1985-1991

	1985	1986	1987	1988	1989	1990	1991 1Q
Yen/$	238	167	144	130	138	144	134
Percent Change		-30	-14	-10	6	4	-7
ECU/$	1.31	1.02	0.87	0.84	0.92	0.79	0.75
Percent Change		-22	-15	-3	10	-14	-6

Source: Dataquest (July 1991)

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Semiconductor Consumption and Shipment Forecast
May 1991

Source:
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Semiconductor Consumption and Shipment Forecast

Introduction

Semiconductor consumption 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 1985 through 1995 and 2000. Semiconductor consumption and shipment tables contain both historical data and forecasts. Historical data begin with 1985 and end with 1990, while forecast data provide annual market size estimates for 1991 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.

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 Delco, IBM, and Unisys. 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.

List of Tables

Table	Region Covered	Years	Units
0	Japan and Western Europe Exchange Rates	1970-1989	Various
1a	Worldwide Market	1985-1990	Dollars
1b	Worldwide Market	1985-1990	Percent
1c	Worldwide Market	1991-1995; 2000	Dollars
1d	Worldwide Market	1991-1995; 2000	Percent
2a	North American Market	1985-1990	Dollars
2b	North American Market	1985-1990	Percent
2c	North American Market	1991-1995; 2000	Dollars
2d	North American Market	1991-1995; 2000	Percent
3a	Japanese Market	1985-1990	Dollars
3b	Japanese Market	1985-1990	Percent
3c	Japanese Market	1991-1995; 2000	Dollars
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4a	Japanese Market	1985-1990	Yen
4b	Japanese Market	1985-1990	Percent
4c	Japanese Market	1991-1995; 2000	Yen
4d	Japanese Market	1991-1995; 2000	Percent

(Continued)

List of Tables (Continued)

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. A regional market size includes all devices sold to or shipped to that region, i.e., the 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 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.
- Dataquest includes revenue for three Japanese companies not included by WSTS until 1990: 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, and China. Western Europe includes Austria, Belgium, Germany, France, Italy, Luxembourg, the Netherlands, the Scandinavian countries (Denmark, Finland, Norway, Sweden), Spain, the United Kingdom, and the rest of Europe. Japan, the fourth region, is the only single-country region.

Data Sources

The historical information presented in the consumption 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 shipments 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 shipments to Japan.
- For Western European markets, marketing statistics from WSTS data and Dataquest's estimates of regional company sales are used to determine market size.
- In Asia/Pacific-ROW, the major published sources used to estimate market size 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 as follows:

- Dataquest's own forecasts of electronic equipment production and semiconductor I/O ratios
- 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 Consumption

Regional market size is expressed in U.S. 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 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 1980s, continuing into the 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 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.

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 7d 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 and the *Wall Street Journal*. 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 market size is originally expressed in yen. The Japanese data published in this study are expressed in both dollars (Tables 3a, 3b, 3c, and 3d) and in yen (Tables 4a, 4b, 4c, and 4d). 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 1991 and beyond are made as if 1991 monetary conditions will continue through 2000 and, therefore, show the absolute year-to-year growth during this period.

Table 0
Foreign Exchange Rates

Year	Yrly/Qtrly	Japan (Yen per US$)	France (US$ per Franc)	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
1990	YR	144	0.18	0.62	1.79
Q191	QTR	134	0.19	0.65	1.91

Source: The International Monetary Fund Financial Times, Dataquest (May 1991)

Table 1a
Worldwide Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	27,116	33,729	41,478	54,521	61,454	62,772
North American Captives	2,773	2,895	3,227	3,662	4,241	4,547
Total Semiconductor	24,343	30,834	38,251	50,859	57,213	58,225
Total IC	18,552	23,618	29,887	41,068	46,924	47,303
Bipolar Digital	3,684	4,325	4,760	5,200	4,510	4,440
Memory	589	606	621	689	540	459
Logic	3,095	3,719	4,139	4,511	3,970	3,981
MOS Digital	10,103	12,815	17,473	26,988	33,024	32,292
Memory	3,817	4,511	6,056	11,692	16,361	13,091
Micro	2,745	3,489	5,108	7,144	8,202	10,068
Logic	3,541	4,815	6,309	8,152	8,461	9,133
Analog	4,765	6,478	7,654	8,880	9,390	10,571
Total Discrete	4,578	5,730	6,655	7,612	7,662	8,235
Total Optoelectronic	1,213	1,486	1,709	2,179	2,627	2,687

Source: Dataquest (May 1991)

Table 1b
Worldwide Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-13.4	24.4	23.0	31.4	12.7	2.1	18.3
North American Captives	10.9	4.4	11.5	13.5	15.8	7.2	10.4
Total Semiconductor	-15.5	26.7	24.1	33.0	12.5	1.8	19.1
Total IC	-18.0	27.3	26.5	37.4	14.3	.8	20.6
Bipolar Digital	-23.0	17.4	10.1	9.2	-13.3	-1.6	3.8
Memory	-23.9	2.9	2.5	11.0	-21.6	-15.0	-4.9
Logic	-22.8	20.2	11.3	9.0	-12.0	.3	5.2
MOS Digital	-22.0	26.8	36.3	54.5	22.4	-2.2	26.2
Memory	-38.7	18.2	34.2	93.1	39.9	-20.0	28.0
Micro	-15.0	27.1	46.4	39.9	14.8	22.8	29.7
Logic	1.4	36.0	31.0	29.2	3.8	7.9	20.9
Analog	-2.5	35.9	18.2	16.0	5.7	12.6	17.3
Total Discrete	-8.2	25.2	16.1	14.4	.7	7.5	12.5
Total Optoelectronic	-.7	22.5	15.0	27.5	20.6	2.3	17.2

Source: Dataquest (May 1991)

Table 1c
Worldwide Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	71,807	83,745	97,321	107,632	114,222	199,971
North American Captives	5,584	6,556	7,518	8,407	8,691	14,610
Total Semiconductor	66,223	77,189	89,803	99,225	105,531	185,361
Total IC	54,103	64,232	75,522	83,934	89,840	164,196
Bipolar Digital	4,624	4,679	4,683	4,480	4,256	3,272
Memory	440	434	433	402	375	248
Logic	4,184	4,245	4,250	4,078	3,881	3,024
MOS Digital	37,709	46,294	55,628	62,243	66,906	130,228
Memory	14,974	18,798	23,001	26,078	28,283	56,891
Micro	12,118	14,907	17,917	20,076	21,604	44,069
Logic	10,617	12,589	14,710	16,089	17,019	29,268
Analog	11,770	13,259	15,211	17,211	18,678	30,696
Total Discrete	9,112	9,703	10,721	11,342	11,513	15,046
Total Optoelectronic	3,008	3,254	3,560	3,949	4,178	6,119

Source: Dataquest (May 1991)

Table 1d
Worldwide Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	14.4	16.6	16.2	10.6	6.1	12.7	11.9
North American Captives	22.8	17.4	14.7	11.8	3.4	13.8	10.9
Total Semiconductor	13.7	16.6	16.3	10.5	6.4	12.6	11.9
Total IC	14.4	18.7	17.6	11.1	7.0	13.7	12.8
Bipolar Digital	4.1	1.2	.1	-4.3	-5.0	-.8	-5.1
Memory	-4.1	-1.4	-.2	-7.2	-6.7	-4.0	-7.9
Logic	5.1	1.5	.1	-4.0	-4.8	-.5	-4.9
MOS Digital	16.8	22.8	20.2	11.9	7.5	15.7	14.2
Memory	14.4	25.5	22.4	13.4	8.5	16.7	15.0
Micro	20.4	23.0	20.2	12.1	7.6	16.5	15.3
Logic	16.2	18.6	16.8	9.4	5.8	13.3	11.5
Analog	11.3	12.7	14.7	13.1	8.5	12.1	10.4
Total Discrete	10.6	6.5	10.4	5.8	1.5	6.9	5.5
Total Optoelectronic	11.9	8.2	9.4	10.9	5.8	9.2	7.9

Source: Dataquest (May 1991)

Table 2a
North American Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	11,663	13,171	15,454	18,789	21,348	20,844
North American Captives	2,243	2,327	2,596	2,945	3,411	3,458
Total Semiconductor	9,420	10,844	12,858	15,844	17,937	17,386
Total IC	7,757	8,986	10,886	13,815	15,909	15,387
Bipolar Digital	1,926	2,030	2,099	2,012	1,701	1,652
Memory	288	267	271	235	203	170
Logic	1,638	1,763	1,828	1,777	1,498	1,482
MOS Digital	4,322	4,912	6,738	9,606	11,682	11,025
Memory	1,753	1,775	2,497	4,298	6,163	4,655
Micro	1,258	1,362	2,012	2,707	2,972	3,563
Logic	1,311	1,775	2,229	2,601	2,547	2,807
Analog	1,509	2,044	2,049	2,197	2,526	2,710
Total Discrete	1,295	1,542	1,642	1,676	1,683	1,669
Total Optoelectronic	368	316	330	353	345	330

Source: Dataquest (May 1991)

