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SEMICONDUCTOR
VENDOR PROFILE SPECIFICATION

July 1992

Preliminary

Corporate Information

- General Information

  Address/Tel/Fax

- Key executives, Board members

- Share holders/Stock exchange

- # of Employees, CY-2, CY-1, CY

Business/Economic Condition

General Economic and Electronic Industry Condition
Source: Terry Birkholz

Corporate Business Analysis
by Product Division - CY-2, CY-1, CY, i.e.,

- Total Corporate Sales by Product Division and by Product Line CY-2, CY-1, CY
- Total Corporate Sales by Geographic Market by Product Line CY-2, CY-1, CY

Financial Analysis

- Financial Performance, Revs, Profits, E.P.S. - CY-2, CY-1, CY
- Financial ratios where available
  Current/Quick/Liquidity/Profitability
- Stock price performance/value

Consolidated Financial Statement

- Balance Sheet, 5 years history
- Income Statement, 5 years history

Semiconductor (Equipment/Materials) Division Highlight

Semiconductor (Equipment/Materials) Industry Overview - Use summary text from recent Industry Trends Publication

Corporate Semiconductor Division (Equipment/Materials) Summary Including

- Division Strategy
- Total Revenue by Product, by Region CY-2, CY-1, CY
- Market Share Ranking in 4 Major Regions for Total Semiconductors (Equipment/Materials) CY-2, CY-1, CY
- Worldwide Market Share Ranking by Major Product Categories CY-2, CY1, CY
- Your assessment of this division strength/Weakness/Opportunity/Threat
- Product Portfolio Charts

Product Lines Evaluation

- Detail Product Lines Revenue by Region and Market Share by Region
- Detail Product Line Strategy for each of the Product Lines to be analyzed
- Strengths/Weaknesses/Opportunities/Threats for each Product line to be analyzed
- Strengths include - Market Share, Alliance, R&D investments, licensing agreements, etc.
- Weaknesses include - Lack of leading edge products, low levels of R&D, stagnant product portfolio, etc.
- Threats - Competitor activities, recent management exchanges, etc.
- Opportunities include - General economics conditions, emerging new systems that will incorporate their devices, recent reorganization, etc.

Semiconductor (Equipment/Materials) Division Investment

- Capital Spending CY-2, CY-1, CY
- R&D Expenditures CY-2, CY-1, CY
- R&D Facility/Domestic, Overseas Locations

Sales Facility

- Sales Office CY

  Domestic/Overseas

- Design Center Locations CY

  Domestic/Overseas

Manufacturing Facility

- Domestic Manufacturing Plants
- Overseas Manufacturing Plants

Fab Name

Location

Open Date

Product

Capacity by Type of Product and by Wafer Size

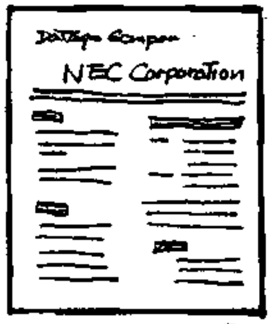
Alliance Relationship

- Alliances by the Company (5 yrs)
- Short Summary

OTHER COMMENTS:

- Should be 50% Text and 50% Graphics
- Should include your opinion in most parts of the profile
- Text should be hard hitting but <u>balanced</u> analysis
  i.e., on one hand . . . and on the other hand . . .
- DEFINITELY show creativity and uniqueness in your analysis
- Contain a maximum of 16 pages, 12 pages preferred

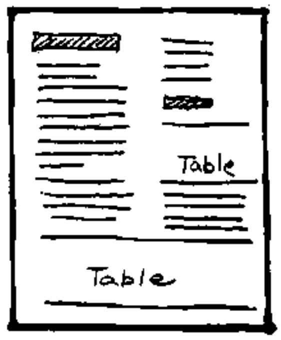
Cover



Corporate Information

1
- General information (date founded)
  Address/Tel/Fax/# of employee etc.
- Key executives, names, ...
- Share holders/Stock exchange
- Org. chart
- Keiretsu chart (for Japanese Cos.)

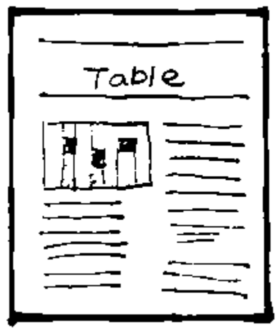
Business/Economic Condition



General business weather
Economy/Industry

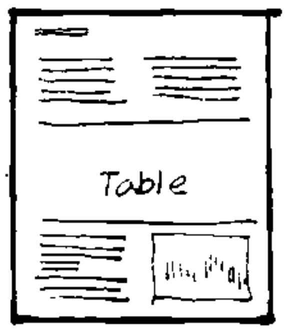
2 CORPORATE STRATEGIC DIRECTION
~~Company~~ Corporate business condition and
By product division

- Sales by product division
- Revenue by geographic market



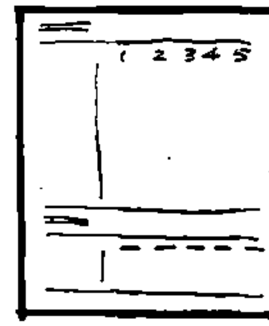
3
- Product line by division
- Recent Developments including one paragraph on these developments

Financial Analysis



4
- 1991 financial performance review
- Financial ratios
  Current/Quick/Liquidity/Profitability
- Stock market value
  Stock price performance/value

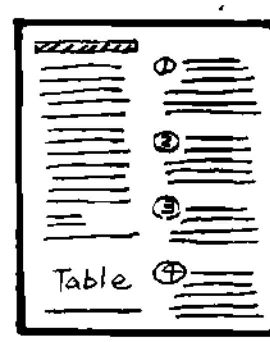
Consolidated Financial Statement (5yrs)



- Balance sheet

5
- Income statement

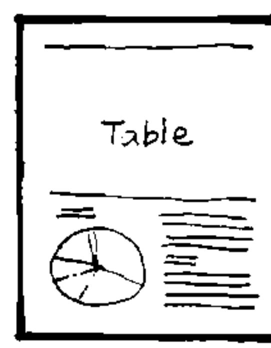
Semiconductor Highlight



Semiconductor industry overview in 1991

6 Corporate Semiconductor division summary

- Performance in 1991
- Business positioning
  Ranking
  Strength/Weakness/Opportunity/Threat



- Revenue by product

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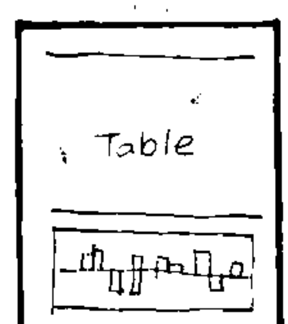
- Revenue by region

- Product mix
  Product lineup

☒ STRATEGIES

Semiconductor Revenue

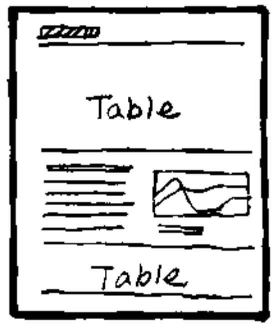


Worldwide semiconductor revenue

8
- By product category
- Growth rate

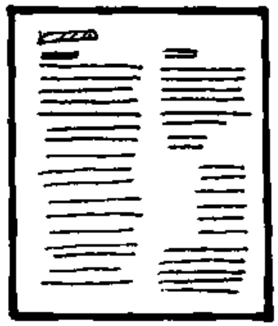
9 **Semiconductor Investment**

- Capital spendings
- R&D expenditure
  R&D facility/domestic, overseas



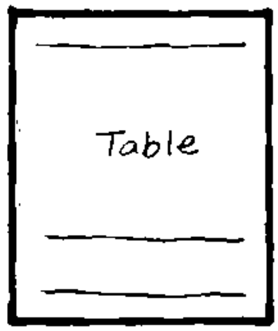
10 **Sales Facility**

- Sales office
  Domestic/Overseas
- Design center
  Domestic/Overseas



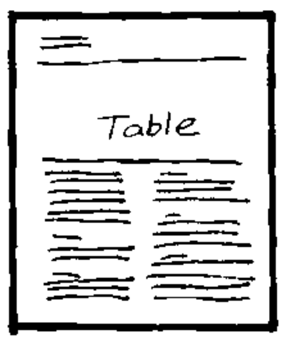
11 **Manufacturing Facility**

- Domestic manufacturing plants
- Overseas manufacturing plants
  Fab name
  Location
  Open date
  Product



12 **Alliance Relationship**

- Alliances by the company (5yrs)
- Short ~~summary~~ analysis of these alliances



13 DQ Perspective on the Company

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SUBJECT: Company Backgrounders

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(1)

(2) Corporate Level Information

(3)

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(4) (for Investor)
Financial Analysis

(5)

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(6)

(7)

(8)

(9) Semiconductor Division

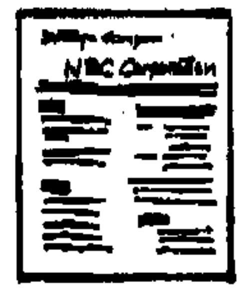
(10)

(11)

(12)

Date founded?
DUNS #?

Cover



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1

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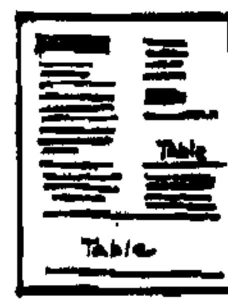
  Address/Tel/Fax/# of employee etc.
- Key executives
- Share holders/Stock exchange

Business/Economic Condition

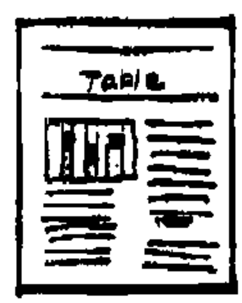


General business weather
Economy/Industry

2

Company business condition
By product division

- Sales by product division
- Revenue by geographic market



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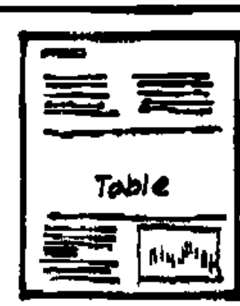
- Product line by division

Corporate Strategic Direction?

Financial Analysis



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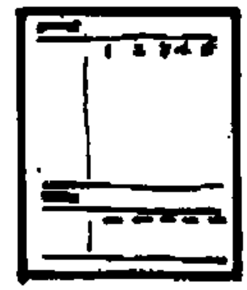
Consolidated Financial Statement (5yrs)

5

- Balance sheet
- Income statement



Semiconductor Highlight

Semiconductor industry overview in 1991

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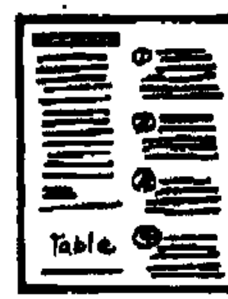
  Strength/Weakness/Opportunity/Threat



- Revenue by product

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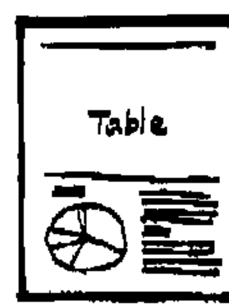
- Revenue by region
- Product mix
  Product lineup

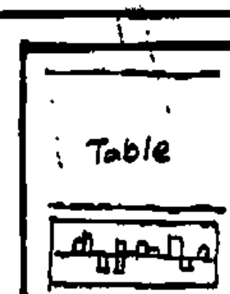


Semiconductor Revenue

Worldwide semiconductor revenue

8

- By product category
- Growth rate



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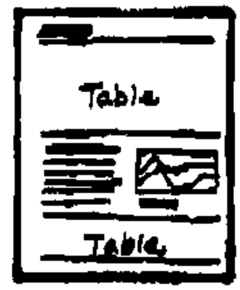
Semiconductor Investment

- Capital spendings
- R&D expenditure
  R&D facility/domestic, overseas



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Sales Facility

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  Domestic/Overseas
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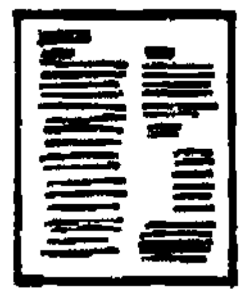
  Domestic/Overseas



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Manufacturing Facility

- Domestic manufacturing plants
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  Fab name
  Location
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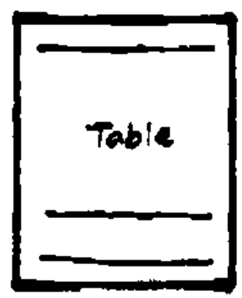
  Product



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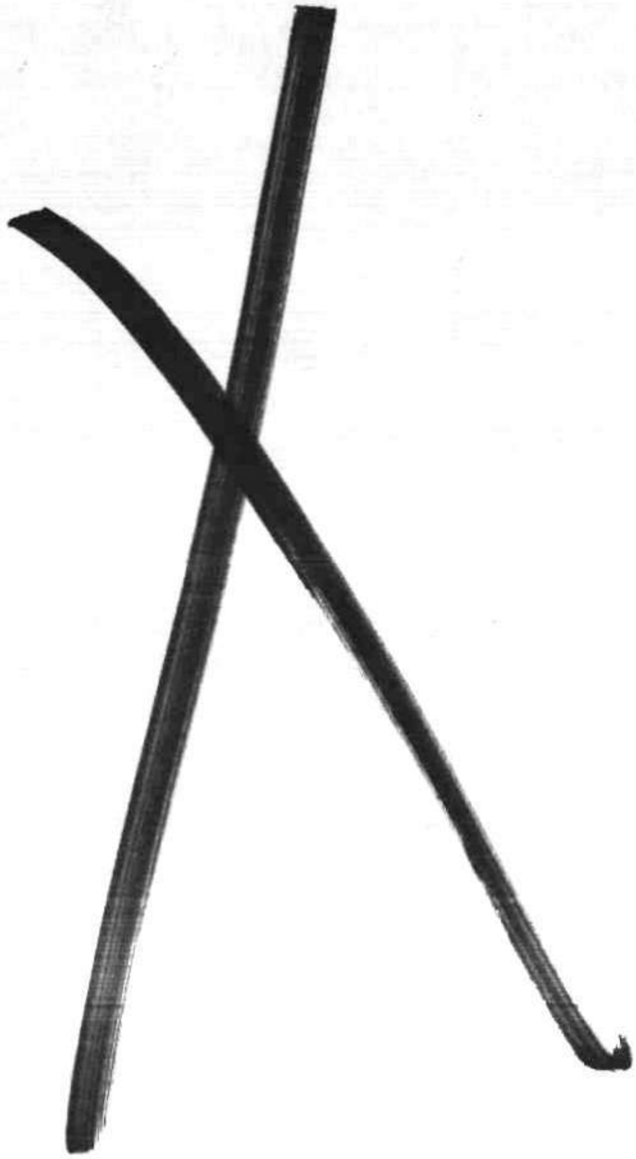

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I International Rectifier Corp

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LSI Logic Corporation
Linear Technology Corporation

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Micron Technology Inc.
Motorola Inc.

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National Semiconductor Corporation
Northern Telecom, LTD.

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VLSI Technology, Inc.

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Dataquest Vendor Profile

Semiconductors

Semiconductors Worldwide

Analog Devices Inc.

Corporate Statistics

Headquarters and Facilities Location	Norwood, MA
Chairman and CEO	Ray Stata
President and COO	Jerald Fishman
Vice President, Sales	Brian McAloon
Vice President, Finance and CFO	Joseph McDonough
Vice President, Manufacturing	Tom Urwin
Fiscal Year Ends	October 31
Stock Exchange	NYSE
Stock Symbol	ADI
Employees	5,200
Fiscal 1992 Revenue	$567 million
Fiscal 1992 Net Income	$14.9 million
Shareholders Equity	$375 million
Shares Outstanding	47.7 million

Analog Devices (ADI) designs, manufactures, and markets precision high-performance linear, mixed-signal, and digital integrated circuits used in real-world signal processing applications involving temperature, pressure, sound, images, speed, acceleration, position, and rotation angle. ADI, formed in 1965, is the only Fortune 500 company specializing in real-world signal processing.

ADI's first products were modular operational amplifiers for instrumentation. They were followed by data converters in 1969. Two years later, ADI acquired Nova Devices, a bipolar monolithic IC manufacturer it helped found in 1969. A hybrid IC operation started in 1975. In 1976, monolithic CMOS circuits were introduced and a CMOS wafer fabrication facility opened in Ireland.

The early 1980s began with IC assembly and testing facility expansion into Shiroyamacho, Japan, and into Manila, the Philippines. A digital signal processing (DSP) group was formed after a 1983 acquisition of Signal Processing Circuits Inc. Sales in 1983 were $214 million, with ICs representing two-thirds of the total.

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Program: Semiconductors Worldwide
Product Code: SEMI-WW-VP-9301
Publication Date: May 31, 1993

ADI invested heavily in new process technology and plants for monolithic CMOS and Bipolar ICs during the mid-1980s. By 1987, three-fourths of the monolithic ICs products introduced were manufactured on processes not available the previous year, and sales reached $360 million. Extending an emphasis begun in 1985, ADI began to improve its response to customers and product quality in 1986 through a formal Quality Improvement Process. Wafer cycle time decreased 38 percent in Ireland, and assembly and test times were reduced nearly twofold.

For the most part, ADI growth rates from 1972 to 1985 averaged more than 25 percent a year in nominal terms and 16 percent in real terms. Economic downturns, maturing products, and aggressive competition were all factors when growth rates fell to 6 percent in the 1985-to-1987 time frame. In the mid- to late 1980s, ADI began to believe that better customer service, manufacturing efficiency, and new market directions, specifically application-specific markets, would be needed to succeed in the 1990s. By 1990, 96 percent of shipments were on time, compared with 75 percent to 80 percent a few years before.

By 1990, sales had reached $485 million, but ADI incurred a $12.9 million loss. More significant for the long term than the financial loss was the acquisition of a strong competitor, Precision Monolithics Inc. (PMI), and restructure and realignment of resources that positioned the company as a market-driven solution supplier rather than an old-style component supplier operating without special attention to market needs. The company remained financially strong with a debt-to-equity ratio of 10 percent. Three-fourths of revenue came from products where the company held a dominant position.

The retargeting of ADI's long-term strategy, which began in 1990, rests on three basic principles, as follows:

- Shift from product-driven to market-driven orientation in response to customer needs for application- and market-specific products
- Economic and competitive pressures require resource consolidation and centralization, especially manufacturing and administration
- Outside alliances offer opportunity to spread financial risks and improve performance quickly

The decentralized organization prevented ADI from responding quickly and effectively to competitive and market pressures. A single industrial electronics group was formed to focus on industrial automation, automatic test equipment, and motor control markets. The new System IC Products Division, made up of the existing DSP and the Mixed-Signal ASIC divisions, was formed to attack the VLSI system-level business.

In late 1991, a new senior management structure was announced with Jerald Fishman, a long-time ADI vice president, assuming the titles of president and chief operating officer. The senior management team also expanded to foster greater participation in company operations and decisions.

Strategic Business Focus

The real-world signal processing market can be broken into four categories, as follows:

- Standard linear ICs (SLICs): General-purpose single-function products such as amplifiers and data converters
- Special-purpose linear ICs (SPLICs): Market-specific ICs that use building blocks to create systems-on-a-chip
- Assembled products: Non-IC products such as modules and hybrids
- Digital signal processors (DSPs): ICs optimized for digital processing of real-world, real-time signals

ADI plans to focus on the SPLIC, DSP, and SLIC product areas, while assembled products will be managed for profits and cash rather than growth.

Key Product Areas

SLICs

More than 800 SLICs form the foundation for ADI and accounted for 64 percent—more than $360 million—of fiscal 1992 revenue. Overall SLIC revenue growth was 7 percent, but sales outside of Japan grew 11 percent. The fastest-growing SLIC product categories are fast high-resolution analog-to-digital (A/D) converters, high-speed operational amplifiers, 8-bit video converters, and single-supply operational amplifiers.

Adding to its traditionally strong amplifier, multiplier, voltage reference, data converter, and comparator position, ADI will develop new interface and power management circuits during 1993. These two new product areas have shown growth rates higher than the linear market average and have been served by competitors such as Linear Technology, Maxim, National Semiconductor, and Unitrode.

ADI is expected to introduce a variable-speed induction motor control two-chip set in 1993 that will reduce motor power consumption. The potential customer benefits are substantial because motor applications account for 50 percent of the U.S. electrical power consumption. The system uses a standard DSP and an application-specific mixed-signal IC for analog signal processing and A/D and D/A conversion.

SLIC products provide high, stable gross margins with profit margins approaching 20 percent of sales. High profit ratios and low capital needs produce high operating cash flows. SLICs are forecast for moderate growth.

Amplifiers

ADI ranked a close second behind National Semiconductor in 1992, with 11.3 percent of the $874 million world amplifier market (see Table 1). ADI clearly ranks No. 1 when precision, noncommodity devices are considered. Other competitors include Texas Instruments (TI) with a 9.3 percent share, Harris Semiconductor with 6.9 percent, and Linear Technology with 3.4 percent. Within the top 10 manufacturers, Linear Technology, Harris, and TI are its closest competitors because commodity products dominate the other suppliers product offerings. With the 1990 acquisition of Precision Monolithics, ADI gained a stronger position in the market and increased its competitive power against smaller companies such as Linear Technology and Maxim.

Data Converters

ADI still remains formidable in data converters with a 25.4 percent share of the $995 million 1992 market, and is even more dominant in the high-resolution segment. Although competition and pricing pressures increased early in the decade, ADI continues to be the leader. ADI's converter technology also makes for an impressive mixed-signal capability. With 1992 converter sales of $253 million, ADI was three times the size of its nearest numerical rival, Brooktree. Brooktree, however, serves the

Table 1
1992 Precision Amplifier and Converter Markets Leaders

Rank	Company	Market Share (%)	Revenue ($M)
Amplifier Integrated Circuit Market Share			
1	National Semiconductor	12.6	110
2	ADI	11.3	99
3	Texas Instruments	9.3	81
4	NEC Corporation	7.6	66
5	Harris Semiconductor	6.9	60
6	Motorola Semiconductor	6.5	57
7	New Japan Radio	5.9	52
8	Mitsubishi Electric	5.8	51
9	SGS-Thomson Microelectronics	3.5	31
10	Linear Technology	3.4	30
Data Converter Integrated Circuit Market Share			
1	ADI	25.4	253
2	Brooktree	8.7	85
3	National Semiconductor	8.5	83
4	Harris Semiconductor	7.0	68
5	Burr-Brown	5.0	49
6	Siliconix	3.9	38
7	Maxim Integrated Products	3.9	38
8	Texas Instruments	3.7	36
9	Sony Corporation	3.1	30
10	Motorola Semiconductor	2.1	21

Source: Dataquest (May 1993)

specialized video graphics market almost exclusively, while ADI markets to a broad market worldwide. National Semiconductor, Harris, Maxim, TI, and Motorola represent ADI's primary competitors, although Crystal Semiconductor, now a division of Cirrus Logic, is a strong competitor in delta-sigma data converters, which are specialized devices used in digital audio and PC multimedia applications. Maxim has alternate-sourced many ADI converter products and takes a particularly aggressive position against ADI both on price and technical innovation.

Assembled Products

Hybrids and modules form the assembled products line. These older products have declined since fiscal 1989, partly because of planned obsolescence as well as replacement by monolithic solutions. Sales were $103 million in 1992, down from 1991's $122 million. These products represent 18 percent of 1992 ADI revenue, down from 29 percent in 1990, and sales declines are now moderating. A 10 percent decline is possible in 1993, much less than the 15 to 20 percent declines seen in recent years. ADI is heavily weighted with proprietary products and expects positive profit and cash flow from the line.

Mixed-Signal SPLICs

SPLIC single-chip products are system-level, multifunction devices that typically replace 5 to 20 simpler ICs. Most SPLICs are mixed-signal devices or linear. Technical inputs from key customers, such as automotive, hard disk, and cellular phone manufacturers, normally are necessary. ADI's technical leadership, application support, and in-house advanced process capability are factors that potential customers weigh heavily in vendor selection. SPLIC customers tend to be large and offer significant volume potential.

Customers look for mixed-signal technology to drive system costs down. More integration translates into smaller, lighter systems with greater reliability and lower operating power requirements. The SPLIC market potential can be realized because customer needs and process technology are now in step. The extensive benefits customer derive from mixed-signal SPLIC solutions become apparent from ADI's analysis of a disk drive electronics evolution (see Table 2).

Table 2
Mixed-Signal Technology as a Disk Drive Strategy

	1990 3.5-Inch Drive	1992 2.5-Inch Drive
Total Number of ICs	12	5
Total Cost of ICs ($)	45	28
ADI Content ($)	15	14
% ADI Content	33	50

Source: Analog Devices Inc.

Emerging mixed-signal markets include disk drives, medical imaging, digital mobile radio, digital audio (CD, DAT, and Dolby Pro Logic Surround Sound), digital video (HDTV and display converters), multimedia, automotive sensors, noise cancellation, modems, faxes, business audio, and smart munitions.

In terms of mixed-signal market presence, ADI ranks third worldwide and holds a 6.8 percent market share, with 1992 sales estimated at $289 million. Aggressive expansion in this market is expected (see Table 3).

DSP Technology

The current DSP ICs are digital-only devices used in complex DSP applications. ADI will combine DSP functions in mixed-signal, system-level ICs along with linear and analog signal-processing circuits. Typical DSP applications include: digital mobile radio, facsimile machines, voice recognition, medical imaging, noise cancellation, smart munitions, disk drives, and modems. ADI will focus on niches where DSP and converter integration have high value and where signal processing is a key need. ADI held 8.8 percent of the 1992 DSP market and improved its ranking from sixth to fourth (see Table 4). Other competitors are TI, AT&T Motorola, and NEC. TI is especially well respected in the DSP market and has also pushed into the mixed-signal analog area. U.S. companies are responsible for more than 85 percent of worldwide DSP sales; Japan is not a strong factor.

With SPLIC and DSP IC sales reaching $101 million in 1992, up 35 percent, this is ADI's fastest-growing product segment (see Table 5). About 40 percent of fiscal 1992 bookings were for products introduced within the last

Table 3
1992 Mixed-Signal IC Rankings

Rank	Company	1992 Mixed-Signal Market Share (%)	1992 Mixed-Signal Sales ($M)
1	National Semiconductor	8.0	340.2
2	SGS-Thomson Microelectronics	7.5	316.2
3	Analog Devices	6.8	289.0
4	Texas Instruments	5.7	243.4
5	Silicon Systems	5.7	241.0

Source: Analog Devices Inc.

Table 4
ADI DSP Market Share Increases (Millions of Dollars)

1992 Rank	1991 Rank	Company	1992 DSP Revenue ($)	1991 DSP Revenue ($)	1992 DSP Market Share (%)
1	1	Texas Instruments	171	143	38.5
2	3	AT&T	105	33	25.3
3	2	Motorola	63	40	14.2
4	6	Analog Devices	39	20	8.8
5	5	NEC	22	21	5.0

Source: Dataquest (May 1993)

Table 5
High-Growth DSP and Special-Purpose Linear ICs

	1992 Sales ($M)	1991 Sales ($M)	FY92-FY91 Growth (%)
Standard-Function Linear ICs (SLIC)	363	341	7
Special-Purpose Linear ICs and DSP	101	75	35
Assembled Products (ASP)	103	122	-16
Total Sales	567	538	6

Source: Analog Devices Inc., Dataquest (May 1993)

five years. SPLICs or DSP ICs accounted for about half of the 100 or so new 1992 product releases, with the remainder being SLICs.

Product Sales

ADI received a sharp increase in amplifier and converter (primarily D/A converters) revenue with its 1990 Precision Monolithics acquisition. Hybrid circuit revenue recently stabilized after sharp drops from 1989 through 1991 (see Table 6).

ADI established a set of "core competencies" that make leadership positions possible in market-specific applications that benefit from both analog and digital signal processing skills. The skills and capabilities in component-level circuits will greatly aid ADI's pursuit of system-level IC business. The markets served by ADI products are as follows:

- Delta-sigma data converters
  - Multimedia sound processing
  - Cellular phones
- High-speed data converters
  - Desktop graphics
  - Camcorders
  - Laser printers
  - Wireless communications
- Precision linear
  - Audio
  - Automotive airbags
  - Power management for portable computers

Table 6
Product Sales History (Millions of Dollars)

Product Class	1989	1990	1991	1992	CAGR (%) 1989-1992
Amplifier	27.5	39.5	96.0	99.0	53.3
Comparator	6.0	6.8	6.0	6.0	0
Regulator	14.0	14.4	16.0	21.0	14.5
Converter	197.0	214.0	255.0	253.0	8.7
Interface	1.0	1.0	0	2.0	26.0
Other Analog	21.5	25.3	20.0	28.0	9.2
Analog ASIC	3.0	4.0	5.0	13.0	63.0
Consumer	0	0	2.0	8.0	NM
Hybrids	67.0	55.0	44.0	47.0	-11.1
Total Monolithic	270.0	305.0	400.0	430.0	16.8

MN = Not meaningful
Source: Dataquest (May 1993)

- DSP
  - Cellular phones
  - Signal processing
  - Modems/faxes
- Mixed-signal system ICs
  - Hard disk drives
  - Business audio
  - AC motor control
  - Desktop graphics

Market Segments

As is common with analog and mixed-signal IC manufacturers, business is distributed among many customers. For fiscal 1992, the 20 largest customers accounted for about 20 percent of sales, and the largest 1,000 customers contributed 55 to 60 percent of sales. ADI's largest customer represented less than 5 percent of sales. As mixed-signal, application-specific VLSI circuits are developed, we expect more customers with large shares of ADI's revenue.

ADI customers are OEMs. Typical applications are in engineering, scientific, and medical instruments; industrial automation equipment; military and aerospace equipment; computer peripherals; communications equipment; and high-end consumer electronics products (see Table 7).

Table 7
Market Segments Served by ADI

Market Segment	Applications/Customers	ADI Capability	Characteristics
Instrumentation	Engineering, scientific, medical	High-performance SLICS	Long life cycles
Industrial Automation	Data acquisition, automatic process and environmental control, robotics and automatic test equipment (ATE)	SLICs, SPLICS in ATE	Long life cycles
Military/Aerospace	Space and military, commercial avionics	SLICs supplied to Class B and S standards	Long life cycles, profitable but volatile; good potential long term
Computers and Peripherals	Personal computers, workstations, video displays, PCMCIA modems and computer peripherals such as hard drives	SPLICS, SLICS, mixed-signal	Rapid technology advancements, short product cycles
Communications	Data and fax modems, digital cellular phones, wireless portable phones	SLICS, SPLICS, high speed	Low power and size; large volume potential
Consumer Electronics	Compact disc players, digital VCRs, digital audio tape, camcorders	SPLICS, mixed-signal ICs	DSP potential
Automotive	Airbag crash sensing	SPLICS, integrated micromachined sensors	High volume

Source: Analog Devices Inc., Dataquest (May 1993)

ADI Brings Sound to PCs

Intel included the AD1848 SoundPort audio-codec in the Pentium "reference design," a complete motherboard design that computer manufacturers can freely copy or modify for their own use.

The AD1848 is also the hardware element of the Microsoft Windows Sound System, which gives PC users CD-quality sound and was developed with ADI and Compaq Computer Corporation. Business audio applications include voice mail, voice commands, voice annotated documents, and voice-proof reading of spreadsheets.

ADI Automotive Airbag "Smart Sensor"

The automotive/transportation market was targeted in 1991 with the ADXL50 accelerometer and "smart sensor" introduction. An on-chip movable, micromachined element senses the rapid deceleration present in a crash. On-chip analog signal conditioning circuits transform the sensor signal so that the airbag control module can trigger airbag inflation. Volume production will be beyond 1993, but ADI believes that the 1997 market for electronic airbag systems exceeds 15 million vehicles. Significant volumes could begin in 1994 or 1995.

Other automotive "smart sensor" circuits include a "bulb watcher" that detects and warns of burned-out bulbs, a temperature sensor, a battery monitor circuit, and a hall-effect engine timing device.

Integrated Hard Disk Electronics

The AD899 Read Channel IC targets small-form factor hard disk drives by replacing many individual ICs needed in earlier designs. The chip performs the read channel functions—signal conditioning, data qualification, synchronization, and encoding/decoding—with only a few external components.

European Digital Cellular Telephones

The AD7000 base band I/O port and ADSP-21msp50 mixed-signal DSP IC are used in the pan-European GSM digital cellular telephone system that became operational in 1992. ADI also expects to participate in the European CT2 digital cordless phone and high-speed digital subscriber loop markets.

Successful Distribution Sales Strategy

Until the 1990 acquisition of PMI from Bourns, ADI used direct selling domestically. PMI, however, brought with it an established domestic distribution network that served as the core for ADI's new domestic distribution sales effort. Initially, the move to distribution negatively impacted revenue and profits because existing established business was moved to distributors at discounted prices. Positive results showed up in fiscal 1991 as the distribution channel captured business from new customers. More importantly, the direct sales force was freed to concentrate and develop larger OEMs accounts and to focus on new markets.

The distribution channel accounted for about 33 percent of fiscal 1992 sales. North America is served by 10 distributors; 35 countries are served by distributors internationally.

About 40 percent of standard linear IC sales comes from the distribution channel, up from zero just two years ago. The recent significant growth shown by SLIC products after several years of slow growth probably can be attributed more to distribution strategy than to economic revival.

Financial Information

Fiscal 1992 saw improvements in sales, operating margins, and bookings. Bookings and revenue reached record highs in the year's last three quarters, with fourth-quarter bookings and sales at $152.0 million and $148.8 million, respectively. Excluding a 1991 restructuring charge, operating expenses declined from 44.8 percent of sales to 42.2 percent. Tight control over operating expenses in conjunction with increasing sales should lead to higher profitability in 1993. R&D expense decreased each quarter, reaching 14.7 percent of sales in the fourth quarter. For the year, R&D expense was reduced from 16.6 percent of sales to 15.5 percent. The R&D reductions reflect a more disciplined approach to R&D activities rather than any reduced emphasis on R&D. Sales and marketing consolidations decreased administration and sales expenses from 28.3 percent of sales to 26.7 percent in fiscal 1992 (see Table 8).

Table 8
Five-Year Operations Summary (Thousands of Dollars)

Operations	1988	1989	1990	1991	1992
Net Sales	439,206	453,372	485,214	537,738	567,315
Growth (%)	19	7	7	11	6
Gross Margin	238,389	238,255	240,960	265,314	265,637
% of Sales	54	53	50	49	47
Sales, General, and Administrative	122,459	125,555	135,926	151,936	151,293
% of Sales	28	28	28	28	27
Operating Income	55,409	43,770	6,218	17,377	26,172
% of Sales	13	10	1	3	5
Net Income	37,989	27,871	-12,913	8,203	14,935
% of Sales	9	6	-3	2	3
Per Share	0.80	0.58	-0.28	0.17	0.31
Number of Shares (K)	47,676	48,273	46,953	46,886	47,749

Source: Analog Devices Inc., Dataquest (May 1993)

Cash from operations decreased to $33.5 million, 5.9 percent of sales, in 1992 from $51 million (9.5 percent) in 1991 as inventory and accounts receivable increased. Inventory rose $25.4 million over 1991. Outside wafer service purchases necessary to service increased DSP and SPLIC business were partially responsible for increased working capital needs. About $22 million in product was purchased from Taiwan Semiconductor Manufacturing Company. Inventories also increased as all wafer fabs went on seven-day work weeks in the fourth quarter and yields improved. Assembled product buffer stocks increased, to maintain customer service levels as plants began to consolidate operations.

Capital expenditure increased by $13.4 million to $65.7 million in 1992, primarily for equipment supporting new processes and products (see Table 9). Capital expenditure in 1993 may reach $100 million and will increase test and internal wafer fabrication capacity.

Because internally generated cash could not fully fund 1992 capital expenditure, debt increased by $30.7 million. Debt-to-equity grew to 20 percent from 12 percent in 1991.

1993 Sales and Booking Point Upward

Financial results for 1993 look very promising. First-quarter fiscal 1993 sales were $151.3 million, up 15 percent from the first quarter a year ago. Net income was $8.1 million, compared with a year-ago loss of almost $1 million. Further good news was mirrored in bookings, which were $160 million, 20 percent above last year's first-quarter and 5 percent above the immediate prior quarter.

Table 9
Five-Year Financial Resource Summary (Thousands of Dollars)

	1988	1989	1990	1991	1992
Working Capital	148,470	159,854	126,054	151,886	197,404
Net Property, Plant and Equipment	200,683	208,695	223,863	223,962	237,423
Total Assets	449,368	452,517	487,188	503,317	561,867
Total Debt	29,795	20,535	35,203	42,656	73,321
Debt-Equity Ratio (%)	9	6%	10%	12	20
Debt-Capital Ratio (%)	8	5	9	11	16
Stockholders Equity	341,198	363,365	342,724	354,445	375,017
Per Share	7.07	7.57	7.31	7.47	7.79
Return on Equity (%)	12	8	-4	2	4
Total Capital	370,993	383,900	377,927	397,101	448,338
Return on Capital	11	7	-3	3	4
Additions to Plant, Property, and Equipment	36,608	41,522	46,776	52,270	65,654
% of Sales	8	9	10	10	12
Depreciation and Amortization	36,608	41,522	46,776	52,705	54,950
% of Sales	8	9	10	10	10
Number of Employees	5,300	5,200	5,700	5,200	5,200

Source: Analog Devices Inc., Dataquest (May 1993)

Strong first-quarter 1993 bookings in Western Europe and the Pacific Rim came from SPLICs and DSP ICs used in PC applications and in applications for handsets and base stations in the pan-European GSM digital cellular telephone system. Orders in Southeast Asia often resulted from design-ins captured in the United States and Europe. New products introduced within the previous five quarters totaled $29 million, 18 percent of total bookings, up from $24 million and 16 percent of total bookings for the previous quarter.

Initial indications show second-quarter 1993 bookings growing 8 percent over the previous quarter and 18 percent over the $147 million achieved in the second quarter of 1992.

International Sales

Internationally, ADI has direct sales offices in 15 countries: Austria, Belgium, Denmark, France, Germany, India, Israel, Italy, Japan, Korea, the Netherlands, Sweden, Switzerland, Taiwan, and the United Kingdom. The European headquarters is in Munich, Germany.

The ADI field sales and application engineering staff are key parts of ADI's total product. A well-trained and technically minded sales and application force can capture design-ins and provide the factory with key new product ideas in emerging markets.

Sales representatives or distributors operate in 25 countries outside the United States. In fiscal 1992, 53 percent of net sales were attributable to international customers, mainly in Western Europe and Japan (see Table 10).

Table 10
ADI's International Sales (Millions of Dollars)

Region	1990 Sales	1991 Sales	1992 Sales
Domestic	258.1	289.1	309.1
Europe	152.7	154.4	169.3
Asia	74.4	94.2	88.9

Source: Analog Devices, Dataquest (May 1993)

Europe accounted for 30 percent of fiscal 1992 sales, 16 percent came from Japan, and 7 percent from other International markets. ADI has penetrated Japan well, but the recession in Japan cut sales in 1992. The PMI division traditionally has been strong in Japan. As a comparison, Japan represented 10.7 percent of Linear Technology's fiscal 1992 sales and 15 percent of Maxim's.

ADI's overall fiscal 1992 sales growth was 6 percent, but Europe grew at an 11 percent rate, far above the 7 percent shown in North America. Japanese revenue decreased by 6 percent to about $91 million. Rest of World sales accounted for about $40 million, flat in comparison with 1991.

The majority of Analog's international sales were made through its direct international sales offices, with about one-third made through distribution.

Acquisitions Build Revenue and Capability

ADI acquired PMI in 1990, a privately held linear and data acquisition IC company, for $60.5 million in cash and warrants to purchase 1 million shares of stock at $12 per share. PMI, founded in 1969, had sales of about $88 million and manufactures operational amplifiers, data conversion products, and consumer audio products. It is a leading military/aerospace manufacturer with Class S processing capability. Two military-process-capable 4-inch fabs were acquired with BiCMOS, Si-Gate CMOS, and bipolar process technology.

PMI was a major ADI competitor in the data conversion and operational amplifier market segments. The synergistic acquisition, from a product and market perspective, also gave ADI a domestic distribution network for the first time. This was a major positive and important change for ADI because customers often desire to do business with distributors for cost, service, and inventory reasons. All of ADI's competitors, especially SLIC competitors Maxim and Linear Technology, have extensive distribution networks. The distribution network gives ADI a way to reach customers that its competitors had easy access to, and also will speed new product acceptance by customers.

Video-graphics technology, software, and patents were acquired from Edsun Laboratories Inc. in July 1991. Edsun became known for Continuous Edge Graphics, a proprietary technique of blending colors by using an interpolation algorithm to adjust the colors of pixels along the boundary of two colored areas, resulting in images that appear to have much higher resolution.

In 1983, ADI acquired Signal Processing Circuits Inc., which was merged with a group within the company to form a DSP division.

In 1979, Computer Labs of Greensboro, North Carolina was acquired for its high-speed technology used in such applications as video and radar.

Alliances Build Mixed-Signal Technology

In January 1992, ADI and Hewlett-Packard entered into a joint process development and manufacturing alliance that targeted digital and mixed-signal submicron IC manufacturing technology. ADI gained immediate access to HP's submicron CMOS and BiCMOS process technologies, critical technologies for the complex, dense mixed-signal VLSI systems integration and DSP applications ADI targets.

The companies will jointly develop advanced submicron, mixed-signal processes. ADI assigned technologists to work at HP's R&D laboratories. Applications can include DSPs, digital mobile phones, cellular telephones, disk drives, and HDTV.

ADI expects to ship its first 0.55-micron parts based on the alliance in 1993. First products will be manufactured at HP, but ADI can license the technology for its own facilities when volume warrants capacity investment.

In 1988, Brooktree signed ADI as a second source of the Bt471 and Bt478 video DACs, which are designed for the PS/2 and VGA add-in display boards.

Intellectual Property

ADI offers more than 750 signal processing components. It owns 222 patents and has 63 patent applications on file with the U.S. patent office. It acquired all of PMI's patents in 1990. While advantageous to the company, a strong patent position does not guarantee success in the competitive linear market. The patents can, however, prove useful in negotiating with other manufacturers when patent issues are in dispute.

Manufacturing Facilities Worldwide

ADI recognized long ago the need for global manufacturing and service centers. European operations were established in 1966, and in 1970 Pacific Rim operations started. Manufacturing facilities operate in Massachusetts, California (PMI), North Carolina, Ireland, Japan, Taiwan, and the Philippines (see Table 11). Wafer fabrication sites are in California, Massachusetts, and Limerick, Ireland. The Limerick facility was opened in 1976. During 1993, the hybrid operation in Wilmington, Massachusetts will be relocated to the Philippines and North Carolina. An idle 38,300-square-foot component manufacturing facility in the United Kingdom is for lease.

Table 11
ADI's Global Manufacturing Presence

Location	Use	Space (sq. ft.)
Wilmington, MA	Wafer fabrication, assembly and test, engineering, and administration	244,900
Wilmington, MA	Hybrid ICs	67,200
Limerick, Ireland	Wafer fabrication, assembly and test, engineering, and administration	205,200
Greensboro, NC	Components and board assembly and testing, engineering, and administration	90,000
Manila	Components assembly and testing, engineering, and administration	73,900
Tokyo	Components assembly and testing, engineering, and administration	69,200
Norwood, MA	Headquarters, engineering, components assembly, and sales	135,000
Westwood, MA	Components and subsystems assembly and testing, engineering, and administration	100,400
Santa Clara, CA	Wafer fabrication, components assembly and testing, engineering, and administration	72,800
Santa Clara, CA	Engineering and administration	43,500
Wilmington, MA	Engineering, systems assembly, and administration	71,000
Taipei, Taiwan	Component testing, engineering, and administration	19,000

Source: Analog Devices Inc., Dataquest (May 1993)

Proprietary Process Technology

ADI must compete with smaller competitors through product innovation, but competition with larger companies hinges on process and manufacturing capability. As systems integration and mixed-signal ICs become crucial to serving customer requirements, the analog companies that have invested heavily in process development will hold strong, profitable market positions and command customer loyalty. ADI has a history of developing proprietary process technologies and recently augmented internal programs with a submicron, mixed-signal process development alliance with HP.

A proprietary linear-compatible CMOS process (LC^2MOS) is used for SLICs and mixed-signal VLSI SPLICs. This process makes single-chip solutions for complex VLSI systems.

ADI's advanced bipolar CMOS process (ABCMOS) process, which offers the high speed of a bipolar processes with the low-power, high-density advantages of CMOS, is different from the processes used to make memories and other digital products. Analog applications require process options that have no use in digital applications: precision capacitors, BiFETs, precision bandgap references, and precision thin film resistors. Operating voltages higher than the 3V to 5V typical of memories are needed to accommodate wide analog dynamic signal ranges. Low-noise performance must also be considered. ADI manufactures with 10V and 12V BiCMOS processes.

A complementary bipolar (CB) process overcomes the speed limitations of pnp transistors and makes high-speed analog circuits possible without using expensive dielectric isolation. Applications include video amplifiers and converters. Compared to conventional bipolar processes, speed performance improvements of tenfold are possible.

ADI's strong process emphasis will allow it to move into the higher-growth mixed-signal system integration markets that will dominate the decade and next century (see Table 12).

Research and Development

ADI spent more than $250 million for product and process development during the last three years. Focusing on products for the 1990s, about $88 million during the last two years targeted SPLICs and DSP ICs and the processes needed for these products. In 1991, according to *Electronic Business* 200, ADI was fourth among the top 200 U.S. electronics companies in percentage of R&D spending (see Table 13).

R&D spending efficiency has been questionable in the past, but ADI has become more disciplined recently. More than 100 products were introduced in fiscal 1992.

Headquarters Locations

ADI's headquarters are as follows:

- Worldwide: One Technology Drive, P.O. Box 9106, Norwood, MA 02062, telephone: 617-329-4700, fax: 617-326-8703
- Europe: Edelsbergstrasse 8-10, W-8000 Munich 21, Germany, telephone: 089/57 005-0, fax: 089/57 005-257
- Japan, Daini Jibiki Building, 7-8 Kojimachi 4 Chome, Chiyoda-ku, Tokyo, Japan, telephone: (3) 3263 6826, fax: (3) 3221 5187

Table 12
Process MAP for the 1990s

Signal Processing Application	Digital, DSP, Blocks, Processors		Merged A/D, D/A ASICs			
Process Technology	**CMOS**		**BiCMOS**		**Bipolar (Comp)**	
Characteristics	DSP4	DSP6	ABCMOS2	ABCMOS3	CB	XFCB
Linewidth (μ)	1.0	0.6	1.5	1.0	4.0	1.5
Voltage (V)	5	3.3/5	12	10	36	12
Speed	200ps	80ps	300ps	200ps	0.5 GHz	3 GHz
			3 GHz	10 GHz		

Source: Analog Devices Inc., Dataquest (May 1993)

Table 13
R&D Investment

	1988	1989	1990	1991	1992
Analog Devices					
R&D Expense ($M)	60.5	68.9	80.3	89.0	88.2
% of Sales	14	15	17	17	16
Linear Technology					
R&D Expense ($M)	NA	NA	7.8	10.2	12.3
% of Sales	NA	NA	10.3	10.9	10.3
Maxim Integrated Products					
R&D Expense ($M)	NA	NA	13.1	11.0	8.5
% of Sales	NA	NA	15.1	14.9	15.3

NA = Not available
Source: Company Reports, Dataquest (May 1993)

Dataquest Perspective

ADI management would like the company to become the Intel of real-world signal processing, a lofty goal. Is this just a boisterous attempt to gather attention, just self-promotion, or a real possibility?

The traditional markets served by analog companies have been fragmented and therefore open targets for many suppliers, small and large alike, to carve out pockets of expertise. One can argue whether the fragmented world has really changed but one cannot reasonably deny that the developments in DSP and mixed-signal processing technology create new markets for manufacturers with the capability to develop, design, and manufacture system solutions on a chip. With nearly $650 million invested over the last five years in R&D and new capital, ADI certainly has the capability. New areas in computers and computer peripherals, automotive electronics, wireless communications, and consumer electronics can now be attacked; a half-decade ago, single-chip solutions were often just costly engineering oddities.

ADI's business "mentality" has changed, perhaps the biggest and most important aspect of any strategy with vision. It wants to build up from, and even away from, its component supplier past. The desire to change, need to change, and will to change are often thwarted by inadequate financial resources brought on by delayed action. This is not the case with ADI, however. ADI appears to be well out in front of the wave of change and has invested heavily in its future without mortgaging its future.

Mixed-signal CAD/CAE tools are perhaps not optimum, but ADI has its own internal capability, and operating history, in this area. It is a critical area but not one that must necessarily hold back progress, especially in a company that understands the linear and DSP world so well. As some digital manufacturers learned in early forays into the analog domain, sophisticated CAD/CAE tools with inadequate analog knowledge do not make for success.

Look for ADI to compete with larger suppliers, such as National, Harris, TI, and AT&T, as the system chip business begins to dominate their operations and thinking. Although smaller competitors such as Maxim and Linear Technology are respectable competitors today, it is not clear whether they desire, or perhaps even have the internal capability, to become major mixed-signal system chip players in this decade.

Much of ADI's success rests in developing markets and new applications. So what is new here? All of today's successful companies, and ADI is a successful company, bet their growth on new and sometimes relatively unknown markets and products in past decades. ADI now returns to a path it successfully traversed in the past. The path today is crowded with other able players and with demanding and unforgiving customers. ADI appears to be mentally, financially, and physically equipped for the journey to a new business level. We doubt that ADI will receive the notoriety and attention that shines on Intel, but the potential for growth and profits may be reward enough.

For More Information...

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Via fax .... (408) 437-0292

Dataquest Vendor Profile

Semiconductors

ASIC Worldwide

Actel Corporation

Corporate Statistics

Location	955 East Arques Avenue Sunnyvale, CA 94086-4533
President	John East
Number of Employees	175
1992 Revenue	$45 million
Telephone	(408) 739-1010
Fax	(408) 739-1054
Date Founded	1985

Company Focus

Actel is a leading supplier of field-programmable gate arrays (FPGAs), a type of integrated circuit (IC) used for logic integration in electronic systems. Because FPGAs can be designed in a short period and programmed in minutes, they offer system designers a design methodology and low-volume production product to meet their ever-increasing time-to-market pressure. FPGAS also are a low-risk solution because there are no supplier nonrecurring engineering charges (design charges) associated with traditional gate arrays. Dataquest believes that the FPGA market is one of the fastest growing markets in the semiconductor industry, with a five-year compound annual growth rate (CAGR) exceeding 25 percent.

Actel focuses on the research, development, and marketing of FPGA devices and associated software tools and has elected not to own a manufacturing facility at this point because of the high costs associated with them. Actel relies on partnerships for manufacturing and has formed key partnerships with Hewlett-Packard, Texas Instruments, and Matsushita Electronics Corporation (Panasonic).

Actel has more than 7,000 worldwide customers in a variety of application markets including computers, computer peripherals, communications, industrial, instrumentation, and military. Actel customers include Apple Computer, AT&T, Compaq, Hewlett-Packard, Hughes Aircraft, IBM, Lockheed, Northern Telecom, Siemens Medical, and Sun Microsystems.

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Corporate Financing

Actel is a privately funded company with a total equity investment of $33 million. Investors include Advanced Technology Ventures, Brentwood Associates, Data General Corporation, Davidow Ventures, Equity Venture Capital, Hewlett-Packard Company, Hillman Ventures, Hughes Aircraft, Mohr, Norwest Growth Fund, Oak Investment Partners, Rothschild Ventures, Shaw Venture Partners, Sprout Venture Capital, and T. Rowe Price.

Corporate Management

The following paragraphs detail key people in Actel's corporate management.

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	Act 3					Act 2					
Device	**A1415**	**A1425**	**A1440**	**A1460**	**A14100**	**A1225**	**A1225-1**	**A1240**	**A1240-1**	**A1280**	**A1280-1**
Gate Array											
Equivalent Gates	1,500	2,500	4,000	6,000	10,000	2,500	2,500	4,000	4,000	8,000	8,000
Dedicated											
Flip-Flop	264	360	568	768	1,153	231	231	348	348	624	624
User I/Os	80	100	140	168	228	83	83	104	104	140	140
Performance (MHz)											
24-Bit Loadable Counter	75	75	75	66	66	30	33	30	33	25	28
24-Bit Accumulator	40	40	40	36	36	25	28	25	28	20	22
24-Bit Prescaled Counters	125	125	125	100	100	72	85	65	75	48	55
Shift Register	125	125	125	100	100	72	85	65	75	48	55

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FPGA Market Projections

The FPGA market has shown stellar growth since its inception in 1986, and Dataquest expects it to continue to outpace the overall semiconductor growth rate by a factor of 1.5 to 2 during the next three to five years. The year 1992 saw the FPGA market grow by about 30 percent over 1991, and Dataquest believes that the FPGA market will enjoy a CAGR of 25 to 30 percent during the next five years. FPGAs will benefit from its wide industry distribution, with 80 percent of its revenue evenly distributed among data processing, communications, and industrial sectors, making it less susceptible to industry-specific economic factors. Figure 1 shows Dataquest's preliminary worldwide FPGA forecast.

We base our optimistic forecast upon three assumptions, which are described in the following paragraphs:

- Technological improvements
- Price decreases
- Migration of traditional ASIC business

Technology Improvements

FPGA architectures still are somewhat immature. FPGAs have only been commercially available for seven years, and there is still a large amount of fine-tuning to be done. Unlike their mask-programmable brethren, in which there is very little die size penalty for interconnection, the programmability overhead of these devices tend to make the die sizes exceedingly large in comparison. Therefore a significant investment must be made in the architectural improvement to optimize the total number of gates that can be placed upon a given die size. Extensive research is being conducted not only at vendor sites, but also in the academic community, where

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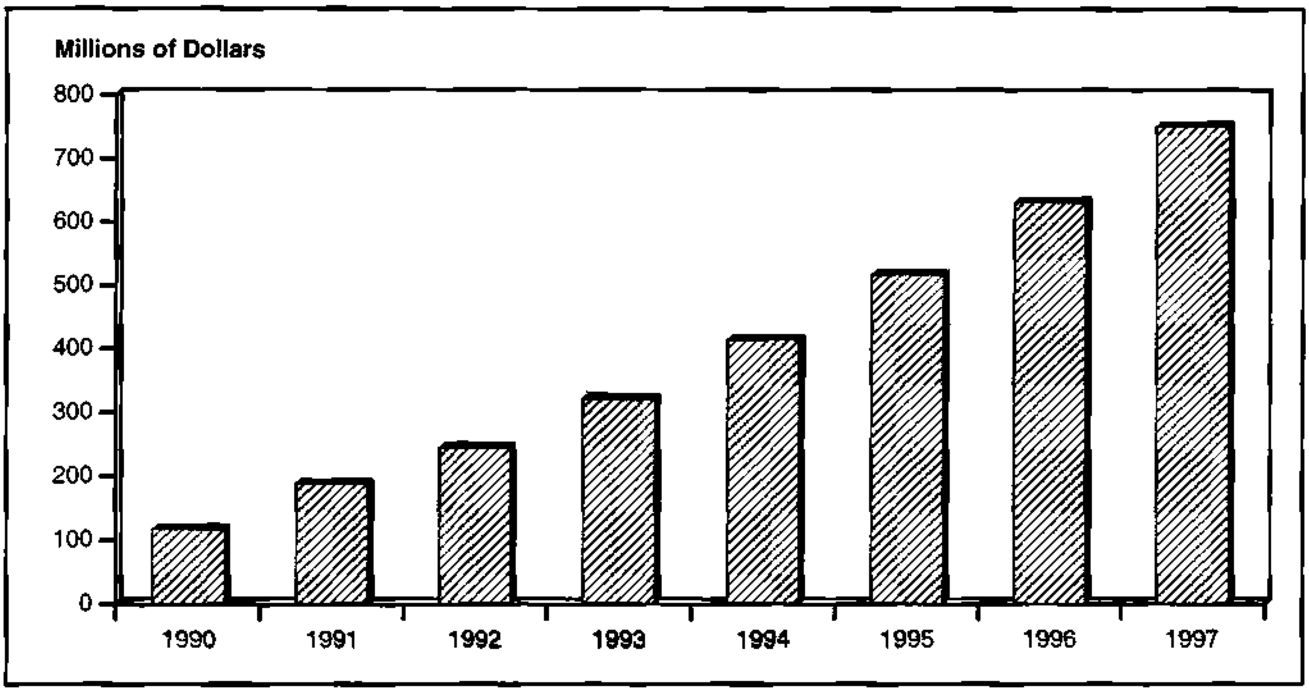

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Dataquest frowns upon using gate densities as a density measure of these devices, as vendor claims and counterclaims have made this metric almost meaningless. However, as an industry, it is safe to say that FPGAs can address the majority of ASIC designs of less than 10,000 gates, based solely upon density. This is a long way from the half-million-gate devices being introduced by gate array suppliers. Dataquest believes that FPGAs will continue to extend their density capability over the coming years, based upon process migration, and architectural and software improvements. The extensions in both speed and density will help to expand the total market that FPGAs address.

Price Decreases

The FPGA market during the past two years has shown price decreases as it benefits from economies of scale. Yet price is still a major obstacle in the usage of these devices. Dataquest end-user research shows that FPGAs are still predominantly used for prototyping and ASIC emulation. A large potential upside exists because these devices are perceived as being at a price point that makes them production-worthy. The small size of the anti-fuse technology makes manufacturing a cornerstone in Actel's strategic thrust to drive the price per functionality down.

Migration of Traditional ASIC Business

The price per gate of programmable solutions continues to decline, and Dataquest believes that sufficient elasticity exists in the market to expand overall revenue with these price reductions. Beyond that, many believe that a certain price-multiple exists that makes a programmable solution more appealing than a traditional mask-programmed ASIC. However, Dataquest believes that this argument may be misleading. The programmability overhead of these devices will continue to make programmable devices an inferior solution to gate arrays based upon price, speed, and density. Even a 2x price differential between gate arrays and FPGAs quickly becomes significant based upon volumes larger than 10,000 units. Making the programmable solution more untenable versus gate arrays is the shortening of gate array lead times, reducing the incentive to use a programmable solution, and the emergence of software tools that may quickly and easily translate a design from a programmable to a mask-based technology.

Dataquest continues to believe that FPGAs will become the workhorse of logic implementation of less than 20,000 gates in the mid- to late 1990s. This opinion is not based solely on the reduction in prices made by FPGA vendors, but rather on the migration of ASIC vendors from this market. Dataquest believes that, for gate array and cell-based suppliers to remain profitable, they must migrate sales toward products in which they have core competencies, namely in process technology and cell-based design. Pricing pressure at low densities has made this an unprofitable market. Indeed, Dataquest has seen anecdotal evidence of this movement, with large ASIC vendors bidding high prices for low-volume, 10,000-gate designs. The vacuum created by ASIC vendors will be supplanted by programmable technologies, namely FPGAs. Actel and other FPGA devices are ideally positioned for this emerging market segment.

Market Position

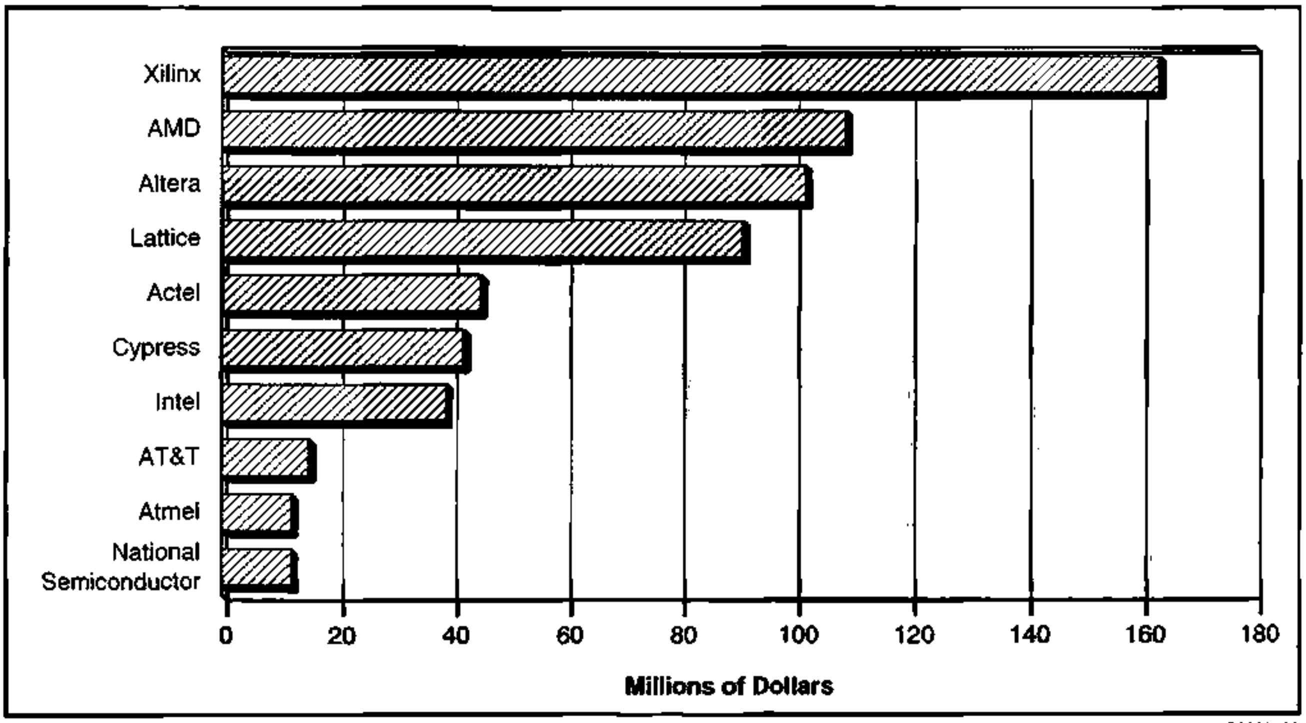
Actel is the fifth largest MOS PLD supplier in the world (see Figure 2). Because AMD, Altera, and Lattice derived the majority of their revenue from non-FPGA products, Actel is the second largest FPGA supplier, trailing only Xilinx.

Table 2 shows the hotly contested MOS PLD suppliers and their 1991 and 1992 preliminary revenue estimates.

Competition

All complex PLD suppliers, FPGA suppliers, and gate array suppliers are competitors to Actel. Although gate array suppliers have a better cost structure than do those for FPGAs, most suppliers are trying to migrate from the low-volume/low-gate count business. Therefore, gate array suppliers should not be considered the leading competitors to Actel. Complex PLD suppliers cannot compete in the same density spectrum as can

Figure 2
1992 Top 10 Worldwide MOS/BiCMOS PLD Suppliers



Source: Dataquest (April 1993) G3000166

Table 2
1992 Preliminary Worldwide Estimated Market Share Ranking: MOS PLD (Millions of Dollars)

1992 Rank	1991 Rank	Company	1991 Revenue	1992 Revenue	Percent Change	1992 Market Share (%)
1	1	Xilinx	130	163	25.4	24.3
2	4	Advanced Micro Devices	62	109	75.8	16.2
3	2	Altera	107	102	-4.7	15.2
4	3	Lattice	68	91	33.8	13.6
5	6	Actel	37	45	21.6	6.7
6	5	Cypress Semiconductor	47	42	-10.6	6.3
7	7	Intel	33	39	18.2	5.8
8	10	Texas Instruments	9	20	122.2	3.0
9	9	AT&T	10	15	50.0	2.2
10	8	Atmel	11	12	9.1	1.8
10	10	National Semiconductor	9	12	33.3	1.8
12	13	SGS-Thomson	7	6	-14.3	0.9
13	14	Gould AMI	5	4	-20.0	0.6
14	16	Toshiba	1	1	0	0.1
14	16	Ricoh	1	1	0	0.1
NM	10	Philips	9	0	-100.0	0
NM	15	GEC Plessey	3	0	-100.0	0
		All Others	10	9	-10.0	1.3
		Total Market	559	671	20.0	100.0

Source: Dataquest (April 1993)

FPGAs, and they again should not be considered the top competitors to Actel. The major competitors to Actel are other FPGA suppliers.

The list of FPGA suppliers continues to grow every year. To date, we have seen devices positioned as FPGAs from the following suppliers:

- Actel
- AT&T
- Altera
- Concurrent Logic (now Atmel)
- Crosspoint Solutions
- GEC Plessey
- QuickLogic
- Texas Instruments
- Xilinx

Those that have announced intentions to participate in the FPGA market include Hitachi, Motorola, and Toshiba. Those that have technology capabilities include Fujitsu, Kawasaki Steel, NEC, Samsung, and Seiko.

Dataquest believes that far too many suppliers are entering the FPGA market. Xilinx clearly has a dominant position, Actel has a strong position, and the market will only accept a limited number of other suppliers with different architectures. Dataquest believes that, to gain substantial market acceptance, newcomers to the market must be able to easily show a 50 percent or better improvement in speed, density, or cost. Only those companies able to clearly separate themselves from the current storm of claims and counterclaims regarding these features have a chance at gaining market share from the established leaders.

Dataquest Perspective

Actel is well positioned to capitalize in the fast-growing FPGA market. It has done well in forming the right partnerships and alliances required to stay competitive in such a high-growth market. Actel's bookings are strong and the profit margins are respectable; therefore, the company's short-term future looks bright.

As for its long-term outlook, Actel faces a number of challenges. First, it must continue to advance at a rapid rate in terms of its products' speed, density, and cost. The competition is fierce, and Actel must keep its R&D investment high. Actel needs to invest in new architectures and technology if it wants to be a broad-based logic integration supplier.

Second, Actel must protect its intellectual property—for which it has 35 patents issued—and defend the current lawsuit with Xilinx, which has not affected Actel's bookings to date.

Third, the company needs to proliferate the design tools and continue its library development. FPGAs are a design-win product, and it is critical that Actel continue its advancements in this area to hold off current competition and potential new entrants such as Japanese companies.

Finally, Actel must stay cost competitive. Because it does not have a fab, it is important that Actel keep its product offering strong to ensure that it has something to trade to get leading-edge, low-cost fab capacity.

Dataquest believes that Actel management is well aware of the challenges the company faces and that it will continue to make the right decisions to keep the company successful.

For More Information...

Bryan Lewis, Sr. Industry Analyst .... (408) 437-8668
Via fax .... (408) 437-0292

Dataquest Vendor Profile

Semiconductors

ASIC Worldwide

Actel Corporation

Corporate Statistics

Location	955 East Arques Avenue Sunnyvale, CA 94086-4533
President	John East
Number of Employees	175
1992 Revenue	$45 million
Telephone	(408) 739-1010
Fax	(408) 739-1054
Date Founded	1985

Company Focus

Actel is a leading supplier of field-programmable gate arrays (FPGAs), a type of integrated circuit (IC) used for logic integration in electronic systems. Because FPGAs can be designed in a short period and programmed in minutes, they offer system designers a design methodology and low-volume production product to meet their ever-increasing time-to-market pressure. FPGAS also are a low-risk solution because there are no supplier nonrecurring engineering charges (design charges) associated with traditional gate arrays. Dataquest believes that the FPGA market is one of the fastest growing markets in the semiconductor industry, with a five-year compound annual growth rate (CAGR) exceeding 25 percent.

Actel focuses on the research, development, and marketing of FPGA devices and associated software tools and has elected not to own a manufacturing facility at this point because of the high costs associated with them. Actel relies on partnerships for manufacturing and has formed key partnerships with Hewlett-Packard, Texas Instruments, and Matsushita Electronics Corporation (Panasonic).

Actel has more than 7,000 worldwide customers in a variety of application markets including computers, computer peripherals, communications, industrial, instrumentation, and military. Actel customers include Apple Computer, AT&T, Compaq, Hewlett-Packard, Hughes Aircraft, IBM, Lockheed, Northern Telecom, Siemens Medical, and Sun Microsystems.

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Program: ASIC Worldwide
Product Code: ASIC-WW-VP-9301
Publication Date: April 26, 1993

Corporate Financing

Actel is a privately funded company with a total equity investment of $33 million. Investors include Advanced Technology Ventures, Brentwood Associates, Data General Corporation, Davidow Ventures, Equity Venture Capital, Hewlett-Packard Company, Hillman Ventures, Hughes Aircraft, Mohr, Norwest Growth Fund, Oak Investment Partners, Rothschild Ventures, Shaw Venture Partners, Sprout Venture Capital, and T. Rowe Price.

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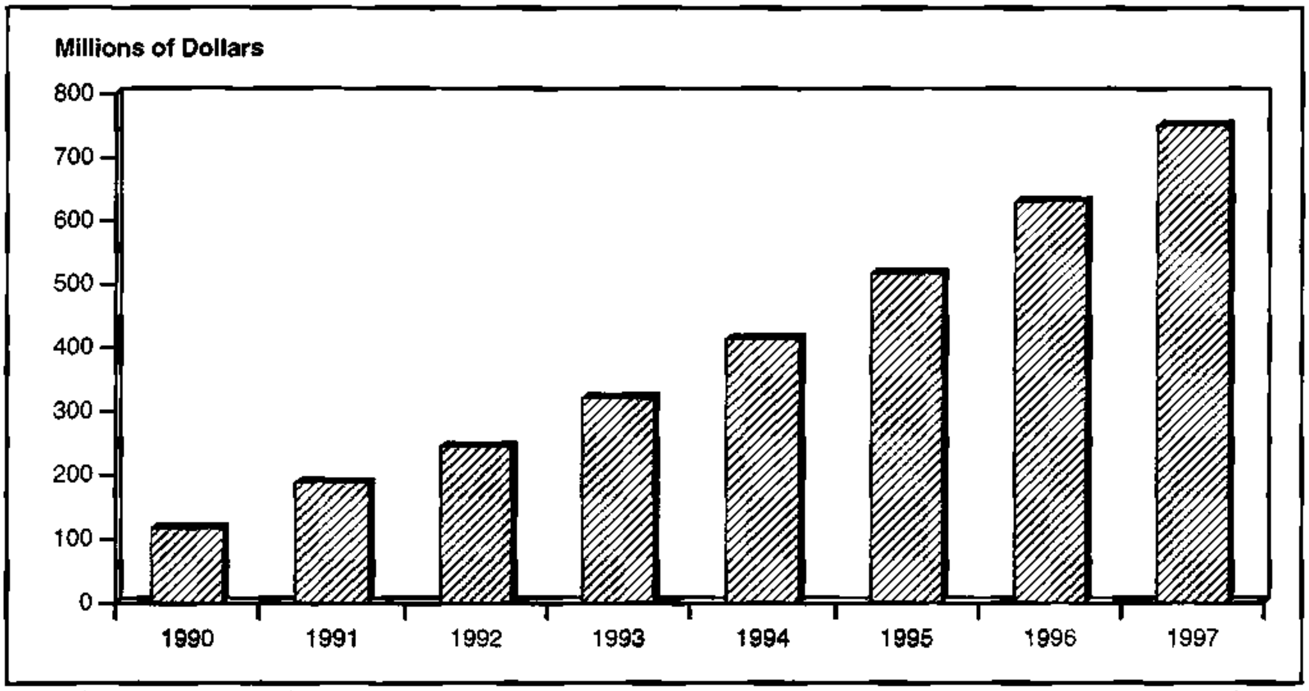

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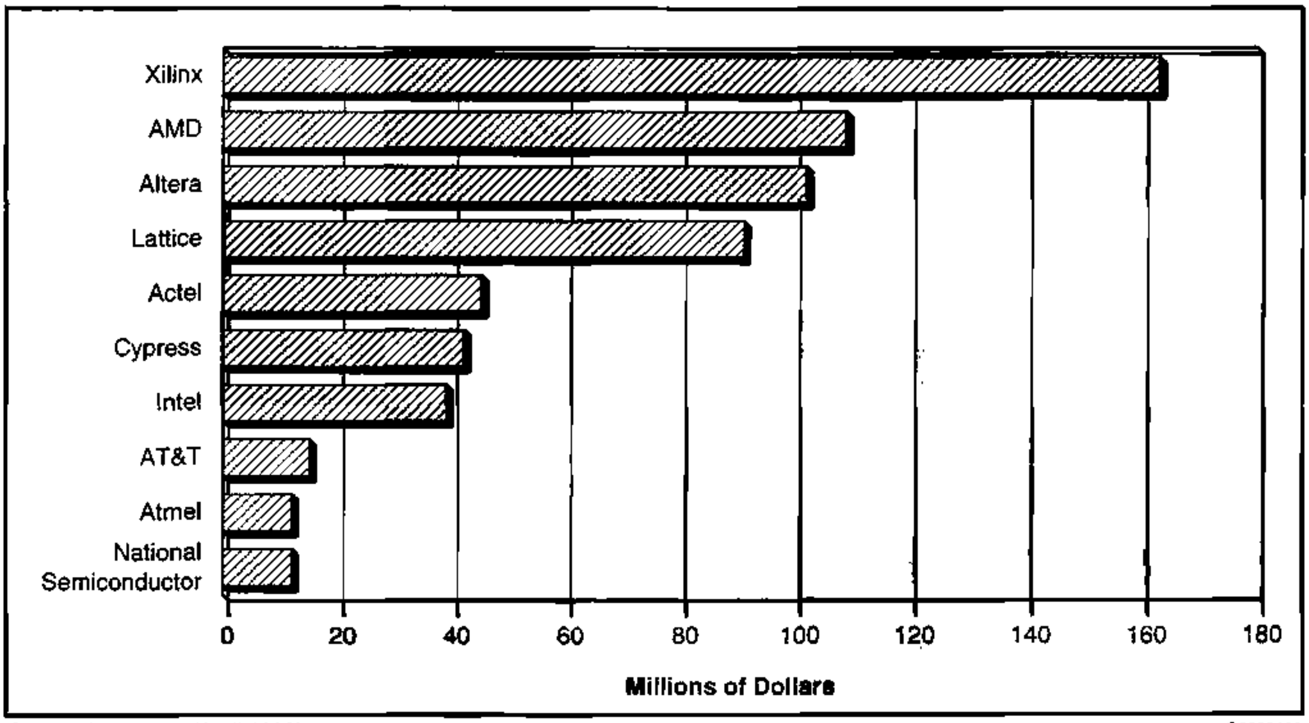

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14	16	Toshiba	1	1	0	0.1
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- Crosspoint Solutions
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- QuickLogic
- Texas Instruments
- Xilinx

Those that have announced intentions to participate in the FPGA market include Hitachi, Motorola, and Toshiba. Those that have technology capabilities include Fujitsu, Kawasaki Steel, NEC, Samsung, and Seiko.

Dataquest believes that far too many suppliers are entering the FPGA market. Xilinx clearly has a dominant position, Actel has a strong position, and the market will only accept a limited number of other suppliers with different architectures. Dataquest believes that, to gain substantial market acceptance, newcomers to the market must be able to easily show a 50 percent or better improvement in speed, density, or cost. Only those companies able to clearly separate themselves from the current storm of claims and counterclaims regarding these features have a chance at gaining market share from the established leaders.

Dataquest Perspective

Actel is well positioned to capitalize in the fast-growing FPGA market. It has done well in forming the right partnerships and alliances required to stay competitive in such a high-growth market. Actel's bookings are strong and the profit margins are respectable; therefore, the company's short-term future looks bright.

As for its long-term outlook, Actel faces a number of challenges. First, it must continue to advance at a rapid rate in terms of its products' speed, density, and cost. The competition is fierce, and Actel must keep its R&D investment high. Actel needs to invest in new architectures and technology if it wants to be a broad-based logic integration supplier.

Second, Actel must protect its intellectual property—for which it has 35 patents issued—and defend the current lawsuit with Xilinx, which has not affected Actel's bookings to date.

Third, the company needs to proliferate the design tools and continue its library development. FPGAs are a design-win product, and it is critical that Actel continue its advancements in this area to hold off current competition and potential new entrants such as Japanese companies.

Finally, Actel must stay cost competitive. Because it does not have a fab, it is important that Actel keep its product offering strong to ensure that it has something to trade to get leading-edge, low-cost fab capacity.

Dataquest believes that Actel management is well aware of the challenges the company faces and that it will continue to make the right decisions to keep the company successful.

For More Information...

Bryan Lewis, Sr. Industry Analyst .... (408) 437-8668
Via fax .... (408) 437-0292

FORTUNE

BUSINESS REPORTS

COMPANY PROFILE

ADVANCED MICRO DEVICES INC

Data sources and updating procedures. This report is a compilation of information from numerous sources, including: annual reports, 10Ks, 10Qs, and proxies filed with the Securities and Exchange Commission, Disclosure Incorporated, Standard & Poor's Corporation, National Register Publishing Company, Reuters News Service, Muller Data Services, CDA Technologies, Inc., and over 300 publicly available journals and periodicals. The information contained in the report is updated on a daily, weekly, monthly, quarterly, or annual cycle depending on the type of information being reported and the collection methods used by the information providers. Every effort is made to obtain and report the most recent data available from the aforementioned sources. This report has not been reviewed or endorsed by FORTUNE Magazine and does not represent the editorial opinion of FORTUNE.

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GENERAL COMPANY INFORMATION

FISCAL YEAR END
December

PRIMARY SIC
3674

TICKER SYMBOL
AMD

EXCHANGE
NYS

1991 EMPLOYEES
11,250

ADVANCED MICRO DEVICES INC
901 THOMPSON PLACE
P.O. BOX 3453
SUNNYVALE, CA 94088
Telephone: 408-732-2400

LEGAL FIRM
BRONSON, BRONSON & MCKINNON

AUDITOR
ERNST & YOUNG

STATE OF INCORPORATION
DELAWARE

COMPANY OVERVIEW

DESIGNS, DEVELOPS, MANUFACTURES AND MARKETS COMPLEX MONOLITHIC INTEGRATED CIRCUITS, FOR USE IN A BROAD RANGE OF ELECTRONIC EQUIPMENT AND SYSTEMS, PRIMARILY WITH APPLICATION SOLUTIONS TO THE MANUFACTURERS OF TELECOMMUNICATIONS EQUIPMENT, PERSONAL COMPUTERS, ENGINEERING WORKSTATIONS AND LOCAL AREA NETWORKS.

(Source: Disclosure 06/28/92)

FIVE YEAR FINANCIAL SUMMARY

To order the company's annual report or 10-K, please see the SEC Filings section at the back of this profile.

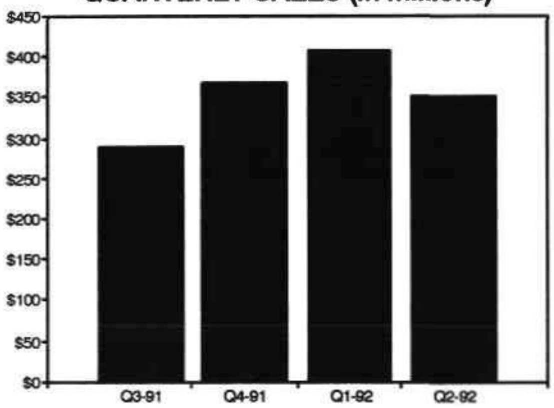
($Millions)	1991	1990	1989	1988	1987
Sales	$1,227	$1,059	$1,105	$1,126	$997
Net Income	$145	($54)	$46	$19	($64)
EPS	$1.53	($0.78)	$0.44	$0.11	($0.92)
Current Assets	$626	$397	$594	$572	$515
Total Assets	$1,292	$1,112	$1,122	$1,081	$1,057
Current Liabilities	$455	$318	$276	$266	$255
Long-Term Debt	$42	$131	$126	$130	$136
Total Liabilities	$508	$475	$432	$436	$434
Equity	$783	$636	$691	$645	$623
Current Ratio	1.38	1.25	2.15		
Inventory Turnover	13.41	11.76	12.21		
Total Debt/Equity	0.20	0.21	0.19		
Return on Equity	19%	(8)%	7%		

4-Year Annual Compound Growth Rate
Sales 5.3%

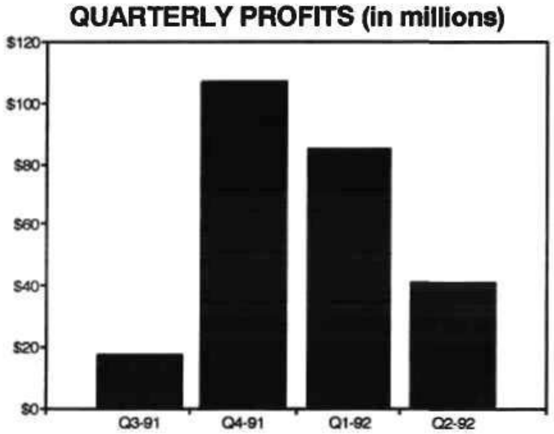
(Source: Disclosure 06/28/92)

RECENT QUARTERLY TRENDS

QUARTERLY SALES (in millions)



QUARTERLY PROFITS (in millions)



QUARTERLY DATA
($ Millions, except EPS)

	Q3-91	Q4-91	Q1-92	Q2-92
Sales	$289	$366	$407	$350
Profits	$17	$107	$85	$41
EPS	N/A	$1.30	N/A	N/A

(Source:10-Q 03/29/92)

BUSINESS DESCRIPTION

Advanced Micro Devices is the fifth largest U.S.-based manufacturer of integrated circuits for telecommunications, office automation and networking applications. The company has a broad cross-licensing agreement with Sony Corp., a Japanese company, that was signed in April 1991. It extends for five years. The company is a leading supplier of high-speed, field programmable integrated circuits. Its programmable array logic devices (PALs) dominate the market for field-programmable logic devices. A major portion of revenues are derived from the sale of erasable programmable read-only memories (EPROMs) and programmable read-only memories (PROMs). Other memory devices are also sold. The company is also a major producer of microprocessors. Sales of microprocessors were boosted significantly in 1991 by the introduction of Am386 chips, which are reversed-engineered verions of Intel's 80386 microprocessors. While the company has a technology exchange agreement with Intel Corp., those agreements and AMD's production of the Am386 are the subject of arbitration and litigation. The company also provides a wide variety of solutions for a broad spectrum of connectivity problems, such as applications involving central office switches, PBX equipment and local area networks. Foreign sales accounted for 36% of revenues and $31.8 million of operating income in 1990 (latest available). Research and development spending totaled $213.8 million (17.4% of sales) in 1991, up from $203.7 million (19.2%) in 1990.

(Source: Standard & Poor's 03/04/92)

RECENT COMPANY NEWS

SAN DIEGO, Calif., Aug 14, 1992, Reuter — Brooktree Corp said it has reached an agreement with Advanced Micro Devices Inc to settle out of court one of several lawsuits pending between the two companies. The suit that was settled was filed by Advanced Micro on April 15, 1991 and concerned an AMD patent covering a process used in the manufacture of integrated circuits. As part of the settlement, AMD dismissed the lawsuit. Brooktree said the settlement does not affect other pending litigation between it and AMD. It noted that a jury award of $25.8 million in damages to Brooktree related to color palettes is currently under appeal by AMD and will not be affected by this settlement.

SUNNYVALE, Calif., July 20, 1992, Reuter — Advanced Micro Devices Inc and Du Pont Co's Du Pont Connector Systems said they signed a two-year joint manufacturing agreement on Flash memory cards intended to address a market for mobile systems. Under the agreement, Du Pont will manufacture and Advanced Micro will market Flash memory cards that comply with recently developed international standards. The cards will utilized Advanced Micro's 12-volt and five-volt flash memory devices. The first products will be available in the fall, the companies said.

TOKYO, July 13, 1992, Reuter — Japan's Fujitsu Ltd <6702.T> and Advanced Micro Devices Inc <AMD.N> of the U.S. said they have joined forces to make flash memory chips, tipped as one of the boom semiconductor products of the 1990s. The two firms said they agreed to invest equally in a $700 million factory in Japan that will make EPROMs (erasable programmable read-only memories) and flash memory chips. Under the agreement they will also take stakes in each other's equity. Unlike many other memory chips, EPROMs and flash chips do not lose data when disconnected from the power supply.

TOKYO, July 13, 1992, Reuter — Fujitsu Ltd and Advanced Micro Devices Inc <AMD.N> of the U.S. have agreed to acquire minority stakes of less than five pct of each other's common stock, the companies said in a statement. The two firms have also agreed to set up a joint venture in Japan and cooperate in building and operating a $700 million dollar wafer fabrication facility to make non-volatile memory devices such as EPROM (erasable programmable read-only memory) chips and flash memories, the statement said.

SUNNYVALE, Calif., July 1, 1992, Reuter — Advanced Micro Devices Inc said severe pricing pressures on its 386 microprocessors have hurt second quarter results. The chip maker said it will be solidly profitable, but that second quarter revenues will come in about 15 pct below its record first quarter sales of $407.4 million. The company reported revenues of $267.7 million in the prior-year second quarter. Final second quarter results will be released July 9. Advanced Micro said the declining prices it was able to charge for its 386 chips more than offset significant quarter-to-quarter revenue gains in other product lines. Advanced Micro had been trying to make inroads against market leader Intel Corp <INTC.O> by offering its own version of Intel's i386 microprocessor. Resulting competition ensued in a price war.

SAN FRANCISCO, June 24, 1992, Reuter — Advanced Micro Devices Inc filed for a restraining order to bar Intel Corp <INTC.O> from discussing how a recent court decision will affect Advanced Micro's current 386 chip, an Intel spokesman said. Last week, a federal jury ruled Advanced Micro does not have the rights to a special software code owned by Intel Corp and used to build various computer chips, including the 386. Advanced Micro also asked the U.S. District court judge to restrain Intel from taking any steps to block importation of computers using Advanced Micro's 386 chip. The court is expected to consider the filing within the next week.

NEW YORK, June 23, 1992, Reuter — Lehman Brothers cut its rating on Advanced Micro Devices Inc to underperform from neutral, traders said. The analyst was not immediately available for comment. Shares of Advanced Micro slipped 1/4 to 9-1/2.

NEW YORK, June 18, 1992, Reuter — Merrill Lynch and Co Inc analyst Thomas Kurlak said he downgraded his intermediate-term rating on Advanced Micro Devices Inc to below average from neutral. He also cut his 1993 estimate to a range of $1.80-2.00 a share from 2.30 to 2.70 a share. He took the action after a jury ruled against Advanced Micro in a copyright infringement case. The jury said Advance Micro cannot use Intel Corp's <INTC.O> microcode, a special chip software, in the 287 math coprocessor chip. Kurlak said he also repeated a buy rating on Intel. "This is the beginning of the end of the clone assault," said Kurlak. He still expects Advanced Micro to earn $2.55 a share in 1992. "We believe a large reason for AMD's success in their 386 (microprocessor) is that their products were viewed as Intel products," he said. Shares of Intel added 3-1/2 to 51-1/4.

NEW YORK, June 18, 1992, Reuter — Intel Corp surged in trading ahead of the U.S. stock market opening and Advanced Micro Devices Inc <AMD.N> tumbled after a jury ruled against Advanced Micro in a copyright infringement case. The jury ruled that Advanced Micro cannot use Intel's microcode, a special chip software, in the 287 math coprocessor chip. Intel traded at 52, up 4-1/4 from Wednesday's close, on the Instinet system, Instinet said. Advanced Micro traded at 10-3/4, down 3-3/4 from Wednesday's close, on Instinet. Jefferies said Advanced Micro traded actively at 11, down 3-1/2 from Wednesday's close. Jefferies said it was not yet making a market in Intel. In other activity, SciMed Life Systems Inc <SMLS.O> fell sharply ahead of the opening after reporting weaker first-quarter earnings. SciMed Life traded at 49, down 3-3/4 from Wednesday's close, on the Instinet system. Instinet said its market for SciMed was 47, 49-1/2. SciMed reported first-quarter earnings of $0.70 a share compared to $0.78 a share a year ago. Analysts had expected earnings of 76 cts a share, traders said. Jefferies said it was making a market in Fund American Cos Inc <FFC.N> at 64, 69. Instinet said it was not yet making a market in Fund American, which closed Wednesday at 69-1/2. Fund American said it has received 5,939,552 of its common shares in response to its offer repurchase up to four million shares at $70 each and it will consider increasing the number of shares to be bought back. Aerospace shares also may come under some pressure on news that aircraft leasing firm GPA has decided not to proceed with its planned share flotation. Boeing Co <BA.N> was offered on Instinet at 43, unchanged from its New York close.

SAN JOSE, Calif., June 10, 1992, Reuter — A federal jury will continue deliberations Thursday in Advanced Micro Devices Inc's <AMD.N> copywrite case with Intel Corp and could recess for a week if a decision is not reached. Tom Armstrong, Advanced Micro's vice-president and general counsel, said that should the jury not come to a decision on Thursday they will likely break for a week while the judge in the case is on vacation. Intel is charging that Advanced Micro illegally used Intel's microcode, or software, when it made a clone copy of a 287 chip. Any decision will impact Advanced Micro's ability to market other chip clones, analysts say.

SAN FRANCISCO, June 10, 1992, Reuter — A federal jury is expected to release its decision soon on whether Advanced Micro Devices Inc illegally used Intel Corp's software in a clone chip. John Greenagle, AMD's director of corporate affairs, said the federal district court jury has begun its deliberations and a decision could be made at any time. Analysts have generally been giving Advanced Micro the edge in the closely-watched case between the two big computer chip makers which have launched a myriad of cases against each other. Michael Gumport at Shearson Lehman Bros gave AMD an 80 pct chance of winning the case in a recent report. The trial, which ended last Thursday, involves a dispute over the right of AMD to use Intel's microcode to market a clone of Intel's 287 chip. The 287 chip, or a math coprocessor, enables a computer to perform advanced math calculations. The case pivots around a 1976 agreement between Advance Micro and Intel and whether Advance Micro had the right in that agreement to fully use the microcode for its own chips. Microcode is essentially software that is built onto a chip. Intel sued AMD in 1990 over the usage of the microcode in the 287 clone. But analysts say any decision could have wide- ranging impact because AMD has used the microcode to build another more popular chip, the 386. Greenagel of AMD, however, does not believe the decision would necessarily impact the 386 because the company won a seperate case on the 386. The 386 is a popular microprocessor that acts as a central "brain" of a personal computer. Earlier this year, AMD was granted the rights to all the technologies surrounding the 386 chip by an arbitrator. In May a state judge upheld the decision. But it is unclear how a decision against AMD would affect the company's plans to market a clone of Intel's 486 microprocessor. Advanced Micro is again using the microcode in the planned 486 chip, which is expected to be released by the end of the year.

OTHER IMPORTANT DEVELOPMENTS

January 1992 — AMD said that its growth in the fourth quarter came from microprocessors and was achieved despite a lackluster semiconductor market. The company said that during the fourth quarter sales of Am386 products doubled from the previous quarter to $145 million, and that its market share was more than 30% of the 386 market.

October 1991 — The company said that during the third quarter surging sales of Am386 microprocessors and strong growth in networking products helped offset the impact of declining revenues from lower-margined EPROM (erasable programmable read-only memory) and bipolar programmable logic devices, which were off sharply in the quarter.

July 1991 — The company said that second quarter sales were led by a trebling in sales of the Am386 family of microprocessors to $35 million.

July 1991 — Siemens AG said that it was considering the possible sale of its 8,221,500 shares of AMD common stock. AMD said it was evaluating whether to make an offer for the shares.

April 1991 — The company and Sony Corp., a Japanese company, signed a broad-ranging patent and copyright cross-license agreement covering patents on process, design and architectures for integrated circuits owned by AMD and Sony Semiconductor. The agreement runs for five years.

November 1990 — The company said that it planned to terminate approximately 200 employees by year-end.

October 1990 — AMD said that its third-quarter results were hurt by usual seasonal weakness, severe pricing pressures on EPROMs, weakening demand for older products, and high investment spending.

June 1990 — AMD increased its interest in Xilinx, Inc., a gate array producer, to 20% from approximately 7% by purchasing approximately 3.4 million common shares at $11 each when Xilinx made its initial public offering. As part of the purchase, AMD agreed to phase out its gate array business by September 30, 1990.

January 1990 — The company said that sales to manufacturers of desktop computers for its core business products, EPROMs (erasable programable read-only memories), iAPX86 microprocessors and programmable logic products, remained strong through the final quarter of 1989.

April 1989 — AMD said that during the second quarter demand from personal computer manufacturers remained strong. It added that during the second quarter revenues derived from products manufactured with CMOS technology reached 20%, up from 18% in the preceeding quarter and the highest level in the company's history.

January 1989 — AMD said that the sales decline in the 1988 fourth quarter was due to soft demand from the personal computer sector. A $17.3 million nonrecurring charge in the quarter was associated with a workforce reduction of 2,400 positions, the closing of a manufacturing facility and other restructuring actions.

July 1988 — AMD said that during the second quarter its bookings were essentially equal to billings, foreshadowing the usual summer slowdown. It added that a substantial portion of the increase in sales over the first quarter came from commodity-like products.

(Source: Standard & Poor's)

COMPANY OUTLOOK

NEW YORK, March 1992 — Earnings for 1992 are estimated at $2.65 a share, up from 1991's $1.53. Cash dividends have never been paid on the common stock. Sales for 1992 are expected to increase about 20%, led by sharply higher sales of Am386 microprocessors, which are the reverse-engineered version of Intel's 80386 chip. Faster industry growth should also assist the gain. Despite the absence of a $0.52 a share gain on the sale of stock, margins are likely to widen significantly, due to high gross profit margins on Am386 chips. However, pricing pressures are likely to intensifiy as the year progresses. The tax rate is likely to approximate 15%, versus the absence of taxes in 1991.

(Source: Standard & Poor's)

PRIMARY INDUSTRY OVERVIEW

— The Electronic Semiconductor & Components industry is greatly affected by the direction of the overall economy and, specifically, the computer industry. In addition, since much of the industry's business is international, the value of the U.S. dollar can dramatically impact a company's bottom line. The primary indicator of industry health is the book-to-bill ratio, which measures the number of orders being placed compared with the number of orders being filled. A number above 1.00 (or parity: booked orders equals fulfilled orders) indicates that there are more orders being placed today than in the past and that the industry is growing.

(Source: Standard & Poor's)

INDUSTRY OUTLOOK

NEW YORK, June 1992 — A buying opportunity appears at hand. Even though the industry is entering its seasonally weak period where the shares usually perform poorly in the first half of the summer, the depressed prices of many issues make them attractive. The $69 billion worldwide industry is projected to post growth of about 8% in 1992, versus an 8.3% climb in sales for 1991, assuming the current economic rebound continues to gain momentum. The slower growth is due to a projected 2% decline in sales from the Japanese market, which is experiencing weakness in its consumer electronics industry. Demand should be stimulated by a shift to a new generation of products, such as 486 microprocessors, mixed signal ASICs and 4-megabit DRAMS.

European economies are expected to display renewed vigor as the year progresses. Meanwhile, the Japanese semiconductor market is unlikely to deteriorate further from its currently depressed level. In fact, promised efforts by the Japanese to increase foreign sales could offset much of the weakness in overall sales.

(Source: Standard & Poor's)

STOCK INFORMATION

EXCHANGE: NYS **TICKER SYMBOL:** AMD

Price For Week Ending:	**09/10/92**
High (or Ask):	**12.250**
Low (or Bid):	**10.750**
Close (or Average):	**12.250**
P/E Ratio:	**4.588**
Shares Outstanding:	**87,168,000**
As of:	**09/10/92**
Indicated Annual Dividend:	**$0.00**

(Source: Muller Data Corporation 09/10/92)

MAJOR SHAREHOLDERS	PERCENT
FMR CORP	10%
CAPITAL GROUP INC	5%

(Source: 10-K 12/29/91)

SHAREHOLDERS GROUPS	OWNERS	PERCENT
INSTITUTIONS	136	48.74%
5% OWNERS	3	17.47%
INSIDERS	36	0.60%

(Source: CDA Technologies, Inc. 06/30/92)

KEY EXECUTIVES

W.J. Sanders III
Chm. Bd. & Chief Exec. Officer

Anthony B. Holbrook
Vice Chm. & Chief Technical Officer

Richard Previte
Pres. & Chief Oper. Officer

Marvin Burkett
Sr. V.P. & Chief Fin. Officer

Gene Connor
Sr. V.P.-Memory, Mfg. & Technology

Stephen Zelencik
Sr. V.P. & Chief Mktg. Exec.

Benjamin M. Anixter
V.P.-External Affairs

Thomas W. Armstrong
V.P. & Gen. Counsel

Gary Ashcraft
V.P.-Communications Prods. Div.

Glen Balzer
V.P.-Sls. & Mktg.-Asia-Pacific Opers.

Frank Barone
V.P.-Standard Product Opers.

John Bourgoin
V.P.-Programmable Logic Div.

Donald M. Brettner
V.P.-Mfg. Srvcs. Div.

Richard Forte
V.P.-High-Performance Memory Products Div.

W. Curtis Francis
V.P.-Opers. & Plng.

Clive Ghest
V.P.-Bus. Devel.

Gary O. Heerssen
V.P. & Grp. Exec.-Austin Wafer Fabrication Opers.

Robert M. Krueger
V.P.-Network Products Div.

W. Richard Marz
V.P.-Sls. & Mktg.-North American Opers.

Robert McConnell
V.P.-Personal Computer Products Div.

Douglas Mincey
V.P.-Logistics

K.C. Murphy
V.P.-Applications & Strategic Mktg.

Joseph Proctor
V.P.-Information Systems

Douglas Ritchie
V.P.-Quality

Fred Roeder
V.P.-Standard Products Div.

William Siegle
V.P.-Integrated Tech. Div. & Chief Scientist

Terryll R. Smith
V.P.-European Sls.

Susan Tanenbaum
V.P.-Human Resource Opers.

Stanley Winvick
V.P.-Human Resources

Ray Mirizzi
Dir.-Pur.

Michael W. Kubiak
Dir.-Investor Rels.

John Breffielh
Dir.-Compensation & Benefits

Dan Barnhart
Mgr.-Adv.

Ralph Colunra
Mgr.

Brec Woodbridge
Mgr.-Real Estate

John Patterson
Mgr.-Cash Mgmnt.

Theresa Wilson
Mgr.-Contributions

Renee Seay
Mgr.-Video Systems

(Source: National Register Publishing Co. 2/16/92)

BOARD OF DIRECTORS

W.J. Sanders III
Charles M. Blalack
Dr. R. Gene Brown
Anthony B. Holbrook
Richard H. Jenrette
Jurgen Knorr
Richard Previte

(Source: National Register Publishing Co. 2/16/92)

DIVISIONS & SUBSIDIARIES

KEY: ■ reports to Parent
● reports to preceding ■
▲ reports to preceding ●

■ **Advanced Micro Devices Export Corporation**
S.I.C. 5045
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901 Thompson Pl.
Sunnyvale, CA 94086
Telephone: (408) 732-2400

■ **Advanced Micro, Ltd.**
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Sunnyvale, CA 94086
Telephone: (408) 732-2400

■ **AMD Corporation**
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■ **Advanced Micro Devices Overseas Corporation**
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■ **Advanced Micro Computers Export Corporation, Inc.**
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Export of Microcomputers
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■ **AMD Far East Ltd.**
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Sunnyvale, CA 94086
Telephone: (408) 732-2400

(Source: National Register Publishing Co. 2/16/92)

PRESIDENT'S LETTER

The following Letter to Shareholders is extracted from the Annual Report,

TO OUR FELLOW SHAREHOLDERS

It was a stampede]

From the introduction of Advanced Micro Devices' Am386(TM) DX microprocessor, internally code-named "Longhorn," late in the first quarter of 1991 and the subsequent introduction of the Am386SX family, code-named "Shorthorn," customer demand for AMD's superior 386 products exceeded our own optimistic expectations.

In an otherwise lackluster semiconductor market, all of AMD's growth came from microprocessors and applications solutions products.

On record revenues of $1,226,649,000, an increase of nearly 16 percent from 1990, the company reported net income of $145,287,000 before preferred stock dividends. After preferred stock dividends, net income amounted to $1.53 per common share. For the prior year, AMD reported revenues of $1,059,242,000, which resulted in a net loss of $53,552,000 before the preferred stock dividends, or a loss of $0.78 per common share after the preferred dividends. The 1991 results included a net gain equivalent to $0.52 per common share from sales of assets, primarily the sale of 3.5 million shares of Xilinx, Inc.

We began the year with a return to profitability in the first quarter, one quarter ahead of our own expectations. Cost-containment measures implemented late in 1990, coupled with growing market acceptance of AMD's richer product portfolio, enabled the company to achieve improved results in a less-than-benign economic climate.

Our second quarter was solidly profitable as sales of Am386 devices grew to more than $35 million. Other product lines also performed well. Our applications solutions businesses--networking and telecommunications products and 29K(TM) RISC (reduced instruction-set computer) embedded processors--all reached record shipment levels. We also recorded a new high in sales of EPROMs (erasable programmable read-only memories), albeit at prices racked by fierce competition. Our initial shipments of 2-megabit FLASH memory devices served notice that AMD will be a major force in this rapid-growth segment of the memory business.

In the third quarter, despite the effects of the nation's lingering recession and a weak personal computer market, AMD's operational performance was outstanding. Although third-quarter semiconductor industry profits declined by 70 percent from the same period in 1990, we were able to maintain operating profit margins on lower sales.

In the final quarter of 1991, AMD achieved record revenues and the highest operating margins since 1984. Sales of Am386 products grew to more than $146 million and attained a 30 percent market share.

Our own initial business plan, admittedly conservative, called for $47 million in sales of Am386 products through the end of 1991. While all of the feedback from systems manufacturers who had evaluated engineering samples indicated that there was a large potential market hungry for a competitive product, we underestimated the impact our higher-performance, lower-power devices would have on the marketplace.

By the time of AMD's annual meeting last May, we had the initial verdict on the Am386 family from the marketplace: it was spectacular success. At that time we revised our forecast and predicted that Am386 product sales would reach a $100 million annual run-rate by the fourth quarter. This projection, too, vastly underestimated customer demand for the superior features of the Am386 family. The Am386 microprocessor is simply a superior product] By the summer quarter we were forecasting first-year sales of more than $100 million. Even this aggressive forecast was too cautious. Barely more than six months after introducing the Am386 family, AMD had shipped more than one million units representing $109 million in sales.

When the dust from the stampede had finally settled and the 1991 year-end results were in, revenues from the Am386 microprocessor family were more than one quarter of a billion dollars] Even more gratifying, most of our sales came from AMD's unique 40-megahertz (MHz) Am386DX and 25-MHz Am386SX devices.

In AMD's 1990 annual message we reported on the progress of our transformation process and noted that "...our 1990 financial performance is a misleading indicator of the actual progress made during the just-concluded 12 months toward our goal of returning to industry-leading profitability." In 1991 we achieved a return on equity of more than 20 percent. Our objective is to raise that in 1992.

Other indicators of the success of AMD's transformation include:

We achieved our long-term goal of becoming either first or second in each of AMD's "spheres of influence"--X86 microprocessors, EPROMs, and programmable logic devices (PLDs). We are important to our customers in our applications solutions businesses, including networking products for both Ethernet and FDDI (fiber distributed data interface) systems, line card circuits for telecommunications and RISC microprocessors for embedded control applications. Indeed, an independent analyst recently reported that our Am29000(TM) RISC microprocessor is now the world's largest selling 32-bit RISC microprocessor.

We have rationalized our manufacturing capacity and our worldwide workforce, resulting in a dramatic improvement in productivity. Revenue per employee reached an annualized run-rate of $130,000 in the fourth quarter of 1991. We expect further gains in productivity as sales continue to grow.

AMD is now a CMOS company. In the third quarter of 1991, for the first time in our history, sales of products manufactured with CMOS technology accounted for more than half of total revenues. In the fourth quarter CMOS sales exceeded $255 million--a $1 billion-plus annual run-rate. All Am386 devices are produced on a 0.8-micron CMOS technology, and the majority of AMD's manufacturing capacity is now submicron CMOS.

AMDs Submicron Development Center (SDC) in Sunnyvale, California, has been a tremendous success. This facility is now fully operational. In less than one year, we progressed from first working wafers to qualified production of a 4-million transistor memory device built with a 0.85-micron technology. We are currently completing the development of new generations of process technology, including a three-layer metal, 0.7-micron logic process that will be in production in the SDC by the end of this year. The first product to employ this technology will be Brahma]

Recently we announced plans for the next generation of 32-bit microprocessors for IBM-compatible personal computers--the Am486(TM) family, internally code-named Brahma. We expect to ship qualified samples during the summer quarter. Our success with the Am386 family indicates enthusiastic renunciation of monopoly activity, and accordingly, we expect to be a major player as demand builds for the higher-cost 486 microprocessor.

Despite our success in the 386 trademark case which upheld our right to use the X86 numbering system for our microprocessor family, AMD's fortunes are still closely tied to the outcome of pending litigation. As we write these words, we are still awaiting the arbitrator's award of damages for Intel's breach of the 1982 technology agreement. A trial that will confirm our rights to use the Intel microcode in our Am386 and Am486 microprocessors and peripherals is now scheduled to begin in March in the U.S. District Court in San Jose, California. We expect to prevail in this action, but no litigation is without risk.

In our view, 1992 will be another year of double-digit growth for AMD. Despite a recession that holds on stubbornly, limiting demand for many commodity products, we expect that we can further improve both operating margins and return on equity. AMD is back]

Thank you for your continuing support.

W.J. Sanders III Chairman and Chief Executive Officer

Richard Previte President and Chief Operating Officer

February 12, 1992

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❑ 10-Q	03/29/92
❑ Proxy	03/28/92
❑ Registration	03/23/92
❑ 8-K	02/24/92
❑ Annual Report to Shareholders	12/31/91
❑ 10-K	12/29/91
❑ 10-K	12/29/91
❑ Annual Report to Shareholders	12/29/91
❑ 8-K	11/14/91
❑ 10-Q	09/29/91
❑ 8-K	09/03/91
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❑ Proxy	03/30/91
❑ Registration	03/28/91
❑ 10-K	12/31/90
❑ 10-K	12/30/90
❑ Annual Report to Shareholders	12/30/90

EXPLANATION OF SEC FILINGS

Annual Report to Shareholders Annual business summary with financial report. Not Required by the SEC.

10-K Audited annual financial report. Required by the SEC. Filing Deadline is 90 days after fiscal year end.

10-Q Unaudited quarterly financial report. Required by the SEC. Filing Deadline is 45 days after the end of each quarter.

8-K Report of unscheduled material events or corporate changes deemed of importance to shareholders or to the SEC. Filing deadline is within 15 working days of the event described.

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- ☐ **Portable Power to Last Twice as Long** *InfoWorld* Vol. 14, Iss. 2, Jan 13, 1992; pp. 23,26. #92-05962
- ☐ **Industry Makes Some Financial Gains** *InfoWorld* Vol. 13, Iss. 42, Oct 21, 1991; pp. 206. #91-53129
- ☐ **Employers Counter 401(k) Tests** *Pensions & Investments* Vol. 19, Iss. 18, Aug 19, 1991; pp. 3,33. #91-42412
- ☐ **Spec Details Use of FDDI Over Shielded Twisted Pair** *Network World* Vol. 8, Iss. 21, May 27, 1991; pp. 2,56. #91-27341
- ☐ **Battling the Technology Giants** *Computerworld* Vol. 25, Iss. 2, Jan 14, 1991; pp. 25. #91-05694
- ☐ **AMD Wins Round 1 in "386" Fight** *Computerworld* Vol. 24, Iss. 47, Nov 19, 1990; pp. 145. #90-49770
- ☐ **AMD Wins Round in 386 Dispute** *Computerworld* Vol. 24, Iss. 42, Oct 15, 1990; pp. 141. #90-46064
- ☐ **Which Side Will They Choose in the FDDI Interoperability War?** *Data Communications* Vol. 18, Iss. 13, Oct 1989; pp. 48,50. #89-43266
- ☐ **Corporations, Culture, and Commitment: Motivation and Social Control** *California Mgmt Review* Vol. 31, Iss. 4, Summer 1989; pp. 9-25. #89-40294
- ☐ **Slaying Dragons with SPC** *Manufacturing Systems* Vol. 6, Iss. 8, Aug 1988; pp. 56-59. #89-05110
- ☐ **FDDI Chipset Will Spur Product Intros** *Network World* Vol. 5, Iss. 30, Jul 25, 1988; pp. 17-18. #88-37301
- ☐ **Will GaAs PLDs Eclipse Bipolar Cousins?** *ESD: The Electronic System Design Magazine* Vol. 18, Iss. 7, Jul 1988; pp. 21-22. #88-29910
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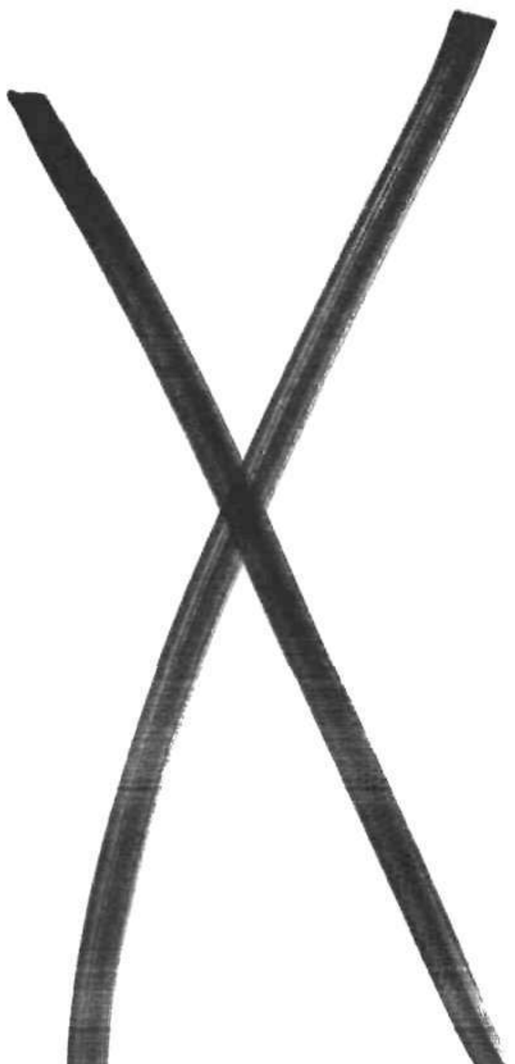

Dataquest Vendor Profile

ASICs *Worldwide*
December 21, 1992

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Corporate Statistics

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President and CEO	Joseph B. Costello
Number of Employees	2,500
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1991 Corporate Revenue*	$392.3 million
Founded	1988
EDA Software Market Share*	24.2 percent
Strongest Competitor	Mentor Graphics

*Adjusted to include Valid revenue

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Cadence Design Systems Inc. develops, markets, and supports electronic design automation (EDA) software products for a variety of technical workstations. The company has a diverse offering of tools, consistent with its history as a company based upon merger and acquisition. It currently enjoys the privilege of being the largest provider of EDA software to the world.

Corporate Organization

Formed as a result of a merger between SDA Systems Inc. and ECAD in May 1988, the management structure at Cadence has been fluid over the past four years, with change being the norm. The company is currently organized along four main product thrusts: IC design, analog design, system design, and CAE tools. Yet through it all, Joseph B. Costello, President and CEO, has provided a very strong leadership presence. Figure 1 outlines the Cadence organizational structure.

For more information on Cadence Design Systems Inc. or the ASICs industry, call Bryan Lewis at (408) 437-8668.

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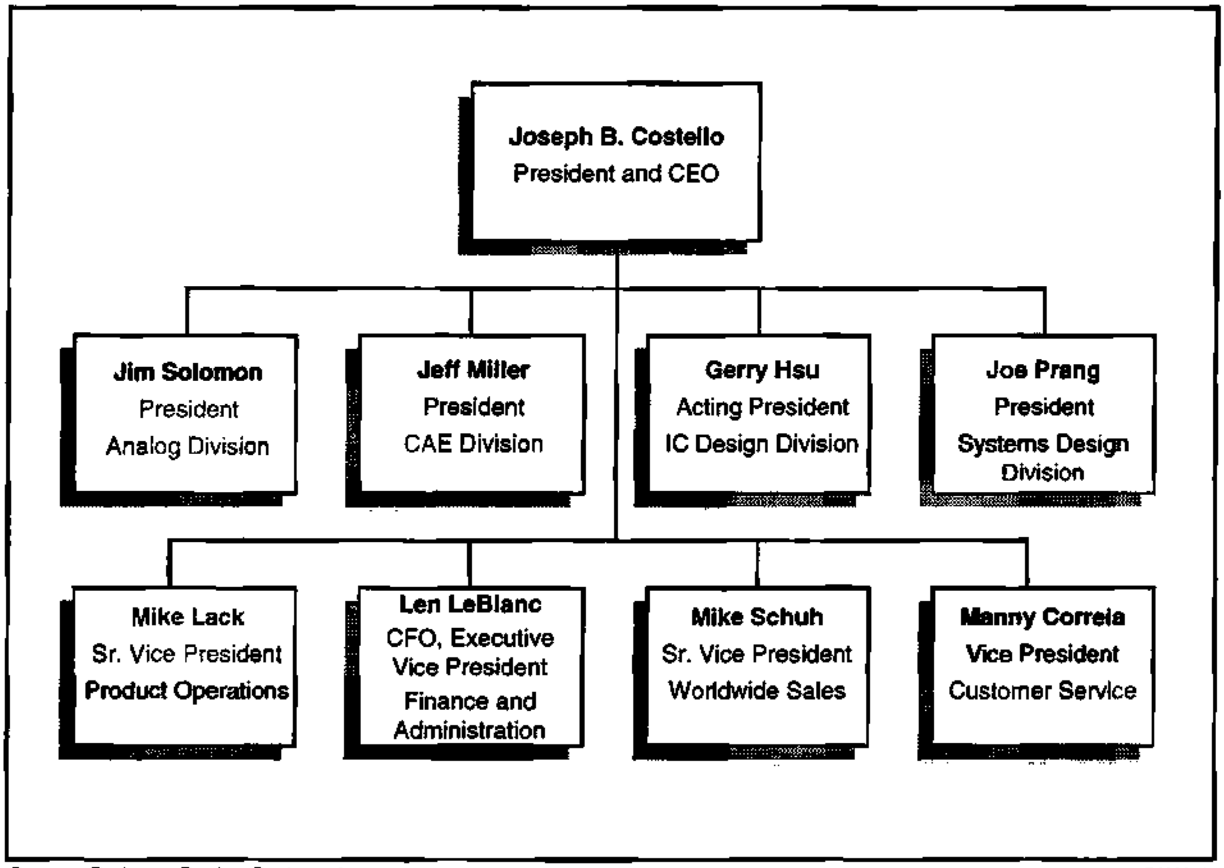

Source: Cadence Design Systems Inc. G2002161

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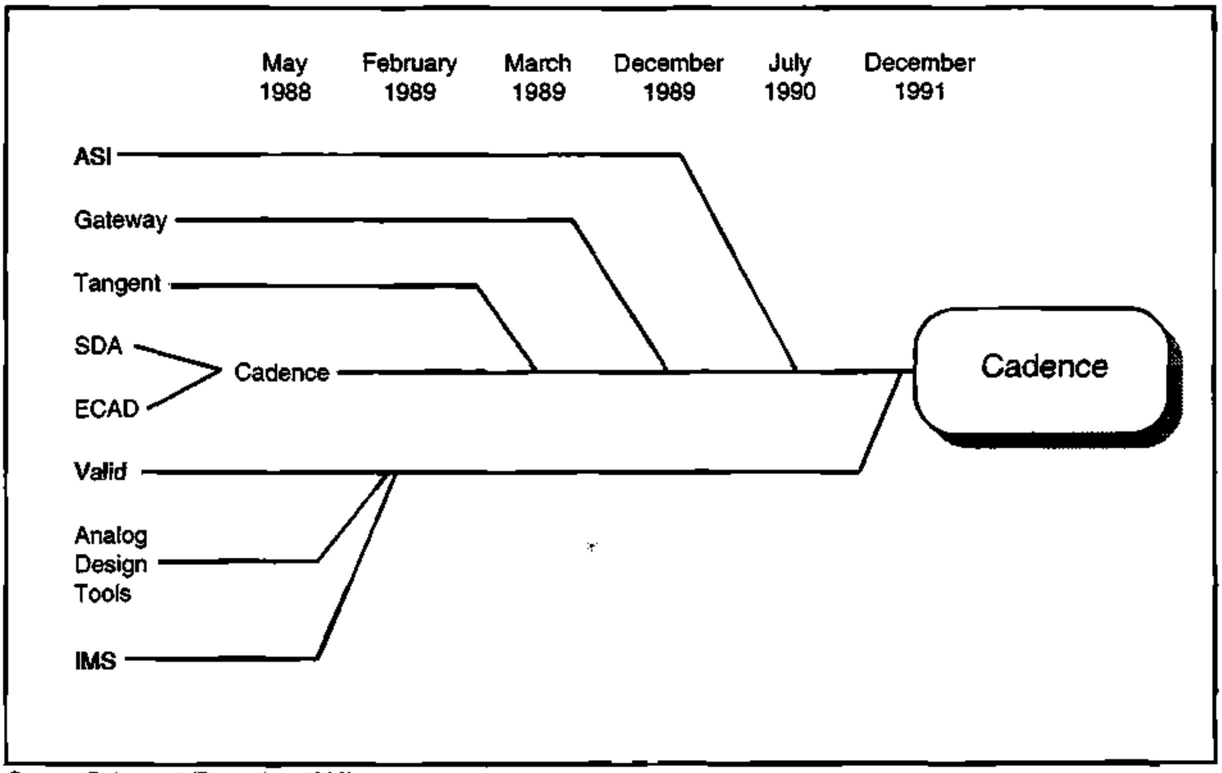


Source: Dataquest (December 1992) G2002182

Design Automation in 1989. He used his B.S.E.E. and M.S. in management science at IBM for 31 years before joining Gateway.

Aki Fujimura, vice president of Central Engineering and Information Services, is responsible for the infrastructure that Cadence's application tools run upon. He rose up through the engineering ranks at Cadence and holds both a bachelor's and master's degree in electrical engineering and computer science from MIT.

Michael D. Lack, senior vice president of Product Operations, had previously been president of Cadence's IC Division. His move into his current position shows top management's renewed focus at delivering quality products in a timely manner.

Leonard J. LeBlanc is the executive vice president of Finance and Administration and chief financial officer. He has the daunting task of making fiscal sense of the continuing saga of mergers and acquisitions at Cadence.

Jeffrey A. Miller is the president of the Computer-Aided Engineering (CAE) Division. With a classic combination of B.S.E.E. and M.B.A. credentials, Miller arrived at Cadence shortly before the merger with Valid. He previously had been general manager of storage products at computer subsystem supplier Adaptec.

Joseph Prang, president of the Systems Design Division, had been vice president of Marketing at Valid prior to the merger. Prang was one of the top executives at Valid that remained a part of the integral functioning of Cadence's day-to-day operations. Prang also has a combination B.S.E.E. and M.B.A. from Purdue University.

James E. Solomon, president of the Analog Division, has been with Cadence since its inception. He had been a founder of SDA, which he created after a tenure at National Semiconductor.

Michael N. Schuh is the senior vice president of Worldwide Sales. An alumni of EDA suppliers Daisy and Computervision, Schuh rides herd on some 60 sales offices worldwide.

EDA Products

Cadence carries a complete portfolio of strong point tools that address the broad range of electronic designer's design problems. This section outlines the major products, segmented by the area they address. Tables 1 through 3 outline Cadence's design products.

Table 1
Cadence's IC Design Products

Product	Application
ASIC Workbench	Front-to-back ASIC design
Dracula	Design verification
Diva	Design verification
Gate Ensemble	Gate Array place and route
Cell Ensemble	Cell-based IC place and route
Cell3 Ensemble	3-layer metal cell-based IC place and route
Preview	ASIC floorplanner
Analog Artist	Analog IC design and simulation
Dantes	Analog design for test

Source: Dataquest (December 1992)

Table 2
Cadence's CAE Design Products

Product	Application
Composer	Design entry
Synergy	ASIC logic synthesis
Verilog-XL	Mixed-level simulation
VHDL-XL	Mixed-level simulation
Veritime-XL	Static timing analysis
Verifault-XL	Fault Simulation

Source: Dataquest (December 1992)

Table 3
Cadence's PCB Design Products

Product	Application
System Workbench	Front-to-back PCB/MCM design
Allegro	PCB/MCM place and route
Thermax	PCB/MCM thermal analysis
SigNoise	PCB/MCM signal integrity analysis
Viable	PCB/MCM reliability analysis
Prance-XL	PCB/MCM autorouting
Analog Workbench	Analog PCB design simulation

Source: Dataquest (December 1992)

Market Position

Cadence is currently the largest supplier of electronic design automation tools. Dataquest estimates that its 1991 software revenue was $184.3 million, as shown in Table 4. However, this figure is based upon premerger conditions. With the addition of Valid's $108.5 million, Cadence's total software revenue is $292.8 million.

By becoming the largest supplier of EDA tools, Cadence has unseated its strongest rival, Mentor Graphics. Mentor Graphics was one of the pioneering companies of EDA, and the only standalone entity left from the boom years of the big three: Daisy, Mentor, and Valid. Table 5 depicts the "tale of the tape" for these two EDA giants. In 1991, both Cadence and Mentor Graphics lost money. Cadence's loss was because of write-downs from merger costs, and Mentor Graphics' problems stemmed from layoffs and restructuring. However, 1992 has seen Cadence's profits improve compared to last year, and the company seems to be on track to break its revenue number of last year. Mentor Graphics, conversely, is still struggling with product transitions, downsizing, and loss of revenue due to its dwindling hardware sales.

While it may seem that Cadence's rise to prominence has been led by purchasing market share, this is not the case. Dataquest has analyzed the market share of the smaller entities that have merged to form the Cadence of today (see Figure 3). The combined market share has continued to rise consistently over the past five years, which shows the telltale signs of excellent management. In this case, the team is definitely greater than the sum of its players. Additionally, the Cadence/Valid merger balanced the software revenue of the company to a more even distribution, which reflects Cadence's vision of becoming a broad range supplier of EDA tools (see Figure 4). Geographic distribution of Cadence's software revenue is outlined in Figure 5.

Table 4
1991 EDA Software Market Share

Company	Software Revenue ($M)	Market Share (%)
Cadence	184.3	15.2
Mentor Graphics	146.4	12.1
Valid	108.5	9.0
Racal-Redac	70.6	5.8
Zuken	62.3	5.1
Intergraph	44.7	3.7
Viewlogic	32.0	2.6
Synopsys	30.1	2.5
Wacom	25.5	2.1
Compass Design	23.9	2.0
All EDA Companies	1,210.0	100.0

Source: Dataquest (December 1992)

Table 5
Tale of the Tape for Cadence/Mentor Graphics Fight (Millions of Dollars)

	Cadence	Mentor Graphics
1991 Corporate Revenue	392.3	400.1
1991 Profit	-21.7	-61.6
1991 Software Revenue	292.8	146.4
1991 Service Revenue	88.1	135.9
1991 Hardware Revenue	5.1	113.8
Q1 1992 Corporate Revenue	101.3	100.1
Q2 1992 Corporate Revenue	105.9	89.0

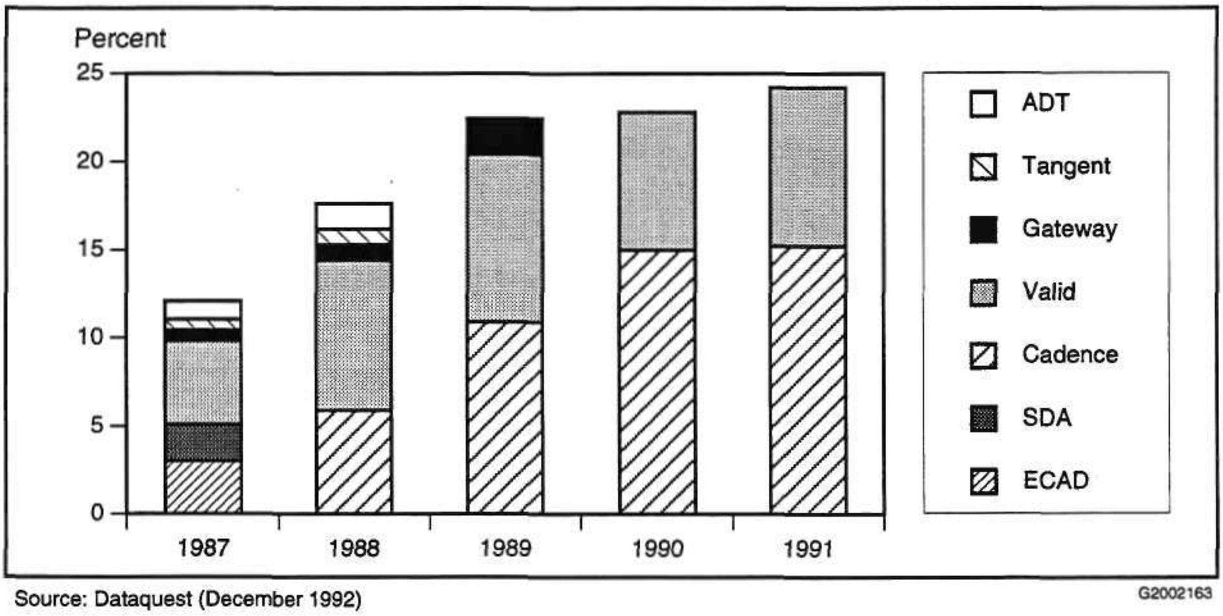
Source: Cadence, Mentor Graphics, and Dataquest (December 1992)

IC Design Drove Cadence's Rise to Prominence

IC design was the base that Cadence worked from to penetrate the EDA market. By 1991, the combined Cadence and Valid entity garnered a whopping 62 percent of the IC layout market (see Figure 6). Cadence has very little competition in this market, with Mentor Graphics trailing Cadence/Valid by almost $87 million. It is from this position of strength in the IC layout market that Cadence had set its sights on total EDA domination.

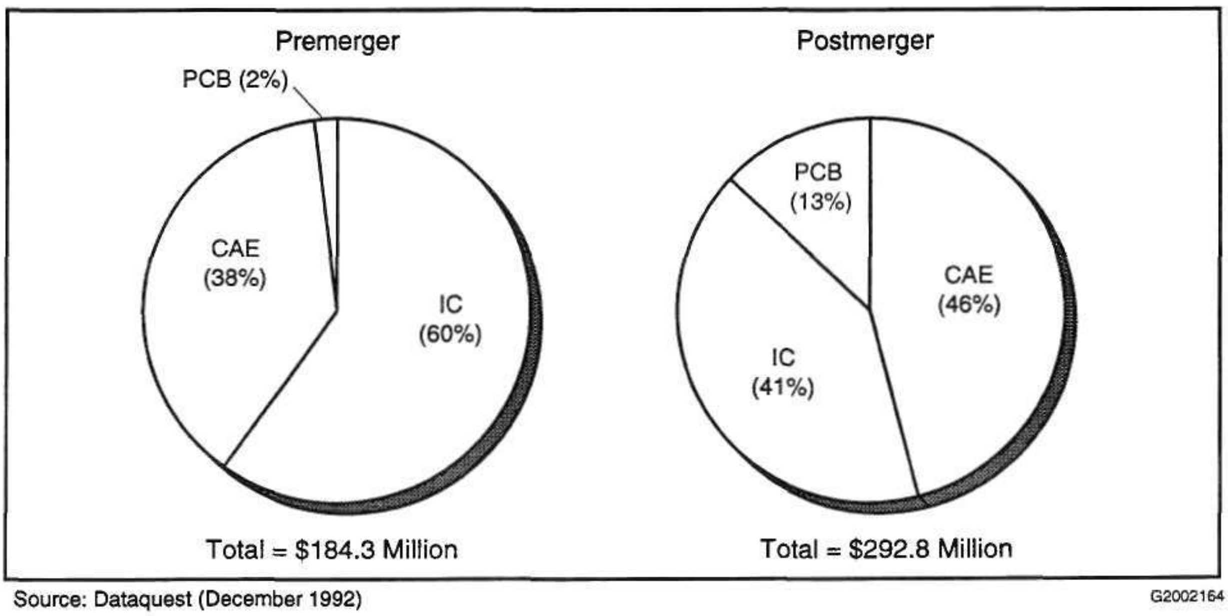
On the downside, the IC design market has reached a saturation point. Slowing worldwide semiconductor growth, as well as the economic downturn in Japan, will further stagnate this market. However, there are shifts in the methodologies used in custom and semicustom IC design, and Cadence is well positioned to migrate with the changing user needs.

Figure 3
Worldwide EDA Software Market Share of Companies Forming Cadence



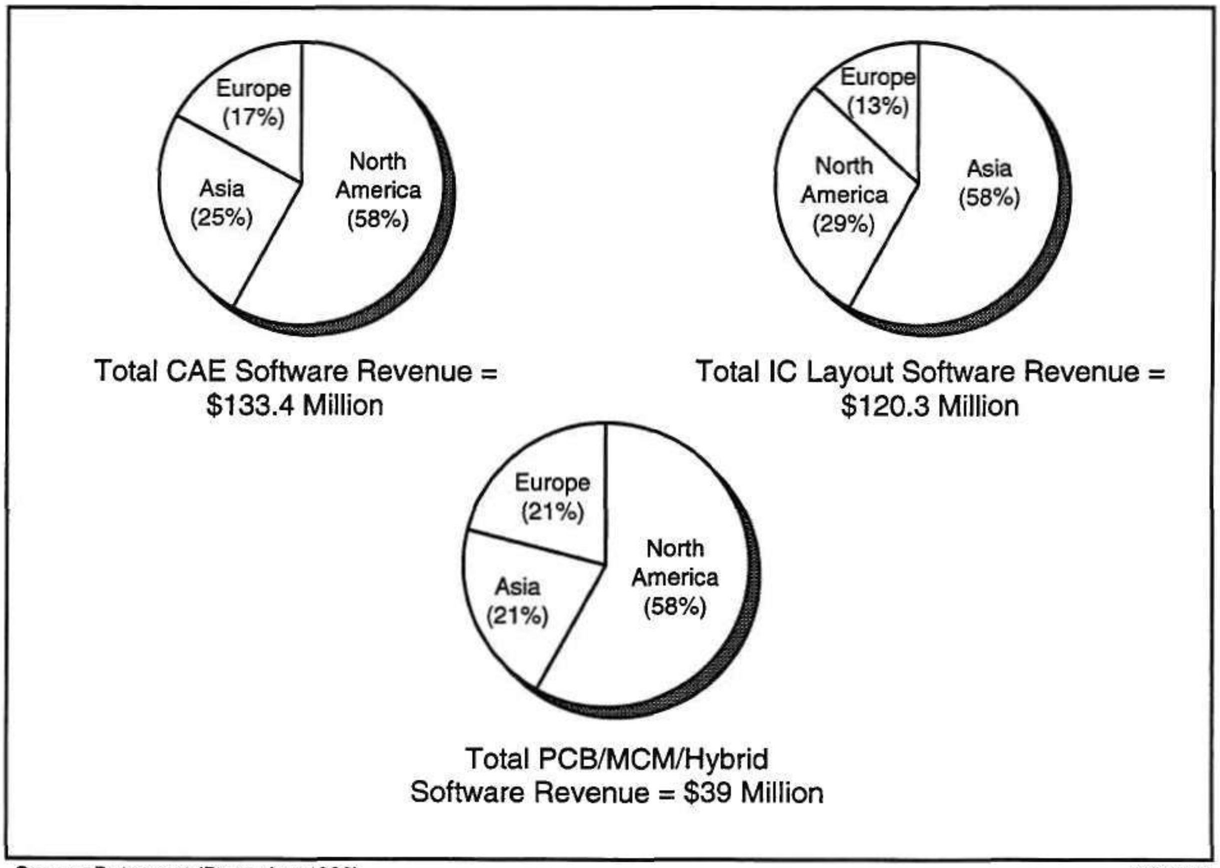
Source: Dataquest (December 1992)

Figure 4
Cadence 1991 Worldwide Software Revenue Percent by Market



Source: Dataquest (December 1992)

Figure 5
Combined Cadence/Valid 1991 Software Revenue by Market and Region



Source: Dataquest (December 1992) G2002165

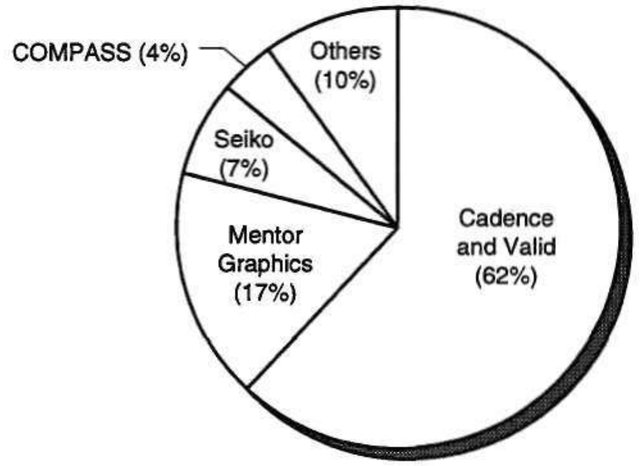
CAE Penetration Has Highs and Lows, with Verilog Leading the Way

Cadence made its big leap into the CAE market with its 1989 acquisition of Gateway Design Automation. The jewel Cadence was after was the Verilog-XL simulator, a simulator that today still is the de facto standard in mixed-level simulation. However, this powerful weapon in the Cadence arsenal has come under attack in two areas.

The first area is the emergence of the VHSIC hardware description language (VHDL). This rival hardware description language (HDL) and mixed-level simulators based upon its use have begun to erode Verilog's market share.

The second factor that will affect Verilog sales is the birth of the Verilog-clone simulation market. As part of Cadence's battle plan against VHDL, it created Open Verilog International (OVI) as an industry body to evolve the Verilog HDL into a true industry standard, as opposed to a proprietary, de facto standard. As a by-product of this effort, we are now beginning to see Verilog-based

Figure 6
1991 Worldwide IC Layout Software Market Share



Source: Dataquest (December 1992)

G2002166

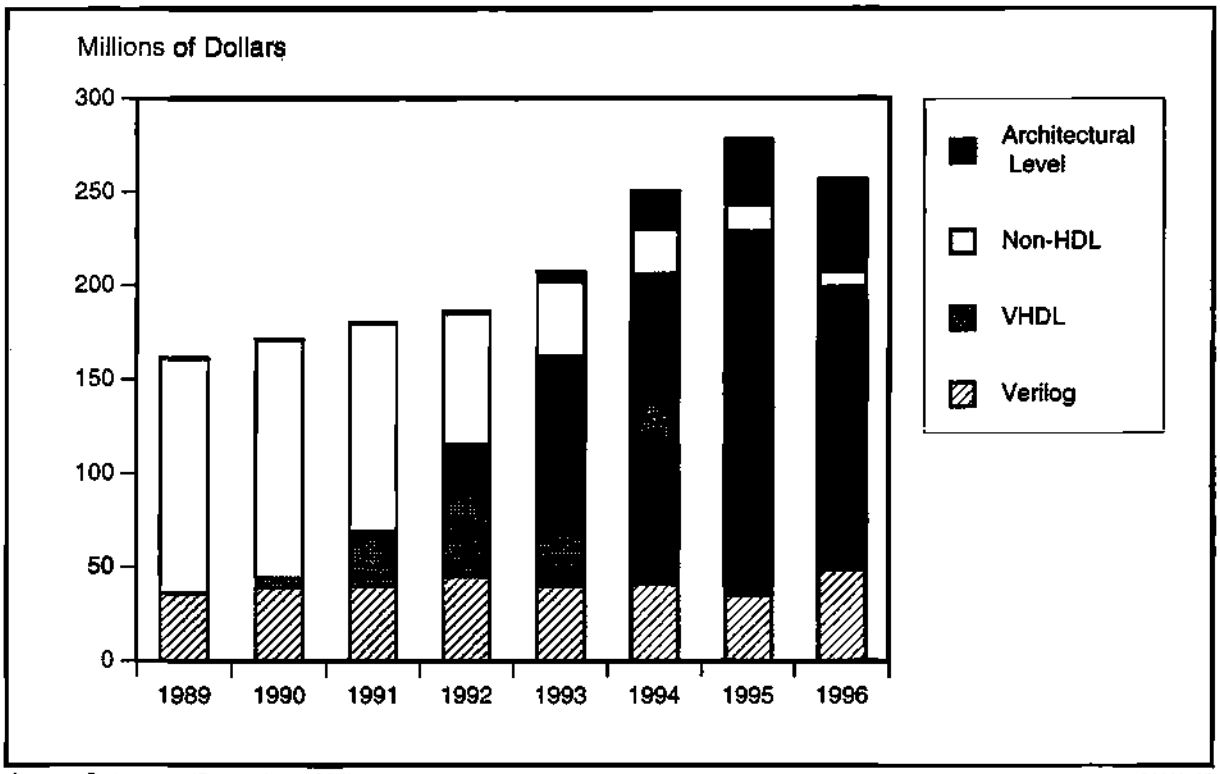
simulators from other companies. Dataquest believes that these new simulators will provide a mid-life extension to the Verilog market; however, it may also decrease the average selling prices (ASPs) of Verilog-based simulators. Based upon these factors and end-user research showing a coming tide of VHDL use, Dataquest anticipates that sales of Verilog-based simulators will stagnate over the coming years, whereas VHDL-based simulators will be more broadly accepted by the mainstream designer (see Figure 7).

Other design verification tools are critical to Cadence's future success. The company has not ignored the VHDL phenomenon and has recently announced a VHDL initiative to help standardize VHDL models for use in a variety of VHDL-based simulators—a vexing problem facing ASIC suppliers. While Cadence has had a VHDL simulator—the VHDL-XL—the product has not received the same attention that its Verilog-XL counterpart has. Look for this to change as Cadence adopts to user's demands and more fully supports VHDL.

Synthesis May Be a Weak Chink in the Cadence Armor

Logic synthesis is the pivotal point tool in the top-down design methodology that is being adopted by the mainstream electronic designer. Synopsys is the one company that has pioneered this productivity-enhancing technology. The combination of the Synopsys synthesis tool with Cadence's Verilog-XL simulator has been a favorite for ASIC designers for some time now. But Synopsys is distancing itself from Cadence, and these once-symbiotic partners now treat each other as competitors. Cadence introduced its own synthesis tools, Synergy, while Synopsys acquired a VHDL simulator from ZYCAD and is now focusing on a VHDL-based top-down

Figure 7
Historical and Projected Growth of Worldwide Software Simulation Market



Source: Dataquest (December 1992) G2002167

design to further differentiate itself from Cadence. It may be quite difficult for Cadence to gain market share in this technically demanding area of logic synthesis.

Attempting to build upon its Verilog strength, Cadence has generated its own front-end design entry system called Composer. In addition, Cadence has generated PLD design tools and other design verification tools. These products are not necessarily "lead" products that drive sales; rather they are "drag" products that are brought along to fill out the solution for the electronic designer. Cadence will look to its strength in Verilog simulation to evolve into a more potent VHDL-based CAE product offering.

PCB Design Tools Complete the Circle

To become the largest supplier of EDA tools, Cadence had the vision to seek out new areas of expansion. While it never had a presence in the printed circuit board (PCB) design area, it sought to acquire this expertise. Its first attempt was to purchase ASI, a PCB production house that had its own internal set of PCB design tools. Unfortunately this strategy proved to be unsuccessful, and after this misstep, Cadence set its sights on larger game. Cadence's weakness in PCB design tools led to its merger with Valid, which had a growing business in PCB design with its Allegro tool set. Cadence's challenge is to keep the momentum of the Allegro tool set while integrating it into the Cadence set of framework and entry tools.

Dataquest Perspective

Cadence is now clearly a master of its own destiny. The vision of becoming the largest supplier of EDA tools has been successfully accomplished by external acquisition and skillful integration and sales. However, Dataquest believes that Cadence's largest challenge is still before it. The EDA market is littered with those who had been No. 1 but who had failed to stay on top due to missed execution or lack of forward thinking. Cadence must base its coming evolution upon the following strengths:

- Technology holding, with a superb portfolio of point tools
- IC design dominance
- Strong field sales and support organization

Software technology has a short shelf life, and Cadence must successfully integrate outstanding point tools into integrated solutions for its customers. It must do so while avoiding the pitfalls of its largest competitor and last year's EDA king-of-the-hill, Mentor Graphics. Cadence's continued success is based upon its ability to do the following:

- Evolve an integration strategy without causing widespread customer disruption
- Use selected technology partnerships to further enhance point tools
- Avoid focusing on internal structural and political battles
- Develop, partner with, and/or acquire new best-of-breed technology to keep the coming generation of start-up companies at bay
- Articulate its vision of the next generation of EDA

Dataquest Vendor Profile

ASICs *Worldwide*
December 21, 1992

Cadence Design Systems Inc.

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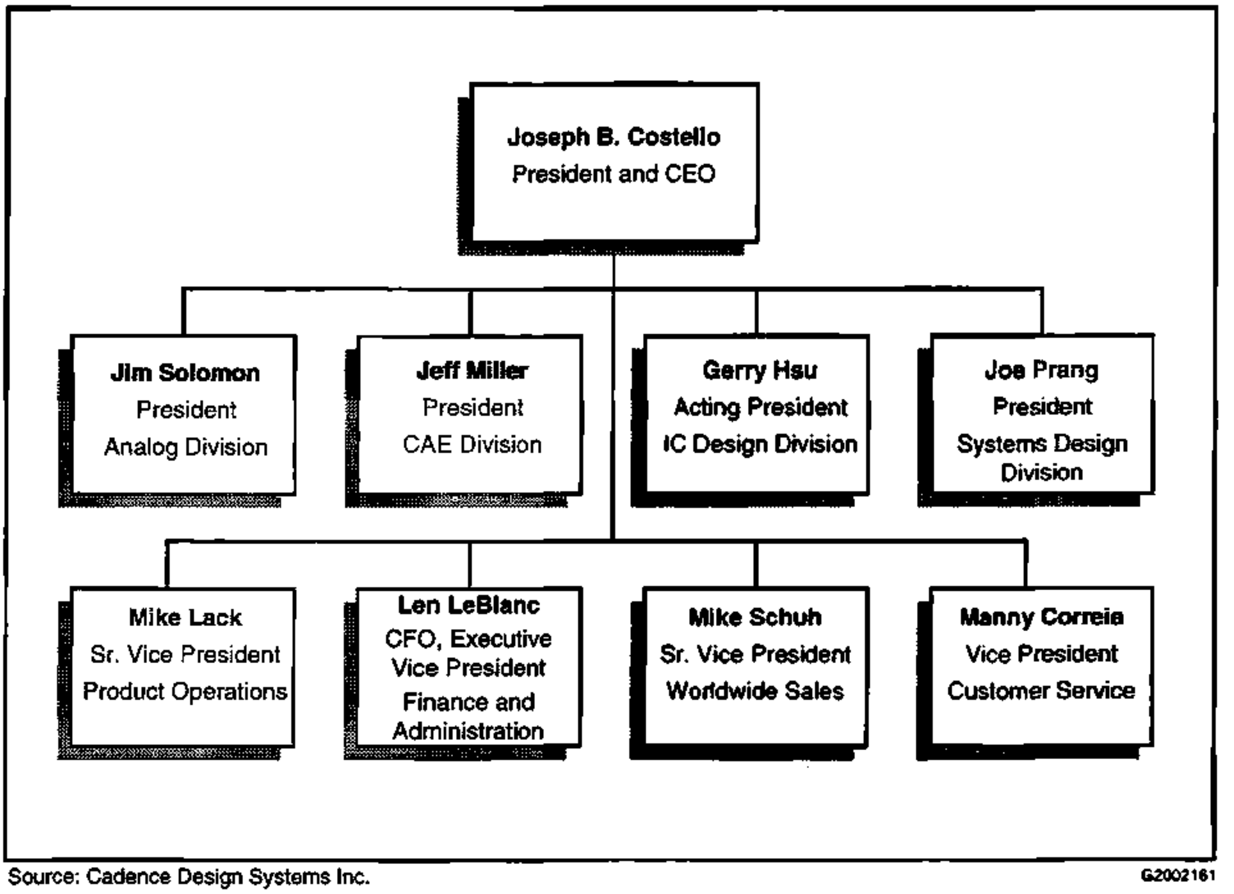

Source: Cadence Design Systems Inc. G2002161

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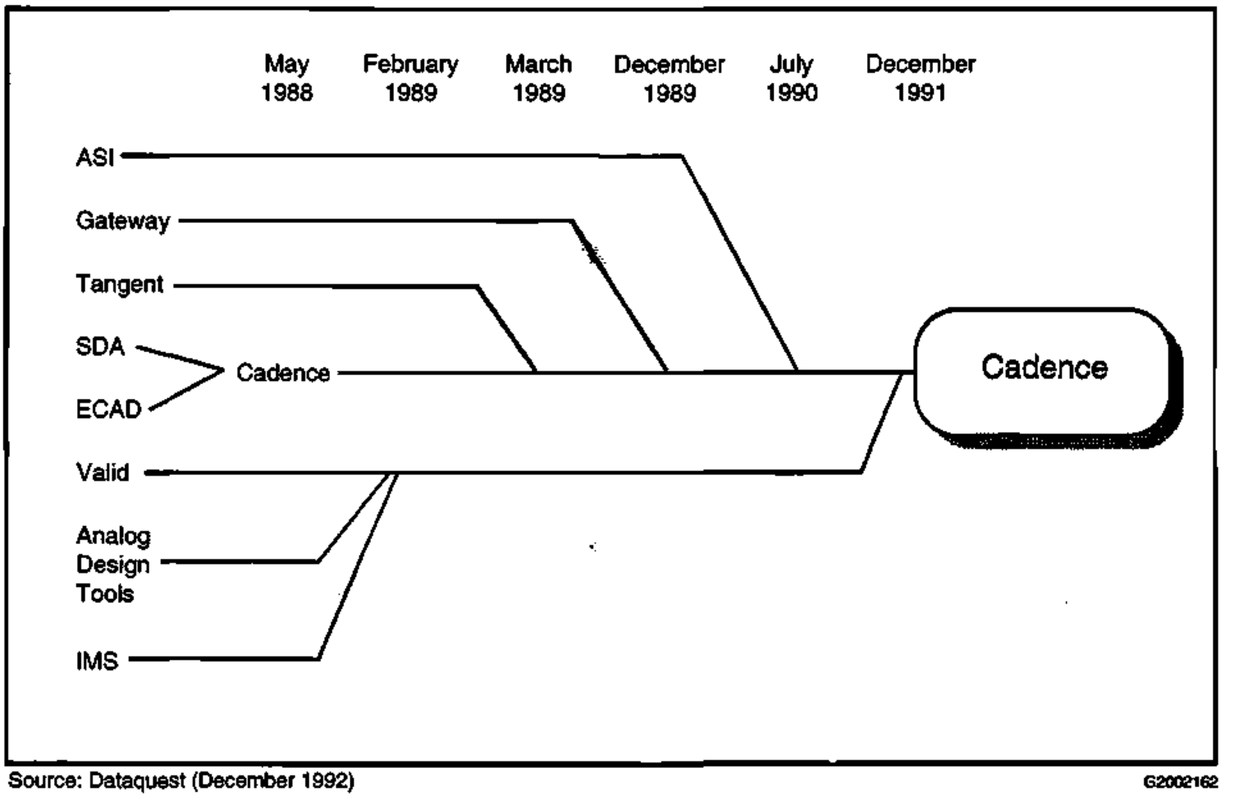

Source: Dataquest (December 1992) G2002162

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Aki Fujimura, vice president of Central Engineering and Information Services, is responsible for the infrastructure that Cadence's application tools run upon. He rose up through the engineering ranks at Cadence and holds both a bachelor's and master's degree in electrical engineering and computer science from MIT.

Michael D. Lack, senior vice president of Product Operations, had previously been president of Cadence's IC Division. His move into his current position shows top management's renewed focus at delivering quality products in a timely manner.

Leonard J. LeBlanc is the executive vice president of Finance and Administration and chief financial officer. He has the daunting task of making fiscal sense of the continuing saga of mergers and acquisitions at Cadence.

Jeffrey A. Miller is the president of the Computer-Aided Engineering (CAE) Division. With a classic combination of B.S.E.E. and M.B.A. credentials, Miller arrived at Cadence shortly before the merger with Valid. He previously had been general manager of storage products at computer subsystem supplier Adaptec.

Joseph Prang, president of the Systems Design Division, had been vice president of Marketing at Valid prior to the merger. Prang was one of the top executives at Valid that remained a part of the integral functioning of Cadence's day-to-day operations. Prang also has a combination B.S.E.E. and M.B.A. from Purdue University.

James E. Solomon, president of the Analog Division, has been with Cadence since its inception. He had been a founder of SDA, which he created after a tenure at National Semiconductor.

Michael N. Schuh is the senior vice president of Worldwide Sales. An alumni of EDA suppliers Daisy and Computervision, Schuh rides herd on some 60 sales offices worldwide.

EDA Products

Cadence carries a complete portfolio of strong point tools that address the broad range of electronic designer's design problems. This section outlines the major products, segmented by the area they address. Tables 1 through 3 outline Cadence's design products.

Table 1
Cadence's IC Design Products

Product	Application
ASIC Workbench	Front-to-back ASIC design
Dracula	Design verification
Diva	Design verification
Gate Ensemble	Gate Array place and route
Cell Ensemble	Cell-based IC place and route
Cell3 Ensemble	3-layer metal cell-based IC place and route
Preview	ASIC floorplanner
Analog Artist	Analog IC design and simulation
Dantes	Analog design for test

Source: Dataquest (December 1992)

Table 2
Cadence's CAE Design Products

Product	Application
Composer	Design entry
Synergy	ASIC logic synthesis
Verilog-XL	Mixed-level simulation
VHDL-XL	Mixed-level simulation
Veritime-XL	Static timing analysis
Verifault-XL	Fault Simulation

Source: Dataquest (December 1992)

Table 3
Cadence's PCB Design Products

Product	Application
System Workbench	Front-to-back PCB/MCM design
Allegro	PCB/MCM place and route
Thermax	PCB/MCM thermal analysis
SigNoise	PCB/MCM signal integrity analysis
Viable	PCB/MCM reliability analysis
Prance-XL	PCB/MCM autorouting
Analog Workbench	Analog PCB design simulation

Source: Dataquest (December 1992)

Market Position

Cadence is currently the largest supplier of electronic design automation tools. Dataquest estimates that its 1991 software revenue was $184.3 million, as shown in Table 4. However, this figure is based upon premerger conditions. With the addition of Valid's $108.5 million, Cadence's total software revenue is $292.8 million.

By becoming the largest supplier of EDA tools, Cadence has unseated its strongest rival, Mentor Graphics. Mentor Graphics was one of the pioneering companies of EDA, and the only standalone entity left from the boom years of the big three: Daisy, Mentor, and Valid. Table 5 depicts the "tale of the tape" for these two EDA giants. In 1991, both Cadence and Mentor Graphics lost money. Cadence's loss was because of write-downs from merger costs, and Mentor Graphics' problems stemmed from layoffs and restructuring. However, 1992 has seen Cadence's profits improve compared to last year, and the company seems to be on track to break its revenue number of last year. Mentor Graphics, conversely, is still struggling with product transitions, downsizing, and loss of revenue due to its dwindling hardware sales.

While it may seem that Cadence's rise to prominence has been led by purchasing market share, this is not the case. Dataquest has analyzed the market share of the smaller entities that have merged to form the Cadence of today (see Figure 3). The combined market share has continued to rise consistently over the past five years, which shows the telltale signs of excellent management. In this case, the team is definitely greater than the sum of its players. Additionally, the Cadence/Valid merger balanced the software revenue of the company to a more even distribution, which reflects Cadence's vision of becoming a broad range supplier of EDA tools (see Figure 4). Geographic distribution of Cadence's software revenue is outlined in Figure 5.

Table 4
1991 EDA Software Market Share

Company	Software Revenue ($M)	Market Share (%)
Cadence	184.3	15.2
Mentor Graphics	146.4	12.1
Valid	108.5	9.0
Racal-Redac	70.6	5.8
Zuken	62.3	5.1
Intergraph	44.7	3.7
Viewlogic	32.0	2.6
Synopsys	30.1	2.5
Wacom	25.5	2.1
Compass Design	23.9	2.0
All EDA Companies	1,210.0	100.0

Source: Dataquest (December 1992)

Table 5
Tale of the Tape for Cadence/Mentor Graphics Fight (Millions of Dollars)

	Cadence	Mentor Graphics
1991 Corporate Revenue	392.3	400.1
1991 Profit	-21.7	-61.6
1991 Software Revenue	292.8	146.4
1991 Service Revenue	88.1	135.9
1991 Hardware Revenue	5.1	113.8
Q1 1992 Corporate Revenue	101.3	100.1
Q2 1992 Corporate Revenue	105.9	89.0

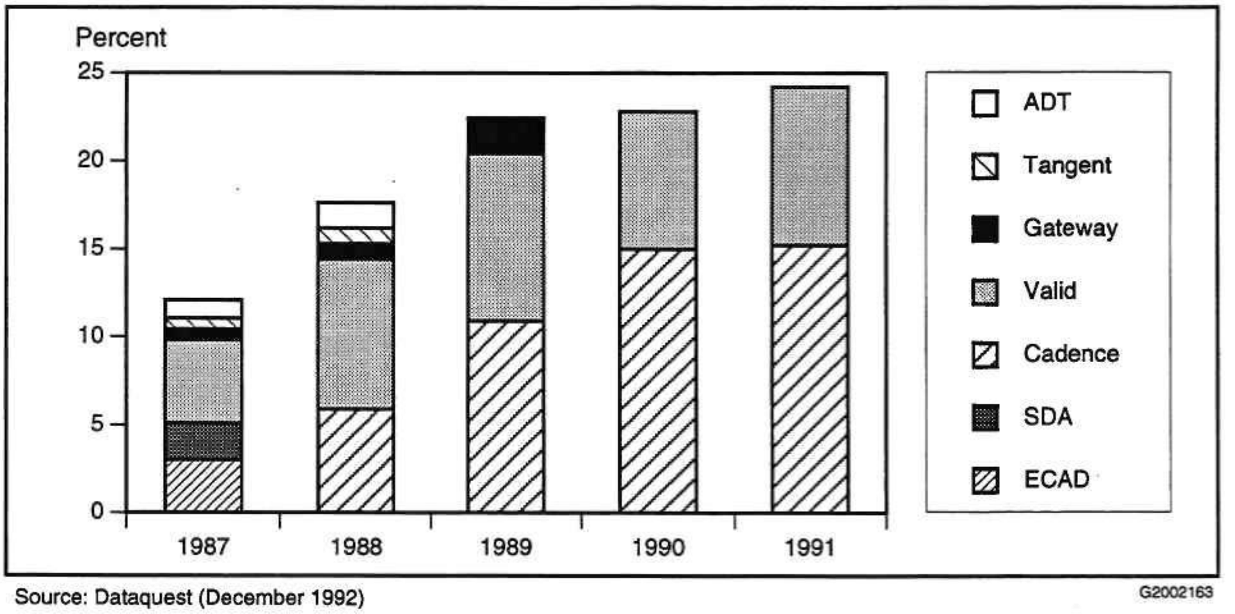
Source: Cadence, Mentor Graphics, and Dataquest (December 1992)

IC Design Drove Cadence's Rise to Prominence

IC design was the base that Cadence worked from to penetrate the EDA market. By 1991, the combined Cadence and Valid entity garnered a whopping 62 percent of the IC layout market (see Figure 6). Cadence has very little competition in this market, with Mentor Graphics trailing Cadence/Valid by almost $87 million. It is from this position of strength in the IC layout market that Cadence had set its sights on total EDA domination.

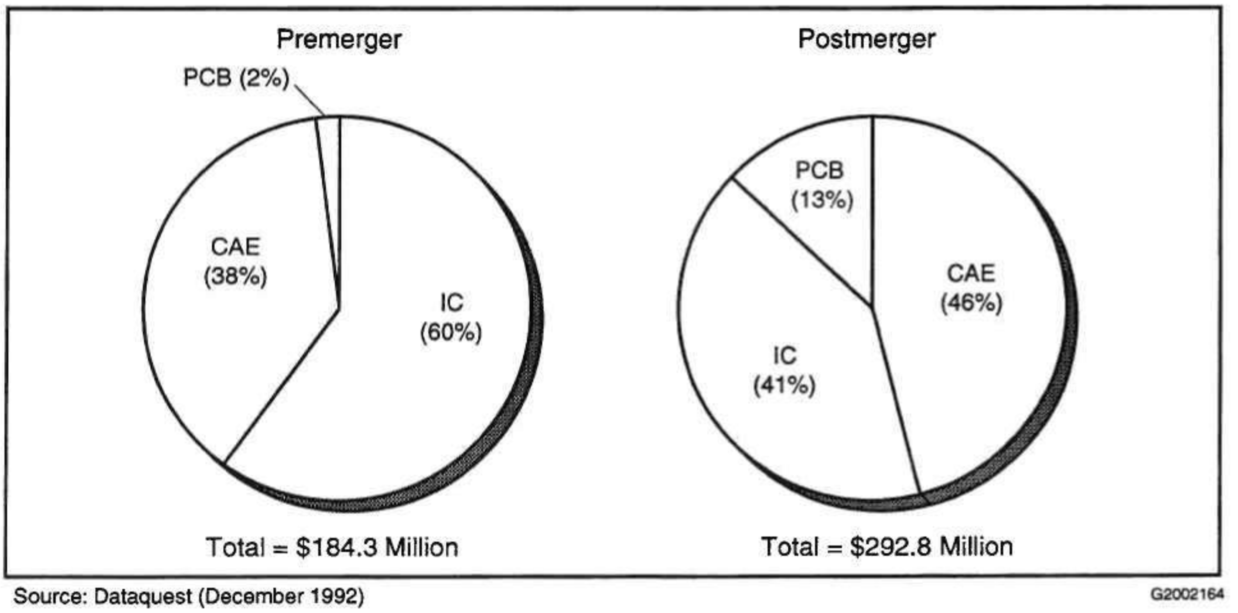
On the downside, the IC design market has reached a saturation point. Slowing worldwide semiconductor growth, as well as the economic downturn in Japan, will further stagnate this market. However, there are shifts in the methodologies used in custom and semicustom IC design, and Cadence is well positioned to migrate with the changing user needs.

Figure 3
Worldwide EDA Software Market Share of Companies Forming Cadence



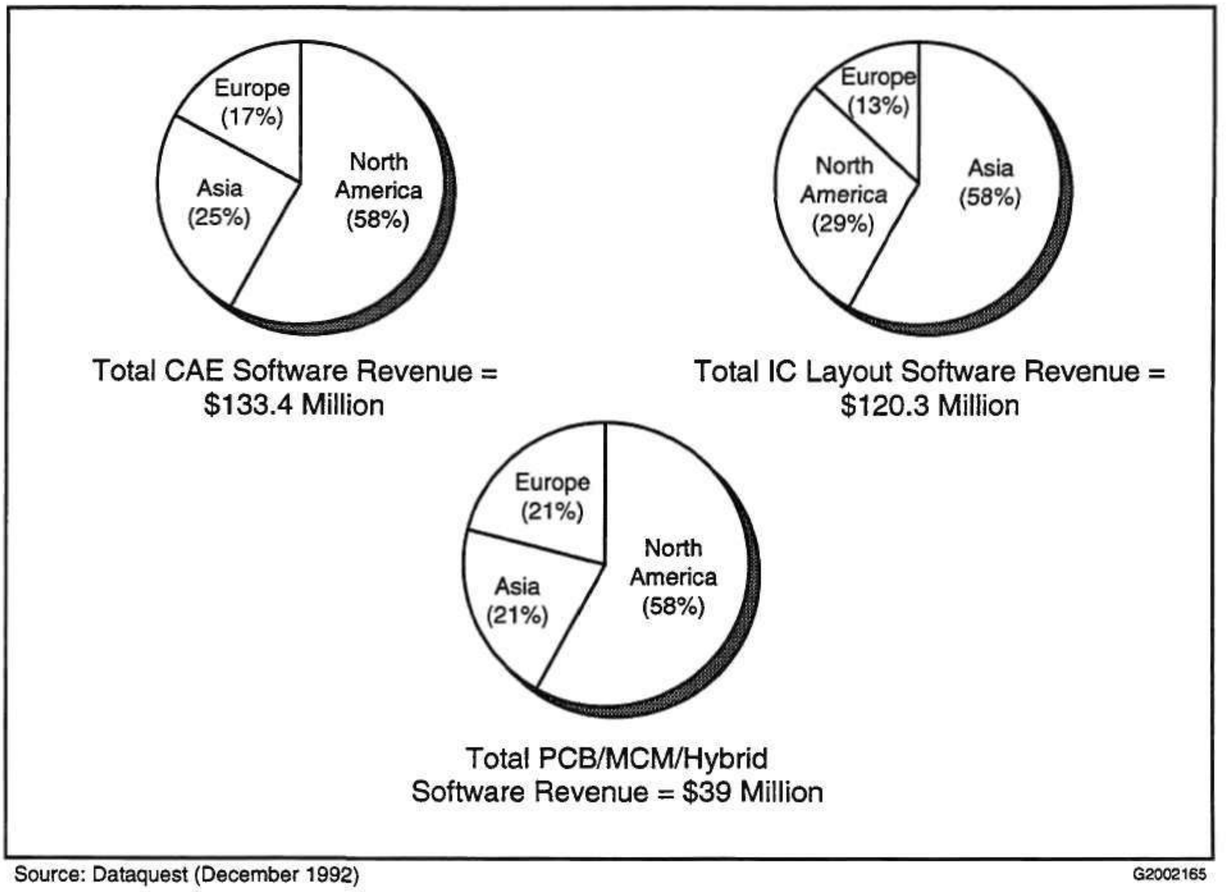
Source: Dataquest (December 1992) G2002163

Figure 4
Cadence 1991 Worldwide Software Revenue Percent by Market



Source: Dataquest (December 1992) G2002164

Figure 5
Combined Cadence/Valid 1991 Software Revenue by Market and Region



Source: Dataquest (December 1992) G2002165

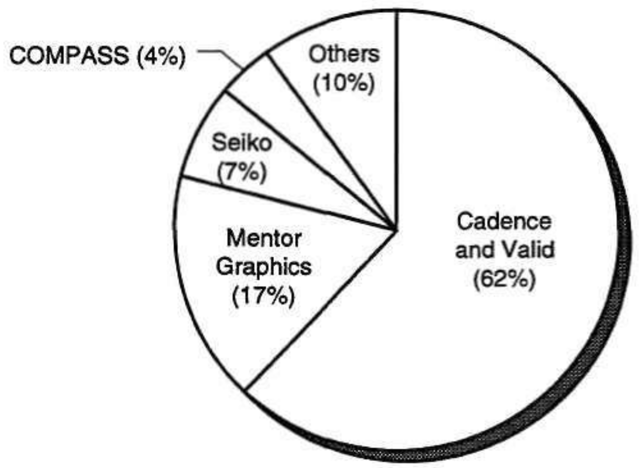
CAE Penetration Has Highs and Lows, with Verilog Leading the Way

Cadence made its big leap into the CAE market with its 1989 acquisition of Gateway Design Automation. The jewel Cadence was after was the Verilog-XL simulator, a simulator that today still is the de facto standard in mixed-level simulation. However, this powerful weapon in the Cadence arsenal has come under attack in two areas.

The first area is the emergence of the VHSIC hardware description language (VHDL). This rival hardware description language (HDL) and mixed-level simulators based upon its use have begun to erode Verilog's market share.

The second factor that will affect Verilog sales is the birth of the Verilog-clone simulation market. As part of Cadence's battle plan against VHDL, it created Open Verilog International (OVI) as an industry body to evolve the Verilog HDL into a true industry standard, as opposed to a proprietary, de facto standard. As a by-product of this effort, we are now beginning to see Verilog-based

Figure 6
1991 Worldwide IC Layout Software Market Share



Source: Dataquest (December 1992) G2002166

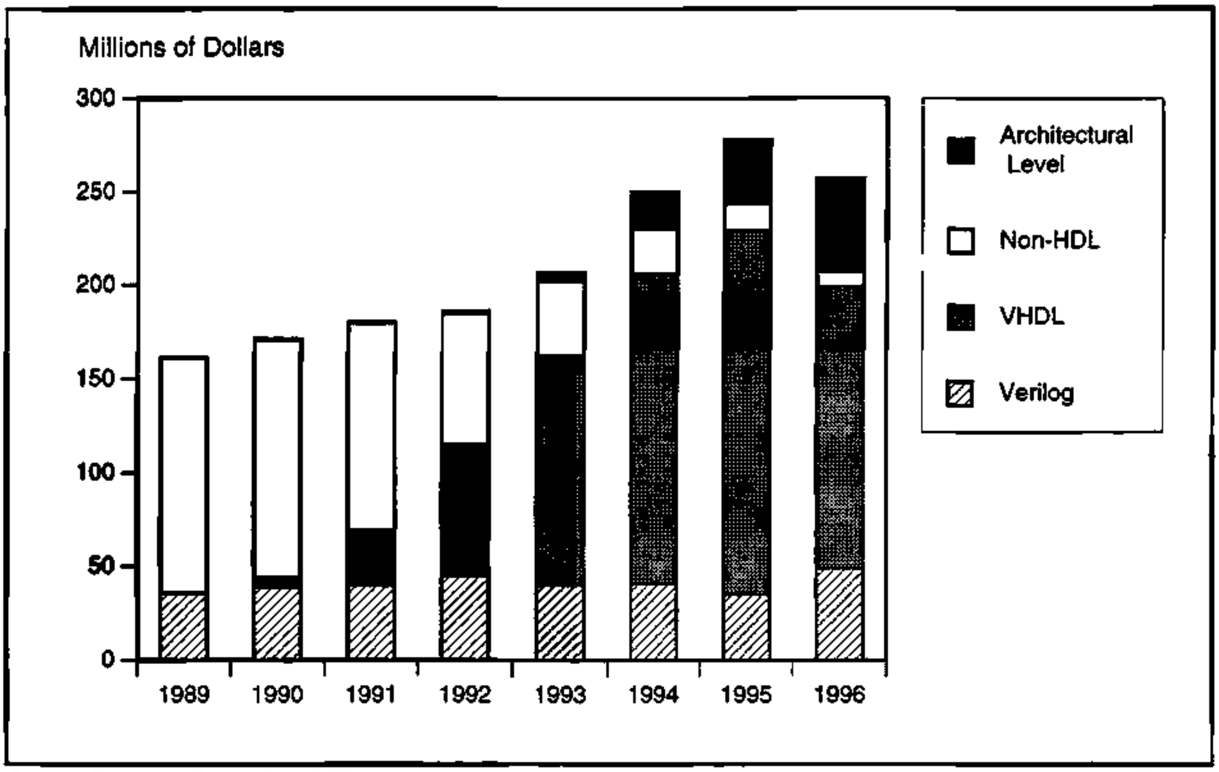
simulators from other companies. Dataquest believes that these new simulators will provide a mid-life extension to the Verilog market; however, it may also decrease the average selling prices (ASPs) of Verilog-based simulators. Based upon these factors and end-user research showing a coming tide of VHDL use, Dataquest anticipates that sales of Verilog-based simulators will stagnate over the coming years, whereas VHDL-based simulators will be more broadly accepted by the mainstream designer (see Figure 7).

Other design verification tools are critical to Cadence's future success. The company has not ignored the VHDL phenomenon and has recently announced a VHDL initiative to help standardize VHDL models for use in a variety of VHDL-based simulators—a vexing problem facing ASIC suppliers. While Cadence has had a VHDL simulator—the VHDL-XL—the product has not received the same attention that its Verilog-XL counterpart has. Look for this to change as Cadence adopts to user's demands and more fully supports VHDL.

Synthesis May Be a Weak Chink in the Cadence Armor

Logic synthesis is the pivotal point tool in the top-down design methodology that is being adopted by the mainstream electronic designer. Synopsys is the one company that has pioneered this productivity-enhancing technology. The combination of the Synopsys synthesis tool with Cadence's Verilog-XL simulator has been a favorite for ASIC designers for some time now. But Synopsys is distancing itself from Cadence, and these once-symbiotic partners now treat each other as competitors. Cadence introduced its own synthesis tools, Synergy, while Synopsys acquired a VHDL simulator from ZYCAD and is now focusing on a VHDL-based top-down

Figure 7
Historical and Projected Growth of Worldwide Software Simulation Market



Source: Dataquest (December 1992)

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design to further differentiate itself from Cadence. It may be quite difficult for Cadence to gain market share in this technically demanding area of logic synthesis.

Attempting to build upon its Verilog strength, Cadence has generated its own front-end design entry system called Composer. In addition, Cadence has generated PLD design tools and other design verification tools. These products are not necessarily "lead" products that drive sales; rather they are "drag" products that are brought along to fill out the solution for the electronic designer. Cadence will look to its strength in Verilog simulation to evolve into a more potent VHDL-based CAE product offering.

PCB Design Tools Complete the Circle

To become the largest supplier of EDA tools, Cadence had the vision to seek out new areas of expansion. While it never had a presence in the printed circuit board (PCB) design area, it sought to acquire this expertise. Its first attempt was to purchase ASI, a PCB production house that had its own internal set of PCB design tools. Unfortunately this strategy proved to be unsuccessful, and after this misstep, Cadence set its sights on larger game. Cadence's weakness in PCB design tools led to its merger with Valid, which had a growing business in PCB design with its Allegro tool set. Cadence's challenge is to keep the momentum of the Allegro tool set while integrating it into the Cadence set of framework and entry tools.

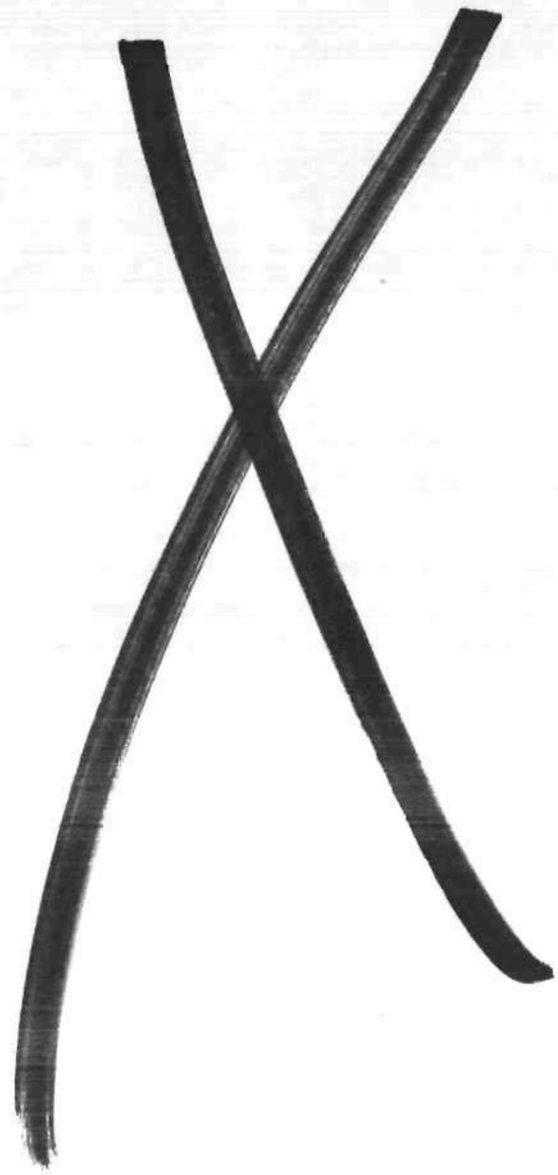
Dataquest Perspective

Cadence is now clearly a master of its own destiny. The vision of becoming the largest supplier of EDA tools has been successfully accomplished by external acquisition and skillful integration and sales. However, Dataquest believes that Cadence's largest challenge is still before it. The EDA market is littered with those who had been No. 1 but who had failed to stay on top due to missed execution or lack of forward thinking. Cadence must base its coming evolution upon the following strengths:

- Technology holding, with a superb portfolio of point tools
- IC design dominance
- Strong field sales and support organization

Software technology has a short shelf life, and Cadence must successfully integrate outstanding point tools into integrated solutions for its customers. It must do so while avoiding the pitfalls of its largest competitor and last year's EDA king-of-the-hill, Mentor Graphics. Cadence's continued success is based upon its ability to do the following:

- Evolve an integration strategy without causing widespread customer disruption
- Use selected technology partnerships to further enhance point tools
- Avoid focusing on internal structural and political battles
- Develop, partner with, and/or acquire new best-of-breed technology to keep the coming generation of start-up companies at bay
- Articulate its vision of the next generation of EDA



Dataquest Vendor Profile

Semiconductors *Japan*
December 28, 1992

Fujitsu Limited

Corporate Statistics

Address	Fujitsu Limited 6-1, Marunouchi 1-chome, Chiyoda-ku, Tokyo 100
Telephone	81-3-3216-3211
Facsimile	81-3-3213-7174
Chairman of the Board	Takuma Yamamoto
President and CEO	Tadashi Sekizawa
Established	1935
Number of Employees	155,779 (as of March 31, 1992)
Total Sales	¥3,442 billion (FY1991)
Net Income	¥12 billion (FY1991)
Total Assets	¥3,992 billion (FY1991)
Main Product Area	Computers and Information Processing Systems Communications Systems Electronic Devices Other Operation

Corporate Overview

Fujitsu was originally established as Fuji-Tsushinki K.K. in 1935. As a spin-off from Fuji Electric, the initial charter of the company was to market telephone products, including set-and-exchange equipment, through sales and manufacturing arrangements with other companies. In 1951, Fujitsu began producing data processing equipment—which subsequently led, three years later, to the company's entry into the business of fabricating semiconductor devices. In 1967, the company was renamed Fujitsu Limited.

For more information on Fujitsu Limited or the semiconductor industry, call Junko Matsubara at (408) 437-8572.

Fujitsu is associated with the Furukawa group of companies, which itself is one of three subdivisions of the Dai-ichi Kangyo Bank (DKB) group. As a member of the DKB keiretsu, Fujitsu has close ties to

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financial institutions that can provide the company with banking services, business advice, and introductions to other keiretsu manufacturers.

Fujitsu has 367 consolidated subsidiaries worldwide and 248 subsidiaries operating outside of Japan.

Corporate Business: Trends and Climate

Fujitsu's consolidated revenue recorded ¥3,442 billion in fiscal year (FY) 1991 (see Table 1). This translated to a 15.8 percent growth rate over the previous year's revenue and gave Fujitsu the highest expansion rate among the top 10 Japanese electronics companies during FY1991. Fujitsu's historical revenue trend is plotted in Figure 1. Although total sales reached a peak in FY1991, net income declined by 85.2 percent to ¥12 billion, marking the lowest net gain in a decade of the company's most recent history. The company attributed the drop in profits to the slowdown in demand for both semiconductor and telecommunications products worldwide.

Fujitsu, like nearly all Japanese industries, began suffering the effects of the collapse of Japan's bubble economy in the second half of 1991. Sustaining gross revenue and market share at the expense of net income has become a hallmark of the Japanese business methodology.

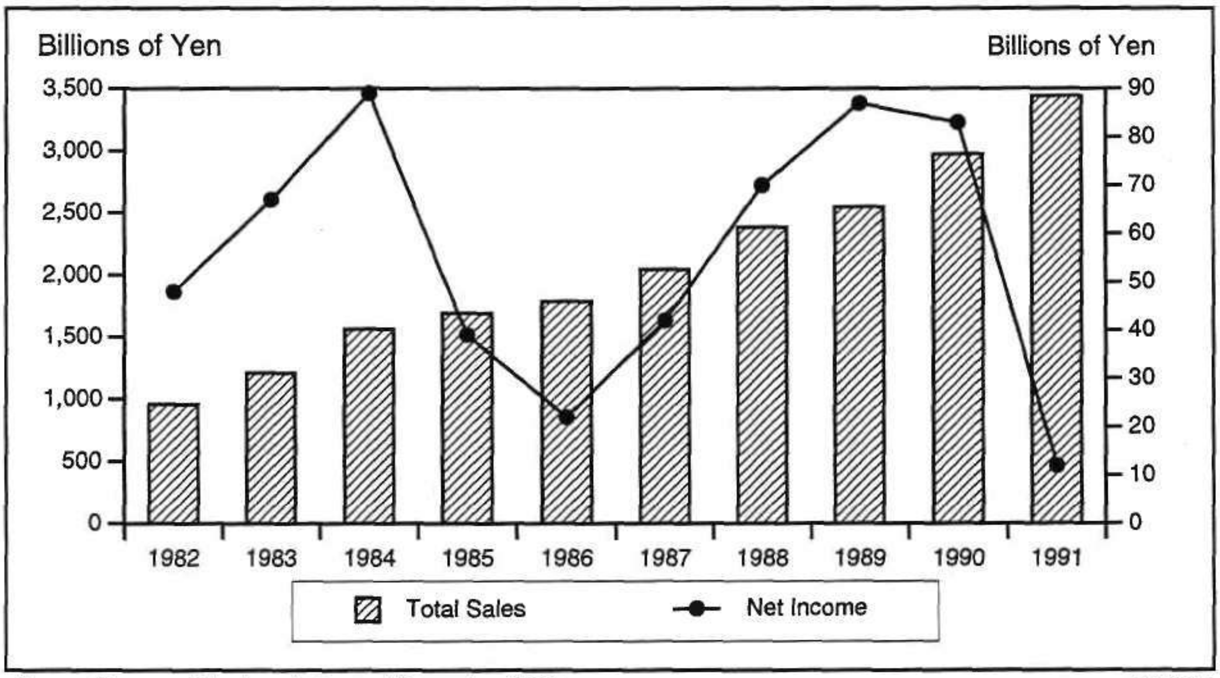
In Fujitsu's implementation of this strategy, rapid adjustments to trends that most affected the company's core systems businesses have allowed the company to remain in the black for the fiscal year. The impending trends that are perceived as most important to Fujitsu's

Table 1
Fujitsu Limited Sales, by Product Segment and Market (Billions of Yen)

Fiscal Year	1987	1988	1989	1990	1991
Computers and Information Processing Systems	1,372	1,579	1,690	2,056	2,511
Communications Systems	325	375	394	442	445
Electronic Devices	256	334	357	349	349
Other Operations	94	99	109	125	138
Total	2,047	2,387	2,550	2,971	3,442
Domestic Market	1,594	1,859	1,941	2,233	2,415
Percentage of Total Revenue	77.9	77.9	76.1	75.2	70.2
Overseas Market	453	528	609	738	1,027
Percentage of Total Revenue	22.1	22.1	23.9	24.8	29.8
Fiscal Year Exchange Rate (¥=U.S.$1)	138	128	142	141	133

Note: Some columns do not add to totals shown because of rounding.
Source: Company Literature, Dataquest (December 1992)

Figure 1
Fujitsu Limited Total Revenue and Net Income



Source: Company Literature, Dataquest (December 1992)

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primary businesses are the move toward downsized-networked systems based on open hardware and software platforms.

To cope with these trends, Fujitsu has instituted new policies and businesses strategies. Some of the aspects of these new policies that may have helped Fujitsu in 1991 were the emphasis on providing new software and service products. The integration of these software and service solutions, while promoting open architectures, may have contributed to the strong domestic sales of Fujitsu's line of large-scale general-purpose mainframe computers during the year. These computer systems have embraced an open UNIX environment as well as Fujitsu's existing operating system, which is becoming an increasingly "open" or user-influenced platform. The continued application of partnerships has also helped in the overseas market performance of Fujitsu systems.

Business Structure

Fujitsu divides its operation into four major sectors: Computers and Information Processing Systems, Communications Systems, Electronic Devices, and Other Operations. Among the four divisions, the Computers and Information Processing Systems grew 22.1 percent and accounted for 73 percent of FY1991 revenue. This heavy emphasis on systems has given Fujitsu the distinction, among horizontally diversified Japanese competitors, of being primarily a business machine supplier, along the lines of an IBM. Unlike other major Japanese companies, Fujitsu does not produce a significant amount of consumer electronics products. Instead, Fujitsu has elected to focus on premium electronics markets for such items as supercomputers, telecommunications equipment, and semiconductors.

While the Information Processing arm of its business grew substantially, Fujitsu's Communications, Electronic Devices, and all other operations saw negligible growth. The Electronic Devices part of Fujitsu's business actually contracted slightly during the year. Although this segment accounts for only 10.1 percent of Fujitsu's corporate revenue, the company's primary products, such as its extensive lines of computers and communications equipment, are heavily dependent on the in-house semiconductor manufacturing technology provided by the Electronic Devices group. Thus, the welfare of its Electronics Devices division has critical impact on the company's ability to leverage technical competitive advantage and obscures the group's immediate contribution to the company's revenue stream.

Multinational Profile

In FY1991, 29.8 percent of Fujitsu revenue was generated in overseas markets. Over the past five years, Fujitsu has gradually increased its revenue from overseas markets, with 1991 recording the highest levels of foreign market sales during the five-year period.

Fujitsu's major overseas growth is occurring in the European markets. This growth can be traced to the company's increased investments in that part of the world. In particular, the high-visibility acquisition and merger with ICL in November 1990 immediately increased Fujitsu's systems customer base and visibility in Europe. This relationship between ICL and Fujitsu has since yielded several new products, including some SPARC-based systems, ranging from mainframe computers to small network servers. In addition, extensive sales and marketing ventures have been jointly financed by Fujitsu and ICL in North America, Australia, and Europe. These efforts have resulted in improvements to Fujitsu's retail market shares in North America and to its business segment performance in Europe and Australia.

Fujitsu has also invested in semiconductor manufacturing capacity in Europe. Its latest venture involved a ¥90 billion investment to its Durham plant in England, which began producing 4Mb DRAM parts in September 1991 for consumption in the European Community (EC).

Although overall corporate sales to the Asia/Pacific region have increased only slightly during the last few years, this region is a stable consumer of Fujitsu's telecommunications products. During 1991, orders for switching systems continued to arrive from the People's Republic of China, Singapore, and Hong Kong; and optical transmission hardware has been purchased to link Japan, Taiwan, Hong Kong, Malaysia, and Singapore. Fujitsu has also just begun marketing its ultracompact cellular telephone units—which have sold well in both Japan and the United States—in Asian markets. With renewed awareness of the need to establish software products on open platforms, Fujitsu has recently established a joint venture in the People's Republic of China to develop software applications to run under UNIX.

The recession in the United States has been the main cause of Fujitsu's slow decline in annual sales to North America since FY1989. This has occurred in spite of the numerous alliances Fujitsu has formed with U.S. companies and the substantial presence of its subsidiaries located in the United States.

Corporate Investment

During FY1991, Fujitsu invested ¥392 billion, or about 11.4 percent of its total corporate sales, in R&D activities (see Table 2). This yen-based expenditure approached the 1991 R&D investment of Matsushita, a company with revenue more than double that of Fujitsu. The steady increase in Fujitsu's R&D costs over the past several years has caused its corporate-level R&D-to-sales ratios to far surpass the ratios exhibited by the other top 10 Japanese electronics companies. These high levels of R&D have allowed Fujitsu to produce leading-edge semiconductor components, as well as field high-performance computer and telecommunications systems. Fujitsu conducts R&D activities at two facilities that are part of the Fujitsu Laboratory, which became an independent subsidiary of Fujitsu in 1968.

Fujitsu's capital spending levels have also exceeded the levels of most of its competitors. Although Toshiba spent roughly the same percentage of its total revenue on capital spending during 1991, Fujitsu has maintained these higher, double-digit capital spending and R&D levels for the past four years. Furthermore, most competitors, such as NEC and Hitachi, actually reduced the magnitude of their capital spending during 1991. Like Toshiba, Fujitsu continues to invest heavily in semiconductor technology with most of FY1991 capital spending being applied toward ramp-up of the Durham facility, increased production capacity at the Yamanashi GaAs LSI plant, and expansion of a semiconductor research facility.

Table 2
Fujitsu Limited Investment: Capital Spending and R&D (Billions of Yen)

Fiscal Year	1987	1988	1989	1990	1991
Total Revenue	2,047	2,387	2,550	2,971	3,442
Capital Spending	167	254	301	315	351
Percentage of Total Revenue	8.2	10.6	11.8	10.6	10.2
R&D Spending	190	247	299	330	392
Percentage of Total Revenue	9.3	10.3	11.7	11.1	11.4

Source: Company Literature, Dataquest (December 1992)

Financial Condition and Analysis in FY1991

Tables 3 and 4 show a cross section of Fujitsu's consolidated balance sheet and income statements, respectively. Total sales in FY1991 reached a record high of ¥3,442 billion, a 15.8 percent increase over the previous year's figure. However, net income declined by a steep 85.2 percent to a mere ¥12 billion.