Table 2b
North American Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-22.4	12.9	17.3	21.6	13.6	-2.4	12.3
North American Captives	10.7	3.7	11.6	13.4	15.8	1.4	9.0
Total Semiconductor	-27.6	15.1	18.6	23.2	13.2	-3.1	13.0
Total IC	-30.0	15.8	21.1	26.9	15.2	-3.3	14.7
Bipolar Digital	-31.7	5.4	3.4	-4.1	-15.5	-2.9	-3.0
Memory	-34.7	-7.3	1.5	-13.3	-13.6	-16.3	-10.0
Logic	-31.1	7.6	3.7	-2.8	-15.7	-1.1	-2.0
MOS Digital	-33.5	13.7	37.2	42.6	21.6	-5.6	20.6
Memory	-48.8	1.3	40.7	72.1	43.4	-24.5	21.6
Micro	-23.0	8.3	47.7	34.5	9.8	19.9	23.1
Logic	-9.1	35.4	25.6	16.7	-2.1	10.2	16.4
Analog	-14.6	35.5	.2	7.2	15.0	7.3	12.4
Total Discrete	-13.8	19.1	6.5	2.1	.4	-.8	5.2
Total Optoelectronic	-11.1	-14.1	4.4	7.0	-2.3	-4.3	-2.2

Source: Dataquest (May 1991)

Table 2c
North American Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	22,918	26,235	30,343	33,112	34,448	53,614
North American Captives	4,157	4,849	5,533	6,217	6,447	10,837
Total Semiconductor	18,761	21,386	24,810	26,895	28,001	42,777
Total IC	16,692	19,198	22,404	24,394	25,557	40,005
Bipolar Digital	1,621	1,588	1,649	1,509	1,381	987
Memory	149	138	134	118	104	50
Logic	1,472	1,450	1,515	1,391	1,277	937
MOS Digital	12,102	14,242	16,899	18,580	19,495	31,615
Memory	4,989	5,808	6,963	8,106	8,681	14,827
Micro	4,003	4,784	5,613	5,960	6,254	10,026
Logic	3,110	3,650	4,323	4,514	4,560	6,762
Analog	2,969	3,368	3,856	4,305	4,681	7,403
Total Discrete	1,733	1,823	2,014	2,089	2,039	2,307
Total Optoelectronic	336	365	392	412	405	465

Source: Dataquest (May 1991)

Table 2d
North American Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	North America
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	10.0	14.5	15.7	9.1	4.0	10.6	9.3
North American Captives	20.2	16.6	14.1	12.4	3.7	13.3	10.9
Total Semiconductor	7.9	14.0	16.0	8.4	4.1	10.0	8.8
Total IC	8.5	15.0	16.7	8.9	4.8	10.7	9.4
Bipolar Digital	-1.9	-2.0	3.8	-8.5	-8.5	-3.5	-6.5
Memory	-12.4	-7.4	-2.9	-11.9	-11.9	-9.4	-13.6
Logic	-.7	-1.5	4.5	-8.2	-8.2	-2.9	-6.0
MOS Digital	9.8	17.7	18.7	9.9	4.9	12.1	10.2
Memory	7.2	16.4	19.9	16.4	7.1	13.3	11.3
Micro	12.3	19.5	17.3	6.2	4.9	11.9	9.9
Logic	10.8	17.4	18.4	4.4	1.0	10.2	8.2
Analog	9.6	13.4	14.5	11.6	8.7	11.6	9.6
Total Discrete	3.8	5.2	10.5	3.7	-2.4	4.1	2.5
Total Optoelectronic	1.8	8.6	7.4	5.1	-1.7	4.2	2.8

Source: Dataquest (May 1991)

Table 3a
Japanese Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	8,300	12,018	15,107	20,977	23,234	23,031
North American Captives	151	163	180	205	237	523
Total Semiconductor	8,149	11,855	14,927	20,772	22,997	22,508
Total IC	5,985	8,802	11,263	16,127	17,946	17,387
Bipolar Digital	824	1,295	1,523	1,906	1,750	1,800
Memory	136	169	227	348	246	209
Logic	688	1,126	1,296	1,558	1,504	1,591
MOS Digital	3,232	4,762	6,424	10,501	12,497	11,799
Memory	1,185	1,738	2,268	4,424	5,992	4,612
Micro	884	1,368	1,902	2,573	2,828	3,210
Logic	1,163	1,656	2,254	3,504	3,677	3,977
Analog	1,929	2,745	3,316	3,720	3,699	3,788
Total Discrete	1,621	2,242	2,693	3,282	3,321	3,392
Total Optoelectronic	543	811	971	1,363	1,730	1,729

Source: Dataquest (May 1991)

Table 3b
Japanese Semiconductor Consumption
(Millions of Dollars)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR (%) 85-90
Total Including Captives	-6.8	44.8	25.7	38.9	10.8	-.9	22.6
North American Captives	11.9	7.9	10.4	13.9	15.6	120.7	28.2
Total Semiconductor	-7.1	45.5	25.9	39.2	10.7	-2.1	22.5
Total IC	-8.2	47.1	28.0	43.2	11.3	-3.1	23.8
Bipolar Digital	-13.7	57.2	17.6	25.1	-8.2	2.9	16.9
Memory	-16.6	24.3	34.3	53.3	-29.3	-15.0	9.0
Logic	-13.1	63.7	15.1	20.2	-3.5	5.8	18.3
MOS Digital	-10.7	47.3	34.9	63.5	19.0	-5.6	29.6
Memory	-25.0	46.7	30.5	95.1	35.4	-23.0	31.2
Micro	-9.7	54.8	39.0	35.3	9.9	13.5	29.4
Logic	9.4	42.4	36.1	55.5	4.9	8.2	27.9
Analog	-.6	42.3	20.8	12.2	-.6	2.4	14.4
Total Discrete	-7.7	38.3	20.1	21.9	1.2	2.1	15.9
Total Optoelectronic	8.4	49.4	19.7	40.4	26.9	-.1	26.1

Source: Dataquest (May 1991)

Table 3c
Japanese Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	27,025	31,580	35,586	39,208	41,787	72,290
North American Captives	671	818	931	1,008	1,025	1,723
Total Semiconductor	26,354	30,762	34,655	38,200	40,762	70,567
Total IC	20,545	24,608	28,096	31,150	33,407	60,667
Bipolar Digital	2,030	2,158	2,142	2,131	2,098	1,685
Memory	222	233	240	237	233	180
Logic	1,808	1,925	1,902	1,894	1,865	1,505
MOS Digital	14,288	17,799	20,751	23,267	25,236	50,100
Memory	5,698	7,537	9,037	10,212	11,131	24,719
Micro	3,835	4,615	5,293	5,928	6,422	11,780
Logic	4,755	5,647	6,421	7,127	7,683	13,601
Analog	4,227	4,651	5,203	5,752	6,073	8,882
Total Discrete	3,827	4,017	4,242	4,467	4,601	5,816
Total Optoelectronic	1,982	2,137	2,317	2,583	2,754	4,084

Source: Dataquest (May 1991)

Table 3d
Japanese Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	17.3	16.9	12.7	10.2	6.6	12.7	11.6
North American Captives	28.3	21.9	13.8	8.3	1.7	14.4	10.9
Total Semiconductor	17.1	16.7	12.7	10.2	6.7	12.6	11.6
Total IC	18.2	19.8	14.2	10.9	7.2	14.0	12.7
Bipolar Digital	12.8	6.3	-.7	-.5	-1.5	3.1	-4.3
Memory	6.2	5.0	3.0	-1.3	-1.7	2.2	-5.0
Logic	13.6	6.5	-1.2	-.4	-1.5	3.2	-4.2
MOS Digital	21.1	24.6	16.6	12.1	8.5	16.4	14.7
Memory	23.5	32.3	19.9	13.0	9.0	19.3	17.3
Micro	19.5	20.3	14.7	12.0	8.3	14.9	12.9
Logic	19.6	18.8	13.7	11.0	7.8	14.1	12.1
Analog	11.6	10.0	11.9	10.6	5.6	9.9	7.9
Total Discrete	12.8	5.0	5.6	5.3	3.0	6.3	4.8
Total Optoelectronic	14.6	7.8	8.4	11.5	6.6	9.8	8.2

Source: Dataquest (May 1991)

Table 4a
Japanese Semiconductor Consumption
(Factory Revenue in Billions of Japanese Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	1,975.3	2,006.9	2,175.4	2,727.0	3,206.3	3,316.4
North American Captives	35.9	27.2	25.9	26.7	32.7	75.3
Total Semiconductor	1,939.4	1,979.7	2,149.5	2,700.3	3,173.6	3,241.1
Total IC	1,424.4	1,469.9	1,621.9	2,096.4	2,476.6	2,503.7
Bipolar Digital	196.1	216.2	219.3	247.7	241.5	259.2
Memory	32.4	28.2	32.7	45.2	33.9	30.1
Logic	163.7	188.0	186.6	202.5	207.6	229.1
MOS Digital	769.2	795.3	925.1	1,365.1	1,724.6	1,699.0
Memory	282.0	290.2	326.6	575.1	826.9	664.1
Micro	210.4	228.5	273.9	334.5	390.3	462.2
Logic	276.8	276.6	324.6	455.5	507.4	572.7
Analog	459.1	458.4	477.5	483.6	510.5	545.5
Total Discrete	385.8	374.4	387.8	426.7	458.3	488.4
Total Optoelectronic	129.2	135.4	139.8	177.2	238.7	249.0
Exchange Rate (Yen/US$)	238	167	144	130	138	144

Source: Dataquest (May 1991)

Table 4b
Japanese Semiconductor Consumption
(Percent Change in Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Including Captives	-6.4	1.6	8.4	25.4	17.6	3.4	10.9
North American Captives	.0	.0	.0	.0	.0	.0	.0
Total Semiconductor	-6.7	2.1	8.6	25.6	17.5	2.1	10.8
Total IC	-7.8	3.2	10.3	29.3	18.1	1.1	11.9
Bipolar Digital	-13.3	10.2	1.4	13.0	-2.5	7.3	5.7
Memory	-16.1	-13.0	16.0	38.2	-25.0	-11.2	-1.5
Logic	-12.8	14.8	-.7	8.5	2.5	10.4	7.0
MOS Digital	-10.4	3.4	16.3	47.6	26.3	-1.5	17.2
Memory	-24.6	2.9	12.5	76.1	43.8	-19.7	18.7
Micro	-9.3	8.6	19.9	22.1	16.7	18.4	17.0
Logic	9.9	-.1	17.4	40.3	11.4	12.9	15.7
Analog	-.2	-.2	4.2	1.3	5.6	6.9	3.5
Total Discrete	-7.3	-3.0	3.6	10.0	7.4	6.6	4.8
Total Optoelectronic	8.8	4.8	3.2	26.8	34.7	4.3	14.0