The decline of net income and profitability occurring during 1986 and 1991 are common dips in the revenue histories of all major electronics firms in Japan. For most Japanese electronics companies, FY1991

Table 3
Fujitsu Limited Consolidated Balance Sheet (Billions of Yen)

Japanese Fiscal Year	1987	1988	1989	1990	1991
Total Current Assets	1,355	1,458	1,647	2,080	2,155
Cash	119	156	134	188	251
Marketable Securities	214	173	160	245	176
Receivables	503	592	737	866	897
Inventory	463	479	586	711	750
Other Current Assets	56	58	30	69	81
Long-Term Receivables and Investment	366	460	495	554	573
Net Property, Plant, and Equipment	592	703	826	981	1,086
Other Assets	4	4	4	123	177
Total Assets	2,317	2,625	2,971	3,737	3,992
Total Current Liabilities	974	1,101	1,283	1,686	1,653
Long-Term Debt	445	485	513	778	1,027
Minority Interest	70	78	90	114	146
Total Liabilities	1,490	1,664	1,886	2,578	2,826
Total Shareholders' Equity	827	961	1,085	1,159	1,165
Common Stock	169	194	216	221	222
Additional Paid-In Capital	296	352	387	393	395
Retained Earnings	350	402	466	528	529
Other Equity	13	14	16	17	19
Total Liabilities and Shareholders' Equity	2,317	2,625	2,971	3,737	3,992
Fiscal Year Exchange Rate (¥ = U.S.$1)	138	128	142	141	133

Note: Some columns do not add to totals shown because of rounding.
Source: Company Literature, Dataquest (December 1992)

Table 4
Fujitsu Limited Consolidated Income Statement
(Billions of Yen)

Japanese Fiscal Year	1987	1988	1989	1990	1991
Net Sales	2,047	2,387	2,550	2,971	3,442
Domestic Sales	1,594	1,859	1,941	2,233	2,415
Overseas Sales	453	528	609	738	1,027
Cost of Goods Sold	1,339	1,528	1,578	1,821	2,120
Selling, General, and Administrative Expense	588	674	776	937	1,185
Operating Income	120	186	195	214	137
Operating Income Margin	5.8	7.8	7.7	7.2	4.0
Other Income	15	16	18	28	29
Interest	9	14	16	26	27
Others	6	2	2	2	2
Other Expenses	29	47	43	88	125
Interest	29	32	39	66	91
Others	0	14	4	22	34
Income before Income Taxes	106	155	170	154	42
Effective Tax Rate (%)	56	56	54	52	52
Income Taxes	73	97	99	91	32
Income after Income Taxes	33	58	71	62	10
Equity in Income of Unconsolidated subsidiaries	13	19	21	24	9
Minority Interests and Others	3	6	6	3	7
Net Income	42	70	87	83	12
Fiscal Year Exchange Rate (¥ = U.S.$1)	138	128	142	141	133

Note: Some columns do not add to totals shown because of rounding.
Source: Company Literature, Dataquest (December 1992)

yielded lower profitability, which is equivalent to net income divided by total sales, than achieved in FY1986. This occurred despite the fact that net income magnitudes were generally higher in FY1991 than in FY1986.

In Fujitsu's case, however, both profitability and net income were lower in FY1991 than in FY1986. This gave Fujitsu the appearance of a lower financial performance than most of its Japanese competitors. In reality, the source of the sag in performance was the higher semiconductor capital spending and R&D levels that reflect Fujitsu's apparent confidence in the recovery of those markets. Although other Japanese companies may or may not share this confidence, they have followed more conservative budgeting schedules for the year. Thus, Fujitsu's lower income rate appears to be more attributable to a conscious decision to invest, perhaps based on optimistic forecasts for a semiconductor market recovery, than to falling sales or a lack of cost control.

Several Japanese electronics companies, such as Hitachi and Matsushita, have a return on sales ratio, which is equal to earnings before taxes divided by net sales, that regularly exceeds their corresponding operating income margin, which is equal to gross operating income divided by net sales. This effect is usually attributable to a company's having surplus income, such as from stock dividends and funds generated from ventures outside of its primary businesses, that have offset its annual debt payments. Fujitsu's external income is relatively insignificant compared with Japanese electronics firms of roughly the same size, such as NEC. Hence, Fujitsu's debt payments typically exceed its supplementary income by a factor of 2. Although Fujitsu's capital-intensive semiconductor operations and 1990 acquisition of a majority stake in ICL required increasing its debt level, Fujitsu has still managed to have reasonable financial ratios by Japanese standards.

Table 5 summarizes some key figures, which represent Fujitsu's financial status, and compares them with those of NEC and Toshiba's for the FY1991 period. From this table, it is clear that Fujitsu's solvency displayed a discrete discontinuity, as measured by its elevated debt-to-equity ratio, following the 1990 investment in ICL. Yet, even with this higher level of insolvency, Fujitsu remained less debt-laden than either NEC or Toshiba, again measured by their respective debt-to-equity ratios. Although Japanese accounting practices have often been viewed with skepticism by U.S. companies, the long-term safety—or debt-to-equity figure—would seem to be a relatively standard calculation that should facilitate comparisons among companies in different countries.

Japanese electronics companies typically can remain stable and liquid with smaller current and quick ratios than their U.S. counterparts can. Although not as conservative as Hitachi, Fujitsu maintains liquidity ratios that are generally higher than either NEC or Toshiba—which are companies of comparable size that also invest heavily in semiconductor manufacturing, particularly in commodity DRAM capacity.

Many large corporations in Japan have large blocks of their stocks owned by financial institutions that belong to a particular family of companies, otherwise known as a keiretsu group. A paradox of such groupings, however, is that often a company will have members of competing keiretsu as major stockholders. To illustrate this point Dataquest notes that Hitachi, Toshiba, and NEC have major stockholders that are members of the Mitsubishi, Mitsui, Sumitomo, and Dai-ichi keiretsu. And Fujitsu is no exception to the multiple-keiretsu influence, where, as shown in Table 6, 13.5 percent of Fujitsu's stock remains in the hands of its original parent company, Fuji Electric. Although this may seem to be a large voting block, the Sumitomo group's influence over NEC is substantially higher. Nearly one-quarter (24.3 percent) of Fujitsu's stock is owned by individual investors, and foreigners own 9.3 percent of the company.

Table 5
Fujitsu Limited Financial Ratios Compared with NEC and Toshiba

	1987	1988	1989	1990	1991	NEC	Toshiba
Total Sales (¥B)	2,047	2,387	2,550	2,971	3,442	3,774	4,722
Net Income (¥B)	42	70	87	83	12	15	39
Total Assets (¥B)	2,317	2,625	2,971	3,737	3,992	4,081	5,724
Operating Income Margin (%)	5.9	7.8	7.7	7.2	4.0	3.2	2.5
Net Income/Total Sales (%)	2.1	2.9	3.4	2.8	0.4	0.4	0.8
Foreign Sales/Total Sales (%)	22.1	22.1	23.9	24.8	29.8	21.0	29.1
Corporate R&D/Total Sales (%)	9.3	10.3	11.7	11.1	11.7	8.0	6.7
Semiconductor Sales* (¥B)	259	339	382	374	368	649	623
Semiconductor Sales/Total Sales (%)	12.7	14.2	15.0	12.6	10.7	17.2	13.2
Sales/Employee (¥M)	21.585	22.846	22.170	20.370	22.095	29.410	28.109
Net Income/Employee (¥M)	0.444	0.669	0.754	0.567	0.078	0.119	0.235
Growth Rate							
Total Sales (%)	14.4	16.6	6.8	16.5	15.8	2.0	0.6
Net Income (%)	94.9	66.1	24.0	-4.7	-85.2	-71.9	-67.3
Financial Ratios							
Current Ratio	1.39	1.32	1.28	1.23	1.30	1.19	1.23
Quick Ratio	0.94	0.89	0.83	0.81	0.85	0.76	0.81
Sales/Net Working Capital	5.37	6.69	7.01	7.54	6.86	9.88	7.04
Net Working Capital/Total Assets	0.16	0.14	0.12	0.11	0.13	0.09	0.12
Debt-Equity Ratio	0.54	0.50	0.47	0.67	0.88	1.30	1.24
Total Asset Turnover	0.88	0.91	0.86	0.80	0.86	0.92	0.82
Return on Sales (%)	5.2	6.5	6.7	5.2	1.2	1.4	2.4
Return on Asset (%)	4.6	5.9	5.7	4.1	1.0	1.3	2.0
Return on Equity (%)	5.1	7.3	8.0	7.2	1.1	1.7	3.3
Earning per Share (¥)	19.38	29.53	37.08	45.17	18.81	25.17	13.22
Payout Ratio	0.41	0.30	0.24	0.22	0.53	0.40	0.76

*Semiconductor sales estimated for a calendar year.
Source: Dataquest (December 1992)

Table 6
Fujitsu Limited Top 10 Shareholders

Shareholders	Share (%)
Fuji Electric	13.5
Asahi Life Insurance	6.5
Dai-ichi Kangyo Bank	4.6
Sumitomo Trust & Banking	2.8
Industrial Bank of Japan	2.3
Mitsubishi Trust & Banking	2.3
Toyo Trust & Banking	1.8
Nippon Life Insurance	1.8
Asahi Bank	1.6
Sakura Bank	1.5

Source: Company Literature, Dataquest (December 1992)

Semiconductor Climate of 1991

Worldwide semiconductor sales totaled $59.7 billion in 1991, which exceeded the previous year's sales by 9.4 percent. The Japanese market comprised 37.7 percent of the global 1991 market, with $22.5 billion in sales, and continued to make Japan the single largest region for chip consumption. Japanese semiconductor consumption has grown 11.1 percent during the past year. The Japanese market expanded by a slight 0.6 percent, relative to the world market, during a one-year period.

In terms of suppliers, Japan's 46.4 percent share of the 1991 global market nearly matched the 1990 figure of 46.3 percent. Asia/Pacific ROW suppliers made market share gains at the expense of North American and European companies.

The Japanese companies continued their dominance of the DRAM market, led by Toshiba, but lost some market share to Korean companies. Samsung moved to the No. 2 position, trailing only Toshiba, in terms of volume of commodity DRAMs products shipped. Fujitsu was the No. 7 leading supplier of DRAMs to world markets. U.S.-based semiconductor companies lost worldwide share; however, many of these companies continued to lead the world in microprocessors and design-intensive ASIC/ASSP chips.

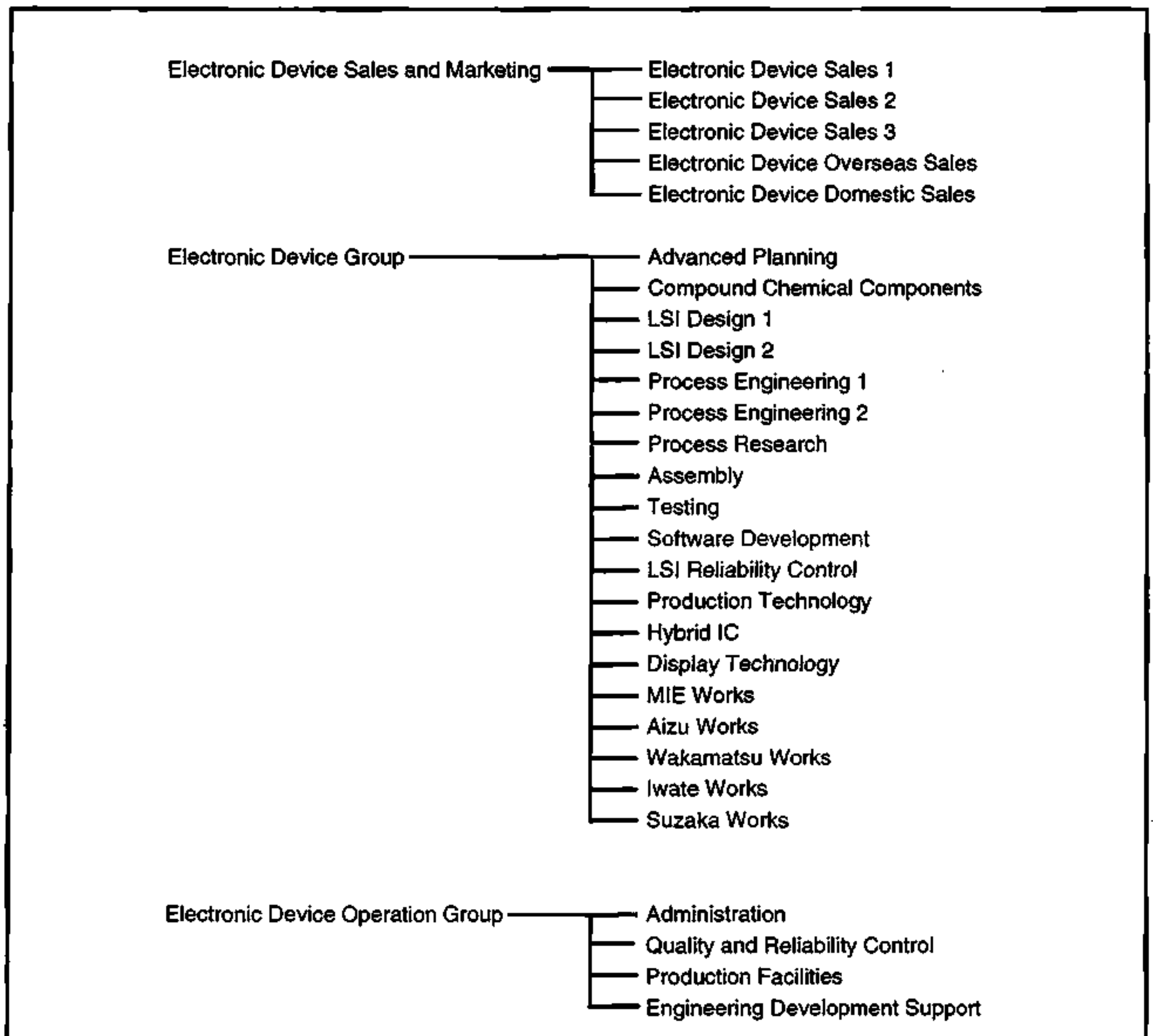
Fujitsu Semiconductor Overview

According to Dataquest's semiconductor market share estimates for 1991, Fujitsu recorded $2,705 million in semiconductor revenue, qualifying the company as the seventh largest in the worldwide semiconductor business. In Japan's domestic market, Fujitsu captured the No. 4 position trailing NEC, Hitachi, and Toshiba. Total annual semiconductor sales declined by a small amount as compared with the previous year's totals.

Figure 2 is an organization chart of Fujitsu's semiconductor-related operations.

Fujitsu is a substantial supplier of all types of silicon-based semiconductors, including commodity memories and microcomponents, as summarized in Table 7 and charted in Figure 3. However, the feature that most differentiates Fujitsu from its chip-producing Japanese competitors is the degree of investment in compound semiconductor technology. Although revenue from GaAs components is modest relative to that from silicon devices, Fujitsu's commitment to the development of GaAs components at all levels of integration is remarkable. Given the company's strength in systems-level, high-frequency

Figure 2
Fujitsu Semiconductor Organization



Source: Fujitsu Limited

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Table 7
Estimated 1991 Fujitsu Ranking, by Product Segment

	Worldwide Market	Japanese Market
Total Semiconductor	7	4
Total Integrated Circuit	7	3
Bipolar Digital	2	1
MOS	6	3
MOS Memory	5	3
MOS Microcomponents	11	7
MOS Logic	3	2
Analog	20	9
Total Discrete	16	8
Total Optoelectronics	8	8

Source: Dataquest (December 1992)

telecommunications products and high-end computers, GaAs technology development has been a logical, if somewhat risky, addition to Fujitsu's technology base.

However, Fujitsu seems to have already proven to itself the feasibility of the various GaAs-device technologies that it intends to use. These technologies include high-electron-mobility transistors (HEMT), heterojunction bipolar transistors, and field-effect transistors (FET). The HEMT devices have already been employed in various telecommunications applications including satellite broadcasting receivers and a prototype of an ultrahigh-speed asynchronous transfer mode switching module capable of switching 640 Gbps.

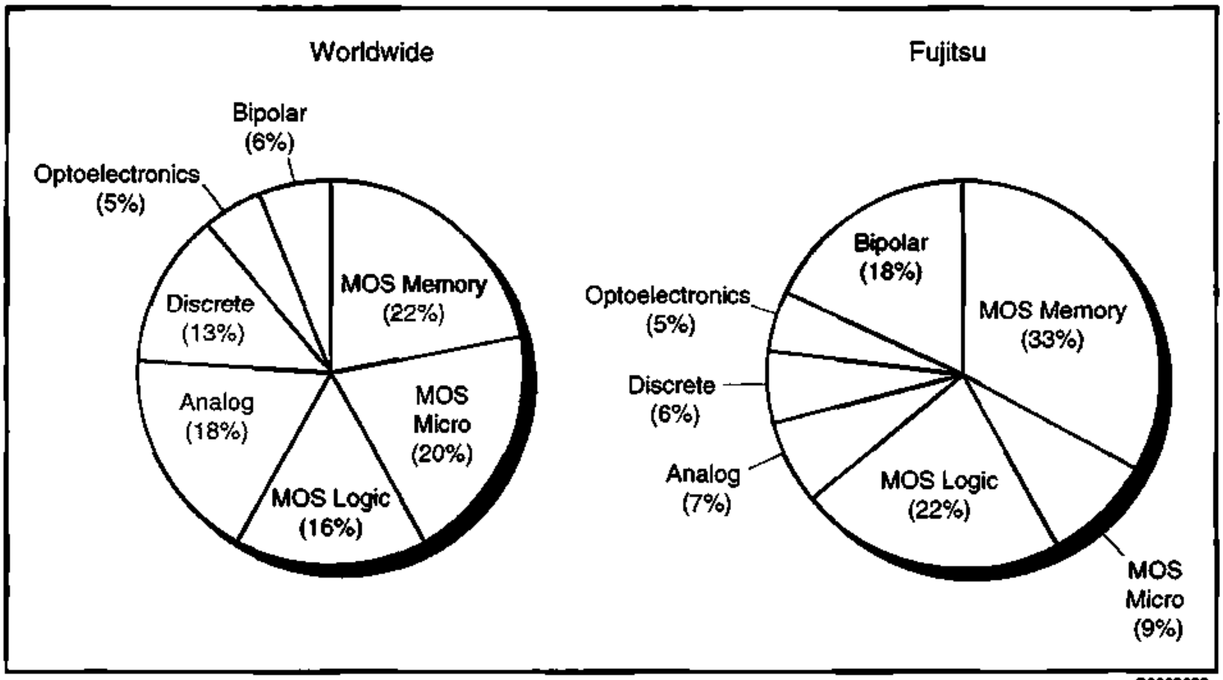
Product Strategy

Figure 3 illustrates the Fujitsu semiconductor product mix revenue and the worldwide product mix revenue recorded in 1991. Fujitsu is a healthy contender in MOS memories, MOS logic, and bipolar markets. In contrast, although Fujitsu captured about 27.7 percent of the market for SPARC RISC microprocessors in 1991, this market was so small that Fujitsu managed only a 0.4 percent share of the world microprocessor market, which translated to a world ranking of No. 17 among microprocessor suppliers. Fujitsu received more than seven times more revenue from selling microcontrollers than it did from sales of its microprocessors in 1991.

As a broad-line computer and telecommunications supplier, Fujitsu has excelled in memory and logic markets both to supply its own internal needs and to further develop competitive advantage for its own system-level products. Strong silicon ECL, CMOS, and BiCMOS—as well as GaAs FET, HEMT, and bipolar—fabrication capabilities have been grown to maturity at Fujitsu.

And the degree to which Fujitsu leverages these technologies in its own computer and telecommunications products appears to be

Figure 3
1991 Semiconductor Market Share Product Mix: Worldwide versus Fujitsu



Source: Dataquest (December 1992)

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increasing relative to its competitors. The high R&D investment levels sustained by Fujitsu for a number of years have made several experimental technologies positioned to make major returns on investments. Although the company's research in superconducting electronics may not yield commercial products in the foreseeable future, its GaAs efforts have resulted in the world's largest GaAs LSI manufacturing plant, built at Fujitsu's Yamanashi site.

The high-performance devices built at Yamanashi will include FET, HEMT, and heterojunction bipolar LSI circuits. Gate arrays with densities of 45K gates and 64Kb SRAM have been constructed in the GaAs HEMT technology. Optoelectronic and experimental quantum-well device structures will also be fabricated at Yamanashi. Circuits from Yamanashi have already been delivered to workstation and supercomputer manufacturers, with Cray Computer Corporation having been a past GaAs customer of Fujitsu.

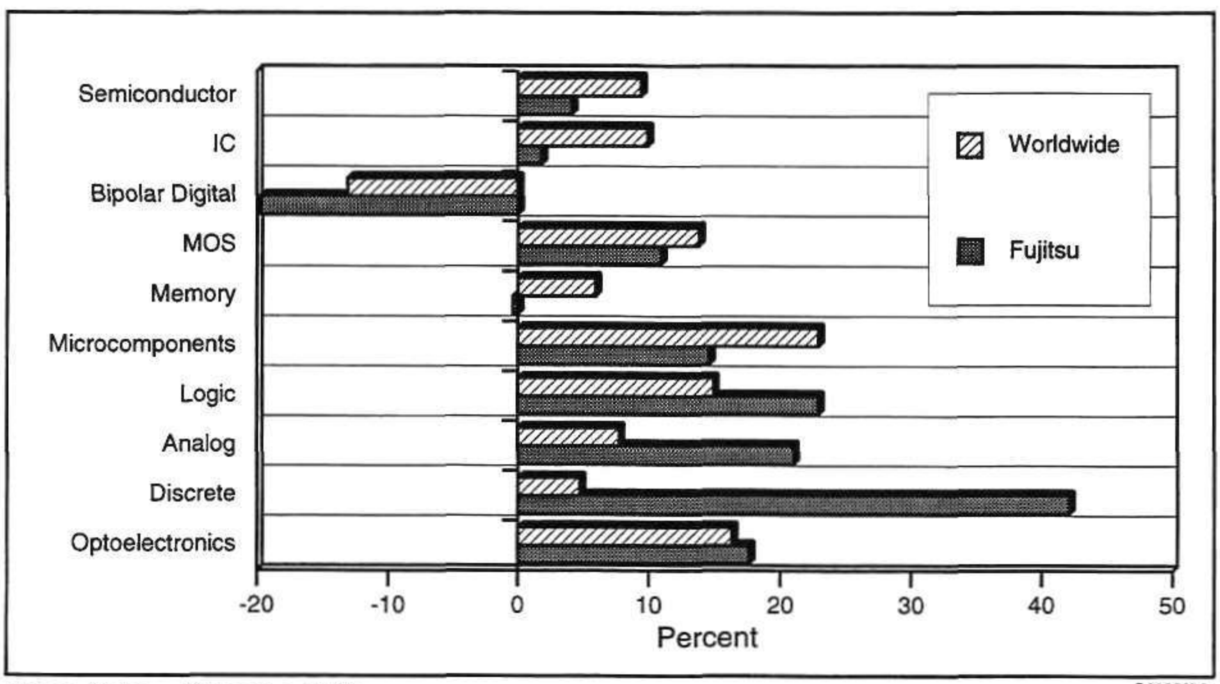
Although the anticipated potential of GaAs technology has not yet been realized, primarily because of the unexpected difficulties of working with compound semiconductors, Yamanashi does seem to have the potential to give Fujitsu a real advantage in telecommunications and high-end computer systems. Furthermore, GaAs technology at-large does appear to be reaching a commercially competitive stage as evident from the growing number of sockets that GaAs IC products are filling. Many GaAs vendors have found success by "tuning" their products into a competitive speed-power dissipation combination to match the needs of various niche applications as opposed to marketing GaAs products purely on the basis of optimum speed.

Figure 4 compares Fujitsu's semiconductor growth rates, by product category, against corresponding product growth rates on the world market for FY1991. Fujitsu captured market share in global markets for logic, analog, discrete, and optoelectronic devices. Brisk sales of a line of discrete and analog GaAs devices for applications in cellular telephones and broadcasting receivers have helped advance Fujitsu's revenue in these market segments. Sales of logic devices were also helped by the introduction of several new high-performance CMOS and BiCMOS gate arrays, as well as ASICs built around a microcontroller.

Fujitsu's 4Mb DRAM facility in Durham came online too late in the year to have had an impact on the 4Mb market, which is beginning to expand. This facility is poised to take advantage of the expected rise in demand for 4Mb parts as memory-intensive graphical interface operating systems continue to gain in popularity in the EC, as they already have in the United States. The Durham plant will complement a Fujitsu Telecommunications VLSI Laboratory in London, which was established in June 1990. Researchers at the London facility will develop semiconductors to meet local demand in telecommunications applications throughout the EC.

Table 8 provides Fujitsu's semiconductor revenue by product segment for the past five years.

Figure 4
Fujitsu's 1991 Growth Rate Compared with Worldwide Market



Source: Dataquest (December 1992)

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Table 8
Estimated Worldwide Semiconductor Revenue, by Product
(Billions of Yen)

Calendar Year	1987	1988	1989	1990	1991	1991 Market Share (%)
Total Semiconductor	259.3	338.9	382.3	374.3	367.9	4.5
Total Integrated Circuit	239.0	314.6	353.7	343.3	329.9	5.0
Bipolar Digital	71.3	84.9	81.4	91.3	69.2	14.0
TTL/Others	33.6	41.2	34.8	39.2	27.3	7.9
ECL	37.7	43.7	46.6	52.1	41.9	28.4
Bipolar Digital	71.3	84.9	81.4	91.3	69.2	14.0
Bipolar Digital Memory	25.6	33.0	18.6	20.7	15.4	31.7
Bipolar Digital Logic	45.6	51.9	62.8	70.6	53.9	12.5
MOS (Technology)	146.0	210.1	251.4	230.7	236.4	5.1
N/PMOS	105.8	69.6	52.0	47.5	43.5	5.3
CMOS	40.2	140.5	185.2	170.2	178.3	4.7
BiCMOS	0	0	14.2	13.0	14.6	19.1
MOS (Function)	146.0	210.1	251.4	230.7	236.4	5.1
MOS Memory	91.3	138.7	163.9	131.5	123.6	7.1
MOS Microcomponents	21.0	26.3	27.2	30.7	33.2	2.1
MOS Logic	33.7	45.1	60.3	68.5	79.6	6.0
Analog	21.7	19.6	20.8	21.3	24.3	1.6
Total Discrete	10.1	10.7	13.8	15.4	20.7	1.9
Total Optoelectronics	10.2	13.7	14.8	15.6	17.3	4.5
Exchange Rate (¥ = U.S.$)	144	130	138	144	136	

Note: Some columns do not add to totals because of rounding.
Source: Dataquest (December 1992)

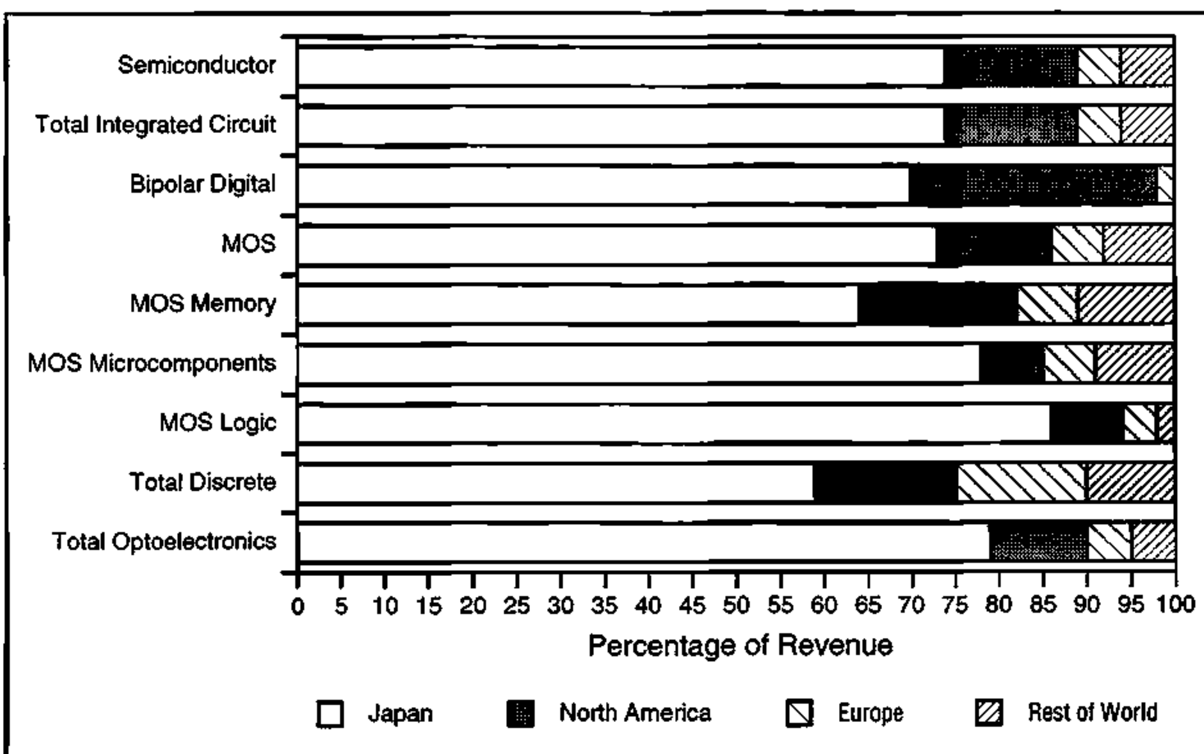
Regional Market

Figure 5 illustrates Fujitsu's semiconductor revenue broken down into four major regional markets: Japan, North America, Europe and the rest of the world (ROW). With 29.8 percent of total corporate revenue derived from overseas markets, Fujitsu's overseas semiconductor sales, as a percentage of its total semiconductor revenue, roughly matched the market share of the company's systems-level products in foreign markets.

On a percentage basis of semiconductors sold in foreign markets, Fujitsu trailed Toshiba by a wide margin but nearly matched both Hitachi and NEC's foreign semiconductor market share. Since both Hitachi and NEC are much larger merchant semiconductor suppliers, based on sales volume, Fujitsu's share of foreign semiconductor markets is not a particular disappointment.

Furthermore, the company's large emphasis in GaAs IC production, particularly at its Yamanashi site, has yet to develop significant sales volumes overseas, although GaAs IC products have begun to ship to engineering workstation and supercomputer manufacturers with high expectations for overseas GaAs consumption.

Figure 5
Fujitsu's Semiconductor Revenue, by Region



Source: Dataquest (December 1992)

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Semiconductor Investment

Table 9 and Figure 6 represent Fujitsu's semiconductor capital spending and R&D expense trends against overall semiconductor revenue for the past five years. The escalation of Fujitsu's investments during the last three years has made Fujitsu the clear semiconductor capital and R&D spending leader in Japan.

However, even by Fujitsu's standards, FY1991 was a record year for capital spending. The ¥154.4 billion spent on semiconductor capacity exceeded the levels spent by all other manufacturers by a wide margin both as a percentage of revenue and in absolute yen. Fujitsu's semiconductor capital-spending-to-revenue ratio came to an unusually high 42 percent, a number that obviously cannot be sustained for long without subsidies from Fujitsu's other business divisions. Falling semiconductor revenue since 1989 is partly to blame for the high ratio of capital spending to revenue; however, it does not explain how a company with semiconductor revenue nearly half that of NEC's can have 50 percent higher capital spending levels.

During the past three years, Fujitsu conducted major expansion of its domestic Wakamatsu ASIC plant, its Iwate memory facility, and one of its subsidiaries at the Yamanashi GaAs LSI facilities. A new 16Mb DRAM production plant at Mie is also scheduled for construction and completion before the end of 1992. Offshore, Fujitsu spent another ¥90 billion at Durham to complete that DRAM facility.

Fujitsu's R&D spending levels are more congruent with its competitors as a percentage of revenue. Fujitsu's 1992 semiconductor R&D costs are expected to rise by 7 percent above the 1991 R&D level.

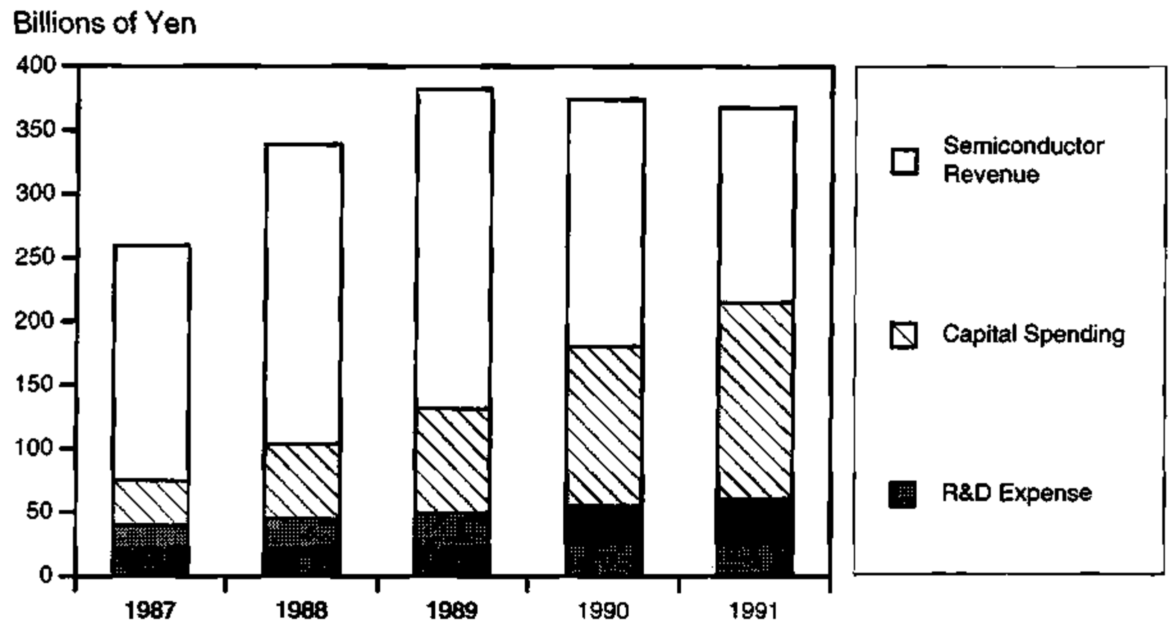
In 1992, worldwide semiconductor capital spending is expected to contract by 9.5 percent. Japan is expected to make the largest cuts in capital spending, with current projections calling for a decline of

Table 9
Fujitsu Semiconductor Investment: Capital Spending and R&D
(Billions of Yen)

	1987	1988	1989	1990	1991
Semiconductor Revenue	259.3	338.9	382.3	374.3	367.9
Capital Spending	35.0	58.7	82.1	125.5	154.4
Percentage of Revenue	13.5	17.3	21.5	33.5	42.0
R&D Expense	40.0	45.0	49.5	55.0	60.5
Percentage of Revenue	15.4	13.3	12.9	14.7	16.4
Total Investment to Revenue Percentage	28.9	30.6	34.4	48.2	58.4

Note: Semiconductor revenue and capital spending are calculated for calendar year periods, while R&D expense is stated for a Japanese fiscal year.
Source: Dataquest (December 1992)

Figure 6
Fujitsu Semiconductor Investment: Capital Spending and R&D



Source: Dataquest (December 1992)

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23.5 percent. Many Japanese semiconductor companies have already announced intentions to make major investment cuts in their 1992 budgets. Although Fujitsu has closed a memory assembly plant in San Diego, and downsized its work force at Fujitsu Microelectronics Inc., in San Jose, California, Fujitsu still appears to be in an expansion mode globally.

Manufacturing Facilities

Fujitsu owns five front-end fab facilities in Japan including its GaAs plant in Yamanashi. Fujitsu's two remaining front-end facilities are located overseas at Gresham, Oregon—which produces ASICs and 1Mb DRAMs—and Durham. The location, size of the work force, and semiconductor products made at Fujitsu's primary manufacturing sites are shown in Table 10. Figure 7 shows the relationship between various semiconductor manufacturing sites and possible chip production steps performed at the various Fujitsu plants.

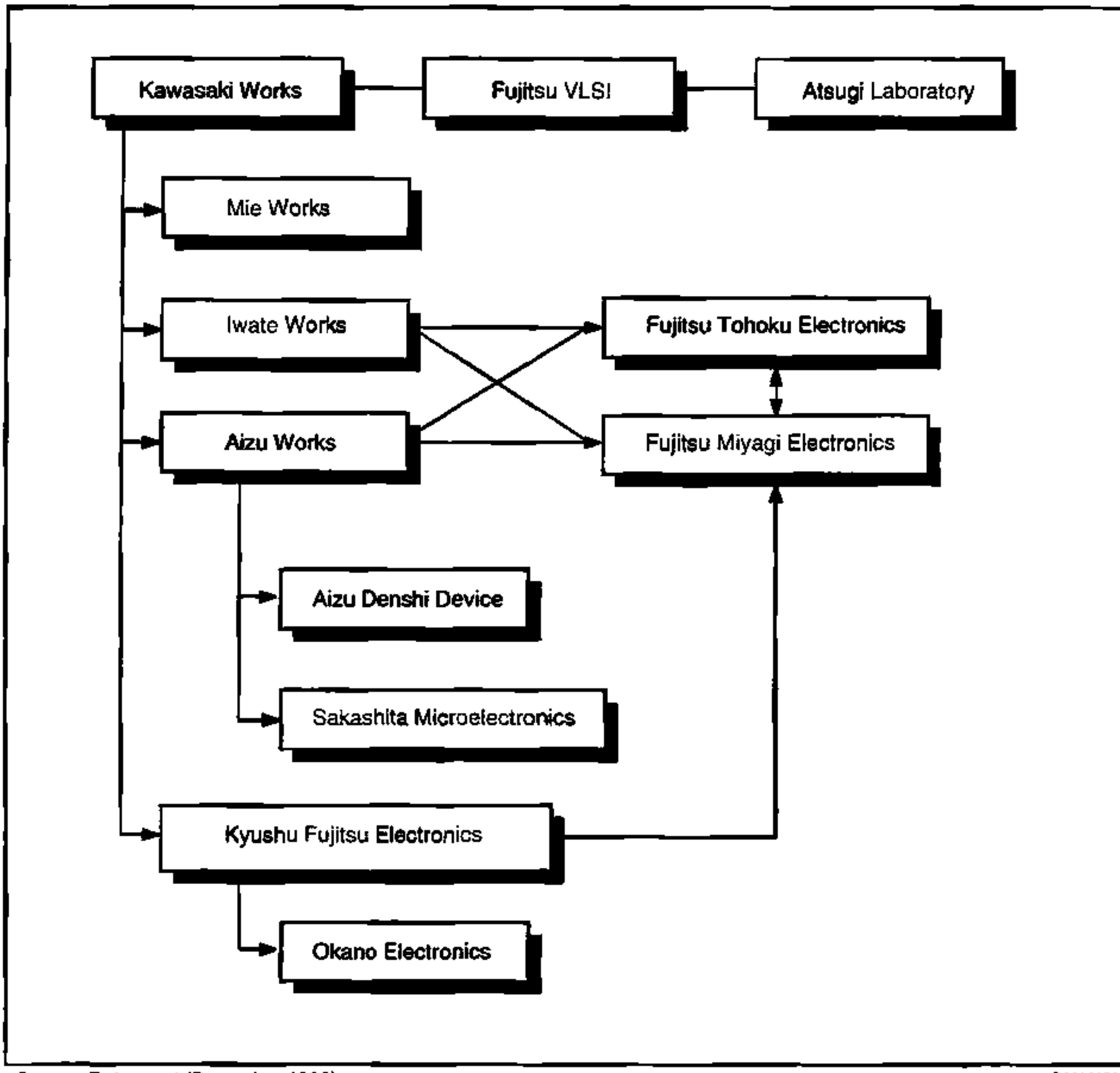
The EC body that governs semiconductor trade policy has already begun imposing import regulations, including procedures for defining, calculating, and establishing limits on foreign chips imported into the EC semiconductor markets. An EC committee has also made rulings defining a domestic semiconductor product as one that has its front-end wafer fabrication steps performed on European territory.

Table 10
Fujitsu Semiconductor Manufacturing Facilities

Plant Name	Location	Type	Product	Number of Employees	Year Opened
Domestic Facilities					
Aizu Works	Fukushima	F	Arrays, micro, EPROM	3,000	1984
Wakamatsu Works	Fukushima	F	ASIC	900	1985
Fujitsu VLSI	Gifu	R	R&D	1,020	1985
Iwate Works	Iwate	F	DRAM, SRAM, ROM	2,600	1984
Atsugi Laboratory	Kanagawa	R	R&D	NA	1987
Kawasaki	Kanagawa	PF	DRAM, HEMT, 3-D ICs	12,000	1938
Mie Works	Mie	PR	Memory, logic	1,500	1984
Quantum Device	Yamanashi	RF	Optoelectronics, GaAs, HEMT	450	1984
Fujitsu Miyagi Electronics	Miyagi	AT	Micro, gate array	670	1989
Fujitsu Tohoku Electronics	Fukushima	AT	Gate array	663	1981
Kyushu Fujitsu Electronics	Miyazaki	AT	Memory, micro, custom LSI	1,486	1985
Sakashita Microelectronics	Fukushima	AT	Discrete	150	1983
Aizu Denshi Device	Fukushima	AT	Micro, ASIC	75	1984
Okano Electronics	Kagoshima	AT	MOS memory	100	1987
Overseas Facilities					
Fujitsu Microelectronics	Gresham, Oregon	F	1Mb DRAM, gate array		1988
Fujitsu Microelectronics	Durham, United Kingdom	F	4Mb DRAM, ASIC		1988
Fujitsu Microelectronics Ireland	Dublin, Ireland	AT	Memory		1981
Fujitsu Microelectronics Asia	Singapore	AT	DRAM		1986
Fujitsu Component	Penang, Malaysia	AT	DRAM, TTL		1988

F: Fab
P: Pilot Line
R: Semiconductor R&D
A: Assembly
T: Test
NA = Not available
Source: Dataquest (December 1992)

Figure 7
Fujitsu Semiconductor Manufacturing Shift



Source: Dataquest (December 1992) G2002673

These mandates have induced major Japanese chip makers—such as Hitachi, NEC, and Toshiba—to construct or upgrade existing fabs in Europe in anticipation of unification of the European markets. Fujitsu's Durham plant is a complete front-end facility for manufacturing 4Mb DRAM and will supply the EC's current memory market. In addition, the company's VLSI Laboratory in London will design telecommunications chips for the EC, and an older facility in Ireland will test and assemble Fujitsu semiconductor products destined for EC markets.

Semiconductor Alliances

Fujitsu has long been a proponent of strategic alliances and joint ventures as a business strategy to leverage resources and to enter new markets. Table 11 lists Fujitsu's publicly announced alliances involving semiconductor-related projects formed during the past five years.

Dataquest classifies strategic alliances into the following major categories, as applied in Table 11.

- LA—Licensing agreement
- SS—Second source agreement
- SA—Sales agency agreement
- FA—Fab agreement
- AT—Assembly and testing agreement
- TE—Technology exchange
- JV—Joint venture
- JD—Joint development
- IV—Investment
- CO—Coordination of standard
- PC—Procurement agreement
- OT—Other

Fujitsu Microelectronics Inc. (FMI), located in San Jose, has pioneered international alliances and is still actively seeking partnerships to assist in its immediate goal of entering the field-programmable gate array business after its April reorganization. This business is believed to be complementary to Fujitsu's existing ASIC product lines and manufacturing capabilities. ASIC development and related design automation software are two likely areas that FMI will investigate as possible targets for alliances. Fujitsu has several ongoing joint ventures with software vendors in various countries. The exploration of further alliances involving software development has become a corporate mandate at Fujitsu. Fujitsu has already established an alliance with Cadence Design Systems Inc. to jointly develop design tools and has created an R&D company in the United States to further develop UNIX software.

Fujitsu has licensed the Rambus technology for implementing high-speed DRAM architectures. In addition, Fujitsu established links with the U.S. company HaL Computer Systems Inc. for the purpose of collectively developing next-generation UNIX systems for use in business environments.

Table 11
Fujitsu's Semiconductor Strategic Alliances

Date	Partner	Agreement Type	Product
5/88	NEC	JD	Military-use infrared seeker
6/88	Mizer/Wind River	JD	SPARC RISC MPU
1/89	Ikos Systems	TE	ASIC libraries
3/89	VIA Technologies	IV	SPARC peripherals
4/89	Sun Microsystems	SS, FA	SPARC RISC MPU
11/89	Vitesse Semiconductor	SS	GaAs material
11/89	Tandem Computers	SA	Wafer-scale memory
11/89	Texas Instrument Japan	LA, JD	ASIC software
1/90	Isuzu Motor	JV	Automotive electronics
1/90	Samsung	SS	Printer-control gate array
1/90	ASCII	JD, IV	16-, 32-bit MPUs
6/90	CrossCheck Technology	LA	ASIC testing technology
7/90	Signetics	SS, JD	Communications ICs
8/90	Toyota Motor	JV	CAE design for automobiles
8/90	Cray Computer	SS	GaAs ICs
10/90	Level One Communications	SS, JD	Communications ICs
11/90	Flash memory cards	FA	Flash memory cards
7/91	Tera Microsystems	FA	SPARC RISC chip set
8/91	SPARC RISC chip	LA	SPARC RISC MPU
8/91	HaL Computer Systems	JD, IV	CMOS RISC microprocessor
10/91	Cadence	JD	ASIC design tool
3/92	Rambus	LA	Memory interface technology
4/92	Wang Laboratories	LA	SIMM license
4/92	Samsung	LA	Cross-licensing
5/92	Mosel	FA	Memory
7/92	AMD	JV, JD	Flash memory

Source: Dataquest (December 1992)

Dataquest Perspective

Fujitsu has a character quite distinct from other Japanese electronics companies. In many ways, Fujitsu is an innovative trendsetter. By being an early advocate of strategic global alliances, the company pioneered this now pervasive business strategy as a means of entering new markets. Although its finances are generally conservative by Japanese standards, Fujitsu is equally willing to risk heavy investments in new technologies such as GaAs HEMT devices. The company established a high level of synergy among its various enterprises because of a focus that appears to be by design; Fujitsu does not make rice cookers, just all types of semiconductors that go into every telecommunications and computer system the company makes. Fujitsu has also adopted the concept that complete systems integration, involving both hardware and software, is the solution it needs to provide in order to effectively compete in future markets.

Fujitsu's semiconductor business appears to be struggling to maintain revenue levels while the company continues to add capacity. For Fujitsu to continue to maintain semiconductor capital spending levels that are more than 40 percent of semiconductor revenue, the semiconductors it produces must be tailored to give its system-level products a higher degree of competitive advantage.

Dataquest Vendor Profile

Semiconductors *Japan*
December 28, 1992

Fujitsu Limited

Corporate Statistics

Address	Fujitsu Limited 6-1, Marunouchi 1-chome, Chiyoda-ku, Tokyo 100
Telephone	81-3-3216-3211
Facsimile	81-3-3213-7174
Chairman of the Board	Takuma Yamamoto
President and CEO	Tadashi Sekizawa
Established	1935
Number of Employees	155,779 (as of March 31, 1992)
Total Sales	¥3,442 billion (FY1991)
Net Income	¥12 billion (FY1991)
Total Assets	¥3,992 billion (FY1991)
Main Product Area	Computers and Information Processing Systems Communications Systems Electronic Devices Other Operation

Corporate Overview

Fujitsu was originally established as Fuji-Tsushinki K.K. in 1935. As a spin-off from Fuji Electric, the initial charter of the company was to market telephone products, including set-and-exchange equipment, through sales and manufacturing arrangements with other companies. In 1951, Fujitsu began producing data processing equipment—which subsequently led, three years later, to the company's entry into the business of fabricating semiconductor devices. In 1967, the company was renamed Fujitsu Limited.

For more information on Fujitsu Limited or the semiconductor industry, call Junko Matsubara at (408) 437-8572.

Fujitsu is associated with the Furukawa group of companies, which itself is one of three subdivisions of the Dai-ichi Kangyo Bank (DKB) group. As a member of the DKB keiretsu, Fujitsu has close ties to financial institutions that can provide the company with banking services, business advice, and introductions to other keiretsu manufacturers.

Fujitsu has 367 consolidated subsidiaries worldwide and 248 subsidiaries operating outside of Japan.

Corporate Business: Trends and Climate

Fujitsu's consolidated revenue recorded ¥3,442 billion in fiscal year (FY) 1991 (see Table 1). This translated to a 15.8 percent growth rate over the previous year's revenue and gave Fujitsu the highest expansion rate among the top 10 Japanese electronics companies during FY1991. Fujitsu's historical revenue trend is plotted in Figure 1. Although total sales reached a peak in FY1991, net income declined by 85.2 percent to ¥12 billion, marking the lowest net gain in a decade of the company's most recent history. The company attributed the drop in profits to the slowdown in demand for both semiconductor and telecommunications products worldwide.

Fujitsu, like nearly all Japanese industries, began suffering the effects of the collapse of Japan's bubble economy in the second half of 1991. Sustaining gross revenue and market share at the expense of net income has become a hallmark of the Japanese business methodology.

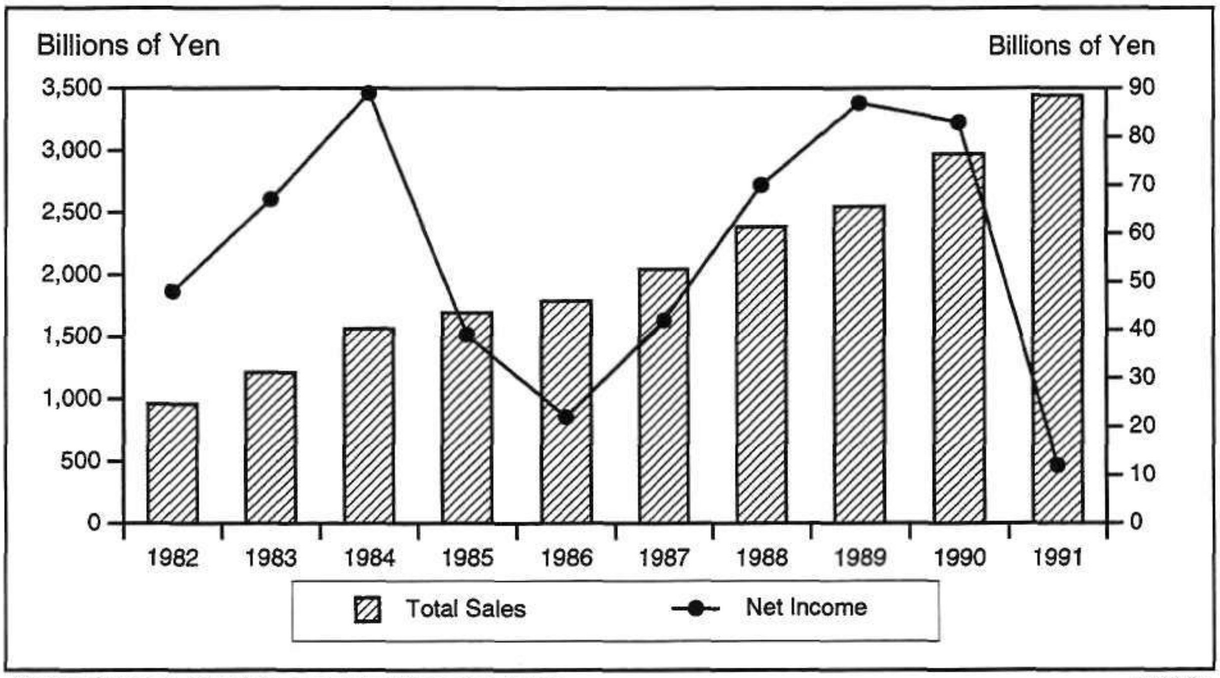
In Fujitsu's implementation of this strategy, rapid adjustments to trends that most affected the company's core systems businesses have allowed the company to remain in the black for the fiscal year. The impending trends that are perceived as most important to Fujitsu's

Table 1
Fujitsu Limited Sales, by Product Segment and Market (Billions of Yen)

Fiscal Year	1987	1988	1989	1990	1991
Computers and Information Processing Systems	1,372	1,579	1,690	2,056	2,511
Communications Systems	325	375	394	442	445
Electronic Devices	256	334	357	349	349
Other Operations	94	99	109	125	138
Total	2,047	2,387	2,550	2,971	3,442
Domestic Market	1,594	1,859	1,941	2,233	2,415
Percentage of Total Revenue	77.9	77.9	76.1	75.2	70.2
Overseas Market	453	528	609	738	1,027
Percentage of Total Revenue	22.1	22.1	23.9	24.8	29.8
Fiscal Year Exchange Rate (¥=U.S.$1)	138	128	142	141	133

Note: Some columns do not add to totals shown because of rounding.
Source: Company Literature, Dataquest (December 1992)

Figure 1
Fujitsu Limited Total Revenue and Net Income



Source: Company Literature, Dataquest (December 1992)

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primary businesses are the move toward downsized-networked systems based on open hardware and software platforms.

To cope with these trends, Fujitsu has instituted new policies and businesses strategies. Some of the aspects of these new policies that may have helped Fujitsu in 1991 were the emphasis on providing new software and service products. The integration of these software and service solutions, while promoting open architectures, may have contributed to the strong domestic sales of Fujitsu's line of large-scale general-purpose mainframe computers during the year. These computer systems have embraced an open UNIX environment as well as Fujitsu's existing operating system, which is becoming an increasingly "open" or user-influenced platform. The continued application of partnerships has also helped in the overseas market performance of Fujitsu systems.

Business Structure

Fujitsu divides its operation into four major sectors: Computers and Information Processing Systems, Communications Systems, Electronic Devices, and Other Operations. Among the four divisions, the Computers and Information Processing Systems grew 22.1 percent and accounted for 73 percent of FY1991 revenue. This heavy emphasis on systems has given Fujitsu the distinction, among horizontally diversified Japanese competitors, of being primarily a business machine supplier, along the lines of an IBM. Unlike other major Japanese companies, Fujitsu does not produce a significant amount of consumer electronics products. Instead, Fujitsu has elected to focus on premium electronics markets for such items as supercomputers, telecommunications equipment, and semiconductors.

While the Information Processing arm of its business grew substantially, Fujitsu's Communications, Electronic Devices, and all other operations saw negligible growth. The Electronic Devices part of Fujitsu's business actually contracted slightly during the year. Although this segment accounts for only 10.1 percent of Fujitsu's corporate revenue, the company's primary products, such as its extensive lines of computers and communications equipment, are heavily dependent on the in-house semiconductor manufacturing technology provided by the Electronic Devices group. Thus, the welfare of its Electronics Devices division has critical impact on the company's ability to leverage technical competitive advantage and obscures the group's immediate contribution to the company's revenue stream.

Multinational Profile

In FY1991, 29.8 percent of Fujitsu revenue was generated in overseas markets. Over the past five years, Fujitsu has gradually increased its revenue from overseas markets, with 1991 recording the highest levels of foreign market sales during the five-year period.

Fujitsu's major overseas growth is occurring in the European markets. This growth can be traced to the company's increased investments in that part of the world. In particular, the high-visibility acquisition and merger with ICL in November 1990 immediately increased Fujitsu's systems customer base and visibility in Europe. This relationship between ICL and Fujitsu has since yielded several new products, including some SPARC-based systems, ranging from mainframe computers to small network servers. In addition, extensive sales and marketing ventures have been jointly financed by Fujitsu and ICL in North America, Australia, and Europe. These efforts have resulted in improvements to Fujitsu's retail market shares in North America and to its business segment performance in Europe and Australia.

Fujitsu has also invested in semiconductor manufacturing capacity in Europe. Its latest venture involved a ¥90 billion investment to its Durham plant in England, which began producing 4Mb DRAM parts in September 1991 for consumption in the European Community (EC).

Although overall corporate sales to the Asia/Pacific region have increased only slightly during the last few years, this region is a stable consumer of Fujitsu's telecommunications products. During 1991, orders for switching systems continued to arrive from the People's Republic of China, Singapore, and Hong Kong; and optical transmission hardware has been purchased to link Japan, Taiwan, Hong Kong, Malaysia, and Singapore. Fujitsu has also just begun marketing its ultracompact cellular telephone units—which have sold well in both Japan and the United States—in Asian markets. With renewed awareness of the need to establish software products on open platforms, Fujitsu has recently established a joint venture in the People's Republic of China to develop software applications to run under UNIX.

The recession in the United States has been the main cause of Fujitsu's slow decline in annual sales to North America since FY1989. This has occurred in spite of the numerous alliances Fujitsu has formed with U.S. companies and the substantial presence of its subsidiaries located in the United States.

Corporate Investment

During FY1991, Fujitsu invested ¥392 billion, or about 11.4 percent of its total corporate sales, in R&D activities (see Table 2). This yen-based expenditure approached the 1991 R&D investment of Matsushita, a company with revenue more than double that of Fujitsu. The steady increase in Fujitsu's R&D costs over the past several years has caused its corporate-level R&D-to-sales ratios to far surpass the ratios exhibited by the other top 10 Japanese electronics companies. These high levels of R&D have allowed Fujitsu to produce leading-edge semiconductor components, as well as field high-performance computer and telecommunications systems. Fujitsu conducts R&D activities at two facilities that are part of the Fujitsu Laboratory, which became an independent subsidiary of Fujitsu in 1968.

Fujitsu's capital spending levels have also exceeded the levels of most of its competitors. Although Toshiba spent roughly the same percentage of its total revenue on capital spending during 1991, Fujitsu has maintained these higher, double-digit capital spending and R&D levels for the past four years. Furthermore, most competitors, such as NEC and Hitachi, actually reduced the magnitude of their capital spending during 1991. Like Toshiba, Fujitsu continues to invest heavily in semiconductor technology with most of FY1991 capital spending being applied toward ramp-up of the Durham facility, increased production capacity at the Yamanashi GaAs LSI plant, and expansion of a semiconductor research facility.

Table 2
Fujitsu Limited Investment: Capital Spending and R&D (Billions of Yen)

Fiscal Year	1987	1988	1989	1990	1991
Total Revenue	2,047	2,387	2,550	2,971	3,442
Capital Spending	167	254	301	315	351
Percentage of Total Revenue	8.2	10.6	11.8	10.6	10.2
R&D Spending	190	247	299	330	392
Percentage of Total Revenue	9.3	10.3	11.7	11.1	11.4

Source: Company Literature, Dataquest (December 1992)

Financial Condition and Analysis in FY1991

Tables 3 and 4 show a cross section of Fujitsu's consolidated balance sheet and income statements, respectively. Total sales in FY1991 reached a record high of ¥3,442 billion, a 15.8 percent increase over the previous year's figure. However, net income declined by a steep 85.2 percent to a mere ¥12 billion.

The decline of net income and profitability occurring during 1986 and 1991 are common dips in the revenue histories of all major electronics firms in Japan. For most Japanese electronics companies, FY1991

Table 3
Fujitsu Limited Consolidated Balance Sheet (Billions of Yen)

Japanese Fiscal Year	1987	1988	1989	1990	1991
Total Current Assets	1,355	1,458	1,647	2,080	2,155
Cash	119	156	134	188	251
Marketable Securities	214	173	160	245	176
Receivables	503	592	737	866	897
Inventory	463	479	586	711	750
Other Current Assets	56	58	30	69	81
Long-Term Receivables and Investment	366	460	495	554	573
Net Property, Plant, and Equipment	592	703	826	981	1,086
Other Assets	4	4	4	123	177
Total Assets	2,317	2,625	2,971	3,737	3,992
Total Current Liabilities	974	1,101	1,283	1,686	1,653
Long-Term Debt	445	485	513	778	1,027
Minority Interest	70	78	90	114	146
Total Liabilities	1,490	1,664	1,886	2,578	2,826
Total Shareholders' Equity	827	961	1,085	1,159	1,165
Common Stock	169	194	216	221	222
Additional Paid-In Capital	296	352	387	393	395
Retained Earnings	350	402	466	528	529
Other Equity	13	14	16	17	19
Total Liabilities and Shareholders' Equity	2,317	2,625	2,971	3,737	3,992
Fiscal Year Exchange Rate (¥ = U.S.$1)	138	128	142	141	133

Note: Some columns do not add to totals shown because of rounding.
Source: Company Literature, Dataquest (December 1992)

Table 4
Fujitsu Limited Consolidated Income Statement
(Billions of Yen)

Japanese Fiscal Year	1987	1988	1989	1990	1991
Net Sales	2,047	2,387	2,550	2,971	3,442
Domestic Sales	1,594	1,859	1,941	2,233	2,415
Overseas Sales	453	528	609	738	1,027
Cost of Goods Sold	1,339	1,528	1,578	1,821	2,120
Selling, General, and Administrative Expense	588	674	776	937	1,185
Operating Income	120	186	195	214	137
Operating Income Margin	5.8	7.8	7.7	7.2	4.0
Other Income	15	16	18	28	29
Interest	9	14	16	26	27
Others	6	2	2	2	2
Other Expenses	29	47	43	88	125
Interest	29	32	39	66	91
Others	0	14	4	22	34
Income before Income Taxes	106	155	170	154	42
Effective Tax Rate (%)	56	56	54	52	52
Income Taxes	73	97	99	91	32
Income after Income Taxes	33	58	71	62	10
Equity in Income of Unconsolidated subsidiaries	13	19	21	24	9
Minority Interests and Others	3	6	6	3	7
Net Income	42	70	87	83	12
Fiscal Year Exchange Rate (¥ = U.S.$1)	138	128	142	141	133

Note: Some columns do not add to totals shown because of rounding.
Source: Company Literature, Dataquest (December 1992)

yielded lower profitability, which is equivalent to net income divided by total sales, than achieved in FY1986. This occurred despite the fact that net income magnitudes were generally higher in FY1991 than in FY1986.

In Fujitsu's case, however, both profitability and net income were lower in FY1991 than in FY1986. This gave Fujitsu the appearance of a lower financial performance than most of its Japanese competitors. In reality, the source of the sag in performance was the higher semiconductor capital spending and R&D levels that reflect Fujitsu's apparent confidence in the recovery of those markets. Although other Japanese companies may or may not share this confidence, they have followed more conservative budgeting schedules for the year. Thus, Fujitsu's lower income rate appears to be more attributable to a conscious decision to invest, perhaps based on optimistic forecasts for a semiconductor market recovery, than to falling sales or a lack of cost control.

Several Japanese electronics companies, such as Hitachi and Matsushita, have a return on sales ratio, which is equal to earnings before taxes divided by net sales, that regularly exceeds their corresponding operating income margin, which is equal to gross operating income divided by net sales. This effect is usually attributable to a company's having surplus income, such as from stock dividends and funds generated from ventures outside of its primary businesses, that have offset its annual debt payments. Fujitsu's external income is relatively insignificant compared with Japanese electronics firms of roughly the same size, such as NEC. Hence, Fujitsu's debt payments typically exceed its supplementary income by a factor of 2. Although Fujitsu's capital-intensive semiconductor operations and 1990 acquisition of a majority stake in ICL required increasing its debt level, Fujitsu has still managed to have reasonable financial ratios by Japanese standards.

Table 5 summarizes some key figures, which represent Fujitsu's financial status, and compares them with those of NEC and Toshiba's for the FY1991 period. From this table, it is clear that Fujitsu's solvency displayed a discrete discontinuity, as measured by its elevated debt-to-equity ratio, following the 1990 investment in ICL. Yet, even with this higher level of insolvency, Fujitsu remained less debt-laden than either NEC or Toshiba, again measured by their respective debt-to-equity ratios. Although Japanese accounting practices have often been viewed with skepticism by U.S. companies, the long-term safety—or debt-to-equity figure—would seem to be a relatively standard calculation that should facilitate comparisons among companies in different countries.

Japanese electronics companies typically can remain stable and liquid with smaller current and quick ratios than their U.S. counterparts can. Although not as conservative as Hitachi, Fujitsu maintains liquidity ratios that are generally higher than either NEC or Toshiba—which are companies of comparable size that also invest heavily in semiconductor manufacturing, particularly in commodity DRAM capacity.

Many large corporations in Japan have large blocks of their stocks owned by financial institutions that belong to a particular family of companies, otherwise known as a keiretsu group. A paradox of such groupings, however, is that often a company will have members of competing keiretsu as major stockholders. To illustrate this point Dataquest notes that Hitachi, Toshiba, and NEC have major stockholders that are members of the Mitsubishi, Mitsui, Sumitomo, and Dai-ichi keiretsu. And Fujitsu is no exception to the multiple-keiretsu influence, where, as shown in Table 6, 13.5 percent of Fujitsu's stock remains in the hands of its original parent company, Fuji Electric. Although this may seem to be a large voting block, the Sumitomo group's influence over NEC is substantially higher. Nearly one-quarter (24.3 percent) of Fujitsu's stock is owned by individual investors, and foreigners own 9.3 percent of the company.

Table 5
Fujitsu Limited Financial Ratios Compared with NEC and Toshiba

	1987	1988	1989	1990	1991	NEC	Toshiba
Total Sales (¥B)	2,047	2,387	2,550	2,971	3,442	3,774	4,722
Net Income (¥B)	42	70	87	83	12	15	39
Total Assets (¥B)	2,317	2,625	2,971	3,737	3,992	4,081	5,724
Operating Income Margin (%)	5.9	7.8	7.7	7.2	4.0	3.2	2.5
Net Income/Total Sales (%)	2.1	2.9	3.4	2.8	0.4	0.4	0.8
Foreign Sales/Total Sales (%)	22.1	22.1	23.9	24.8	29.8	21.0	29.1
Corporate R&D/Total Sales (%)	9.3	10.3	11.7	11.1	11.7	8.0	6.7
Semiconductor Sales* (¥B)	259	339	382	374	368	649	623
Semiconductor Sales/Total Sales (%)	12.7	14.2	15.0	12.6	10.7	17.2	13.2
Sales/Employee (¥M)	21.585	22.846	22.170	20.370	22.095	29.410	28.109
Net Income/Employee (¥M)	0.444	0.669	0.754	0.567	0.078	0.119	0.235
Growth Rate							
Total Sales (%)	14.4	16.6	6.8	16.5	15.8	2.0	0.6
Net Income (%)	94.9	66.1	24.0	-4.7	-85.2	-71.9	-67.3
Financial Ratios							
Current Ratio	1.39	1.32	1.28	1.23	1.30	1.19	1.23
Quick Ratio	0.94	0.89	0.83	0.81	0.85	0.76	0.81
Sales/Net Working Capital	5.37	6.69	7.01	7.54	6.86	9.88	7.04
Net Working Capital/Total Assets	0.16	0.14	0.12	0.11	0.13	0.09	0.12
Debt-Equity Ratio	0.54	0.50	0.47	0.67	0.88	1.30	1.24
Total Asset Turnover	0.88	0.91	0.86	0.80	0.86	0.92	0.82
Return on Sales (%)	5.2	6.5	6.7	5.2	1.2	1.4	2.4
Return on Asset (%)	4.6	5.9	5.7	4.1	1.0	1.3	2.0
Return on Equity (%)	5.1	7.3	8.0	7.2	1.1	1.7	3.3
Earning per Share (¥)	19.38	29.53	37.08	45.17	18.81	25.17	13.22
Payout Ratio	0.41	0.30	0.24	0.22	0.53	0.40	0.76

*Semiconductor sales estimated for a calendar year.
Source: Dataquest (December 1992)

Table 6
Fujitsu Limited Top 10 Shareholders

Shareholders	Share (%)
Fuji Electric	13.5
Asahi Life Insurance	6.5
Dai-ichi Kangyo Bank	4.6
Sumitomo Trust & Banking	2.8
Industrial Bank of Japan	2.3
Mitsubishi Trust & Banking	2.3
Toyo Trust & Banking	1.8
Nippon Life Insurance	1.8
Asahi Bank	1.6
Sakura Bank	1.5

Source: Company Literature, Dataquest (December 1992)

Semiconductor Climate of 1991

Worldwide semiconductor sales totaled $59.7 billion in 1991, which exceeded the previous year's sales by 9.4 percent. The Japanese market comprised 37.7 percent of the global 1991 market, with $22.5 billion in sales, and continued to make Japan the single largest region for chip consumption. Japanese semiconductor consumption has grown 11.1 percent during the past year. The Japanese market expanded by a slight 0.6 percent, relative to the world market, during a one-year period.

In terms of suppliers, Japan's 46.4 percent share of the 1991 global market nearly matched the 1990 figure of 46.3 percent. Asia/Pacific ROW suppliers made market share gains at the expense of North American and European companies.

The Japanese companies continued their dominance of the DRAM market, led by Toshiba, but lost some market share to Korean companies. Samsung moved to the No. 2 position, trailing only Toshiba, in terms of volume of commodity DRAMs products shipped. Fujitsu was the No. 7 leading supplier of DRAMs to world markets. U.S.-based semiconductor companies lost worldwide share; however, many of these companies continued to lead the world in microprocessors and design-intensive ASIC/ASSP chips.

Fujitsu Semiconductor Overview

According to Dataquest's semiconductor market share estimates for 1991, Fujitsu recorded $2,705 million in semiconductor revenue, qualifying the company as the seventh largest in the worldwide semiconductor business. In Japan's domestic market, Fujitsu captured the No. 4 position trailing NEC, Hitachi, and Toshiba. Total annual semiconductor sales declined by a small amount as compared with the previous year's totals.

Figure 2 is an organization chart of Fujitsu's semiconductor-related operations.

Fujitsu is a substantial supplier of all types of silicon-based semiconductors, including commodity memories and microcomponents, as summarized in Table 7 and charted in Figure 3. However, the feature that most differentiates Fujitsu from its chip-producing Japanese competitors is the degree of investment in compound semiconductor technology. Although revenue from GaAs components is modest relative to that from silicon devices, Fujitsu's commitment to the development of GaAs components at all levels of integration is remarkable. Given the company's strength in systems-level, high-frequency

Figure 2
Fujitsu Semiconductor Organization

- Electronic Device Sales and Marketing
  - Electronic Device Sales 1
  - Electronic Device Sales 2
  - Electronic Device Sales 3
  - Electronic Device Overseas Sales
  - Electronic Device Domestic Sales
- Electronic Device Group
  - Advanced Planning
  - Compound Chemical Components
  - LSI Design 1
  - LSI Design 2
  - Process Engineering 1
  - Process Engineering 2
  - Process Research
  - Assembly
  - Testing
  - Software Development
  - LSI Reliability Control
  - Production Technology
  - Hybrid IC
  - Display Technology
  - MIE Works
  - Aizu Works
  - Wakamatsu Works
  - Iwate Works
  - Suzaka Works
- Electronic Device Operation Group
  - Administration
  - Quality and Reliability Control
  - Production Facilities
  - Engineering Development Support

Source: Fujitsu Limited

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Table 7
Estimated 1991 Fujitsu Ranking, by Product Segment

	Worldwide Market	Japanese Market
Total Semiconductor	7	4
Total Integrated Circuit	7	3
Bipolar Digital	2	1
MOS	6	3
MOS Memory	5	3
MOS Microcomponents	11	7
MOS Logic	3	2
Analog	20	9
Total Discrete	16	8
Total Optoelectronics	8	8

Source: Dataquest (December 1992)

telecommunications products and high-end computers, GaAs technology development has been a logical, if somewhat risky, addition to Fujitsu's technology base.

However, Fujitsu seems to have already proven to itself the feasibility of the various GaAs-device technologies that it intends to use. These technologies include high-electron-mobility transistors (HEMT), heterojunction bipolar transistors, and field-effect transistors (FET). The HEMT devices have already been employed in various telecommunications applications including satellite broadcasting receivers and a prototype of an ultrahigh-speed asynchronous transfer mode switching module capable of switching 640 Gbps.

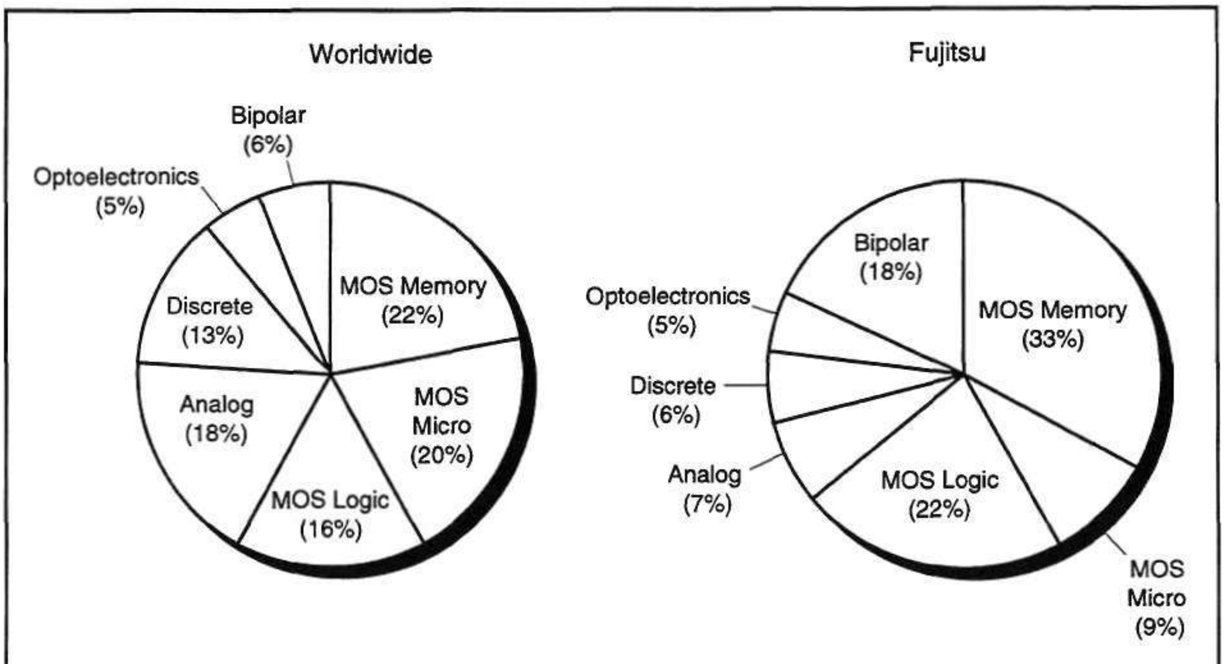
Product Strategy

Figure 3 illustrates the Fujitsu semiconductor product mix revenue and the worldwide product mix revenue recorded in 1991. Fujitsu is a healthy contender in MOS memories, MOS logic, and bipolar markets. In contrast, although Fujitsu captured about 27.7 percent of the market for SPARC RISC microprocessors in 1991, this market was so small that Fujitsu managed only a 0.4 percent share of the world microprocessor market, which translated to a world ranking of No. 17 among microprocessor suppliers. Fujitsu received more than seven times more revenue from selling microcontrollers than it did from sales of its microprocessors in 1991.

As a broad-line computer and telecommunications supplier, Fujitsu has excelled in memory and logic markets both to supply its own internal needs and to further develop competitive advantage for its own system-level products. Strong silicon ECL, CMOS, and BiCMOS—as well as GaAs FET, HEMT, and bipolar—fabrication capabilities have been grown to maturity at Fujitsu.

And the degree to which Fujitsu leverages these technologies in its own computer and telecommunications products appears to be

Figure 3
1991 Semiconductor Market Share Product Mix: Worldwide versus Fujitsu



Source: Dataquest (December 1992)

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increasing relative to its competitors. The high R&D investment levels sustained by Fujitsu for a number of years have made several experimental technologies positioned to make major returns on investments. Although the company's research in superconducting electronics may not yield commercial products in the foreseeable future, its GaAs efforts have resulted in the world's largest GaAs LSI manufacturing plant, built at Fujitsu's Yamanashi site.

The high-performance devices built at Yamanashi will include FET, HEMT, and heterojunction bipolar LSI circuits. Gate arrays with densities of 45K gates and 64Kb SRAM have been constructed in the GaAs HEMT technology. Optoelectronic and experimental quantum-well device structures will also be fabricated at Yamanashi. Circuits from Yamanashi have already been delivered to workstation and supercomputer manufacturers, with Cray Computer Corporation having been a past GaAs customer of Fujitsu.

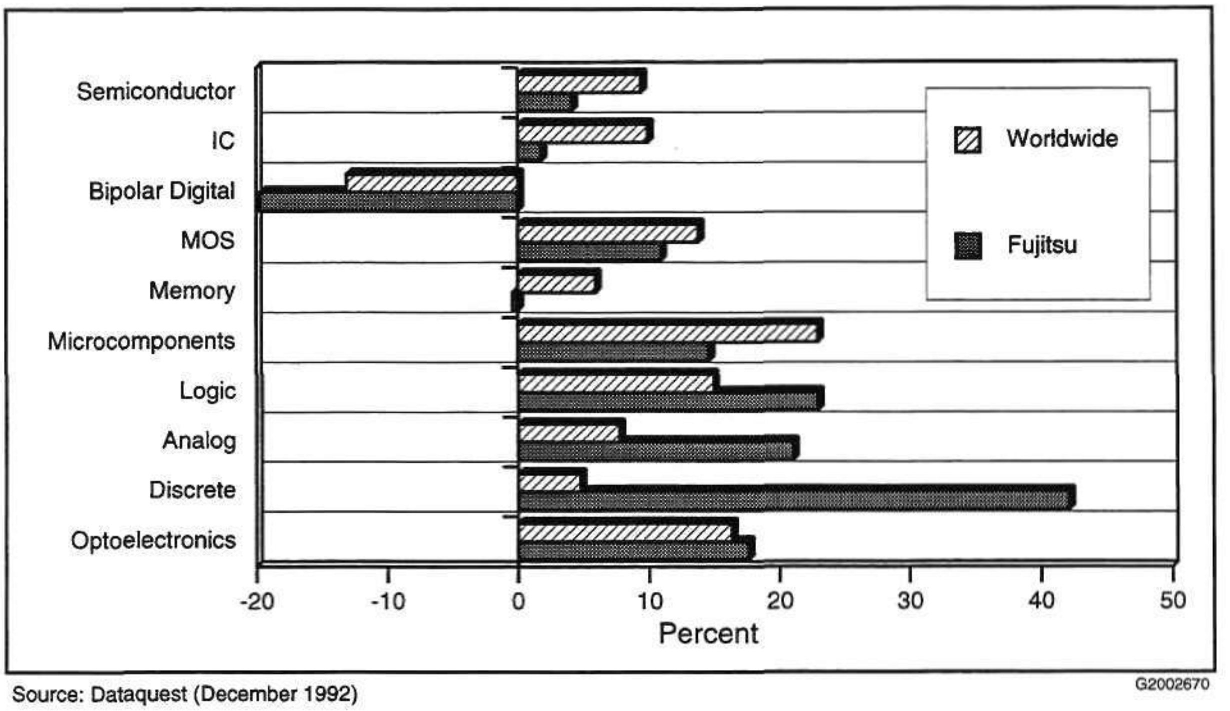
Although the anticipated potential of GaAs technology has not yet been realized, primarily because of the unexpected difficulties of working with compound semiconductors, Yamanashi does seem to have the potential to give Fujitsu a real advantage in telecommunications and high-end computer systems. Furthermore, GaAs technology at-large does appear to be reaching a commercially competitive stage as evident from the growing number of sockets that GaAs IC products are filling. Many GaAs vendors have found success by "tuning" their products into a competitive speed-power dissipation combination to match the needs of various niche applications as opposed to marketing GaAs products purely on the basis of optimum speed.

Figure 4 compares Fujitsu's semiconductor growth rates, by product category, against corresponding product growth rates on the world market for FY1991. Fujitsu captured market share in global markets for logic, analog, discrete, and optoelectronic devices. Brisk sales of a line of discrete and analog GaAs devices for applications in cellular telephones and broadcasting receivers have helped advance Fujitsu's revenue in these market segments. Sales of logic devices were also helped by the introduction of several new high-performance CMOS and BiCMOS gate arrays, as well as ASICs built around a microcontroller.

Fujitsu's 4Mb DRAM facility in Durham came online too late in the year to have had an impact on the 4Mb market, which is beginning to expand. This facility is poised to take advantage of the expected rise in demand for 4Mb parts as memory-intensive graphical interface operating systems continue to gain in popularity in the EC, as they already have in the United States. The Durham plant will complement a Fujitsu Telecommunications VLSI Laboratory in London, which was established in June 1990. Researchers at the London facility will develop semiconductors to meet local demand in telecommunications applications throughout the EC.

Table 8 provides Fujitsu's semiconductor revenue by product segment for the past five years.

Figure 4
Fujitsu's 1991 Growth Rate Compared with Worldwide Market



Source: Dataquest (December 1992)

Table 8
Estimated Worldwide Semiconductor Revenue, by Product
(Billions of Yen)

Calendar Year	1987	1988	1989	1990	1991	1991 Market Share (%)
Total Semiconductor	259.3	338.9	382.3	374.3	367.9	4.5
Total Integrated Circuit	239.0	314.6	353.7	343.3	329.9	5.0
Bipolar Digital	71.3	84.9	81.4	91.3	69.2	14.0
TTL/Others	33.6	41.2	34.8	39.2	27.3	7.9
ECL	37.7	43.7	46.6	52.1	41.9	28.4
Bipolar Digital	71.3	84.9	81.4	91.3	69.2	14.0
Bipolar Digital Memory	25.6	33.0	18.6	20.7	15.4	31.7
Bipolar Digital Logic	45.6	51.9	62.8	70.6	53.9	12.5
MOS (Technology)	146.0	210.1	251.4	230.7	236.4	5.1
N/PMOS	105.8	69.6	52.0	47.5	43.5	5.3
CMOS	40.2	140.5	185.2	170.2	178.3	4.7
BiCMOS	0	0	14.2	13.0	14.6	19.1
MOS (Function)	146.0	210.1	251.4	230.7	236.4	5.1
MOS Memory	91.3	138.7	163.9	131.5	123.6	7.1
MOS Microcomponents	21.0	26.3	27.2	30.7	33.2	2.1
MOS Logic	33.7	45.1	60.3	68.5	79.6	6.0
Analog	21.7	19.6	20.8	21.3	24.3	1.6
Total Discrete	10.1	10.7	13.8	15.4	20.7	1.9
Total Optoelectronics	10.2	13.7	14.8	15.6	17.3	4.5
Exchange Rate (¥ = U.S.$)	144	130	138	144	136	

Note: Some columns do not add to totals because of rounding.
Source: Dataquest (December 1992)

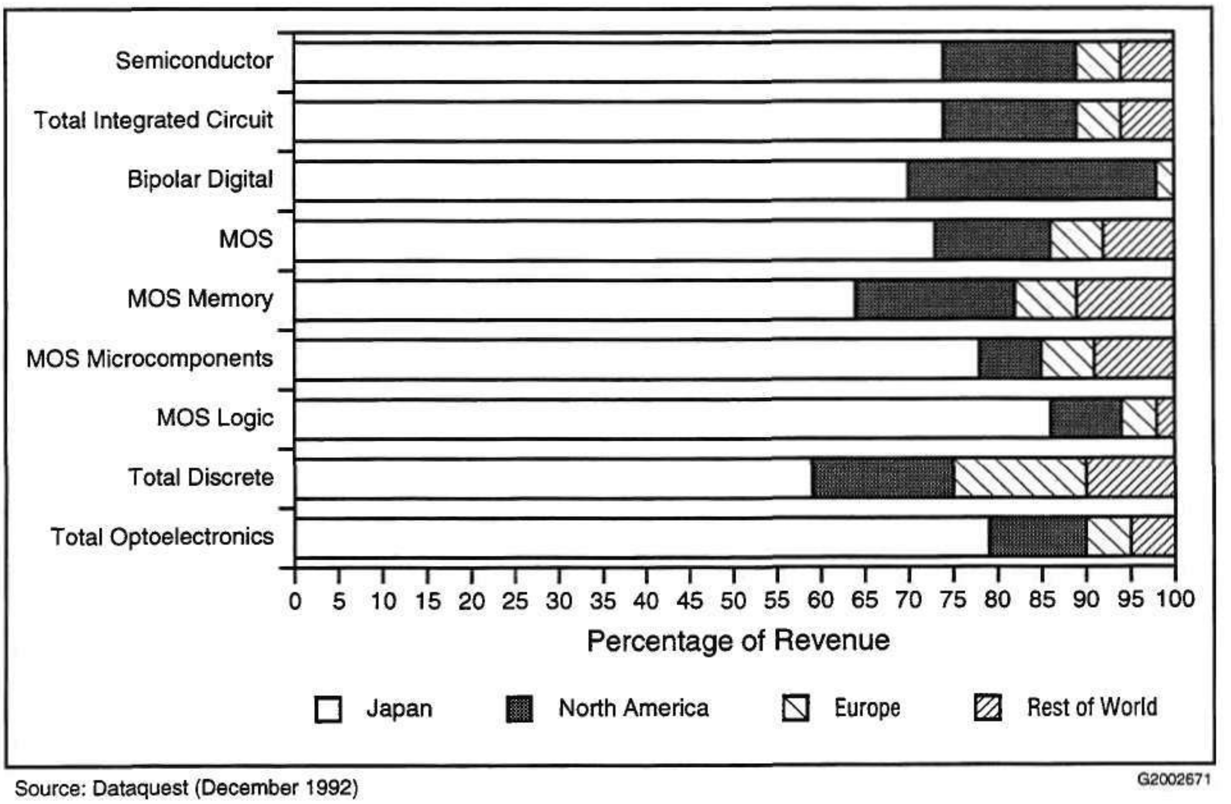
Regional Market

Figure 5 illustrates Fujitsu's semiconductor revenue broken down into four major regional markets: Japan, North America, Europe and the rest of the world (ROW). With 29.8 percent of total corporate revenue derived from overseas markets, Fujitsu's overseas semiconductor sales, as a percentage of its total semiconductor revenue, roughly matched the market share of the company's systems-level products in foreign markets.

On a percentage basis of semiconductors sold in foreign markets, Fujitsu trailed Toshiba by a wide margin but nearly matched both Hitachi and NEC's foreign semiconductor market share. Since both Hitachi and NEC are much larger merchant semiconductor suppliers, based on sales volume, Fujitsu's share of foreign semiconductor markets is not a particular disappointment.

Furthermore, the company's large emphasis in GaAs IC production, particularly at its Yamanashi site, has yet to develop significant sales volumes overseas, although GaAs IC products have begun to ship to engineering workstation and supercomputer manufacturers with high expectations for overseas GaAs consumption.

Figure 5
Fujitsu's Semiconductor Revenue, by Region



Source: Dataquest (December 1992)

Semiconductor Investment

Table 9 and Figure 6 represent Fujitsu's semiconductor capital spending and R&D expense trends against overall semiconductor revenue for the past five years. The escalation of Fujitsu's investments during the last three years has made Fujitsu the clear semiconductor capital and R&D spending leader in Japan.

However, even by Fujitsu's standards, FY1991 was a record year for capital spending. The ¥154.4 billion spent on semiconductor capacity exceeded the levels spent by all other manufacturers by a wide margin both as a percentage of revenue and in absolute yen. Fujitsu's semiconductor capital-spending-to-revenue ratio came to an unusually high 42 percent, a number that obviously cannot be sustained for long without subsidies from Fujitsu's other business divisions. Falling semiconductor revenue since 1989 is partly to blame for the high ratio of capital spending to revenue; however, it does not explain how a company with semiconductor revenue nearly half that of NEC's can have 50 percent higher capital spending levels.

During the past three years, Fujitsu conducted major expansion of its domestic Wakamatsu ASIC plant, its Iwate memory facility, and one of its subsidiaries at the Yamanashi GaAs LSI facilities. A new 16Mb DRAM production plant at Mie is also scheduled for construction and completion before the end of 1992. Offshore, Fujitsu spent another ¥90 billion at Durham to complete that DRAM facility.

Fujitsu's R&D spending levels are more congruent with its competitors as a percentage of revenue. Fujitsu's 1992 semiconductor R&D costs are expected to rise by 7 percent above the 1991 R&D level.

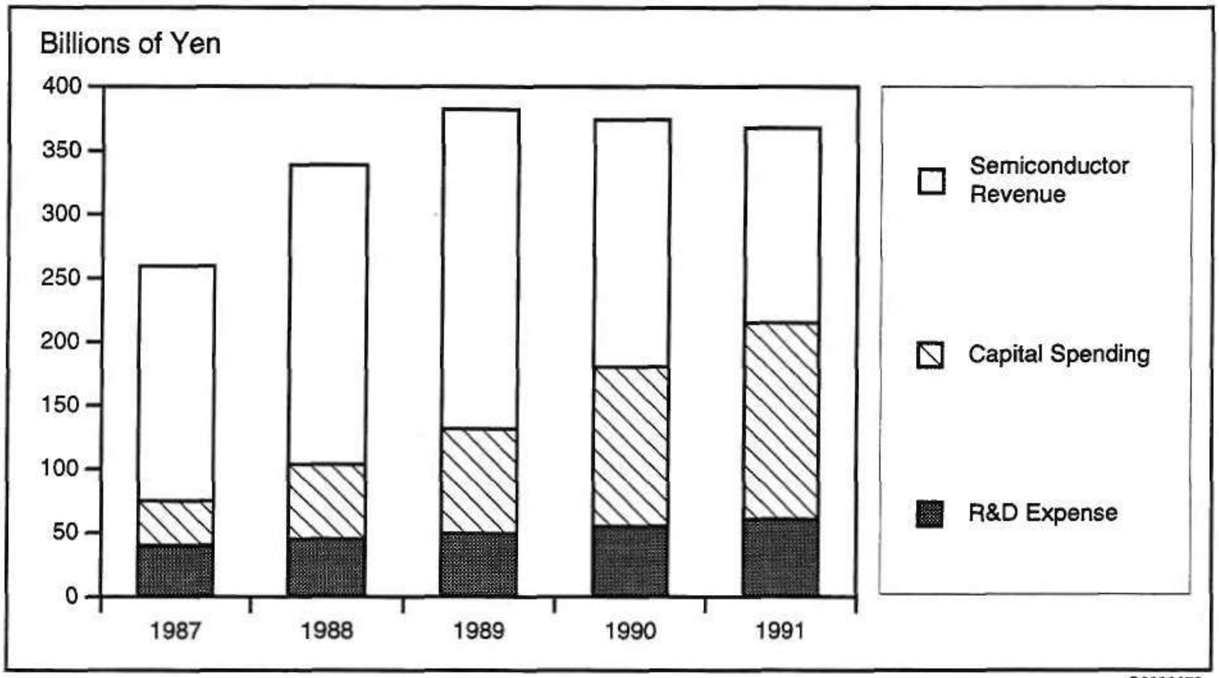
In 1992, worldwide semiconductor capital spending is expected to contract by 9.5 percent. Japan is expected to make the largest cuts in capital spending, with current projections calling for a decline of

Table 9
Fujitsu Semiconductor Investment: Capital Spending and R&D
(Billions of Yen)

	1987	1988	1989	1990	1991
Semiconductor Revenue	259.3	338.9	382.3	374.3	367.9
Capital Spending	35.0	58.7	82.1	125.5	154.4
Percentage of Revenue	13.5	17.3	21.5	33.5	42.0
R&D Expense	40.0	45.0	49.5	55.0	60.5
Percentage of Revenue	15.4	13.3	12.9	14.7	16.4
Total Investment to Revenue Percentage	28.9	30.6	34.4	48.2	58.4

Note: Semiconductor revenue and capital spending are calculated for calendar year periods, while R&D expense is stated for a Japanese fiscal year.
Source: Dataquest (December 1992)

Figure 6
Fujitsu Semiconductor Investment: Capital Spending and R&D



Source: Dataquest (December 1992)

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23.5 percent. Many Japanese semiconductor companies have already announced intentions to make major investment cuts in their 1992 budgets. Although Fujitsu has closed a memory assembly plant in San Diego, and downsized its work force at Fujitsu Microelectronics Inc., in San Jose, California, Fujitsu still appears to be in an expansion mode globally.

Manufacturing Facilities

Fujitsu owns five front-end fab facilities in Japan including its GaAs plant in Yamanashi. Fujitsu's two remaining front-end facilities are located overseas at Gresham, Oregon—which produces ASICs and 1Mb DRAMs—and Durham. The location, size of the work force, and semiconductor products made at Fujitsu's primary manufacturing sites are shown in Table 10. Figure 7 shows the relationship between various semiconductor manufacturing sites and possible chip production steps performed at the various Fujitsu plants.

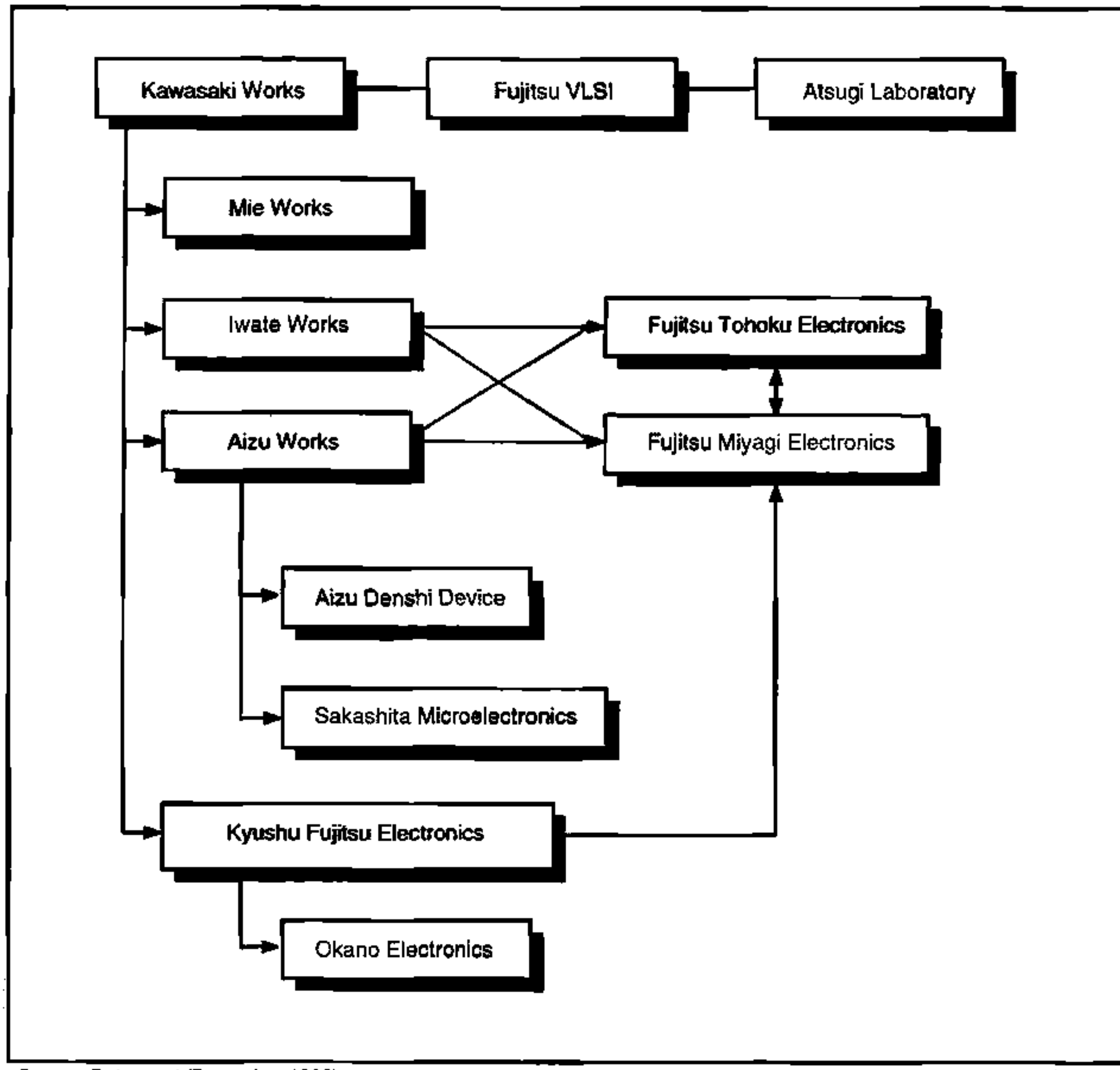
The EC body that governs semiconductor trade policy has already begun imposing import regulations, including procedures for defining, calculating, and establishing limits on foreign chips imported into the EC semiconductor markets. An EC committee has also made rulings defining a domestic semiconductor product as one that has its front-end wafer fabrication steps performed on European territory.

Table 10
Fujitsu Semiconductor Manufacturing Facilities

Plant Name	Location	Type	Product	Number of Employees	Year Opened
Domestic Facilities					
Aizu Works	Fukushima	F	Arrays, micro, EPROM	3,000	1984
Wakamatsu Works	Fukushima	F	ASIC	900	1985
Fujitsu VLSI	Gifu	R	R&D	1,020	1985
Iwate Works	Iwate	F	DRAM, SRAM, ROM	2,600	1984
Atsugi Laboratory	Kanagawa	R	R&D	NA	1987
Kawasaki	Kanagawa	PF	DRAM, HEMT, 3-D ICs	12,000	1938
Mie Works	Mie	PR	Memory, logic	1,500	1984
Quantum Device	Yamanashi	RF	Optoelectronics, GaAs, HEMT	450	1984
Fujitsu Miyagi Electronics	Miyagi	AT	Micro, gate array	670	1989
Fujitsu Tohoku Electronics	Fukushima	AT	Gate array	663	1981
Kyushu Fujitsu Electronics	Miyazaki	AT	Memory, micro, custom LSI	1,486	1985
Sakashita Microelectronics	Fukushima	AT	Discrete	150	1983
Aizu Denshi Device	Fukushima	AT	Micro, ASIC	75	1984
Okano Electronics	Kagoshima	AT	MOS memory	100	1987
Overseas Facilities					
Fujitsu Microelectronics	Gresham, Oregon	F	1Mb DRAM, gate array		1988
Fujitsu Microelectronics	Durham, United Kingdom	F	4Mb DRAM, ASIC		1988
Fujitsu Microelectronics Ireland	Dublin, Ireland	AT	Memory		1981
Fujitsu Microelectronics Asia	Singapore	AT	DRAM		1986
Fujitsu Component	Penang, Malaysia	AT	DRAM, TTL		1988

F: Fab
P: Pilot Line
R: Semiconductor R&D
A: Assembly
T: Test
NA = Not available
Source: Dataquest (December 1992)

Figure 7
Fujitsu Semiconductor Manufacturing Shift



Source: Dataquest (December 1992) G2002673

These mandates have induced major Japanese chip makers—such as Hitachi, NEC, and Toshiba—to construct or upgrade existing fabs in Europe in anticipation of unification of the European markets. Fujitsu's Durham plant is a complete front-end facility for manufacturing 4Mb DRAM and will supply the EC's current memory market. In addition, the company's VLSI Laboratory in London will design telecommunications chips for the EC, and an older facility in Ireland will test and assemble Fujitsu semiconductor products destined for EC markets.

Semiconductor Alliances

Fujitsu has long been a proponent of strategic alliances and joint ventures as a business strategy to leverage resources and to enter new markets. Table 11 lists Fujitsu's publicly announced alliances involving semiconductor-related projects formed during the past five years.

Dataquest classifies strategic alliances into the following major categories, as applied in Table 11.

- LA—Licensing agreement
- SS—Second source agreement
- SA—Sales agency agreement
- FA—Fab agreement
- AT—Assembly and testing agreement
- TE—Technology exchange
- JV—Joint venture
- JD—Joint development
- IV—Investment
- CO—Coordination of standard
- PC—Procurement agreement
- OT—Other

Fujitsu Microelectronics Inc. (FMI), located in San Jose, has pioneered international alliances and is still actively seeking partnerships to assist in its immediate goal of entering the field-programmable gate array business after its April reorganization. This business is believed to be complementary to Fujitsu's existing ASIC product lines and manufacturing capabilities. ASIC development and related design automation software are two likely areas that FMI will investigate as possible targets for alliances. Fujitsu has several ongoing joint ventures with software vendors in various countries. The exploration of further alliances involving software development has become a corporate mandate at Fujitsu. Fujitsu has already established an alliance with Cadence Design Systems Inc. to jointly develop design tools and has created an R&D company in the United States to further develop UNIX software.

Fujitsu has licensed the Rambus technology for implementing high-speed DRAM architectures. In addition, Fujitsu established links with the U.S. company HaL Computer Systems Inc. for the purpose of collectively developing next-generation UNIX systems for use in business environments.

Table 11
Fujitsu's Semiconductor Strategic Alliances

Date	Partner	Agreement Type	Product
5/88	NEC	JD	Military-use infrared seeker
6/88	Mizer/Wind River	JD	SPARC RISC MPU
1/89	Ikos Systems	TE	ASIC libraries
3/89	VIA Technologies	IV	SPARC peripherals
4/89	Sun Microsystems	SS, FA	SPARC RISC MPU
11/89	Vitesse Semiconductor	SS	GaAs material
11/89	Tandem Computers	SA	Wafer-scale memory
11/89	Texas Instrument Japan	LA, JD	ASIC software
1/90	Isuzu Motor	JV	Automotive electronics
1/90	Samsung	SS	Printer-control gate array
1/90	ASCII	JD, IV	16-, 32-bit MPUs
6/90	CrossCheck Technology	LA	ASIC testing technology
7/90	Signetics	SS, JD	Communications ICs
8/90	Toyota Motor	JV	CAE design for automobiles
8/90	Cray Computer	SS	GaAs ICs
10/90	Level One Communications	SS, JD	Communications ICs
11/90	Flash memory cards	FA	Flash memory cards
7/91	Tera Microsystems	FA	SPARC RISC chip set
8/91	SPARC RISC chip	LA	SPARC RISC MPU
8/91	HaL Computer Systems	JD, IV	CMOS RISC microprocessor
10/91	Cadence	JD	ASIC design tool
3/92	Rambus	LA	Memory interface technology
4/92	Wang Laboratories	LA	SIMM license
4/92	Samsung	LA	Cross-licensing
5/92	Mosel	FA	Memory
7/92	AMD	JV, JD	Flash memory

Source: Dataquest (December 1992)

Dataquest Perspective

Fujitsu has a character quite distinct from other Japanese electronics companies. In many ways, Fujitsu is an innovative trendsetter. By being an early advocate of strategic global alliances, the company pioneered this now pervasive business strategy as a means of entering new markets. Although its finances are generally conservative by Japanese standards, Fujitsu is equally willing to risk heavy investments in new technologies such as GaAs HEMT devices. The company established a high level of synergy among its various enterprises because of a focus that appears to be by design; Fujitsu does not make rice cookers, just all types of semiconductors that go into every telecommunications and computer system the company makes. Fujitsu has also adopted the concept that complete systems integration, involving both hardware and software, is the solution it needs to provide in order to effectively compete in future markets.

Fujitsu's semiconductor business appears to be struggling to maintain revenue levels while the company continues to add capacity. For Fujitsu to continue to maintain semiconductor capital spending levels that are more than 40 percent of semiconductor revenue, the semiconductors it produces must be tailored to give its system-level products a higher degree of competitive advantage.

X

Dataquest Vendor Profile

Semiconductors *Japan*
November 30, 1992

Hitachi Ltd.

Corporate Statistics

Address	Hitachi Ltd. 6, Kanda-Surugadai 4-chome, Chiyoda-ku, Tokyo 101
Phone	81-3-3258-1111
Facsimile	81-3-3253-2186
Chairman	Katsushige Mita
President	Tsutomu Kanai
Established	1910 (Incorporated in 1920)
Number of Employees	324,292 (as of March 31, 1992)
Total Sales	¥7,766 billion (FY1991)
Net Income	¥128 billion (FY1991)
Total Assets	¥8,858 billion (FY1991)
Main Product Area	Information systems and electronics Power and industrial systems Consumer products Materials and others

Corporate Overview

Hitachi Ltd. was founded in 1910 and initially emphasized the development of heavy electrical equipment and industrial machinery. After World War II, the company expanded into the consumer product area. In the 1950s, it entered into several electronics markets that eventually led to the production of semiconductors, computers, and various other consumer electronics devices. Over the years, Hitachi has continued to expand and diversify the scope of its business activities. Its growth has propelled it into the ranks of giant multinational corporate entities with highly leveraged competitive strengths, allowing it to excel in many high-technology fields.

Hitachi has 799 consolidated subsidiaries worldwide and 209 subsidiaries operating outside Japan.

For more information on Hitachi Ltd. or the semiconductor industry, call Junko Matsubara at (408) 437-8572.

SCJA-SVC-VP-9202

Corporate Business

Japanese industries experienced two distinct economic phases during fiscal year 1991. For the first half of the year, Japan remained in the tail end of the record-long "Heisei Boom," a historically periodic bubble economy. Although many economic forecasts predicted an earlier end of the boom in Japan, it lasted until the third quarter of the 1991 calendar year. While product sales in all business sectors were buoyed by the extended duration of the bubble, the ensuing burst was quickly followed by a steep decline into a recession that few anticipated. The climate at the close of 1991 could not have been more dissimilar to forecasts of the early part of the year.

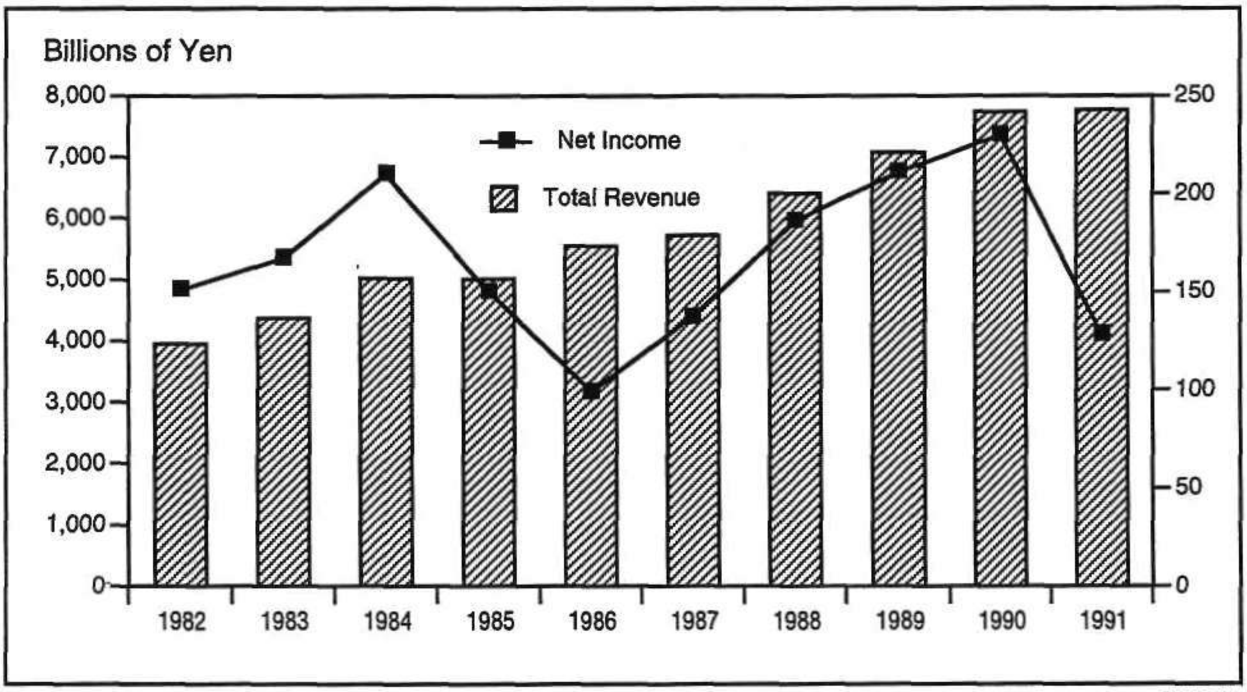
Hitachi's consolidated revenue was ¥7,766 billion in fiscal year (FY) 1991, a slight 0.4 percent increase over the previous year's showing (see Table 1). Hitachi's historical revenue trend is plotted in Figure 1. Although total sales were the highest in Hitachi's history, and the highest among Japan's electronics companies, net income fell 44.4 percent to ¥128 billion. The company attributed the drop in profits to the slowdown of consumer spending and corporate investment because of the unstable economy.

Table 1
Hitachi Ltd. Sales, by Product Segment and Market (Billions of Yen)

Fiscal Year	1987	1988	1989	1990	1991
Information Systems and Electronics	-	2,202	2,473	2,781	2,921
Power and Industrial Systems	-	1,959	2,243	2,358	2,459
Consumer Products	-	1,041	1,009	1,107	1,067
Materials and Others	-	1,686	1,884	2,101	2,105
Eliminations	-	-486	-530	-611	-787
Total	5,717	6,401	7,078	7,737	7,766
Fiscal Year	1987	1988	1989	1990	1991
Domestic Market	4,527	4,933	5,420	5,882	5,922
Percentage of Total Revenue	79.2	77.1	76.6	76.0	76.3
Overseas Market	1,190	1,469	1,658	1,855	1,844
Percentage of Total Revenue	20.8	22.9	23.4	24.0	23.7
Fiscal Year Exchange Rate (¥=U.S.$1)	138	128	142	141	133

Notes: Columns may not add to totals shown because of rounding.
The company has reorganized its industry segmentation from FY1988.
The figures for FY1987 were restated.
Source: Company literature, Dataquest (November 1992)

Figure 1
Hitachi Ltd. Total Revenue and Net Income (Billions of Yen)



Source: Company Literature, Dataquest (November 1992)

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Business Segments

Hitachi divides its operation into four major sectors: Information Systems and Electronics, Power Industrial Systems, Consumer Products, and Materials and Others. Consumer Products was the only area to show a negative growth during the year. This drop in performance was attributed to weak sales of consumer electronic products in Japan, in particular audio-visual (AV) related items, combined with a lack of new products and applications. Although the remaining divisions showed growth, the rates were modest, leading to a continuation of a steady leveling trend in the company's overall sales. Since FY1987, when Hitachi experienced a near 12.0 percent increase in revenue over the previous year's totals, the growth rate has dropped continuously to reach under 0.4 percent for 1991. The latest reduction in revenue has been associated with the decline in computer and semiconductor sales brought on by the poor economy in Japan.

Although not historically where Hitachi has its roots, the Information Systems and Electronics group has become the company's primary emphasis and now accounts for 34.2 percent of its revenue. Hitachi plans for computers and semiconductors to continue to play keys roles in its long-term business strategies.

In August 1992, Hitachi announced plans for consolidation of its various operations. For some time, Hitachi had followed a system of independent oversight at each of its plants, intended to encourage plants to be individually accountable. However, the system is now credited with having produced an overly conservative corporate culture that is somewhat lacking in direction and purpose. In the consolidation effort, Hitachi implemented a divisional control system to govern consumer products, computers, and semiconductors product areas. In about February 1989, the company began shifting control from each chip fabrication plant to a specialized division within its semiconductor operations. In contrast, Hitachi elected to retain its previous management structure within the heavy electric machinery product areas, thus resulting in the coexistence of two management systems within Hitachi.

International Business

In FY1991, 23.8 percent of Hitachi revenue was generated in overseas markets. As a percentage of total sales, overseas revenue peaked at 32.6 percent in 1985 and has since fallen steadily to its current level of between 23 and 24 percent. Most Japanese electronic companies' foreign trade has suffered from the combined effects of an appreciating yen on world currency markets and escalating trade friction, particularly with the United States and the European Community (EC). International semiconductor trade management adversely affected exports of Japanese semiconductor parts beginning in 1986 and severely altered revenue levels for most of the largest electronic businesses in Japan.

As were most of these large Japanese-based multinational companies, Hitachi was continuing to expand its overseas production capabilities. Currently 15.1 percent of the company's products are made outside of Japan, compared with a 5 percent offshore production level in 1987. Hitachi undoubtedly will continue to strengthen its overseas production capacity to increase its global presence and to insulate its revenue stream from the effects of domestic or localized foreign market fluctuations.

Corporate Investment

During FY1991, Hitachi invested ¥520 billion, or about 6.7 percent of its total sales, in research and development (R&D) activities (see Table 2). Hitachi's R&D has consistently ranked among the highest R&D investors among Japanese electronics companies. Although many Japanese companies have been criticized for overemphasizing applications and not contributing sufficiently to fundamental advances through basic research, Hitachi's corporate charter mandates that at least 1 percent of the corporate R&D expense be dedicated to funding basic research. In FY1991, basic research accounted for more than ¥5 billion of Hitachi's annual budget. As an indication of the effectiveness of these policies regarding R&D investment, Hitachi filed more U.S. patents than any other institution during two of the past three years. Although patent filings admittedly are a less-than-perfect measure of creativity or talent, they can act as a gauge of the intent and dedication a particular company has toward the creation of competitive advantage through development of intellectual property.

Table 2
Hitachi Ltd. Investment: Capital Spending and R&D (Billions of Yen)

Fiscal Year	1987	1988	1989	1990	1991
Total Revenue	5,717	6,401	7,078	7,737	7,766
Capital Spending	371	532	658	781	757
Percentage of Total Revenue	6.5	8.3	9.3	10.1	9.8
R&D Spending	332	374	429	491	520
Percentage of Total Revenue	5.8	5.8	6.1	6.3	6.7

Source: Company literature, Dataquest (November 1992)

Financial Condition in FY1991

Tables 3 and 4 depict the essence of Hitachi's consolidated financial statements. Although total sales in FY1991 reached a record high of ¥7,766 billion, net income was a mere ¥128 billion, representing a 44 percent decline in net revenue over the previous year's figure. However, while FY1991 did not hit the low income mark set in FY1986, the profitability ratio (net income divided by total sales) for FY1991 was actually below that achieved in FY1986. These low profitability totals during 1986 and 1991 are a trait prevalent in the financial history of virtually all major electronics companies in Japan. Even

Table 3
Hitachi Ltd. Consolidated Balance Sheet (Billions of Yen)

Fiscal Year	1987	1988	1989	1990	1991
Total Current Assets	4,303	4,869	5,390	5,751	5,849
Cash	1,404	1,638	1,853	1,648	1,495
Marketable Securities	350	385	324	384	487
Receivables	1,219	1,372	1,594	1,833	1,820
Inventory	1,135	1,250	1,355	1,597	1,750
Other Current Assets	193	224	263	286	295
Long-Term Receivables and Investments	396	445	493	575	608
Net Property, Plant, and Equipment	1,353	1,473	1,708	1,985	2,169
Other Assets	134	148	211	213	230
Total Assets	6,187	6,937	7,805	8,526	8,857
Total Current Liabilities	2,851	3,183	3,314	3,694	3,741
Long-Term Debt	907	1,002	1,380	1,411	1,540
Minority Interest	410	470	548	609	657
Total Liabilities	4,169	4,656	5,244	5,715	5,940
Total Shareholders' Equity	2,018	2,281	2,560	2,811	2,918
Common Stock	180	219	246	269	270
Additional Paid-In Capital	232	302	357	410	436
Retained Earnings	1,591	1,740	1,911	2,093	2,174
Other Equity	14	19	45	37	36
Total Liabilities and Shareholders' Equity	6,188	6,937	7,805	8,526	8,857
Fiscal Year Exchange Rate (¥=U.S.$1)	138	128	142	141	133

Note: Columns may not add to totals shown because of rounding.
Source: Company literature, Dataquest (November 1992)

Table 4
Hitachi Ltd. Consolidated Income Statement
(Billions of Yen)

Japanese Fiscal Year	1987	1988	1989	1990	1991
Net Sales	5,717	6,401	7,077	7,737	7,765
Domestic Sales	4,286	4,932	5,420	5,881	5,921
Overseas Sales	1,431	1,468	1,657	1,855	1,844
Cost of Goods Sold	4,122	4,552	5,023	5,417	5,488
SG & A Expense	1,275	1,416	1,553	1,813	1,924
Operating Income	319	433	501	506	352
Operating Income Margin (%)	5.6	6.8	7.1	6.5	4.5
Other Income (Loss)	141	143	177	204	187
Other Expenses	80	85	148	149	164
Interest	72	71	97	129	140
Others	8	13	51	19	24
Income before Income Taxes	380	491	530	562	374
Effective Tax Rate (%)	56	56	54	52	52
Income Taxes	218	272	281	290	219
Income after Income Taxes	161	218	248	271	155
Minority Interests and Others	24	32	37	41	27
Net Income	136	185	211	230	127
Fiscal Year Exchange Rate (¥=U.S.$1)	138	128	142	141	133

Note: Columns may not add to totals shown because of rounding.
Source: Source: Company literature, Dataquest (November 1992)

though Hitachi's profitability still exceeds those of major competitors such as NEC and Toshiba, the 1.6 percent net has left the company just as concerned with market forecasts as competitors that did not fare as well during the year. As with most Japanese electronics giants, Hitachi was strongly affected by soft demand for both computer systems and semiconductor components.

Hitachi has an uncommonly high return on sales ratio, equal to earnings before taxes divided by net sales, than its corresponding operating income margin, equal to operating income divided by net sales, would normally suggest. This irregularity seems to indicate that Hitachi has a surplus of extra income, such as from stock dividends and funds generated from ventures outside of its primary businesses, relative to its interest payments. Hitachi frequently is among the Japanese corporations that generate the most supplemental income from financial activities outside of their primary business ventures. These ventures have contributed significantly to Hitachi's overall financial performance during lean periods such as FY1991. However, even this source of income dwindled for Hitachi during 1991; having peaked in 1990, the supplement fell by 8.4 percent to a total ¥187.8 billion for 1991. Japan's slow economy and recent financial scandals all have contributed to a climate in which investors have lesser confidence in stocks as a secondary investment strategy. This lack of confidence has resulted in severe stock price declines since October 1991. Japanese electronics companies often generate funds for large capital investment by equity financing. The reduction of stock values has made it more difficult for most Japanese electronics companies, including Hitachi, to finance new investment via equity financing. During FY1991, however, Hitachi still maintained a supplemental income that ranked third in Japan behind Toyota and Matsushita.

Financial Analysis

Table 5 summarizes key figures, which represent Hitachi's financial status, and compares them with those of Matsushita and NEC in FY1991. Japanese electronics companies typically can maintain stable stock values with financial ratios and low liquidity figures that would normally precipitate stock devaluation in the United States. By Japanese standards, however, Hitachi maintains relatively high liquidity and leverage ratios in its distinctly conservative approach to corporate finances. This conservatism is shown in Table 5, where Hitachi's financial ratios are in stark contrast to the aggressive business style of the smaller NEC. Despite annual profitability that fell steeply in FY1991, Hitachi maintains a greater profitability than NEC.

Traditionally, many large corporations' have large blocks of their stocks owned by financial institutions in Japan. This has often led to or been the result of actions designed to expand or promote a particular keiretsu. In a surprising divergence from this norm, 29.4 percent of Hitachi's stock is owned by individual investors, including its own employees, making Hitachi one of Japan's most publicly owned companies. Hence Hitachi's shareholder profile has perhaps secured Hitachi from the dominant influence of any single keiretsu. While Hitachi has created its own internal league, known as the Hitachi Group, this label is more indicative of a conventional business grouping that associates a collection of businesses that all belong to a parent organization.

Hitachi's ownership profile also includes a significant number of foreign shareholders comprising a 15.3 percent interest in the company. This ratio is the second highest in Japan, behind Sony, and is indicative of Hitachi's global status as a good stock investment with tolerable risk. Furthermore, the international appeal of Hitachi's stock might also help to explain the rather conservative approach to its finances. Table 6 lists the company's top 10 shareholders and the size of their holdings. Of particular interest to foreigners may be the high representation of competing keiretsu interests in the form of such organizations as Mitsubishi and the Sumitomo group, the keiretsu with heavy influence at NEC.

Table 5
Hitachi Ltd. Financial Ratios

	1987	1988	1989	1990	1991	Matsushita	NEC
Total Sales	5,717	6,401	7,078	7,737	7,766	7,449	3,774
Net Income	137	186	211	230	128	133	15
Total Asset	5,621	6,938	7,805	8,526	8,858	9,020	4,081
Operating Income Margin (%)	5.6	6.8	7.1	6.6	4.5	5.2	3.2
Net Income/Total Sales (%)	2.4	2.9	3.0	3.0	1.6	1.8	0.4
Foreign Sales/Total Sales (%)	20.8	22.9	23.4	24.0	23.7	48.2	21.0
Corporate R&D/Total Sales (%)	5.8	5.8	6.1	6.3	6.7	6.1	8.0
Semiconductor Sales (¥B)	377	456	500	506	512	277	649
Semiconductor Sales/Total Sales (%)	6.6	7.1	7.1	6.5	6.6	3.7	17.2
Sales/Employee (¥M)	21.655	23.320	24.338	24.978	23.946	30.750	29.410
Net Income/Employee (¥M)	0.518	0.676	0.725	0.743	0.394	0.549	0.119
Growth Rate							
Total Sales (%)	10.8	12.0	10.6	9.3	0.4	12.9	-49.3
Net Income (%)	68.7	35.7	13.7	9.1	-44.6	-48.7	-88.5
Financial Ratios							
Current Ratio	1.51	1.53	1.63	1.56	1.56	1.36	1.19
Quick Ratio	1.11	1.14	1.22	1.12	1.10	1.03	0.76
Sales/Net Working Capital (NWC)	3.94	3.80	3.41	3.76	3.68	6.33	9.88
NWC/Total Assets	0.23	0.24	0.27	0.24	0.24	0.13	0.09
Debt-Equity Ratio	0.45	0.44	0.54	0.50	0.53	0.45	1.30
Total Asset Turnover	0.92	0.92	0.91	0.91	0.88	0.83	0.92
Return on Sales (%)	6.7	7.7	7.5	7.3	4.8	4.9	1.4
Return on Assets (%)	6.1	7.1	6.8	6.6	4.2	4.0	1.3
Return on Equity (%)	6.8	8.1	8.2	8.2	4.4	3.8	1.7
Earning per Share	22.74	33.62	37.71	37.92	25.12	52.28	25.17
Payout Ratio	0.40	0.27	0.29	0.29	0.44	0.24	0.40

Source: Company literature, Dataquest (November 1992)

Table 6
Hitachi Ltd. Top 10 Shareholders

Shareholders	Percentage Share
Nippon Life Insurance	3.9
Mitsubishi Trust & Banking	2.6
Dai-ichi Life Insurance	2.5
Hitachi Group Employee Own	2.4
Industrial Bank of Japan	2.3
Sanwa Bank	2.3
Toyo Trust & Banking	2.1
Sumitomo Trust & Banking	2.1
Meiji Life Insurance	2.0
Dai-ichi Kangyo Bank	2.0

Source: Company literature (November 1992)

Semiconductor Climate of 1991

Worldwide semiconductor sales totaled $59.7 billion in 1991, which exceeded the previous year's sales by 9.4 percent. The Japanese market comprised 37.7 percent of the global 1991 market with $22.5 billion in sales and continued to make Japan the single largest region for chip consumption. Japanese semiconductor consumption has grown 11.1 percent during the past year. The Japanese market expanded by a slight 0.6 percent, relative to the world market, during a one-year period.

In terms of suppliers, Japan's 46.4 percent share of the 1991 global market nearly matched the 1990 figure of 46.3 percent. Asia/Pacific-Rest of World suppliers made market share gains at the expense of North American and European companies.

The Japanese companies continued their dominance of the DRAM market but lost market share to Korean companies. Samsung became the No. 2 supplier of commodity DRAMs products, trailing only Toshiba. U.S.-based semiconductor companies lost worldwide share; however, many of these companies continued to lead the world in microprocessors and design-intensive ASIC/ASSP chips.

Hitachi Semiconductor Overview

According to Dataquest's semiconductor market share estimates, Hitachi had $3.77 billion in semiconductor revenue during 1991, ranking the company fifth among global competitors. In Japan's domestic market, Hitachi captured the No. 2 position. Hitachi has consistently performed well as a semiconductor supplier but has never fully realized its potential to dominate as a chip supplier. If this has been by strategic design, then the Hitachi business strategy has been vindicated during the recent semiconductor recession because many of Hitachi's major competitors, more heavily dependent on semiconductor revenue, sustained greater losses in the chip markets during FY1991. Nevertheless, Hitachi placed first among Japanese suppliers to the domestic MOS memory markets in 1991. Hitachi's early lead in 4Mb DRAM technology is at least partially responsible for its strength in domestic memory markets. Table 7 summarizes Hitachi's semiconductor ranking by product segment in 1991.

Product Strategy

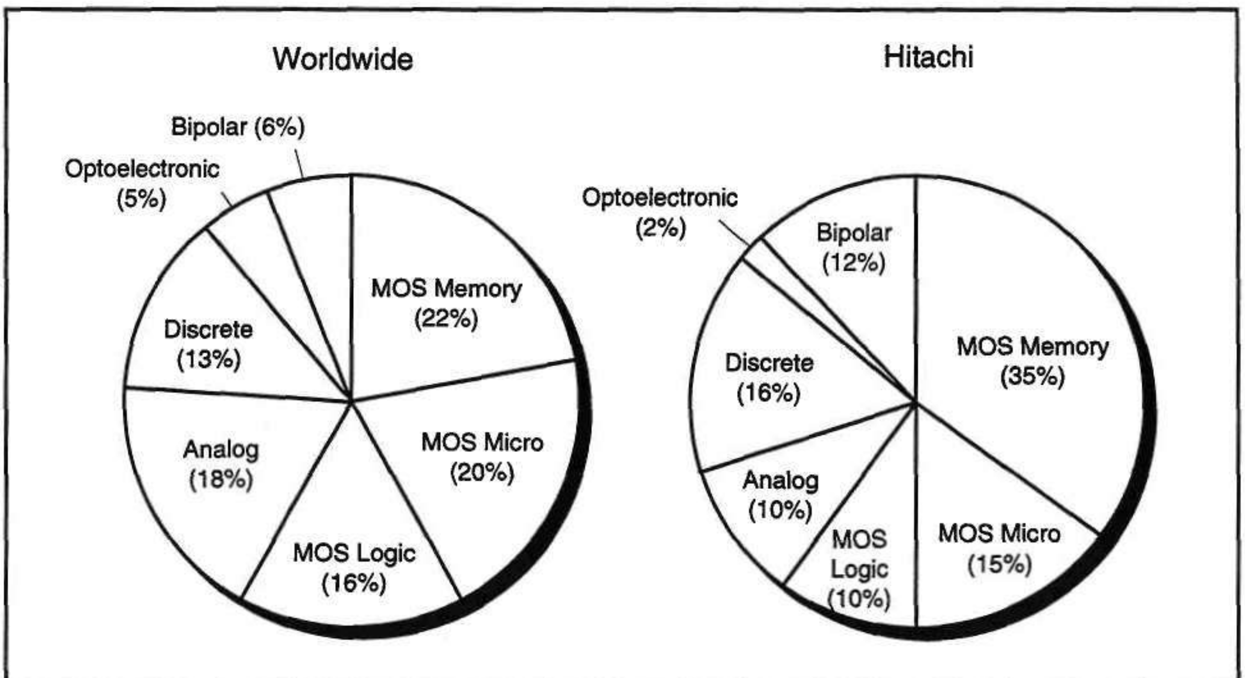
Figure 2 shows both Hitachi's semiconductor product mix revenue and the worldwide product mix revenue recorded in 1991. Hitachi's strengths reside in its MOS capabilities. Total MOS production, including memories, microcomponents, and logic, nearly match world demand for MOS products. Like most Japanese semiconductor manufacturers, Hitachi's semiconductor revenue is heavily dependent on commodity MOS memories, which accounted for more than one-third of its total semiconductor business. DRAMs contributed about 18 percent to total semiconductor revenue, which translates to about 50 percent of Hitachi's MOS memory sales. About 70 percent of all DRAMs sold by Hitachi in 1991 were of the 4Mb variety. Although

Table 7
Estimated 1991 Hitachi Ranking, by Product Segment

	Worldwide Market	Japanese Market
Total Semiconductor	5	2
Total Integrated Circuit	4	2
Bipolar Digital	3	2
MOS	4	2
MOS Memory	2	1
MOS Microcomponents	4	4
MOS Logic	8	5
Analog	13	6
Total Discrete	3	2
Total Optoelectronic	12	9

Source: Dataquest (November 1992)

Figure 2
1991 Semiconductor Market Share Product Mix: Worldwide versus Hitachi



Source: Dataquest (November 1992)

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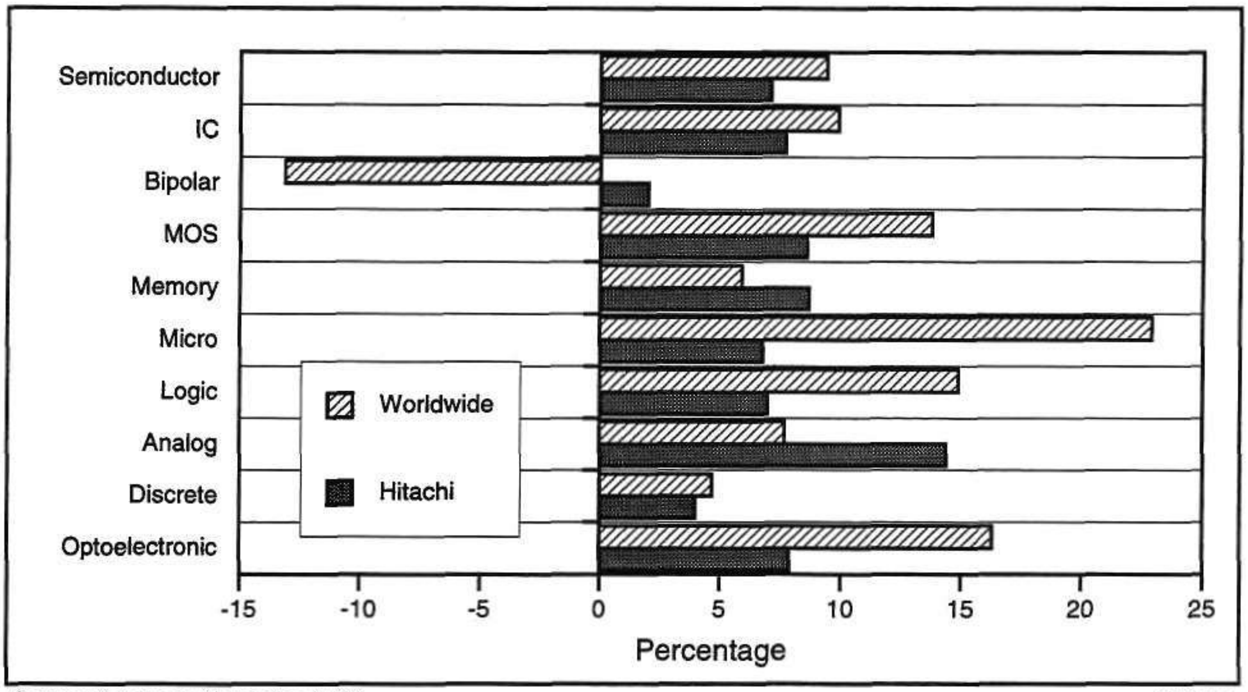
this figure was sufficient to propel Hitachi into the position of leading market supplier of 4Mb parts, 1990 saw a rapid erosion of 4Mb DRAM prices as demand fell short of both supply and booking projections. The repercussions of these events were that, while Hitachi's market share held firm, the DRAM business was not profitable during 1991.

The rapid deterioration of DRAM markets, coupled with the determination of Korean manufacturers to establish a dominant role in these markets, has caused most Japanese DRAM manufacturers to suspend or delay their advanced DRAM manufacturing plans. Hitachi completed construction of a new building at Naka Plant, and the company planned to install equipment for 16Mb DRAM mass production by the end of 1992. However, Hitachi recently decided to freeze this additional equipment investment because of uncertain 16Mb DRAM demand. Hitachi has also made the strategic decision to reduce memory revenue as percentage of total semiconductor sales from its current value of more than 35 percent to a goal of about 30 percent.

Figure 3 compares Hitachi's semiconductor growth rates, by product category, against corresponding product growth rates on the world market for 1991. Hitachi clearly has been a dominant supplier of MOS memory and has outpaced world growth in this area. Yet the cost of gaining this market share at a rate surpassing the growth of the market itself may have been too high and directly related to Hitachi's subsequent decision to scale back memory emphasis relative to other semiconductor endeavors. The diminishing returns of dominating the memory business, particularly in the capital-intensive DRAM businesses, no longer appear cost-effective unless one clings to expectations of driving competitors completely out of the business by thorough market domination. Such a strategy is clearly unrealistic given today's proliferation of technology alliances and the determination of many nations' governments to subsidize development of leading-edge memory fabrication technologies. In the year's major growth areas of microcomponents and logic, Hitachi failed to capitalize on its MOS expertise. This inability to grow with the increased demand for microcomponents and logic possibly is because of its overemphasis on memory production. Hitachi's absence as a significant producer of a main stream CISC or RISC microprocessor may be another reason for its minor role in these markets.

Based on its actions to date, it would appear that Hitachi, as a vertically integrated player, prefers to manufacture microprocessors primarily for internal use in its own systems products. Open RISC architectures, such as the SPARC and MIPS standards, offer the most readily accessible platforms for foundries and second-source manufacturers to gain microprocessor market share as RISC architectures expand their acceptance. Rather than adopt this strategy to become another commodity RISC vendor, Hitachi elected to align with the Hewlett-Packard Precision RISC Architecture. Although this architecture is also rapidly becoming another viable open platform, it trails both SPARC and MIPS in the number of different companies supporting its designs. It is therefore possible that Hitachi's role as a

Figure 3
Hitachi's 1991 Growth Rate, Compared with the Worldwide Market



Source: Dataquest (November 1992)

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less-than-dominant supplier of microprocessors is more of a business decision than an inability to position itself within the market. While it may seem to be a conservative approach to an important market, the HP/Hitachi lead efforts probably have as much of an opportunity to establish a standard as the IBM-Apple-Motorola Power RISC chip designs. Furthermore, the cause of these RISC designs in trying to make a transition from proprietary to open architectures has perhaps not been hurt by the merger between Silicon Graphics Inc. and MIPS. This is because many may regard the SGI-MIPS merger as an obstruction to a truly open architecture based on the MIPS designs. In any case, at this point an SGI/MIPS lead consortium would seem to be no more viable than an HP/Hitachi lead consortium in creating a successful open platform.

Hitachi's lack of performance in the logic/ASIC markets could also be linked to conscious decisions to focus on providing for its own internal requirements and to maintain a competitive advantage for systems produced higher in the vertical structure of the company.

Bipolar products accounted for 12.7 percent of Hitachi's semiconductor revenue. Pure bipolar product lines are shrinking categorically because of the widespread success of BiCMOS, which generally offer more control of speed, power, and integration density trade-offs than do pure bipolar devices. Unfortunately, categorization of parts has not yet expanded to include this class of devices. Hitachi is considered a leading producer of components made in BiCMOS, which is often used as an indicator of the technical sophistication of a company's semiconductor fabrication technology.

Table 8 provides Hitachi' semiconductor revenue, by product segment, for the past five years.

Regional Market

Figure 4 shows Hitachi's semiconductor revenue, broken into four major regional markets. About one-third of Hitachi's total revenue was generated in overseas markets during 1991. Foreign sales of MOS memories captured about half of Hitachi's memory revenue, and helped offset the weak domestic memory markets during the same year.

Semiconductor Investment

Table 9 and Figure 5 present Hitachi's semiconductor capital spending and R&D expense trends against overall semiconductor revenue for the past five years. Capital spending and R&D costs have steadily increased to where Hitachi reinvested about one-third of its semiconductor revenue in 1991. Hitachi achieved a high revenue-to-investment efficiency in semiconductor sales during the past decade, not an uncommon trait for a dominant memory supplier during that time frame. In 1987, because of a semiconductor business downturn, Hitachi cut its capital spending to ¥38 billion, or about 10 percent of revenue. This action is believed to have resulted in Toshiba's forging ahead in the 1Mb DRAM race, and Hitachi has subsequently been spending heavily to regain and maintain a lead in 4Mb that never fully developed as expected. In terms of R&D, Hitachi had been investing about 14 to 15 percent of semiconductor revenue up until 1989, when it began increasing that rate to reach 18.4 percent by 1991.

Although absolute R&D costs continue to escalate, revenue increases have not kept pace with the cost of advanced R&D projects and thus R&D expenditure as a percentage of revenue tends to exaggerate R&D investment trends, even though the burden is real and must be sustained by flat revenue. Hitachi enjoys the luxury of having sufficient capital to indulge in many long-term basic research projects that have uncertain commercial value. Nevertheless, the rate at which patents are generated by Hitachi guarantees that the company will not be at a disadvantage when intellectual licensing exchanges are made.

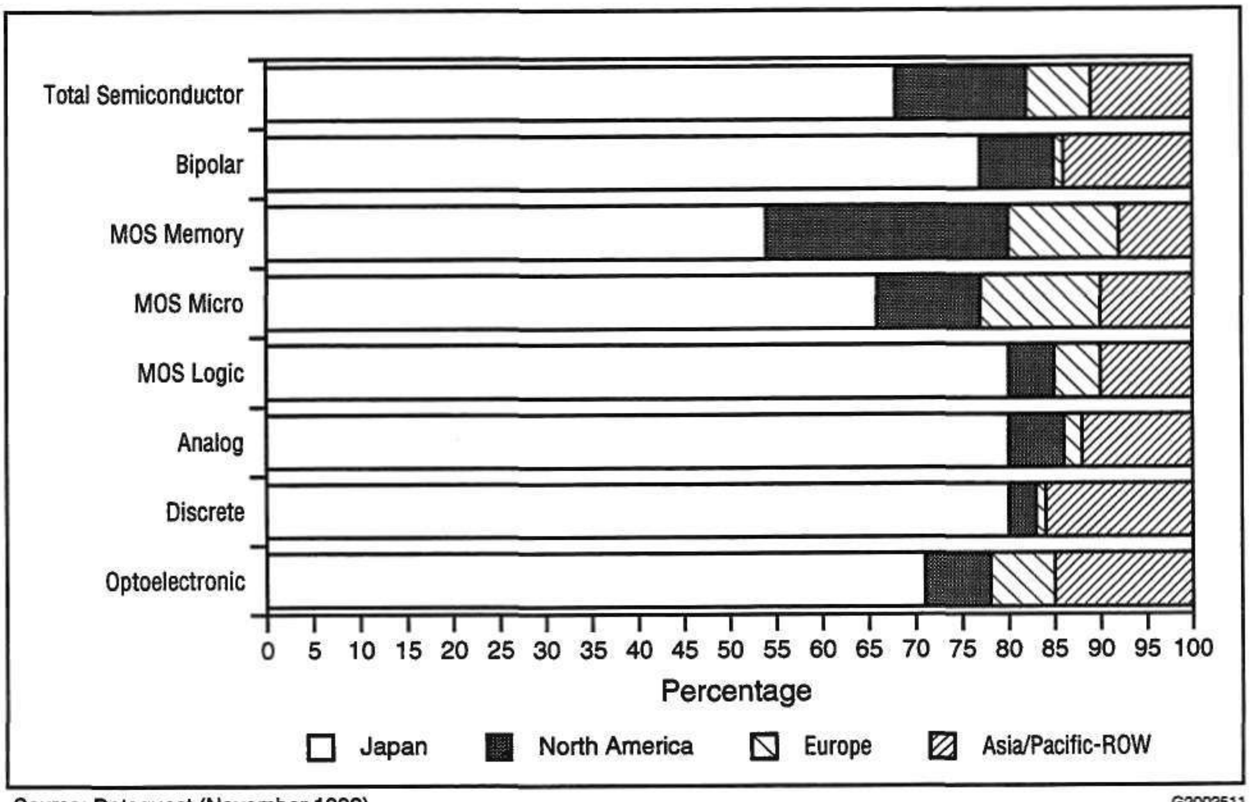
Hitachi has been devoting more than 30 percent of its total corporate investment, which includes both capital spending and R&D expenditure, on semiconductor-related activities. Since Hitachi's merchant semiconductor sales accounted for only 6.6 percent of total corporate revenue during 1991, a relatively modest figure compared with figures from competitors such as NEC and Toshiba, Hitachi's commitment toward establishing a competitive advantage through the development of semiconductor technologies remains clear. The application of technology toward merchant chip products or systems further up the manufacturing tree is what separates Hitachi from those that place a greater emphasis on their merchant semiconductor sales.

Table 8
Estimated Semiconductor Revenue, by Product in Worldwide Market
(Billions of Yen)

Calendar Year	1987	1988	1989	1990	1991	1991 Market Share (%)
Total Semiconductor	377.0	455.8	499.8	506.3	512.0	6.3
Total Integrated Circuit	280.2	354.8	409.3	414.4	421.5	6.3
Bipolar Digital	66.7	65.1	61.7	65.1	62.7	12.7
TTL/Other	51.3	48.9	42.5	44.4	34.0	9.8
ECL	15.4	16.3	19.2	20.7	28.7	19.5
Bipolar Digital	66.7	65.1	61.7	65.1	62.7	12.7
Bipolar Digital Memory	13.7	15.5	13.4	13.7	13.5	27.8
Bipolar Digital Logic	53.0	49.7	48.3	51.4	49.2	11.4
MOS (Technology)	168.9	245.1	305.0	304.3	310.1	6.6
N/PMOS	67.8	93.7	61.5	61.3	59.4	7.3
CMOS	100.7	150.4	229.8	229.1	235.0	6.2
BiCMOS	0.4	0.9	13.7	13.8	15.6	20.5
MOS (Function)	168.9	245.1	305.0	304.3	310.1	66.4
MOS Memory	82.9	144.8	192.6	176.3	180.9	10.4
MOS Microcomponent	57.9	68.3	69.7	78.6	79.3	5.0
MOS Logic	28.1	32.0	42.6	49.4	49.9	3.8
Analog	44.6	44.6	42.6	45.1	48.7	3.3
Total Discrete	90.0	91.9	82.0	82.8	81.3	7.4
Total Optoelectronics	6.8	9.1	8.6	9.1	9.2	2.4
Exchange Rate (¥=U.S.$1)	144	130	138	144	136	

Note: Columns may not add to totals because of rounding.
Source: Dataquest (November 1992)

Figure 4
Hitachi's Semiconductor Revenue, by Region



Source: Dataquest (November 1992)

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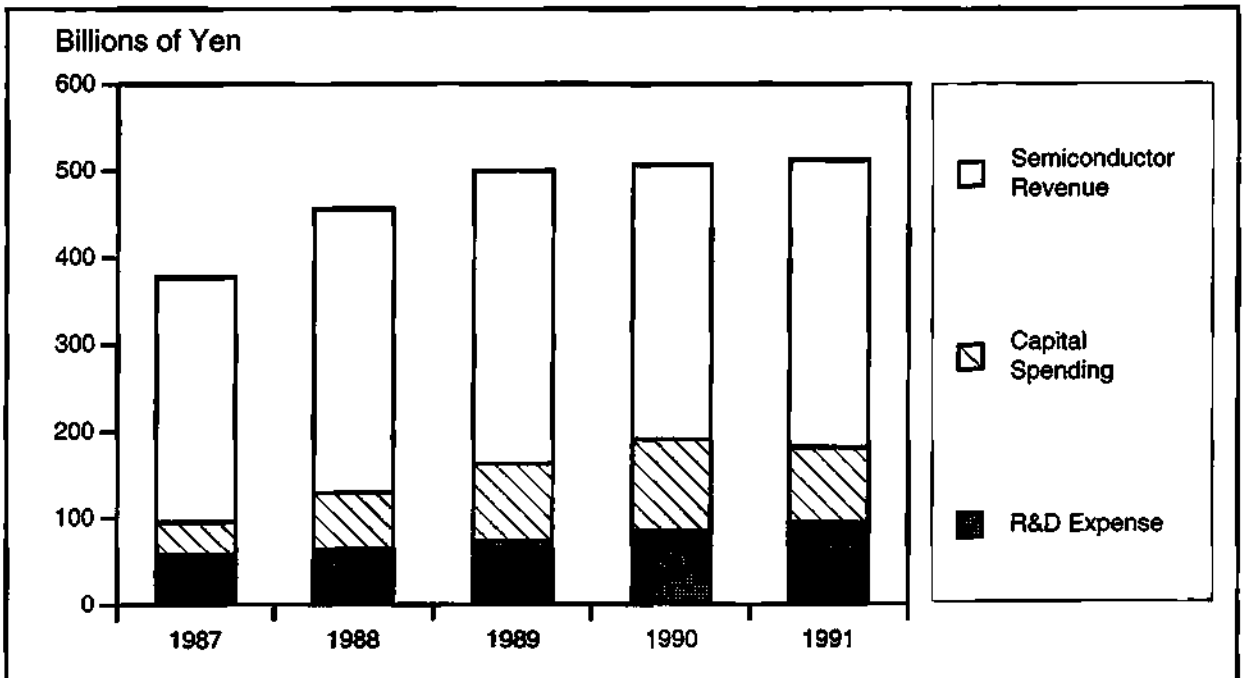
Table 9
Semiconductor Investment: Capital Spending and R&D (Billions of Yen)

	1987	1988	1989	1990	1991
Semiconductor Revenue	377.0	455.8	499.8	506.3	512.0
Capital Spending	37.5	65.0	88.8	106.3	87.5
Percentage of Revenue	9.9	14.3	17.8	21.0	17.1
R&D Expense	58.0	64.0	73.5	84.5	94.0
Percentage of Revenue	15.4	14.0	14.7	16.7	18.4
Total Investment to Revenue	25.3	28.3	32.5	37.7	35.4

Note: Semiconductor revenue and capital spending are calculated for calendar year periods, while R&D expense is stated for a Japanese fiscal year.
Source: Dataquest (November 1992)

Figure 5
Hitachi Semiconductor Investment: Capital Spending and R&D



Source: Dataquest (November 1992)

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Manufacturing Facilities

Hitachi generally manages front-end production in its own plants and channels end production and assembly/testing to subsidiaries or affiliated companies. Table 10 shows the location, work force size, and semiconductor products made at Hitachi's primary manufacturing sites. Figure 6 shows the relationship between various semiconductor manufacturing sites and possible chip production steps performed at the various Hitachi plants.

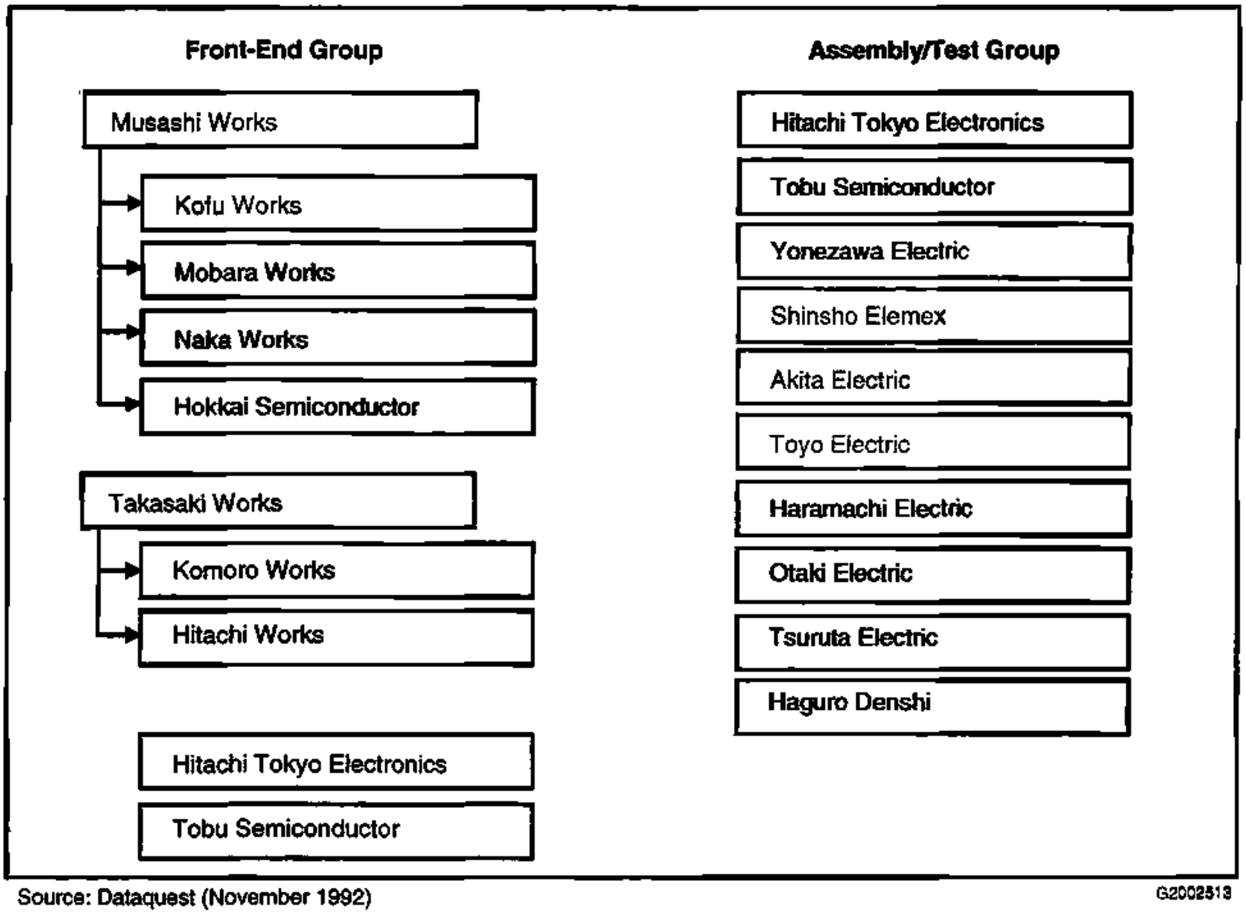
Hitachi completed a new front-end fab facility in Germany at the close of 1991. The EC body that governs semiconductor trade policy has already begun defensive moves, including procedures for defining, calculating, and establishing limits on foreign chips imported into the EC semiconductor markets. An EC committee has also made rulings on semiconductors that require front-end wafer fabrication to be performed on European territory to qualify as "made in EC." These mandates have induced major Japanese chip makers such as Hitachi and NEC to construct or upgrade existing fabs in Europe in anticipation of unification of the European markets. Hitachi's total investment at its Germany fab line is estimated to be more than $450 million. Current schedules call for the plant in Germany to produce 4Mb DRAM and logic chips; fab line qualification testing is now under way.

Table 10
Hitachi Semiconductor Manufacturing Facilities

Plant Name	Location	Facility	Product	Number of Employees	Year Opened
Domestic Facilities					
Mobara Works	Chiba	F	Memory, logic, TFT	400	1943
Komoro Works	Nagano	F	Optoelectonics	900	1969
Takasaki Works	Gunma	F	Bipolar, logic, ROM	2,000	1988
Hokkai Semiconductor	Hokkaido	F	DRAM, SRAM	750	1982
Hitachi Works	Ibaragi	F	Discrete	200	1910
Naka Works	Ibaragi	F	DRAM, equipment	300	1961
Musashi Works	Tokyo	PR	MOS IC, VLSI	2,600	1958
Central Research Lab	Tokyo	R	R&D	NA	NA
Device Development Center	Tokyo	R	Micro, semi custom ICs	1,000	1983
Kofu Works	Yamanashi	F	Memory, micro, logic	1,300	1969
Hitachi Tokyo Electronics	Yamanashi	AT	MOS ICs, discrete	50	NA
Tobu Semiconductor	Aomori	FAT	Linear, logic, SRAM	600	1974
Tsuruta Electric	Aomori	AT	Discrete, GaAs	450	1981
Yonezawa Electric	Yamagata	AT	MOS ICs	700	1969
Haguro Denshi	Yamagata	AT	MOS ICs	240	1984
Shinsho Elemex	Yamagata	AT	Bipolar	185	1983
Akita Electric Tenno	Akita	AT	MOS, bipolar	550	1969
Akita Electric Yuwa	Akita	AT	MOS ICs	650	1982
Toyo Electric	Niigata	AT	Bipolar digital	260	1973
Haramachi Electric	Ibaragi	AT	Discrete	500	1973
Otaki Electric	Chiba	F	LCD module	160	NA
Overseas Facilities					
Hitachi America	Irving, Texas	F	Micro, DRAM, SRAM		1988
Hitachi Denshi	Landshut, Germany	FAT	DRAM, micro, bipolar		1980
Hitachi Semiconductor	Taiwan	AT	Transistor		1967
Hitachi Semiconductor	Penang, Malaysia	AT	DRAM, micro, bipolar		1972

NA = Not available
F: Fab
P: Pilot line
R: Semiconductor R&D
A: Assembly
T: Test
Source: Dataquest (November 1992)

Figure 6
Hitachi Semiconductor Manufacturing Shift



Source: Dataquest (November 1992)

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Semiconductor Alliances

Table 11 lists Hitachi's publicly announced alliances formed during the past five years. Hitachi was, and continues to be, an early ally to HP in efforts to transform HP's RISC architecture into an open platform. In addition, Hitachi has often been linked to Texas Instruments in various ambitious technology codevelopment agreements. In fact the close ties between TI and Hitachi were cause for concern by Sematech members as a potential source of a technology leak. Having had a peak number of alliances in 1989, Hitachi continues to embrace alliances as a business methodology; its rate of entering new alliance agreements leveled at about four per year for the past several years.

Dataquest classifies strategic alliances into the following major categories, as applied in Table 11:

- LA—Licensing agreement
- SS—Second-source agreement
- SA—Sales agency agreement
- FA—Fab agreement
- AT—Assembly and testing agreement
- TE—Technology exchange
- JV—Joint venture
- JD—Joint development
- IV—Investment
- CO—Coordination of standard
- PC—Procurement agreement
- OT—Other

Dataquest Perspective

Hitachi, a leading supplier of everything from home appliances to heavy machinery and from semiconductors to supercomputers, is both vertically and horizontally diversified. During FY1991, Hitachi's Information & Communication Systems and Electronic Devices Division generated 34.2 percent of Hitachi's total revenue, a percentage that has been steadily increasing during the past few years. Key to the continued success of this division is development of leading-edge semiconductor technology in which Hitachi is investing heavily. Although Hitachi possesses the capacity to be a more aggressive merchant semiconductor supplier, there is evidence to suggest that Hitachi has chosen to utilize much of its technology to gain competitive advantage in systems-level products rather than as a dominant merchant.

Collectively, HP and Hitachi lead a RISC consortium that is a formidable threat to the SPARC, MIPS, or Power designs. As a systems supplier in the fast-growing workstation and PC markets, Hitachi has yet to make an impact. Hitachi's strategy of designing systems around the HP PA RISC is consistent with its role as a sophisticated supplier of systems. By combining its expertise in semiconductor manufacturing of MOS logic, memories, and microprocessors with its established systems manufacturing capabilities, the workstation and PC products it fields should prove both competitive and interesting.

Table 11
Hitachi's Semiconductor Strategic Alliances

Date	Partner	Agreement Type	Product
1/87	Chinese government	LA	Linear IC assembly and test
4/87	VLSI Technology	FA	1Mb mask ROM
8/87	Oklahoma University	JD	Product and material
9/89	Nanometrics	LA	Equipment
10/87	International Rectifier	LA	Power MOS-FETs
7/89	Mitsubishi	CO	EDTV chip sets
9/88	Intel Japan	PC	Consumer MPUs
12/88	Texas Instruments	JD	16Mb DRAM
1/89	VLSI Technology	FA	High-speed SRAM
6/89	National Semiconductor	LA, JD	Logic IC
7/89	Texas Instruments	SS	256Kb SRAM
7/89	Kimsung (Goldstar)	SS, TE	1Mb DRAM
7/89	Hewlett-Packard	TE	RISC MPU
7/89	Cray Computer	LA	Supercomputer
9/89	National Semiconductor	SS	CMOS logic ICs
10/89	Goldstar	LA, SS	1Mb DRAM
6/90	Hewlett-Packard	LA	RISC MPU
6/90	Goldstar	LA	4Mb DRAM
8/90	Nissan Motor	JV	Automotive electronics
5/91	Compass Design Automation	JD	0.8-micron ASIC cell libraries
6/91	NMB Semiconductors	FA	4Mb DRAMs
8/91	Bull	LA	IC card
11/91	Texas Instruments	JD	64Mb DRAM
3/92	Wang Laboratories	LA	SIMM
4/92	Oki	JD, CO	HP PA-RISC MPU
4/92	Texas Instruments	SA, FA, CO	BiCMOS bus interface
7/92	National Semiconductor	FA	CMOS logic devices

Source: Dataquest (November 1992)

Dataquest Vendor Profile

Semiconductors *Japan*
November 30, 1992

Hitachi Ltd.

Corporate Statistics

Address	Hitachi Ltd. 6, Kanda-Surugadai 4-chome, Chiyoda-ku, Tokyo 101
Phone	81-3-3258-1111
Facsimile	81-3-3253-2186
Chairman	Katsushige Mita
President	Tsutomu Kanai
Established	1910 (Incorporated in 1920)
Number of Employees	324,292 (as of March 31, 1992)
Total Sales	¥7,766 billion (FY1991)
Net Income	¥128 billion (FY1991)
Total Assets	¥8,858 billion (FY1991)
Main Product Area	Information systems and electronics Power and industrial systems Consumer products Materials and others

Corporate Overview

Hitachi Ltd. was founded in 1910 and initially emphasized the development of heavy electrical equipment and industrial machinery. After World War II, the company expanded into the consumer product area. In the 1950s, it entered into several electronics markets that eventually led to the production of semiconductors, computers, and various other consumer electronics devices. Over the years, Hitachi has continued to expand and diversify the scope of its business activities. Its growth has propelled it into the ranks of giant multinational corporate entities with highly leveraged competitive strengths, allowing it to excel in many high-technology fields.

Hitachi has 799 consolidated subsidiaries worldwide and 209 subsidiaries operating outside Japan.

For more information on Hitachi Ltd. or the semiconductor industry, call Junko Matsubara at (408) 437-8572.

SGJA-SVC-VP-9202

Corporate Business

Japanese industries experienced two distinct economic phases during fiscal year 1991. For the first half of the year, Japan remained in the tail end of the record-long "Heisei Boom," a historically periodic bubble economy. Although many economic forecasts predicted an earlier end of the boom in Japan, it lasted until the third quarter of the 1991 calendar year. While product sales in all business sectors were buoyed by the extended duration of the bubble, the ensuing burst was quickly followed by a steep decline into a recession that few anticipated. The climate at the close of 1991 could not have been more dissimilar to forecasts of the early part of the year.

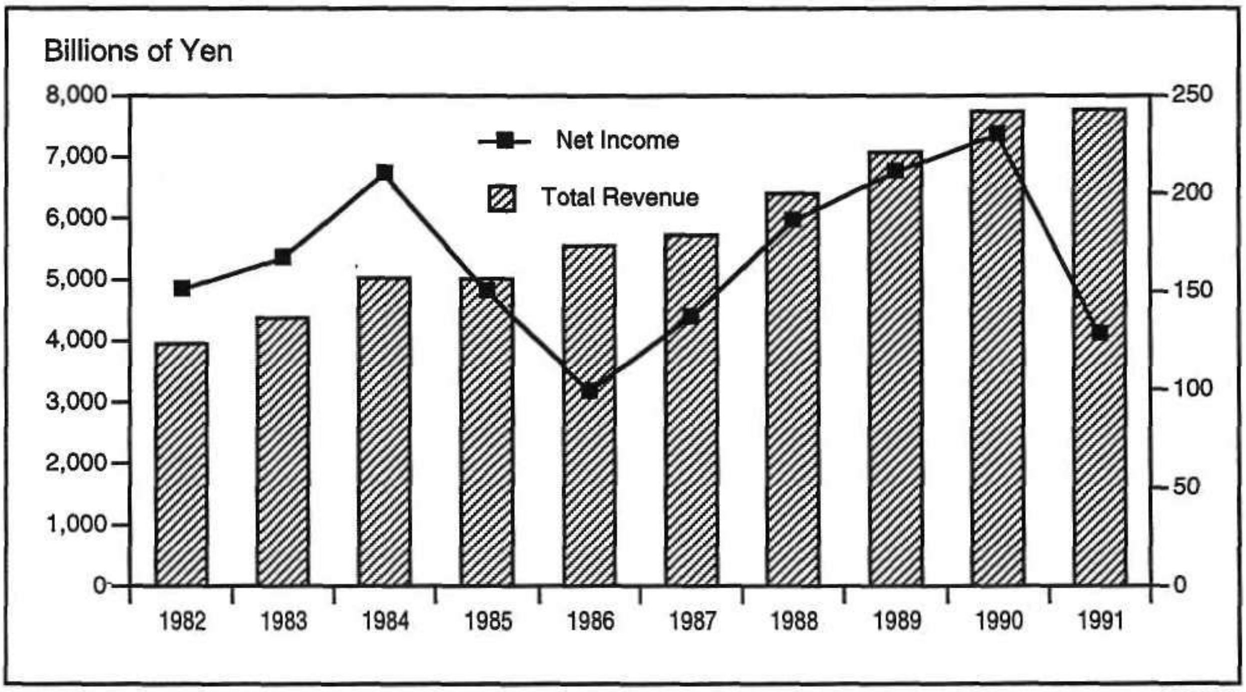
Hitachi's consolidated revenue was ¥7,766 billion in fiscal year (FY) 1991, a slight 0.4 percent increase over the previous year's showing (see Table 1). Hitachi's historical revenue trend is plotted in Figure 1. Although total sales were the highest in Hitachi's history, and the highest among Japan's electronics companies, net income fell 44.4 percent to ¥128 billion. The company attributed the drop in profits to the slowdown of consumer spending and corporate investment because of the unstable economy.

Table 1
Hitachi Ltd. Sales, by Product Segment and Market (Billions of Yen)

Fiscal Year	1987	1988	1989	1990	1991
Information Systems and Electronics	-	2,202	2,473	2,781	2,921
Power and Industrial Systems	-	1,959	2,243	2,358	2,459
Consumer Products	-	1,041	1,009	1,107	1,067
Materials and Others	-	1,686	1,884	2,101	2,105
Eliminations	-	-486	-530	-611	-787
Total	5,717	6,401	7,078	7,737	7,766
Fiscal Year	1987	1988	1989	1990	1991
Domestic Market	4,527	4,933	5,420	5,882	5,922
Percentage of Total Revenue	79.2	77.1	76.6	76.0	76.3
Overseas Market	1,190	1,469	1,658	1,855	1,844
Percentage of Total Revenue	20.8	22.9	23.4	24.0	23.7
Fiscal Year Exchange Rate (¥=U.S.$1)	138	128	142	141	133

Notes: Columns may not add to totals shown because of rounding.
The company has reorganized its industry segmentation from FY1988.
The figures for FY1987 were restated.
Source: Company literature, Dataquest (November 1992)

Figure 1
Hitachi Ltd. Total Revenue and Net Income (Billions of Yen)



Source: Company Literature, Dataquest (November 1992)

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Business Segments

Hitachi divides its operation into four major sectors: Information Systems and Electronics, Power Industrial Systems, Consumer Products, and Materials and Others. Consumer Products was the only area to show a negative growth during the year. This drop in performance was attributed to weak sales of consumer electronic products in Japan, in particular audio-visual (AV) related items, combined with a lack of new products and applications. Although the remaining divisions showed growth, the rates were modest, leading to a continuation of a steady leveling trend in the company's overall sales. Since FY1987, when Hitachi experienced a near 12.0 percent increase in revenue over the previous year's totals, the growth rate has dropped continuously to reach under 0.4 percent for 1991. The latest reduction in revenue has been associated with the decline in computer and semiconductor sales brought on by the poor economy in Japan.

Although not historically where Hitachi has its roots, the Information Systems and Electronics group has become the company's primary emphasis and now accounts for 34.2 percent of its revenue. Hitachi plans for computers and semiconductors to continue to play keys roles in its long-term business strategies.

In August 1992, Hitachi announced plans for consolidation of its various operations. For some time, Hitachi had followed a system of independent oversight at each of its plants, intended to encourage plants to be individually accountable. However, the system is now credited with having produced an overly conservative corporate culture that is somewhat lacking in direction and purpose. In the consolidation effort, Hitachi implemented a divisional control system to govern consumer products, computers, and semiconductors product areas. In about February 1989, the company began shifting control from each chip fabrication plant to a specialized division within its semiconductor operations. In contrast, Hitachi elected to retain its previous management structure within the heavy electric machinery product areas, thus resulting in the coexistence of two management systems within Hitachi.

International Business

In FY1991, 23.8 percent of Hitachi revenue was generated in overseas markets. As a percentage of total sales, overseas revenue peaked at 32.6 percent in 1985 and has since fallen steadily to its current level of between 23 and 24 percent. Most Japanese electronic companies' foreign trade has suffered from the combined effects of an appreciating yen on world currency markets and escalating trade friction, particularly with the United States and the European Community (EC). International semiconductor trade management adversely affected exports of Japanese semiconductor parts beginning in 1986 and severely altered revenue levels for most of the largest electronic businesses in Japan.

As were most of these large Japanese-based multinational companies, Hitachi was continuing to expand its overseas production capabilities. Currently 15.1 percent of the company's products are made outside of Japan, compared with a 5 percent offshore production level in 1987. Hitachi undoubtedly will continue to strengthen its overseas production capacity to increase its global presence and to insulate its revenue stream from the effects of domestic or localized foreign market fluctuations.

Corporate Investment

During FY1991, Hitachi invested ¥520 billion, or about 6.7 percent of its total sales, in research and development (R&D) activities (see Table 2). Hitachi's R&D has consistently ranked among the highest R&D investors among Japanese electronics companies. Although many Japanese companies have been criticized for overemphasizing applications and not contributing sufficiently to fundamental advances through basic research, Hitachi's corporate charter mandates that at least 1 percent of the corporate R&D expense be dedicated to funding basic research. In FY1991, basic research accounted for more than ¥5 billion of Hitachi's annual budget. As an indication of the effectiveness of these policies regarding R&D investment, Hitachi filed more U.S. patents than any other institution during two of the past three years. Although patent filings admittedly are a less-than-perfect measure of creativity or talent, they can act as a gauge of the intent and dedication a particular company has toward the creation of competitive advantage through development of intellectual property.

Table 2
Hitachi Ltd. Investment: Capital Spending and R&D
(Billions of Yen)

Fiscal Year	1987	1988	1989	1990	1991
Total Revenue	5,717	6,401	7,078	7,737	7,766
Capital Spending	371	532	658	781	757
Percentage of Total Revenue	6.5	8.3	9.3	10.1	9.8
R&D Spending	332	374	429	491	520
Percentage of Total Revenue	5.8	5.8	6.1	6.3	6.7

Source: Company literature, Dataquest (November 1992)

Financial Condition in FY1991

Tables 3 and 4 depict the essence of Hitachi's consolidated financial statements. Although total sales in FY1991 reached a record high of ¥7,766 billion, net income was a mere ¥128 billion, representing a 44 percent decline in net revenue over the previous year's figure. However, while FY1991 did not hit the low income mark set in FY1986, the profitability ratio (net income divided by total sales) for FY1991 was actually below that achieved in FY1986. These low profitability totals during 1986 and 1991 are a trait prevalent in the financial history of virtually all major electronics companies in Japan. Even

Table 3
Hitachi Ltd. Consolidated Balance Sheet (Billions of Yen)

Fiscal Year	1987	1988	1989	1990	1991
Total Current Assets	4,303	4,869	5,390	5,751	5,849
Cash	1,404	1,638	1,853	1,648	1,495
Marketable Securities	350	385	324	384	487
Receivables	1,219	1,372	1,594	1,833	1,820
Inventory	1,135	1,250	1,355	1,597	1,750
Other Current Assets	193	224	263	286	295
Long-Term Receivables and Investments	396	445	493	575	608
Net Property, Plant, and Equipment	1,353	1,473	1,708	1,985	2,169
Other Assets	134	148	211	213	230
Total Assets	6,187	6,937	7,805	8,526	8,857
Total Current Liabilities	2,851	3,183	3,314	3,694	3,741
Long-Term Debt	907	1,002	1,380	1,411	1,540
Minority Interest	410	470	548	609	657
Total Liabilities	4,169	4,656	5,244	5,715	5,940
Total Shareholders' Equity	2,018	2,281	2,560	2,811	2,918
Common Stock	180	219	246	269	270
Additional Paid-In Capital	232	302	357	410	436
Retained Earnings	1,591	1,740	1,911	2,093	2,174
Other Equity	14	19	45	37	36
Total Liabilities and Shareholders' Equity	6,188	6,937	7,805	8,526	8,857
Fiscal Year Exchange Rate (¥=U.S.$1)	138	128	142	141	133

Note: Columns may not add to totals shown because of rounding.
Source: Company literature, Dataquest (November 1992)

Table 4
Hitachi Ltd. Consolidated Income Statement
(Billions of Yen)

Japanese Fiscal Year	1987	1988	1989	1990	1991
Net Sales	5,717	6,401	7,077	7,737	7,765
Domestic Sales	4,286	4,932	5,420	5,881	5,921
Overseas Sales	1,431	1,468	1,657	1,855	1,844
Cost of Goods Sold	4,122	4,552	5,023	5,417	5,488
SG & A Expense	1,275	1,416	1,553	1,813	1,924
Operating Income	319	433	501	506	352
Operating Income Margin (%)	5.6	6.8	7.1	6.5	4.5
Other Income (Loss)	141	143	177	204	187
Other Expenses	80	85	148	149	164
Interest	72	71	97	129	140
Others	8	13	51	19	24
Income before Income Taxes	380	491	530	562	374
Effective Tax Rate (%)	56	56	54	52	52
Income Taxes	218	272	281	290	219
Income after Income Taxes	161	218	248	271	155
Minority Interests and Others	24	32	37	41	27
Net Income	136	185	211	230	127
Fiscal Year Exchange Rate (¥=U.S.$1)	138	128	142	141	133

Note: Columns may not add to totals shown because of rounding.
Source: Source: Company literature, Dataquest (November 1992)

though Hitachi's profitability still exceeds those of major competitors such as NEC and Toshiba, the 1.6 percent net has left the company just as concerned with market forecasts as competitors that did not fare as well during the year. As with most Japanese electronics giants, Hitachi was strongly affected by soft demand for both computer systems and semiconductor components.

Hitachi has an uncommonly high return on sales ratio, equal to earnings before taxes divided by net sales, than its corresponding operating income margin, equal to operating income divided by net sales, would normally suggest. This irregularity seems to indicate that Hitachi has a surplus of extra income, such as from stock dividends and funds generated from ventures outside of its primary businesses, relative to its interest payments. Hitachi frequently is among the Japanese corporations that generate the most supplemental income from financial activities outside of their primary business ventures. These ventures have contributed significantly to Hitachi's overall financial performance during lean periods such as FY1991. However, even this source of income dwindled for Hitachi during 1991; having peaked in 1990, the supplement fell by 8.4 percent to a total ¥187.8 billion for 1991. Japan's slow economy and recent financial scandals all have contributed to a climate in which investors have lesser confidence in stocks as a secondary investment strategy. This lack of confidence has resulted in severe stock price declines since October 1991. Japanese electronics companies often generate funds for large capital investment by equity financing. The reduction of stock values has made it more difficult for most Japanese electronics companies, including Hitachi, to finance new investment via equity financing. During FY1991, however, Hitachi still maintained a supplemental income that ranked third in Japan behind Toyota and Matsushita.

Financial Analysis

Table 5 summarizes key figures, which represent Hitachi's financial status, and compares them with those of Matsushita and NEC in FY1991. Japanese electronics companies typically can maintain stable stock values with financial ratios and low liquidity figures that would normally precipitate stock devaluation in the United States. By Japanese standards, however, Hitachi maintains relatively high liquidity and leverage ratios in its distinctly conservative approach to corporate finances. This conservatism is shown in Table 5, where Hitachi's financial ratios are in stark contrast to the aggressive business style of the smaller NEC. Despite annual profitability that fell steeply in FY1991, Hitachi maintains a greater profitability than NEC.

Traditionally, many large corporations' have large blocks of their stocks owned by financial institutions in Japan. This has often led to or been the result of actions designed to expand or promote a particular keiretsu. In a surprising divergence from this norm, 29.4 percent of Hitachi's stock is owned by individual investors, including its own employees, making Hitachi one of Japan's most publicly owned companies. Hence Hitachi's shareholder profile has perhaps secured Hitachi from the dominant influence of any single keiretsu. While Hitachi has created its own internal league, known as the Hitachi Group, this label is more indicative of a conventional business grouping that associates a collection of businesses that all belong to a parent organization.

Hitachi's ownership profile also includes a significant number of foreign shareholders comprising a 15.3 percent interest in the company. This ratio is the second highest in Japan, behind Sony, and is indicative of Hitachi's global status as a good stock investment with tolerable risk. Furthermore, the international appeal of Hitachi's stock might also help to explain the rather conservative approach to its finances. Table 6 lists the company's top 10 shareholders and the size of their holdings. Of particular interest to foreigners may be the high representation of competing keiretsu interests in the form of such organizations as Mitsubishi and the Sumitomo group, the keiretsu with heavy influence at NEC.

Table 5
Hitachi Ltd. Financial Ratios

	1987	1988	1989	1990	1991	Matsushita	NEC
Total Sales	5,717	6,401	7,078	7,737	7,766	7,449	3,774
Net Income	137	186	211	230	128	133	15
Total Asset	5,621	6,938	7,805	8,526	8,858	9,020	4,081
Operating Income Margin (%)	5.6	6.8	7.1	6.6	4.5	5.2	3.2
Net Income/Total Sales (%)	2.4	2.9	3.0	3.0	1.6	1.8	0.4
Foreign Sales/Total Sales (%)	20.8	22.9	23.4	24.0	23.7	48.2	21.0
Corporate R&D/Total Sales (%)	5.8	5.8	6.1	6.3	6.7	6.1	8.0
Semiconductor Sales (¥B)	377	456	500	506	512	277	649
Semiconductor Sales/Total Sales (%)	6.6	7.1	7.1	6.5	6.6	3.7	17.2
Sales/Employee (¥M)	21.655	23.320	24.338	24.978	23.946	30.750	29.410
Net Income/Employee (¥M)	0.518	0.676	0.725	0.743	0.394	0.549	0.119
Growth Rate							
Total Sales (%)	10.8	12.0	10.6	9.3	0.4	12.9	-49.3
Net Income (%)	68.7	35.7	13.7	9.1	-44.6	-48.7	-88.5
Financial Ratios							
Current Ratio	1.51	1.53	1.63	1.56	1.56	1.36	1.19
Quick Ratio	1.11	1.14	1.22	1.12	1.10	1.03	0.76
Sales/Net Working Capital (NWC)	3.94	3.80	3.41	3.76	3.68	6.33	9.88
NWC/Total Assets	0.23	0.24	0.27	0.24	0.24	0.13	0.09
Debt-Equity Ratio	0.45	0.44	0.54	0.50	0.53	0.45	1.30
Total Asset Turnover	0.92	0.92	0.91	0.91	0.88	0.83	0.92
Return on Sales (%)	6.7	7.7	7.5	7.3	4.8	4.9	1.4
Return on Assets (%)	6.1	7.1	6.8	6.6	4.2	4.0	1.3
Return on Equity (%)	6.8	8.1	8.2	8.2	4.4	3.8	1.7
Earning per Share	22.74	33.62	37.71	37.92	25.12	52.28	25.17
Payout Ratio	0.40	0.27	0.29	0.29	0.44	0.24	0.40

Source: Company literature, Dataquest (November 1992)

Table 6
Hitachi Ltd. Top 10 Shareholders

Shareholders	Percentage Share
Nippon Life Insurance	3.9
Mitsubishi Trust & Banking	2.6
Dai-ichi Life Insurance	2.5
Hitachi Group Employee Own	2.4
Industrial Bank of Japan	2.3
Sanwa Bank	2.3
Toyo Trust & Banking	2.1
Sumitomo Trust & Banking	2.1
Meiji Life Insurance	2.0
Dai-ichi Kangyo Bank	2.0

Source: Company literature (November 1992)

Semiconductor Climate of 1991

Worldwide semiconductor sales totaled $59.7 billion in 1991, which exceeded the previous year's sales by 9.4 percent. The Japanese market comprised 37.7 percent of the global 1991 market with $22.5 billion in sales and continued to make Japan the single largest region for chip consumption. Japanese semiconductor consumption has grown 11.1 percent during the past year. The Japanese market expanded by a slight 0.6 percent, relative to the world market, during a one-year period.

In terms of suppliers, Japan's 46.4 percent share of the 1991 global market nearly matched the 1990 figure of 46.3 percent. Asia/Pacific-Rest of World suppliers made market share gains at the expense of North American and European companies.

The Japanese companies continued their dominance of the DRAM market but lost market share to Korean companies. Samsung became the No. 2 supplier of commodity DRAMs products, trailing only Toshiba. U.S.-based semiconductor companies lost worldwide share; however, many of these companies continued to lead the world in microprocessors and design-intensive ASIC/ASSP chips.

Hitachi Semiconductor Overview

According to Dataquest's semiconductor market share estimates, Hitachi had $3.77 billion in semiconductor revenue during 1991, ranking the company fifth among global competitors. In Japan's domestic market, Hitachi captured the No. 2 position. Hitachi has consistently performed well as a semiconductor supplier but has never fully realized its potential to dominate as a chip supplier. If this has been by strategic design, then the Hitachi business strategy has been vindicated during the recent semiconductor recession because many of Hitachi's major competitors, more heavily dependent on semiconductor revenue, sustained greater losses in the chip markets during FY1991. Nevertheless, Hitachi placed first among Japanese suppliers to the domestic MOS memory markets in 1991. Hitachi's early lead in 4Mb DRAM technology is at least partially responsible for its strength in domestic memory markets. Table 7 summarizes Hitachi's semiconductor ranking by product segment in 1991.

Product Strategy

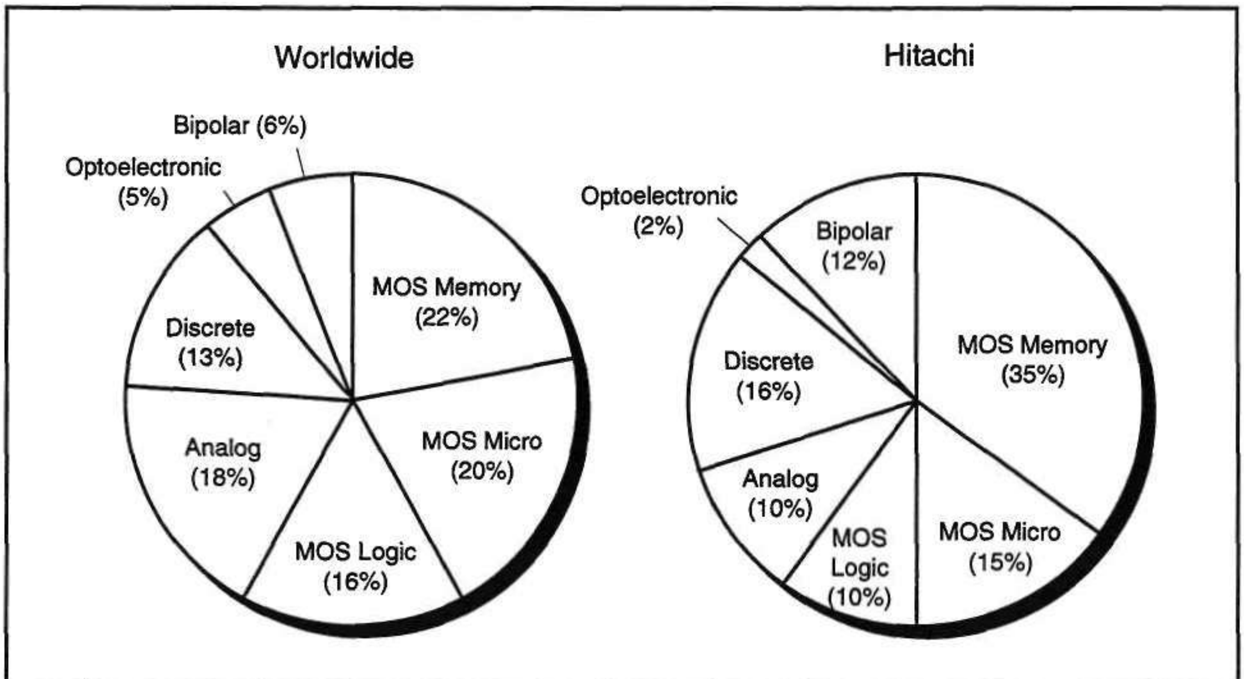
Figure 2 shows both Hitachi's semiconductor product mix revenue and the worldwide product mix revenue recorded in 1991. Hitachi's strengths reside in its MOS capabilities. Total MOS production, including memories, microcomponents, and logic, nearly match world demand for MOS products. Like most Japanese semiconductor manufacturers, Hitachi's semiconductor revenue is heavily dependent on commodity MOS memories, which accounted for more than one-third of its total semiconductor business. DRAMs contributed about 18 percent to total semiconductor revenue, which translates to about 50 percent of Hitachi's MOS memory sales. About 70 percent of all DRAMs sold by Hitachi in 1991 were of the 4Mb variety. Although

Table 7
Estimated 1991 Hitachi Ranking, by Product Segment

	Worldwide Market	Japanese Market
Total Semiconductor	5	2
Total Integrated Circuit	4	2
Bipolar Digital	3	2
MOS	4	2
MOS Memory	2	1
MOS Microcomponents	4	4
MOS Logic	8	5
Analog	13	6
Total Discrete	3	2
Total Optoelectronic	12	9

Source: Dataquest (November 1992)

Figure 2
1991 Semiconductor Market Share Product Mix: Worldwide versus Hitachi



Source: Dataquest (November 1992)

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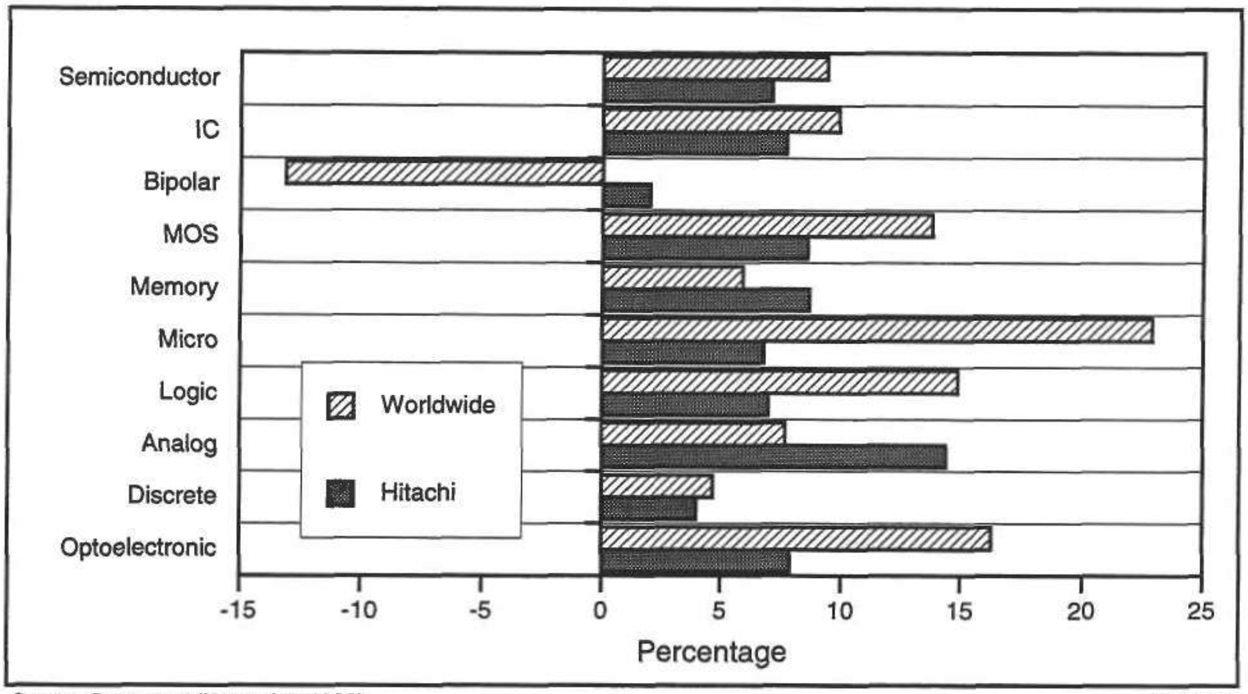
this figure was sufficient to propel Hitachi into the position of leading market supplier of 4Mb parts, 1990 saw a rapid erosion of 4Mb DRAM prices as demand fell short of both supply and booking projections. The repercussions of these events were that, while Hitachi's market share held firm, the DRAM business was not profitable during 1991.

The rapid deterioration of DRAM markets, coupled with the determination of Korean manufacturers to establish a dominant role in these markets, has caused most Japanese DRAM manufacturers to suspend or delay their advanced DRAM manufacturing plans. Hitachi completed construction of a new building at Naka Plant, and the company planned to install equipment for 16Mb DRAM mass production by the end of 1992. However, Hitachi recently decided to freeze this additional equipment investment because of uncertain 16Mb DRAM demand. Hitachi has also made the strategic decision to reduce memory revenue as percentage of total semiconductor sales from its current value of more than 35 percent to a goal of about 30 percent.