NA = Not available

Source: Dataquest (May 1991)

Table 4c
Japanese Semiconductor Consumption
(Factory Revenue in Billions of Japanese Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	3,618.6	4,228.5	4,765.0	5,250.0	5,595.3	9,679.6
North American Captives	89.8	109.5	124.7	135.0	137.2	230.7
Total Semiconductor	3,528.8	4,119.0	4,640.3	5,115.0	5,458.1	9,448.9
Total IC	2,751.0	3,295.0	3,762.1	4,171.0	4,473.2	8,123.3
Bipolar Digital	271.8	289.0	286.8	285.3	280.9	225.6
Memory	29.7	31.2	32.1	31.7	31.2	24.1
Logic	242.1	257.8	254.7	253.6	249.7	201.5
MOS Digital	1,913.2	2,383.2	2,778.6	3,115.5	3,379.1	6,708.4
Memory	763.0	1,009.2	1,210.1	1,367.4	1,490.4	3,309.9
Micro	513.5	617.9	708.7	793.8	859.9	1,577.3
Logic	636.7	756.1	859.8	954.3	1,028.8	1,821.2
Analog	566.0	622.8	696.7	770.2	813.2	1,189.3
Total Discrete	512.4	537.9	568.0	598.1	616.1	778.8
Total Optoelectronic	265.4	286.1	310.2	345.9	368.8	546.8
Exchange Rate (Yen/US$)	133.9	133.9	133.9	133.9	133.9	133.9

Source: Dataquest (May 1991)

Table 4d
Japanese Semiconductor Consumption
(Percent Change in Yen)

Company:	All
Product:	Each
Region of Consumption:	Japan
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	9.1	16.9	12.7	10.2	6.6	11.0	11.6
North American Captives	.0	.0	.0	.0	.0	.0	.0
Total Semiconductor	8.9	16.7	12.7	10.2	6.7	11.0	11.6
Total IC	9.9	19.8	14.2	10.9	7.2	12.3	12.7
Bipolar Digital	4.9	6.3	-.8	-.5	-1.5	1.6	-4.3
Memory	-1.3	5.1	2.9	-1.2	-1.6	.7	-5.0
Logic	5.7	6.5	-1.2	-.4	-1.5	1.7	-4.2
MOS Digital	12.6	24.6	16.6	12.1	8.5	14.7	14.7
Memory	14.9	32.3	19.9	13.0	9.0	17.5	17.3
Micro	11.1	20.3	14.7	12.0	8.3	13.2	12.9
Logic	11.2	18.8	13.7	11.0	7.8	12.4	12.1
Analog	3.8	10.0	11.9	10.5	5.6	8.3	7.9
Total Discrete	4.9	5.0	5.6	5.3	3.0	4.8	4.8
Total Optoelectronic	6.6	7.8	8.4	11.5	6.6	8.2	8.2

NA = Not available

Source: Dataquest (May 1991)

Table 5a
European Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	5,174	5,992	6,949	9,003	10,348	11,227
North American Captives	379	405	451	512	593	566
Total Semiconductor	4,795	5,587	6,498	8,491	9,755	10,661
Total IC	3,615	4,116	4,840	6,669	7,794	8,326
Bipolar Digital	719	719	727	772	640	577
Memory	150	147	88	74	72	58
Logic	569	572	639	698	568	519
MOS Digital	1,933	2,270	2,761	4,364	5,458	5,403
Memory	745	813	854	1,797	2,548	2,154
Micro	486	574	805	1,212	1,469	1,836
Logic	702	883	1,102	1,355	1,441	1,413
Analog	963	1,127	1,352	1,533	1,696	2,346
Total Discrete	969	1,207	1,377	1,516	1,594	1,915
Total Optoelectronic	211	264	281	306	367	420

Source: Dataquest (May 1991)

Table 5b
European Semiconductor Consumption
(Millions of Dollars)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR (%) 85-90
Total Including Captives	-.5	15.8	16.0	29.6	14.9	8.5	16.8
North American Captives	12.1	6.9	11.4	13.5	15.8	-4.6	8.4
Total Semiconductor	-1.4	16.5	16.3	30.7	14.9	9.3	17.3
Total IC	-3.1	13.9	17.6	37.8	16.9	6.8	18.2
Bipolar Digital	-3.0	.0	1.1	6.2	-17.1	-9.8	-4.3
Memory	4.2	-2.0	-40.1	-15.9	-2.7	-19.4	-17.3
Logic	-4.7	.5	11.7	9.2	-18.6	-8.6	-1.8
MOS Digital	-8.9	17.4	21.6	58.1	25.1	-1.0	22.8
Memory	-24.4	9.1	5.0	110.4	41.8	-15.5	23.7
Micro	3.2	18.1	40.2	50.6	21.2	25.0	30.5
Logic	5.4	25.8	24.8	23.0	6.3	-1.9	15.0
Analog	11.1	17.0	20.0	13.4	10.6	38.3	19.5
Total Discrete	2.9	24.6	14.1	10.1	5.1	20.1	14.6
Total Optoelectronic	10.5	25.1	6.4	8.9	19.9	14.4	14.8

Source: Dataquest (May 1991)

Table 5c
European Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Including Captives	13,030	15,305	18,367	20,508	21,983	41,690
North American Captives	756	889	1,054	1,182	1,219	2,050
Total Semiconductor	12,274	14,416	17,313	19,326	20,764	39,640
Total IC	9,634	11,542	14,002	15,818	17,138	34,417
Bipolar Digital	571	540	500	458	403	268
Memory	57	52	50	40	32	17
Logic	514	488	450	418	371	251
MOS Digital	6,462	8,155	10,264	11,703	12,757	28,000
Memory	2,570	3,346	4,293	4,667	5,140	11,269
Micro	2,225	2,873	3,706	4,447	4,847	11,762
Logic	1,667	1,936	2,265	2,589	2,770	4,969
Analog	2,601	2,847	3,238	3,657	3,978	6,149
Total Discrete	2,178	2,370	2,755	2,894	2,981	4,280
Total Optoelectronic	462	504	556	614	645	943

Source: Dataquest (May 1991)

Table 5d
European Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Europe
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	16.1	17.5	20.0	11.7	7.2	14.4	13.7
North American Captives	33.6	17.6	18.6	12.1	3.1	16.6	11.0
Total Semiconductor	15.1	17.5	20.1	11.6	7.4	14.3	13.8
Total IC	15.7	19.8	21.3	13.0	8.3	15.5	15.0
Bipolar Digital	-1.0	-5.4	-7.4	-8.4	-12.0	-6.9	-7.8
Memory	-1.7	-8.8	-3.8	-20.0	-20.0	-11.2	-11.9
Logic	-1.0	-5.1	-7.8	-7.1	-11.2	-6.5	-7.5
MOS Digital	19.6	26.2	25.9	14.0	9.0	18.7	17.0
Memory	19.3	30.2	28.3	8.7	10.1	19.0	17.0
Micro	21.2	29.1	29.0	20.0	9.0	21.4	19.4
Logic	18.0	16.1	17.0	14.3	7.0	14.4	12.4
Analog	10.9	9.5	13.7	12.9	8.8	11.1	9.1
Total Discrete	13.7	8.8	16.2	5.0	3.0	9.3	7.5
Total Optoelectronic	10.0	9.1	10.3	10.4	5.0	9.0	7.9

Source: Dataquest (May 1991)

Table 6a
Asia/Pacific-Rest of World Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Asia/ROW
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Including Captives	1,979	2,548	3,968	5,752	6,524	7,670
North American Captives	0	0	0	0	0	0
Total Semiconductor	1,979	2,548	3,968	5,752	6,524	7,670
Total IC	1,195	1,714	2,898	4,457	5,275	6,203
Bipolar Digital	215	281	411	510	419	411
Memory	15	23	35	32	19	22
Logic	200	258	376	478	400	389
MOS Digital	616	871	1,550	2,517	3,387	4,065
Memory	134	185	437	1,173	1,658	1,670
Micro	117	185	389	652	933	1,459
Logic	365	501	724	692	796	936
Analog	364	562	937	1,430	1,469	1,727
Total Discrete	693	739	943	1,138	1,064	1,259
Total Optoelectronic	91	95	127	157	185	208

Source: Dataquest (May 1991)

Table 6b
Asia/Pacific-Rest of World Semiconductor Consumption
(Millions of Dollars)

Company:	All
Product:	Each
Region of Consumption:	Asia/ROW
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR (%) 85-90
Total Including Captives	-9.3	28.8	55.7	45.0	13.4	17.6	31.1
North American Captives	NM	NM	NM	NM	NM	NM	NM
Total Semiconductor	-9.3	28.8	55.7	45.0	13.4	17.6	31.1
Total IC	-6.7	43.4	69.1	53.8	18.4	17.6	39.0
Bipolar Digital	-20.1	30.7	46.3	24.1	-17.8	-1.9	13.8
Memory	-42.3	53.3	52.2	-8.6	-40.6	15.8	8.0
Logic	-17.7	29.0	45.7	27.1	-16.3	-2.8	14.2
MOS Digital	-12.0	41.4	78.0	62.4	34.6	20.0	45.8
Memory	-42.7	38.1	136.2	168.4	41.3	.7	65.6
Micro	-19.3	58.1	110.3	67.6	43.1	56.4	65.6
Logic	13.7	37.3	44.5	-4.4	15.0	17.6	20.7
Analog	16.7	54.4	66.7	52.6	2.7	17.6	36.5
Total Discrete	-11.7	6.6	27.6	20.7	-6.5	18.3	12.7
Total Optoelectronic	-20.9	4.4	33.7	23.6	17.8	12.4	18.0