Figure 3 compares Hitachi's semiconductor growth rates, by product category, against corresponding product growth rates on the world market for 1991. Hitachi clearly has been a dominant supplier of MOS memory and has outpaced world growth in this area. Yet the cost of gaining this market share at a rate surpassing the growth of the market itself may have been too high and directly related to Hitachi's subsequent decision to scale back memory emphasis relative to other semiconductor endeavors. The diminishing returns of dominating the memory business, particularly in the capital-intensive DRAM businesses, no longer appear cost-effective unless one clings to expectations of driving competitors completely out of the business by thorough market domination. Such a strategy is clearly unrealistic given today's proliferation of technology alliances and the determination of many nations' governments to subsidize development of leading-edge memory fabrication technologies. In the year's major growth areas of microcomponents and logic, Hitachi failed to capitalize on its MOS expertise. This inability to grow with the increased demand for microcomponents and logic possibly is because of its overemphasis on memory production. Hitachi's absence as a significant producer of a main stream CISC or RISC microprocessor may be another reason for its minor role in these markets.

Based on its actions to date, it would appear that Hitachi, as a vertically integrated player, prefers to manufacture microprocessors primarily for internal use in its own systems products. Open RISC architectures, such as the SPARC and MIPS standards, offer the most readily accessible platforms for foundries and second-source manufacturers to gain microprocessor market share as RISC architectures expand their acceptance. Rather than adopt this strategy to become another commodity RISC vendor, Hitachi elected to align with the Hewlett-Packard Precision RISC Architecture. Although this architecture is also rapidly becoming another viable open platform, it trails both SPARC and MIPS in the number of different companies supporting its designs. It is therefore possible that Hitachi's role as a

Figure 3
Hitachi's 1991 Growth Rate, Compared with the Worldwide Market



Source: Dataquest (November 1992)

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less-than-dominant supplier of microprocessors is more of a business decision than an inability to position itself within the market. While it may seem to be a conservative approach to an important market, the HP/Hitachi lead efforts probably have as much of an opportunity to establish a standard as the IBM-Apple-Motorola Power RISC chip designs. Furthermore, the cause of these RISC designs in trying to make a transition from proprietary to open architectures has perhaps not been hurt by the merger between Silicon Graphics Inc. and MIPS. This is because many may regard the SGI-MIPS merger as an obstruction to a truly open architecture based on the MIPS designs. In any case, at this point an SGI/MIPS lead consortium would seem to be no more viable than an HP/Hitachi lead consortium in creating a successful open platform.

Hitachi's lack of performance in the logic/ASIC markets could also be linked to conscious decisions to focus on providing for its own internal requirements and to maintain a competitive advantage for systems produced higher in the vertical structure of the company.

Bipolar products accounted for 12.7 percent of Hitachi's semiconductor revenue. Pure bipolar product lines are shrinking categorically because of the widespread success of BiCMOS, which generally offer more control of speed, power, and integration density trade-offs than do pure bipolar devices. Unfortunately, categorization of parts has not yet expanded to include this class of devices. Hitachi is considered a leading producer of components made in BiCMOS, which is often used as an indicator of the technical sophistication of a company's semiconductor fabrication technology.

Table 8 provides Hitachi' semiconductor revenue, by product segment, for the past five years.

Regional Market

Figure 4 shows Hitachi's semiconductor revenue, broken into four major regional markets. About one-third of Hitachi's total revenue was generated in overseas markets during 1991. Foreign sales of MOS memories captured about half of Hitachi's memory revenue, and helped offset the weak domestic memory markets during the same year.

Semiconductor Investment

Table 9 and Figure 5 present Hitachi's semiconductor capital spending and R&D expense trends against overall semiconductor revenue for the past five years. Capital spending and R&D costs have steadily increased to where Hitachi reinvested about one-third of its semiconductor revenue in 1991. Hitachi achieved a high revenue-to-investment efficiency in semiconductor sales during the past decade, not an uncommon trait for a dominant memory supplier during that time frame. In 1987, because of a semiconductor business downturn, Hitachi cut its capital spending to ¥38 billion, or about 10 percent of revenue. This action is believed to have resulted in Toshiba's forging ahead in the 1Mb DRAM race, and Hitachi has subsequently been spending heavily to regain and maintain a lead in 4Mb that never fully developed as expected. In terms of R&D, Hitachi had been investing about 14 to 15 percent of semiconductor revenue up until 1989, when it began increasing that rate to reach 18.4 percent by 1991.

Although absolute R&D costs continue to escalate, revenue increases have not kept pace with the cost of advanced R&D projects and thus R&D expenditure as a percentage of revenue tends to exaggerate R&D investment trends, even though the burden is real and must be sustained by flat revenue. Hitachi enjoys the luxury of having sufficient capital to indulge in many long-term basic research projects that have uncertain commercial value. Nevertheless, the rate at which patents are generated by Hitachi guarantees that the company will not be at a disadvantage when intellectual licensing exchanges are made.

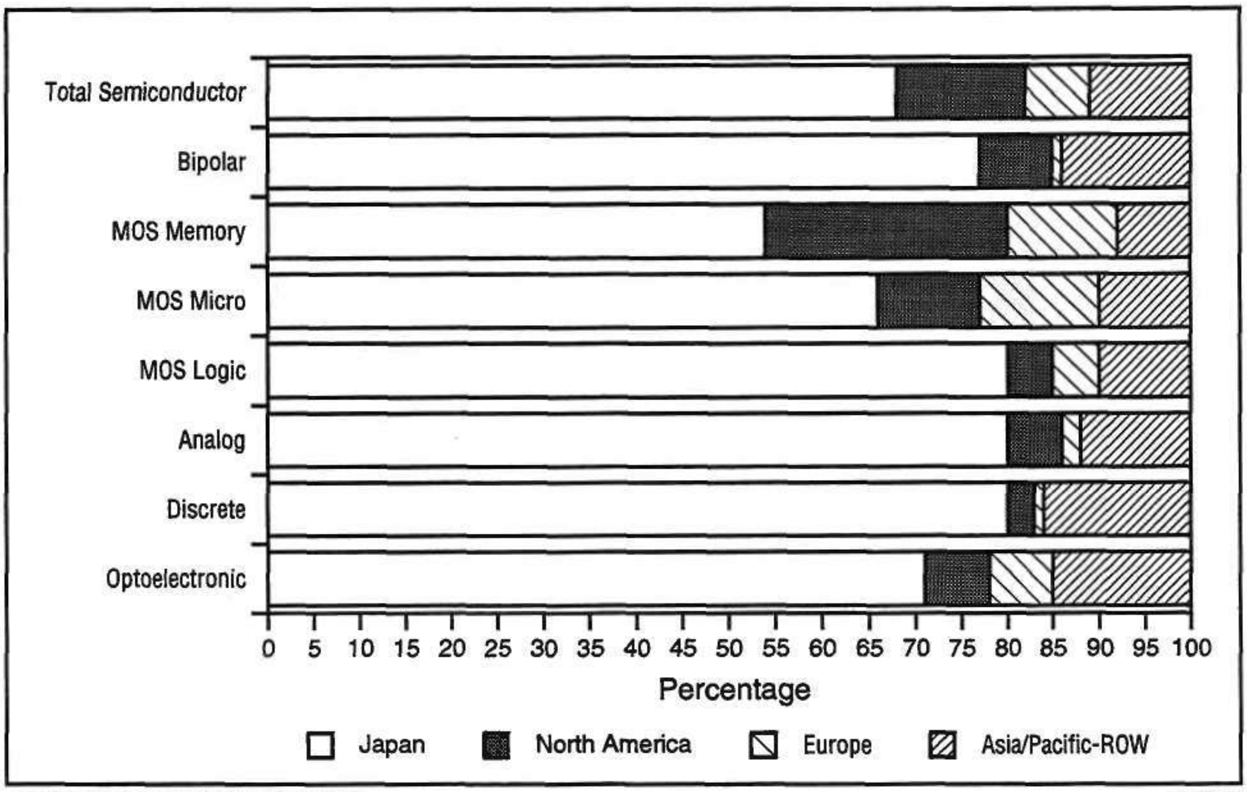
Hitachi has been devoting more than 30 percent of its total corporate investment, which includes both capital spending and R&D expenditure, on semiconductor-related activities. Since Hitachi's merchant semiconductor sales accounted for only 6.6 percent of total corporate revenue during 1991, a relatively modest figure compared with figures from competitors such as NEC and Toshiba, Hitachi's commitment toward establishing a competitive advantage through the development of semiconductor technologies remains clear. The application of technology toward merchant chip products or systems further up the manufacturing tree is what separates Hitachi from those that place a greater emphasis on their merchant semiconductor sales.

Table 8
Estimated Semiconductor Revenue, by Product in Worldwide Market (Billions of Yen)

Calendar Year	1987	1988	1989	1990	1991	1991 Market Share (%)
Total Semiconductor	377.0	455.8	499.8	506.3	512.0	6.3
Total Integrated Circuit	280.2	354.8	409.3	414.4	421.5	6.3
Bipolar Digital	66.7	65.1	61.7	65.1	62.7	12.7
TTL/Other	51.3	48.9	42.5	44.4	34.0	9.8
ECL	15.4	16.3	19.2	20.7	28.7	19.5
Bipolar Digital	66.7	65.1	61.7	65.1	62.7	12.7
Bipolar Digital Memory	13.7	15.5	13.4	13.7	13.5	27.8
Bipolar Digital Logic	53.0	49.7	48.3	51.4	49.2	11.4
MOS (Technology)	168.9	245.1	305.0	304.3	310.1	6.6
N/PMOS	67.8	93.7	61.5	61.3	59.4	7.3
CMOS	100.7	150.4	229.8	229.1	235.0	6.2
BiCMOS	0.4	0.9	13.7	13.8	15.6	20.5
MOS (Function)	168.9	245.1	305.0	304.3	310.1	66.4
MOS Memory	82.9	144.8	192.6	176.3	180.9	10.4
MOS Microcomponent	57.9	68.3	69.7	78.6	79.3	5.0
MOS Logic	28.1	32.0	42.6	49.4	49.9	3.8
Analog	44.6	44.6	42.6	45.1	48.7	3.3
Total Discrete	90.0	91.9	82.0	82.8	81.3	7.4
Total Optoelectronics	6.8	9.1	8.6	9.1	9.2	2.4
Exchange Rate (¥=U.S.$1)	144	130	138	144	136	

Note: Columns may not add to totals because of rounding.
Source: Dataquest (November 1992)

Figure 4
Hitachi's Semiconductor Revenue, by Region



Source: Dataquest (November 1992)

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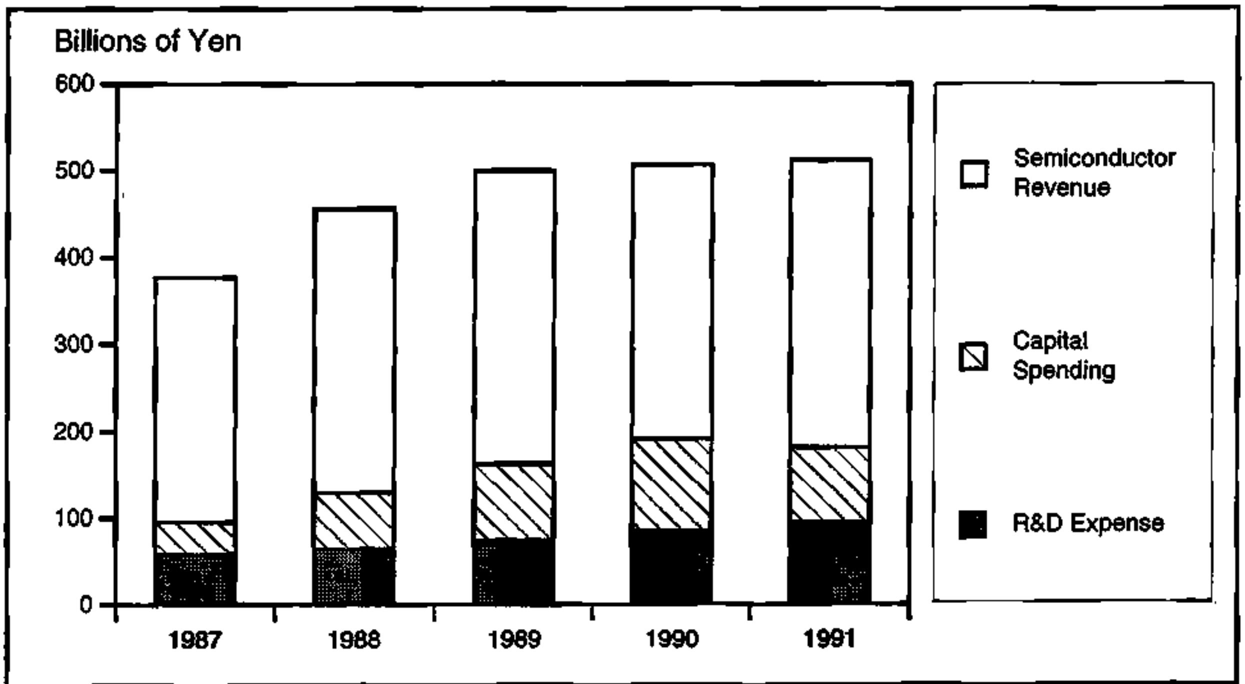
Table 9
Semiconductor Investment: Capital Spending and R&D (Billions of Yen)

	1987	1988	1989	1990	1991
Semiconductor Revenue	377.0	455.8	499.8	506.3	512.0
Capital Spending	37.5	65.0	88.8	106.3	87.5
Percentage of Revenue	9.9	14.3	17.8	21.0	17.1
R&D Expense	58.0	64.0	73.5	84.5	94.0
Percentage of Revenue	15.4	14.0	14.7	16.7	18.4
Total Investment to Revenue	25.3	28.3	32.5	37.7	35.4

Note: Semiconductor revenue and capital spending are calculated for calendar year periods, while R&D expense is stated for a Japanese fiscal year.
Source: Dataquest (November 1992)

Figure 5
Hitachi Semiconductor Investment: Capital Spending and R&D



Source: Dataquest (November 1992)

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Manufacturing Facilities

Hitachi generally manages front-end production in its own plants and channels end production and assembly/testing to subsidiaries or affiliated companies. Table 10 shows the location, work force size, and semiconductor products made at Hitachi's primary manufacturing sites. Figure 6 shows the relationship between various semiconductor manufacturing sites and possible chip production steps performed at the various Hitachi plants.

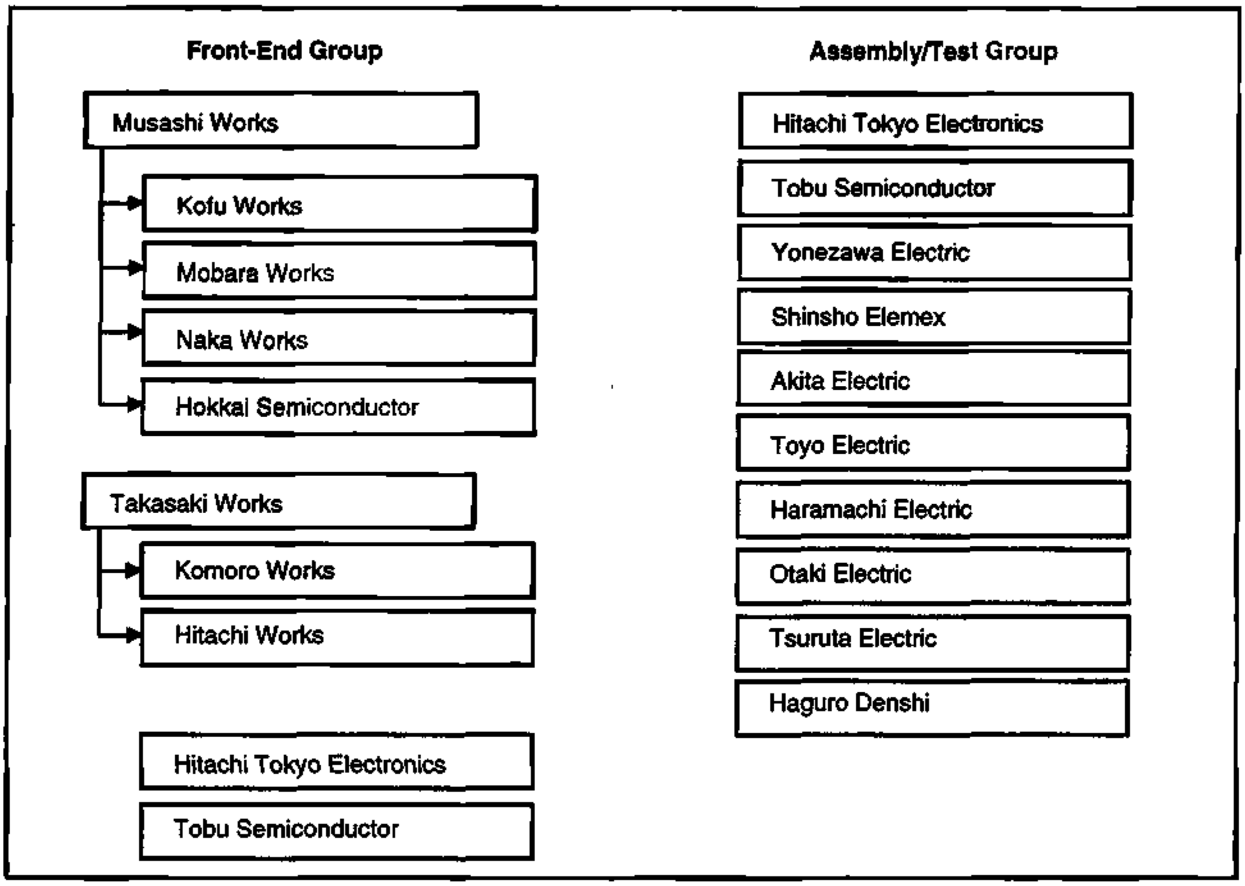
Hitachi completed a new front-end fab facility in Germany at the close of 1991. The EC body that governs semiconductor trade policy has already begun defensive moves, including procedures for defining, calculating, and establishing limits on foreign chips imported into the EC semiconductor markets. An EC committee has also made rulings on semiconductors that require front-end wafer fabrication to be performed on European territory to qualify as "made in EC." These mandates have induced major Japanese chip makers such as Hitachi and NEC to construct or upgrade existing fabs in Europe in anticipation of unification of the European markets. Hitachi's total investment at its Germany fab line is estimated to be more than $450 million. Current schedules call for the plant in Germany to produce 4Mb DRAM and logic chips; fab line qualification testing is now under way.

Table 10
Hitachi Semiconductor Manufacturing Facilities

Plant Name	Location	Facility	Product	Number of Employees	Year Opened
Domestic Facilities					
Mobara Works	Chiba	F	Memory, logic, TFT	400	1943
Komoro Works	Nagano	F	Optoelectonics	900	1969
Takasaki Works	Gunma	F	Bipolar, logic, ROM	2,000	1988
Hokkai Semiconductor	Hokkaido	F	DRAM, SRAM	750	1982
Hitachi Works	Ibaragi	F	Discrete	200	1910
Naka Works	Ibaragi	F	DRAM, equipment	300	1961
Musashi Works	Tokyo	PR	MOS IC, VLSI	2,600	1958
Central Research Lab	Tokyo	R	R&D	NA	NA
Device Development Center	Tokyo	R	Micro, semi custom ICs	1,000	1983
Kofu Works	Yamanashi	F	Memory, micro, logic	1,300	1969
Hitachi Tokyo Electronics	Yamanashi	AT	MOS ICs, discrete	50	NA
Tobu Semiconductor	Aomori	FAT	Linear, logic, SRAM	600	1974
Tsuruta Electric	Aomori	AT	Discrete, GaAs	450	1981
Yonezawa Electric	Yamagata	AT	MOS ICs	700	1969
Haguro Denshi	Yamagata	AT	MOS ICs	240	1984
Shinsho Elemex	Yamagata	AT	Bipolar	185	1983
Akita Electric Tenno	Akita	AT	MOS, bipolar	550	1969
Akita Electric Yuwa	Akita	AT	MOS ICs	650	1982
Toyo Electric	Niigata	AT	Bipolar digital	260	1973
Haramachi Electric	Ibaragi	AT	Discrete	500	1973
Otaki Electric	Chiba	F	LCD module	160	NA
Overseas Facilities					
Hitachi America	Irving, Texas	F	Micro, DRAM, SRAM		1988
Hitachi Denshi	Landshut, Germany	FAT	DRAM, micro, bipolar		1980
Hitachi Semiconductor	Taiwan	AT	Transistor		1967
Hitachi Semiconductor	Penang, Malaysia	AT	DRAM, micro, bipolar		1972

NA = Not available
F: Fab
P: Pilot line
R: Semiconductor R&D
A: Assembly
T: Test
Source: Dataquest (November 1992)

Figure 6
Hitachi Semiconductor Manufacturing Shift



Source: Dataquest (November 1992) G2002513

Semiconductor Alliances

Table 11 lists Hitachi's publicly announced alliances formed during the past five years. Hitachi was, and continues to be, an early ally to HP in efforts to transform HP's RISC architecture into an open platform. In addition, Hitachi has often been linked to Texas Instruments in various ambitious technology codevelopment agreements. In fact the close ties between TI and Hitachi were cause for concern by Sematech members as a potential source of a technology leak. Having had a peak number of alliances in 1989, Hitachi continues to embrace alliances as a business methodology; its rate of entering new alliance agreements leveled at about four per year for the past several years.

Dataquest classifies strategic alliances into the following major categories, as applied in Table 11:

- LA—Licensing agreement
- SS—Second-source agreement
- SA—Sales agency agreement
- FA—Fab agreement
- AT—Assembly and testing agreement
- TE—Technology exchange
- JV—Joint venture
- JD—Joint development
- IV—Investment
- CO—Coordination of standard
- PC—Procurement agreement
- OT—Other

Dataquest Perspective

Hitachi, a leading supplier of everything from home appliances to heavy machinery and from semiconductors to supercomputers, is both vertically and horizontally diversified. During FY1991, Hitachi's Information & Communication Systems and Electronic Devices Division generated 34.2 percent of Hitachi's total revenue, a percentage that has been steadily increasing during the past few years. Key to the continued success of this division is development of leading-edge semiconductor technology in which Hitachi is investing heavily. Although Hitachi possesses the capacity to be a more aggressive merchant semiconductor supplier, there is evidence to suggest that Hitachi has chosen to utilize much of its technology to gain competitive advantage in systems-level products rather than as a dominant merchant.

Collectively, HP and Hitachi lead a RISC consortium that is a formidable threat to the SPARC, MIPS, or Power designs. As a systems supplier in the fast-growing workstation and PC markets, Hitachi has yet to make an impact. Hitachi's strategy of designing systems around the HP PA RISC is consistent with its role as a sophisticated supplier of systems. By combining its expertise in semiconductor manufacturing of MOS logic, memories, and microprocessors with its established systems manufacturing capabilities, the workstation and PC products it fields should prove both competitive and interesting.

Table 11
Hitachi's Semiconductor Strategic Alliances

Date	Partner	Agreement Type	Product
1/87	Chinese government	LA	Linear IC assembly and test
4/87	VLSI Technology	FA	1Mb mask ROM
8/87	Oklahoma University	JD	Product and material
9/89	Nanometrics	LA	Equipment
10/87	International Rectifier	LA	Power MOS-FETs
7/89	Mitsubishi	CO	EDTV chip sets
9/88	Intel Japan	PC	Consumer MPUs
12/88	Texas Instruments	JD	16Mb DRAM
1/89	VLSI Technology	FA	High-speed SRAM
6/89	National Semiconductor	LA, JD	Logic IC
7/89	Texas Instruments	SS	256Kb SRAM
7/89	Kimsung (Goldstar)	SS, TE	1Mb DRAM
7/89	Hewlett-Packard	TE	RISC MPU
7/89	Cray Computer	LA	Supercomputer
9/89	National Semiconductor	SS	CMOS logic ICs
10/89	Goldstar	LA, SS	1Mb DRAM
6/90	Hewlett-Packard	LA	RISC MPU
6/90	Goldstar	LA	4Mb DRAM
8/90	Nissan Motor	JV	Automotive electronics
5/91	Compass Design Automation	JD	0.8-micron ASIC cell libraries
6/91	NMB Semiconductors	FA	4Mb DRAMs
8/91	Bull	LA	IC card
11/91	Texas Instruments	JD	64Mb DRAM
3/92	Wang Laboratories	LA	SIMM
4/92	Oki	JD, CO	HP PA-RISC MPU
4/92	Texas Instruments	SA, FA, CO	BiCMOS bus interface
7/92	National Semiconductor	FA	CMOS logic devices

Source: Dataquest (November 1992)

Dataquest Vendor Profile

Microcomponents *Worldwide*

September 7, 1992

Intel Corporation

Corporate Statistics

Headquarters Location	Santa Clara, California
President and CEO	Andy Grove
Primary Business	Microcomputer components
Annual Sales (FY1991)	$4,779 million (U.S. Dollars)
Total Employees	24,600
Manufacturing Locations	10 worldwide
Founding Date	July 1968
Fiscal Year	January-December
Ownership	Public (NASDAQ ... INTC)

Corporate Overview

Over the last five years, Intel has recovered from a downhill slide capped by heavy losses in 1986 to become the kingpin of microprocessors and perhaps the most powerful semiconductor company in existence. Driven by Intel toward increased performance levels, the enormous market for 80x86-based PCs grew in 1991 to more than $2.5 billion in microprocessor revenue and about $1.0 billion in related peripheral products. Now at the pinnacle of its success, Intel faces its toughest challenge: to keep its 80x86 family ahead of competing RISC families and other 80x86 clone products while maintaining attractive profit margins.

Intel defines its mission to be the leading supplier of microcomputer building blocks at the component, module, or system level used within computers and embedded control equipment. Today, most of the company's activities are focused on growing its business derived from the IBM-compatible PC market. This direction means that Intel must remain the dominant leader in 80x86 microprocessors and microperipherals.

For more information on Intel Corporation or the microcomponents industry, call Ken Lowe at (408) 437-8366.

Founded in 1968, Intel originally concentrated on semiconductor memory products, which still remain an important part of its business. Among its many innovations (see Table 1), Intel is credited with inventing the most important memory in use today, the dynamic

Dataquest
a company of The Dun & Bradstreet Corporation

MCRO-SEG-VP-9201

Table 1
Major Milestones for Intel Corporation

Year	Description
1968	Intel Corporation founded.
1970	Introduced the first commercial DRAM (1Kb).
1971	Introduced the first commercial EPROM (1Kb). Introduced the first commercial microprocessor (4004). Goes public.
1973	Introduced the first microprocessor development system.
1974	Introduced the 8080 (initiated major growth of MPU industry). Achieved more than $100 million in net sales.
1976	Introduced the first microcontroller with EPROM.
1978	Introduced the 8086 (spawning the most successful line of MPU in history).
1979	Introduced the first 5V DRAM (previously all 12V).
1980	Introduced the 8051 microcontroller (most widely used MCU in world). Introduced the first math coprocessor (8087).
1981	Intel 8088 selected by IBM for its first personal computer (IBM PC).
1982	Introduced the 80286 (used in IBM PC AT).
1983	Achieved more than $1 billion in net sales.
1985	Exits the DRAM business (after developing 1Mb working silicon). Enters the PC enhancement market (AboveBoard memory adapters). Introduced the 80386, first 32-bit x86-compatible generation.
1987	Enters the market for parallel supercomputers.
1988	Introduced its first flash memory product. Introduced the i960 embedded RISC processor family.
1989	Introduced the first 1-million-transistor microprocessor (i860). Introduced the 80486, first MPU with integrated CPU, FPU, and cache.
1990	Exits EPROM development race (at 4Mb) to focus on flash.
1991	Achieves fastest installed supercomputer (32 gflops). Introduced the first 2.5-million-transistor microprocessor (i860XP).
1992	Introduced the first 8Mb flash memory component.

Source: Intel, Dataquest

random access memory (DRAM). Its strategy has always been built on innovation: invent something unique, enjoy higher profits from that uniqueness, then move on when competition crowds the market. Yet, as it entered the 1980s, Intel (like most semiconductor companies) sold a broad range of mostly commodity products. Then, in 1981, IBM chose the 8088 as the engine for its first PC, eventually changing the profile of Intel's entire business.

By 1985 it was clear that the DRAM business was at best a low-margin proposition where the Japanese were taking over in the midst of a chip recession. As a result, Intel accumulated operating losses of $250 million over 1985 and 1986. These and other factors drove Intel's decision to exit the commodity-oriented DRAM business in favor of the innovation-oriented microprocessor business. At that time, Intel's future hinged on the success of its proprietary 386 microprocessor, an advanced 32-bit architecture compatible with the 16-bit 8086 PC standard.

As history shows, this was the best decision Intel could have made. The 386 became the most successful logic chip in the semiconductor industry, accounting for nearly half of Intel's 1988 revenue of $2.9 billion. Intel followed up with the 387 math coprocessor and later, in 1989, with the 486, a 1.2-million-transistor chip that combined the functions of the 386 and 387 and had a primary cache yielding a twofold performance improvement at a fourfold pricing increase. As a result, the 486 now represents Intel's leading revenue generator, which will account for more than $1.4 billion in revenue for 1992.

Intel's 386 monopoly weakened in 1991 when Advanced Micro Devices (AMD) became the first of several vendors to enter the 386-compatible market, taking considerable unit volumes and effectively lowering the exceptionally high pricing structure Intel had enjoyed. At the same time, RISC microprocessors were reaching the peak of their momentum with IBM, Apple, and Motorola teaming up to create next-generation systems based on the PowerPC architecture. Meanwhile, Intel has increased its penetration into other markets, trying to balance its portfolio of products to increase its non-80x86 revenue.

Business Strategy and Segmentation

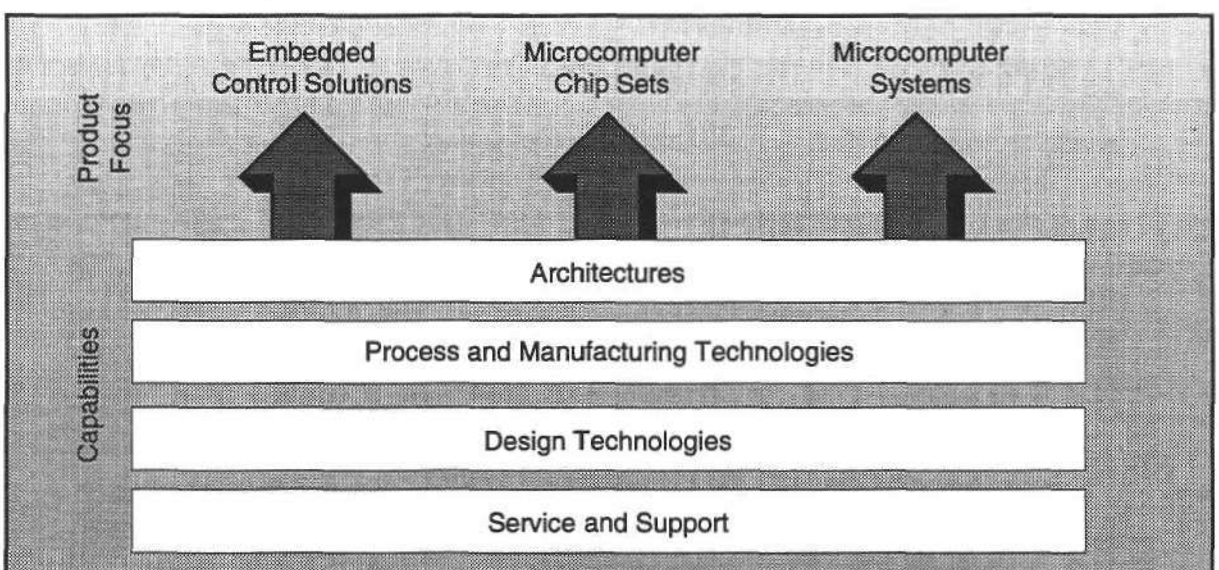
Intel's vision for the 1990s centers around a concept referred to as "computer-supported collaboration. " It believes that as the pace of competition picks up (among businesses in general) there will be a transition to a "just-in-time" business environment, where getting the right information to where it is needed quickly becomes a primary competitive advantage. This transition will be achieved through cooperative work facilitated by interconnected, interactive electronic communication in which all forms of data are shared quickly and easily. The worldwide computer infrastructure will be extended to become a communications infrastructure, hence "computer-supported collaboration." Intel integrates its product mix around this central theme, paving the way for increasing levels of processing power, miniaturization, and communications capabilities.

To realize this overall vision, Intel pursues the evolution of its primary target market, computer systems, by focusing on three main product areas supported by four key capabilities (see Figure 1). Intel's overall business strategy anticipates integration of the computer and communications industries and positions the company to pursue the additional opportunities that will result. Intel's primary product focuses are microcomputer chip sets, embedded control solutions, and microcomputer systems, the first two of which are semiconductor product businesses representing the bulk of Intel's total sales. The key capabilities developed by Intel to support its growth in these areas include proprietary architectures (mainly microprocessors), manufacturing and process technologies, design technologies, and support services.

Major Market Segments

Intel participates in a wide range of market segments. However, sales are dominated by the data processing market, which accounts for an estimated 70 percent of its total revenue. Sales into this segment include semiconductor components (microprocessors, microperipherals, and memory devices), computer upgrade modules (coprocessors, memory cards, and add-in adapters), and supercomputers—all sold to computer companies, distributors, or end users. Intel has targeted the computer systems markets since the mid-1980s because of the higher margins afforded to the components that serve that market. Other market segments served (in order of decreasing revenue) are industrial, communication, automotive, military, and consumer.

Figure 1
Intel Core Strategy

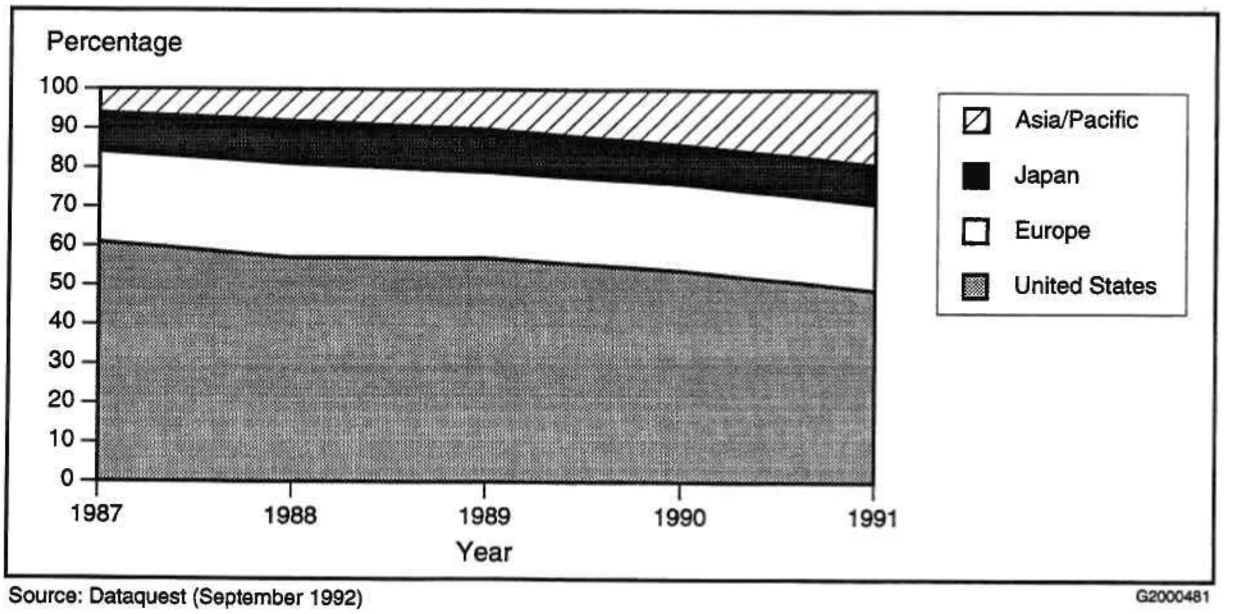


Source: Intel Corporation

Intel sells most of its components directly to companies that incorporate them into their products. These customers primarily are computer systems manufacturers such as IBM and Compaq, but they also include producers of telecommunications equipment, industrial equipment, and automobiles. Intel maintains a broad, balanced customer base; no single customer accounted for more than 10 percent of its revenue during the last two years (in 1989, IBM accounted for 10.5 percent of Intel's revenue). Intel also sells certain products through distribution, which accounted for about 25 percent of its net revenue during 1991.

An expanding base of international customers, primarily in the Asia-Pacific region, has driven Intel's sales mix to an all-time high of 51 percent non-U.S. revenue (see Figure 2). Over the last five years, Intel's sales from the Asia-Pacific region have steadily increased from 6 percent in 1987 to 19 percent in 1991, making it the No. 1 vendor in the region, primarily driven by the growth of the PC clone industry in Taiwan. However, as a result of AMD and other x86 clones entering the 386/486 market and penetrating primarily the Asia-Pacific clone vendors, this shift in regional sales mix is expected to come to a halt during 1992. In exchange for this increase in international business, sales in the United States decreased from 61 percent in 1987 to only 49 percent in 1991, which also indicates the shift toward offshore manufacturing of PCs. During this same period, the percentage of regional sales to both Europe and Japan remained relatively constant at about 22 percent and 10 percent, respectively.

Figure 2
Intel Sales, by Geographic Region



Source: Dataquest (September 1992)

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Major Product Segments

Though its product mix includes items as diverse as supercomputers and adapter boards, Intel is primarily a semiconductor company, with microprocessors central to its entire product mix. This section will provide an overview of Intel's product mix as defined by the company. A subsequent section will provide a complete analysis of Intel's semiconductor-related businesses, which accounted for a combined total of about $4.0 billion, or 84 percent of its 1991 revenue.

The first product segment, microcomputer chip sets, feeds the bulk of Intel's growth, 65 percent of 1991 revenue or about $3.1 billion (see Figure 3). This segment includes semiconductors and integrated modules as building blocks for computer systems ranging from desktops to floortops to portables. Specifically, this segment includes the following products:

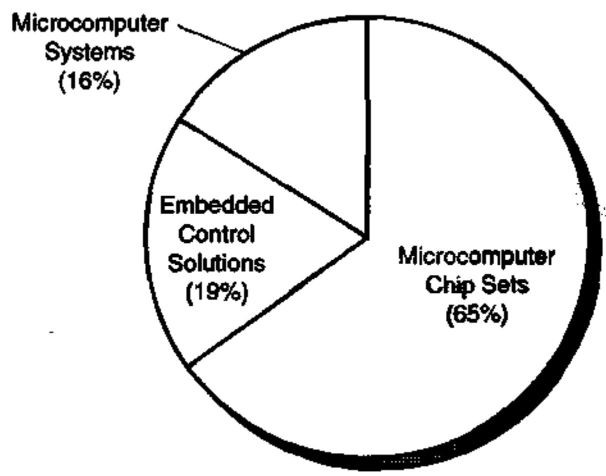
- Computer microprocessors, the central control units used for computer systems, now primarily focused on 32-bit 80x86 processors (that is, 386, 486, and P5). Also includes the older 16-bit 80x86 processors (8088/86/286) and the i860 processor for supercomputing and graphics.
- Microperipherals, which work directly with the microprocessors to handle specific I/O and processing functions. Intel's sales here are dominated by math coprocessors but also include PC core logic chips, network controller chips, multimedia, and modem chips.
- SRAM memory and CPU/cache modules (sold for the 486DX-50), which account for a small amount of revenue but represent a strategic technology for integration with the CPU.

Embedded control solutions, the second semiconductor business area, accounted for about $900 million (19 percent) of 1991 revenue. This business segment includes components used in various embedded applications such as laser printers, communications systems, and automobiles. This segment spreads out the use of Intel components as the core of intelligent noncomputer electronic systems. Specifically, this segment includes the following products:

- Microcontrollers, which represent the largest revenue source for this product segment, integrate microprocessor and memory technologies on one chip and include the 8048, 8051, and proprietary MCS-96 families of components.
- Nonvolatile memory/logic, which permanently store control programs, includes Intel's line of EPROMs, flash memory devices, and PLD devices.
- Embedded microprocessors, the processors used to control the actions and data flow in noncomputer applications, include the i960 family as well as the embedded versions of the 80x86 family (80186/188/376).

Microcomputer systems, a nonsemiconductor business area, accounted for about $800 million of Intel's 1991 revenue. This business segment supports the proliferation of the other two segments,

Figure 3
Intel Sales, by Product Segment



Source: Dataquest (September 1992) G2000492

creating and manufacturing systems designed around Intel components at both the commodity level (PC motherboards) and leading edge (supercomputers). Specifically, this segment includes the following:

- PC motherboards, based primarily on Intel microprocessor and I/O components, are manufactured by Intel for OEMs such as Digital Equipment Corporation.
- PC enhancement products, which are sold through retail computer stores, include add-in adapter boards (memory, fax/modem, network controllers), PCMCIA cards (memory, fax/modem), and component upgrades (math coprocessors, overdrive processors).
- Supercomputer systems, ultra-high-performance computers utilizing massively parallel processing primarily for scientific and engineering problems, are designed around Intel's i860 microprocessor and sold directly to large end users.
- Software products, which include microcomputer operating systems (iRMX real-time kernel for industrial control applications), development/debug support tools, and high-level networking software support.

Key Capabilities and Competencies

Intel to date has been successful in optimizing its four key capabilities around its product mix to leverage its position as the incumbent king of microprocessors.

The first of Intel's four key capabilities is proprietary architectures. Leveraging the momentum of the IBM PC legacy, Intel pushes leading-edge performance and integration while maintaining pull-through 80x86 compatibility. The 80x86 microcomputer architecture is the most widely used in the industry, representing more than 80 percent of the PC units shipped. Intel works closely with major software vendors to ensure that the 80x86 family maintains the largest complement of operating systems and application packages available. Intel also maintains two proprietary RISC microprocessor architectures, the i960 for the 32-bit embedded processing market and the i860 for supercomputers and graphics/imaging subsystems.

Intel's next emphasis is advanced process and manufacturing technology. Intel's strength in manufacturing capability is underscored by its enormous capital investment (nearly $1 billion in 1991) used for continually upgrading facilities. Intel's process technology developments have enabled it to double the number of transistors it can integrate on one chip about every 18 months since the early 1970s. Its strategy is to gain a twofold leverage from the following leading-edge processes:

- Enable state-of-the-art products not possible or economical without the investment in fabrication expertise
- Lower unit cost through smaller die sizes and higher yields as older products become commodities, affording them higher margins

Intel's third key capability is design technology, where it has long been recognized that design time is a bottleneck in bringing new chips to the market. Intel's level of design technology is reinforced by its continued high spending in R&D, which represented 13 percent of total sales in 1990 and 1991. As a result, Intel expects to reduce its time to market for next-generation chips while significantly increasing their complexity. Thus, as the P5 is introduced in early 1993, the P6 generation should be out in mid-1994 and the P7 in early 1996.

Intel's fourth key capability is service and support. As with most major companies, service is a key element in the overall marketing mix. At Intel, the differential advantage focuses on extensive documentation, training programs, and hardware/software development tools that make its components easy to design with.

Marketing Strategy and Alliances

Though not included under key capabilities, another key Intel strength is its marketing program, which is an integrated mix of brand promotion, competitive counterattacks, and high-impact product introductions. Combined with its position in the 80x86 microprocessor market, Intel delivers the image of leadership within the PC industry through its marketing programs.

Intel's brand promotion program has been aimed at increasing the awareness of its brand products and their advantages at the end-user level. To date, more than 340 manufacturers have participated in the "Intel Inside" cooperative advertising program. Intel hopes to use this program to develop preference for PCs with Intel microprocessors because of their absolute compatibility, upgradability paths, and other features.

Intel has also begun strengthening its relationships with key customers and third parties because it faces increasing competition on its mainstream microprocessors. As a result, Intel is forming more and more strategic alliances, such as its recent cross-licensing agreement with VLSI Technology. This agreement establishes a program for developing highly integrated 386-based processors for the handheld market through a vendor that leads in PC logic chip sets and excels in customization services. In addition, it focuses VLSI's development and marketing efforts on Intel's microprocessors, rather than on AMD, Cyrix, or others.

Intel's 1992 alliances were as follows:

- VLSI Technology and Intel entered into a cross-licensing and equity exchange agreement (Intel now owns 16 percent of VLSI) to design integrated 386-based products primarily for the handheld market.
- IBM and Intel entered into a licensing agreement for IBM's XGA graphics architecture in which Intel will integrate XGA features into IBM's multimedia and microcomputer products.
- Defense Advanced Research Projects Agency (DARPA) and Intel announced a joint research program to produce a 1-teraflop-level supercomputer system.

Intel's 1991 alliances were as follows:

- IBM and Intel jointly announced the formation of the Noyce Development Center, a 100-engineer design center to develop very highly integrated 80x86 microprocessors.
- Digital and Intel entered into an agreement in which Digital would introduce a new family of PC products based on Intel 386/486 microprocessors and manufactured by Intel.
- NMB Semiconductor and Intel entered into a supply agreement in which NMB will turn one of its plants into a flash memory foundry (for die only) dedicated to Intel.
- Pacific Bell and Intel signed an agreement to market network integration services and equipment in conjunction with Pacific Bell's Data Communications Group.
- Tartan Laboratories and Intel's military division signed an agreement to jointly market Tartan's i960 ADA compilation system.

In 1990, IBM and Intel entered into an agreement providing Intel exclusive rights to its parallel interface (PI) bus interface unit, currently used in IBM's Common Avionics Modules.

Intel's 1989 alliances were as follows:

- AT&T, Convergent Technologies, Ing. C. Olivetti S.p.A., Prime Computer, and Intel announced a joint engineering effort to create a multiprocessing version of UNIX for the i860.
- AT&T Microelectronics and Intel signed a five-year agreement to provide OEMs with an array of products supporting ISDN and LANs from a common source.
- (DARPA) and Intel signed a $7.6 million research agreement to develop prototypes of a CRAY-1-level supercomputer.
- IBM and Intel signed an agreement in which Intel would develop an MCA board to utilize DVI for the IBM PS/2 computer.

Company Organization and Operations

Intel is organized around a business unit structure (see Figure 4) that focuses on the development and marketing of its product segments while relying on centralized departments for all of the support functions including manufacturing, sales, finance, and administration. There are five product groups, four of which focus strictly on one product segment while the fifth splits attention between two product segments. At the top is an executive office shared by Chairman Gordon Moore, President Andy Grove, and Executive Vice President Craig Barrett. As the company's chief strategist and visionary, Andy Grove maintains the most visible role of the three executives in shaping Intel's direction. Craig Barrett, currently positioned as the heir-apparent, primarily focuses on day-to-day operations.

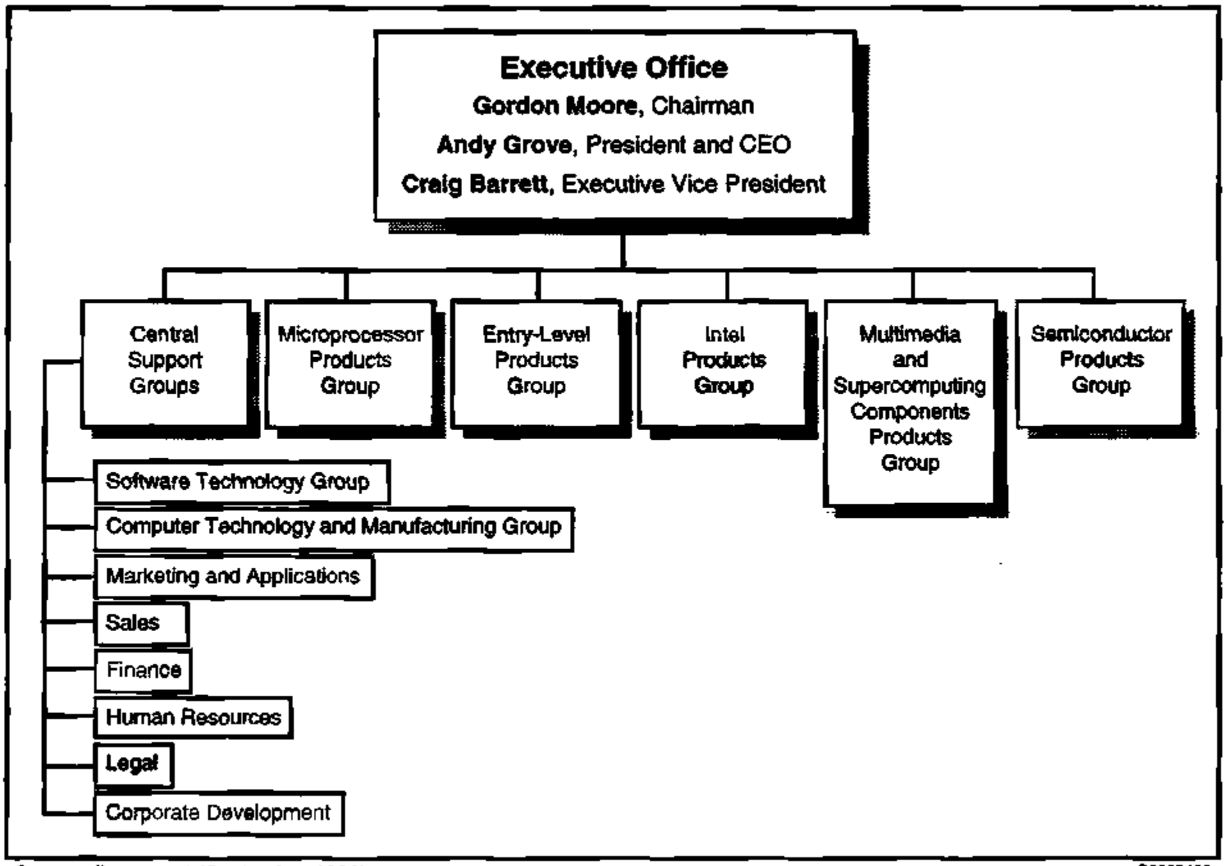
Development of the 80x86 product line is split between two separate operating groups based on both product and market focus, the first of which is the Microprocessor Products Group. This group is responsible for the development of high-performance 80x86 processors targeted primarily for office systems (PC desktops, workstations, and servers). The group is headed by Paul Otellini and Albert Yu, both vice presidents who share the general manager position. Specific products under this group include the following:

- i486 product line (SX, DX, and other desktop versions)
- Future 80x86 architectures including P5 (due out in the first quarter of 1993), P6, and P7

Intel's second 80x86 group is Entry-Level Products, which is responsible for development of highly integrated 80x86 microprocessors and standard microperipheral chips used to manufacture mainstream PC systems. This group is headed by Mike Aymar, vice president and general manager. Specific products under this group include the following:

- Intel's SL product line of integrated architectures, including i386SL and H4C (486SL)

Figure 4
Intel Organization Structure



Source: Dataquest (September 1992) G2000483

- Core logic chip sets including EISA, cache controllers, PCI, and other related chips
- I/O modules including Intel's ExCA (Exchange Cards) and other I/O chips and adapters

Multimedia and Supercomputing Component Products was formed in May 1991 to pursue non-80x86 architectures that extend the current bounds of computing. This group is headed by Ken Fine, vice president and general manager. Specific products under this group include the following:

- Digital Video Interactive (DVI) product line (i750 series)
- i860 family of supercomputer microprocessors
- i960 family of embedded microprocessors

The Intel Products Group is actually a collection of separate divisions, each focused on a different line of Intel-branded components, software, or systems. This group is headed by Frank Gill, senior vice president and general manager. Included in this product group are the following divisions and specific products:

- PC Enhancement Division, which includes adapter products such as fax/modems and network controllers
- End-User Components Division, which includes math coprocessors and overdrive processors
- OEM Products Division, which includes multibus products, iRMX software, and PC platforms
- Supercomputer Systems Division, which includes the iPSC/860 supercomputer products
- Networks and Services Division, which includes other deliverable software and services

The Semiconductor Products Group is responsible for the development of nonvolatile memories, microcontrollers, and related products. This group is headed by Robert Reed, senior vice president and general manager. Specific products under this group include the following:

- Nonvolatile memories, which includes standard EPROMs and flash products
- Microcontrollers, which includes 8048, 8051, and MCS-96 families

Sales Channels and Distribution

Most of Intel's products are sold or licensed directly to OEMs through a network of 68 sales offices located in 20 nations. Intel also uses distributors and representatives to sell products indirectly to smaller OEMs and end users. Intel's sales channels and distributors are managed directly by a centralized sales department.

In North America, Intel maintains 43 direct sales offices; 39 are located throughout the United States and 4 are in various parts of Canada. Intel also has the following distributors throughout the United States and Canada:

- Alliance Electronics
- Almac Electronics (United States and Canada)
- Arrow Commercial Systems and Arrow/Schweber (United States and Canada)
- Avnet Computer and Hamilton/Avnet Electronics (United States and Canada)
- MTI Systems
- North Atlantic Industries
- Pioneer-Standard and Pioneer Technologies Group
- WYLE Laboratories
- Zentronics (Canada only)

In Europe, Intel has 9 direct sales offices and 28 distributors providing complete regional coverage on a country-by-country basis. Direct Intel sales offices are located in the following countries:

- Germany
- United Kingdom
- France
- Italy
- Sweden
- Finland
- Netherlands
- Spain
- Israel

In Japan, Asia, and the Rest-of-Word (ROW), Intel maintains 16 direct sales offices and a host of distributors. Direct Intel sales offices are located in the following countries:

- Japan (7)
- Australia (2)
- Brazil
- China
- Hong Kong
- India
- Korea
- Singapore
- Taiwan

Manufacturing Plants and Subsidiaries

Intel operates 10 major manufacturing facilities throughout the world, 6 in the United States, 1 in Europe, and 3 in ROW. Intel also has 25 subsidiaries throughout the world, 20 of which are direct sales/service operations in various countries. The other 5 are primarily holding companies or acquisitions and include Intel Electronics Ltd. (United States), Intel International Inc. (United States), Intel Investment Ltd. (United States), Intel Overseas Corporation (United States), Intel Puerto Rico (Puerto Rico), and Jupiter Technology Inc. (United States). Table 2 lists the locations and describes the major semiconductor fabrication facilities.

Intel closed its oldest fabrication facility, located in Livermore, California, in the third quarter of 1991. This 17-year-old facility was reportedly last used for producing 386 microprocessors; its closing was delayed by more than a year because of parts shortages.

Table 2
Intel Semiconductor Fabrication Facilities

Plant Location	Fab Name	Began Operating	Technology and Products Produced	Line Width (µm)	Wafer Size
Aloha, OR	Fab 4	1981	High-volume commodity, logic	2.0	4
	D1(Fab 5)	1987	MPU: 386, 486, SRAM, logic	1.0	6
Chandler, AZ	Fab 6	1984	MCU, MPU: 286, 186	1.5	6
Jerusalem, Israel	Fab 8	1985	MPU: 286, 386	0.8	6
Rio Rancho, NM	Fab 7	1984	EPROM, MCU: military standard	1.0	6
	Fab 9.1	1988	MPU: 386, 486	0.8	6
	Fab 9.2	1991	MPU: 486, EPROM	1.0	6
	Fab 9.3	1992	MPU: P5, EPROM	0.8	6
Santa Clara, CA	Fab 1	1987	EPROM, flash, MCU, logic	1.5	4
	R1*	1986	NA	NA	6
	D2*	1989	EPROM development	0.8	8
	PED*	NA	NA	1.0	6

NA = Not available
Notes: All fab facilities are full production unless noted with an asterisk (*). All process technology used is CMOS unless noted under products.
Source: Dataquest (September 1992)

Intel is spending more than $1 billion a year in plant and capital equipment to build new fabrication plants and refurbish existing ones. This investment is focused on development of the following facilities:

- Aloha, Oregon D1A Fab: Intel started construction in June 1991 and plans to bring this facility on-line in the second quarter of 1993. This 430,000-square-foot facility will cost $200 million to $300 million and will offer capabilities of running 8-inch wafers, from 0.6 to 0.35 µm, aimed at supporting the P5 and future processors. The present D1 facility will simultaneously be converted to 0.6 µm and 8-inch wafers.
- Dublin, Ireland: Intel will spend about $500 million to build this state-of-the-art facility to support the European market. This plant is scheduled to go on-line by the end of 1992.
- New Mexico: Intel is reportedly expanding fab lines to accommodate the P5 as it goes into volume production.

Intel also operates the following manufacturing plants for component and board-level assembly operations:

- Hillsboro, Oregon: Memory boards and microcomputer systems.
- Las Piedras, Puerto Rico: Memory boards and microcomputer systems.
- Leixlip, Ireland: Memory boards and microcomputer systems.
- Manila, Philippines: Component assembly and final testing.
- Penang, Malaysia: Component assembly and final testing.

Adding to its list of operations, in 1991 Intel acquired the Network Products Division of New York-based LANSystems Inc. as a part of an ongoing thrust into the market for LAN software and hardware. In 1990, Intel acquired Jupiter Technology, a supplier of data communications computers, operating systems, and networking products, to broaden its technology and offerings in the connectivity market.

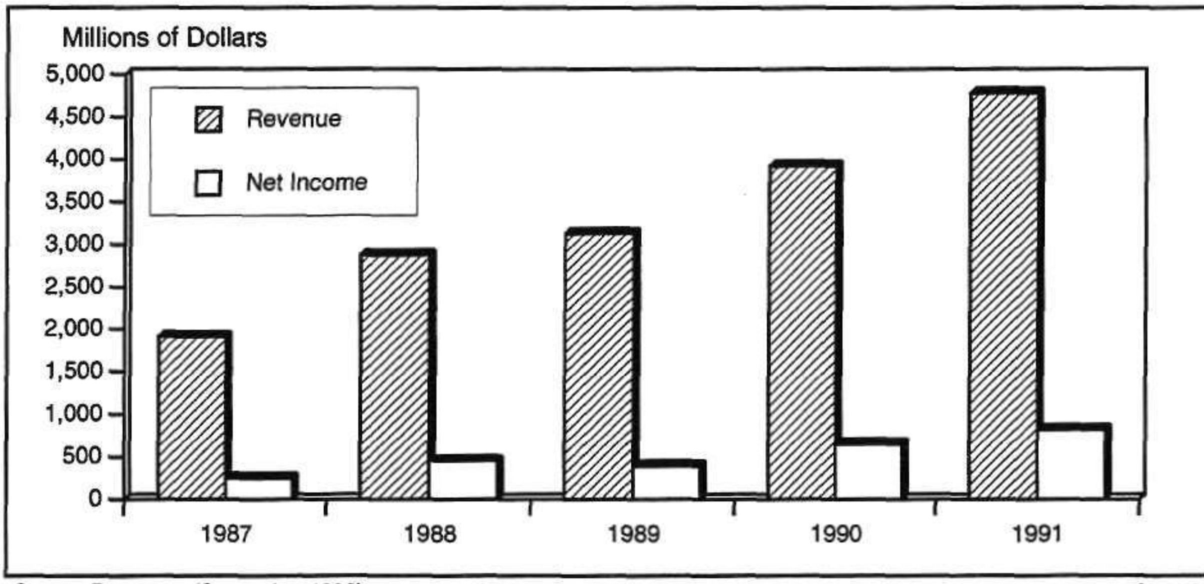
Financial Performance and Conditions

Five-Year Financial Highlights

Over the last five years, Intel's revenue has continued to grow at an industry leading pace with a five-year compound annual growth rate (CAGR) of 20 percent (see Figure 5). Despite increasing competition in its primary product segments (386/486 microprocessors), Intel still enjoys healthy financial growth and is expected to turn in about 15 percent growth in revenue for 1992.

Net income has generally kept pace with revenue growth, with the exception of 1989, when a slowdown in revenue growth resulted in a decrease in net income (see Table 3). This is a direct result of the high gross margins Intel is able to sustain because of its monopoly in the 386/486 microprocessor market, which is just now coming into fierce competition. As a result, average selling prices have

Figure 5
Intel Historical Growth



Source: Dataquest (September 1992)

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Table 3
Intel's Five-Year Financial Summary

	1987	1988	1989	1990	1991
Revenue ($M)	1,907	2,875	3,127	3,921	4,779
Growth Rate (%)	51	51	9	25	22
Cost of Sales ($M)	1,044	1,506	1,721	1,930	2,316
Gross Margin (%)	45	48	45	51	52
Net Income ($M)	248	453	391	650	819
Net ROS (%)	13	16	13	17	17
Total Employees	19,200	20,800	21,700	23,900	24,600
Sales/Employee ($)	99,323	138,221	144,101	164,059	194,268
Total Equity ($M)	1,276	2,080	2,549	3,592	4,418
Return on Equity (%)	19	22	15	18	19
R&D Expenses ($M)	260	318	365	517	618
Percent of Sales	14	11	12	13	13
Capital Expenses ($M)	302	477	422	680	948
Percent of Sales	16	17	13	17	20
Total Assets ($M)	2,499	3,550	3,994	5,376	6,292

Source: Dataquest (September 1992)

eroded significantly and Intel is expected to see a drop in gross margins for 1992.

Intel has seen its most dramatic changes in productivity, as indicated by the sales per employee ratio climbing from $99,000 in 1987 to more than $194,000 in 1991. Intel has been investing in the tools that are critical to enabling high productivity, primarily those used in design and development. These tools reduce the time to complete design tasks and thus reduce work hours per design and time to market. Intel also runs on a highly disciplined structure where planning is an essential element, decision-making is done quickly, and people are encouraged to take risks to move ahead.

Comparison to Industry Conditions

In comparison to other large semiconductor companies, Intel has exhibited nothing short of stellar performance from a financial operating standpoint. Intel revenue grew 250 percent from 1987 to 1991 (see Table 4). In comparison, AMD's revenue grew 23 percent, TI's 17 percent, Motorola's 168 percent, and National's 71 percent.

Intel's profitability and productivity ratios also stand out, again stemming from higher-than-average gross margins, which led the industry at 52 percent. Intel led the industry in 1991 in return on sales (net income) and return on equity. However, its most dramatic lead is in sales per employee, which reached an all-time high in 1991 of $194,000, nearly twice that of the competition.

Table 4
Comparative Industry Financial Conditions

	Company				
	Intel	AMD	TI	Motorola	National
1987-1991 Revenue Growth (%)	250	23	17	168	71
Gross Profit Margin* (%)	52	46	17	36	24
Return on Sales* (%)	17	12	-6	4	-9
Return on Equity* (%)	19	19	-21	10	-23
Sales/Employee* ($K)	194	109	108	111	57
Sum of 1989-1991 R&D Expense ($M)	1,500	620	1,600	2,893	703
Sum of 1989-1991 Capital Expense ($M)	2,050	609	2,276	3,701	570
Total Revenue* ($M)	4,779	1,227	6,784	11,341	1,702
Semiconductor Revenue* (%)	84	100	40	34	94

*1991 calendar year.
Source: Dataquest (September 1992)

Intel has been investing heavily in R&D and capital equipment, positioning itself as a world-class semiconductor manufacturer. When investment expenses accumulated over the last three years are compared, Intel is in the middle in total R&D expenses and capital expenses. However, for the semiconductor business segment, if it is assumed that these expenses are allocated as a percentage of revenue, Intel is probably the leading U.S. semiconductor investor in both categories.

Semiconductor Business Analysis

This section will focus on analyzing the position, opportunities, and threats for Intel's $4.0 billion semiconductor business segments. After providing an overview of the semiconductor market, our discussion will divide into three major areas: the 80x86 microprocessor, other microcomponents, and memories.

Semiconductor Market Outlook

The worldwide semiconductor market represented a $60 billion business in 1991 and is forecast to grow 58 percent over the next five years, reaching about $95 billion by 1996 (see Table 5 and Figure 6). The market can be divided into six product-type segments: MOS microcomponents, MOS memory, MOS logic, analog, bipolar digital, and discrete/optoelectronic. The first five of these segments comprise the integrated circuit (IC) subset; the first three comprise the MOS digital subset. All segments except bipolar digital are projected to grow over the next five years, with the strongest growth coming in MOS microcomponents and MOS memory, the two areas Intel competes in.

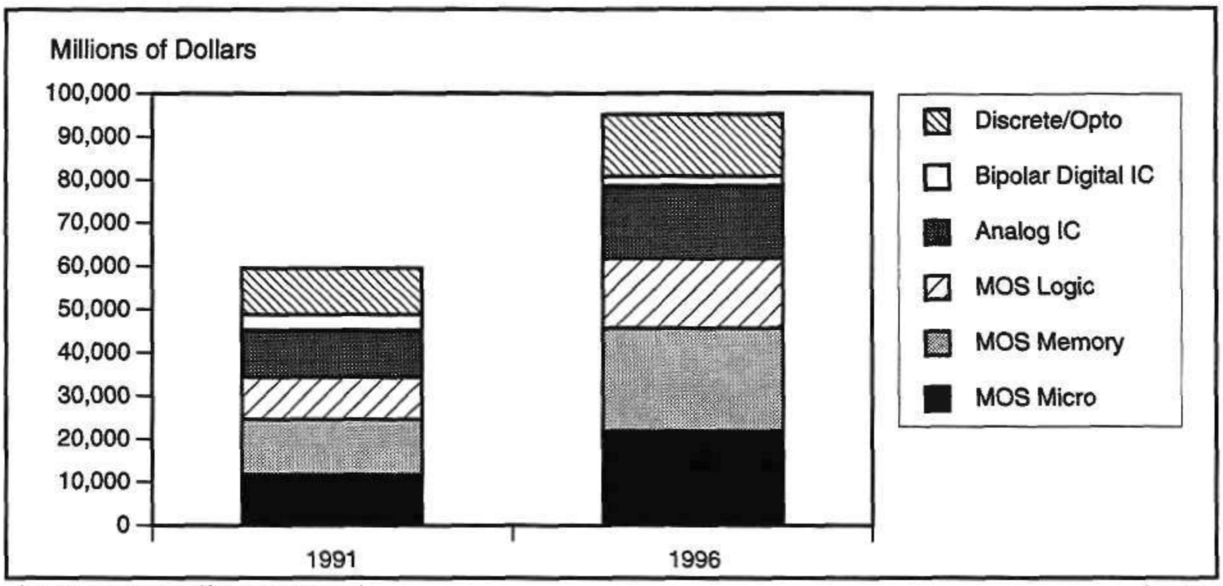
MOS microcomponents represent the brainpower behind most electronic devices performing data processing, numerical calculations,

Table 5
1991 Worldwide Revenue, Top 10 Vendors in Total Semiconductors

Rank	Vendor	Revenue ($M)	Share (%)
1	NEC	4,774	8.00
2	Toshiba	4,579	7.67
3	*Intel*	*4,019*	*6.73*
4	Motorola	3,802	6.37
5	Hitachi	3,765	6.31
6	Texas Instruments	2,738	4.59
7	Fujitsu	2,705	4.53
8	Mitsubishi	2,303	3.86
9	Matsushita	2,037	3.41
10	Philips	2,022	3.39
	Total Worldwide Revenue	59,694	100.00

Source: Dataquest (September 1992)

Figure 6
Semiconductor Market Overview



Source: Dataquest (September 1992)

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Table 6
1991 Worldwide Revenue, Top 5 Vendors in MOS Microcomponents

Rank	Vendor	Revenue ($M)	Share (%)
1	*Intel*	*3,578*	*30.15*
2	Motorola	1,171	9.87
3	NEC	1,149	9.68
4	Hitachi	583	4.91
5	Mitsubishi	543	4.58
	Total Worldwide Revenue	11,867	100.00

Source: Dataquest (September 1992)

and I/O control functions. Intel holds the dominant position in the MOS microcomponents segment, turning in $3.6 billion of the total $11.8 billion potential, or a 30 percent market share (see Table 6). The only two competitors close to Intel are Motorola and NEC, each with a 10 percent share and each less than one-third Intel's size in microcomponents.

Microcomponents comprises three related subsegments: microprocessors, microcontrollers, and microperipherals. Intel is the kingpin of microprocessors, taking $2.5 billion or nearly two-thirds of this $3.9 billion market (see Table 7). More than 95 percent of this revenue results from the 80x86 family of microprocessors, and nearly 95 percent of this 80x86 revenue comes from the 32-bit 386/486 generation of processors. Microprocessors will be the growth leader in MOS microcomponents and will be Intel's market to lose over the next five years.

Intel is also the leader in MOS microperipherals with a 20 percent market share—$650 million of this $3.2 billion segment (see Table 8). Its largest contributor is the math coprocessor, which accounts for some $300 million in revenue completely tied to the 80x86 market growth, as are most of Intel's microperipheral sales. The math coprocessor portion of this market will go away over the next few years but in turn will lead to further growth in the microprocessor market as the function is absorbed inside the CPU.

Ranking fourth in MOS microcontroller revenue, Intel finds itself catching up in the race for microcontrollers (see Table 9). Because the largest portion of microcontroller shipments are consumed in Japan, its not surprising that NEC is the leading vendor, followed by several other Japanese vendors. However, second-ranked Motorola is actually Intel's top competitor and will give it a tough fight.

Table 7
1991 Worldwide Revenue, Top 5 Vendors in MOS Microprocessors

Rank	Vendor	Revenue ($M)	Share (%)
1	*Intel*	*2,504*	*64.32*
2	Motorola	363	9.32
3	AMD	327	8.40
4	National	81	2.08
5	Hitachi	76	1.95
	Total Worldwide Revenue	3,893	100.00

Source: Dataquest (September 1992)

Table 8
1991 Worldwide Revenue, Top 5 Vendors in MOS Microperipherals

Rank	Vendor	Revenue ($M)	Share (%)
1	*Intel*	*650*	*20.19*
2	Western Digital	209	6.49
3	Motorola	194	6.03
4	Texas Instruments	194	6.03
5	NEC	192	5.96
	Total Worldwide Revenue	3,219	100.00

Source: Dataquest (September 1992)

Table 9
1991 Worldwide Revenue, Top 5 Vendors in MOS Microcontrollers

Rank	Vendor	Revenue ($M)	Share (%)
1	NEC	860	19.43
2	Motorola	574	12.97
3	Mitsubishi	463	10.46
4	*Intel*	*424*	*9.58*
5	Hitachi	364	8.22
	Total Worldwide Revenue	4,427	100.00

Source: Dataquest (September 1992)

Table 10
1991 Worldwide Revenue, Top 5 Vendors in MOS Nonvolatile Memories

Rank	Vendor	Revenue ($M)	Share (%)
1	*Intel*	*311*	*10.13*
2	Sharp	306	9.96
3	NEC	258	8.40
4	AMD	237	7.72
5	Toshiba	226	7.36
	Total Worldwide Revenue	3,071	100.00

Source: Dataquest (September 1992)

MOS memory provides exactly what its name suggests, data retention capability for digital systems, and can be divided between volatile and nonvolatile types. Intel does not hold a significant share of the overall MOS memory market. However, it is the leader in nonvolatile memories (see Table 10), a $3.1 billion segment of this market. Volatile memories are the bulk (more than 75 percent) of the market, which is further divided between DRAMs and SRAMs. Intel invented the commercial DRAM and developed technology all the way to the 1Mb level before deciding to exit the market in 1985 because of its commodity nature, low margins, and the high capital investment required. Intel does produce some SRAMs, primarily for military use and use with its high-end microprocessors, though these are not of financial consequence to the company.

Intel's 80x86 Microprocessor Business

Intel has had four generations of upward-compatible microprocessors since the 80x86 family was first introduced (see Table 11). The original 8086 introduced by Intel in 1978 had 29,000 transistors (then state-of-the-art), ran at under 5 MHz, had a die size of 51,000 square mils, and initially sold for nearly $200 (now a

Table 11
Intel 80x86 Product Line

Microprocessor	Introduction Date	Word Width (int-ext)	Transistor Count (K)	Performance Range (mips)	Price Range ($ per 1,000)
8086	1978	16-16	29	<1	5-6
8088	1979	16-8	29	<1	3-5
80286	1982	16-16	130	1-2	7-9
80386SX	1988	32-16	275	2-4	49-79
80386DX	1985	32-32	275	6-11	99-119
80386SL	1990	32-16	855	4-5	48-96
80486SX	1991	32-32	1,185	13-20	99-119
80486DX	1989	32-32	1,200	20-40	367-536
80486DX2	1991	32-32	1,200	40-54	487-650
P5 ("586")*	1992	32-64	3,100	80-100	900-1,400

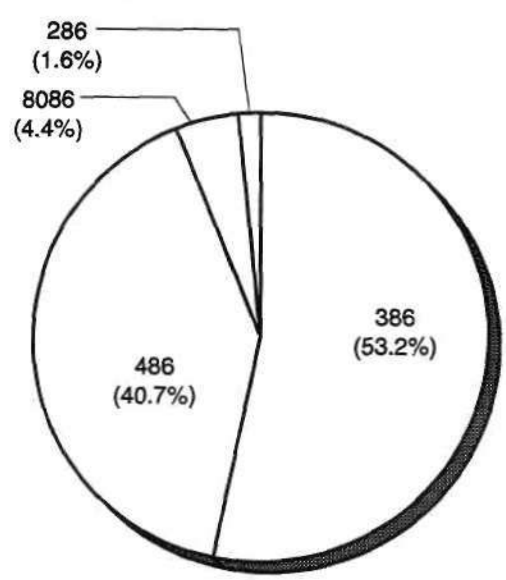
*Estimated parameters
Source: Dataquest (September 1992)

$6 part). Now the 80486 has 1.2 million transistors, runs up to 50 MHz, has a die size of 261,000 square mils, and initially sold for nearly $800. What these parts have in common is the power of compatibility with more than 10,000 software applications, with chips and systems cloned by anyone that can make them. This power has driven 80x86 microprocessor volumes to more than 50 million units per year, with increasing ASPs that have made the cloning of this golden goose a very hot target.

Intel makes nearly 95 percent of its 80x86 revenue from its proprietary 386/486 products (see Figure 7). The 80x86 market was originally opened through second-source licensing agreements, pushed by IBM as a result of its selecting the 8088 for its PC. The scene changed after growing critical mass in the market, using the early 8088 and 80286 processors, both of which were widely second-sourced. Intel introduced the 32-bit generation of 80x86 processors with the intent to grow its business around a family of single-sourced, upward-compatible processors that would eventually reach workstation performance.

As of 1991, Intel had only about 50 percent of the 80x86 unit volume (see Figure 8) but took an estimated 85 percent of the total revenue. A rapid decline is beginning for the 16-bit 80x86 processors (8086/88 and 286 generations), except the integrated versions

Figure 7
Intel 80x86 Revenue Breakdown



Source: Dataquest (September 1992)

G2000486

such as the 80186 and Chips and Technologies' PC-Chip, which will continue to grow in embedded and hand-held devices. These processors were the lifeblood of the 1980s' PC, which is now dominated by the 386/486 generation. However, these proprietary products face competition from two angles: direct 386/486 clones and the various members of the RISC camp.

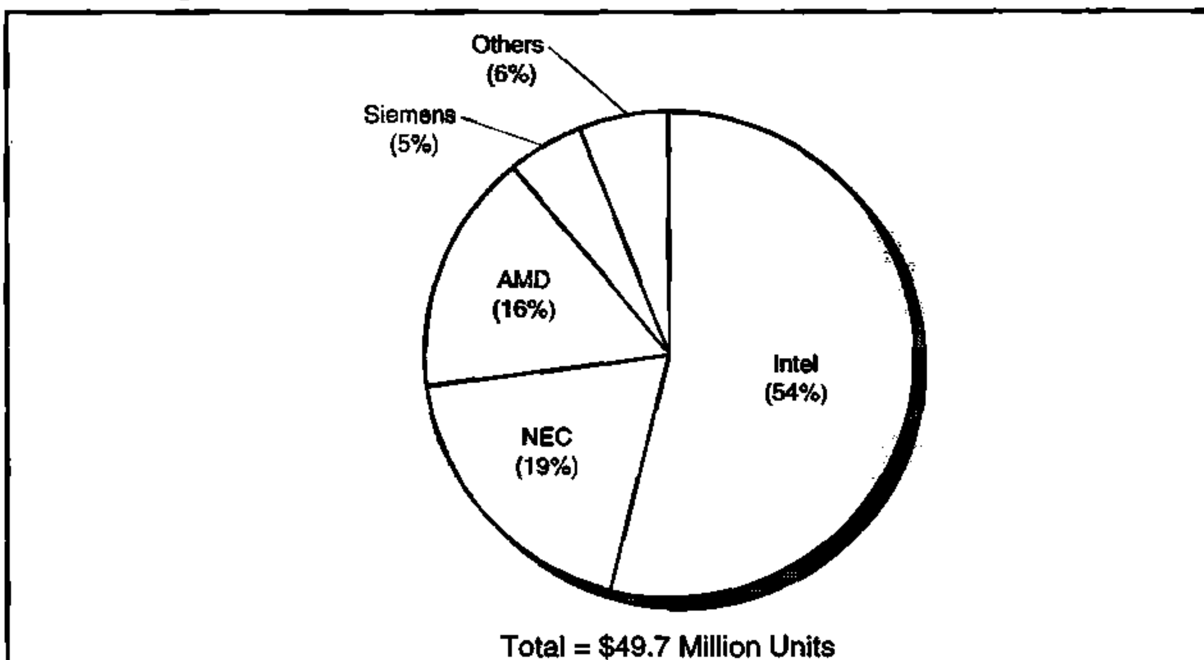
From the RISC front, there is only one viable long-term competitor to the 80x86 family, the PowerPC from the IBM-Motorola-Apple alliance. It has a large pull component from joint systems marketing by Apple and IBM, excellent design expertise from IBM and Motorola, plenty of manufacturing muscle from Motorola, and planned strong mainstream operating systems development from the roots of the Macintosh. The primary problem with the other RISC camps, including MIPS, SPARC, PA-RISC, and ALPHA, is lack of critical mass from system vendor support, lack of mainstream operating systems, or both.

As for the 386/486 clones, until last year Intel had 100 percent of the market, but after AMD's successful entry in 1991 the scene has changed. The following sections discuss competitive positions.

AMD

AMD entered the market in the second quarter of 1991 with exact copies (including microcode) of the 386DX and 386SX versions. Its

Figure 8
80x86 Microprocessor Market Share



Source: Dataquest (September 1992)

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strategy has been to use its "licensed rights" to Intel's intellectual property to reverse-engineer fully compatible clones of Intel's products, including microcode, and offer higher-speed grades at the same price Intel offers the standard speed grades. This strategy paid off initially as AMD attained about 15 percent of the 386 market by the end of 1991 and about 35 percent by the end of the second quarter of 1992. Keeping the momentum going, in January 1992 the company preannounced plans for 486 clones to be sampled in the third quarter and shipped in the fourth quarter. However, these plans were severely impacted in June 1992 when AMD lost a court battle over intellectual property rights (the 287 microcode case). It will suffer a significant setback because it must now forward-engineer its 486 clones, which will result in AMD moving them out to mid-1993 for shipments and taking away its "exact replica" advantage over other clones. AMD is expected to provide additional focus during 1993 on versions of 386 and 486 products for the portable market.

Cyrix

Cyrix entered the market in the second quarter of 1992 with a proprietary design representing a cross between the 486SX (instruction-set, cache) and 386SX and DX versions. Its strategy has been to forward-engineer its designs with 486 instruction-set compatibility and attack the installed base of 386 designs and units, offering OEMs a pin-compatible option to upgrade their 386 system designs to 486s, and offering corporate end users the option to upgrade their installed 386s to 486s. Furthermore, Cyrix intends to do the same thing for the 486 installed base as it starts releasing upscaled versions of its product line in the coming months. Having recently won a court battle contesting its rights to use SGS-Thomson as its foundry, Cyrix is successfully growing its sales and will probably ship some 400,000 units by the end of this year, representing a growing threat to Intel.

C&T

C&T entered the market in the fourth quarter of 1991 with a combination of exact clones and proprietary enhancements to the 386, as well as a single-chip PC based on an enhanced 8086 core. Having suffered severe technical problems in addition to poor financial health, C&T has announced its departure from the 386/486 clone race to pursue only integrated versions of the x86 family for handheld and portable devices. In its current condition, it does not pose a real threat to Intel.

Texas Instruments

TI announced that it will enter the market in the fourth quarter of 1992 using the Cyrix design with intentions of following up with more highly integrated versions using its wide array of technologies. Based on its manufacturing capabilities and widespread sales channels, TI presents a potential long-term threat to Intel. However, its limited microprocessor design expertise mitigates some of this threat.

Nexgen

Nexgen has preannounced plans for years to enter the market and now aims at a P5-like product, expected to be announced during the first quarter of 1993. Nexgen has an historical credibility problem to overcome in the industry and must align itself with an appropriate foundry for its parts.

UMC

UMC is working on a clone of the 486SX, expected to be introduced in the first quarter of 1993, having acquired design house Meridian Technology during 1991. With limited manufacturing muscle, a relatively low technology base, and limited sales channels (except in Asia-Pacific), UMC may have a difficult time sustaining its growth in this ultimately competitive arena.

Other companies rumored to be working on 386/486 clone products include VM Technology, a Japanese company reportedly with funding from Fujitsu; Seiko-Epson, which is working on a version of the 486 primarily for captive use; and IIT, a competitor in the math coprocessor arena working on a 486-type product with ultrahigh floating point performance.

Intel's 80x86 road map for the future calls for a dual focus on both desktops and portables, delivered in concert with its central strategy. It has long believed that its ultimate marketing edge is to drive up available transistor count through process and design technology and use that transistor count to do the following:

- Create leading-edge performance (desktop focus). This direction will result in the introduction of the P5 during the first quarter of 1993, a 100-mips class microprocessor with workstation-level floating point performance. Following this at 18- to 24-month intervals will be the P6 and P7, offering additional increases in performance level and multiprocessor support.
- Create leading-edge integration (portable focus). This direction will result in the 486SL, a 486 equivalent to the 386SL providing the ideal match for color notebooks. Following this will be the 386SC (single chip) class of devices, now being jointly developed with VLSI Technology.
- Continually decrease manufacturing costs. This direction will result in continued shrinkage of existing 486 and SL lines of products, reducing the die sizes and thus costs, enabling Intel to offer high-end (relative to competition) performance and integration at mainstream prices.
- Continually increase barriers to entry. This direction will result in limiting the available foundry capacity to the industry because of the level of design and process technology required to be performance- or cost-competitive, creating a strategic weakness for fabless vendors.

To maintain momentum in the marketplace, Intel uses a two-pronged marketing strategy as a countermeasure to the insurgence of competition. First, extensive litigation is used to slow existing competitors, discourage potential new competitors, and create anxiety within the market over using potentially illegal competitive products. Second, Intel is driving the PC market transition into its second-wave products (486 and SL versions) where end users gain better performance/features, competition is limited, and barriers to entry are much higher. Intel also intends to increase its brand preference through aggressive advertising of the "Intel Inside" concept and its "overdrive processor" upgrade programs.

Intel's Other Microcomponents

Beyond the 80x86 product line, Intel has two other families of microprocessors, the i960 embedded microprocessor and the i860 microprocessor. Together, these two families represented a combined total of about $25 million in business for Intel in 1991, or 1 percent of 80x86 revenue. The i960 is beginning to pick up momentum and is winning designs in many embedded areas including communication, X terminals, and laser printers. Having shipped about 250,000 units in 1991, Intel claims it is on track to ship close to 1 million units this year, a fourfold increase. Based on evidence at hand, we expect the i960 family to reach respectable business levels in two to three years. On the other hand, the i860 family is expected to remain a niche part for supercomputers and very high end graphic subsystems and to not provide a substantial revenue contribution for the foreseeable future.

Most of Intel's microperipheral products are designed to be fully compatible with one of its microprocessors. As mentioned earlier, Intel's line of 80x86-compatible math coprocessors has accounted for nearly 50 percent of the microperipheral revenue. With an estimated 1991 market size of more than $350 million, 80x86 math coprocessors are poised to head downward fast as the coprocessor function becomes integrated into the microprocessor, as it has in the 486 generation of devices. Intel has maintained the lion's share of this market, taking more than 75 percent of the market, leaving the remainder to Cyrix, IIT, and others. Having planned this evolution of coprocessor integration, Intel has now switched its strategy to overdrive processors (microprocessors for field upgrades) and will supplant this microperipheral revenue loss with gains in microprocessor revenue.

Among Intel's other microperipherals, PC chip sets—specifically high-performance versions—have been a focal point. After the AT bus became mature and performance needs exceeded its capacity, the industry spawned the EISA (Compaq-driven) and MCA (IBM-created) busses. Intel was the first to create compatible chip sets for these busses and remains the dominant vendor for each type. Unfortunately, the ISA bus remains the dominant standard and the others have not risen to great proportions. Thus PC chip sets represent a small contribution to the overall revenue (estimated at $100 million) and are expected to remain that way for the near future.

Intel is the third largest producer of ethernet controller chips, producing high-performance versions for workstations, X terminals, network routers/bridges, and high-end PCs, yielding some $25 million in revenue. Fax/modem chip sets, cache controllers, and its DVI line of multimedia controllers are examples of other minor revenue-producing microperipheral chips for Intel. Intel is expected to grow market share in each of these other areas as they become more central to its overall strategies.

Microcontrollers will present Intel with its toughest challenge to maintain or grow market share. Currently ranked fourth, Intel will have to place a greater emphasis on these components to pose a threat to Motorola or the Japanese vendors. Its focus has been on the proprietary MCS-96 family of 16-bit microcontrollers, where it currently dominates, attempting to change the industry momentum from 8-bit to 16-bit products. Though expected to continue success in the 16-bit segment, Motorola and other vendors will be attempting to shift focus to 32-bit parts as a counter to Intel's strategy.

Intel's Memory Business

Intel's bent toward innovation has also paid off in memories, yielding it substantial revenue (more than $300 million in 1991) from its leadership in the nonvolatile market (which it invented) and from royalties on DRAM and SRAM products (well over $60 million since 1990). There also is potential exploitation of its flash products. Though Intel is now primarily a microcomponents company, its inventions in the memory area include the following:

- The first DRAM (a 1Kb part in 1970)
- The first EPROM (a 1Kb part in 1971)
- The first high-speed MOS technology SRAM

Ironically, Intel does not plan to pursue market share using any of its own original inventions in the memory business, but it will place its emphasis on flash memories, a device first conceived by Toshiba.

Intel announced in 1990 that it would discontinue pursuit of EPROM developments to pursue the development of flash technology. Intel leads the industry in flash technology and holds an 85 percent market share in this subsegment of the nonvolatile market. In April 1992, Intel introduced the highest-density flash device, an 8Mb part, aggressively priced at $29 in low quantities. Intel also just entered an agreement to provide Sharp with rights to Intel's flash technology in exchange for Sharp building a $700 million facility for the production of Intel and Sharp flash memory products. This move may afford Intel a competitive manufacturing cost structure it has lacked in the past.

Intel's vision for flash includes being able to overcome problems with endurance (cycles), write speed, and programming voltage to produce the ideal memory that is nonvolatile, reads as fast as DRAM, writes quickly enough to keep up with an input write buffer, and is scalable in density beyond that of any other technology. This means that the bulk of portable products could replace DRAM and magnetic storage with one type of solid-state memory product. Intel's arguments carry enough weight that Microsoft has produced a FlashFile system for its operating systems that supports the Intel 8Mb flash memories. Based on current momentum, Intel should gain market share in memories over the next five years, providing a positive contribution to its overall growth.

Dataquest Perspective

Intel's strengths

Strategically Balanced Product Mix

Intel has gained leadership positions in all forms of computational systems and has structured its participation toward maximum leverage at each level. At the center is the PC, where the 80x86 family reigns supreme and Intel uses its microprocessor design and manufacturing expertise on top of compatibility to offer a range of industry-leading products with high revenue and attractive margins. At the low end are the hand-held devices where Intel will use its intellectual property and alliances with VLSI technology (integrated 386 cores) and Sharp (flash memories) to proliferate large volumes with reasonable royalties. At the high end are supercomputer systems where Intel develops and markets the complete system (including microprocessors) to gain high sales and margins in a low-volume business. In addition, Intel gains the technological synergy from participating in all areas, enabling it to push supercomputing advances into the desktop or take desktop performance into a hand-held device.

Strong Momentum in the PC Market

Intel is the leader in microprocessors for PCs and can drive the transition toward microprocessors that result in higher performance, higher ASPs, and higher barriers to entry. This transition includes support by all the top PC manufacturers, which includes very close relationships with IBM, which remains a steadfast customer and joint-developer of Intel's 80x86 processors; Compaq, which is a joint developer/tester at the systems-level that dropped the MIPS/ACE initiative to focus on Intel's P5; NCR, which works directly with Intel on innovative directions in servers and pen-based systems; Digital, which entered into an agreement for Intel to manufacture its systems; and all major Japanese vendors including Toshiba, NEC, and Epson, which have remained 100 percent Intel houses.

Leader in 80x86 Microprocessor Products

Intel maintains the leading position in performance, integration, and product breadth. With planned R&D investment of $800 million per year, 75 percent of which ($600 million) will directly apply to the 80x86 product line, Intel will most likely maintain this lead. Adding to this, Intel's joint development programs with IBM and VLSI technology for highly integrated processors will also strengthen its position. Furthermore, Intel's relentless pursuit of intellectual property protection using the legal system presents an additional financial drain to many smaller would-be cloners.

Strong Process and Manufacturing Capabilities

Intel was yielding 1-million-transistor processors (486) two years before the competition and began producing a 2.5-million-transistor chip (i860XP) more than one year ahead of any others. As competition begins to form by pairing innovative fabless design companies with large semiconductor manufacturers, Intel will have the cost advantage of vertical integration. We believe that Intel has a significant advantage in manufacturing technology for logic products, which will give it an edge for the next several years.

Leader in Flash Memory Products

Intel's focus on flash technology, its partnership with Sharp, and its captive ExCA marketing program for portable PCs and hand-helds will keep it ahead of the market for some time.

Leader in Supercomputer Performance

Intel's move into the supercomputer business strengthens its ability to design leading-edge microprocessors, especially as the move into an era of multiprocessor systems begins.

Intel's Weaknesses

Strategic Shift Upcoming in the PC Market

The first PCs came from IBM. Then vendors produced IBM-compatible PCs—clones of the complete system design. Then Intel drove the transition to PCs that were 80x86-compatible, clones of the instruction-set architecture, starting with the Compaq 386. Now Microsoft is driving the transition to PCs that are Windows-compatible, clones of the operating system environment, starting with the MIPS/ACE environment. As we enter the mid-1990s, this paradigm will be in full swing with users purchasing Windows NT systems or PowerOpen systems on various microprocessor-based systems. Though the 80x86 family has the most operating system support of any microprocessor, the loss of instruction-set compatibility as a requirement will level the playing field and enable competition to grow where a monopoly once was.

Lack of PC Systems Profitability

The same power that created demand for more than 100 million installed 80x86-compatible PCs has resulted in lack of differentiation, weak prices, and thus low profits for nearly all vendors in the PC industry. Though stuck for now in the mode of moving low-margin undifferentiated PCs, many of these vendors must change to remain financially viable for the long term. This means either using a differentiated approach with a non-Intel 386/486 product, or moving to a RISC architecture with an upscale pricing structure.

Growing 80x86 Competition

As the lure of high profits draws more competitors into the 386/486 clone game, Intel's product monopolies become shorter and harder to defend. In the past, Intel's product positioning left holes in its product line, such as 25-MHz 386SXs. Existing and future holes are prime targets for competition looking for differentiation among the compatibility. Furthermore, the period over which Intel can monopolize the market will shrink and increase pressure on time-to-market of next-generation products.

Weak Products in PC Microperipherals

Outside of math coprocessors, Intel has had problems developing a strong line of support chips. This includes failures in PC core-logic chip sets (it was reselling ISA chip sets from VLSI Technology), graphics controllers (82786 and various VGA controllers), and its early DVI chip sets.

Summary and Outlook

Intel's future depends on leveraging its strengths in the semiconductor business segments, particularly the 80x86 microcomputer chip sets. It was clearly evident during 1991 that the future for the 80x86 class of processors will be a competitive arena filled with Intel, AMD, and others. Intel intends to migrate desktop computers to the increasingly fast 486s (and soon to be P5s) and portables to the increasingly integrated SL line of 386s (and soon to be 486s). Dataquest believes that Intel has the power to make this happen by 1993, which will impose increasingly high barriers to competition. However, as Intel repositions its products to maintain market share, it will begin to lower its gross margins and thus some of its revenue growth will come at the expense of profits.