NM = Not meaningful

Source: Dataquest (May 1991)

Table 6c
Asia/Pacific-Rest of World Semiconductor Consumption
(Factory Revenue in Millions of U.S. Dollars)

Company: All
Product: Each
Region of Consumption: Asia/ROW
Distribution Channel: All
Application: All
Specification: All

	1991	1992	1993	1994	1995	2000
Total Including Captives	8,834	10,625	13,025	14,804	16,004	32,377
North American Captives	0	0	0	0	0	0
Total Semiconductor	8,834	10,625	13,025	14,804	16,004	32,377
Total IC	7,232	8,884	11,020	12,572	13,738	29,107
Bipolar Digital	402	393	392	382	374	332
Memory	12	11	9	7	6	1
Logic	390	382	383	375	368	331
MOS Digital	4,857	6,098	7,714	8,693	9,418	20,513
Memory	1,717	2,107	2,708	3,093	3,331	6,076
Micro	2,055	2,635	3,305	3,741	4,081	10,501
Logic	1,085	1,356	1,701	1,859	2,006	3,936
Analog	1,973	2,393	2,914	3,497	3,946	8,262
Total Discrete	1,374	1,493	1,710	1,892	1,892	2,643
Total Optoelectronic	228	248	295	340	374	627

Source: Dataquest (May 1991)

Table 6d
Asia/Pacific-Rest of World Semiconductor Consumption
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Asia/ROW
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Including Captives	15.2	20.3	22.6	13.7	8.1	15.8	15.1
North American Captives	NM	NM	NM	NM	NM	NM	NM
Total Semiconductor	15.2	20.3	22.6	13.7	8.1	15.8	15.1
Total IC	16.6	22.8	24.0	14.1	9.3	17.2	16.2
Bipolar Digital	-2.2	-2.2	-.3	-2.6	-2.1	-1.9	-2.4
Memory	-45.5	-8.3	-18.2	-22.2	-14.3	-22.9	-30.1
Logic	.3	-2.1	.3	-2.1	-1.9	-1.1	-2.1
MOS Digital	19.5	25.6	26.5	12.7	8.3	18.3	16.8
Memory	2.8	22.7	28.5	14.2	7.7	14.8	12.8
Micro	40.8	28.2	25.4	13.2	9.1	22.8	20.8
Logic	15.9	25.0	25.4	9.3	7.9	16.5	14.4
Analog	14.2	21.3	21.8	20.0	12.8	18.0	15.9
Total Discrete	9.1	8.7	14.5	10.6	.0	8.5	6.9
Total Optoelectronic	9.6	8.8	19.0	15.3	10.0	12.5	10.9

NM = Not meaningful

Source: Dataquest (May 1991)

Table 7a
Worldwide Semiconductor Average Selling Prices
(Factory ASP in U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Semiconductor	.30	.34	.33	.42	.42	.39
Total IC	1.05	1.09	1.18	1.32	1.45	1.33
Bipolar Digital	.71	.71	.69	.70	.70	.68
Memory						
Logic						
MOS Digital	1.64	1.63	1.94	2.38	2.65	2.32
Memory	2.59	2.41	3.09	4.87	5.88	4.43
Micro	3.14	3.13	3.56	4.15	3.77	4.28
Logic	.93	.99	1.12	1.13	1.13	1.06
Analog	.76	.84	.82	.72	.70	.70
Total Discrete	.08	.09	.08	.09	.08	.08
Total Optoelectronic	.22	.25	.28	.34	.27	.29

Source: Dataquest (May 1991)

Table 7b
Worldwide Semiconductor Average Selling Prices
(Percent Change in Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Semiconductor	-15.7	13.2	-2.7	24.8	-.3	-5.1	5.4
Total IC	-4.4	3.5	8.5	11.6	10.0	-8.4	4.8
Bipolar Digital	9.2	.0	-2.8	1.4	.0	-2.9	-.9
Memory							
Logic							
MOS Digital	-16.0	-.5	18.6	23.0	11.5	-12.6	7.2
Memory	-33.6	-6.9	28.2	57.6	20.7	-24.7	11.3
Micro	-11.0	-.3	13.7	16.6	-9.2	13.5	6.4
Logic	9.4	6.5	13.1	.9	.0	-6.2	2.7
Analog	1.3	10.5	-2.4	-12.2	-2.8	.0	-1.6
Total Discrete	-11.1	15.0	-13.0	12.5	-11.1	.0	.0
Total Optoelectronic	-21.4	13.6	12.0	21.4	-20.6	7.4	5.7

Source: Dataquest (May 1991)

Table 7c
Worldwide Semiconductor Average Selling Prices
(Factory ASP in U.S. Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Semiconductor	.41	.44	.47	.48	.49	.64
Total IC	1.40	1.53	1.65	1.62	1.63	2.00
Bipolar Digital	.70	.71	.72	.70	.69	.69
Memory						
Logic						
MOS Digital	2.46	2.79	3.17	3.08	3.18	4.02
Memory	4.86	6.07	7.34	8.10	9.00	17.56
Micro	4.36	4.43	4.49	4.35	4.29	4.34
Logic	1.12	1.24	1.41	1.30	1.32	1.54
Analog	.71	.71	.70	.68	.67	.68
Total Discrete	.08	.08	.08	.08	.08	.08
Total Optoelectronic	.29	.29	.29	.29	.29	.29

Source: Dataquest (May 1991)

Table 7d
Worldwide Semiconductor Average Selling Prices
(Percent Change in Dollars)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Semiconductor	3.2	8.7	5.7	2.4	3.3	4.6	5.2
Total IC	5.6	9.2	7.5	-2.0	.8	4.1	4.1
Bipolar Digital	2.9	1.4	1.4	-2.8	-1.4	.3	.0
Memory							
Logic							
MOS Digital	6.0	13.3	13.7	-2.8	3.1	6.5	4.8
Memory	9.7	24.9	20.9	10.4	11.1	15.2	14.3
Micro	1.9	1.6	1.4	-3.1	-1.4	.0	.2
Logic	5.7	10.7	13.7	-7.8	1.5	4.5	3.1
Analog	1.4	.0	-1.4	-2.9	-1.5	-.9	.3
Total Discrete	.0	.0	.0	.0	.0	.0	.0
Total Optoelectronic	.0	.0	.0	.0	.0	.0	.0

Source: Dataquest (May 1991)

Table 8a
Worldwide Semiconductor Unit Shipments
(Millions of Units)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990
Total Semiconductor	80,380	89,881	114,551	122,085	137,808	147,757
Total IC	17,607	21,654	25,260	31,098	32,303	35,553
Bipolar Digital	5,172	6,092	6,899	7,429	6,443	6,529
Memory						
Logic						
MOS Digital	6,171	7,850	9,028	11,336	12,446	13,923
Memory	1,475	1,872	1,960	2,401	2,782	2,955
Micro	875	1,115	1,435	1,721	2,176	2,352
Logic	3,820	4,864	5,633	7,214	7,488	8,616
Analog	6,264	7,712	9,334	12,333	13,414	15,101
Total Discrete	57,200	62,283	83,188	84,578	95,775	102,938
Total Optoelectronic	5,573	5,944	6,104	6,409	9,730	9,266

Source: Dataquest (May 1991)

Table 8b
Worldwide Semiconductor Unit Shipments
(Percent Change)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1985	1986	1987	1988	1989	1990	CAGR 85-90
Total Semiconductor	.0	11.8	27.4	6.6	12.9	7.2	12.9
Total IC	-14.4	23.0	16.7	23.1	3.9	10.1	15.1
Bipolar Digital	-29.5	17.8	13.2	7.7	-13.3	1.3	4.8
Memory							
Logic							
MOS Digital	-7.1	27.2	15.0	25.6	9.8	11.9	17.7
Memory	-7.6	26.9	4.7	22.5	15.9	6.2	14.9
Micro	-4.5	27.4	28.7	20.0	26.4	8.1	21.9
Logic	-7.4	27.3	15.8	28.1	3.8	15.1	17.7
Analog	-5.0	23.1	21.0	32.1	8.8	12.6	19.2
Total Discrete	3.2	8.9	33.6	1.7	13.2	7.5	12.5
Total Optoelectronic	26.9	6.7	2.7	5.0	51.8	-4.8	10.7

Source: Dataquest (May 1991)

Table 8c
Worldwide Semiconductor Unit Shipments
(Millions of Units)

Company:	All
Product:	Each
Region of Consumption:	Worldwide
Distribution Channel:	All
Application:	All
Specification:	All

	1991	1992	1993	1994	1995	2000
Total Semiconductor	162,794	174,510	192,080	207,313	213,438	291,457
Total IC	38,522	41,864	45,791	51,921	55,118	82,282
Bipolar Digital	6,606	6,575	6,504	6,400	6,168	4,742
Memory						
Logic						
MOS Digital	15,339	16,614	17,557	20,211	21,072	32,399
Memory	3,081	3,097	3,134	3,220	3,143	3,240
Micro	2,779	3,365	3,990	4,615	5,036	10,154
Logic	9,479	10,152	10,433	12,376	12,893	19,005
Analog	16,577	18,675	21,730	25,310	27,878	45,141
Total Discrete	113,900	121,425	134,013	141,775	143,913	188,075
Total Optoelectronic	10,372	11,221	12,276	13,617	14,407	21,100

Source: Dataquest (May 1991)

Table 8d
Worldwide Semiconductor Unit Shipments
(Percent Change)

Company: All
Product: Each
Region of Consumption: Worldwide
Distribution Channel: All
Application: All
Specification: All

	1991	1992	1993	1994	1995	CAGR 90-95	CAGR 95-00
Total Semiconductor	10.2	7.2	10.1	7.9	3.0	7.6	6.4
Total IC	8.4	8.7	9.4	13.4	6.2	9.2	8.3
Bipolar Digital	1.2	-.5	-1.1	-1.6	-3.6	-1.1	-5.1
Memory							
Logic							
MOS Digital	10.2	8.3	5.7	15.1	4.3	8.6	9.0
Memory	4.3	.5	1.2	2.7	-2.4	1.2	.6
Micro	18.2	21.1	18.6	15.7	9.1	16.4	15.1
Logic	10.0	7.1	2.8	18.6	4.2	8.4	8.1
Analog	9.8	12.7	16.4	16.5	10.1	13.0	10.1
Total Discrete	10.6	6.6	10.4	5.8	1.5	6.9	5.5
Total Optoelectronic	11.9	8.2	9.4	10.9	5.8	9.2	7.9

Source: Dataquest (May 1991)

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Semiconductor Equipment, Manufacturing, and Materials Forecast

January 1991

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Table of Contents

This booklet is divided into five major sections.

Chapter 1

Semiconductor Consumption Forecast

Introduction

This section presents data on the worldwide semiconductor market by region. The regional semiconductor market, or regional semiconductor consumption, deals with where chips are consumed; this contrasts with regional semiconductor production, which deals with where chips are made. The data presented here are for the merchant market and do not include the value of chips made by captive semiconductor manufacturers for internal use.

Semiconductor Consumption

Table 1.1 shows the historical regional semiconductor consumption for the years 1985 through 1990; it also breaks down the merchant market by nationality of the merchant semiconductor companies. Table 1.2 shows forecast semiconductor consumption by region for the period from 1990 through 1995. Figures 1.1 and 1.2 illustrate the data from Tables 1.1 and 1.2 in graphic format. Figure 1.3 depicts the share of the worldwide market by nationality of semiconductor company for the period from 1985 through 1990. Figure 1.4 also graphically illustrates worldwide market share by nationality of producer, covering the years 1985 and 1990.

Table 1.1

Worldwide Semiconductor Consumption by Region
Sales by Merchant Semiconductor Companies in the Region—Historical
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990*	Market Share 1990 (%)
North America							
U.S. Companies	7,380	8,566	9,671	11,146	11,715	11,993	68.2
Japanese Companies	1,279	1,434	2,110	3,277	4,574	3,945	22.4
European Companies	731	751	913	1,006	1,025	1,069	6.1
Asia/Pacific Companies	28	93	164	415	623	566	3.2
Total	9,418	10,844	12,858	15,844	17,937	17,573	100.0
Japan							
U.S. Companies	695	933	1,249	1,965	2,162	2,353	10.4
Japanese Companies	7,387	10,851	13,588	18,630	20,628	20,115	88.6
European Companies	60	63	70	115	130	156	0.7
Asia/Pacific Companies	7	8	20	62	77	84	0.4
Total	8,149	11,855	14,927	20,772	22,997	22,708	100.0

(Continued)

Table 1.1 (Continued)

Worldwide Semiconductor Consumption by Region
Sales by Merchant Semiconductor Companies in the Region—Historical
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990*	Market Share 1990 (%)
Europe							
U.S. Companies	2,428	2,580	2,845	3,664	4,032	4,483	41.9
Japanese Companies	549	715	900	1,466	1,924	1,899	17.8
European Companies	1,806	2,282	2,714	3,196	3,562	4,083	38.2
Asia/Pacific Companies	12	10	39	165	237	228	2.1
Total	4,795	5,587	6,498	8,491	9,755	10,693	100.0
Asia/Pacific-ROW							
U.S. Companies	548	730	1,165	1,811	2,069	2,478	33.3
Japanese Companies	929	1,160	1,852	2,569	2,683	2,946	39.6
European Companies	254	347	503	600	726	847	11.4
Asia/Pacific Companies	248	311	448	772	1,046	1,169	15.7
Total	1,979	2,548	3,968	5,752	6,524	7,440	100.0
Worldwide							
U.S. Companies	11,051	12,809	14,930	18,586	19,978	21,307	36.5
Japanese Companies	10,144	14,160	18,450	25,942	29,809	28,905	49.5
European Companies	2,851	3,443	4,200	4,917	5,443	6,155	10.5
Asia/Pacific-ROW Companies	295	422	671	1,414	1,983	2,047	3.5
Total Worldwide Market	24,341	30,834	38,251	50,859	57,213	58,414	100.0
Percent Growth	-15.6	26.7	24.1	33.0	12.5	2.1	

*Preliminary estimate
Source: Dataquest (January 1991)

Table 1.2

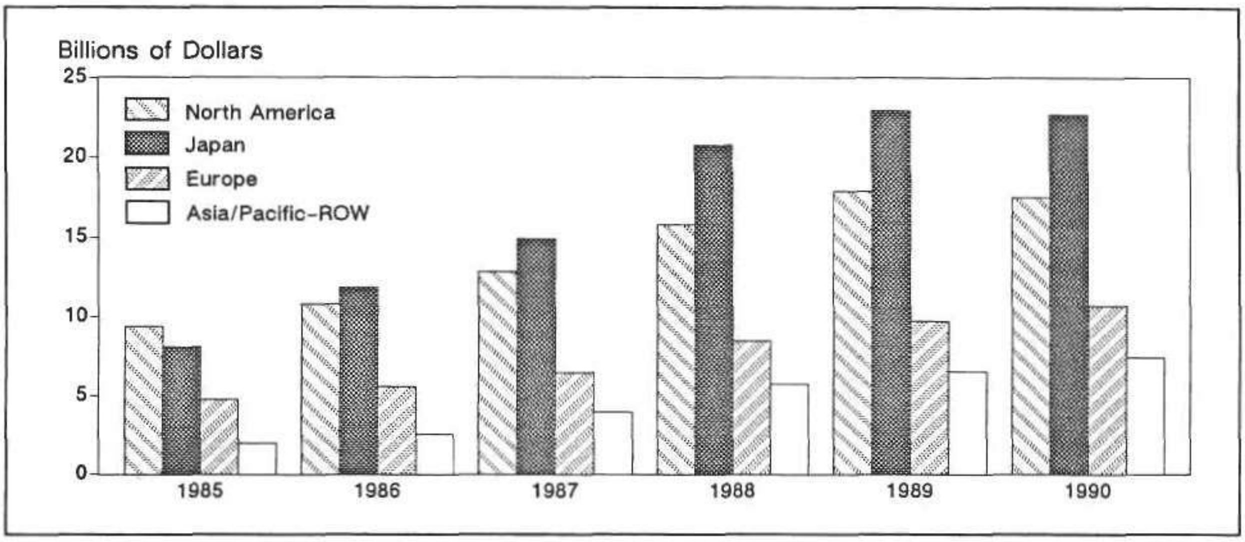
Worldwide Semiconductor Consumption by Region
Merchant Semiconductor Company Sales Only—Forecast
(Millions of Dollars)

	1990*	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America	17,573	18,803	22,724	27,442	30,061	31,138	12
Percent Growth	-2.0	7.0	20.9	20.8	9.5	3.6	
Japan	22,708	24,752	27,111	32,395	33,675	36,567	10
Percent Growth	-1.3	9.0	9.5	19.5	4.0	8.6	
Europe	10,693	11,655	13,702	17,178	19,114	20,291	14
Percent Growth	9.6	9.0	17.6	25.4	11.3	6.2	
Asia/Pacific-ROW	7,440	8,556	10,263	13,426	15,113	16,213	17
Percent Growth	14.0	15.0	20.0	30.8	12.6	7.3	
Total Worldwide Market	58,414	63,766	73,800	90,442	97,963	104,209	12
Total Percent Growth	2.1	9.2	15.7	22.5	8.3	6.4	

*Preliminary estimate
Source: Dataquest (January 1991)

Figure 1.1

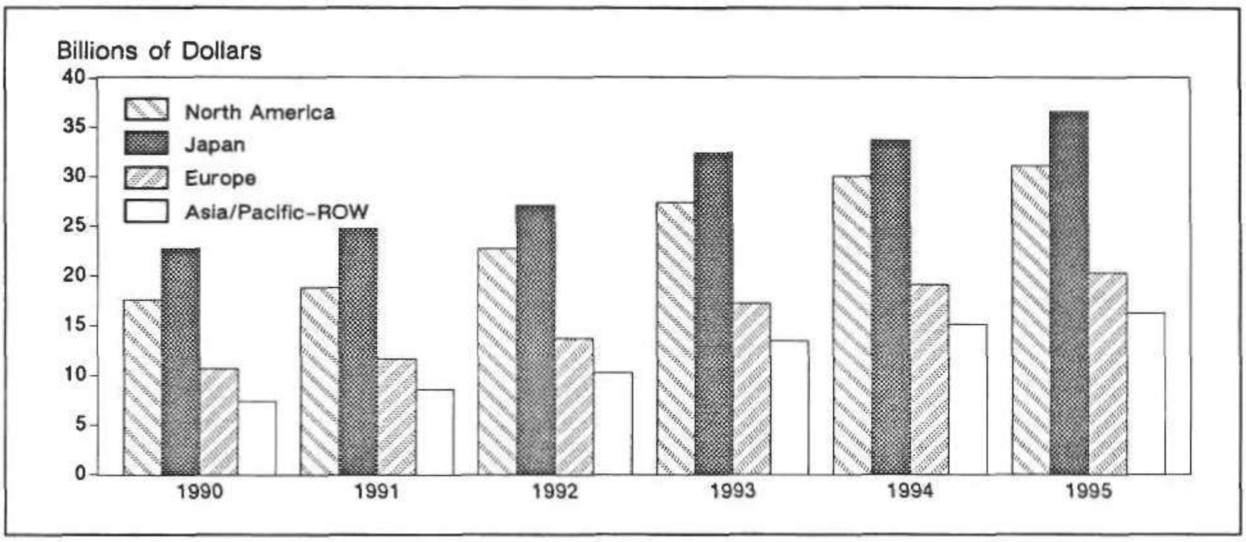
Worldwide Semiconductor Consumption
Merchant Market—Historical