Using the projected growth of the microcomponent and memory segments and assuming Intel's market share remains constant over the next five years, its semiconductor revenue should grow 85 percent or from $4.0 billion to $7.4 billion. Based on the current environment, this is a likely scenario because we believe that Intel will maintain market share in microcomponents while slightly growing its share in memories over the next five years. Assuming an equivalent growth rate for its nonsemiconductor businesses, Intel could see a $10 billion business by the end of 1997.

Dataquest Vendor Profile

Microcomponents *Worldwide*
September 7, 1992

Intel Corporation

Corporate Statistics

Headquarters Location	Santa Clara, California
President and CEO	Andy Grove
Primary Business	Microcomputer components
Annual Sales (FY1991)	$4,779 million (U.S. Dollars)
Total Employees	24,600
Manufacturing Locations	10 worldwide
Founding Date	July 1968
Fiscal Year	January-December
Ownership	Public (NASDAQ ... INTC)

Corporate Overview

Over the last five years, Intel has recovered from a downhill slide capped by heavy losses in 1986 to become the kingpin of microprocessors and perhaps the most powerful semiconductor company in existence. Driven by Intel toward increased performance levels, the enormous market for 80x86-based PCs grew in 1991 to more than $2.5 billion in microprocessor revenue and about $1.0 billion in related peripheral products. Now at the pinnacle of its success, Intel faces its toughest challenge: to keep its 80x86 family ahead of competing RISC families and other 80x86 clone products while maintaining attractive profit margins.

Intel defines its mission to be the leading supplier of microcomputer building blocks at the component, module, or system level used within computers and embedded control equipment. Today, most of the company's activities are focused on growing its business derived from the IBM-compatible PC market. This direction means that Intel must remain the dominant leader in 80x86 microprocessors and microperipherals.

Founded in 1968, Intel originally concentrated on semiconductor memory products, which still remain an important part of its business. Among its many innovations (see Table 1), Intel is credited with inventing the most important memory in use today, the dynamic

For more information on Intel Corporation or the microcomponents industry, call Ken Lowe at (408) 437-8366.

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MCRO-SEG-VP-9201

Table 1
Major Milestones for Intel Corporation

Year	Description
1968	Intel Corporation founded.
1970	Introduced the first commercial DRAM (1Kb).
1971	Introduced the first commercial EPROM (1Kb). Introduced the first commercial microprocessor (4004). Goes public.
1973	Introduced the first microprocessor development system.
1974	Introduced the 8080 (initiated major growth of MPU industry). Achieved more than $100 million in net sales.
1976	Introduced the first microcontroller with EPROM.
1978	Introduced the 8086 (spawning the most successful line of MPU in history).
1979	Introduced the first 5V DRAM (previously all 12V).
1980	Introduced the 8051 microcontroller (most widely used MCU in world). Introduced the first math coprocessor (8087).
1981	Intel 8088 selected by IBM for its first personal computer (IBM PC).
1982	Introduced the 80286 (used in IBM PC AT).
1983	Achieved more than $1 billion in net sales.
1985	Exits the DRAM business (after developing 1Mb working silicon). Enters the PC enhancement market (AboveBoard memory adapters). Introduced the 80386, first 32-bit x86-compatible generation.
1987	Enters the market for parallel supercomputers.
1988	Introduced its first flash memory product. Introduced the i960 embedded RISC processor family.
1989	Introduced the first 1-million-transistor microprocessor (i860). Introduced the 80486, first MPU with integrated CPU, FPU, and cache.
1990	Exits EPROM development race (at 4Mb) to focus on flash.
1991	Achieves fastest installed supercomputer (32 gflops). Introduced the first 2.5-million-transistor microprocessor (i860XP).
1992	Introduced the first 8Mb flash memory component.

Source: Intel, Dataquest

random access memory (DRAM). Its strategy has always been built on innovation: invent something unique, enjoy higher profits from that uniqueness, then move on when competition crowds the market. Yet, as it entered the 1980s, Intel (like most semiconductor companies) sold a broad range of mostly commodity products. Then, in 1981, IBM chose the 8088 as the engine for its first PC, eventually changing the profile of Intel's entire business.

By 1985 it was clear that the DRAM business was at best a low-margin proposition where the Japanese were taking over in the midst of a chip recession. As a result, Intel accumulated operating losses of $250 million over 1985 and 1986. These and other factors drove Intel's decision to exit the commodity-oriented DRAM business in favor of the innovation-oriented microprocessor business. At that time, Intel's future hinged on the success of its proprietary 386 microprocessor, an advanced 32-bit architecture compatible with the 16-bit 8086 PC standard.

As history shows, this was the best decision Intel could have made. The 386 became the most successful logic chip in the semiconductor industry, accounting for nearly half of Intel's 1988 revenue of $2.9 billion. Intel followed up with the 387 math coprocessor and later, in 1989, with the 486, a 1.2-million-transistor chip that combined the functions of the 386 and 387 and had a primary cache yielding a twofold performance improvement at a fourfold pricing increase. As a result, the 486 now represents Intel's leading revenue generator, which will account for more than $1.4 billion in revenue for 1992.

Intel's 386 monopoly weakened in 1991 when Advanced Micro Devices (AMD) became the first of several vendors to enter the 386-compatible market, taking considerable unit volumes and effectively lowering the exceptionally high pricing structure Intel had enjoyed. At the same time, RISC microprocessors were reaching the peak of their momentum with IBM, Apple, and Motorola teaming up to create next-generation systems based on the PowerPC architecture. Meanwhile, Intel has increased its penetration into other markets, trying to balance its portfolio of products to increase its non-80x86 revenue.

Business Strategy and Segmentation

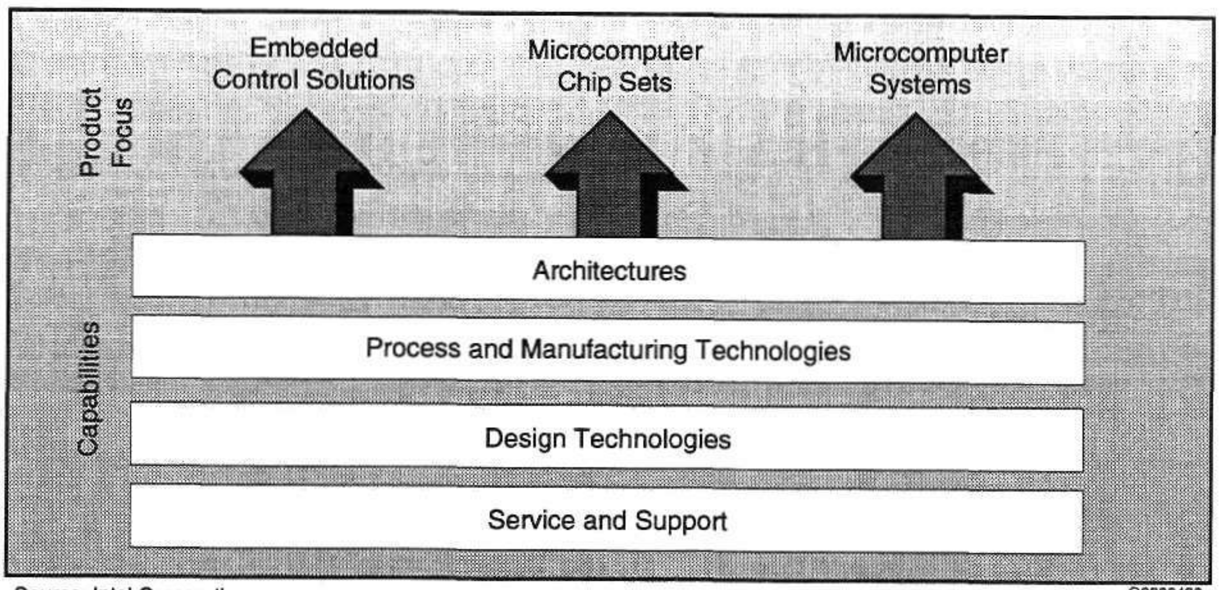
Intel's vision for the 1990s centers around a concept referred to as "computer-supported collaboration." It believes that as the pace of competition picks up (among businesses in general) there will be a transition to a "just-in-time" business environment, where getting the right information to where it is needed quickly becomes a primary competitive advantage. This transition will be achieved through cooperative work facilitated by interconnected, interactive electronic communication in which all forms of data are shared quickly and easily. The worldwide computer infrastructure will be extended to become a communications infrastructure, hence "computer-supported collaboration." Intel integrates its product mix around this central theme, paving the way for increasing levels of processing power, miniaturization, and communications capabilities.

To realize this overall vision, Intel pursues the evolution of its primary target market, computer systems, by focusing on three main product areas supported by four key capabilities (see Figure 1). Intel's overall business strategy anticipates integration of the computer and communications industries and positions the company to pursue the additional opportunities that will result. Intel's primary product focuses are microcomputer chip sets, embedded control solutions, and microcomputer systems, the first two of which are semiconductor product businesses representing the bulk of Intel's total sales. The key capabilities developed by Intel to support its growth in these areas include proprietary architectures (mainly microprocessors), manufacturing and process technologies, design technologies, and support services.

Major Market Segments

Intel participates in a wide range of market segments. However, sales are dominated by the data processing market, which accounts for an estimated 70 percent of its total revenue. Sales into this segment include semiconductor components (microprocessors, microperipherals, and memory devices), computer upgrade modules (coprocessors, memory cards, and add-in adapters), and supercomputers—all sold to computer companies, distributors, or end users. Intel has targeted the computer systems markets since the mid-1980s because of the higher margins afforded to the components that serve that market. Other market segments served (in order of decreasing revenue) are industrial, communication, automotive, military, and consumer.

Figure 1
Intel Core Strategy



Source: Intel Corporation

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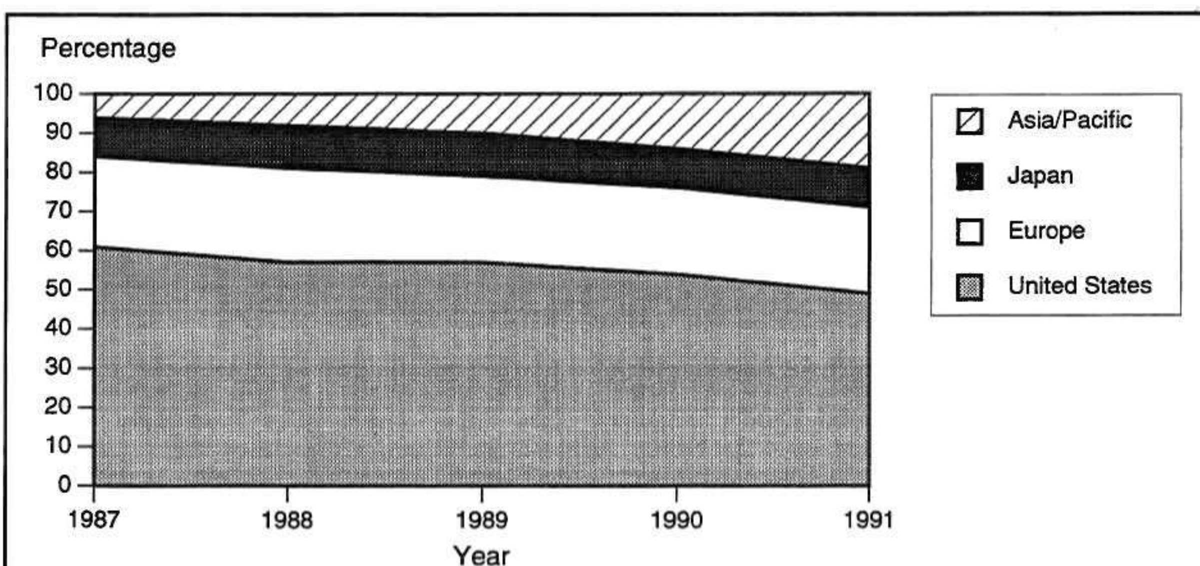
Intel sells most of its components directly to companies that incorporate them into their products. These customers primarily are computer systems manufacturers such as IBM and Compaq, but they also include producers of telecommunications equipment, industrial equipment, and automobiles. Intel maintains a broad, balanced customer base; no single customer accounted for more than 10 percent of its revenue during the last two years (in 1989, IBM accounted for 10.5 percent of Intel's revenue). Intel also sells certain products through distribution, which accounted for about 25 percent of its net revenue during 1991.

An expanding base of international customers, primarily in the Asia-Pacific region, has driven Intel's sales mix to an all-time high of 51 percent non-U.S. revenue (see Figure 2). Over the last five years, Intel's sales from the Asia-Pacific region have steadily increased from 6 percent in 1987 to 19 percent in 1991, making it the No. 1 vendor in the region, primarily driven by the growth of the PC clone industry in Taiwan. However, as a result of AMD and other x86 clones entering the 386/486 market and penetrating primarily the Asia-Pacific clone vendors, this shift in regional sales mix is expected to come to a halt during 1992. In exchange for this increase in international business, sales in the United States decreased from 61 percent in 1987 to only 49 percent in 1991, which also indicates the shift toward offshore manufacturing of PCs. During this same period, the percentage of regional sales to both Europe and Japan remained relatively constant at about 22 percent and 10 percent, respectively.

Figure 2
Intel Sales, by Geographic Region



Source: Dataquest (September 1992)

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Major Product Segments

Though its product mix includes items as diverse as supercomputers and adapter boards, Intel is primarily a semiconductor company, with microprocessors central to its entire product mix. This section will provide an overview of Intel's product mix as defined by the company. A subsequent section will provide a complete analysis of Intel's semiconductor-related businesses, which accounted for a combined total of about $4.0 billion, or 84 percent of its 1991 revenue.

The first product segment, microcomputer chip sets, feeds the bulk of Intel's growth, 65 percent of 1991 revenue or about $3.1 billion (see Figure 3). This segment includes semiconductors and integrated modules as building blocks for computer systems ranging from desktops to floortops to portables. Specifically, this segment includes the following products:

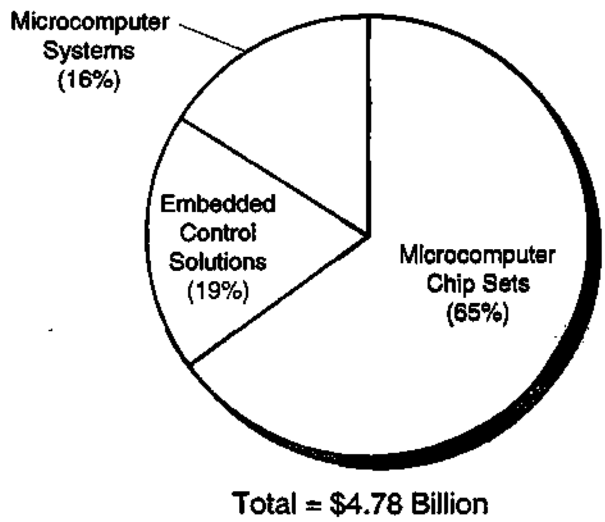
- Computer microprocessors, the central control units used for computer systems, now primarily focused on 32-bit 80x86 processors (that is, 386, 486, and P5). Also includes the older 16-bit 80x86 processors (8088/86/286) and the i860 processor for supercomputing and graphics.
- Microperipherals, which work directly with the microprocessors to handle specific I/O and processing functions. Intel's sales here are dominated by math coprocessors but also include PC core logic chips, network controller chips, multimedia, and modem chips.
- SRAM memory and CPU/cache modules (sold for the 486DX-50), which account for a small amount of revenue but represent a strategic technology for integration with the CPU.

Embedded control solutions, the second semiconductor business area, accounted for about $900 million (19 percent) of 1991 revenue. This business segment includes components used in various embedded applications such as laser printers, communications systems, and automobiles. This segment spreads out the use of Intel components as the core of intelligent noncomputer electronic systems. Specifically, this segment includes the following products:

- Microcontrollers, which represent the largest revenue source for this product segment, integrate microprocessor and memory technologies on one chip and include the 8048, 8051, and proprietary MCS-96 families of components.
- Nonvolatile memory/logic, which permanently store control programs, includes Intel's line of EPROMs, flash memory devices, and PLD devices.
- Embedded microprocessors, the processors used to control the actions and data flow in noncomputer applications, include the i960 family as well as the embedded versions of the 80x86 family (80186/188/376).

Microcomputer systems, a nonsemiconductor business area, accounted for about $800 million of Intel's 1991 revenue. This business segment supports the proliferation of the other two segments,

Figure 3
Intel Sales, by Product Segment



Source: Dataquest (September 1992) G2000482

creating and manufacturing systems designed around Intel components at both the commodity level (PC motherboards) and leading edge (supercomputers). Specifically, this segment includes the following:

- PC motherboards, based primarily on Intel microprocessor and I/O components, are manufactured by Intel for OEMs such as Digital Equipment Corporation.
- PC enhancement products, which are sold through retail computer stores, include add-in adapter boards (memory, fax/modem, network controllers), PCMCIA cards (memory, fax/modem), and component upgrades (math coprocessors, overdrive processors).
- Supercomputer systems, ultra-high-performance computers utilizing massively parallel processing primarily for scientific and engineering problems, are designed around Intel's i860 microprocessor and sold directly to large end users.
- Software products, which include microcomputer operating systems (iRMX real-time kernel for industrial control applications), development/debug support tools, and high-level networking software support.

Key Capabilities and Competencies

Intel to date has been successful in optimizing its four key capabilities around its product mix to leverage its position as the incumbent king of microprocessors.

The first of Intel's four key capabilities is proprietary architectures. Leveraging the momentum of the IBM PC legacy, Intel pushes leading-edge performance and integration while maintaining pull-through 80x86 compatibility. The 80x86 microcomputer architecture is the most widely used in the industry, representing more than 80 percent of the PC units shipped. Intel works closely with major software vendors to ensure that the 80x86 family maintains the largest complement of operating systems and application packages available. Intel also maintains two proprietary RISC microprocessor architectures, the i960 for the 32-bit embedded processing market and the i860 for supercomputers and graphics/imaging subsystems.

Intel's next emphasis is advanced process and manufacturing technology. Intel's strength in manufacturing capability is underscored by its enormous capital investment (nearly $1 billion in 1991) used for continually upgrading facilities. Intel's process technology developments have enabled it to double the number of transistors it can integrate on one chip about every 18 months since the early 1970s. Its strategy is to gain a twofold leverage from the following leading-edge processes:

- Enable state-of-the-art products not possible or economical without the investment in fabrication expertise
- Lower unit cost through smaller die sizes and higher yields as older products become commodities, affording them higher margins

Intel's third key capability is design technology, where it has long been recognized that design time is a bottleneck in bringing new chips to the market. Intel's level of design technology is reinforced by its continued high spending in R&D, which represented 13 percent of total sales in 1990 and 1991. As a result, Intel expects to reduce its time to market for next-generation chips while significantly increasing their complexity. Thus, as the P5 is introduced in early 1993, the P6 generation should be out in mid-1994 and the P7 in early 1996.

Intel's fourth key capability is service and support. As with most major companies, service is a key element in the overall marketing mix. At Intel, the differential advantage focuses on extensive documentation, training programs, and hardware/software development tools that make its components easy to design with.

Marketing Strategy and Alliances

Though not included under key capabilities, another key Intel strength is its marketing program, which is an integrated mix of brand promotion, competitive counterattacks, and high-impact product introductions. Combined with its position in the 80x86 microprocessor market, Intel delivers the image of leadership within the PC industry through its marketing programs.

Intel's brand promotion program has been aimed at increasing the awareness of its brand products and their advantages at the end-user level. To date, more than 340 manufacturers have participated in the "Intel Inside" cooperative advertising program. Intel hopes to use this program to develop preference for PCs with Intel microprocessors because of their absolute compatibility, upgradability paths, and other features.

Intel has also begun strengthening its relationships with key customers and third parties because it faces increasing competition on its mainstream microprocessors. As a result, Intel is forming more and more strategic alliances, such as its recent cross-licensing agreement with VLSI Technology. This agreement establishes a program for developing highly integrated 386-based processors for the handheld market through a vendor that leads in PC logic chip sets and excels in customization services. In addition, it focuses VLSI's development and marketing efforts on Intel's microprocessors, rather than on AMD, Cyrix, or others.

Intel's 1992 alliances were as follows:

- VLSI Technology and Intel entered into a cross-licensing and equity exchange agreement (Intel now owns 16 percent of VLSI) to design integrated 386-based products primarily for the handheld market.
- IBM and Intel entered into a licensing agreement for IBM's XGA graphics architecture in which Intel will integrate XGA features into IBM's multimedia and microcomputer products.
- Defense Advanced Research Projects Agency (DARPA) and Intel announced a joint research program to produce a 1-teraflop-level supercomputer system.

Intel's 1991 alliances were as follows:

- IBM and Intel jointly announced the formation of the Noyce Development Center, a 100-engineer design center to develop very highly integrated 80x86 microprocessors.
- Digital and Intel entered into an agreement in which Digital would introduce a new family of PC products based on Intel 386/486 microprocessors and manufactured by Intel.
- NMB Semiconductor and Intel entered into a supply agreement in which NMB will turn one of its plants into a flash memory foundry (for die only) dedicated to Intel.
- Pacific Bell and Intel signed an agreement to market network integration services and equipment in conjunction with Pacific Bell's Data Communications Group.
- Tartan Laboratories and Intel's military division signed an agreement to jointly market Tartan's i960 ADA compilation system.

In 1990, IBM and Intel entered into an agreement providing Intel exclusive rights to its parallel interface (PI) bus interface unit, currently used in IBM's Common Avionics Modules.

Intel's 1989 alliances were as follows:

- AT&T, Convergent Technologies, Ing. C. Olivetti S.p.A., Prime Computer, and Intel announced a joint engineering effort to create a multiprocessing version of UNIX for the i860.
- AT&T Microelectronics and Intel signed a five-year agreement to provide OEMs with an array of products supporting ISDN and LANs from a common source.
- (DARPA) and Intel signed a $7.6 million research agreement to develop prototypes of a CRAY-1-level supercomputer.
- IBM and Intel signed an agreement in which Intel would develop an MCA board to utilize DVI for the IBM PS/2 computer.

Company Organization and Operations

Intel is organized around a business unit structure (see Figure 4) that focuses on the development and marketing of its product segments while relying on centralized departments for all of the support functions including manufacturing, sales, finance, and administration. There are five product groups, four of which focus strictly on one product segment while the fifth splits attention between two product segments. At the top is an executive office shared by Chairman Gordon Moore, President Andy Grove, and Executive Vice President Craig Barrett. As the company's chief strategist and visionary, Andy Grove maintains the most visible role of the three executives in shaping Intel's direction. Craig Barrett, currently positioned as the heir-apparent, primarily focuses on day-to-day operations.

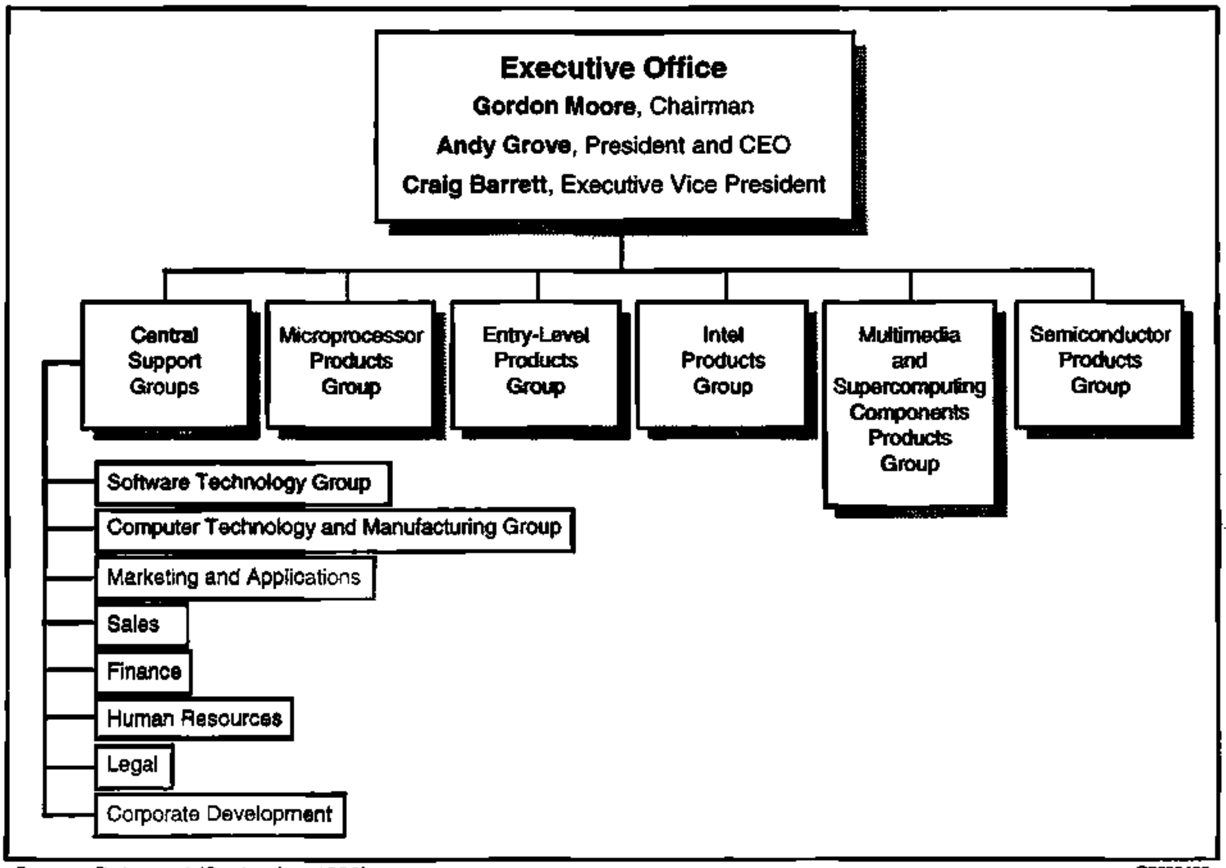
Development of the 80x86 product line is split between two separate operating groups based on both product and market focus, the first of which is the Microprocessor Products Group. This group is responsible for the development of high-performance 80x86 processors targeted primarily for office systems (PC desktops, workstations, and servers). The group is headed by Paul Otellini and Albert Yu, both vice presidents who share the general manager position. Specific products under this group include the following:

- i486 product line (SX, DX, and other desktop versions)
- Future 80x86 architectures including P5 (due out in the first quarter of 1993), P6, and P7

Intel's second 80x86 group is Entry-Level Products, which is responsible for development of highly integrated 80x86 microprocessors and standard microperipheral chips used to manufacture mainstream PC systems. This group is headed by Mike Aymar, vice president and general manager. Specific products under this group include the following:

- Intel's SL product line of integrated architectures, including i386SL and H4C (486SL)

Figure 4
Intel Organization Structure



Source: Dataquest (September 1992) G2000483

- Core logic chip sets including EISA, cache controllers, PCI, and other related chips
- I/O modules including Intel's ExCA (Exchange Cards) and other I/O chips and adapters

Multimedia and Supercomputing Component Products was formed in May 1991 to pursue non-80x86 architectures that extend the current bounds of computing. This group is headed by Ken Fine, vice president and general manager. Specific products under this group include the following:

- Digital Video Interactive (DVI) product line (i750 series)
- i860 family of supercomputer microprocessors
- i960 family of embedded microprocessors

The Intel Products Group is actually a collection of separate divisions, each focused on a different line of Intel-branded components, software, or systems. This group is headed by Frank Gill, senior vice president and general manager. Included in this product group are the following divisions and specific products:

- PC Enhancement Division, which includes adapter products such as fax/modems and network controllers
- End-User Components Division, which includes math coprocessors and overdrive processors
- OEM Products Division, which includes multibus products, iRMX software, and PC platforms
- Supercomputer Systems Division, which includes the iPSC/860 supercomputer products
- Networks and Services Division, which includes other deliverable software and services

The Semiconductor Products Group is responsible for the development of nonvolatile memories, microcontrollers, and related products. This group is headed by Robert Reed, senior vice president and general manager. Specific products under this group include the following:

- Nonvolatile memories, which includes standard EPROMs and flash products
- Microcontrollers, which includes 8048, 8051, and MCS-96 families

Sales Channels and Distribution

Most of Intel's products are sold or licensed directly to OEMs through a network of 68 sales offices located in 20 nations. Intel also uses distributors and representatives to sell products indirectly to smaller OEMs and end users. Intel's sales channels and distributors are managed directly by a centralized sales department.

In North America, Intel maintains 43 direct sales offices; 39 are located throughout the United States and 4 are in various parts of Canada. Intel also has the following distributors throughout the United States and Canada:

- Alliance Electronics
- Almac Electronics (United States and Canada)
- Arrow Commercial Systems and Arrow/Schweber (United States and Canada)
- Avnet Computer and Hamilton/Avnet Electronics (United States and Canada)
- MTI Systems
- North Atlantic Industries
- Pioneer-Standard and Pioneer Technologies Group
- WYLE Laboratories
- Zentronics (Canada only)

In Europe, Intel has 9 direct sales offices and 28 distributors providing complete regional coverage on a country-by-country basis. Direct Intel sales offices are located in the following countries:

- Germany
- United Kingdom
- France
- Italy
- Sweden
- Finland
- Netherlands
- Spain
- Israel

In Japan, Asia, and the Rest-of-Word (ROW), Intel maintains 16 direct sales offices and a host of distributors. Direct Intel sales offices are located in the following countries:

- Japan (7)
- Australia (2)
- Brazil
- China
- Hong Kong
- India
- Korea
- Singapore
- Taiwan

Manufacturing Plants and Subsidiaries

Intel operates 10 major manufacturing facilities throughout the world, 6 in the United States, 1 in Europe, and 3 in ROW. Intel also has 25 subsidiaries throughout the world, 20 of which are direct sales/service operations in various countries. The other 5 are primarily holding companies or acquisitions and include Intel Electronics Ltd. (United States), Intel International Inc. (United States), Intel Investment Ltd. (United States), Intel Overseas Corporation (United States), Intel Puerto Rico (Puerto Rico), and Jupiter Technology Inc. (United States). Table 2 lists the locations and describes the major semiconductor fabrication facilities.

Intel closed its oldest fabrication facility, located in Livermore, California, in the third quarter of 1991. This 17-year-old facility was reportedly last used for producing 386 microprocessors; its closing was delayed by more than a year because of parts shortages.

Table 2
Intel Semiconductor Fabrication Facilities

Plant Location	Fab Name	Began Operating	Technology and Products Produced	Line Width (µm)	Wafer Size
Aloha, OR	Fab 4	1981	High-volume commodity, logic	2.0	4
	D1(Fab 5)	1987	MPU: 386, 486, SRAM, logic	1.0	6
Chandler, AZ	Fab 6	1984	MCU, MPU: 286, 186	1.5	6
Jerusalem, Israel	Fab 8	1985	MPU: 286, 386	0.8	6
Rio Rancho, NM	Fab 7	1984	EPROM, MCU: military standard	1.0	6
	Fab 9.1	1988	MPU: 386, 486	0.8	6
	Fab 9.2	1991	MPU: 486, EPROM	1.0	6
	Fab 9.3	1992	MPU: P5, EPROM	0.8	6
Santa Clara, CA	Fab 1	1987	EPROM, flash, MCU, logic	1.5	4
	R1*	1986	NA	NA	6
	D2*	1989	EPROM development	0.8	8
	PED*	NA	NA	1.0	6

NA = Not available
Notes: All fab facilities are full production unless noted with an asterisk (*). All process technology used is CMOS unless noted under products.
Source: Dataquest (September 1992)

Intel is spending more than $1 billion a year in plant and capital equipment to build new fabrication plants and refurbish existing ones. This investment is focused on development of the following facilities:

- Aloha, Oregon D1A Fab: Intel started construction in June 1991 and plans to bring this facility on-line in the second quarter of 1993. This 430,000-square-foot facility will cost $200 million to $300 million and will offer capabilities of running 8-inch wafers, from 0.6 to 0.35 µm, aimed at supporting the P5 and future processors. The present D1 facility will simultaneously be converted to 0.6 µm and 8-inch wafers.
- Dublin, Ireland: Intel will spend about $500 million to build this state-of-the-art facility to support the European market. This plant is scheduled to go on-line by the end of 1992.
- New Mexico: Intel is reportedly expanding fab lines to accommodate the P5 as it goes into volume production.

Intel also operates the following manufacturing plants for component and board-level assembly operations:

- Hillsboro, Oregon: Memory boards and microcomputer systems.
- Las Piedras, Puerto Rico: Memory boards and microcomputer systems.
- Leixlip, Ireland: Memory boards and microcomputer systems.
- Manila, Philippines: Component assembly and final testing.
- Penang, Malaysia: Component assembly and final testing.

Adding to its list of operations, in 1991 Intel acquired the Network Products Division of New York-based LANSystems Inc. as a part of an ongoing thrust into the market for LAN software and hardware. In 1990, Intel acquired Jupiter Technology, a supplier of data communications computers, operating systems, and networking products, to broaden its technology and offerings in the connectivity market.

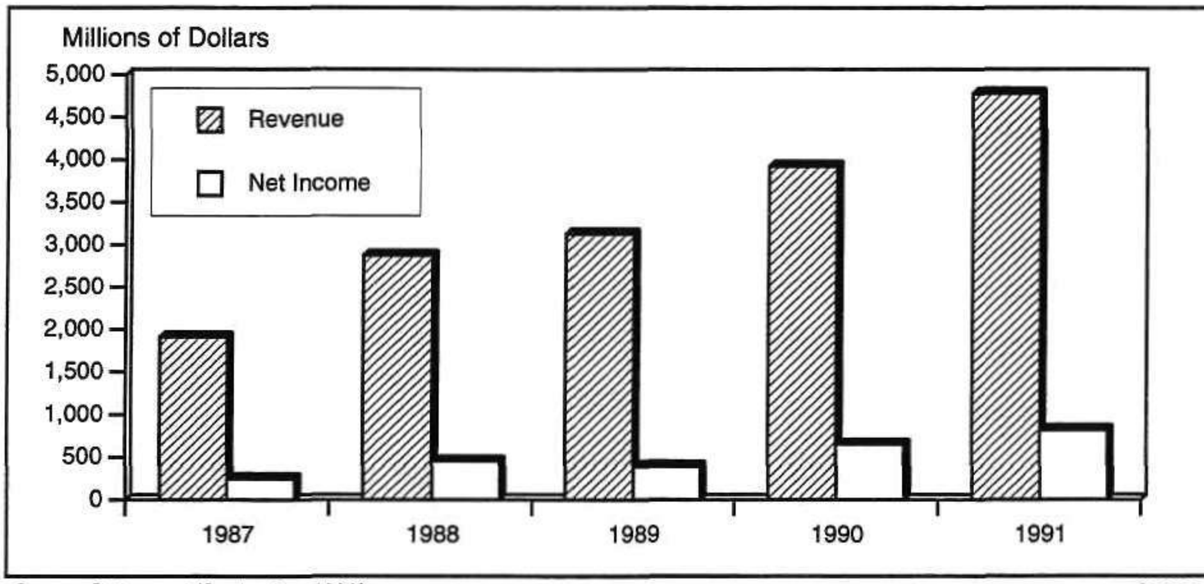
Financial Performance and Conditions

Five-Year Financial Highlights

Over the last five years, Intel's revenue has continued to grow at an industry leading pace with a five-year compound annual growth rate (CAGR) of 20 percent (see Figure 5). Despite increasing competition in its primary product segments (386/486 microprocessors), Intel still enjoys healthy financial growth and is expected to turn in about 15 percent growth in revenue for 1992.

Net income has generally kept pace with revenue growth, with the exception of 1989, when a slowdown in revenue growth resulted in a decrease in net income (see Table 3). This is a direct result of the high gross margins Intel is able to sustain because of its monopoly in the 386/486 microprocessor market, which is just now coming into fierce competition. As a result, average selling prices have

Figure 5
Intel Historical Growth



Source: Dataquest (September 1992) G2000484

Table 3
Intel's Five-Year Financial Summary

	1987	1988	1989	1990	1991
Revenue ($M)	1,907	2,875	3,127	3,921	4,779
Growth Rate (%)	51	51	9	25	22
Cost of Sales ($M)	1,044	1,506	1,721	1,930	2,316
Gross Margin (%)	45	48	45	51	52
Net Income ($M)	248	453	391	650	819
Net ROS (%)	13	16	13	17	17
Total Employees	19,200	20,800	21,700	23,900	24,600
Sales/Employee ($)	99,323	138,221	144,101	164,059	194,268
Total Equity ($M)	1,276	2,080	2,549	3,592	4,418
Return on Equity (%)	19	22	15	18	19
R&D Expenses ($M)	260	318	365	517	618
Percent of Sales	14	11	12	13	13
Capital Expenses ($M)	302	477	422	680	948
Percent of Sales	16	17	13	17	20
Total Assets ($M)	2,499	3,550	3,994	5,376	6,292

Source: Dataquest (September 1992)

eroded significantly and Intel is expected to see a drop in gross margins for 1992.

Intel has seen its most dramatic changes in productivity, as indicated by the sales per employee ratio climbing from $99,000 in 1987 to more than $194,000 in 1991. Intel has been investing in the tools that are critical to enabling high productivity, primarily those used in design and development. These tools reduce the time to complete design tasks and thus reduce work hours per design and time to market. Intel also runs on a highly disciplined structure where planning is an essential element, decision-making is done quickly, and people are encouraged to take risks to move ahead.

Comparison to Industry Conditions

In comparison to other large semiconductor companies, Intel has exhibited nothing short of stellar performance from a financial operating standpoint. Intel revenue grew 250 percent from 1987 to 1991 (see Table 4). In comparison, AMD's revenue grew 23 percent, TI's 17 percent, Motorola's 168 percent, and National's 71 percent.

Intel's profitability and productivity ratios also stand out, again stemming from higher-than-average gross margins, which led the industry at 52 percent. Intel led the industry in 1991 in return on sales (net income) and return on equity. However, its most dramatic lead is in sales per employee, which reached an all-time high in 1991 of $194,000, nearly twice that of the competition.

Table 4
Comparative Industry Financial Conditions

	Company				
	Intel	AMD	TI	Motorola	National
1987-1991 Revenue Growth (%)	250	23	17	168	71
Gross Profit Margin* (%)	52	46	17	36	24
Return on Sales* (%)	17	12	-6	4	-9
Return on Equity* (%)	19	19	-21	10	-23
Sales/Employee* ($K)	194	109	108	111	57
Sum of 1989-1991 R&D Expense ($M)	1,500	620	1,600	2,893	703
Sum of 1989-1991 Capital Expense ($M)	2,050	609	2,276	3,701	570
Total Revenue* ($M)	4,779	1,227	6,784	11,341	1,702
Semiconductor Revenue* (%)	84	100	40	34	94

*1991 calendar year.
Source: Dataquest (September 1992)

Intel has been investing heavily in R&D and capital equipment, positioning itself as a world-class semiconductor manufacturer. When investment expenses accumulated over the last three years are compared, Intel is in the middle in total R&D expenses and capital expenses. However, for the semiconductor business segment, if it is assumed that these expenses are allocated as a percentage of revenue, Intel is probably the leading U.S. semiconductor investor in both categories.

Semiconductor Business Analysis

This section will focus on analyzing the position, opportunities, and threats for Intel's $4.0 billion semiconductor business segments. After providing an overview of the semiconductor market, our discussion will divide into three major areas: the 80x86 microprocessor, other microcomponents, and memories.

Semiconductor Market Outlook

The worldwide semiconductor market represented a $60 billion business in 1991 and is forecast to grow 58 percent over the next five years, reaching about $95 billion by 1996 (see Table 5 and Figure 6). The market can be divided into six product-type segments: MOS microcomponents, MOS memory, MOS logic, analog, bipolar digital, and discrete/optoelectronic. The first five of these segments comprise the integrated circuit (IC) subset; the first three comprise the MOS digital subset. All segments except bipolar digital are projected to grow over the next five years, with the strongest growth coming in MOS microcomponents and MOS memory, the two areas Intel competes in.

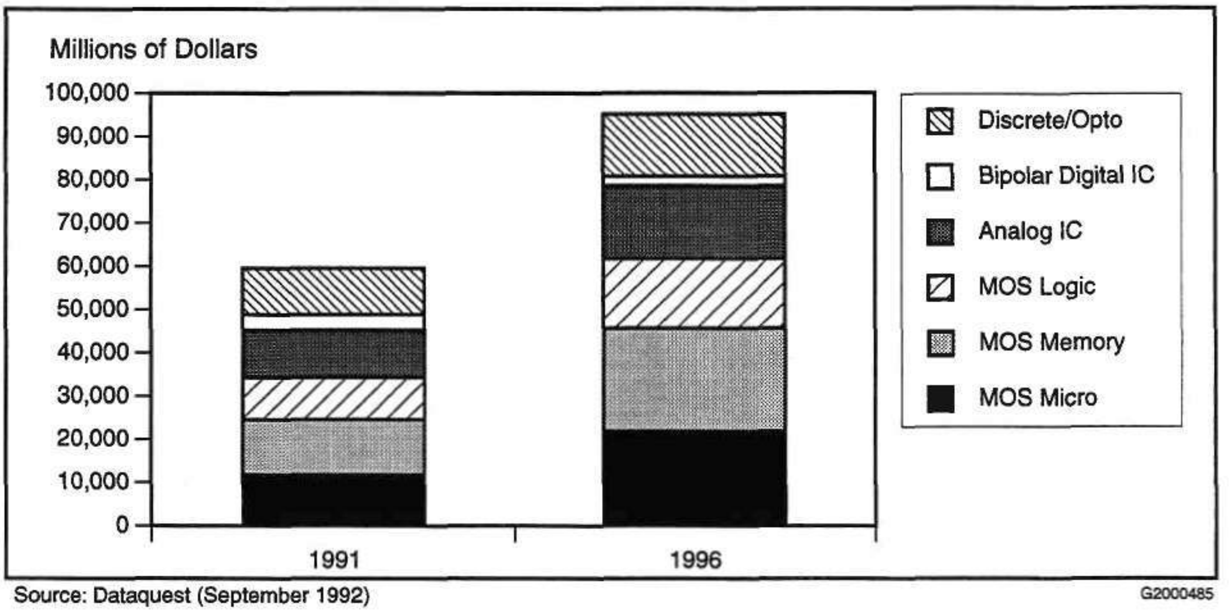
MOS microcomponents represent the brainpower behind most electronic devices performing data processing, numerical calculations,

Table 5
1991 Worldwide Revenue, Top 10 Vendors in Total Semiconductors

Rank	Vendor	Revenue ($M)	Share (%)
1	NEC	4,774	8.00
2	Toshiba	4,579	7.67
3	*Intel*	*4,019*	*6.73*
4	Motorola	3,802	6.37
5	Hitachi	3,765	6.31
6	Texas Instruments	2,738	4.59
7	Fujitsu	2,705	4.53
8	Mitsubishi	2,303	3.86
9	Matsushita	2,037	3.41
10	Philips	2,022	3.39
	Total Worldwide Revenue	59,694	100.00

Source: Dataquest (September 1992)

Figure 6
Semiconductor Market Overview



Source: Dataquest (September 1992)

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Table 6
1991 Worldwide Revenue, Top 5 Vendors in MOS Microcomponents

Rank	Vendor	Revenue ($M)	Share (%)
1	*Intel*	*3,578*	*30.15*
2	Motorola	1,171	9.87
3	NEC	1,149	9.68
4	Hitachi	583	4.91
5	Mitsubishi	543	4.58
	Total Worldwide Revenue	11,867	100.00

Source: Dataquest (September 1992)

and I/O control functions. Intel holds the dominant position in the MOS microcomponents segment, turning in $3.6 billion of the total $11.8 billion potential, or a 30 percent market share (see Table 6). The only two competitors close to Intel are Motorola and NEC, each with a 10 percent share and each less than one-third Intel's size in microcomponents.

Microcomponents comprises three related subsegments: microprocessors, microcontrollers, and microperipherals. Intel is the kingpin of microprocessors, taking $2.5 billion or nearly two-thirds of this $3.9 billion market (see Table 7). More than 95 percent of this revenue results from the 80x86 family of microprocessors, and nearly 95 percent of this 80x86 revenue comes from the 32-bit 386/486 generation of processors. Microprocessors will be the growth leader in MOS microcomponents and will be Intel's market to lose over the next five years.

Intel is also the leader in MOS microperipherals with a 20 percent market share—$650 million of this $3.2 billion segment (see Table 8). Its largest contributor is the math coprocessor, which accounts for some $300 million in revenue completely tied to the 80x86 market growth, as are most of Intel's microperipheral sales. The math coprocessor portion of this market will go away over the next few years but in turn will lead to further growth in the microprocessor market as the function is absorbed inside the CPU.

Ranking fourth in MOS microcontroller revenue, Intel finds itself catching up in the race for microcontrollers (see Table 9). Because the largest portion of microcontroller shipments are consumed in Japan, its not surprising that NEC is the leading vendor, followed by several other Japanese vendors. However, second-ranked Motorola is actually Intel's top competitor and will give it a tough fight.

Table 7
1991 Worldwide Revenue, Top 5 Vendors in MOS Microprocessors

Rank	Vendor	Revenue ($M)	Share (%)
1	*Intel*	*2,504*	*64.32*
2	Motorola	363	9.32
3	AMD	327	8.40
4	National	81	2.08
5	Hitachi	76	1.95
	Total Worldwide Revenue	3,893	100.00

Source: Dataquest (September 1992)

Table 8
1991 Worldwide Revenue, Top 5 Vendors in MOS Microperipherals

Rank	Vendor	Revenue ($M)	Share (%)
1	*Intel*	*650*	*20.19*
2	Western Digital	209	6.49
3	Motorola	194	6.03
4	Texas Instruments	194	6.03
5	NEC	192	5.96
	Total Worldwide Revenue	3,219	100.00

Source: Dataquest (September 1992)

Table 9
1991 Worldwide Revenue, Top 5 Vendors in MOS Microcontrollers

Rank	Vendor	Revenue ($M)	Share (%)
1	NEC	860	19.43
2	Motorola	574	12.97
3	Mitsubishi	463	10.46
4	*Intel*	*424*	*9.58*
5	Hitachi	364	8.22
	Total Worldwide Revenue	4,427	100.00

Source: Dataquest (September 1992)

Table 10
1991 Worldwide Revenue, Top 5 Vendors in MOS Nonvolatile Memories

Rank	Vendor	Revenue ($M)	Share (%)
1	*Intel*	*311*	*10.13*
2	Sharp	306	9.96
3	NEC	258	8.40
4	AMD	237	7.72
5	Toshiba	226	7.36
	Total Worldwide Revenue	3,071	100.00

Source: Dataquest (September 1992)

MOS memory provides exactly what its name suggests, data retention capability for digital systems, and can be divided between volatile and nonvolatile types. Intel does not hold a significant share of the overall MOS memory market. However, it is the leader in nonvolatile memories (see Table 10), a $3.1 billion segment of this market. Volatile memories are the bulk (more than 75 percent) of the market, which is further divided between DRAMs and SRAMs. Intel invented the commercial DRAM and developed technology all the way to the 1Mb level before deciding to exit the market in 1985 because of its commodity nature, low margins, and the high capital investment required. Intel does produce some SRAMs, primarily for military use and use with its high-end microprocessors, though these are not of financial consequence to the company.

Intel's 80x86 Microprocessor Business

Intel has had four generations of upward-compatible microprocessors since the 80x86 family was first introduced (see Table 11). The original 8086 introduced by Intel in 1978 had 29,000 transistors (then state-of-the-art), ran at under 5 MHz, had a die size of 51,000 square mils, and initially sold for nearly $200 (now a

Table 11
Intel 80x86 Product Line

Microprocessor	Introduction Date	Word Width (int-ext)	Transistor Count (K)	Performance Range (mips)	Price Range ($ per 1,000)
8086	1978	16-16	29	<1	5-6
8088	1979	16-8	29	<1	3-5
80286	1982	16-16	130	1-2	7-9
80386SX	1988	32-16	275	2-4	49-79
80386DX	1985	32-32	275	6-11	99-119
80386SL	1990	32-16	855	4-5	48-96
80486SX	1991	32-32	1,185	13-20	99-119
80486DX	1989	32-32	1,200	20-40	367-536
80486DX2	1991	32-32	1,200	40-54	487-650
P5 ("586")*	1992	32-64	3,100	80-100	900-1,400

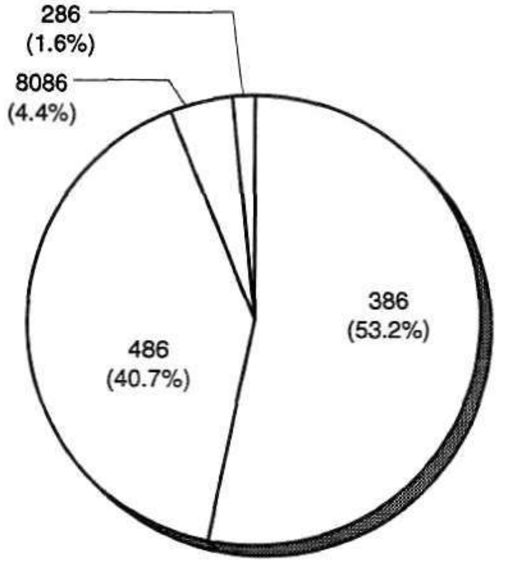
*Estimated parameters
Source: Dataquest (September 1992)

$6 part). Now the 80486 has 1.2 million transistors, runs up to 50 MHz, has a die size of 261,000 square mils, and initially sold for nearly $800. What these parts have in common is the power of compatibility with more than 10,000 software applications, with chips and systems cloned by anyone that can make them. This power has driven 80x86 microprocessor volumes to more than 50 million units per year, with increasing ASPs that have made the cloning of this golden goose a very hot target.

Intel makes nearly 95 percent of its 80x86 revenue from its proprietary 386/486 products (see Figure 7). The 80x86 market was originally opened through second-source licensing agreements, pushed by IBM as a result of its selecting the 8088 for its PC. The scene changed after growing critical mass in the market, using the early 8088 and 80286 processors, both of which were widely second-sourced. Intel introduced the 32-bit generation of 80x86 processors with the intent to grow its business around a family of single-sourced, upward-compatible processors that would eventually reach workstation performance.

As of 1991, Intel had only about 50 percent of the 80x86 unit volume (see Figure 8) but took an estimated 85 percent of the total revenue. A rapid decline is beginning for the 16-bit 80x86 processors (8086/88 and 286 generations), except the integrated versions

Figure 7
Intel 80x86 Revenue Breakdown



Source: Dataquest (September 1992) G2000486 such as the 80186 and Chips and Technologies' PC-Chip, which will continue to grow in embedded and hand-held devices. These processors were the lifeblood of the 1980s' PC, which is now dominated by the 386/486 generation. However, these proprietary products face competition from two angles: direct 386/486 clones and the various members of the RISC camp.

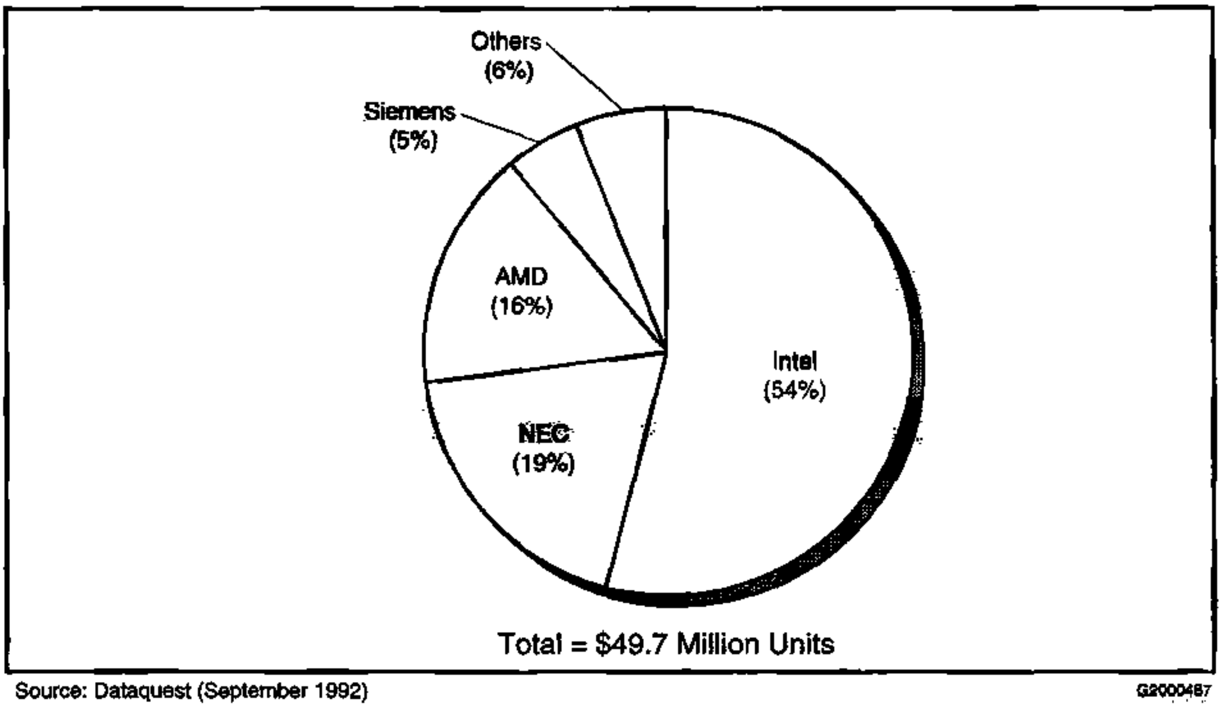
From the RISC front, there is only one viable long-term competitor to the 80x86 family, the PowerPC from the IBM-Motorola-Apple alliance. It has a large pull component from joint systems marketing by Apple and IBM, excellent design expertise from IBM and Motorola, plenty of manufacturing muscle from Motorola, and planned strong mainstream operating systems development from the roots of the Macintosh. The primary problem with the other RISC camps, including MIPS, SPARC, PA-RISC, and ALPHA, is lack of critical mass from system vendor support, lack of mainstream operating systems, or both.

As for the 386/486 clones, until last year Intel had 100 percent of the market, but after AMD's successful entry in 1991 the scene has changed. The following sections discuss competitive positions.

AMD

AMD entered the market in the second quarter of 1991 with exact copies (including microcode) of the 386DX and 386SX versions. Its

Figure 8
80x86 Microprocessor Market Share



Source: Dataquest (September 1992)

G2000487

strategy has been to use its "licensed rights" to Intel's intellectual property to reverse-engineer fully compatible clones of Intel's products, including microcode, and offer higher-speed grades at the same price Intel offers the standard speed grades. This strategy paid off initially as AMD attained about 15 percent of the 386 market by the end of 1991 and about 35 percent by the end of the second quarter of 1992. Keeping the momentum going, in January 1992 the company preannounced plans for 486 clones to be sampled in the third quarter and shipped in the fourth quarter. However, these plans were severely impacted in June 1992 when AMD lost a court battle over intellectual property rights (the 287 microcode case). It will suffer a significant setback because it must now forward-engineer its 486 clones, which will result in AMD moving them out to mid-1993 for shipments and taking away its "exact replica" advantage over other clones. AMD is expected to provide additional focus during 1993 on versions of 386 and 486 products for the portable market.

Cyrix

Cyrix entered the market in the second quarter of 1992 with a proprietary design representing a cross between the 486SX (instruction-set, cache) and 386SX and DX versions. Its strategy has been to forward-engineer its designs with 486 instruction-set compatibility and attack the installed base of 386 designs and units, offering OEMs a pin-compatible option to upgrade their 386 system designs to 486s, and offering corporate end users the option to upgrade their installed 386s to 486s. Furthermore, Cyrix intends to do the same thing for the 486 installed base as it starts releasing upscaled versions of its product line in the coming months. Having recently won a court battle contesting its rights to use SGS-Thomson as its foundry, Cyrix is successfully growing its sales and will probably ship some 400,000 units by the end of this year, representing a growing threat to Intel.

C&T

C&T entered the market in the fourth quarter of 1991 with a combination of exact clones and proprietary enhancements to the 386, as well as a single-chip PC based on an enhanced 8086 core. Having suffered severe technical problems in addition to poor financial health, C&T has announced its departure from the 386/486 clone race to pursue only integrated versions of the x86 family for handheld and portable devices. In its current condition, it does not pose a real threat to Intel.

Texas Instruments

TI announced that it will enter the market in the fourth quarter of 1992 using the Cyrix design with intentions of following up with more highly integrated versions using its wide array of technologies. Based on its manufacturing capabilities and widespread sales channels, TI presents a potential long-term threat to Intel. However, its limited microprocessor design expertise mitigates some of this threat.

Nexgen

Nexgen has preannounced plans for years to enter the market and now aims at a P5-like product, expected to be announced during the first quarter of 1993. Nexgen has an historical credibility problem to overcome in the industry and must align itself with an appropriate foundry for its parts.

UMC

UMC is working on a clone of the 486SX, expected to be introduced in the first quarter of 1993, having acquired design house Meridian Technology during 1991. With limited manufacturing muscle, a relatively low technology base, and limited sales channels (except in Asia-Pacific), UMC may have a difficult time sustaining its growth in this ultimately competitive arena.

Other companies rumored to be working on 386/486 clone products include VM Technology, a Japanese company reportedly with funding from Fujitsu; Seiko-Epson, which is working on a version of the 486 primarily for captive use; and IIT, a competitor in the math coprocessor arena working on a 486-type product with ultrahigh floating point performance.

Intel's 80x86 road map for the future calls for a dual focus on both desktops and portables, delivered in concert with its central strategy. It has long believed that its ultimate marketing edge is to drive up available transistor count through process and design technology and use that transistor count to do the following:

- Create leading-edge performance (desktop focus). This direction will result in the introduction of the P5 during the first quarter of 1993, a 100-mips class microprocessor with workstation-level floating point performance. Following this at 18- to 24-month intervals will be the P6 and P7, offering additional increases in performance level and multiprocessor support.
- Create leading-edge integration (portable focus). This direction will result in the 486SL, a 486 equivalent to the 386SL providing the ideal match for color notebooks. Following this will be the 386SC (single chip) class of devices, now being jointly developed with VLSI Technology.
- Continually decrease manufacturing costs. This direction will result in continued shrinkage of existing 486 and SL lines of products, reducing the die sizes and thus costs, enabling Intel to offer high-end (relative to competition) performance and integration at mainstream prices.
- Continually increase barriers to entry. This direction will result in limiting the available foundry capacity to the industry because of the level of design and process technology required to be performance- or cost-competitive, creating a strategic weakness for fabless vendors.

To maintain momentum in the marketplace, Intel uses a two-pronged marketing strategy as a countermeasure to the insurgence of competition. First, extensive litigation is used to slow existing competitors, discourage potential new competitors, and create anxiety within the market over using potentially illegal competitive products. Second, Intel is driving the PC market transition into its second-wave products (486 and SL versions) where end users gain better performance/features, competition is limited, and barriers to entry are much higher. Intel also intends to increase its brand preference through aggressive advertising of the "Intel Inside" concept and its "overdrive processor" upgrade programs.

Intel's Other Microcomponents

Beyond the 80x86 product line, Intel has two other families of microprocessors, the i960 embedded microprocessor and the i860 microprocessor. Together, these two families represented a combined total of about $25 million in business for Intel in 1991, or 1 percent of 80x86 revenue. The i960 is beginning to pick up momentum and is winning designs in many embedded areas including communication, X terminals, and laser printers. Having shipped about 250,000 units in 1991, Intel claims it is on track to ship close to 1 million units this year, a fourfold increase. Based on evidence at hand, we expect the i960 family to reach respectable business levels in two to three years. On the other hand, the i860 family is expected to remain a niche part for supercomputers and very high end graphic subsystems and to not provide a substantial revenue contribution for the foreseeable future.

Most of Intel's microperipheral products are designed to be fully compatible with one of its microprocessors. As mentioned earlier, Intel's line of 80x86-compatible math coprocessors has accounted for nearly 50 percent of the microperipheral revenue. With an estimated 1991 market size of more than $350 million, 80x86 math coprocessors are poised to head downward fast as the coprocessor function becomes integrated into the microprocessor, as it has in the 486 generation of devices. Intel has maintained the lion's share of this market, taking more than 75 percent of the market, leaving the remainder to Cyrix, IIT, and others. Having planned this evolution of coprocessor integration, Intel has now switched its strategy to overdrive processors (microprocessors for field upgrades) and will supplant this microperipheral revenue loss with gains in microprocessor revenue.

Among Intel's other microperipherals, PC chip sets—specifically high-performance versions—have been a focal point. After the AT bus became mature and performance needs exceeded its capacity, the industry spawned the EISA (Compaq-driven) and MCA (IBM-created) busses. Intel was the first to create compatible chip sets for these busses and remains the dominant vendor for each type. Unfortunately, the ISA bus remains the dominant standard and the others have not risen to great proportions. Thus PC chip sets represent a small contribution to the overall revenue (estimated at $100 million) and are expected to remain that way for the near future.

Intel is the third largest producer of ethernet controller chips, producing high-performance versions for workstations, X terminals, network routers/bridges, and high-end PCs, yielding some $25 million in revenue. Fax/modem chip sets, cache controllers, and its DVI line of multimedia controllers are examples of other minor revenue-producing microperipheral chips for Intel. Intel is expected to grow market share in each of these other areas as they become more central to its overall strategies.

Microcontrollers will present Intel with its toughest challenge to maintain or grow market share. Currently ranked fourth, Intel will have to place a greater emphasis on these components to pose a threat to Motorola or the Japanese vendors. Its focus has been on the proprietary MCS-96 family of 16-bit microcontrollers, where it currently dominates, attempting to change the industry momentum from 8-bit to 16-bit products. Though expected to continue success in the 16-bit segment, Motorola and other vendors will be attempting to shift focus to 32-bit parts as a counter to Intel's strategy.

Intel's Memory Business

Intel's bent toward innovation has also paid off in memories, yielding it substantial revenue (more than $300 million in 1991) from its leadership in the nonvolatile market (which it invented) and from royalties on DRAM and SRAM products (well over $60 million since 1990). There also is potential exploitation of its flash products. Though Intel is now primarily a microcomponents company, its inventions in the memory area include the following:

- The first DRAM (a 1Kb part in 1970)
- The first EPROM (a 1Kb part in 1971)
- The first high-speed MOS technology SRAM

Ironically, Intel does not plan to pursue market share using any of its own original inventions in the memory business, but it will place its emphasis on flash memories, a device first conceived by Toshiba.

Intel announced in 1990 that it would discontinue pursuit of EPROM developments to pursue the development of flash technology. Intel leads the industry in flash technology and holds an 85 percent market share in this subsegment of the nonvolatile market. In April 1992, Intel introduced the highest-density flash device, an 8Mb part, aggressively priced at $29 in low quantities. Intel also just entered an agreement to provide Sharp with rights to Intel's flash technology in exchange for Sharp building a $700 million facility for the production of Intel and Sharp flash memory products. This move may afford Intel a competitive manufacturing cost structure it has lacked in the past.

Intel's vision for flash includes being able to overcome problems with endurance (cycles), write speed, and programming voltage to produce the ideal memory that is nonvolatile, reads as fast as DRAM, writes quickly enough to keep up with an input write buffer, and is scalable in density beyond that of any other technology. This means that the bulk of portable products could replace DRAM and magnetic storage with one type of solid-state memory product. Intel's arguments carry enough weight that Microsoft has produced a FlashFile system for its operating systems that supports the Intel 8Mb flash memories. Based on current momentum, Intel should gain market share in memories over the next five years, providing a positive contribution to its overall growth.

Dataquest Perspective

Intel's strengths

Strategically Balanced Product Mix

Intel has gained leadership positions in all forms of computational systems and has structured its participation toward maximum leverage at each level. At the center is the PC, where the 80x86 family reigns supreme and Intel uses its microprocessor design and manufacturing expertise on top of compatibility to offer a range of industry-leading products with high revenue and attractive margins. At the low end are the hand-held devices where Intel will use its intellectual property and alliances with VLSI technology (integrated 386 cores) and Sharp (flash memories) to proliferate large volumes with reasonable royalties. At the high end are supercomputer systems where Intel develops and markets the complete system (including microprocessors) to gain high sales and margins in a low-volume business. In addition, Intel gains the technological synergy from participating in all areas, enabling it to push supercomputing advances into the desktop or take desktop performance into a hand-held device.

Strong Momentum in the PC Market

Intel is the leader in microprocessors for PCs and can drive the transition toward microprocessors that result in higher performance, higher ASPs, and higher barriers to entry. This transition includes support by all the top PC manufacturers, which includes very close relationships with IBM, which remains a steadfast customer and joint-developer of Intel's 80x86 processors; Compaq, which is a joint developer/tester at the systems-level that dropped the MIPS/ACE initiative to focus on Intel's P5; NCR, which works directly with Intel on innovative directions in servers and pen-based systems; Digital, which entered into an agreement for Intel to manufacture its systems; and all major Japanese vendors including Toshiba, NEC, and Epson, which have remained 100 percent Intel houses.

Leader in 80x86 Microprocessor Products

Intel maintains the leading position in performance, integration, and product breadth. With planned R&D investment of $800 million per year, 75 percent of which ($600 million) will directly apply to the 80x86 product line, Intel will most likely maintain this lead. Adding to this, Intel's joint development programs with IBM and VLSI technology for highly integrated processors will also strengthen its position. Furthermore, Intel's relentless pursuit of intellectual property protection using the legal system presents an additional financial drain to many smaller would-be cloners.

Strong Process and Manufacturing Capabilities

Intel was yielding 1-million-transistor processors (486) two years before the competition and began producing a 2.5-million-transistor chip (i860XP) more than one year ahead of any others. As competition begins to form by pairing innovative fabless design companies with large semiconductor manufacturers, Intel will have the cost advantage of vertical integration. We believe that Intel has a significant advantage in manufacturing technology for logic products, which will give it an edge for the next several years.

Leader in Flash Memory Products

Intel's focus on flash technology, its partnership with Sharp, and its captive ExCA marketing program for portable PCs and hand-helds will keep it ahead of the market for some time.

Leader in Supercomputer Performance

Intel's move into the supercomputer business strengthens its ability to design leading-edge microprocessors, especially as the move into an era of multiprocessor systems begins.

Intel's Weaknesses

Strategic Shift Upcoming in the PC Market

The first PCs came from IBM. Then vendors produced IBM-compatible PCs—clones of the complete system design. Then Intel drove the transition to PCs that were 80x86-compatible, clones of the instruction-set architecture, starting with the Compaq 386. Now Microsoft is driving the transition to PCs that are Windows-compatible, clones of the operating system environment, starting with the MIPS/ACE environment. As we enter the mid-1990s, this paradigm will be in full swing with users purchasing Windows NT systems or PowerOpen systems on various microprocessor-based systems. Though the 80x86 family has the most operating system support of any microprocessor, the loss of instruction-set compatibility as a requirement will level the playing field and enable competition to grow where a monopoly once was.

Lack of PC Systems Profitability

The same power that created demand for more than 100 million installed 80x86-compatible PCs has resulted in lack of differentiation, weak prices, and thus low profits for nearly all vendors in the PC industry. Though stuck for now in the mode of moving low-margin undifferentiated PCs, many of these vendors must change to remain financially viable for the long term. This means either using a differentiated approach with a non-Intel 386/486 product, or moving to a RISC architecture with an upscale pricing structure.

Growing 80x86 Competition

As the lure of high profits draws more competitors into the 386/486 clone game, Intel's product monopolies become shorter and harder to defend. In the past, Intel's product positioning left holes in its product line, such as 25-MHz 386SXs. Existing and future holes are prime targets for competition looking for differentiation among the compatibility. Furthermore, the period over which Intel can monopolize the market will shrink and increase pressure on time-to-market of next-generation products.

Weak Products in PC Microperipherals

Outside of math coprocessors, Intel has had problems developing a strong line of support chips. This includes failures in PC core-logic chip sets (it was reselling ISA chip sets from VLSI Technology), graphics controllers (82786 and various VGA controllers), and its early DVI chip sets.

Summary and Outlook

Intel's future depends on leveraging its strengths in the semiconductor business segments, particularly the 80x86 microcomputer chip sets. It was clearly evident during 1991 that the future for the 80x86 class of processors will be a competitive arena filled with Intel, AMD, and others. Intel intends to migrate desktop computers to the increasingly fast 486s (and soon to be P5s) and portables to the increasingly integrated SL line of 386s (and soon to be 486s). Dataquest believes that Intel has the power to make this happen by 1993, which will impose increasingly high barriers to competition. However, as Intel repositions its products to maintain market share, it will begin to lower its gross margins and thus some of its revenue growth will come at the expense of profits.

Using the projected growth of the microcomponent and memory segments and assuming Intel's market share remains constant over the next five years, its semiconductor revenue should grow 85 percent or from $4.0 billion to $7.4 billion. Based on the current environment, this is a likely scenario because we believe that Intel will maintain market share in microcomponents while slightly growing its share in memories over the next five years. Assuming an equivalent growth rate for its nonsemiconductor businesses, Intel could see a $10 billion business by the end of 1997.

FORTUNE

BUSINESS REPORTS

COMPANY PROFILE

INTERNATIONAL RECTIFIER CORP

Data sources and updating procedures. This report is a compilation of information from numerous sources, including: annual reports, 10Ks, 10Qs, and proxies filed with the Securities and Exchange Commission, Disclosure Incorporated, Standard & Poor's Corporation, National Register Publishing Company, Reuters News Service, Muller Data Services, CDA Technologies, Inc., and over 300 publicly available journals and periodicals. The information contained in the report is updated on a daily, weekly, monthly, quarterly, or annual cycle depending on the type of information being reported and the collection methods used by the information providers. Every effort is made to obtain and report the most recent data available from the aforementioned sources. This report has not been reviewed or endorsed by FORTUNE Magazine and does not represent the editorial opinion of FORTUNE.

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GENERAL COMPANY INFORMATION

FISCAL YEAR END
N/A

PRIMARY SIC
3674

TICKER SYMBOL
IRF

EXCHANGE
NYS

1992 EMPLOYEES
3,000

INTERNATIONAL RECTIFIER CORP
233 KANSAS STREET
EL SEGUNDO, CA 902454316
Telephone: 310-322-3331

AUDITOR
COOPERS & LYBRAND

STATE OF INCORPORATION
DELAWARE

COMPANY OVERVIEW

DESIGNS, DEVELOPS, MANUFACTURES AND SELLS A BROAD RANGE OF POWER SEMI-CONDUCTOR PRODUCTS USED TO CONTROL ELECTRICITY IN A VARIETY OF INDUSTRIAL, CONSUMER AND MILITARY APPLICATIONS; AND MANUFACTURES AND MARKETS POWER INTERFACE CIRCUIT DEVICES.

(Source: Disclosure 03/31/93)

FIVE YEAR FINANCIAL SUMMARY

($Millions)	1991	1990	1989	1988	1987
Sales	$265	$253	$230	$196	$179
Net Income	$9	$16	$2	($13)	($12)
EPS	$0.46	$1.24	$0.18	($1.13)	($1.09)
Current Assets	$136	$125	$92		
Total Assets	$286	$250	$218		
Current Liabilities	$68	$50	$66		
Long-Term Debt	$12	$12	$63		
Total Liabilities	$94	$71	$196		
Equity	$192	$180	$22		
Current Ratio	1.99	2.51	1.39		
Inventory Turnover	3.78	4.94	5.46		
L-T Debt/Equity	0.09	0.11	3.54		
Return on Equity	5%	9%	10%		

4-Year Annual Compound Growth Rate

Sales 10.3%

(Source: Disclosure 03/31/93)

To order the company's annual report or 10-K, please see the SEC Filings section at the back of this profile.

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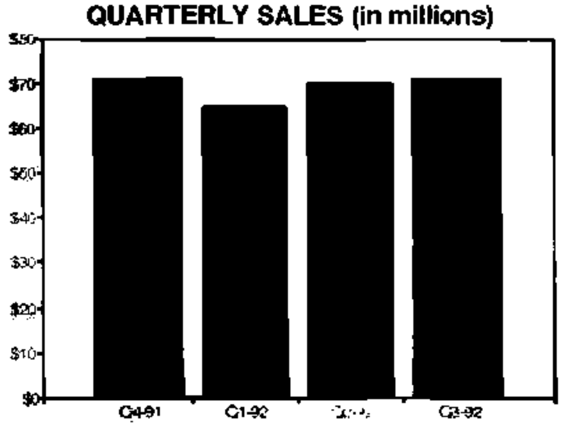
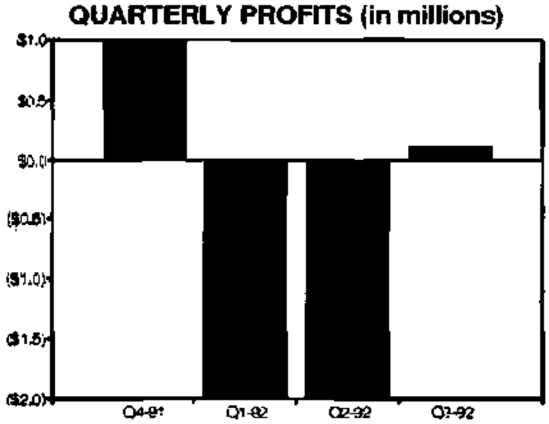
RECENT QUARTERLY TRENDS

QUARTERLY SALES (in millions)



QUARTERLY PROFITS (in millions)



QUARTERLY DATA
($ Millions, except EPS)

	Q4-91	Q1-92	Q2-92	Q3-92
Sales	$71	$65	$70	$71
Profits	$1	($2)	($2)	$0.1
EPS	$0.05	N/A	N/A	N/A

(Source: 10-Q 12/31/92)

BUSINESS DESCRIPTION

International Rectifier is a major worldwide supplier of power semiconductors and the market leader in the fast-growing power MOSFET (metal oxide silicon field effect transistor) segment.

Power MOSFETs form the large majority of the electronic products sales. These power semiconductors switch or condition electricity at relatively high voltage and current levels. Industry growth has been fueled in recent years by the conversion from older bipolar power transistor technologies and the creation of new applications. The company believes the market for power MOSFETs will continue to grow rapidly following the 27% average annual growth rate from 1988 through 1991. Although other electronic product families such as insulated gate bipolar transistor and smart power integrated circuits contribute to the revenue base, they are in early stages of development. Electronic product devices are used in power supplies and motor controls in a wide variety of equipment such as computer/peripherals, telecommunication equipment, automotive electronics, industrial controls, consumer products and defense-aerospace. Power products are diodes and thyristors which employ traditional silicon processing technology. The market for these products is mature and is expected to continue to reflect demand for capital goods. Foreign operations accounted for 49% of sales and 33% of operating profit in fiscal 1992 (latest available).

(Source: Standard & Poor's 9/07/93)

RECENT COMPANY NEWS

WASHINGTON, Nov 17, 1992, Reuter — A group including Crabbe Huson Growth Fund Inc, Portland, Ore., said it raised its stake in International Rectifier Corp to 6.7 pct or 1,339,200 common shares. In a Securities and Exchange Commission filing, the group said its investment advisory clients bought a net of 375,600 additional shares of International Rectifier between July 22 to Oct 28 for $8.375 to $9.50 a share.

OTHER IMPORTANT DEVELOPMENTS

August 1993 — IRF said that commercial power MOSFET shipments increased by $6.5 million from March to June, reflecting a sharp increase in production output, while commercial demand for electronic products remained strong. IRF added that order input ran 15-percent ahead of the comparable year-ago period.

April 1993 — IRF said that its unit output of power MOSFETs increased 20% in the third quarter from the second quarter, while its gross profit margin improved 1.5 points during that time. It added that demand remained strong throughout the quarter and that it anticipates further production increases in the fourth quarter.

December 1992 — IRF said that it was increasing the availability of several HEXFETS due to accelerating output resulting from the continuing expansion and improved efficiency of worldwide assembly operations. The company added that the lead times on these devices would be reduced and the allocation of product to buyers would be somewhat relaxed.

July 1992 — The company said that its margins had remained under pressure in fiscal 1992's fourth quarter because it was revamping its production line, including the addition of new capacity. This had caused restrictions on its output which had resulted in an allocation of product. Together with the usual seasonal weakness, this was expected to also result in a weak first quarter.

(Source: Standard & Poor's)

COMPANY OUTLOOK

NEW YORK, September 1993 — Share earnings for the fiscal year ending June 30, 1994, are expected to reach $0.55, in contrast to the $0.15 loss incurred for fiscal 1993. Early resumption of dividends is not anticipated. Sales for fiscal 1994 should rise approximately 15%, as capacity is expanded and MOSFET demand increases substantially. Growth in the power MOSFET market should be aided by stronger industry conditions and an increase in their share of the power transistor market. Stronger industry conditions should also allow sales of power products to advance. Margins will be aided by an improved product mix resulting from a shift to higher margined products made pos sible by greater capacity, improved yields, better absorption of overhead, and a stabilization of prices.

(Source: Standard & Poor's)

INDUSTRY OUTLOOK

NEW YORK, September 1993 — Semiconductor stocks have been on a roll during the past year as industry conditions have strengthened far beyond original forecasts. The gains in the stocks have continued recently with the release of better-than-expected second-quarter earnings. However, valuations of semiconductor stocks appear generous. Furthermore, projections of future earnings have been raised to levels that make earnings surprises unlikely in the short term. Any negative news, therefore, could cause a retrenchment. We would postpone commitments in the semiconductor group until weakness presents a buying opportunity. Most of the semiconductor issues that we follow are rated avoid.

Growth in the worldwide semiconductor industry is expected to approximate 20% in 1993 following the 9% gain last year. The strength will be led by the U.S., which is benefiting from strong personal computer sales and an expanding economy. Recent reports indicate that demand in the U.S. is broadening beyond the personal computer industry, which has experienced sharply higher unit volume in the past year due to price reductions. Sales should also be strong in the Asia/Pacific region as manufacturing continues to move offshore. Demand from Europe has been surprisingly robust given the weak economic conditions that prevail in many of those countries. However, growth in the Japanese market is only likely to be modest. Industry sales will be further spurred by a new generation of products, such as the next generation Pentium (586) microprocessor, mixed signal ASICs (application specific integrated circuits) and 4-megabit DRAMs (dynamic random access memories).

The strengthening industry conditions have allowed profits to move substantially higher because of the higher volume, easing pressure on prices, a shift to proprietary products and benefits from recent restructurings, as well as the absence of restructuring charges themselves. Certain markets are likely to see increased competition in the future, however. Intel faces competition from Advanced Micro Devices, Cyrix and Texas Instruments in the 486 microprocessor market. In addition, the PowerPC microprocessor being developed by Motorola and IBM will also compete directly with Intel's 486 and Pentium. The fast growing field programmable gate arrays are another market that is also facing increased competition, although recent earnings reports from industry leaders Xilinx and Altera have been excellent.

(Source: Standard & Poor's)

STOCK INFORMATION

EXCHANGE: NYS **TICKER SYMBOL:** IRF

Price For Week Ending:	**09/23/93**
High (or Ask):	**11.000**
Low (or Bid):	**10.125**
Close (or Average):	**10.750**
P/E Ratio:	**-71.667**
Shares Outstanding:	**20,231,000**
As of:	**09/23/93**
Indicated Annual Dividend:	**$0.00**

(Source: Muller Data Corporation 09/23/93)

MAJOR SHAREHOLDERS	PERCENT
ERIC LIDOW	7.7%

(Source: 10-K 06/30/92)

SHAREHOLDERS GROUPS	OWNERS	PERCENT
INSTITUTIONS	38	38.97%
5% OWNERS	5	3.34%
INSIDERS	9	10.65%

(Source: CDA Technologies, Inc. 06/30/93)

KEY EXECUTIVES

Eric Lidow
Chm. Bd., Pres., Chief Oper. & Exec. Officer

Robert J. Mueller
Exec. V.P.-External Affairs

Alexander Lidow
Exec. V.P.-Operations

Derek B. Lidow
Exec. V.P.-Quality & Admin.

Roger Hay
Exex V.P.-Fin & Chief Fin. Officer

James Fiedler
Sr. V.P. Bus. Dev. & Intellectual Property Mgmt.

Michael P. McGee
V.P. & Controller

Shelley Baumsten Wagers
V.P.-Fin. Relations

Don Prescott
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Robert Anderson
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(Source: National Register Publishing Co. 5/6/93)

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(Source: National Register Publishing Co. 5/6/93)

PRESIDENT'S LETTER

The following Letter to Shareholders is extracted from the Annual Report,

Letter to Shareholders

International Rectifier's worldwide market leadership in a fast-growing semi-conductor category framed our challenges in fiscal 1992, as we expanded manufacturing capacity to meet rising demand for power MOSFETs and reoriented the Company to address the changing needs of some of the most demanding customers in the world.

Costs of these programs impacted results well in advance of realizing their full benefits. Year-to-year revenue growth was constrained by assembly output of power MOSFETs, the Company's key growth products. Earnings reflected substantial long-term investment in IR's competitiveness. For the year, we reported net income of $9.2 million on revenues of $265.5 million, compared to year-ago income of $16.4 million on revenues of $252.8 million. Results included income of $1.3 million from non-operating items, compared to income of $4 million from non-operating items in the prior year.

Increasing power MOSFET assembly capacity was the primary focus of attention and resources last year. The expansion comprises three major elements: new capacity at both HEXFET America, IR's principal power MOSFET manufacturing plant, and at our MOSFET assembly plant in Great Britain; improved performance of existing equipment at those two plants; and an increase in capacity at our offshore subcontractors and at IR's own assembly plant in Mexico.

We strengthened our management team in the areas of plant management, assembly production, and industrial engineering. We also used the more successful manufacturing sites as models for the sites where progress came more slowly. Our equipment vendors worked closely with us to improve equipment performance and to help train operators and technicians. Meanwhile, we refurbished older assembly equipment and upgraded the facilities support for assembly operations.

Paced by our ability to increase assembly capacity, shipment of electronic products increased 13 percent in fiscal 1992. Though the increase in assembly output has fallen well short of our original goal, we believe that improvements seen in assembly cycle time and equipment up-time lay a strong foundation for future progress.

International Rectifier remains the worldwide market leader in power MOSFETs. Semiconductor Industry Association figures show that MOSFET penetration of the available $2.1 billion power transistor market for calendar 1991 rose to 33 percent, compared to 28 percent the year before.

Last year, the Company also intensified its focus on continuous improvement programs to meet and anticipate the changing needs of our customers. A comprehensive survey of customer values and opinions conducted during the year confirmed International Rectifier's strong position as technology, quality, and market leader and helped to set the direction for improvements in service and support functions.

original goal, we believe that improvements seen in

strong foundation for future progress.

International ... MOSFET ... Association ... MOSFET

... compared ...

... Annual Report.

... Shareholders:

... worldwide market ... semiconductor ... 1995, as

The culture of continuous improvement began to produce some positive results in fiscal 1992. One impressive accomplishment came in the area of water fabrication for HEXFET power MOSFETs, where yields reached record levels. Better teamwork also shortened manufacturing cycle times in military products, improved delivery performance in power products, and produced a well-integrated business plan for fiscal 1993.

On another front, IR made a substantial investment in expanding and upgrading its research and development facilities and capabilities to maintain our leadership in power transistor and related technologies. During the year we installed more advanced equipment and developed processes needed for our next generations of HEXFET power MOSFETs, IGBT transistors, and power ICs.

IR received independent confirmation of the superiority of its IGBT devices last year. An evaluation conducted by the Norwegian Institute of Technology concluded that IR's UltraFast IGBTs significantly outperform competitive devices in a key specification, turn-off switching loss. Their study found that despite its smaller size the IR chip operated nearly twice as efficiently as competitive devices.

Though the market for IGBTs (advanced technology power transistors closely related to power MOSFETs) is currently estimated to be under $100 million per year, we believe that the superior performance of these devices challenges the older bipolar power transistors in many high-voltage, high-current motor control and power conditioning applications. Module packages containing multiple IGBT chips are expected to be an important part of this market, and International Rectifier introduced its first IGBT modules last year.

Product and technology development during fiscal 1992 targeted opportunities to improve circuit performance and add value. We introduced the first products in our family of HEXFREDs (Fast Recovery Epitaxial Diodes using IR's patented hexagonal cell structure). These new products allow customers to take full advantage of MOS power transistors with high-speed, high-efficiency companion diodes.

In fiscal 1992, the Company saw further consolidation in its already strong intellectual property position.

In February, we settled pending patent litigation initiated by Harris Semiconductor with a royalty-bearing agreement involving IR's portfolio of power MOSFET patents and one IGBT patent held by Harris. We believe the balance of payments under the agreement will favor IR.

In March, the world's first-ranked merchant semiconductor supplier, NEC Corporation, became the eighth company to enter into a royalty-bearing license under IR's power MOSFET patents.

The Company continued to broaden its international sales and marketing base, opening offices in Poland, Hungary, and Czechoslovakia to position us in emerging markets.

In fiscal 1992 the Company invested substantially in growth as we made a major addition to capacity, expanded our management resources, are reshaped our systems and business practices to assure IR's continued leadership in its well-defined area of concentration. At the end of a challenging and difficult year, we are moving confidently towards renewed growth and improvement in fiscal 1993.

Eric Lidow President & Chairman

RECENT SEC FILINGS

The documents listed below were filed by the company with the Securities and Exchange Commission on the date indicated. A description of each document type is provided at the end of this section.

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❑ 10-Q	12/31/92
❑ Proxy	10/09/92
❑ 10-Q	09/30/92
❑ 10-K	06/30/92
❑ Annual Report to Shareholders	06/30/92
❑ 10-Q	03/31/92

EXPLANATION OF SEC FILINGS

Annual Report to Shareholders Annual business summary with financial report. Not Required by the SEC.

10-K Audited annual financial report. Required by the SEC. Filing Deadline is 90 days after fiscal year end.

10-Q Unaudited quarterly financial report. Required by the SEC. Filing Deadline is 45 days after the end of each quarter.

8-K Report of unscheduled material events or corporate changes deemed of importance to shareholders or to the SEC. Filing deadline is within 15 working days of the event described.

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September 8, 1992

Perspectives

Alan G. Rieper (617) 589-4435

ntel (INTC: $60)

VESTMENT THESIS: Intel remains **our #1 buy in the semiconductor industry, for a 6 month ice target in the mid-$70s.** EPS growth should accelerate sharply in coming quarters, powered by oliferating new product offerings, a price-elastic spur to unit demand from cascading PC prices and ounding cyclical momentum in the U.S. Migration of customers to the totally proprietary "second ive" products is preserving superior profitability; and competitive pressures have eased on the legal front. oreover, the 586 generation will open up a huge new, high performance, RISC-class market for Intel in 93. These dynamics, plus expanding cash and investments of roughly $12 per share, provide management th the flexibility to maximize return to investors and sustain a superior ROE. Just a partial closing of the % relative P/E discount to the market and restoration of a more normal price/book would produce upside over 30% in the next 6 months, and downside risk looks modest. The potential of using a portion of tel's building cash hoard for a nominal dividend could broaden institutional ownership without impairing owth.

ntel Remains Our Preeminent Purchase Recommendation In Semiconductors

Intel Leads The Secular Change In Computing Hardware -- While competitive issues will persist, we believe the rapid growth of the microprocessor served market will easily allow for additional, minor players, while affording an excellent growth opportunity for Intel. Computing continues to migrate to desktop platforms, and Intel is the dominant architecture in this strong growth market, with a worldwide installed base of over 100MM units. Intel microprocessors are increasingly showing up in larger computers, and expanding downward into the higher volume notebook market. We believe this provides the backdrop for 15-20% annual revenue growth for Intel for the foreseeable future.

Price Elasticity And High Value-Added Equate To High Profit Margins -- Profitability follows control of value added, increasingly evident in Intel's microprocessors. Because of its industry-dominant architecture, and despite competitive challenges, gross margins have continued to rise, concurrent with a richening of the product mix. Additionally, the end-user is responding favorably to aggressive pricing by PC manufacturers, driving Intel's unit demand, sales growth and operating leverage.

Balance Sheet Strong And Getting Stronger -- Cash (including marketable securities) is $2.5B--representing 36% of total assets. Return on equity is holding near 18% despite the lower return on this cash hoard, and debt is less than 10% of total capitalization. The need for any financing is remote.

Valuation Remains Attractive -- Based on our 1992 EPS estimate of $4.15, Intel is selling at nearly a 20% discount to the S&P 500, a valuation we regard as extremely depressed given the company's superior performance and high ROE. At 2.4X estimated year-end 1992 book value, the stock is trading at the mid-point of its 1.7-3.0 range of the last 4 years. Given the prospect for a further 20% EPS gain in 1993, INTC is attractive for purchase at current levels.

				Quarterly EPS			
	EPS	Revision	P/E	Q1	Q2	Q3	Q4
1991	$3.92		19X	$0.95	$1.10	$0.96	$0.90
1992E	4.15	---	14	0.86A	1.00A	1.08	1.21
1993E	4.95	---	12	1.21	1.23	1.22	1.29
Market Cap: $12.8 Billion				52-Week Range: $38-68			

Intel Is Attractive For The Following Reasons:

- **Earnings Growth Will Accelerate In Late 1992, Into 1993** -- With the most difficult quarterly earnin comparisons behind, EPS will accelerate beginning Q3:92 and improve sharply by year-end. The mod 6% EPS growth we are projecting for 1992 should expand to a near 20% increase in 1993, driven by gradually improving worldwide economy, rising acceptance of Intel's newer microprocessors, and a mo favorable competitive environment. Our 1993 model assumes no further margin improvement, hence t slope of the revenue curve remains a crucial variable.

- **Intel's Product Line Addresses A Rapidly Growing Market** -- For the foreseeable future, we belie Intel can grow revenues by 15-20% annually. The microprocessor continues to revolutionize computin and Intel remains firmly entrenched as the dominant microprocessor architecture. Growth in Intel primary market, personal computing, is being stimulated by rapid advances in price/performance -- both the component and systems level, driving unit growth of microprocessors. Faced with competition fro desk top systems, traditional large system vendors are incorporating microprocessors into their designs well. Finally, the burgening notebook and emerging palm-top markets should provide an even great stimulus for microprocessor unit growth. In short, Intel is at the heart of the secular revolution computing systems based on standard microprocessors.

- **Systems Manufacturers Have Jumped On The Price Elasticity Bandwagon, And The User Responding To This Stimulus** -- Technology markets are driven by improvements in price/performanc Price reductions in PC's have accelerated and price/performance benefits to the end-user are now on steeper curve, stimulating unit demand. Users are responding by purchasing more computing power, and growing share of this computing power is based on leading-edge Intel microprocessors.

- **As Intel's Product Line Richens, Its Profit Margins Are Holding At High Levels** -- While virtually a of the classic, "wafer-fab-intensive" semiconductor manufacturers have struggled to improve margins double digit levels, Intel's OPM has held at 20% or better since early 1990. A richening product mi coupled with the secular strength of microprocessors, has enhanced Intel profits through both rising "valu added" and high capacity utilization (positive operating leverage). Even during the heyday of Advance Micro Devices' challenge in the 386 clone arena, Intel's operating margins never receded below 21%.

- **Intel Remains In The Drivers Seat With The 486 And 586** -- Intel was a clear beneficiary of the rece legal decision which ruled that **AMD** illegally used Intel microcode in its math coprocessor (387 case AMD's rights to manufacture a clone of Intel's 386 had been upheld by an earlier arbitration decisio Notwithstanding this, the most recent court ruling would appear to bar AMD from using Intel microcod for **future** (e.g., 486) products and beyond (586 scheduled for introduction in early 1993). This ha delayed AMD's 486 offering, and the 486 is Intel's main demand driver at present. **Cyrix** has introduce a clone with many of the features of the 486, with Texas Instruments as a second source, but as yet ha not entered meaningful production. As a result, in the crucial 486 battleground, Intel has its competito seriously outgunned. Additionally, with prices falling 50% Y/Y on the 486 product line, price elasticit has driven unit demand higher than we previously counted on--with operating margins still holding at hig levels. While the number, of "players" is increasing, the "pie" is also growing.