Source: Dataquest (January 1991)

Figure 1.2

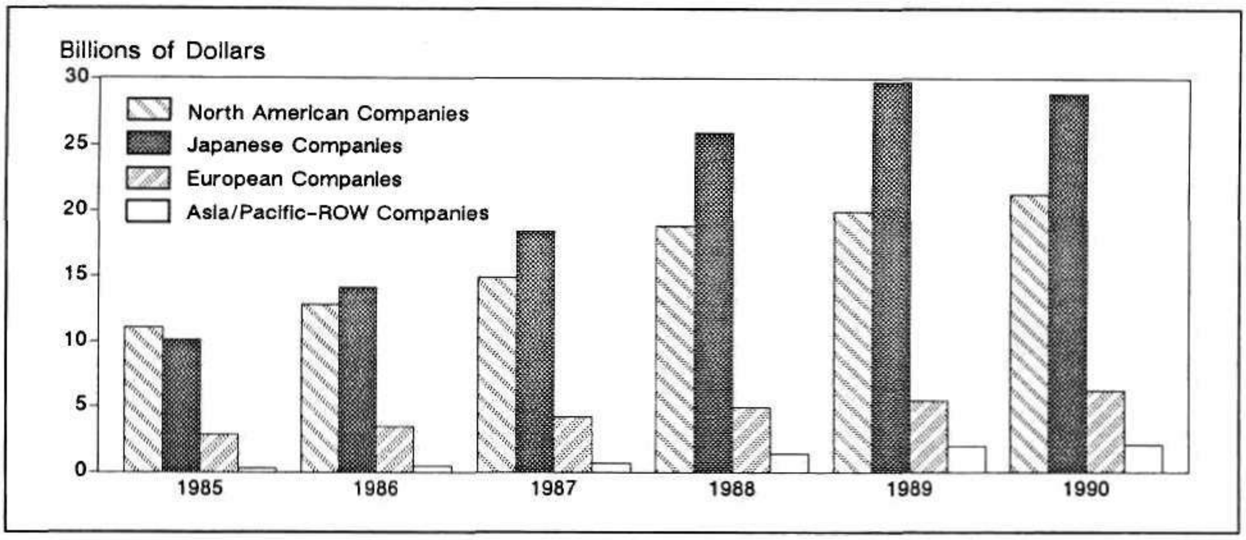
Worldwide Semiconductor Consumption
Merchant Market—Forecast



Source: Dataquest (January 1991)

Figure 1.3

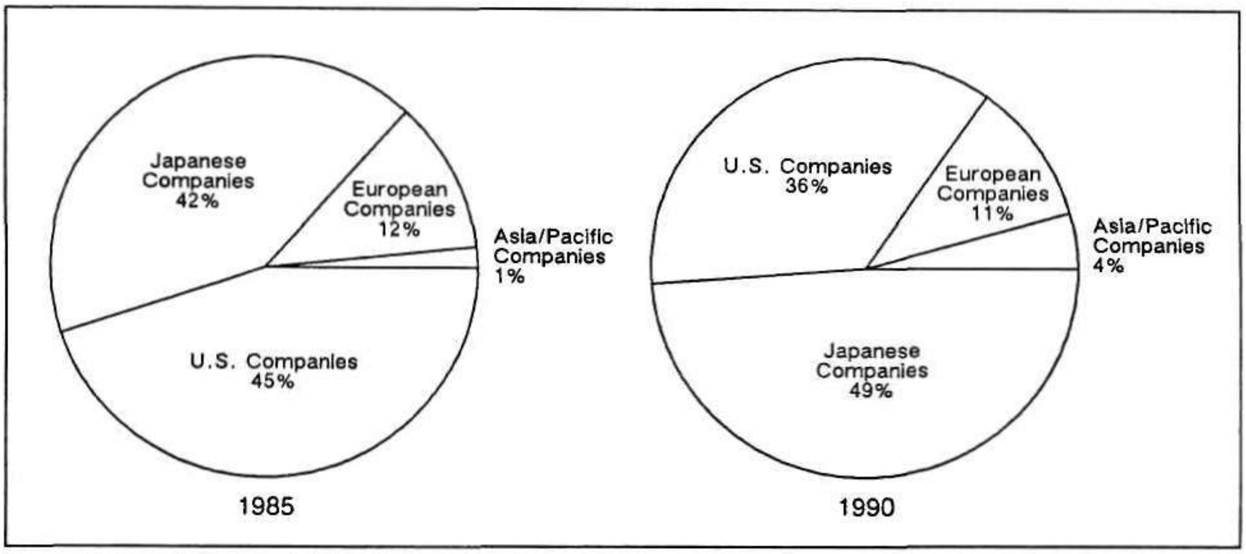
Merchant Semiconductor Company Sales
Worldwide Market Share—Historical



Source: Dataquest (January 1991)

Figure 1.4

Merchant Semiconductor Company Sales
Worldwide Market Share



Source: Dataquest (January 1991)

Chapter 2

Semiconductor Production Forecast

Introduction

This section presents data on worldwide semiconductor production by region. Semiconductor production is defined by the place where the wafers are fabricated, and regional semiconductor production includes all production in the region including merchant and captive producers and all foreign producers. For instance, North American semiconductor production includes IBM and Delco fabs as well as Japanese and European fabs in the United States.

Semiconductor Production

Table 2.1 shows historical semiconductor production for the years 1985 through 1990, and Table 2.2 shows forecast production for the period from 1990 through 1995. Figures 2.1 and 2.2 illustrate the same data graphically. Figure 2.3 depicts the five-year trend for regional production; it shows percent production by region in 1985 and in 1990.

Table 2.1

Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Historical
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990*	CAGR (%) 1985-1990
North America							
Merchant	10,411	12,129	14,116	17,326	18,675	19,096	12.9
Captive	2,243	2,327	2,596	2,845	3,244	3,469	9.1
Total	12,654	14,456	16,712	20,171	21,919	22,565	12.3
Japan							
Merchant	10,500	14,524	18,824	26,388	29,835	28,770	22.3
Captive	151	162	180	305	440	525	28.3
Total	10,651	14,686	19,004	26,693	30,275	29,295	22.4
Europe							
Merchant	3,024	3,426	4,223	5,277	6,232	7,279	19.2
Captive	379	405	451	512	557	568	8.4
Total	3,403	3,831	4,674	5,789	6,789	7,847	18.2
Asia/Pacific							
Merchant	406	756	1,088	1,868	2,472	3,270	51.8
Captive	0	0	0	0	0	0	
Total	406	756	1,088	1,868	2,472	3,270	51.8
Total Worldwide							
Merchant	24,341	30,834	38,251	50,859	57,213	58,414	19.1
Captive	2,773	2,894	3,227	3,662	4,241	4,562	10.5
Total Production	27,114	33,728	41,478	54,521	61,454	62,976	18.4
Percent Growth	-16	24	23	31	13	2	

*Preliminary estimate
Source: Dataquest (January 1991)

Table 2.2

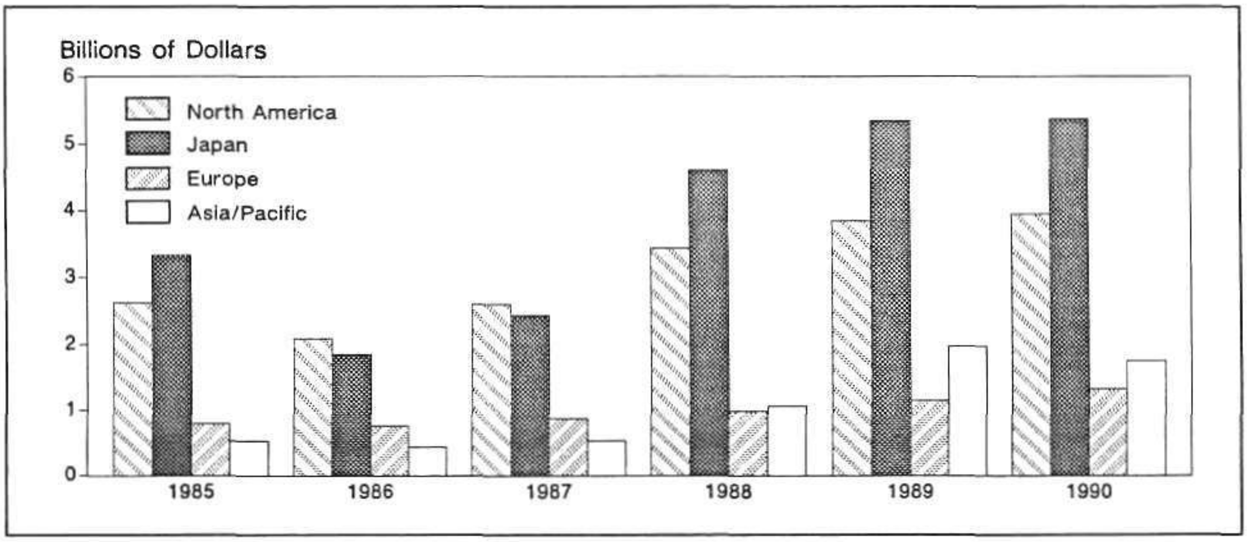
Worldwide Semiconductor Production by Region
Merchant and Captive Semiconductor Manufacturers—Forecast
(Millions of Dollars)