Intel Stock Undervalues Strong Financial Returns, High ROE -- As Intel continues to realize margin benefits from its superior intellectual property, we believe the company can stabilize its previously volatile return on equity and enjoy an ROE in the "upper teens" over the longer term. Indeed, Intel's cash hoard at today's low interest rates is masking an even higher operating ROE, of well above 20%. In recent years, Intel's stock has traded between 1.6 and 3.3 times book value, and book value grew without interruption at a CGR of 30% 1987-91. At present, Intel is discounting an ROE below our 1992 and longer term estimate. Using our estimate of 1992 Y/E book value of $24.90 and a price/book of "only" 3.0X, **we believe the stock has upside potential of 25%+ to nearly $75 over the next 6 months.**

ıtel's EPS Growth Poised To Accelerate Once Again In 1993

There is little question that the entry of AMD into the 386 clone arena took a toll on Intel's revenue momentum during late 1991/early 1992. We believe this impact peaked in Q1:92, as Intel reported a mild deterioration in operating expense ratios (slowdown in sequential sales growth). Despite these competitive intrusions, gross margins actually rose Y/Y in H1:92. We project that EPS growth will accelerate to 23% in H2:92, aided by the growing momentum of the 486 product line, and the recent court ruling that throws a wrench into AMD's X86 integration plans, and notably easier comparisons. Building off this acceleration, even modest sequential improvement in 1993 produces a Y/Y EPS gain of nearly 20%, as shown below, **with upside from this projection a realistic possibility.**

1992-1993 Quarterly P&L Model ($MM)

	1992E				1993E				
	Q1A	Q2A	Q3	Q4	Q1	Q2	Q3	Q4	Year
Sales	$1241	$1320	$1399	$1525	$1579	$1634	$1658	$1729	$6600
Gross Margin	53.2%	53.7%	54.3%	54.3%	54.4%	54.3%	54.3%	54.3%	54.3%
Oper. Margin	21.6%	21.4%	22.4%	23.5%	22.9%	22.6%	22.0%	22.4%	22.5%
Pretax Profit	$278	$306	$339	$383	$390	$398	$396	$422	$1606
Pretax Margin	22.4%	23.2%	24.2%	25.1%	24.7%	24.3%	23.9%	24.4%	24.3%
Tax Rate	33.8%	30.4%	32.0%	32.0%	33.0%	33.0%	33.0%	33.0%	33.0%
Net Income	$184	$213	$231	$261	$261	$266	$265	$284	$1076
EPS	$0.86	$1.00	$1.08	$1.21	$1.21	$1.23	$1.22	$1.29	$4.95
Prior-Year EPS	$0.95	$1.10	$0.96	$0.90	$0.86A	$1.00A	$1.08	$1.21	$4.15
% Change	(9%)	(9%)	+13%	+34%	+41%	+23%	+13%	+7%	19%
Avg. Shares (MM)	214	213	214	215	216	217	218	219	217

Led By "Second Wave" Products, Sales And EPS Growth Projected To Accelerate To 20% In 1993 -- Much by its own design, but accelerated by AMD's entry, Intel's 386 revenues will decline rapidly through 1993. As shown in the P&L on page 4, we estimate that 486-586 sales will account for fully half of Intel's total revenues in 1993, up from an estimated 17% and 41% in 1991 and 1992 respectively. New product momentum is driving Intel's sales, and Intel enjoys a significant lead over its potential competitors in these new products. Despite this ongoing richening in product mix, we are still allowing for further price reductions (to stimulate demand), with R&D continuing to grow faster than sales (further shortening of product cycles). Overall, our 1993 model calls for gains of 20% in both sales and earnings.

1992-93 P&L Model ($MM)

Logic Sales	1991	1992E	1993E	% Change 92/91	% Change 93/92
80286	$25	$15	$5	(44%)	(67%)
80386DX	727	230	55	(68%)	(77%)
80386SX/SL	900	450	150	(50%)	(66%)
80486	800	2250	2920	2.8X%	30%
80586	--	--	500		
i860	125	240	300	92%	25%
Other	882	850	1070	(3)%	25%
Total Logic	$3459	$4035	$5000	17%	24%
Memory	320	350	400	9%	14%
Systems	1000	1100	1200	10%	9%
Total Sales	$4779	$5485	$6600	15%	20%
Gross Profit	$2463	$2956	$3584	20%	21%
Gross Margin	51.5%	53.9%	54.3%		
SGA	$765	$955	$1121	25%	17%
% Sales	16.0%	17.4%	17.0%		
R&D	$618	$778	$980	26%	26%
% Sales	12.9%	14.2%	14.8%		
Operating Income	$1080	$1223	$1483	13%	21%
% Sales	22.6%	22.3%	22.5%		
Interest and Other	$114	$83	$122	(27%)	46%
% Sales	2.4%	1.5%	1.8%		
Pretax Income	$1194	$1306	$1605	9%	23%
Pretax Margin	25.0%	23.8%	24.3%		
Taxes	$376	$418	$529	11%	27%
Tax Rate	31.5%	32.0%	33.0%		
Net Income	$818	$888	$1075	9%	21%
EPS	**$3.92**	**$4.15**	**$4.95**	**6%**	**19%**
Avg. Shares (MM)	209	213	217	2%	2%
Incremental Gross Margin	55%	70%	56%		
Incremental Oper. Margin	26%	20%	23%		

3. **$4.95 Single-Point 1993 EPS Estimate Set At Upper End Of Wide $4.40-5.35 Range Based C Richening Mix And Further Gains In Manufacturing Efficiency** -- The case can be made for eve further improvement in gross margins. Given Intel's richening mix of highly profitable 32-b microprocessors, gross margins could very easily hold near current levels. Nevertheless, despite a acceleration in sales growth to nearly 20% 93/92, we assume that Intel will strategically opt to mainta gross margins at near 1992 levels, putting cost pressure on would-be competitors while stimulating furth sales gains through aggressive pricing. Hence, EPS growth should closely track revenue gains. As show in the following series of matrixes, we project 16-28% growth for component sales in 1993. Even und our most optimistic scenario, we are assuming that the incremental gross margin on 1993 component sal falls well short of the near-80% estimated for 1992. This could prove conservative, as 1992's increment gross margin is surpassing our earlier projections. An acceleration in revenue growth seems likely 1993, with a richening mix (additions to 486 line, introduction of 586 in early 1993) affording a valuab cushion to gross margins. Overall, we estimate that each 1 percentage point variation in componen growth off our 23% projection could translate into $0.05-0.10 in EPS. With Intel's margin recovery no well along, top-line growth becomes increasingly important to earnings.

Matrix of Possible 1993 Gross Margins

Component Sales Growth / Systems Sales Growth	+16%	+23%	+28%
+5%	53.1%	54.5%	55.6%
+9	52.8	54.3	55.4
+20	52.4	54.0	55.1

Gross Margin Assumption

		Incremental Gross Margin	Corporate Gross Margin	
	1992E	1993E	1992E	1993E
Components	78%	65% high end sales to 40% low end sales est	61%	57-62%
Systems	20%	20% mid-high end sales est. 15% low end sales est.	26%	25-26%
Corporate	70%	38-60% over full range	54%	52-55%

Matrix of Possible 1993 EPS Outcomes

Component Sales Growth / Systems Sales Growth	+16%	+23%	+28%
+5%	$4.45	$4.95	$5.35
+9	4.45	4.95	5.30
+20	4.40	4.90	5.30

'ositive Secular Demand Trends, Improved Competitive Positioning Augur Well For \cceleration In 1993 Revenue Growth

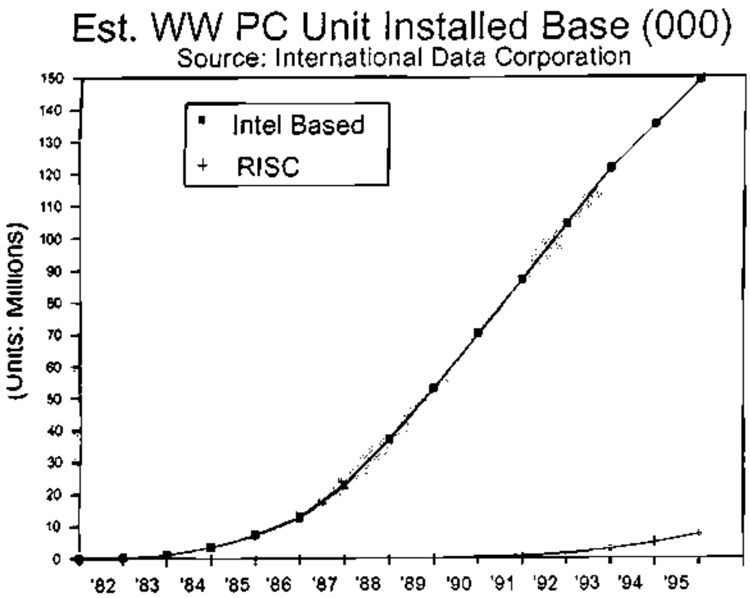
. **Microprocessors Still One Of The Hottest Markets** -- Year-to-date 1992, microprocessors (including microcontrollers and microperipherals) accounted for 22% of total worldwide semiconductor shipments, and over 60% of growth year-to-date for the semiconductor industry. From the peak of the last industry up-cycle in 1984 to the end of the recent industry "soft landing" in 1991, worldwide semiconductor shipments grew at a average annual compound rate of 11%, while microprocessors increased by 21%/year. Microprocessors represent the single largest semiconductor sub-market, accounting for nearly 60% of total MOS logic, and generate annual sales over 4X the entire bipolar logic market. **Long term, we believe annual sales growth for microprocessors of 20% or better is quite achievable. Microprocessors are the design logic of the future, and Intel is the driving force in this business.**

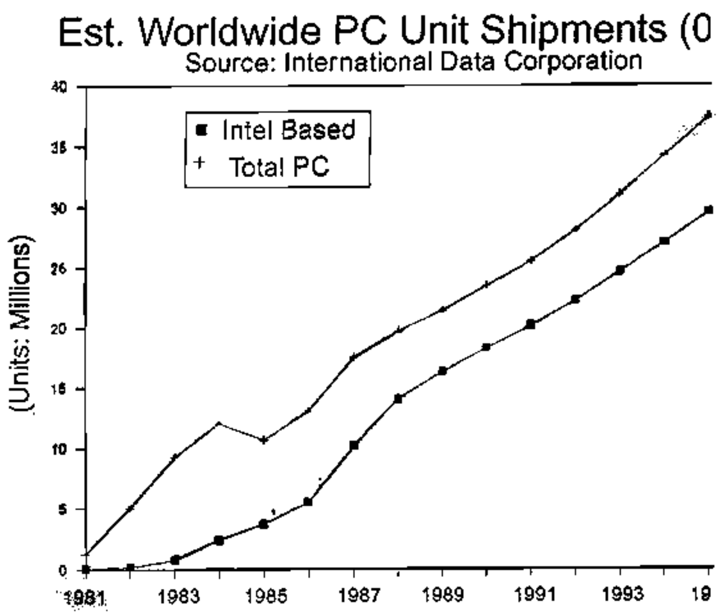
Dynamics Of Microprocessor Growth

	Y/Y % Gain In Industry	Y/Y % Gain In MOS Micros	MOS Microprocessors % Industry Shipments	MOS Microprocessor Share Of Y/Y Industry Growth
1992(****)	4%	11%	22%	63%
1991	8	24	21	55
1990	4	26	18	109
1989(*)	8	7	15	13
1988(**)	38	50	15	18
1987	23	44	14	22
1986	23	27	12	14
1985	(17)	(19)	12	13 (***)
1984	46	69	12	15%
CGR 84-91	**11%**	**21%**		

(*) Inventory correction in 386 microprocessors distorts microprocessor gain
(**) Surge in DRAM prices distorts industry gain
(***) Percent of industry decline accorded to microprocessors
(****) 6 Mos Data
Source: SIA

2. **"Pervasiveness" Of Microprocessor-Based Systems Accelerating** -- In 1992, microprocessor industı sales will total $11 billion. Intel dominates the microprocessor "CPU" market (CPU's represented rough 1/3 of total microprocessor industry sales), with Motorola a distant #2. The principal market f microprocessor CPU's is Personal Computers, with Workstations accounting for a far lesser share. Int dominates the PC marketplace (IBM architecture) with Motorola serving the remaining 10-15% (App architecture). As shown in the data below from International Data Corporation, the installed base of Int architecture PC's continues to grow rapidly, and will surpass 100 MM installed platforms in 199 Importantly, at Y/E 1991 nearly 3/4 of the worldwide PC installed base was based on 286 processors lower. **The potential base of PC upgrades to run new software is enormous.**





We believe Intel's domination of the desktop will continue, and will broaden both upward and downwarc This trend is well established, is secular, and is enormously positive for Intel. This secular momentum driven by the following factors:

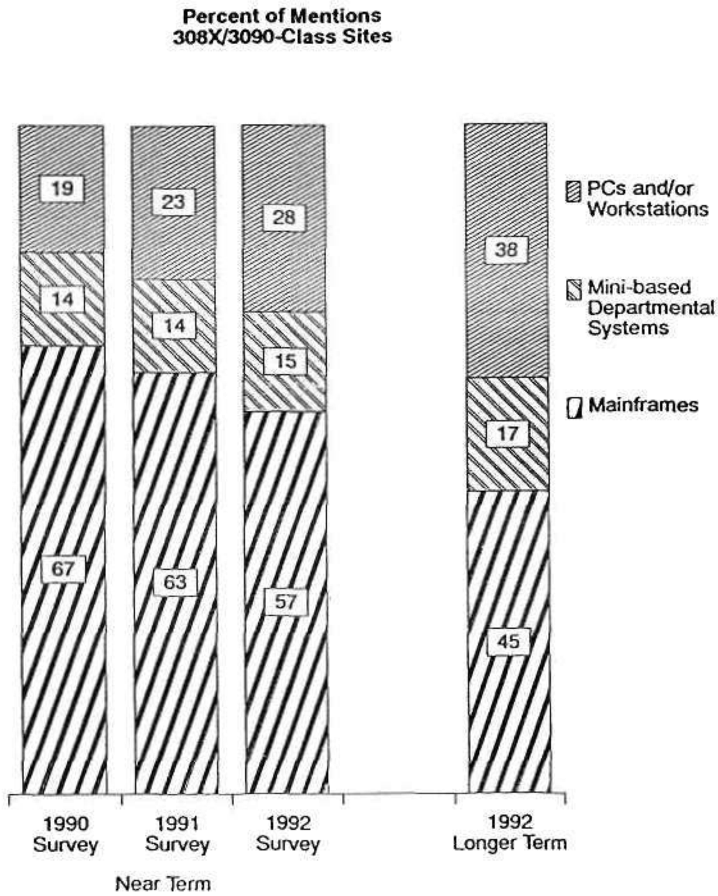
a. **Intel's Installed Base Attracts New Software** -- RISC architectures grope for an industry standarc but Intel already is one. While RISC manufacturers attempt to attract software support, their installe base is too small a market to attract the same software development effort as Intel's enormous base.

b. **Price Elasticity Works At The Systems Level** -- Today the PC has many commodity characteristic Accordingly, the end-user is seeing greater price concessions by PC manufacturers than at any time i history. The end-user is responding in traditional fashion, by buying more units/power/features a prices decline. Price elasticity works well at the systems level just as it did at the component leve Now, however, the prime beneficiaries of this elasticity are the user (more "bang for the buck"), an the makers of value-added components, e.g., Intel (acceleration of unit growth in high value adde product).

c. **Intel's Market Not Limited To PC's** -- Intel's primary market is computing. To date, its penetration has been largely in PC's, but the pervasiveness of Intel's architecture affords growth opportunities both upward and downward from the PC itself. Aggressive price concessions by PC manufacturers and the emergence of notebooks, fully compatible with desktops, are opening up the high end of the calculator market to the power of Intel's leading edge microprocessors. **Intel's PC market is extending downward into an even higher volume market.** At the high-performance end, **incremental applications formerly done by larger computers (mainframes, minis) are migrating down towards LAN-based network client/server solutions.** This latter phenomenon is shown in the graph below taken from our 1992 spring survey of large mainframe users. This enormous installed base is increasingly considering desktop platforms for its future applications. Finally, while large computer users initially balked at using microprocessors in their hardware designs (preferring the higher value added, hence proprietary margins of their own "hand-crafted" designs), they are finding that to remain competitive they must incorporate microprocessors in their hardware. While a smaller unit market than PC's, this is essentially a "found business" for Intel.

At The Edge, An Unquestionable, And Accelerating Drift Toward The Desktop For New Applications

Please estimate the percentage of your new applications that will be implemented on the following types of computer equipment during the next 1-2 years and longer term.



Source: Cowen Datamation Survey Spring, 1992

d. **Intel Now Plays A Major Role In The Computing Product Cycle** -- Intel's enormous installed ba is a powerful asset. Billions of dollars are invested in software for it. Hardware advances will lead, t steady improvements in software will follow, affording the user a clear upgrade path with compl compatibility. PC manufacturers, serving the highly competitive Intel architecture market, mu consider new Intel product offerings or lose market share to more aggressive competitors. Time-t market for new PC's is crucial, as new PC's afford more potential profits to PC manufacturers early the cycle before aggressive prices erode already thin profits. Intel, therefore, is cast in the role creating new systems product cycles, not serving them.

e. **Price/Elasticity Bottleneck Broken** -- We contend that improvements in price/performance realized the end-user historically lagged price/performance improvements generated by semiconduct manufacturers. Much of the difference went into the margins of the systems manufacturer (who th controlled much of the value added), who sold a differentiated product. Today, the intense competiti among PC suppliers from the commoditization of the PC has resulted in price/performan improvements to the end-user at least equal to those generated by the semiconductor learning curv hence the former price elasticity bottleneck at the systems level has been broken, and the user responding with higher demand.

3. **Competitive Environment Has Improved Substantially** -- To date, the most formidable microprocess competitor to INTC has been Advanced Micro Devices. AMD launched its clone of Intel's 386DX in la 1990, followed by a 386SX clone in early 1991. As shown in the table on page 9, we estimate that by Y/ 1991 AMD gained a 35% share (in dollars) of the 386 market, with the most substantial gains late in tl year. Intel's initial response was to accelerate user migration to its proprietary 486 product line. Th succeeded, but erosion of 386 sales neutralized much of this. We estimate that Intel's **combined** 386-4 sales peaked initially in Q2:91, and did not meaningfully surpass this peak until Q1:92. Late in this cycl Intel supplemented its 486 push with a combination of price reductions (on both 386 and 486 models) ar feature enhancements to the 386 (to close some of the gap introduced by AMD's lower power, faster 3 versions). The result of these actions was an acceleration in the migration to the 486, and a sharp erosi in 386 demand in late spring 1992. With the worst Y/Y comparisons behind, the base of 386 revenu now sharply reduced, and the momentum shifting to the 486, Intel is back on track towards restori superior revenue growth. Finally, and importantly, because AMD's access to Intel's microcode has be blocked by a recent court decision, AMD's efforts to develop its own 486 product have been dealt a maj setback. While Cyrix offers an "almost 486" product, it is not a direct replacement for an Intel 486, ar revenues from Cyrix's product are presently inconsequential compared to Intel. Overall, Intel h successfully forced the upward migration from the 386, and competition in the 486 is virtually nonexiste at present. Even as competition emerges in the 486, as we believe it will, Intel will continue to drive i manufacturing and design technology, enjoying an important lead over its competitors. Intel learned valuable lesson from AMD -- not to take a potential competitor for granted -- and will continue to fig possible competitors in the lab, in the fab, and in the courts.

Estimated 386-486 Sales By Vendor ($MM)

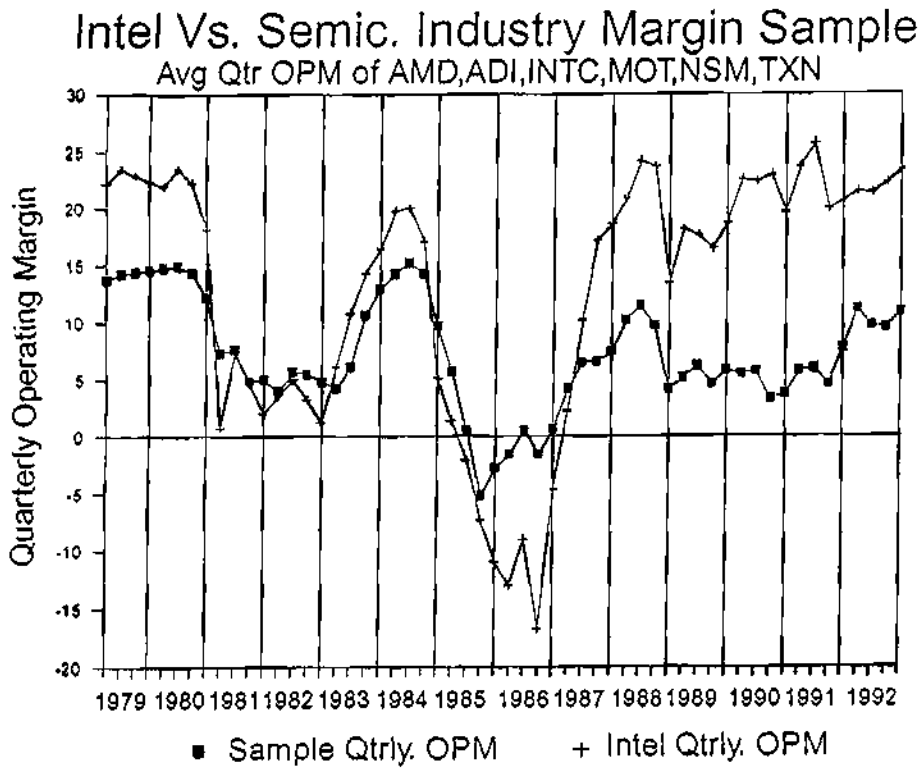
	1991					1992		% Change	
	Q1	Q2	Q3	Q4	Year	Q1	Q2	Q1/Q1	Q2/Q2
386									
Intel	$400	$503	$400	$325	$1628	$300	$190	-25%	-60%
AMD	12	37	58	146	253	180	99		+2.7X
Subtotal	$412	$540	$458	$471	$1881	$480	$289	17%	-46%
486									
Intel	$100	$150	$210	$340	$800	$450	$570	+4.5X	+3.8X
AMD	—	—	—	—	—	—	—		
Subtotal	$100	$150	$210	$340	$800	$450	$570	+4.5X	+3.8X
Total	$512	$690	$668	$811	$2681	$930	$864	82%	25%
Total Intel	$500	$653	$610	$665	$2428	$750	$760	50%	16%
Total AMD	$12	$37	$58	$146	$253	$180	$99		+2.7%
AMD % 386	3%	7%	13%	31%	13%	38%	34%		
AMD % Total	2%	5%	9%	18%	9%	19%	11%		

Source: Cowen & Co. estimates

586 Will Address New Market For Intel -- Intel plans to unveil its next processor, the 586 (code named the "P5"), in early 1993. While this is later than originally planned (late 1992), we believe the delay is strategically motivated, and not related to any problems with finalizing the chip design. Indeed, samples are in the hands of many customers and we believe the time lag between the product introduction and its implementation in end systems will be shorter than for earlier Intel microprocessors. **Beyond representing the next iteration of the 486 architecture, we expect the 586 to position Intel to address the mainstream high performance/mission critical computing arena, while maintaining total software compatibility with the X86 installed base.** In particular, the emergence of Microsoft's new NT operating system could significantly leverage Intel's 586 thrust into these markets. For some time Reduced Instruction Set (RISC) Computers have offered a challenge to Intel's classic Complex Instruction Set (CISC) architecture. The 586 will incorporate many of the advantages of RISC, and afford power previously thought not to be available in the Intel architecture. While several RISC architectures currently exist (SPARC, MIPS, DEC's Alpha, Hewlet-Packard to name only a few), we estimate that the installed base of all RISC machines is under 2MM, compared to a base of Intel architecture PC's of 100MM+. Intel has not been a factor in this high performance market, and will now have access to it. The 586, and subsequent generations of product, will extend Intel's product line further into the mainstream of computing.

Intel's Profits Should Be Sustainable At Superior Levels

1. **Intel Operating Margins A Standout Among Large Established Semiconductor Manufacturers** -- The graph on page 10 depicts Intel's operating margin against an average OPM of 6 large U.S. merchant semiconductor manufacturers (includes the non-semiconductor business of TXN and MOT). Intel's margin tracked the average in the early 1980's, when it was more of a "classic" semiconductor manufacturer. In the late 1980's, however, Intel's margins surged to match prior cyclical peaks, even as the overall industry was operating well below prior margin highs. Much of this gap is attributable to Intel's richer mix of value added product (32-bit microprocessors), but positive operating leverage concurrent with its superior sales growth is also a factor. Operating margins are stabilizing near prior highs, even as the overall semiconductor industry is only beginning its cyclical upturn.



2. **Intel's Margins Are Competitive With Smaller Leading Edge Semiconductor Suppliers As Well**
The following table ranks a broader sample of semiconductor manufacturers by the latest reporte quarterly margin. Many of these were not public companies in the early 1980's. The line bisecting th table essentially divides high and low margin companies.

Latest Reported Quarterly Operating Margin Sample			
	Qtr. Ending	Oper. Margin	Y/Y Sales Gain
Linear Technology	Jun	32.0%	23%
Maxim	Jun	23.6	19
Xilinx	Jun	22.3	18
Intel	**Jun**	**21.4**	**5**
Lattice	Jun	20.8	21
Altera	Jun	18.9	(11)
Adv. Micro Devices	Jun	12.6	18
Motorola (1)	Jun	7.4	12
Texas Instruments (1)	Jun	6.9	11
National Semiconductor	May	5.9	10
Analog Devices	Jun	5.8	11
VLSI Technology	Jun	(1.8)	(5)
Cypress	Jun	(1.6)	(12)
13-Company Average		13.4%	9%

(1) Corporate margin, sales gains

"Filling The Fab" Remains Crucial -- Fabs are expensive, with high fixed costs, which requires a strong revenue stream to generate profits. As shown in the table below, Intel's sales per average gross plant have eroded since 1988, but are well above the trough levels of 1985-86 (industry downturn, units and prices collapsed, Intel's mix had yet to richen). With its proprietary product line now well established, Intel must continue to add capacity to meet customers growing demands, passing cost reductions along to the user to stimulate unit demand further while hastening migration to newer devices as well. As shown in the table, Intel has been able to preserve high margins even with sharp fluctuations in sales growth, benefiting from rising value added. Indeed, even as sales per gross plant declined, gross margins rose. We project that gross margins will improve modestly in 1993 to 54.3% driven by a richening mix of 486-586 sales and positive operating leverage. This "moving target" of declining production costs along the learning curve is a major obstacle for a potential competitor who is late with a copy of an Intel device. We believe that Intel will continue to price aggressively along the learning curve, seeking to expand the market rather than strive for usurous margins.

Intel
Plant Efficiency Analysis

	($MM)				Capital Spending		
	Sales	Y/E Gross Plant	Sales/Avg G.P.	Y/Y Chg Sales	Y/Y Increase	% Prior Yr G.P.	Gross Margin
1993E	$6600	$5636	$1.29	20%	8%	27%	54.3%
1992E	5485	4599	1.33	15	18	32	53.9
1991	4779	3644	1.48	22	28	34	51.5
1990	3921	2814	1.55	25	38	30	50.8
1989	3127	2249	1.51	9	(13)	22	45.0
1988	2874	1898	1.67	51	37	31	47.6
1987	1907	1536	1.32	51	49	22	45.3
1986	1265	1364	0.94	(7)	(53)	12	32.0
1985	1365	1338	1.09	(16)	(64)	20	30.9
1984	1629	1165	1.66	45	63	49	45.8
1983	1122	801	1.50	25	5	21	44.4
1982	900	697	1.40	14	(12)	23	39.8
1981	789	591	1.52	(8)	1	34	41.9

Source: Intel, Cowen & Co. Estimates

Product Mix Continues To Richen As Processor ASP's Rise -- The single greatest stimulant to Intel's margin recovery has been the richening of its product mix towards proprietary microprocessors. The table on page 12 illustrates the magnitude of this evolution. In 1987, we estimate that 32-bit logic (386) accounted for only 8% of corporate revenues and corporate gross margins were 45%. By 1991, we estimate that 32-bit logic (386+486+i860) had risen to 53% of total sales, and gross margins approached 52%-- despite AMD's intrusion into the 386 base and a likely decline in the "blended ASP" of Intel's leading edge microprocessors. We project that 32-bit products will rise to 58% of sales this year and 60% in 1993. Rising volumes of highly profitable "second wave" products (386SL, 486) continue to richen the mix and we are estimating an increase in the "blended ASP" for both 1992 and 1993. Clearly, recent court victories against AMD are aiding this process.

Intel Product Mix Analysis
Product Revenues % Total

	1987	1988	1989	1990	1991	1992	1993
32 Bit CPU	8%	22%	27%	37%	53%	58%	60%
Other Logic	50	38	33	26	19	16	16
Memory	16	15	14	11	7	6	6
Systems	26	25	26	26	21	20	18
Total	100%	100%	100%	100%	100%	100%	100%

Estimated Corporate Microprocessor Blended ASP
(286 Thru 586, Excl Controllers, Periph, i860, etc.)

	1987	1988	1989	1990	1991	1992	1993
ASP	$59	$99	$90	$100	$99	$120	$132
Y/Y % Chg		69%	(9%)	12%	(2%)	21%	10%

Estimated Share of 286 Thru 586 % Corporate Revenues

	1987	1988	1989	1990	1991	1992	1993
286	9%	7%	4%	2%	1%	0%	0%
386	8	22	26	27	34	12	3
486	0	0	1	8	17	41	44
586	0	0	0	0	0	0	8
286-586	17	29	30	37	51	54	55
386-586	8	22	27	35	50	53	54

5. **Intel Will Aggressively Defend Its Intellectual Property** -- Investing in Intel means learning to li\ with lawsuits. We expect the company to defend aggressively its intellectual property against a contenders. Even delaying would-be competitors will work in Intel's favor (learning curve benefits and battling Intel in the courts will be long and costly for potential microprocessor clone maker. Importantly, while legal decisions may swing either way, the rising dominance of Intel's architectui continues to expand the target market.

Financial Strength Is Impressive

1. **Cash Continues To Build Despite Aggressive Capital Expansion Program** -- Intel remains a financi powerhouse. As shown in the cash flow analysis on page 13, we estimate that during 1992 nearl $300MM will be added to its already high cash position despite an ambitious capital spending program an a $50MM investment in VLSI Technology (gaining access to VLSI's extensive cell library). Cash at Y/ 1992 should approach $1.8 billion (short term investments add another $600MM in liquidity), and wit the potential threat of any substantial cash payment for damages to AMD under a recent arbitratio decision now eliminated, Intel's cash hoard should remain intact. Indeed, based on our earning projections for 1993, cash could increase by over $400MM next year, to nearly $3B (including short terr investments), tantamont to nearly $14 share.

Analysis Of Cash Requirements ($MM)

	1989	1990	1991	1992E	1993E
Sources:					
Net Income	$391	$650	$819	$888	$1075
Depreciation	237	292	418	490	570
Other	36	28	41	30	30
Total Sources	$664	$970	$1278	$1408	$1675
Uses:					
Capital Expenditures	$422	$680	$948	$1150	$1250
Other	---	---	---	50	---
Total Uses	$422	$680	$948	$1200	$1250
From Operations	242	290	330	208	425
Increm. Working Capital Needs	(31)	130	566*	4	0
Total Cash (Needs) generated	$273	$160	$(236)	$204	$425
Provided By:					
Decr. (Incr.) Cash	$(134)	$(556)	$101	$(254)	$(475)
Incr. (Decr.) Debt	(128)	54	(89)	---	
Sale of Stock	78	392	8	50	50
Change in Other Assets	(89)	50	216	---	
Y/E Balance Sheet					
Cash **	$1064	$1620	$1519	$1773	$2248
Total Debt	$569	$663	$536	$536	$536
Equity	$2549	$3591	$4418	$5356	$6481
Debt % Total Capital	18%	15%	11%	9%	8%
Return on Average Equity	16.9%	21.2%	20.4%	18.2%	18.2%

*Incl $592MM increase in short term investments
**excludes short term investments

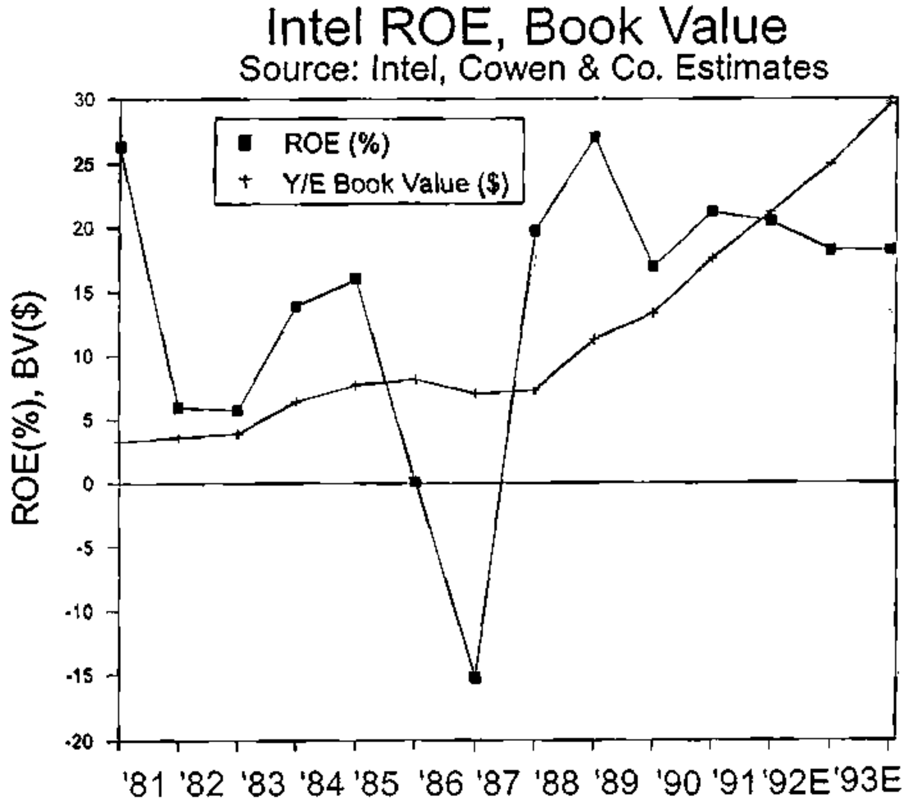
. **Debt Is Low** -- Debt as a percent of total capitalization continues to decline, falling from as high as 37% in 1987 to 11% at Y/E 1991, and currently slightly below 10%. The steady growth in earnings we are projecting, coupled with positive cash flow from operations, suggests further improvement in debt/equity.

. **Put Warrants Further Aiding Cash Growth** -- Since Y/E 1990, Intel sold Put Warrants totaling nearly $390MM ($140MM in 1991, an additional $246MM thus far in 1992). These warrants obligate Intel to purchase one share of common stock at prices ranging from $38 to $40/share and begin expiring in December, 1992. The amount related to the company's potential $386MM obligation to buy back shares has been removed from Stockholders' Equity, and recorded as "Put Warrants". Our estimates of Stockholders' Equity exclude the value of these warrants. If exercised, the warrants would be antidilutive.

. **Possibility Of Token Dividend Not Far Fetched** -- While Intel has steadfastly maintained a policy of reinvesting all of its earnings, the magnitude of its cash hoard, and the low interest it is earning on this asset suggests to us that management may consider paying a modest dividend. In our opinion, as long as the company maintains superior earnings growth, a dividend would not impair Intel's growth image, while on the positive side it could broaden the base of potential investors. An alternative would be to increase the size of the current authorized stock buyback program. In any case, **Intel's financial strength affords management several options to maximize return to investors, while providing ample cash to sustain superior growth.**

Valuation Of Stock Attractive

1. **Stock Does Not Fully Reflect Intel's Superior Returns** -- Intel's ROE appears to be stabilizing in t high teens, and book value continues to grow steadily by a 28% compound rate 1987-92E (see ch below). The surge in ROE in recent years is a direct result of margin recovery. We believe the compa can sustain ROE at current levels. Further, nearly $0.30/share of non-operating earnings (largely inter income at well below what the company is earning on its business) is lowering operating ROE. Excludi cash, we estimate that 1992 ROE would be about 25% (using fully taxed estimated operating earnin before interest income divided by 1992 estimated Y/E equity minus cash after paying off all debt). Thu Intel has ample opportunity to boost downstream ROE by deploying cash in some higher-return fashic With the average ROE on the S&P 500 still hovering in the mid-teens, we believe that INTC's near 20 P/E discount on estimated 1992 EPS grossly undervalues the company's superior returns. In addition, v project a 19% Y/Y gain in book value in 1993 from $24.90E to $29.65, indicating sizable further upsi for the stock.



2. **Current Price/Book Range Lower Than Early 1980's Despite Uptick In Financial Returns** -- A shown in the graph above, Intel's financial performance in recent years has been stronger and mo consistent than in the early 1980's. Despite this improvement, the annual high price/book has average 3.0X in 1988-92, compared to an average high price/book of 3.8X during 1981-87. Although Intel return on book (ROE) has risen, its price/book has eroded. We believe this erosion is unwarranted, furthe enhancing the upside potential for the stock.

6-Months Price Objective Of $75 Achievable Based On 1992 Earnings Outlook -- INTC stock remains an outstanding value relative to earnings and growth. At 12.0X 1993E EPS the stock sells at nearly a 20% P/E discount to the S&P 500 and well below the 15%+ sustainable growth rate. Over time, we believe the best measures of a stock's growth potential are (a) the level and direction of return on equity, and (b) the compound growth rate of the book value. The table below derives alternative price targets based on ROE's in the 16-18% range and our estimate of 1992 year-end book value. Over the last 4+ years, Intel has sold as high as 3.3X book value and never lower than 1.6X book. In the analysis below, Intel's current price/book is discounting an ROE of 17%, below the 18%+ we believe the company will achieve this year and at least sustain over the longer term. Indeed, as noted earlier, cash is holding down ROE significantly. At merely 3X estimated 1992 book value of $24.90, INTC stock would trade up to $74, up 24% from current levels.

INTEL STOCK VALUATION

Longer Term ROE X	1992 S&P 500 P/E (1) X	Relative P/E (1) =	Price/Book X	Y/E 92 Book Value =	Derived Stock Price
16%	17.3X	0.75X	2.1X	$24.90	$52
17	17.3	0.83(2)	2.4	24.90	60
18	17.3	0.95	3.0	24.90	74

(1) Based on 1992 EPS estimate of $24.00 for S&P 500

(2) Equivalent to current relative P/E on 1992 earnings estimates

Upside To Near $90 Possible, Based On 1993E Book Value -- Beyond 1992, further steady growth in book value provides for additional stock appreciation, to nearly $90 based on our 1993 EPS estimate. For Intel to trade towards the lower end of its historic range would require either (a) earnings falling well short of our estimate, or (b) the market P/E to contract. In the later case, if Intel preserves its current earnings recovery, as we believe it will, its relative P/E should rise, limiting downside erosion in price.

Cowen & Co. makes a market in INTC

FORTUNE

BUSINESS REPORTS

COMPANY PROFILE

INTEL CORP

Data sources and updating procedures. This report is a compilation of information from numerous sources, including: annual reports, 10Ks, 10Qs, and proxies filed with the Securities and Exchange Commission, Disclosure Incorporated, Standard & Poor's Corporation, National Register Publishing Company, Reuters News Service, Muller Data Services, CDA Technologies, Inc., and over 300 publicly available journals and periodicals. The information contained in the report is updated on a daily, weekly, monthly, quarterly, or annual cycle depending on the type of information being reported and the collection methods used by the information providers. Every effort is made to obtain and report the most recent data available from the aforementioned sources. This report has not been reviewed or endorsed by FORTUNE Magazine and does not represent the editorial opinion of FORTUNE.

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GENERAL COMPANY INFORMATION

FISCAL YEAR END
December

PRIMARY SIC
3674

TICKER SYMBOL
INTC

EXCHANGE
NMS

1991 EMPLOYEES
24,600

INTEL CORP
2200 MISSION COLLEGE BOULEVARD
SANTA CLARA, CA 95052
Telephone: 408-765-8080

AUDITOR
ERNST & YOUNG

STATE OF INCORPORATION
DELAWARE

COMPANY OVERVIEW

DESIGNS, DEVELOPS, MANUFACTURES AND MARKETS ADVANCED MICROCOMPUTER COMPONENTS, SUCH AS INTEGRATED CIRCUITS AND OTHER SIMILAR PRODUCTS, SOFTWARE AND MICROCOMPUTER PLATFORMS.

(Source: Disclosure 06/27/92)

FIVE YEAR FINANCIAL SUMMARY

To order the company's annual report or 10-K, please see the SEC Filings section at the back of this profile.

($Millions)	1991	1990	1989	1988	1987
Sales	$4,779	$3,921	$3,127	$2,875	$1,907
Net Income	$819	$650	$391	$453	$248
EPS	$3.92	$3.20	$2.07	$2.51	$1.38
Current Assets	$3,604	$3,119	$2,163	$1,970	$1,431
Total Assets	$6,292	$5,376	$3,994	$3,550	$2,597
Current Liabilities	$1,228	$1,314	$921	$934	$882
Long-Term Debt	$363	$345	$412	$479	$298
Total Liabilities	$1,734	$1,785	$1,445	$1,470	$1,291
Equity	$4,558	$3,592	$2,549	$2,080	$1,306
Current Ratio	2.94	2.37	2.35		
Inventory Turnover	11.32	9.44	9.01		
Total Debt/Equity	0.08	0.12	0.16		
Return on Equity	18%	18%	15%		

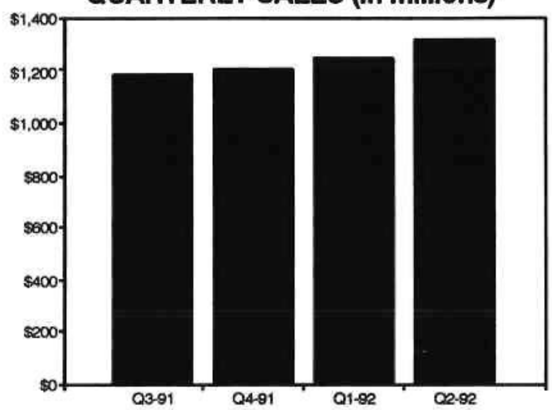
4-Year Annual Compound Growth Rate

Sales	25.8%
Net Income	34.7%
EPS	29.8%

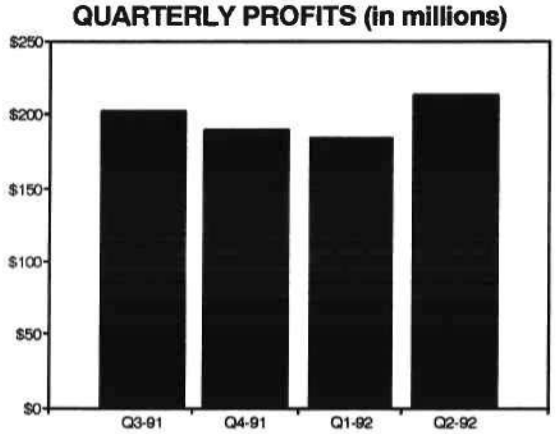
(Source: Disclosure 06/27/92)

RECENT QUARTERLY TRENDS

QUARTERLY SALES (in millions)



QUARTERLY PROFITS (in millions)



QUARTERLY DATA
($ Millions, except EPS)

	Q3-91	Q4-91	Q1-92	Q2-92
Sales	$1,188	$1,205	$1,241	$1,320
Profits	$202	$189	$184	$213
EPS	$0.99	$0.93	$0.89	$1.03

(Source:10-Q 03/28/92)

BUSINESS DESCRIPTION

Intel designs and manufactures semiconductor components and related single-board computers, microcomputer systems and software for original equipment manufacturers. The company introduced the first microprocessor in 1971 and remains the world's largest manufacturer of such devices. A microprocessor is the central processing unit in a microcomputer-based system. Microprocessor peripherals, microcontrollers, microcomputer modules and systems and microcommunications products are also manufactured. Intel is the largest supplier of EPROMs--erasable, programmable, read-only memories. Memory components store computer programs and data entered during system operation. Software, which is a set of programming instructions that directs a microcomputer-based system to perform specific tasks, is provided for microcomputer operating systems and high-level networking. In 1986, Intel entered the application-specific integrated circuit (ASIC) market. An ASIC is a chip designed by a customer for one application. Foreign business accounted for 51% of sales and 32% of operating income in 1991.

(Source: Standard & Poor's 06/19/92)

RECENT COMPANY NEWS

SEATTLE, July 14, 1992, Reuter — Microsoft Corp and Apple Computer Inc are expected to set aside a fierce legal skirmish Wednesday to unveil several technology-sharing accords that provide access to each others' standards, analysts said. "Its strategically important for both companies," said Dean Witter analyst Tim McCollum. "Microsoft certainly sells a lot into the Apple (market) and Apple needs to be as conversant with Microsoft products as they can." The companies stressed a joint briefing Wednesday would have no bearing on a four-year-old lawsuit brought by Apple. Both Microsoft chairman Bill Gates and Apple chairman John Sculley were scheduled to attend the news briefing at a San Jose hotel near Apple's headquarters. Microsoft said the companies would announce new products and agreements involving technology relationships between the two rivals. But both companies declined to provide details. But industry executives said they expected Microsoft to discuss its applications programs for the Macintosh and that the two companies are prepared to proceed with cross-license agreements or acceptance of certain software standards, such as Microsoft's object imbedding and mapping protocols. Despite their bitter lawsuit, the two continue to work together on certain fronts. Through 1991, Microsoft dominated the market for several major applications on Apple's Macintosh computer -- including up to 80 pct or more of the Mac word processing, spreadsheet and integrated program market. Although Microsoft expanded rapidly through sales of the DOS, then Windows, operating systems for International Business Machines Corp <IBM.N> compatible personal computers, applications now account for more than half its revenues -- projected at $2.8 billion in the fiscal year ended June 30. Apple -- whose computer sales comprise less than 10 pct of the overall world desktop computer market -- has taken its own steps to counter Microsoft's dominance in desktop software. Apple has spun off its software operations into a separate unit to offer Mac software separately -- including plans to extend it onto the PC platform to compete with Microsoft on certain applications on Intel Corp <INTC.O> based computers. The Cupertino, Calif. company also has joined IBM in a joint venture which aims to produce a new-generation operating system that could compete with Microsoft's systems. Microsoft closed up 1-1/8 Tuesday at 71-1/8. Apple rose 1/2 to 47-1/2. In March 1988, Apple Computer filed suit against Microsoft and Hewlett-Packard Co <HWP.N> in the U.S. District Court for Northern California alleging that Microsoft Windows and HP New Wave infringed on Apple's copyrights. In court documents, Apple has estimated it lost billions in sales since then due to alleged copying of the "look and feel" of its Macintosh computer. But in April a federal judge dismissed all but a few items from the lawsuit. The judge, Vaughn Walker, is reviewing that ruling and is expected to decide sometime soon on whether to set a hearing on remaining issues, proceed with a trial or dismiss the suit.

NEW YORK, July 14, 1992, Reuter — Kidder Peabody analyst John Joseph confirmed he upgraded Texas Instruments Inc to buy from hold and said he also repeated his buy recommendations on a number of other semiconductor companies in response to strong U.S. book-to-bill numbers. Joseph said he repeated his buy ratings on Intel Corp <INTC.O>, Linear Technology Corp <LLTC.O>, National Semiconductor Corp <NSM.N> and Micron Technology Inc <MU.N> "primarily based on the book-to-bill numbers and strength in the industry as a whole". Texas Instruments was up 1/4 to 38-1/2, off a session high of 39-1/8.

SANTA CLARA, Calif., July 13, 1992, Reuter — Intel Corp said that sales of its newer microprocessors are "quite strong," while sales of its earlier-generation chips continue to decline. "The era of the first-wave 386 processors is over," said Intel chairman Andy Grove in a statement accompanying second quarter results. He said the company's newer 486 and 386 SL chips are replacing its earlier 386 line, long a mainstay of personal computers. The microprocessors serve as the "brain" of a PC's operating system. "Revenues from older 'first-wave' Intel386 DX and SX chips continued to decline as a result of the personal computer market's dramatic shift to second wave systems," Intel said. Added Grove, "Software like Windows (from Microsoft Corp <MSFT.O>) and OS/2 (from International Business Machines Corp <IBM.N>) have driven the need for more power, and falling system prices have made very powerful systems affordable for everyone." Intel reported record second quarter revenues of $1.32 billion, up from $1.25 billion in the prior-year period.

SUNNYVALE, Calif., July 1, 1992, Reuter — Advanced Micro Devices Inc said severe pricing pressures on its 386 microprocessors have hurt second quarter results. The chip maker said it will be solidly profitable, but that second quarter revenues will come in about 15 pct below its record first quarter sales of $407.4 million. The company reported revenues of $267.7 million in the prior-year second quarter. Final second quarter results will be released July 9. Advanced Micro said the declining prices it was able to charge for its 386 chips more than offset significant quarter-to-quarter revenue gains in other product lines. Advanced Micro had been trying to make inroads against market leader Intel Corp <INTC.O> by offering its own version of Intel's i386 microprocessor. Resulting competition ensued in a price war.

BEAVERTON, Ore., July 1, 1992, Reuter — Intel Corp said Oak Ridge National Laboratory ordered its 150 GFLOPS Paragon XP/S supercomputer. Intel said the order was part of a multiyear collaboration with Oak Ridge, which is operated by Martin Marietta's Corp's <ML.N> Energy Systems Inc. Intel said Oak Ridge and several other organizations will use the supercomputer to "address the modeling of pollution movement in groundwater and designing new materials and alloys." Intel and the lab signed a three-year Cooperative Research and Development Agreement under which the two will collaborate in support of the Department of Energy's Technology Commercialization Initiative.

MARLBORO, Mass., June 25, 1992, Reuter — Stratus Computer Inc said it will base a future generation of its Continuous Processing System on Hewlett-Packard Co's PA-RISC microprocessors. Stratus said applications running on PA-RISC, or precision architecture reduced instruction set computing microprocessors, will be compatible with all its systems, including its forthcoming symmetric multiprocessing systems based on Intel Corp's <INTC.O> Intel i860 RISC microprocessor. PAS-RISC allows computer systems to quickly perform complex functions.

SAN FRANCISCO, June 24, 1992, Reuter — Advanced Micro Devices Inc filed for a restraining order to bar Intel Corp <INTC.O> from discussing how a recent court decision will affect Advanced Micro's current 386 chip, an Intel spokesman said. Last week, a federal jury ruled Advanced Micro does not have the rights to a special software code owned by Intel Corp and used to build various computer chips, including the 386. Advanced Micro also asked the U.S. District court judge to restrain Intel from taking any steps to block importation of computers using Advanced Micro's 386 chip. The court is expected to consider the filing within the next week.

BLUE BELL, Pa., June 23, 1992, Reuter — Unisys Corp said it was offering new models of its U 6000/65 mid-range UNIX OS-based servers that use Intel Corp's <INTC.O> 50 MHz Intel486 processor to deliver up to 40 pct better performance than previous models. Unisys also said the release of the UNIX-based Unisys System V operating system for the U 6000/65 and other U 6000 servers has been certified for compliance with key open systems standards by both the National Institute of Standards and Technology and the X/Open Co Ltd.

OTHER IMPORTANT DEVELOPMENTS

May 1992 — INTC said that it would reduce in the third quarter the list price on its 486 SX microprocessor by 58%.

April 1992 — The company announced a new 8-megabit flash memory chip priced, on a per-memory-bit basis, equivalent to DRAMs (dynamic random access memory).

February 1992 — INTC and Sharp Corp. announced the formation of a long-term partnership to jointly develop and manufacture future generations of flash memory products and technology.

January 1992 — The company and Toshiba reached a comprehensive patent cross-licensing agreement effective through the end of the decade.

September 1991 — INTC said that the combination of seasonal weakness, a sluggish economy and a computer industry in rapid transition had produced poor results in the third quarter for commodity EPROMs, microcontrollers and PC platforms. However, it noted that demand for its microprocessors in the third quarter would roughly balance declines in older Intel386 chips.

May 1991 — INTC announced the creation of three new operating groups--The Architecture and Applications Group, the Software Technology Group and the Multimedia and Supercomputing Components Group--in an effort to streamline the company.

January 1991 — The company said that at year-end it was continuing to experience good demand for its microprocessors worldwide. During 1990, shipments of its 386 and 486 microprocessors was nearly doubled. However, it noted that pricing pressures remained in force for commodity products at the chip and system levels.

July 1990 — The company said that demand was strong worldwide, particularly for components such as 32-bit microprocessors, high-density EPROMs and microcontrollers. It added that unit shipments of the 386 family chips in the second quarter doubled compared with last year's second quarter.

April 1990 — The company said that first quarter results benefited from strong demand for its 32-bit microcomputer components. However, aggressive pricing continued to characterize commodity products such as EPROMs. INTC estimated capital spending would total $600 million in 1990, up from $422 million.

(Source: Standard & Poor's)

COMPANY OUTLOOK

NEW YORK, June 1992 — Earnings for 1992 are projected to approximate $4.20 a share, up from 1991's $3.92. Initiation of cash dividends, which have never been paid, is unlikely. Net revenues are expected to increase approximately 15% in 1992, aided by an aggressive new product introduction program that includes over 30 variations of the Intel486 and Intel386SL microprocessors. The gain should also be assisted by an acceleration of industry growth in the U.S., Europe and Asia/Pacific due to stronger economic conditions. Margins are likely to narrow somewhat, as pricing pressures increase on certain microprocessors, due to increasing competition. Partially offsetting will be higher margins on newer microprocessors and the easing of pricing pressures on certain other products due to the stronger industry conditions. Long-term prospects should benefit from the company's broad technological base and its strong finances.

(Source: Standard & Poor's)

PRIMARY INDUSTRY OVERVIEW

— The Electronic Semiconductor & Components industry is greatly affected by the direction of the overall economy and, specifically, the computer industry. In addition, since much of the industry's business is international, the value of the U.S. dollar can dramatically impact a company's bottom line. The primary indicator of industry health is the book-to-bill ratio, which measures the number of orders being placed compared with the number of orders being filled. A number above 1.00 (or parity: booked orders equals fulfilled orders) indicates that there are more orders being placed today than in the past and that the industry is growing.

(Source: Standard & Poor's)

INDUSTRY OUTLOOK

NEW YORK, June 1992 — A buying opportunity appears at hand. Even though the industry is entering its seasonally weak period where the shares usually perform poorly in the first half of the summer, the depressed prices of many issues make them attractive. The $69 billion worldwide industry is projected to post growth of about 8% in 1992, versus an 8.3% climb in sales for 1991, assuming the current economic rebound continues to gain momentum. The slower growth is due to a projected 2% decline in sales from the Japanese market, which is experiencing weakness in its consumer electronics industry. Demand should be stimulated by a shift to a new generation of products, such as 486 microprocessors, mixed signal ASICs and 4-megabit DRAMS.

European economies are expected to display renewed vigor as the year progresses. Meanwhile, the Japanese semiconductor market is unlikely to deteriorate further from its currently depressed level. In fact, promised efforts by the Japanese to increase foreign sales could offset much of the weakness in overall sales.

(Source: Standard & Poor's)

STOCK INFORMATION

EXCHANGE: NMS **TICKER SYMBOL:** INTC

Price For Week Ending:	**09/10/92**
High (or Ask):	**64.500**
Low (or Bid):	**60.250**
Close (or Average):	**64.250**
P/E Ratio:	**17.225**
Shares Outstanding:	**206,399,000**
As of:	**09/10/92**
Indicated Annual Dividend:	**$0.00**

(Source: Muller Data Corporation 09/10/92)

MAJOR SHAREHOLDERS	PERCENT
GORDON E. MOORE	5.7%

(Source: 10-K 12/28/91)

SHAREHOLDERS GROUPS	OWNERS	PERCENT
INSTITUTIONS	433	73.88%
5% OWNERS	1	5.68%
INSIDERS	23	2.36%

(Source: CDA Technologies, Inc. 06/30/92)

KEY EXECUTIVES

Gordon E. Moore
Chm. Bd.

Andrew S. Grove
Pres. & Chief Exec. Officer

Craig R. Barrett
Exec. V.P.

Frank C. Gill
Sr. V.P. & Pres.-Systems Group

David L. House
Sr. V.P. & Pres.-Microcomputer Components Group

Gerhard H. Parker
Sr. V.P. & Gen. Mgr.-Tech. & Mfg. Group

Robert Reed
Sr. V.P. & Gen. Mgr.-Semiconductor Products Group

Leslie L. Vadasz
Sr. V.P. & Dir.-Corp. Bus. Devel.

Michael Aymar
V.P. & Gen. Mgr.-Entry Level Prods. Grp.

Richard D. Boucher
V.P. & Dir.-Corp. Programs

Sunlin Chou
V.P. & Dir.-Logic Tech. Devel. & Tech. Mfg. Grp.

Jean Claude Cornet
V.P. & Gen. Mgr.-Desktop Computer Div.

F. Thomas Dunlap, Jr.
V.P., Gen. Counsel & Sec.

Carlene Ellis
V.P. & Dir.-Human Resources

G. Carl Everett, Jr.
V.P. & Dir.-Sls.

Kenneth B. Fine
V.P. & Gen. Mgr.-Multimedia & Supercomputing Components Grp.

Harold E. Hughes, Jr.
V.P. & Chief Fin. Officer

Robert T. Jenkins
V.P. & Dir.-Corporate Liscensing

Paul S. Otellini
V.P. & Gen. Mgr.-Microprocessor Products Grp.

Arvind Sodhani
V.P. & Treas.

Keith L. Thomson
V.P. & Gen. Mgr.-Desktop Computer Div.

Ronald J. Whittier
V.P. & Gen. Mgr.-Software Tech. Group

Albert Y.C. Yu
V.P. & G.M.-Micro Products Group

(Source: National Register Publishing Co. 6/2/92)

BOARD OF DIRECTORS

Gordon E. Moore
Andrew S. Grove
D. James Guzy
Richard Hodgson
Sanford Kaplan
Max Palevsky
Arthur Rock
Charles E. Young

Leslie L. Vodasz
David B. Yoffie
(Source: National Register Publishing Co. 6/2/92)

DIVISIONS & SUBSIDIARIES

KEY: ■ reports to Parent
● reports to preceding ■
▲ reports to preceding ●

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(Source: National Register Publishing Co. 6/2/92)

PRESIDENT'S LETTER

The following Letter to Shareholders is extracted from the Annual Report,

LETTER TO STOCKHOLDERS

A rapid market transition to our newest-generation microprocessors fueled Intel's continued growth in 1991, producing record results for the year. Both revenues and earnings per share were up 22 percent over 1990.

SUPPORTING A STRONG PRODUCT TRANSITION Computers based on our "second-wave" products--Intel486(TM) CPUs for desktop computers and Intel386(TM) SL microprocessors for notebook computers--are displacing machines based on the earlier "first wave" of Intel 32-bit microprocessors. We shipped 2 million second-wave CPUs in 1991, setting a record for new product ramps.

Committed to expanding manufacturing capacity for high-performance microprocessors, we spent close to $1 billion on capital programs in 1991. This included the new 0.8-micron chip production line in Rio Rancho, New Mexico, which began production in mid-year, as well as the opening of a new systems plant in Ireland and the "sodbreaking" for our Irish wafer production plant.

On the other side of this coin, we phased out production at older chip fabrication facilities in Santa Clara and Livermore, California, and at our Singapore systems plant.

We are also supporting the market's rapid transition with an aggressive advertising program. Our Intel Inside(TM) cooperative program, aimed at creating a PC-user preference for Intel 32-bit CPU-based PCs, has enlisted 342 original equipment manufacturers (OEMs) to date. The Intel Inside logo appeared on approximately 3000 pages of these companies' advertising in 1991. Another campaign, including a venture into TV advertising, educates PC users about the easy upgradability offered by many new Intel486 SX

CPU-based PCs.

INDUSTRY TRENDS In a year of considerable turmoil in the PC industry, the Intel X86 architecture was generally acknowledged as the "port of choice" for the principal desktop computing software environments. Most major operating systems and software applications available today are aimed at the Intel standard. For the future, companies such as Microsoft (Windows NT), Sun Microsystems (SunSoft Solaris 2.0), the new Apple/IBM joint venture (Taligent's operating system) and NeXT Inc. (NeXTstep/486) have all announced that their operating systems will be ported to the Intel architecture. No other microprocessor offers the same range of operating-system options as the Intel386/Intel486 standard.

According to preliminary Dataquest estimates, Intel became the largest U.S. semiconductor supplier in 1991, passing Motorola. Worldwide, Intel became the second largest integrated circuit producer, passing Hitachi and Toshiba. Over the past five-year period, Intel's average annual compound growth rate of 32.6 percent in semiconductor revenues ranks first among the world's top ten semiconductor producers.

Following global trends, in 1991, Intel's international business exceeded our domestic business for the first time. Sales in Europe increased to more than $1 billion.

NEW PRODUCTS The Intel486 SX CPU, introduced in April, offers twice the power of an Intel386 CPU at the same clock speed. This processor is rapidly gaining acceptance as the new engine for mainstream desktop computing.

New standards in supercomputing were set in 1991 with the installation of the Intel Touchstone Delta system, the world's fastest installed computer, at the California Institute of Technology. The introduction of Intel's next-generation Paragon(TM) supercomputer brings this high-end parallel computing power to commercial users for the first time.

The i860(TM) XP microprocessor, introduced in June, is a second-generation microprocessor that is garnering design wins in high-end supercomputing and parallel processing applications, and in visualization and graphics systems.

The 23 local area networking (LAN) products introduced in September are meeting with excellent acceptance, with LAN adapter demand well beyond original expectations.

Intel's position in multimedia was strengthened by the joint announcement with IBM of the ActionMedia(TM) II products, which won the Best of Show award at the COMDEX trade show in October.

CUSTOMER PARTNERSHIPS We continue to work closely with our customers to ensure progress toward common goals, marked by the following key events:

We were honored to be the first semiconductor company in the world to receive the NEC Second Office Automation Division's "zero-defect award," as well as its "partnership award." The award reads, in part, "You have made a significant contribution to our success by meeting our requirements in the areas of quality, cost and delivery, in spite of difficult business circumstances."

We announced, with IBM, the formation of the Robert N. Noyce Development Center in Boca Raton, Florida. The 100 employees of the joint design center, named for late Intel cofounder Robert Noyce, will design very highly integrated microprocessors. Intel's 10-year technology agreement with IBM continues the close relationship between the two companies.

In January 1992, Intel and the Defense Advanced Research Projects Agency (DARPA) announced a joint research program to accelerate development of computer systems capable of sustaining one trillion floating point operations per second (teraFLOPS). DARPA plans to contribute approximately $21 million over five years to the jointly funded effort.

PROTECTING INTEL'S INTELLECTUAL PROPERTY We were pleased with several favorable court rulings which included dismissal of a major portion of the antitrust suit filed by Advanced Micro Devices, Inc., two decisions preventing patent infringers from using licensed foundries to avoid infringement, and dismissal of five separate antitrust suits filed as counterclaims in response to various Intel cases. As imitations of our products continue to appear in the market, we will continue to protect our intellectual property and, if necessary, defend against its illegal use by other companies.

COMMUNITY NEWS In 1991, we were pleased to announce that we have completely eliminated ozone-depleting substances from our worldwide systems manufacturing processes. We believe we are the world's first electronics company to do this. This milestone marks the first of three phases that will make all our manufacturing processes CFC-free by the end of 1992.

The Intel Corporation Foundation funded several significant programs in 1991, including co-sponsoring the Intel/Department of Energy National Science Bowl for hundreds of teenagers across the country, and underwriting the popular public television series, Square One TV, a math and science program for elementary school students.

A VIEW TO '92 After a turbulent year for the PC industry, Intel emerges from 1991 in a strong position. We believe that the coming year will bring a reordering of the market, driven by advances in microprocessor technology and new distribution channels for PC systems. Our new P5 microprocessor, expected to be introduced in the summer of 1992, will extend the high end of our compatible family, with Intel486 CPU-based machines becoming the business desktop standard, and Intel386 CPU-based PCs, increasingly available at prices below $1000, offering an attractive entry point for first-time users. With continued R&D and capital development, we intend to continue as an aggressive competitor on all three market tiers.

We see exciting possibilities for the future of the PC industry. The proliferation of technologies such as networking and multimedia will bring increased opportunity for Intel products. The feature section of this report explores the technologies of "computer-supported collaboration," which is key to making PCs more beneficial to users in the next decade.

GORDON E. MOORE Chairman of the Board

CRAIG R. BARRETT Executive Vice President

ANDREW S. GROVE President and Chief Executive Officer

RECENT SEC FILINGS

The documents listed below were filed by the company with the Securities and Exchange Commission on the date indicated. A description of each document type is provided at the end of this section.

To order the SEC documents listed below please check the box next to the desired title, complete the attached **Order Form**, and fax both pages to the number provided on the **Order Form**.

DOCUMENT	DATE FILED
☐ 10-Q	06/27/92
☐ 10-Q	03/28/92
☐ Proxy	03/05/92
☐ Annual Report to Shareholders	12/28/91
☐ 10-K	12/28/91
☐ 10-Q	09/28/91
☐ Registration	07/19/91
☐ 10-Q	06/29/91
☐ 10-Q	03/30/91
☐ Proxy	03/28/91
☐ 10-K	12/29/90
☐ Annual Report to Shareholders	12/29/90

EXPLANATION OF SEC FILINGS

Annual Report to Shareholders Annual business summary with financial report. Not Required by the SEC.

10-K Audited annual financial report. Required by the SEC. Filing Deadline is 90 days after fiscal year end.

10-Q Unaudited quarterly financial report. Required by the SEC. Filing Deadline is 45 days after the end of each quarter.

8-K Report of unscheduled material events or corporate changes deemed of importance to shareholders or to the SEC. Filing deadline is within 15 working days of the event described.

Registration Statement Filed to register securities before they are offered to investors, or to permit trading among investors on a securities or in the OTC market. Contains a preliminary prospectus.

Proxy Provides official notification to designated classes of shareholders of matters to be brought to a vote at a shareholders meeting.

RECENT MAGAZINE ARTICLES

To order reprints of the articles listed below please check the box next to the desired title, complete the attached **Order Form**, and fax both pages to the number provided on the order form.

FORTUNE Articles

- ☐ **Chipper Days for U.S. Chipmakers** Vol. 123, Iss. 9, May 6, 1991; pp. 90-96. #91-21298
- ☐ **What 25-Year-Olds Want** Vol. 122, Iss. 5, Aug 27, 1990; pp. 42-50. #90-35416
- ☐ **Intel's Plan for Staying on Top** Vol. 119, Iss. 7, Mar 27, 1989; pp. 98-100. #89-11565

Other Publications

- ☐ **Seeing Is Believing for ACE Plan** *Computerworld* Vol. 26, Iss. 5, Feb 3, 1992; pp. 1,101. #92-10679
- ☐ **Intel, Novell Unveil HMI-Compliant Hubs** *Network World* Vol. 9, Iss. 5, Feb 3, 1992; pp. 19-20. #92-15194
- ☐ **Chip Wars; Advertising a Chip You'll Never See; AMD, Chips and** *Business Marketing* Vol. 77, Iss. 2, Feb 1992; pp. 16-20. #92-12129
- ☐ **I486: The New Deal in Desktop Design** *Computerworld* Vol. 26, Iss. 3, Jan 20, 1992; pp. 1,110. #92-08057
- ☐ **Network Menuing and Metering** *InfoWorld* Vol. 14, Iss. 3, Jan 20, 1992; pp. 75-91. #92-08340
- ☐ **Court Rules for Intel in Pollution Dispute** *Business Insurance* Vol. 26, Iss. 2, Jan 13, 1992; pp. 2,35. #92-07840
- ☐ **Portable Power to Last Twice as Long** *InfoWorld* Vol. 14, Iss. 2, Jan 13, 1992; pp. 23,26. #92-05962
- ☐ **Stock Picks for Uncertain Times** *Institutional Investor* Vol. 26, Iss. 1, Jan 1992; pp. 219-221. #92-07147
- ☐ **Check Out the U.S. Stocks That Foreigners Like the Best** *Money* Vol. 21, Iss. 1, Jan 1992; pp. 61-65. #92-08575
- ☐ **An Avenue of Caring** *Manufacturing Systems* Vol. 10, Iss. 1, Jan 1992; pp. 8. #92-07251
- ☐ **Court Cases That Will Change Your Job** *Computerworld* Vol. 25, Iss. 51, Dec 23, 1991/Jan 2, 1992; pp. 29. #92-04460
- ☐ **Acronym Update for the Multimedia Mix** *Training* Vol. 28, Iss. 12, Dec 1991; pp. 72. #92-03005
- ☐ **Fast Systems No Lure for Commercial Users** *Computerworld* Vol. 25, Iss. 47, Nov 25, 1991; pp. 93. #91-58440
- ☐ **DVI Multimedia Applications and Products** *CD-ROM Professional* Vol. 4, Iss. 6, Nov 1991; pp. 33-36. #91-55519
- ☐ **Computers Geared for Third Parties** *Software Magazine (Special Edition)* Vol. 11, Iss. 14, Nov 1991; pp. 63-64. #91-58045
- ☐ **Industry Makes Some Financial Gains** *InfoWorld* Vol. 13, Iss. 42, Oct 21, 1991; pp. 206. #91-53129
- ☐ **Testing Group Proceeds With "Reality" Search** *InfoWorld* Vol. 13, Iss. 42, Oct 21, 1991; pp. 160,163. #91-53126
- ☐ **In Dublin's Fair City . . . How Ireland Won Intel's European** *Financial World* Vol. 160, Iss. 21, Oct 15, 1991; pp. 38-40. #91-49840

- [ ] **FTC Turns up Heat on Technology Firms** *Computerworld* Vol. 25, Iss. 40, Oct 7, 1991; pp. 117-118. #91-50236

- [ ] **Business Marketing's Top 100 Companies: Time Warner; Sony; Toshiba;** *Business Marketing* Vol. 76, Iss. 10, Oct 1991; pp. 26-30. #91-50593

- [ ] **How to Achieve Worldwide JIT** *Material Handling Engineering* Vol. 46, Iss. 10, Oct 1991; pp. 59-60. #91-52017

- [ ] **Hardware Upgrades: Getting into First Class** *InfoWorld* Vol. 13, Iss. 39, Sep 30, 1991; pp. S51-S56. #91-49357

- [ ] **Losing the High-Tech Lead** *InfoWorld* Vol. 13, Iss. 38, Sep 23, 1991; pp. 40-44. #91-48414

- [ ] **Intel Offers Bevy of LAN User Products** *Network World* Vol. 8, Iss. 37, Sep 16, 1991; pp. 21,24. #91-45957

- [ ] **Chip Choices Outnumber User Needs** *Computerworld* Vol. 25, Iss. 34, Aug 26, 1991; pp. 1,81. #91-42823

- [ ] **Canadian Bank to Upgrade LANs to LAN Server Nets** *Network World* Vol. 8, Iss. 33, Aug 19, 1991; pp. 2,63. #91-42324

- [ ] **Intel Pushes into Market with New LAN Products** *Network World* Vol. 8, Iss. 33, Aug 19, 1991; pp. 2,8,62. #91-42325

- [ ] **Flash Memory Cards En Route** *InfoWorld* Vol. 13, Iss. 30, Jul 29, 1991; pp. 23,28. #91-37062

- [ ] **Spring Quarter Results Are Mixed** *InfoWorld* Vol. 13, Iss. 29, Jul 22, 1991; pp. 94. #91-37059

- [ ] **More Features or Fewer Choices? Trends Toward Higher Integration and** *InfoWorld* Vol. 13, Iss. 28, Jul 15, 1991; pp. 50-52. #91-35796

- [ ] **Product Comparison - High-Speed Modems: Faster than a Speeding Bullet** *InfoWorld* Vol. 13, Iss. 26, Jul 1, 1991; pp. 51-58. #91-33373

- [ ] **DOS and UNIX Coexist with Help from Dual Architecture** *Computerworld* Vol. 25, Iss. 26, Jul 1, 1991; pp. 73. #91-33026

- [ ] **PC Watch** *Canadian Datasystems* Vol. 23, Iss. 7, Jul 1991; pp. 25-27. #91-55169

- [ ] **No More Hide and Seek on Multiserver LANs** *Data Communications* Vol. 20, Iss. 8, Jun 21, 1991; pp. 75-79. #91-31985

- [ ] **Denny's POS Effort** *Computerworld* Vol. 25, Iss. 21, May 27, 1991; pp. 81,84. #91-26790

- [ ] **IBM Hits the Ground Running with Clever 486SX-Based PC** *InfoWorld* Vol. 13, Iss. 21, May 27, 1991; pp. 93-94. #91-27032

- [ ] **33-MHz 386: Round 2** *InfoWorld* Vol. 13, Iss. 21, May 27, 1991; pp. 71-81. #91-27027

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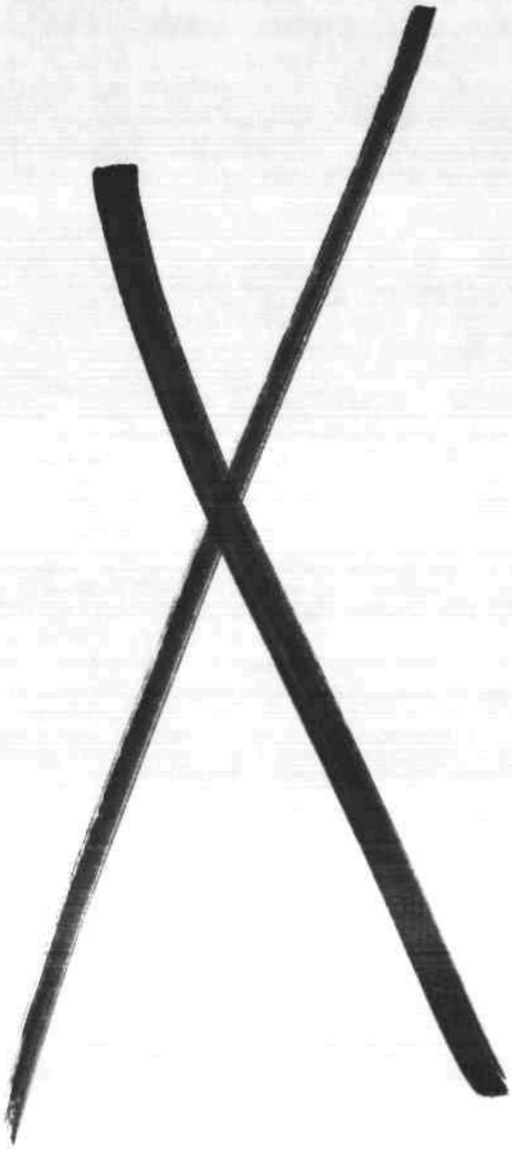

FORTUNE

BUSINESS REPORTS

COMPANY PROFILE

■ LAM RESEARCH CORP

Data sources and updating procedures. This report is a compilation of information from numerous sources, including: annual reports, 10Ks, 10Qs, and proxies filed with the Securities and Exchange Commission, Disclosure Incorporated, Standard & Poor's Corporation, National Register Publishing Company, Reuters News Service, Muller Data Services, CDA Technologies, Inc., and over 300 publicly available journals and periodicals. The information contained in the report is updated on a daily, weekly, monthly, quarterly, or annual cycle depending on the type of information being reported and the collection methods used by the information providers. Every effort is made to obtain and report the most recent data available from the aforementioned sources. This report has not been reviewed or endorsed by FORTUNE Magazine and does not represent the editorial opinion of FORTUNE.

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GENERAL COMPANY INFORMATION

FISCAL YEAR END
N/A

PRIMARY SIC
3559

TICKER SYMBOL
LRCX

EXCHANGE
NMS

1992 EMPLOYEES
976

LAM RESEARCH CORP
4650 CUSHING PARKWAY
FREMONT, CA 945386401
Telephone: 510-659-0200

LEGAL FIRM
WILSON, SONSINI, GOODRICH & ROSATI

AUDITOR
ERNST & YOUNG

STATE OF INCORPORATION
DELAWARE

COMPANY OVERVIEW

DEVELOPS, MANUFACTURES AND MARKETS SINGLE WAFER PLASMA ETCH SYSTEMS, USED PRIMARILY IN FABRICATION OF VERY LARGE SCALE INTEGRATED CIRCUITS.

(Source: Disclosure 03/31/93)

FIVE YEAR FINANCIAL SUMMARY

($Millions)	1991	1990	1989	1988	1987
Sales	$171	$144	$141	$129	$76
Net Income	$10	$6	($9)	$9	$3
EPS	$0.73	$0.50	($0.77)	$0.84	$0.21
Current Assets	$118	$85	$87		
Total Assets	$157	$117	$106		
Current Liabilities	$36	$34	$36		
Long-Term Debt	$14	$22	$16		
Total Liabilities	$50	$56	$52		
Equity	$107	$61	$54		
Current Ratio	3.25	2.54	2.45		
Inventory Turnover	3.75	3.47	3.74		
L-T Debt/Equity	0.19	0.44	0.32		
Return on Equity	9%	10%	(16)%		

4-Year Annual Compound Growth Rate

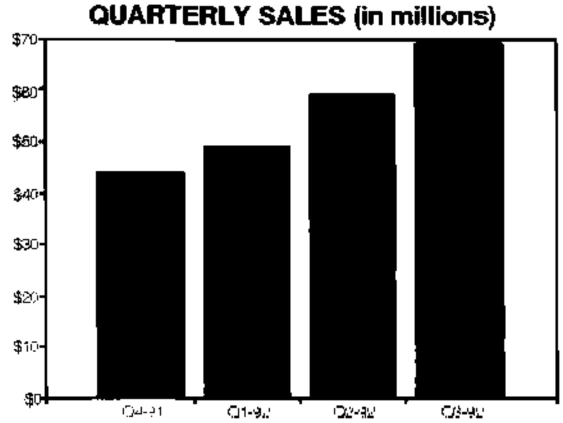
Sales	22.6%
Net Income	41.1%
EPS	36.5%

(Source: Disclosure 03/31/93)

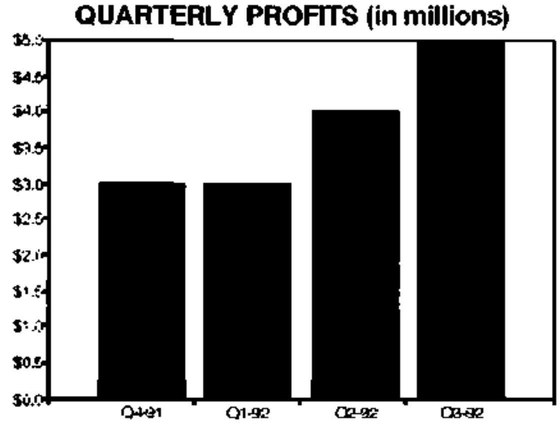
To order the company's annual report or 10-K, please see the SEC Filings section at the back of this profile.

RECENT QUARTERLY TRENDS

QUARTERLY SALES (in millions)



QUARTERLY PROFITS (in millions)



QUARTERLY DATA
($ Millions, except EPS)

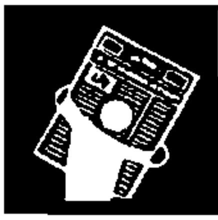
	Q4-91	Q1-92	Q2-92	Q3-92
Sales	$44	$49	$59	$69
Profits	$3	$3	$4	$5
EPS	$0.21	$0.21	$0.26	$0.36

(Source:10-Q 12/31/92)

BUSINESS DESCRIPTION

Lam Research Corporation develops, manufactures, markets and services semiconductor wafer processing capital equipment used in the fabrication of very-large-scale integrated (VLSI) circuits. The company's core technologies are focused on etch and deposition, two of the most vital steps in the device manufacturing cycle. Lam addresses the etch market with three major products: its AutoEtch series of single-wafer, plasma-etch systems; its advanced Rainbow series platform for submicron capabilities, eight-inch wafer handling and advanced automation; and its Transformer Coupled Plasma (TCP) product, a low pressure, high density, planar plasma etch source. Lam's advanced etch development programs, sponsored by SEMATECH and a key customer, are expected to produce products meeting requirements for the sub half-micron device market. The company has also introduced its Alliance advanced multichamber etch cluster system, which provides higher wafer throughput. In the chemical vapor deposition (CVD) area, Lam has introduced its Integrity platform, an integrated processing series to address a wide range of films, the first of which is BPSG. Integrity is a patented, low-pressure, thermal CVD system that represents a major breakthrough in both system design and CVD process technology. Lam also markets and supports electron cyclotron resonance (ECR) systems. The Epic CVD system incorporates ECR to form high density, low pressure plasma that deposits films onto semiconductor devices with very small feature sizes. In the final quarter of fiscal 1990, Lam announced a phaseout of its Gemini epitaxy product line, based on sharp declines in epitaxy revenues and a decrease in the overall epi market. In August 1992, Lam sold the Gemini epitaxial manufacturing technology to Concept Systems Design. Lam's products are sold through company personnel and a worldwide distribution network of independent representatives and distributors. Export sales represented 46% of net sales in both fiscal 1992 and fiscal 1991. IBM and Intel each accounted for 10% of fiscal 1992's sales. The semiconductor equipment industry is subject to rapid technological change. R&D outlays equaled 17%, 20% and 21% of net sales in fiscal 1993, 1992 and 1991, respectively.

(Source: Standard & Poor's 9/03/93)



RECENT COMPANY NEWS

FREMONT, Calif., Aug 10, 1993, (Reuter) — Lam Research Corp announced a three for two stock split effected in the form of a stock dividend, to be paid to stockholders of record August 20. The pay date of the split was not announced.

NEW YORK, July 8, 1993 (Reuter) — Needham & Co said it cut its rating on Lam Research Corp to hold from buy, and replaced it with Parallan Computer <PLLN.O> on its focus list. "It's based on valuation," said analyst Byron Walker, referring to the Lam dowgnrade. "We still like what the company is doing and we think it will see earnings momentum." "We feel that its earnings power is fully valued in the stock price at $40. Lam was off 2-5/8 at 37-1/2. The analyst who covers Parallan was not available. Parallan was up 1/4 at 15-1/3.

STAMFORD, Conn., June 23, 1993, Reuter — General Signal Corp said it agreed to sell its Drytek unit to Lam Research Corp <LRCX.O> for undisclosed terms. General Signal said the agreement follows its decision, announced in January, to divest its semiconductor equipment operations. Since then it completed the sale of its Ultratech Stepper unit and filed a registration for its Electroglas unit's initial public offering. Talks are underway with potential buyers of General's Assembly Technologies unit, and the Integrated Solutions business.

NEW YORK, April 26, 1993, Reuter — Needham and Co managing director James Kloppenburg said the brokerage firm put 15 stocks including Informix Corp <IFMX.O> and Advanced Micro Devices Inc <AMD.N> on a new focus list. Kloppenburg said the list contained names the firm sees as outperforming the market over the next three to six months. The focus list is a subset of Needham's recommended list. Needham's focus list is where the brokerage will be "concentrating new money in the short term," Kloppenburg said. He said the firm will look for stocks with timely events or particularily attractive valuations to put on the list. Also added to Needham's new focus list were Altera Corp <ALTR.O>, Bed Bath & Beyond Inc <BBBY.O>, Cisco Systems Inc <CSCO.O>, Homedco Group Inc <HOME.O>, IEC Electronics Corp <IECE.N>, Lam Research Corp <LRCX.O> and Lattice Semiconductor Corp <LSCC.O>, PeopleSoft Inc <PSFT.O>, Progress Software Corp <PRGS.O>, Quantum Health Resources Inc <QHRI.O>, Sybase Inc <SYBS.O>, Synopsys Inc <SNPS.O> and Value Health Inc <VH.N> were also put on the Needham list, Kloppenburg said.

FREMONT, Calif., April 20, 1993, Reuter — Lam Research Corp said it filed a registration statement with the Securities & Exchange Commission for a proposed offering of $50 million of convertible subordinated debentures due 2003. Net proceeds from the offering, to be underwritten by Smith Barney, Harris Upham & Co, Cowen & Co and Montgomery Securities, will be used to buy capital equipment, and fund leasehold improvements and facilities expansion.

OTHER IMPORTANT DEVELOPMENTS

July 1993 — Lam introduced its Advanced Capability Alliance integrated processing platform, and also introduced a dual-chamber Epic configuration of the system.

June 1993 — The company signed a definitive agreement to purchase the assets of Drytek Inc., which has helped innovate many plasma etch advantages, specifically in the oxide etch arena, and which has a strong presence in the Eastern U.S. and Europe.

March 1993 — Lam shipped its first plasma etch system to Russia, which management believes is a market with tremendous long-term potential. Separately, the company introduced the industry's most comprehensive warranty program, which covers parts and maintenance on a 24-hour, seven-day-a-week basis for two years.

May 1992 — Lam announced it had completed development of a revolutionary plasma source that can be used to manufacture future generation semiconductor chips such as 64- and 256-megabit DRAMS. The new TCP technology takes etching capabilities beyond existing levels through precise control in the 0.25 micron regime.

(Source: Standard & Poor's)

INDUSTRY OUTLOOK

NEW YORK, September 1993 — Semiconductor stocks have been on a roll during the past year as industry conditions have strengthened far beyond original forecasts. The gains in the stocks have continued recently with the release of better-than-expected second-quarter earnings. However, valuations of semiconductor stocks appear generous. Furthermore, projections of future earnings have been raised to levels that make earnings surprises unlikely in the short term. Any negative news, therefore, could cause a retrenchment. We would postpone commitments in the semiconductor group until weakness presents a buying opportunity. Most of the semiconductor issues that we follow are rated avoid.

Growth in the worldwide semiconductor industry is expected to approximate 20% in 1993 following the 9% gain last year. The strength will be led by the U.S., which is benefiting from strong personal computer sales and an expanding economy Recent reports indicate that demand in the U.S. is broadening beyond the personal computer industry, which has experienced sharply higher unit volume in the past year due to price reductions. Sales should also be strong in the Asia/Pacific region as manufacturing continues to move offshore. Demand from Europe has been surprisingly robust given the weak economic conditions that prevail in many of those countries. However, growth in the Japanese market is only likely to be modest. Industry sales will be further spurred by a new generation of products, such as the next generation Pentium (586) microprocessor, mixed signal ASICs (application specific integrated circuits) and 4-megabit DRAMs (dynamic random access memories).

The strengthening industry conditions have allowed profits to move substantially higher because of the higher volume, easing pressure on prices, a shift to proprietary products and benefits from recent restructurings, as well as the absence of restructuring charges themselves. Certain markets are likely to see increased competition in the future, however. Intel faces competition from Advanced Micro Devices, Cyrix and Texas Instruments in the 486 microprocessor market. In addition, the PowerPC microprocessor being developed by Motorola and IBM will also compete directly with Intel's 486 and Pentium. The fast growing field programmable gate arrays are another market that is also facing increased competition, although recent earnings reports from industry leaders Xilinx and Altera have been excellent.

(Source: Standard & Poor's)

STOCK INFORMATION

EXCHANGE: NMS **TICKER SYMBOL:** LRCX

Price For Week Ending:	**09/23/93**
High (or Ask):	**35.000**
Low (or Bid):	**32.250**
Close (or Average):	**34.500**
P/E Ratio:	**43.671**
Shares Outstanding:	**23,012,000**
As of:	**09/23/93**
Indicated Annual Dividend:	**$0.00**

(Source: Muller Data Corporation 09/23/93)

MAJOR SHAREHOLDERS	PERCENT
FIDELITY MANAGEMENT & RESEARCH	9.9%

(Source: 10-K 06/30/92)

SHAREHOLDERS GROUPS	OWNERS	PERCENT
INSTITUTIONS	91	87.92%
5% OWNERS	2	0.68%
INSIDERS	16	1.69%

(Source: CDA Technologies, Inc. 06/30/93)

KEY EXECUTIVES

Roger D. Emerick
Chm., & Chief Exec. Officer

Henk Evenhuis
Sr. V.P.-Fin. & Admin., Chief Fin. Officer & Sec.

David Jones
V.P.

Alan Nolet
V.P.

Bruce Rhine
V.P.

Julia Chubb
Treas.

Carolyn Schwartz
Mgr.-Investor Rels.

(Source: National Register Publishing Co. 8/4/93)

NOMINEES TO BOARD OF DIRECTORS

ROGER D. EMERICK
DAVID G. ARSCOTT
JACK R. HARRIS
GRANT M. INMAN
OSAMU KANO

(Source: Proxy 10/05/92)

SUBSIDIARIES

KEY: ■ reports to Parent
● reports to preceding ■
▲ reports to preceding ●

- ■ GEMINI RESEARCH
- ■ LAM RESEARCH GMBH
- ■ MONKOWSKI RHINE INC
- ■ LRC INTERNATIONAL CORP
- ■ LAM RESEARCH LTD
- ■ LAM TECHNOLOGY CENTER K K
- ■ LAM RESEARCH SARL
- ■ LAM RESEARCHKOREA
- ■ LAM RESEARCH SINGAPORE PTE LTD

(Source:10-K 06/30/92)

PRESIDENT'S LETTER

The following Letter to Shareholders is extracted from the Annual Report,

To Our Stockholders

The trends shaping our industry, taken together, point to a major shift: customers are looking to equipment suppliers for total manufacturing solutions. And they want these solutions worldwide. While some of our competitors are focusing on one or two of the trends presented in this report, our customers tell us few successfully address all three.

This is where Lam rises above the pack. We've built a strong, flexible infrastructure that allows us to deliver a complete solution -- one that encompasses lower cost of ownership, a clear technological edge, and a customer-responsive global presence.

The results we delivered this year demonstrate the success of this three-tiered strategy. Despite the lagging economy and tough industry climate, we advanced our etch market share and achieved record revenues and profits -- capping off eight straight quarters of profit growth. The momentum achieved to date also spelled success for a secondary stock offering, which raised $33 million.

But this performance is not based solely on our fiscal 1992 accomplishments. It stems from early insight into the very trends presented here.

To reduce cost of ownership, for example, we invest in solid product platforms for our core technologies. This accomplishes several goals. It allows us to advance automation, deliver 95% uptime, increase reliability and boost quality so customers reap one of the lowest cost-of-ownership ratings in the industry. At the same time, platforms ensure that performance-related benefits extend to multiple product generations. They also allow us to tailor products for specific applications -- opening the door to a larger available market. As an added bonus, these foundational platforms speed time to market for new products targeting emerging device applications.

As for technology, our record speaks for itself. We've earned a leadership position in our primary market, etch, thanks to the performance of our advanced capability Rainbow platform. This product line continues to increase our market share and tap growing etch sectors. Even as we take stock of current successes, we are gearing up for tomorrow's challenges. Our Transformer Coupled Plasma (TCP) etch technology launch in June focused industry attention on an entirely new plasma source that will meet advanced etch requirements. In metal etch, this new source has resulted in a best-of-breed solution, posing an excellent growth opportunity for Lam -- especially in Japan. We also completed development on Alliance, a high-performance cluster tool that allows us to address our customer's automation challenges.

In the deposition arena, we continued to make headway. Our Electron Cyclotron Resonance (ECR) program received supplemental SEMATECH funding. In addition, we have strategically placed our Integrity system with key customers to test its production worthiness for next-generation technology. These projects set the stage for device applications in the 1993-1997 time frame.

Like technology, global presence is a long-term commitment. While Lam has an established worldwide sales and support network, globalization is more than simply locating offices in strategic countries worldwide. It is building an infrastructure that draws on the local culture and empowers individual business units to respond to their unique customer requirements.

In Japan, for example, we are forging direct relationships with customers to understand their five-year technology roadmap. Toward this end, we opened a Lam technology center near Tokyo this year, and expansion plans are already underway. We're hiring Japanese technologists to work with the Lam team already in place at the center. We're also augmenting the center with a sophisticated cleanroom and demo facility -- all to ensure that Lam's process solutions are in step with our customers' evolving requirements.

It's evident that our customers need lower operating costs, leading-edge technology and reliable equipment -- along with the assurance of continuous improvements -- to compete in the '90s. Ultimately, they need a global supplier with responsive support everywhere in the world. Today, Lam is that supplier. But the real question is, how will we continue to succeed in this challenging marketplace in the years ahead?

We have the vision -- our active partnerships help us anticipate requirements and constantly measure development efforts against our role in the next generation of devices.

We have the infrastructure -- one that inspires and empowers our employees with Lam's customer commitment.

We've made the necessary investments -- creating the cost-of-ownership advantages, technical excellence and global structure that position Lam for longterm success.

And we have the financial buoyancy and strength -- balancing business opportunities with current economic realities.