	1990*	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America							
Merchant	19,096	20,765	24,144	29,678	31,846	33,609	12.0
Captive	3,469	4,003	4,636	5,572	6,138	6,366	12.9
Total	22,565	24,768	28,780	35,250	37,984	39,975	12.1
Japan							
Merchant	28,770	29,863	33,387	40,214	42,842	44,986	9.4
Captive	525	646	782	938	995	1,012	14.0
Total	29,295	30,509	34,169	41,152	43,837	45,998	9.4
Europe							
Merchant	7,279	8,880	10,950	13,829	15,306	17,002	18.5
Captive	568	728	850	1,062	1,167	1,203	16.2
Total	7,847	9,608	11,800	14,891	16,473	18,205	18.3
Asia/Pacific							
Merchant	3,270	4,258	5,318	6,721	7,969	8,612	21.4
Captive	0	0	0	0	0	0	
Total	3,270	4,258	5,318	6,721	7,969	8,612	21.4
Total Worldwide							
Merchant	58,414	63,766	73,800	90,442	97,963	104,209	12.3
Captive	4,562	5,377	6,268	7,572	8,300	8,582	13.5
Total Production	62,976	69,143	80,068	98,014	106,263	112,791	12.4
Percent Growth	2	10	16	22	8	6	

*Preliminary estimate
Source: Dataquest (January 1991)

Figure 3.1

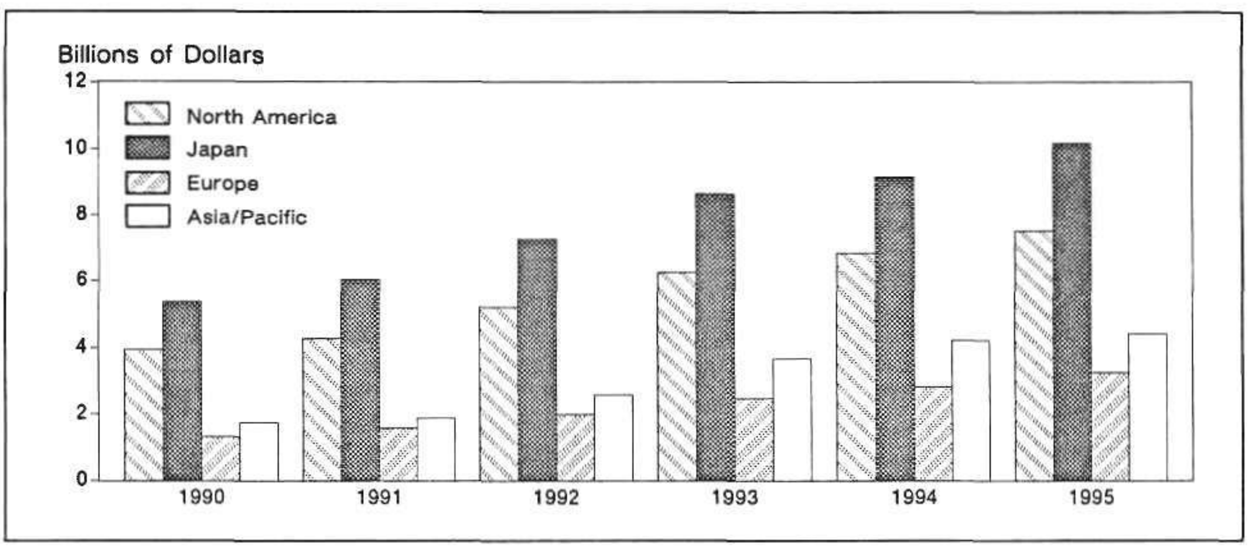
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers
Historical



Source: Dataquest (January 1991)

Figure 3.2

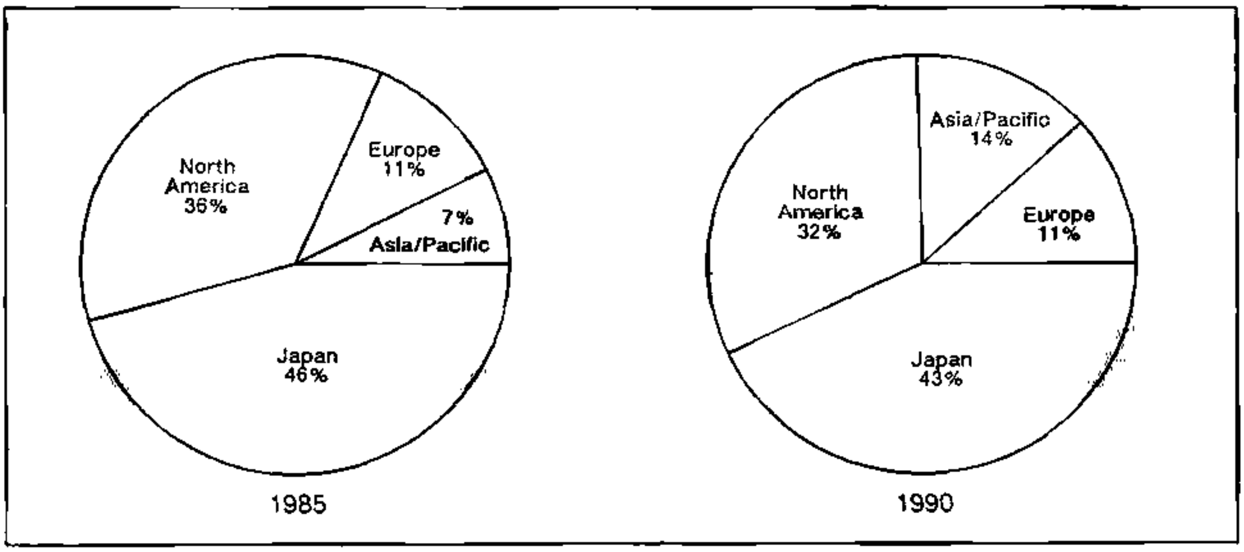
Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers
Forecast



Source: Dataquest (January 1991)

Figure 3.3

Worldwide Capital Spending by Region
Merchant and Captive Semiconductor Manufacturers



Source: Dataquest (January 1991)

Chapter 4

Wafer Fab Equipment Forecast

Introduction

This section presents historical and forecast data on the worldwide wafer fabrication equipment market. Table 4.1 presents the historical data by equipment category for the years 1985 through 1990, and Table 4.2 shows forecast data by category for the years 1990 through 1995.

Production Versus Spending

Table 4.3 summarizes the historical worldwide semiconductor production, capital spending, and wafer fab equipment expenditure for the years 1985 through 1990. Table 4.4 presents Dataquest's forecast regarding these items for the years 1990 through 1995.

Market Growth

Figure 4.1 shows year-to-year growth for semiconductor production and wafer fab equipment for the 10-year period from 1985 through 1995. Table 4.5 shows the compound annual growth rate (CAGR) forecast for semiconductor production, capital spending, and wafer fab equipment. Table 4.6 presents Dataquest's forecast for the wafer fab equipment market by region.

Table 4.1

Worldwide Wafer Fab Equipment Market—Historical, 1985-1990
(Millions of Dollars)

	1985	1986	1987	1988	1989	1990[1]	CAGR (%) 1985-1990
World Fab Equipment Market	3,356	2,710	3,135	4,937	5,887	5,562	10.6
Lithography							
Contact/Proximity	48	31	25	22	20	17	-18.7
Projection Aligners	266	171	129	148	94	80	-21.4
Steppers	430	363	503	921	1,191	1,115	21.0
Direct-Write Lithography	31	68	67	69	70	75	19.6
Maskmaking Lithography	81	51	68	62	73	81	-0.1
X-Ray	2	1	0	6	5	4	17.3
Total	858	685	791	1,228	1,453	1,372	9.8
Automatic Photoresist							
Processing Equipment	158	146	164	247	325	311	14.6
Etch and Clean							
Wet Process	157	162	168	240	306	278	12.1
Dry Strip	39	34	55	94	116	110	23.5
Dry Etch[2]	306	244	314	554	645	610	14.8
Total	502	440	538	889	1,066	998	14.8
Deposition							
Chemical Vapor Deposition	247	220	260	456	580	550	17.4
Physical Vapor Deposition	263	237	254	305	377	360	6.5
Silicon Epitaxy	72	46	36	85	72	60	-3.4
Metalorganic CVD	25	31	35	42	44	42	11.1
Molecular Beam Epitaxy	53	66	68	81	73	67	5.0
Total	658	600	652	969	1,145	1,079	10.4
Diffusion	207	156	145	295	327	300	7.7
Rapid Thermal Processing	14	15	18	22	28	26	12.7
Ion Implantation							
Medium Current	125	55	61	118	140	134	1.5
High Current	167	55	107	241	306	299	12.4
High Voltage	2	10	18	18	23	11	39.3
Total	293	119	186	377	468	444	8.6
Process Control							
CD (Optical and SEM)	30	44	88	151	153	166	40.7
Wafer Inspection	34	42	58	101	115	98	23.3
Other Process Control	358	287	286	355	404	368	0.6
Total	423	373	432	607	672	632	8.4
Factory Automation	125	81	99	130	195	205	10.4
Other Equipment	117	95	110	173	206	195	10.6
Total World Fab Equipment	3,356	2,710	3,135	4,937	5,887	5,562	10.6
Percent Change	-5	-19	16	57	19	-6	

[1] Preliminary estimate
[2] Includes ion milling
Note: Columns may not add to totals shown because of rounding.
Source: Dataquest (January 1991)

Table 4.2

Worldwide Wafer Fab Equipment Market—Forecast, 1990-1995
(Millions of Dollars)

	1990[1]	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
World Fab Equipment Market	5,562	6,211	7,689	9,483	10,416	10,902	14.4
Lithography							
Contact/Proximity	17	16	16	15	15	14	-3.8
Projection Aligners	80	86	99	112	119	122	8.8
Steppers	1,115	1,264	1,576	1,970	2,145	2,251	15.1
Direct-Write Lithography	75	85	105	131	154	173	18.2
Maskmaking Lithography	81	94	116	145	167	173	16.4
X-Ray	4	10	15	31	50	70	77.3
Total	1,372	1,555	1,927	2,404	2,650	2,803	15.4
Automatic Photoresist							
Processing Equipment	311	348	425	523	569	593	13.8
Etch and Clean							
Wet Process	278	312	385	465	500	520	13.3
Dry Strip	110	120	150	190	210	220	14.8
Dry Etch[2]	610	690	845	1,068	1,180	1,252	15.5
Total	998	1,122	1,380	1,723	1,890	1,992	14.8
Deposition							
Chemical Vapor Deposition	550	630	770	970	1,070	1,140	15.7
Physical Vapor Deposition	360	405	490	600	650	690	13.9
Silicon Epitaxy	60	55	85	74	105	110	12.9
Metalorganic CVD	42	48	60	72	79	85	15.1
Molecular Beam Epitaxy	67	71	82	94	103	110	10.4
Total	1,079	1,209	1,487	1,810	2,007	2,135	14.6
Diffusion	300	330	400	500	550	575	13.9
Rapid Thermal Processing	26	30	45	60	70	80	25.2
Ion Implantation							
Medium Current	134	145	180	216	230	218	10.2
High Current	299	329	423	521	562	523	11.8
High Voltage	11	16	29	37	43	48	34.3
Total Implant	444	490	632	774	835	789	12.2
Process Control							
CD (Optical and SEM)	166	192	239	290	320	330	14.7
Wafer Inspection	98	109	136	165	181	191	14.3
Other Process Control	368	391	483	574	619	644	11.8
Total Process Control	632	692	858	1,029	1,120	1,165	13.0
Factory Automation	205	225	275	340	375	400	14.3
Other Equipment	195	210	260	320	350	370	13.7
Total World Fab Equipment	5,562	6,211	7,689	9,483	10,416	10,902	14.4
Percent Change	-6	12	24	23	10	5	

[1] Preliminary estimate
[2] Includes ion milling
Note: Columns may not add to totals shown because of rounding.
Source: Dataquest (January 1991)

Table 4.3

Worldwide Semiconductor Production, Capital Spending, and Wafer Fab Equipment—Historical, 1985-1990 (Millions of Dollars)

	1985	1986	1987	1988	1989	1990[1]	CAGR (%) 1985-1990
Semiconductor Production[2]	27,114	33,728	41,478	54,521	61,454	61,031	17.6
Capital Spending	7,299	5,129	6,435	10,088	12,296	12,379	11.1
Wafer Fab Equipment	3,356	2,710	3,135	4,937	5,887	5,562	10.6

[1]Preliminary estimate
[2]Semiconductor production includes worldwide merchant and captive production.
Source: Dataquest (January 1991)

Table 4.4

Worldwide Semiconductor Production, Capital Spending, and Wafer Fab Equipment—Forecast, 1990-1995 (Millions of Dollars)

	1990[1]	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
Semiconductor Production[2]	62,976	69,143	80,068	98,014	106,263	112,791	12.4
Capital Spending	12,379	13,760	17,062	21,049	23,026	25,352	15.4
Wafer Fab Equipment	5,562	6,211	7,689	9,483	10,416	10,902	14.4

[1]Preliminary estimate
[2]Semiconductor production includes worldwide merchant and captive production.
Source: Dataquest (January 1991)

Table 4.5

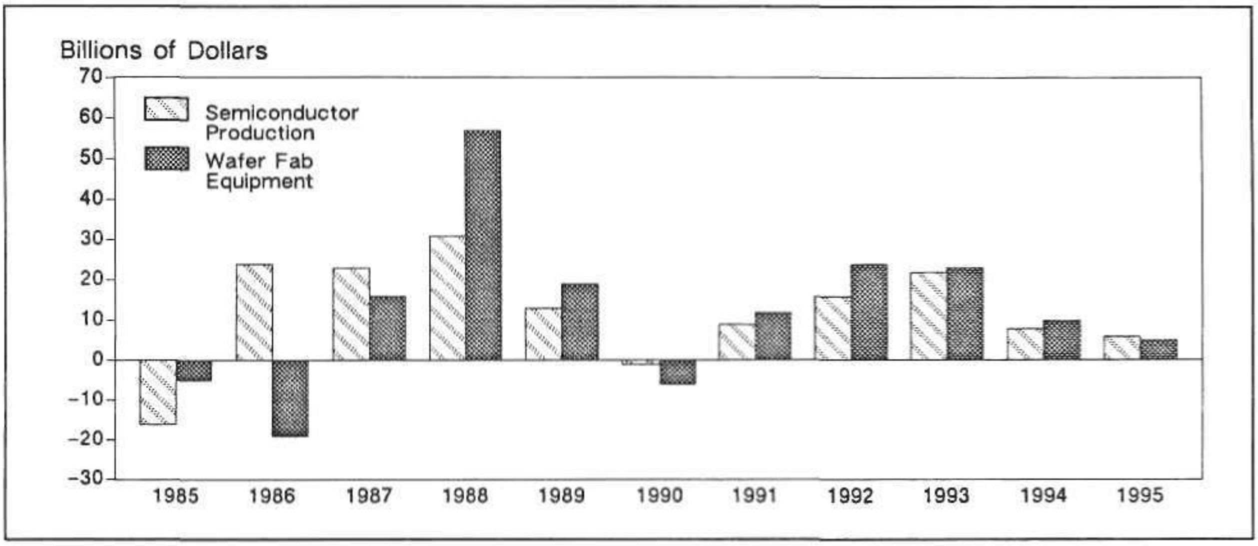
Estimated 10-Year CAGR, 1985-1995

	CAGR (%) 1985-1995
Semiconductor Production	15.3
Capital Spending	13.3
Wafer Fab Equipment	12.5

Source: Dataquest (January 1991)

Figure 4.1

Estimated Semiconductor Production and Wafer Fab Equipment
10-Year Growth Pattern, 1985-1995



Source: Dataquest (January 1991)

Table 4.6

Regional Wafer Fab Equipment Market Forecast
(Millions of Dollars)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995
North America	1,691	1,835	2,239	2,700	2,936	3,053	12.5
Japan	2,414	2,651	3,171	3,785	4,029	4,216	11.8
Europe	689	834	1,068	1,340	1,517	1,655	19.2
Asia/Pacific-ROW	768	890	1,211	1,657	1,935	1,977	20.8
Worldwide Total	5,562	6,211	7,689	9,482	10,417	10,901	14.4

Source: Dataquest (January 1991)

Chapter 5

Silicon Wafer Forecast

Tables 5.1 and 5.2 present the historical and forecast consumption of silicon in million square inches by region.

Table 5.1

Silicon Consumption by Region—Historical, 1985-1990
(Million Square Inches)

	1985	1986	1987	1988	1989	1990	CAGR (%) 1985-1990
United States	398	405	435	496	560	620	9.3
Percent Growth	-43.7	1.9	7.3	13.6	12.9	10.7	
Japan	588	642	670	772	909	1,022	11.7
Percent Growth	-11.0	9.1	4.4	15.2	17.7	12.5	
Europe	148	155	172	196	216	217	8.0
Percent Growth	-7.5	4.6	10.9	14.0	10.2	0.1	
Rest of World	43	64	78	98	127	169	31.5
Percent Growth	-15.7	47.9	22.0	26.8	29.6	32.8	
World	1,177	1,266	1,355	1,562	1,812	2,028	11.5
Percent Growth	-25.5	7.5	7.0	15.2	16.0	11.9	

Source: Dataquest (January 1991)

Table 5.2

Silicon Consumption by Region—Forecast, 1990-1995
(Million Square Inches)

	1990	1991	1992	1993	1994	1995	CAGR (%) 1990-1995	Delta msi 1990-1995
United States	620	662	733	847	861	855	6.6	235
Percent Growth	10.7	6.8	10.7	15.5	1.7	-0.7		
Japan	1,022	1,101	1,221	1,400	1,434	1,447	7.2	425
Percent Growth	12.5	7.7	10.9	14.7	2.4	0.9		
Europe	217	244	285	343	368	395	12.8	178
Percent Growth	0.1	12.6	17.0	20.2	7.4	7.3		
Rest of World	169	221	273	338	389	417	19.8	248
Percent Growth	32.8	30.6	23.6	23.9	15.1	7.0		
Total	2,028	2,228	2,512	2,928	3,053	3,114	9.0	1,086
Percent Growth	11.9	9.9	12.8	16.6	4.3	2.0		

Source: Dataquest (January 1991)

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