At Lam, we know that our technology and cost-of-ownership advantages give us the opportunity to compete. But customer responsiveness is what differentiates Lam in every chip-producing country in the world. This is our message to our investors as well as our customers, suppliers, partners and employees. The powerful combination of strong foundational technology, solid business strategies and a customer-first attitude will continue to drive our success.

Roger D. Emerick Chairman and Chief Executive Officer

RECENT SEC FILINGS

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❑ Registration	04/30/93
❑ Registration	04/21/93
❑ Registration	04/20/93
❑ 10-Q	03/31/93
❑ 10-Q	12/31/92
❑ Proxy	10/05/92
❑ 10-Q	09/30/92
❑ 10-K	06/30/92
❑ Annual Report to Shareholders	06/30/92
❑ Registration	05/28/92
❑ 10-Q	03/31/92

EXPLANATION OF SEC FILINGS

Annual Report to Shareholders Annual business summary with financial report. Not Required by the SEC.

10-K Audited annual financial report. Required by the SEC. Filing Deadline is 90 days after fiscal year end.

10-Q Unaudited quarterly financial report. Required by the SEC. Filing Deadline is 45 days after the end of each quarter.

8-K Report of unscheduled material events or corporate changes deemed of importance to shareholders or to the SEC. Filing deadline is within 15 working days of the event described.

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FORTUNE

BUSINESS REPORTS

COMPANY PROFILE

■ LSI LOGIC CORP

Data sources and updating procedures. This report is a compilation of information from numerous sources, including: annual reports, 10Ks, 10Qs, and proxies filed with the Securities and Exchange Commission, Disclosure Incorporated, Standard & Poor's Corporation, National Register Publishing Company, Reuters News Service, Muller Data Services, CDA Technologies, Inc., and over 300 publicly available journals and periodicals. The information contained in the report is updated on a daily, weekly, monthly, quarterly, or annual cycle depending on the type of information being reported and the collection methods used by the information providers. Every effort is made to obtain and report the most recent data available from the aforementioned sources. This report has not been reviewed or endorsed by FORTUNE Magazine and does not represent the editorial opinion of FORTUNE.

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GENERAL COMPANY INFORMATION

FISCAL YEAR END
December

PRIMARY SIC
3674

TICKER SYMBOL
LSI

EXCHANGE
NYS

1991 EMPLOYEES
1,204

LSI LOGIC CORP
1551 MCCARTHY
BOULEVARD
MILPITAS, CA 95035
Telephone: 408-433-8000

AUDITOR
PRICE WATERHOUSE

STATE OF INCORPORATION
DELAWARE

COMPANY OVERVIEW

DESIGNS, MANUFACTURES AND MARKETS INTEGRATED CIRCUITS; PROVIDES DESIGN DEVELOPMENT AND RELATED SERVICES TO ELECTRONICS MANUFACTURERS, INCLUDING SOFTWARE DESIGN AND ACTUAL CHIP PRODUCTION.

(Source: Disclosure 03/31/92)

FIVE YEAR FINANCIAL SUMMARY

To order the company's annual report or 10-K, please see the SEC Filings section at the back of this profile.

($Millions)	**1991**	**1990**	**1989**	**1988**	**1987**
Sales	$698	$655	$547	$379	$262
Net Income	$8	($30)	($31)	$25	$11
EPS	$0.19	($0.72)	($0.76)	$0.47	$0.28
Current Assets	$386	$424	$392	$425	$383
Total Assets	$748	$772	$765	$787	$699
Current Liabilities	$161	$193	$151	$130	$72
Long-Term Debt	$166	$190	$204	$192	$188
Total Liabilities	$353	$405	$373	$344	$275
Equity	$293	$268	$297	$332	$308
Current Ratio	2.40	2.20	2.60		
Inventory Turnover	7.89	5.25	4.76		
Total Debt/Equity	0.67	0.93	0.86		
Return on Equity	4%	(18)%	(15)%		

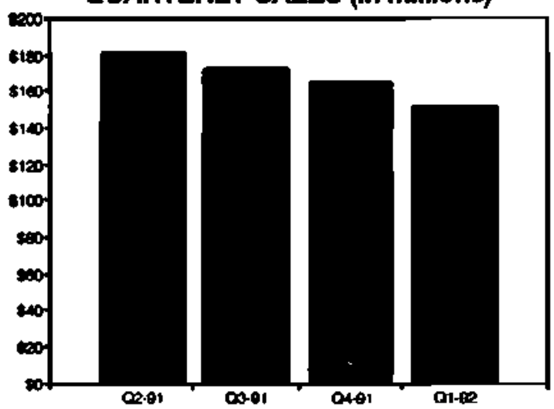
4-Year Annual Compound Growth Rate

Sales	27.7%
Net Income	(7.3)%
EPS	(9.2)%

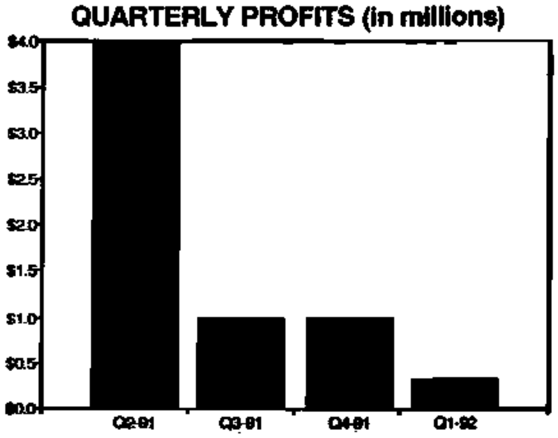
(Source: Disclosure 03/31/92)

RECENT QUARTERLY TRENDS

QUARTERLY SALES (in millions)



QUARTERLY PROFITS (in millions)



QUARTERLY DATA
($ Millions, except EPS)

	Q2-91	Q3-91	Q4-91	Q1-92
Sales	$181	$172	$164	$151
Profits	$4	$1	$1	$0.3
EPS	$0.10	$0.02	$0.02	$7.04

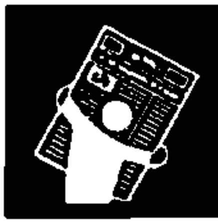
(Source:10-Q 12/29/91)

BUSINESS DESCRIPTION

LSI Logic designs, develops, manufacturers and markets integrated circuit products and provides computer aided design and technology services and tools based on application-specific integrated circuit (ASIC) technologies.

Foreign sales accounted for 35% of revenues and a 15% of operating income in 1991. ASICs include metal programmable array, cell-based and Embedded Array architectures. The company offers ASICs that may include both logic and memory elements. The company offers customers its proprietary Modular Design Environment software that is used to design ASICs for customer's specific functionality and performance requirements. It currently operates on engineering workstations amd comprises libraries of semiconductor macrocells (the basic silicon structures used in the design of logic circuits) and larger predefined functional building blocks, technology bases and design automation programs. Standard products include 32-bit RISC (reduced instruction set computing) microprocessors, peripheral logic chips and 16-bit microprocessors. The company also offers high-speed digital signal and image processing devices and graphics chips and logic chip sets, as well as video graphics technology board based products. Products and services are marketed primarily to manufacturers in the electronic data processing, military/aerspace and telecommunications industries.

(Source: Standard & Poor's 07/07/92)



RECENT COMPANY NEWS

BERLIN, March 17, 1992, Reuter — The government's Treuhand privatisation agency has found investors for part of eastern Germany's former communist-run electronics industry but has saved only 1,500 out of 22,000 jobs. A Treuhand statement said LSI Logic Corp <LSI.N> of the United States would buy 19.8 pct of a new company formed out of the <Mikroelektronik-und Technologie GmbH> (MTG) electronics group in Erfurt, with the 80.2 pct going to an unnamed bank. America's VLSI Technology Inc <VLSI.O> would take 19.8 pct of MTG's core activities in Dresden with 49 pct going to a bank. The Treuhand was still looking to sell the 31.2 pct.

MILPITAS, Calif., Feb 18, 1992, Reuter — LSI Logic Corp said it introduced CoreWare Technology, a line of semiconductors that allows computer makers to design complete systems on a single chip. The chips can include advanced building blocks such as RISC microprocessors, video compression and digital signal processing. A company spokesman said the product enhances reliablity of the computer system, helps manufacturers custom design to suit client needs and also speeds time to market.

BERLIN, Feb 13, 1992, Reuter — U.S. High technology companies LSI Logic Corp <LSI.N> and VLSI Tech Inc <VLSI.O> will take a minority stake in the former electronics empire of communist East Germany, the Treuhand privatisation agency said. Treuhand board member Wolf Klinz said the two companies had agreed to share a 19.8 pct stake in the state-owned <Mikroelektronik und Technologie Gesellschaft> (MTG). But the government agency's efforts to sell the rest of the electronics industry has failed to attract other investors. "We came as beggars rather than with trumps in our hands," Klinz told reporters.

LOS ANGELES, Jan 28, Reuter — Prudential Securities analyst Daniel Klesken cut his 1992 estimate on LSI Logic Inc to 55 cts a share from 75 cts a share, his assistant said. Klesken estimates LSI will earn 1.25 dlrs a share in 1993, his assistant said. Klesken was not available for comment. LSI yesterday reported 1991 fourth quarter net of 939,000 dlrs or two cts a share, versus year-ago loss of 43.6 mln dlrs or 1.03 dlrs a share including a 43 mln dlr restructuring charge. In the 1991 year LSI earned 8,341,000 dlrs or 19 cts a share, versus 1990 loss of 30.3 mln dlrs or 72 cts a share. The 1990 year includes a gain of two cts a share.

OTHER IMPORTANT DEVELOPMENTS

April 1992 — The company introduced a new generation of ASIC products based on a 0.60-micron drawn (0.45-micron effective) CMOS silicon gate process, including gate array, Embedded Array and cell-based technologies. The process offers the smallest feature size of any ASIC or microprocessor process in the world below 0.65-micron.

March 1992 — The company said that orders in February had improved from weakness experienced in January. However, it added that it was still being hurt by the sluggish economy and that it was premature to predict a turn in industry conditions. LSI also said that it was continuing to aggressively introduce new products.

November 1991 — The company announced that in response to sluggishness in the worldwide electronics industry it was reducing its workforce by 130 people, or 5%. The company added that it expected further workforce reductions over the next several quarters due to attrition. It also said it would delay the opening of a new wafer fabrication facility in Japan.

July 1991 — LSI noted that new bookings slowed considerably in the second quarter. It beleives that customers worldwide sought to keep inventories lean due to concerns about the economy and because of turmoil in the computer industry involving new product cycles, open standards and realignments in the retail distribution channel.

April 1991 — The company said that its revenue growth in the first quarter was strong due to accelerating demand from the workstation, personal computer and defense-related industries. LSI added that orders in the first quarter exceeded billings and were ahead of forecast in all geographic areas and major product groups.

October 1990 — The company said that during the seasonally weak third quarter its book-to-bill ratio was slightly below one to one. It added that while new orders were stronger than expected in September, its customers were clearly cautious and were generally scheduling longer-term deliveries.

July 1990 — The company said its book-to-bill ratio was nearly 1.3-to-1 in the second quarter, primarily reflecting strong demand from workstation and personal computer suppliers. However, it added that all industry segments contributed to the improved order pattern.

March 1990 — The company said in its 1989 Annual Report that by year-end 1989 its revenues had resumed growing, manufacturing utilization had improved and all major factories were equipped to produce cost-efficient six-inch wafers following the decision in the third quarter of 1989 to phase out five-inch wafer capacity.

November 1989 — The company said that the $43 million restructuring charge (pretax) in 1989's third quarter reflected a combinations of factors, including excess capacity exacerbated by a slowdown in the rate of growth, and the recognition that the company's 5-inch wafer capacity is outdated.

June 1989 — The company said that its earnings for the second quarter were expected to be in the range of $0.11 to $0.13 a share. The expected decline in earnings was attributed to a shortfall in anticipated revenues, due to customers' delaying orders and lower-than-expected design services and factory utilization.

January 1989 — The company said that its bookings remained strong. This followed a 20% increase in orders and a record number of new ASIC designs that were booked in the 1988 fourth quarter. The company noted that during 1988 it grew faster than the semiconductor industry and the ASIC sector.

July 1988 — The company said that during the second quarter its book-to-bill ratio was 1.6-to-1, which far exceeded the industry average. LSI added that it expected continued revenue gains in the second half of 1988, as well as improved profitability.

(Source: Standard & Poor's)

COMPANY OUTLOOK

NEW YORK, July 1992 — Earnings for 1992 should approximate $0.25 a share, up from 1991's $0.19. A further increase to $0.75 is projected for 1993. Initiation of cash dividends is not anticipated. Sales in 1992 are expected remain essentially unchanged, year to year, as weakness in the first half of the year is offset by higher sales in the second half. The growth in the second half should reflect an acceleration of industry growth in a stronger economy and an aggressive new product introduction program. Margins should widen on the higher volume due to better absorption of overhead, less pricing competition, and recent cost reductions. Earnings in 1993 should increase substantially as the company benefits from stronger industry growth that should result in sharply higher demand for new products.

(Source: Standard & Poor's)

STOCK INFORMATION

EXCHANGE: NYS TICKER SYMBOL: LSI

Price For Week Ending:	**09/10/92**
High (or Ask):	**6.750**
Low (or Bid):	**5.500**
Close (or Average):	**6.500**
P/E Ratio:	**-81.250**
Shares Outstanding:	**43,727,000**
As of:	**09/10/92**
Indicated Annual Dividend:	**$0.00**

(Source: Muller Data Corporation 09/10/92)

MAJOR SHAREHOLDERS	PERCENT
WILFRED J. CORRIGAN	10.33%
CAPITAL GROUP INC	9.98%
CAPITAL RESEARCH & MANAGEMENT CO	6.35%
TRIMARK INVESTMENT MANAGEMENT INC	5.74%

(Source: 10-K 12/29/91)

SHAREHOLDERS GROUPS	OWNERS	PERCENT
INSTITUTIONS	59	38.14%
5% OWNERS	3	17.23%
INSIDERS	26	12.13%

(Source: CDA Technologies, Inc. 06/30/92)

CORPORATE OFFICERS

WILFRED J. CORRIGAN
CHAIRMAN OF THE BOARD, CHIEF EXECUTIVE OFFICER
ANNUAL SALARY: $477,092 AGE: 54

GEORGE D. WELLS
PRESIDENT, CHIEF OPERATING OFFICER
ANNUAL SALARY: $359,878 AGE: 56

ROBERT N. BLAIR
SUBSIDIARY OFFICER
AGE: 49

JOHN T. DICKSON
SUBSIDIARY OFFICER
AGE: 46

BRUCE L. ENTIN
SUBSIDIARY OFFICER
AGE: 41

BRIAN L. HALLA
SUBSIDIARY OFFICER
AGE: 45

CYRIL F. HANNON
EXECUTIVE VICE PRESIDENT
ANNUAL SALARY: $224,124 AGE: 53

PATRICK S. JONES
VICE PRESIDENT, CHIEF FINANCIAL OFFICER
AGE: 47

JAMES S. KOFORD
SUBSIDIARY OFFICER
AGE: 53

MURRAY L. MCLACHLAN
VICE PRESIDENT
AGE: 51

DAVID E. SANDERS
VICE PRESIDENT, LEGAL COUNSEL, SECRETARY
AGE: 44

HORST G. SANDFORT
SUBSIDIARY OFFICER
ANNUAL SALARY: $302,924 **AGE:** 49

ROBERT M. SKINNER
VICE PRESIDENT
AGE: 61

CHARLES H. SMITH
VICE PRESIDENT
AGE: 47

LEWIS C. WALLBRIDGE
VICE PRESIDENT
AGE: 48

A TRAVIS WHITE
SUBSIDIARY OFFICER
AGE: 46

KEISKE K. YAWATA
SUBSIDIARY OFFICER
ANNUAL SALARY: $312,989 **AGE:** 57

(Source: 10-K 12/29/91)

NOMINEES TO BOARD OF DIRECTORS

WILFRED J. CORRIGAN
GEORGE D. WELLS
JAMES H. KEYES
LARRY W. SONSINI
T. Z. CHU

(Source: Proxy 03/30/92)

SUBSIDIARIES

KEY: ■ reports to Parent
● reports to preceding ■
▲ reports to preceding ●

■ LSI LOGIC EUROPE PLC [96%]

■ LSI LOGIC CORP CANADA INC [57%]

■ LSI LOGIC K K [58%]

■ NIHON SEMICONDUCTOR INC [55%]

■ HEADLAND TECHNOLOGY INC [86%]

■ LSI LOGIC ASIAINC

■ LSI LOGIC INTERNATIONAL SERVICES INC

■ LSI LOGIC FOREIGN SALES CORP

(Source:10-K 12/29/91)

PRESIDENT'S LETTER

The following Letter to Shareholders is extracted from the Annual Report,

Dear Shareholder

1991 was not the best of times nor the most memorable, but it was still a recovery year for LSI Logic. The economy was locked in a recession and the electronics industry was in upheaval, but our revenues increased 7%, and we were modestly profitable following two years of red ink.

Revenues in 1991 were a record $698 million compared with $655 million in 1990, and international revenues accounted for 38% of the total in 1991. Semiconductor-related revenues, excluding video boards, grew more than 12%, or faster than the industry as a whole. Net income was $8.3 million or 19 cents a share compared with a restructuring-related loss of $30.3 million or 72 cents a share in 1990.

During the year, the balance sheet improved. Our cash balance at year-end was $157 million, or about the same as year-end 1990 -- despite the fact that we reduced total debt by $54 million or 22%. In addition, accounts receivable declined 12% and inventories fell 29% -- for a total reduction of $50 million. Shareholders' equity increased 9%. The actions taken to strengthen the balance sheet will increase our flexibility in both good times and bad.

For LSI Logic, the real story of 1991 goes well beyond the financial results. We streamlined the Company, shaved spending plans, and focused on profitability growth. Improving profitability is the Company's number one goal.

We believe the electronics industry will continue to be a vibrant, growing sector of the economy. Within that envelope of growth, though, there is considerable turmoil. The personal computer and workstation industries -- among the fastest-growing and largest segments of the electronics industry -- experienced radical and permanent changes. The broad acceptance of open operating systems and computer standards turned many computers into low-priced commodities. Since the computer industry accounts for about 70% of our revenues, these changes caused a chain reaction that affected us directly.

The highly regarded ComputerLetter newsletter described the turn of events this way: "The era of the commodity computer has arrived, and those who don't adapt will pass from the scene like so many dinosaurs."

LSI Logic is adapting in real time.

Ultimately, we are in business to serve the customer, and our product strategy is aimed at helping customers define, modify and differentiate their products. However, as 1991 progressed, it became increasingly clear that we needed to reshape our long-term financial model to be more consistent with changing trends in the industry.

The computer industry spent much of 1991 adjusting to lower prices and tighter cost controls. We had to make adjustments ourselves. We had to be leaner, more productive, more responsive and consistently profitable. There were no alternatives.

Our actions have been both short- and long-term in nature. We have reduced the workforce, taken forced vacations during slow periods, delayed pay increases and pared budgets for selling, general and administrative expenses. We also delayed the opening of a factory in Japan by one year, and reduced the workforce at our assembly and test facility in Germany.

The Company also focused on strategic, leading-edge manufacturing capacity, and de-emphasized older capacity. We closed a non-competitive factory in the United Kingdom and discontinued wafer manufacturing in Canada. We dropped our dues-paying membership in Sematech because we weren't getting an appropriate return on our investment from the research consortium. However, we increased our internal R&D spending by 34%, and invested in a submicron R&D pilot line in California. All in all, we lowered our breakeven point by roughly 15%.

We articulated a goal in 1991 to at least break even in tough times, and to make acceptable and consistent levels of profit in good times. We are focused on the business fundamentals that will allow us to profitably serve the changing needs of the worldwide electronics industry.

First and foremost, we are focused on creating a quality company; the number of employee-led quality improvement groups increased nearly three-fold in 1991, and their work made the Company more responsive to the needs of customers. In this regard, we are fundamentally rethinking the Corporation. We are systematically improving quality and service as a means to improve customer satisfaction. In 1991, factory cycle times improved 59%, prototype cycle time improved 13% and lead times to customers were cut by 40%.

We invested 12% of revenues on R&D, and one result is a leading-edge 0.7-micron, three-layer metal CMOS process technology. We also created ASIC circuits with a record 800,000 usable transistors on a chip, and paved the way for even more highly integrated ASIC products in 1992. Also created were Concurrent Modular Design Environment (C-MDE) and Silicon 1076 design automation tools used by customer engineers as well as our own engineers to develop advanced chips and systems. Booking for new customer designs set a record in 1991. With design automation tools comes silicon offspring. We developed more than 30 new silicon products, including customized ASIC families, 32-bit RISC-based SPARC microprocessors, 32- and 64-bit MIPS microprocessors, embedded controllers, X-terminal processors, graphics accelerators, graphics bus products, PC chipsets, digital signal processing products and other system-level products that add value for our customers. We also have emerged as a leader in the fast-growing area of video compression, with products at the cutting edge of MPEG (full motion), JPEG (still picture), and H.261 (video teleconferencing) standards. Design wins in these areas exceeded our expectations.

In total, product families that began shipping in 1990 accounted for approximately 70% of 1991 revenues. We are controlling our destiny and creating our future with new products. The Company formed a new CoreWare division at the end of 1991 to promote the use of high-level building block "cores" such as RISC microprocessors to make it possible to create a system on a chip.

In recognition of our advanced technology and broad product portfolio, LSI Logic was awarded several key design programs in 1991:

LSI Logic was the only U.S.-based company selected to participate in two high-definition television (HDTV) projects in Japan. Sanyo Electric and LSI Logic announced a joint development agreement to design the core of an HDTV system, and a consortium led by Matsushita and NEC picked LSI Logic to help design an HDTV system.

In Europe, LSI Logic was designed into synchronous optical network (SONET) programs intended to enable all Europeans to communicate over a standardized telecommunications system. In addition, the Company's technology was incorporated in designs for three separate portable telephone projects. Also, LSI Logic's video compression technology was selected as the basis for a new generation of video phones.

In North America, after a long evaluation process, the Radar Systems Group of Hughes Aircraft Company selected LSI Logic as its strategic partner and "supplier-of-choice" for future ASIC requirements.

What lies ahead for 1992? We believe the semiconductor industry will experience a healthy growth rate over the long term, but it is difficult to predict the course of events in any single year. For that reason, we don't intend to add infrastructure or employees in advance of an industry upturn that may, in the end, prove less robust than anticipated. Instead, we are keeping a lid on costs to gain maximum earnings leverage from any increase in revenues.

We approach 1992 with a renewed sense of mission. We will focus on improving quality, accelerating the pace of new technologies, designing innovative products, increasing productivity and, of course, improving profits -- all to serve our customers, shareholders and employees alike. Our employees -- ever a hard-working and dedicated group -- are driving the changes at LSI Logic.

Sincerely,

Wilfred J. Corrigan Chairman and Chief Executive Officer

RECENT SEC FILINGS

The documents listed below were filed by the company with the Securities and Exchange Commission on the date indicated. A description of each document type is provided at the end of this section.

To order the SEC documents listed below please check the box next to the desired title, complete the attached **Order Form**, and fax both pages to the number provided on the **Order Form**.

DOCUMENT	DATE FILED
☐ 10-Q	06/28/92
☐ Proxy	03/30/92
☐ 10-Q	03/29/92
☐ Annual Report to Shareholders	12/31/91
☐ 10-K	12/29/91
☐ 10-Q	09/29/91
☐ Registration	07/31/91
☐ 10-Q	06/30/91
☐ 10-Q	03/31/91
☐ Proxy	03/28/91
☐ Annual Report to Shareholders	12/31/90
☐ 10-K	12/30/90

EXPLANATION OF SEC FILINGS

Annual Report to Shareholders Annual business summary with financial report. Not Required by the SEC.

10-K Audited annual financial report. Required by the SEC. Filing Deadline is 90 days after fiscal year end.

10-Q Unaudited quarterly financial report. Required by the SEC. Filing Deadline is 45 days after the end of each quarter.

8-K Report of unscheduled material events or corporate changes deemed of importance to shareholders or to the SEC. Filing deadline is within 15 working days of the event described.

Registration Statement Filed to register securities before they are offered to investors, or to permit trading among investors on a securities or in the OTC market. Contains a preliminary prospectus.

Proxy Provides official notification to designated classes of shareholders of matters to be brought to a vote at a shareholders meeting.

RECENT MAGAZINE ARTICLES

To order reprints of the articles listed below please check the box next to the desired title, complete the attached **Order Form**, and fax both pages to the number provided on the order form.

- ☐ **Firm Uses Fractional T-1 to Tie Int'l Sites** *Network World* Vol. 8, Iss. 14, Apr 8, 1991; pp. 25,28. #91-19153

- ☐ **Prophet Without Profit** *Financial World* Vol. 159, Iss. 20, Oct 2, 1990; pp. 53-55. #90-41801

- ☐ **Regional Networks and the Resurgence of Silicon Valley** *California Mgmt Review* Vol. 33, Iss. 1, Fall 1990; pp. 89-112. #91-06747

- ☐ **ASICs - Forcing Change in Silicon Chip Technology** *Management Accounting (UK)* Vol. 68, Iss. 6, Jun 1990; pp. 22-23. #91-27167

- ☐ **Arrays with 100,000 Gates Shrink Systems to Silicon** *ESD: The Electronic System Design Magazine* Vol. 18, Iss. 1, Jan 1988; pp. 26,28. #88-09469

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LSI LOGIC

NEWS RELEASE

FOR IMMEDIATE RELEASE

FOR MORE INFORMATION
CONTACT BRUCE ENTIN 408-433-4067

Jenny Pls File with the LSI Logic Vendor Profile in my Vendor Profile Book Tnx Kz

CC92-266

LSI LOGIC CORPORATION ANNOUNCES STRATEGIC RESTRUCTURING

MILPITAS, California, August 21, 1992 -- LSI Logic Corporation today announced that, in order to pursue a major shift in strategic direction, it will take a restructuring charge in the range of $95-110 million that will result in a net loss of more than $100 million, or more than $2 a share in the third quarter ended September 27, 1992.

The non-recurring charge includes costs associated with the phase-out of the company's Braunschweig, Germany assembly and test operations; the write-down of certain manufacturing assets, and inventory related to commodity products; the write-off of certain U.S. manufacturing assets made redundant through a strategic consolidation of the company's manufacturing operations; severance costs; and certain other costs.

As a result of the restructuring, the company expects to reduce the company's manufacturing and operating costs by approximately $10 million per quarter. Assuming the company will achieve planned revenue levels, LSI Logic expects to return to profitability in the fourth quarter of 1992.

"LSI Logic is taking the bold steps necessary to make the company more competitive now and into the mid-1990s," said Wilfred J. Corrigan, chairman and chief executive officer.

"The company is accelerating the phaseout of older process technologies, increasing the role of the Far East for high volume wafer manufacturing and assembly and test, and relying upon subcontractors and other outside sources to satisfy an increased portion of the company's future capacity requirements.

more........

Over the next 18 months, the U.S. manufacturing operations will be refocused on low-volume, fast turnaround production, and pilot line manufacturing using newly introduced technologies. The U.S. also will continue as the center for the corporation's research and development efforts. The restructuring of the U.S. operations involves the preparation over the next 18 months for a shift of the majority of sub-micron volume manufacturing to the company's manufacturing complex in Japan.

Mr. Corrigan said, "The company has been burdened with the effects of older, excess capacity and high operating costs that have obscured the true profitability of its product portfolio. The actions taken today include the phase down of an assembly and test facility in Germany and the reduction of approximately 175 U.S. overhead employees . Over time, the worldwide workforce will be adjusted in accordance with the changes anticipated for the company's manufacturing requirements.

LSI Logic also intends to de-emphasize commodity standard products that are currently unprofitable. The company announced that its PC chipset operation, Headland Technology, is being downsized from a separate organization into a focused semiconductor product line whose products will be sold by the LSI Logic salesforce. The corporation announced earlier this week that it sold the Video Seven assets of Headland, as the graphics board business is no longer consistent with LSI's product strategy.

"The chipset market is fiercely competitive, and characterized by severe price cutting. Our aim, Mr. Corrigan said, "is to reduce expenses associated with the chipset business, and target the product line primarily towards high-margin graphics applications and high-performance portions of the core logic market."

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In disoussing the corporation's product strategy overall, Mr. Corrigan said, "The company is embarking on a new product cycle, fueled in part by its new .60-micron CMOS process technology, and its predecessor .70-micron CMOS process. The .60-micron technology is the foundation for a new 300K family of application-specific integrated circuits (ASICs) that have the capacity to hold up to 2.4 million transistors on a single chip. By capitalizing upon this chip density, as well as ASIC design methodology, LSI Logic's product strategy is to integrate electronic systems on a single chip. The company's approach is to integrate building-block cores of intellectual property on a single chip as a means to penetrate targeted vertical markets.

Commenting on the restructuring and the reduction in the workforce, LSI Logic chairman and chief executive Wilfred J. Corrigan, said, "The reality is that our cost structure is out of line with the current level of revenues, and we are compelled to reduce costs, and do it quickly. We are committed to lowering our breakeven point, restoring profitability, and pursuing a value-added product strategy with emphasis on intellectual property, ASIC design tools and system-level integration."

Regarding the actions taken in Germany, Mr. Corrigan said, "The assembly and test factory was built on the assumption that it could achieve certain operating efficiencies based upon expected strong demand from the European computer industry. However, the anticipated level of demand never materialized. In addition, the significant rise in the value of the Deutschmark over the last five years has made the factory more costly to operate. As a result, while the factory has leading-edge assembly and test capabilities, it is not now as cost efficient as subcontractors in the Far East."

In a larger manufacturing context, Mr. Corrigan added, "Following completion of the new joint-venture wafer factory in Japan in 1993, LSI Logic does not foresee the need to build new wholly owned plant capacity. The company is exploring strategic partnerships to satisfy some portion of its capacity needs beyond the 1995 timeframe."

more........

Commenting on the current business environment, Mr. Corrigan said, "It is difficult to predict how robust new orders will be for the entire third quarter, but new orders in July were at the highest dollar level in 16 months." Orders in July this year increased approximately 30% from the same month a year ago. Design activity has been strong throughout the first half of the year.

LSI Logic Corporation (NYSE:LSI) is a Fortune 500 supplier of high-performance semiconductors, employing people in the United States, Europe, Japan, and Canada. The company manufactures and markets 32-bit MIPS and SPARC RISC microprocessors, application-specific integrated circuits (ASICs), a growing line of electronic imaging and digital signal-processing ICs, and chipsets and graphics products for IBM compatible personal computers. The company also develops and sells design software. LSI Logic is headquartered in Milpitas, California (95035) at 1551 McCarthy Blvd.

LSI LOGIC CORPORATION
1551 McCarthy Blvd.
Milpitas, CA 95035

FOR:

Fax: 437-0292

Name: Jerry Banks
Company: Dataquest
Phone: 437-8677

FROM:

Gary Bonham
Phone: 408/433-4070
Fax: 408-433-7715

Page 1 of 5 Pages
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Jerry -
Rich is ill
& we need to get
started on DQ Monday.
Would you comment
on this?
Mary

Jerry B.

BW470 AUG 24,1992 6:14 PACIFIC 9:14 EASTERN

(BW)(LSI-LOGIC-CORP-RPT)(LSI) LSI Logic Corp. announces strategic restructuring

Business Editors & Computer/Electronics Writers
REPEATING LATE FRIDAY TRANSMISSION...

MILPITAS, Calif.--(BUSINESS WIRE)--LSI Logic Corp. (NYSE:LSI) Friday annouced that, in order to pursue a major shift in strategic direction, it will take a restructuring charge in the range of $95-$110 million that will result in a net loss of more than $100 million, or more than $2 a share in the third quarter ended Sept. 27, 1992.

The non-recurring charge includes costs associated with the phase-out of the company's Braunschweig, Germany, assembly and test operations; the write-down of certain manufacturing assets, and inventory related to commodity products; the write-off of certain U.S. manufacturing assets made redundant through a strategic consolidation of the company's manufacturing operations; severance costs; and certain other costs.

As a result of the restructuring, the company expects to reduce the company's manufacturing and operating costs by approximately $10 million per quarter. Assuming the company will achieve planned revenue levels, LSI Logic expects to return to profitability in the fourth quarter of 1992.

''LSI Logic is taking the bold steps necessary to make the company more competitive now and into the mid-1990s,'' said Wilfred J. Corrigan, chairman and chief executive officer.

''The company is accelerating the phaseout of older process technologies, increasing the role of the Far East for high-volume wafer manufacturing and assembly and test, and relying upon subcontractors and other outside sources to satisfy an increased portion of the company's future capacity requirements.''

Over the next 18 months, the U.S. manufacturing operations will be refocused on low-volume, fast turnaround production, and pilot line manufacturing using newly introduced technologies. The United States also will continue as the center for the corporation's research and development efforts. The restructuring of the U.S. operations involves the preparation over the next 18 months for a shift of the majority of sub-micron volume manufacturing to the company's manufacturing complex in Japan.

Corrigan said: ''The company has been burdened with the effects of older, excess capacity and high operating costs that have obscured the true profitability of its product portfolio. The actions taken today include the phase down of an assembly and test facility in Germany and the reduction of approximately 175 overhead employees or 4 percent of the worldwide workforce. Over time, the workforce will be adjusted in accordance with the changes anticipated for the company's manufacturing requirements.''

LSI Logic also intends to de-emphasize commodity standard products that are currently unprofitable. The company announced that its PC chipset operation, Headland Technology, is being downsized from a ersonal computers. The company also develops and sells design software. LSI Logic has headquarters in Milpitas, Calif., 95035, at 1551 McCarthy Blvd.

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CONTACT: LSI Logic Corp., Milpitas
Bruce Entin, 408/433-4067

KEYWORD: CALIFORNIA
INDUSTRY KEYWORD: COMPUTERS/ELECTRONICS

REPEATS: New York 212-575-8822 or 800-221-2462; Boston 617-330-5311 or parate organization into a focused semiconductor product line whose products will be sold by the LSI Logic salesforce. The corporation announced earlier this week that it sold the Video Seven assets of Headland, as the graphics board business is no longer consistent with LSI's product strategy.

''The chipset market is fiercely competitive, and characterized by severe price cutting. Our aim,'' Corrigan said, ''is to reduce expenses associated with the chipset business, and target the product line primarily toward high-margin graphics applications and high-performance portions of the core logic market.''

In discussing the corporation's product strategy overall, Corrigan said: ''The company is embarking on a new product cycle, fueled in part by its new .60-micron CMOS process technology, and its predecessor .70-micron CMOS process. The .60-micron technology is the foundation for a new 300K family of application-specific integrated circuits (ASICs) that have the capacity to hold up to 2.4 million transistors on a single chip. By capitalizing upon this chip density, as well as ASIC design methodology, LSI Logic's product strategy is to integrate electronic systems on a single chip. The company's approach is to integrate building-block cores of intellectual property on a single chip as a means to penetrate targeted vertical markets.''

Commenting on the restructuring and the reduction in the workforce, Corrigan said: ''The reality is that our cost structure is out of line with the current level of revenues and we are compelled to reduce costs, and do it quickly. We are committed to lowering our eakeven point, restoring profitability, and pursuing a value-added roduct strategy with emphasis on intellectual property, ASIC design tools and system-level integration.''

Regarding the actions taken in Germany, Corrigan said: ''The assmbly and test factory was built on the assumption that it could achieve certain operating efficiencies based upon expected strong demand from the European computer industry. However, the anticipated level of demand never materialized. In addition, the significant rise in the value of the Deutschmark over the last five years has made the factory more costly to operate. As a result, while the factory has leading-edge assembly and test capabilities, it is not now as cost efficient as subcontractors in the Far East.''

In a larger manufacturing context, Corrigan added: ''Following completion of the new joint-venture wafer factory in Japan in 1993, LSI Logic does not forsee the need to build new wholly owned plant capacity. The company is exploring strategic partnerships to satisfy some portion of its capacity needs beyond the 1995 timeframe.''

Commenting on the current business environment, Corrigan said: ''It is difficult to predict how robust new orders will be for the entire third quarter, but new orders in July were at the highest dollar level in 16 months.'' Orders in July this year increased approximately 30 percent from the same month a year ago. Design activity has been strong throughout the first half of the year.

LSI Logic Corp. is a Fortune 500 supplier of high-performance semiconductors, employing people in the United States, Europe, Japan d Canada. The company manufactures and markets 32-bit MIPS and SPARC SC microprocessors, application-specific integrated circuits (ASICs), a growing line of electronic imaging and digital signal processing ICs, and chipsets and graphics products for IBM compatible

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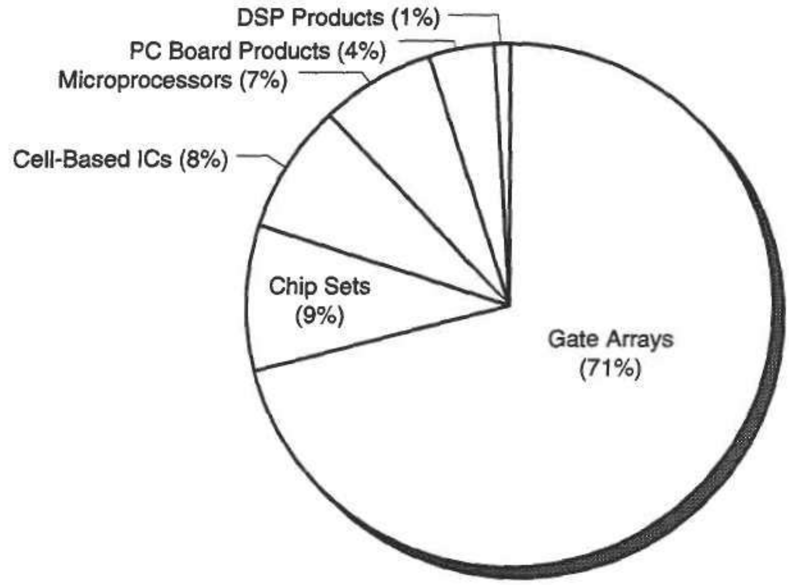

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In April 1992, LSI Logic announced the industry's first cell-based IC product line based on a 0.6-micron drawn CMOS process with up to 600,000 gates. Table 5 shows a summary of LSI Logic's cell-based IC product offering.

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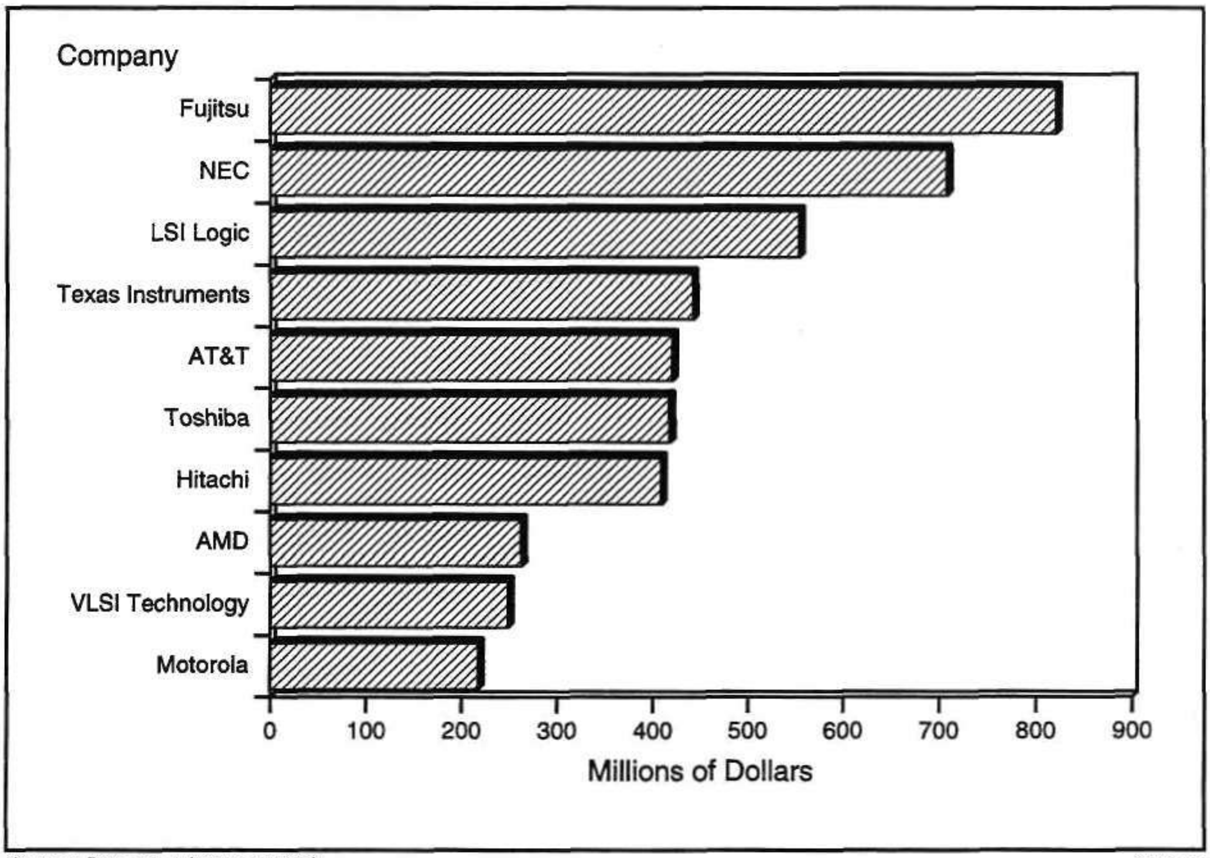

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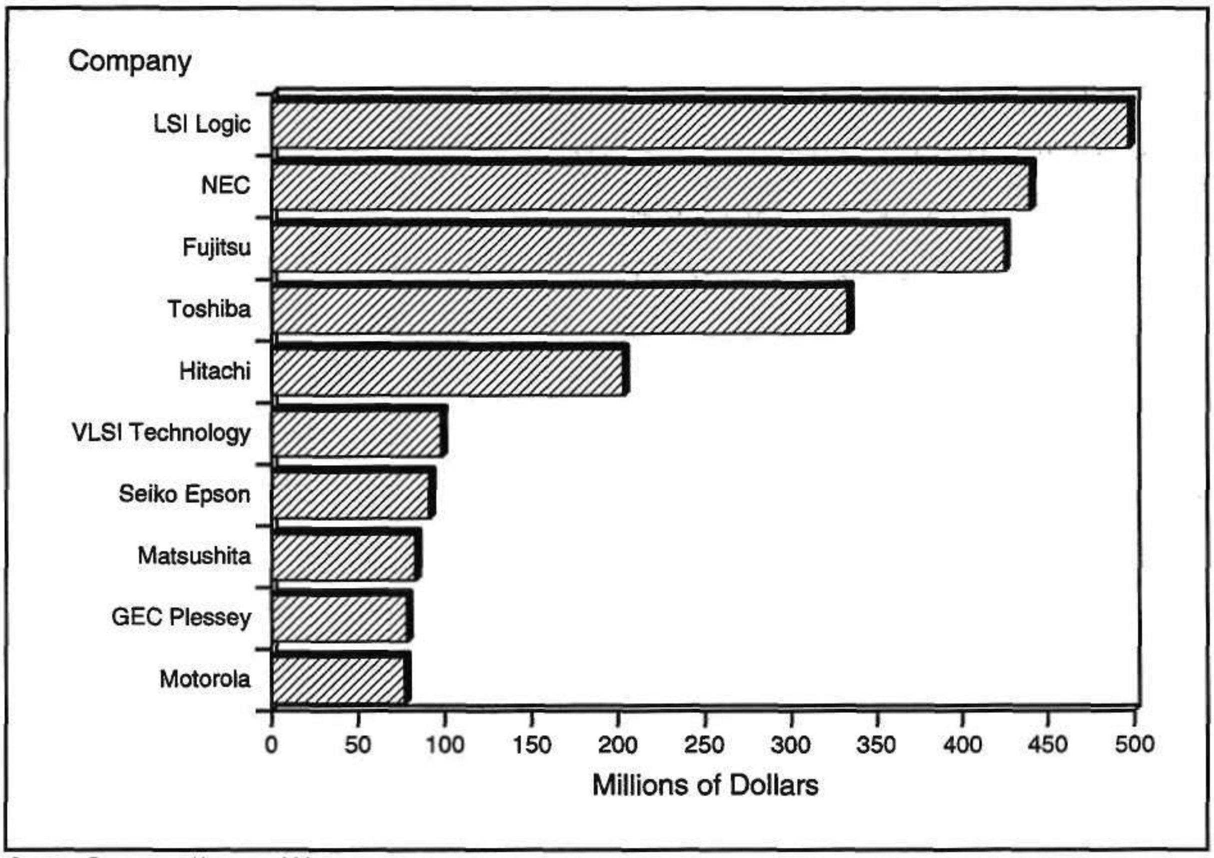

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Competition

The leading ASIC suppliers shown in Figure 2 and Figure 3 can be grouped into three basic categories, as follows:

- Vertically integrated system suppliers that manufacture ASICs (that is, Fujitsu, NEC, Toshiba, and AT&T)
- Broad-based semiconductor suppliers that manufacture ASICs (that is, Texas Instruments and Motorola)
- Focused ASIC manufacturers with fabs (that is, LSI Logic and VLSI Technology)

Vertically integrated system suppliers use ASIC technology as a competitive weapon for internal system design. This type of supplier wields a powerful advantage over other ASIC suppliers in the merchant ASIC market for two reasons. First, large vertically integrated system suppliers typically boast the most efficient manufacturing, which stems from economies of scale in manufacturing. In short, they have both large internal and merchant consumption, which enables greater amortization of development costs. Furthermore, they are often broad-based semiconductor suppliers, which provides an added advantage in allowing them to amortize their manufacturing costs across standard products as well as ASICs. This clearly gives them a highly competitive cost structure. Second, they have a large amount of in-house system expertise available to develop advanced ASIC cell libraries. In our view, these suppliers are well positioned to capitalize on the merchant ASIC market.

Broad-based semiconductor suppliers, however, develop ASICs to defend their semiconductor business. They have a cost structure that is somewhat less imposing because manufacturing costs can be amortized across both standard products (for example, DRAMs) and ASICs. However, they do not have the internal consumption necessary to reduce their merchant manufacturing cost structure. Therefore, their cost structure is typically less favorable than that of vertically integrated suppliers, but more favorable than that of focused ASIC suppliers with fabs.

Focused ASIC suppliers with fabs are in the most difficult position. They must find ways to maintain fab capacity to achieve a profitable cost structure as well as invest in the following areas:

- Development of next-generation manufacturing processes
- Development of next-generation products
- Development of dedicated macrocell libraries
- Development of a competitive EDA environment

As with ASICs or any other device of the semiconductor industry, the main goal in having a manufacturing facility with fab, assemble, and test is to keep all parts of the process running at full capacity. Concerning LSI Logic's assembly and test (A&T) operation in Germany, this has surely not been the case. It was originally planned to support the computer industry in Europe, and the goal was for it to reach high levels of efficiency. The hard reality is that the computer market in Germany and other parts of Europe has been in a recession for two years and this facility became a very expensive operation. This will not be an easy one to unload, because there is significant excess A&T capacity in Europe and the Asians have far lower cost structures.

LSI Logic's new fab strategy of exercising its soon-to-be-completed joint venture fab with Kawasaki Steel is a smart one, but it will test the communications and planning skills of the senior production management based in Milpitas. Also, LSI Logic now plans to utilize foundries and other partnerships to fill gaps in capacity.

In our view, partnerships are extremely critical for focused ASIC suppliers that have fabs. They typically do not have the R&D budgets required to develop all the areas of concern, such as the next-generation processes. Even more problematic, the cost of a state-of-the-art fab continues to rise at an increasing rate. A complete 0.8-micron diffusion ASIC fab costs about $200 million, requiring very high volume production to support it.

Dataquest Perspective

Consistent profitability is clearly a challenging goal for LSI Logic. With the U.S. economy struggling through a slow recovery and the Japan economy in a severe recession, the challenge is even greater.

In our view, the No. 1 problem that LSI Logic must solve to achieve consistent profitability is reshaping its long-term manufacturing cost model. Clearly it has taken some bold steps with its August 21 release. Although LSI Logic has a strong product offering, it does not have the economies of scale required to remain cost-competitive considering the competition and the rising costs associated with state-of-the-art fabs.

Even though management has taken significant steps to reduct costs and redirect its strategic direction, we believe that LSI Logic still has to drive costs lower until it has its new joint venture fab completed in 1993. But in the meantime current costs are too high and geometries are too large to successfully compete with the likes of NEC and Fujitsu.

LSI Logic must move quickly to establish the other partnerships required to compete in the future. LSI Logic has a strong bargaining position when forming these alliances because it has much to offer, including the following:

- Competitive proprietary CAD tools
- Robust dedicated cell libraries
- Solid test and packaging capabilities
- Large customer base
- Very experienced fab partner in Kawasaki Steel

Dataquest believes that LSI Logic has a good understanding of the issues it faces and has made short- and long-term moves toward improving profitability. Wilf Corrigan's track record demonstrates that once he sets his sights on an objective and becomes personally involved—and stays involved—success is achieved.

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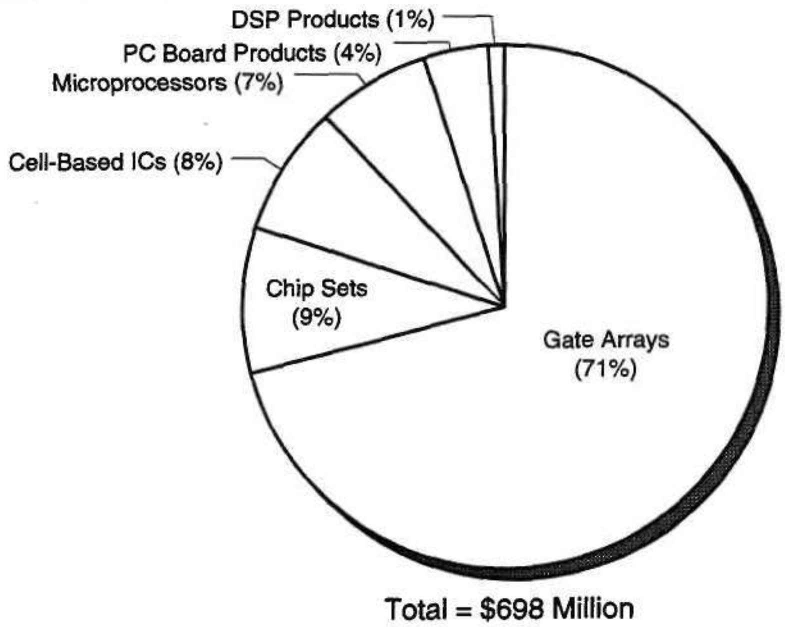

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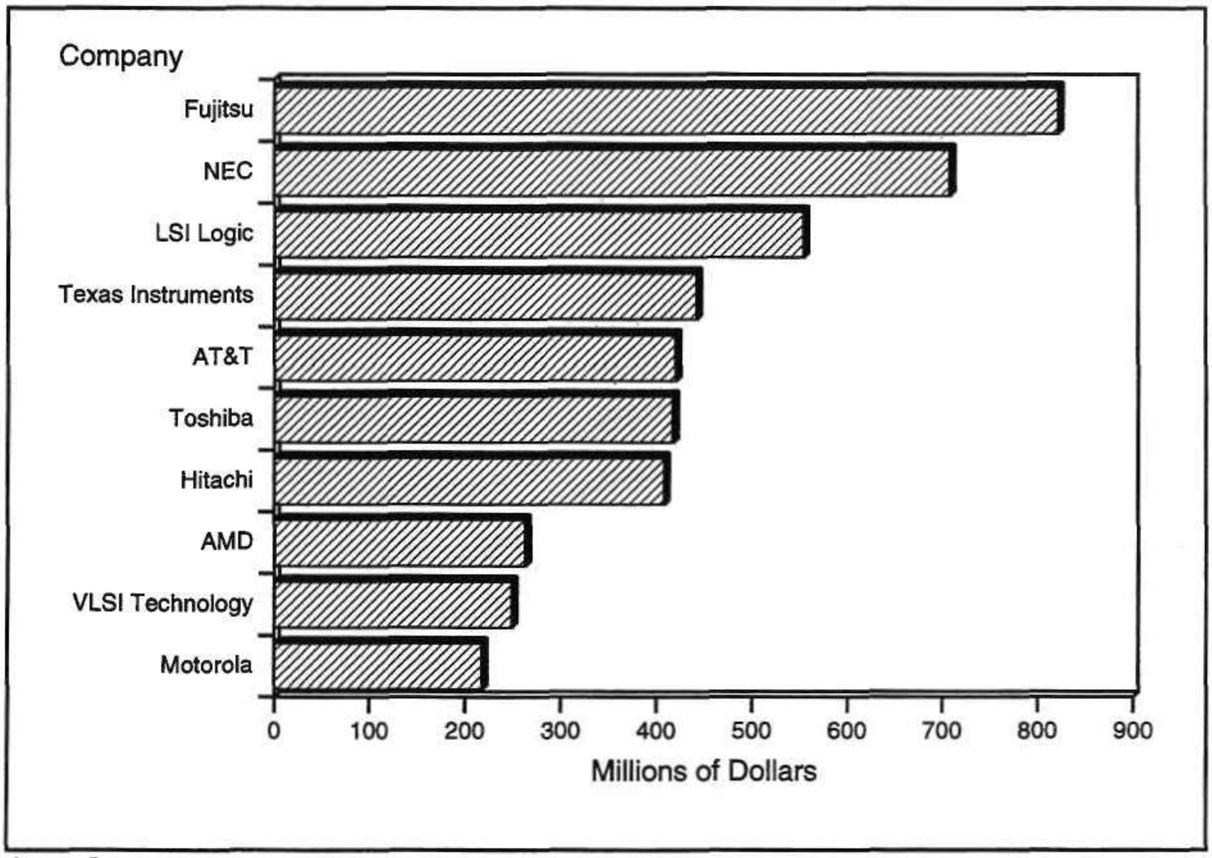

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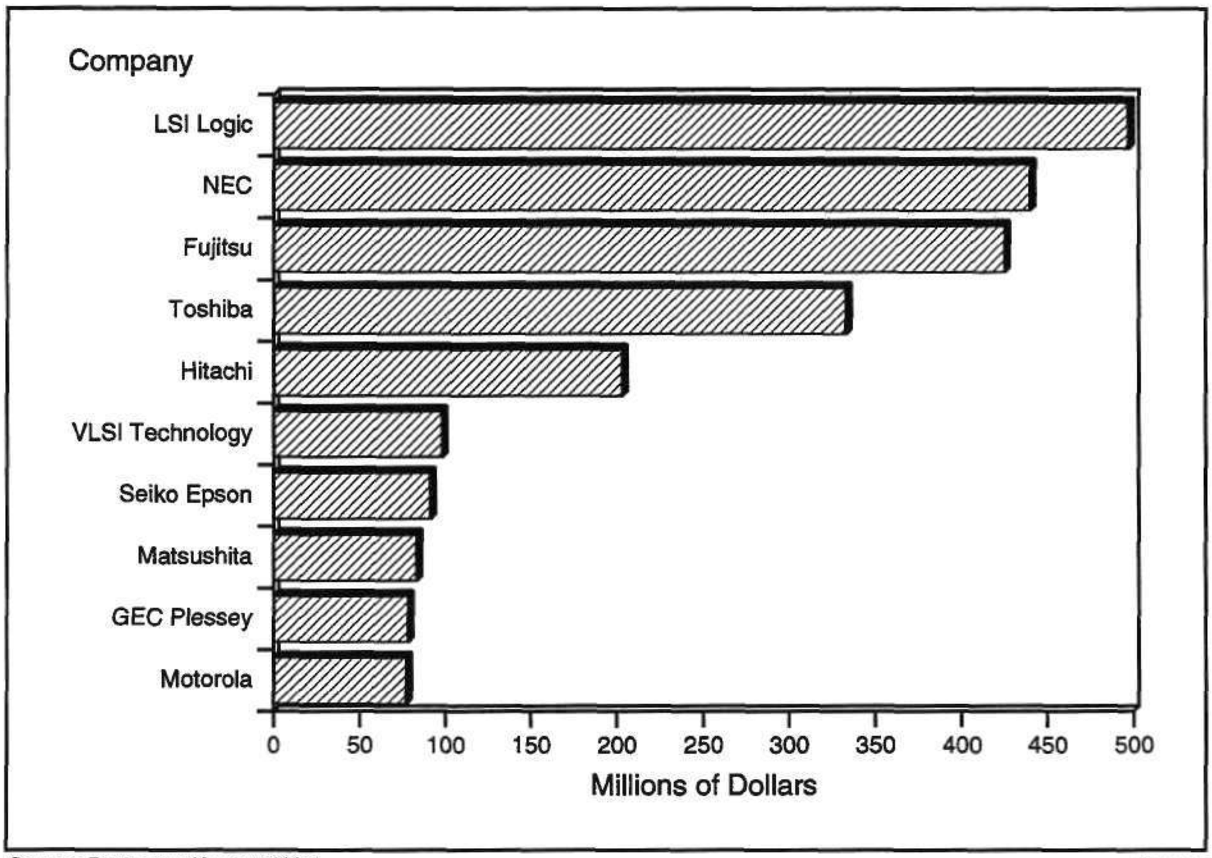

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The leading ASIC suppliers shown in Figure 2 and Figure 3 can be grouped into three basic categories, as follows:

- Vertically integrated system suppliers that manufacture ASICs (that is, Fujitsu, NEC, Toshiba, and AT&T)
- Broad-based semiconductor suppliers that manufacture ASICs (that is, Texas Instruments and Motorola)
- Focused ASIC manufacturers with fabs (that is, LSI Logic and VLSI Technology)

Vertically integrated system suppliers use ASIC technology as a competitive weapon for internal system design. This type of supplier wields a powerful advantage over other ASIC suppliers in the merchant ASIC market for two reasons. First, large vertically integrated system suppliers typically boast the most efficient manufacturing, which stems from economies of scale in manufacturing. In short, they have both large internal and merchant consumption, which enables greater amortization of development costs. Furthermore, they are often broad-based semiconductor suppliers, which provides an added advantage in allowing them to amortize their manufacturing costs across standard products as well as ASICs. This clearly gives them a highly competitive cost structure. Second, they have a large amount of in-house system expertise available to develop advanced ASIC cell libraries. In our view, these suppliers are well positioned to capitalize on the merchant ASIC market.

Broad-based semiconductor suppliers, however, develop ASICs to defend their semiconductor business. They have a cost structure that is somewhat less imposing because manufacturing costs can be amortized across both standard products (for example, DRAMs) and ASICs. However, they do not have the internal consumption necessary to reduce their merchant manufacturing cost structure. Therefore, their cost structure is typically less favorable than that of vertically integrated suppliers, but more favorable than that of focused ASIC suppliers with fabs.

Focused ASIC suppliers with fabs are in the most difficult position. They must find ways to maintain fab capacity to achieve a profitable cost structure as well as invest in the following areas:

- Development of next-generation manufacturing processes
- Development of next-generation products
- Development of dedicated macrocell libraries
- Development of a competitive EDA environment

As with ASICs or any other device of the semiconductor industry, the main goal in having a manufacturing facility with fab, assemble, and test is to keep all parts of the process running at full capacity. Concerning LSI Logic's assembly and test (A&T) operation in Germany, this has surely not been the case. It was originally planned to support the computer industry in Europe, and the goal was for it to reach high levels of efficiency. The hard reality is that the computer market in Germany and other parts of Europe has been in a recession for two years and this facility became a very expensive operation. This will not be an easy one to unload, because there is significant excess A&T capacity in Europe and the Asians have far lower cost structures.

LSI Logic's new fab strategy of exercising its soon-to-be-completed joint venture fab with Kawasaki Steel is a smart one, but it will test the communications and planning skills of the senior production management based in Milpitas. Also, LSI Logic now plans to utilize foundries and other partnerships to fill gaps in capacity.

In our view, partnerships are extremely critical for focused ASIC suppliers that have fabs. They typically do not have the R&D budgets required to develop all the areas of concern, such as the next-generation processes. Even more problematic, the cost of a state-of-the-art fab continues to rise at an increasing rate. A complete 0.8-micron diffusion ASIC fab costs about $200 million, requiring very high volume production to support it.

Dataquest Perspective

Consistent profitability is clearly a challenging goal for LSI Logic. With the U.S. economy struggling through a slow recovery and the Japan economy in a severe recession, the challenge is even greater.

In our view, the No. 1 problem that LSI Logic must solve to achieve consistent profitability is reshaping its long-term manufacturing cost model. Clearly it has taken some bold steps with its August 21 release. Although LSI Logic has a strong product offering, it does not have the economies of scale required to remain cost-competitive considering the competition and the rising costs associated with state-of-the-art fabs.

Even though management has taken significant steps to reduct costs and redirect its strategic direction, we believe that LSI Logic still has to drive costs lower until it has its new joint venture fab completed in 1993. But in the meantime current costs are too high and geometries are too large to successfully compete with the likes of NEC and Fujitsu.

LSI Logic must move quickly to establish the other partnerships required to compete in the future. LSI Logic has a strong bargaining position when forming these alliances because it has much to offer, including the following:

- Competitive proprietary CAD tools
- Robust dedicated cell libraries
- Solid test and packaging capabilities
- Large customer base
- Very experienced fab partner in Kawasaki Steel

Dataquest believes that LSI Logic has a good understanding of the issues it faces and has made short- and long-term moves toward improving profitability. Wilf Corrigan's track record demonstrates that once he sets his sights on an objective and becomes personally involved–and stays involved—success is achieved.

Dataquest Vendor Profile

Semiconductor Procurement *Worldwide*
August 31, 1992

Linear Technology Corporation

Corporate Statistics

Corporate Headquarters	Milpitas, California
President and CEO	Robert H. Swanson Jr.
Vice President and Chief Operating Officer	Clive B. Davies
Fiscal 1992 Revenue	$120 million
Total Assets	$159.8 million
Stockholders Equity	$123.5 million
Number of Employees Worldwide	814
Revenue per Employee	$147,400
Number of Offices Worldwide	13
Number of U.S. Offices	6
Fiscal Year	July to June
Year Founded	1981

Corporate Overview

Linear Technology Corporation designs, manufactures, and markets high-performance analog ICs targeted for computer, industrial, telecommunications, and military applications. The company was founded in 1981 on a business plan that called for revenue to reach $99 million and profits of $13 million toward the end of the decade. The incredibly prescient result was fiscal year 1991 revenue of $94 million and profits of $17 million. A more recent result is revenue of $120 million for fiscal year ending June 28, 1992—and income of $25 million.

The backdrop question to this company profile is whether Linear Technology, which remains relatively small in the face of giant worldwide analog IC suppliers such as SGS-Thomson, Toshiba, and National Semiconductor, can sustain the kind of growth and success during the 1990s that it achieved during the 1980s. Framing the question more ominously, will this $100 million supplier lose the battle to billion-dollar-plus competitors and disappear later this decade? The perspective of Professor Carver Mead of the California Institute of Technology should be kept in mind. He believes that analog technology will be to this decade and the next what digital technology meant to the industry during the 1970s and 1980s.

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Dataquest
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Organization

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- Robert H. Swanson, Jr., president and chief executive officer
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In terms of management stability, which is a critical element to most companies' future prospects but especially so to a relatively young supplier such as this, Robert Swanson and Robert Dobkin were two of the original five founders of the company. The employee base increased to 814 employees as of June 1992 versus 729 as of June 1991. The strong engineering teams (design, test, and process) and manufacturing teams have also remained quite stable.

Business and Economic Conditions

This section provides the world economic background against which Linear Technology will operate during 1992 and 1993. As the semiconductor industry has matured, the marketplace—including the analog segment—has moved more into synchronization with general economic trends vis-a-vis the somewhat countercyclical pattern during the 1970s and early 1980s. For example, demand for commodity-type linear ICs such as operational amplifiers and voltage regulators now conforms largely to general economic cycles. Even so, more specialized analog parts such as mixed-signal ICs and high-performance operational amplifiers—which exemplify some of Linear Technology's key product technologies—typically outpace general rates of growth.

Linear Technology has pursued a global sales strategy. Dataquest estimates that Linear Technology's worldwide analog revenue as of calendar year 1991 derived from four regions: North America—58 percent; Europe—20 percent; Japan—12 percent; and Rest of World/Asia—10 percent. The strategy calls for continuing expansion (for example, offices) of global sales support.

The worldwide economy continues to show mixed results as of the second half of 1992. The Dun & Bradstreet Corporation forecasts an improving outlook for Linear Technology's key geographic markets. For example, the U.S., Canadian, and U.K. economies are expected to recover from the recession in 1992, although in quite modest fashion.

Real gross domestic product (GDP) is expected to expand 2.1, 1.6, and 0.5 percent, respectively, in 1992. Expansion should increase to 2.5, 4.0, and 2.2 percent, respectively, in 1993.

Another example is as follows: Real GDP growth is expected to decelerate in Germany and Japan during 1992, from 3.2 percent in 1991 to 1.1 percent and from 4.4 percent in 1991 to 2.0 percent, respectively. The respective economies are expected to reaccelerate to 2.8 percent and 3.3 percent growth in 1993.

Application Markets Strategy

Overall, worldwide electronic systems production is expected to expand 3.1 percent in 1992, slightly faster than the 2.4 percent rate of growth in 1991. For Linear Technology—which has performed well under global recessionary conditions—this outlook should mean market momentum. Worldwide expansion is expected to accelerate further in 1993 to 7.6 percent as the worldwide economic climate improves.

The emerging host of battery-powered applications represents a key market opportunity for Linear Technology. From an application-market perspective that focuses on Linear Technology's target markets, the forecast makes the following series of assumptions.

The Computer Market—Poised for Recovery?

Data processing production—which marks an estimated 25 percent of Linear Technology's business as of calendar year 1991—should make a moderate 2.6 percent recovery in 1992, after a depressing 2.2 percent decline in 1991. Key system applications in this marketplace for Linear Technology include desktop PCs, laptop PCs, disk drives, modems, monitors, plotters, and printers, along with an increased emphasis on switching power supplies.

In North America, recovery in the computer and other markets will continue into 1993 as economic conditions continue to improve and stabilize. In Europe—which is Linear Technology's second largest market—local content regulations are spurring the placement of production facilities, helping explain a boost of growth expected for 1993. Nevertheless, the specter of trade friction pervades that region.

The Japanese economy, including the computer segment—which is Linear Technology's third largest marketplace—will remain hemmed in for the remainder of 1992, as business and households adjust downward their spending plans in response to the lackluster business climate. However, Japan should be back on the path of normal growth during 1993 and beyond, and growth in Japan should resume a more sustainable pace once facilities are in place. Production prospects in the Asia/Pacific region, a growth market for Linear Technology, remain upbeat because this region has become the choice for mass manufacturing of established technologies such as PCs.

A Challenge—The Industrial Market Downturn

There are no free lunches or stress-free paths to success, even for bright stars such as Linear Technology. A major challenge is that production of industrial equipment has borne the brunt of the recent downturn in business conditions, especially in North America. For Linear Technology, industrial applications account for more than 30 percent of IC revenue for 1991. Leading applications for Linear Technology's products in this segment include industrial process control systems such as for flow metering or energy management. Instrumentation systems such as medical scanners (EKG and CAT) and test equipment are other key industrial segments.

Europe and Asia/Pacific have been somewhat insulated from the recent cyclical downturn in the industrial electronics sector, owing to foreign investment spurred by local production factors and cost of production advantages, respectively. In North America and Japan, though, these application markets are forecast to rebound in 1993 with the expected relaxation of budget constraints.

A Bright Spot—Telecommunication

By contrast, communications production ranks as one of the most stable-growing of the application markets for IC suppliers such as Linear Technology. The reason is the heterogeneous composition of personal wireless communication, premise voice and data products, and large-scale, long-life investment in public telecommunications infrastructure.

Linear Technology should be positioned well in this market not only for the 1992 to 1993 period but also for the long-term horizon. The company garners an estimated 19 percent of its analog IC revenue from telecom applications, which range from cellular phones through modems and fax machines to PBX systems. This segment of the electronics markets will decelerate slightly in 1992 to 6.1 percent from 7.3 percent in 1991. However, investment in networking the existing stock of data processing equipment should drive communications hardware growth through 1996.

Evolving Markets: Military and Automotive

Military and civil aerospace electronics production—which account for just less than 15 percent of the company's business—was hit hard by Washington, D.C. budget cuts in 1991 and the global output of these systems declined to 5.5 percent worldwide. Few positive opportunities remain for all but the most specialized niche players participating in simulation systems, dedicated military computer systems, and civil-space projects. Linear Technology has targeted a range of military applications over the past decade including communication, displays, radar systems, sonar systems, and surveillance equipment. Civil aerospace electronics production will remain the most bright spot in this application market, fueled by replacement of aging jet airliners and upgrades of the worldwide air traffic control system.

The automotive sector—primarily engine and transmission control systems—accounts for an estimated 10 percent of Linear Technology's analog IC sales as of 1991. Transportation electronics production growth is expected to accelerate from 4.8 percent growth in 1991 to 6.0 percent in 1992, and to 10.2 percent in 1993. Production was hurt by the recession, but growth prospects are relatively positive because of increased household spending, combined with increasing share of electronic systems' added value to new vehicles.

A Snapshot of Application Market Prospects

In aggregate, Linear Technology faces some short-term challenges in the worldwide industrial marketplaces and the Japan region. However, the company should be well-positioned for continuing expansion in the telecommunications and automotive segments. The company is well-positioned for Europe and is positioning itself for an advance in Asia/Pacific. For 1993, Linear Technology should benefit from recovery in the global computer marketplace and industrial markets such as North America and Japan.

In the early start-up years, the military segment was one of Linear Technology's most important markets. The company has carefully positioned itself for decreasing reliance on this revenue stream. The automotive market in part should displace military sales at Linear Technology during this decade.

Succinct Financial Analysis—Impressive Results

For the global network of Semiconductor Procurement service clients who are using or evaluating the use of Linear Technology's products, financial performance over the past several years clearly weighs heavily in the decision-making process. Since 1981, Linear Technology has consistently achieved record quarterly revenue and profits—along with associated record annual financial results. The most recent five-year result is as follows: For fiscal years 1988 through 1992, Linear Technology's worldwide analog IC revenue more than doubled—from $51 million for 1988 to $120 million for 1992—while income excluding extraordinary credits more than tripled from $7 million to $25 million.

Consolidated Financial Statements

Table 1 provides Linear Technology's balance sheet for fiscal years 1988 through 1992 (unaudited for 1992). Table 2 provides Linear Technology's consolidated statement of income for the same period (unaudited for 1992).

The Fundamental Financial Question

The critical question remains, as stated at the outset. Can Linear Technology sustain the performance shown in the financial statements?

Product Strategy

Analog ICs—which include linear ICs and mixed-signal circuits—constitute the company's sole product division. Table 3 depicts the company's estimated product segmentation for calendar year 1991. The

Table 1
Linear Technology Corporation Balance Sheet (in Thousands, except Share Amounts)

Fiscal Year Ending	6/30/92*	6/30/91	7/1/90	7/2/89	7/3/88
Cash	27,757	17,479	25,059	46,468	40,322
Marketable Securities	67,521	51,746	28,379	NA	NA
Receivables	19,719	14,094	14,619	11,887	9,395
Inventories	7,921	7,543	5,882	5,690	4,647
Raw Materials	1,214	1,273	789	771	652
Work in Progress	4,652	4,453	3,449	3,734	2,711
Finished Goods	2,055	1,817	1,644	1,185	1,284
Prepaid Income Taxes and Other Current Assets	11,330	9,628	6,485	5,755	2,984
Total Current Assets	134,248	100,490	80,42	469,800	57,348
Prop., Plant, and Equip.	50,454	40,613	32,464	27,37	21,241
Accumulated Dep.	(24,903)	(20,361)	(16,534)	(12,535)	(9,217)
Net Prop. and Equip.	25,551	20,252	15,930	14,842	12,024
Total Assets	159,799	120,742	96,354	84,642	69,372
Annual Liabilities ($K)					
Fiscal Year Ending	**6/30/92**	**6/30/91**	**7/1/90**	**7/2/89**	**7/3/88**
Accounts Payable	3,542	4,199	2,255	2,216	2,000
Current Portions of Long-Term Debt and Capital Lease Obligation	4,713	1,731	1,997	2,186	NA
Accrued Expenses	10,863	7,654	3,492	6,365	3,908
Income Taxes	7,558	4,963	3,694	2,887	3,792
Other Current Liabilities	6,838	5,171	7,162	3,271	2,518
Total Current Liabilities	33,514	23,718	18,600	16,925	14,436
Deferred Charges/Inc.	1,028	903	815	538	NA
Long-Term Debt	1,726	6,439	8,170	9,003	NA
Total Liabilities	36,268	31,060	27,585	26,466	21,112
Common Stock Net	62,352	50,683	46,186	45,281	44,379
Retained Earnings	61,179	38,999	22,583	13,130	4,228
Other Liabilities	NA	NA	NA	(234)	(346)
Shareholder Equity	123,531	89,682	68,769	58,176	48,260
Total Liabilities and Net Worth	159,799	120,742	96,354	84,642	69,372

*Unaudited for 1992
NA = Not applicable
Source: Linear Technology, Dataquest (August 1992)

Table 2
Linear Technology Corporation Income Statement (in Thousands of Dollars)

Fiscal Year Ending	6/30/92*	6/30/91	7/1/90	7/2/89	7/3/88
Net Sales	119,440	94,152	75,620	64,722	51,325
Cost of Sales	49,505	41,778	36,048	31,216	24,765
Gross Profit	69,935	52,374	39,572	33,506	26,560
Expenses					
Research and Development	12,344	10,219	7,763	6,088	4,779
Selling General and Administrative	21,996	19,096	16,619	14,948	11,465
Operating Income	35,595	23,059	15,190	12,470	10,316
Interest Income	3,931	4,419	3,762	3,615	2,362
Interest Expense	(1,038)	1,256	1,460	1,490	1,352
Income before Income Taxes	38,488	26,222	17,492	14,595	11,326
Provision for Income Taxes	13,471	9,283	6,191	5,693	4,416
Net Income	25,017	16,939	11,301	8,902	8,916

*Unaudited for 1992
Source: Linear Technology, Dataquest (August 1992)

fast-growing mixed-signal technology represents slightly more than 20 percent of the company's analog market revenue.

The information in Table 3 reveals that amplifiers and voltage regulators are the company's two largest analog product markets, followed by special-function analog, voltage reference, and interface circuits. Linear Technology ranks 19th for 1991 among worldwide suppliers of linear ICs. Dataquest estimates that Linear Technology's worldwide analog IC revenue broke the $100 million revenue barrier during calendar year 1991.

Product Strengths and Weaknesses

This section steps through a critical examination of Linear Technology's market strengths and weaknesses and related threats and opportunities. The predominant competitive threat derives from the much broader product lines and the greater technical service and support capabilities of competitors such as Analog Devices, Motorola, National Semiconductor, and Texas Instruments.

Linear Technology has consistently and profitably managed this "giant competitor" risk since the start-up days by targeting specialized analog requirements that the giants tend to overlook. The full product portfolio includes high-performance operational amplifiers, voltage references, voltage regulators, switching regulators, and voltage converters, comparators, filters, instrumentation amplifiers, data conversion circuits, interface circuits, analog switches, and special analog function circuits.

Some of the opportunities have already been described, such as medium-term prospects in the global industrial, computer, and telecommunications markets. However, Linear Technology's real

Table 3
Linear Technology Corporation
Calendar Year 1991 Estimated Revenue, by Product Type

	Company Revenue (%)	Worldwide Ranking
Amplifiers	22	11
Voltage Regulator	22	6
Voltage Reference	13	1
Comparator	5	10
Special Function	16	11
Automotive	2	15
Data Converter	5	22
Telecom	3	40
Interface	12	7
Total Revenue ($M)	105	19

Source: Dataquest (August 1992)

opportunity continues to rest in a relentless search for systems' unsatisfied analog needs.

Key Points on Strategic Alliances and R&D

In assessing Linear Technology's competitive strengths and weaknesses, two key points should be noted. First, Linear Technology has no strategic alliances in effect. This reflects current market strength that serves as a wild card option should long-term market conditions change unexpectedly. An alliance with TI terminated in April 1991. Nor is the company currently embroiled in any major patent or related legal actions.

The second point is that Linear Technology typically spends an estimated 10 percent of revenue on research and development (R&D) efforts, which take place at facilities in Milpitas, California and Singapore. This level of R&D spending likely will be maintained over the long term in order for the company to maintain its edge in serving the specialized niches of the analog marketplace.

Under the aegis of industry legend Bob Dobkin, analog engineering expertise propels the R&D effort. Linear Technology had more than 50 analog engineers at the headquarters facility during fiscal year 1991.

Operational Amplifiers

As shown in Table 3, Linear Technology ranks 11th among worldwide suppliers of operational amplifiers. Top-ranked suppliers include Analog Devices and National Semiconductor—which have shares of slightly more than 10 percent—as well as Harris and Texas Instruments, with shares of just less than 10 percent.

Linear Technology does not compete against industry titans such as National Semiconductor and TI in the commodity op amp business. Rather, it focuses on circuits that Linear Technology claims offer lowest noise or else universal precision. Voltage levels range from 5V to 15V as well as the emerging 3V devices targeted for battery applications.

The refrain in the analog product/market evaluations that follow will sound similar because Linear Technology's competitive strategy basically holds across the product board—to bypass industry giants in order to profitably serve high-performance segments.

Voltage Regulators

Table 3 reveals that the company ranks sixth worldwide in the voltage regulator marketplace. The top-ranked companies are National Semiconductor and Motorola, each with a share of 15 percent or more. TI ranks third with a 7 percent stake.

Linear Technology's competitive line includes low dropout linear regulators and switch mode regulators, a growing segment that targets switch mode power supplies. The product line includes high-speed pulse width modulator controllers.

Special Function

The information in Table 3 shows that Linear Technology ranks 11th among suppliers of special-analog function ICs. SGS-Thomson holds more than one-third of the market share. Hitachi has garnered a 9 percent stake of the market; Philips and National Semiconductor follow with 5 percent shares, with TI just behind.

This segment allows for potentially lucrative returns—independent of market share—if a supplier such as Linear Technology can serve systems demanding specialized analog requirements. In segments such as this, analog engineering expertise combines with considerable customer hand-holding in order to precisely "tweak" circuits in line with systems' specialized needs.

Voltage Reference

As shown in Table 3, Linear Technology ranks as the world's leading supplier in the small-voltage reference segment. Other leading suppliers in this somewhat fragmented market include Sanyo, Analog Devices, Matsushita, Mitsubishi, GEC Plessey, and TI.

Linear Technology's approach is to achieve what it views as the industry benchmark-setters on parameters such as lowest long term drift.

Interface

Table 3 depicts Linear Technology's seventh-place ranking worldwide in the interface circuit market. TI commands nearly one-third of the market. National Semiconductor holds 17 percent of the market, followed by Toshiba and Motorola.

Data Converter

The information in Table 3 shows that Linear Technology ranks 22nd among suppliers of data converters. Analog Devices remains the market kingpin by far with almost one-third of market share. Brooktree—which is noted for its video DACs—ranks second, with National Semiconductor and Burr-Brown next.

Although Linear Technology offers some impressive and presumably reasonably profitable 8-bit, 10-bit, and 12-bit converters, the supplier has not made the level of penetration that was originally expected. Linear Technology commands a respectable 5 percent share of this attractive market, but not only does Analog Devices remain the market leader by far, but also a host of small suppliers such as Brooktree and Burr-Brown command more market attention than does Linear Technology.

Automotive

As shown in Table 3, Linear Technology ranks 15th among suppliers of analog automotive ICs. SGS-Thomson holds nearly 30 percent of this segment and is trailed by Motorola, National Semiconductor, Allegro MicroSystems, and TI.

Linear Technology faces fierce competition in this market. The company holds less than 1 percent market share. The customer base prefers larger suppliers. However, the automotive industry has been undergoing a restructuring process that opens a window of opportunity for Linear Technology in terms of system design-ins or perhaps strategic alliances. We should also note that when all of Linear Technology's analog IC revenue is aggregated, the automotive segment represents nearly 10 percent of the company's business—a good foundation for future penetration of this specialized segment.

Comparator

Table 3 depicts Linear Technology's 10th-place ranking worldwide in the comparator market. National Semiconductor commands nearly 20 percent of this market, followed by TI, NEC, Motorola, and Philips. Linear Technology's ever-familiar-sounding product line of comparators are high-performance devices that offer ultrahigh-speed or micropower capability.

Design Center Locations

As noted, the company has two design centers. The domestic North American facility is located in Milpitas, California.

A newer center was opened in Singapore during the second half of 1991.

Manufacturing Facilities

Linear Technology has two fabs in Milpitas, California (see Table 4).

The facility in Singapore performs metal-can assembly, test, marking, and other design functions. The expanding scope of operation will include direct shipping to customers. Singapore will become the Asian headquarters with construction of a 50,000-square-foot high-tech facility scheduled to start by the fourth quarter of 1992.

The first Milpitas fab was constructed in 1981 and supports an estimated $150 million of product sales. The new Milpitas fab can support an estimated $100 million of product sales—setting the stage for Linear Technology's move during this decade toward the goal of being a quarter-billion-dollar business.

Process Technology

Linear Technology emphasizes the versatility of its fab processing capability. The company offers 20 different process flows, which represent a variety of bipolar and linear CMOS processes. These competitive processes—which in effect are required for survival in the analog marketplace—include p-well silicon gate CMOS, n-well silicon gate CMOS, high-power bipolar, low-noise bipolar, high-speed bipolar, complementary bipolar, and high-voltage CMOS. These processes are clearly geared to serving high-speed, precision applications. Regarding military/aerospace applications, the company has earned JAN S level certification.

Table 4
Linear Technology Manufacturing Overview

	Operation Begin	Clean Room (Sq. Ft. Gross)*	Process Technology	Combined Wafer Start Capacity**	Wafer Diameter
Fab I	1982	18,000	CMOS M2, BiCMOS M2, Bipolar	15,000	4 Inches
Fab II	1992	*			

*Combined square footage for both Fab 1 and Fab 2
**Estimated maximum theoretical capacity per four-week month
Source: Dataquest (August 1992)

Dataquest Perspective

To answer the lead question in this profile, although it is unlikely that Linear Technology—or any company—can maintain such stellar financial performance throughout the 1990s, Dataquest believes that the supplier will continue to outpace the IC market. Dataquest certainly does not foresee the company stumbling and disappearing later this decade.

Carver Mead expects that complete analog solutions will be a driving force to market success during the 1990s—and Linear Technology's core of analog design expertise puts the company in position for global success. Linear Technology will flow with the market into low-voltage battery applications. One application focus likely will be power supplies for portable systems. Linear Technology will aim at producing complete 3V analog solutions. The company clearly faces a stiff challenge from competitors such as Analog Devices in the data converter marketplace and industry giants such as SGS-Thomson in the automotive arena.

Regardless, Linear Technology will continue to evolve with the market—in fact, lead the evolution to some extent—into the high-performance analog systems of the 1990s and beyond.

Dataquest's blunt assessment is as follows: as long as the core management and analog engineering teams remain relatively intact, Linear Technology should thrive during this decade. Five years ago, some Silicon Valley reporters and investment analysts queried the author of this report regarding major management/engineering defections from the company—and its impending demise. Dataquest did not see that scenario then—and we do not see it today.

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In terms of management stability, which is a critical element to most companies' future prospects but especially so to a relatively young supplier such as this, Robert Swanson and Robert Dobkin were two of the original five founders of the company. The employee base increased to 814 employees as of June 1992 versus 729 as of June 1991. The strong engineering teams (design, test, and process) and manufacturing teams have also remained quite stable.

Business and Economic Conditions

This section provides the world economic background against which Linear Technology will operate during 1992 and 1993. As the semiconductor industry has matured, the marketplace—including the analog segment—has moved more into synchronization with general economic trends vis-a-vis the somewhat countercyclical pattern during the 1970s and early 1980s. For example, demand for commodity-type linear ICs such as operational amplifiers and voltage regulators now conforms largely to general economic cycles. Even so, more specialized analog parts such as mixed-signal ICs and high-performance operational amplifiers—which exemplify some of Linear Technology's key product technologies—typically outpace general rates of growth.

Linear Technology has pursued a global sales strategy. Dataquest estimates that Linear Technology's worldwide analog revenue as of calendar year 1991 derived from four regions: North America—58 percent; Europe—20 percent; Japan—12 percent; and Rest of World/Asia—10 percent. The strategy calls for continuing expansion (for example, offices) of global sales support.

The worldwide economy continues to show mixed results as of the second half of 1992. The Dun & Bradstreet Corporation forecasts an improving outlook for Linear Technology's key geographic markets. For example, the U.S., Canadian, and U.K. economies are expected to recover from the recession in 1992, although in quite modest fashion.

Real gross domestic product (GDP) is expected to expand 2.1, 1.6, and 0.5 percent, respectively, in 1992. Expansion should increase to 2.5, 4.0, and 2.2 percent, respectively, in 1993.

Another example is as follows: Real GDP growth is expected to decelerate in Germany and Japan during 1992, from 3.2 percent in 1991 to 1.1 percent and from 4.4 percent in 1991 to 2.0 percent, respectively. The respective economies are expected to reaccelerate to 2.8 percent and 3.3 percent growth in 1993.

Application Markets Strategy

Overall, worldwide electronic systems production is expected to expand 3.1 percent in 1992, slightly faster than the 2.4 percent rate of growth in 1991. For Linear Technology—which has performed well under global recessionary conditions—this outlook should mean market momentum. Worldwide expansion is expected to accelerate further in 1993 to 7.6 percent as the worldwide economic climate improves.

The emerging host of battery-powered applications represents a key market opportunity for Linear Technology. From an application-market perspective that focuses on Linear Technology's target markets, the forecast makes the following series of assumptions.

The Computer Market—Poised for Recovery?

Data processing production—which marks an estimated 25 percent of Linear Technology's business as of calendar year 1991—should make a moderate 2.6 percent recovery in 1992, after a depressing 2.2 percent decline in 1991. Key system applications in this marketplace for Linear Technology include desktop PCs, laptop PCs, disk drives, modems, monitors, plotters, and printers, along with an increased emphasis on switching power supplies.

In North America, recovery in the computer and other markets will continue into 1993 as economic conditions continue to improve and stabilize. In Europe—which is Linear Technology's second largest market—local content regulations are spurring the placement of production facilities, helping explain a boost of growth expected for 1993. Nevertheless, the specter of trade friction pervades that region.

The Japanese economy, including the computer segment—which is Linear Technology's third largest marketplace—will remain hemmed in for the remainder of 1992, as business and households adjust downward their spending plans in response to the lackluster business climate. However, Japan should be back on the path of normal growth during 1993 and beyond, and growth in Japan should resume a more sustainable pace once facilities are in place. Production prospects in the Asia/Pacific region, a growth market for Linear Technology, remain upbeat because this region has become the choice for mass manufacturing of established technologies such as PCs.

A Challenge—The Industrial Market Downturn

There are no free lunches or stress-free paths to success, even for bright stars such as Linear Technology. A major challenge is that production of industrial equipment has borne the brunt of the recent downturn in business conditions, especially in North America. For Linear Technology, industrial applications account for more than 30 percent of IC revenue for 1991. Leading applications for Linear Technology's products in this segment include industrial process control systems such as for flow metering or energy management. Instrumentation systems such as medical scanners (EKG and CAT) and test equipment are other key industrial segments.

Europe and Asia/Pacific have been somewhat insulated from the recent cyclical downturn in the industrial electronics sector, owing to foreign investment spurred by local production factors and cost of production advantages, respectively. In North America and Japan, though, these application markets are forecast to rebound in 1993 with the expected relaxation of budget constraints.

A Bright Spot—Telecommunication

By contrast, communications production ranks as one of the most stable-growing of the application markets for IC suppliers such as Linear Technology. The reason is the heterogeneous composition of personal wireless communication, premise voice and data products, and large-scale, long-life investment in public telecommunications infrastructure.

Linear Technology should be positioned well in this market not only for the 1992 to 1993 period but also for the long-term horizon. The company garners an estimated 19 percent of its analog IC revenue from telecom applications, which range from cellular phones through modems and fax machines to PBX systems. This segment of the electronics markets will decelerate slightly in 1992 to 6.1 percent from 7.3 percent in 1991. However, investment in networking the existing stock of data processing equipment should drive communications hardware growth through 1996.

Evolving Markets: Military and Automotive

Military and civil aerospace electronics production—which account for just less than 15 percent of the company's business—was hit hard by Washington, D.C. budget cuts in 1991 and the global output of these systems declined to 5.5 percent worldwide. Few positive opportunities remain for all but the most specialized niche players participating in simulation systems, dedicated military computer systems, and civil-space projects. Linear Technology has targeted a range of military applications over the past decade including communication, displays, radar systems, sonar systems, and surveillance equipment. Civil aerospace electronics production will remain the most bright spot in this application market, fueled by replacement of aging jet airliners and upgrades of the worldwide air traffic control system.

The automotive sector—primarily engine and transmission control systems—accounts for an estimated 10 percent of Linear Technology's analog IC sales as of 1991. Transportation electronics production growth is expected to accelerate from 4.8 percent growth in 1991 to 6.0 percent in 1992, and to 10.2 percent in 1993. Production was hurt by the recession, but growth prospects are relatively positive because of increased household spending, combined with increasing share of electronic systems' added value to new vehicles.

A Snapshot of Application Market Prospects

In aggregate, Linear Technology faces some short-term challenges in the worldwide industrial marketplaces and the Japan region. However, the company should be well-positioned for continuing expansion in the telecommunications and automotive segments. The company is well-positioned for Europe and is positioning itself for an advance in Asia/Pacific. For 1993, Linear Technology should benefit from recovery in the global computer marketplace and industrial markets such as North America and Japan.

In the early start-up years, the military segment was one of Linear Technology's most important markets. The company has carefully positioned itself for decreasing reliance on this revenue stream. The automotive market in part should displace military sales at Linear Technology during this decade.

Succinct Financial Analysis—Impressive Results

For the global network of Semiconductor Procurement service clients who are using or evaluating the use of Linear Technology's products, financial performance over the past several years clearly weighs heavily in the decision-making process. Since 1981, Linear Technology has consistently achieved record quarterly revenue and profits—along with associated record annual financial results. The most recent five-year result is as follows: For fiscal years 1988 through 1992, Linear Technology's worldwide analog IC revenue more than doubled—from $51 million for 1988 to $120 million for 1992—while income excluding extraordinary credits more than tripled from $7 million to $25 million.

Consolidated Financial Statements

Table 1 provides Linear Technology's balance sheet for fiscal years 1988 through 1992 (unaudited for 1992). Table 2 provides Linear Technology's consolidated statement of income for the same period (unaudited for 1992).

The Fundamental Financial Question

The critical question remains, as stated at the outset. Can Linear Technology sustain the performance shown in the financial statements?

Product Strategy

Analog ICs—which include linear ICs and mixed-signal circuits—constitute the company's sole product division. Table 3 depicts the company's estimated product segmentation for calendar year 1991. The

Table 1
Linear Technology Corporation Balance Sheet (in Thousands, except Share Amounts)

Fiscal Year Ending	6/30/92*	6/30/91	7/1/90	7/2/89	7/3/88
Cash	27,757	17,479	25,059	46,468	40,322
Marketable Securities	67,521	51,746	28,379	NA	NA
Receivables	19,719	14,094	14,619	11,887	9,395
Inventories	7,921	7,543	5,882	5,690	4,647
Raw Materials	1,214	1,273	789	771	652
Work in Progress	4,652	4,453	3,449	3,734	2,711
Finished Goods	2,055	1,817	1,644	1,185	1,284
Prepaid Income Taxes and Other Current Assets	11,330	9,628	6,485	5,755	2,984
Total Current Assets	134,248	100,490	80,42	469,800	57,348
Prop., Plant, and Equip.	50,454	40,613	32,464	27,37	21,241
Accumulated Dep.	(24,903)	(20,361)	(16,534)	(12,535)	(9,217)
Net Prop. and Equip.	25,551	20,252	15,930	14,842	12,024
Total Assets	159,799	120,742	96,354	84,642	69,372
Annual Liabilities ($K)					
Fiscal Year Ending	6/30/92	6/30/91	7/1/90	7/2/89	7/3/88
Accounts Payable	3,542	4,199	2,255	2,216	2,000
Current Portions of Long-Term Debt and Capital Lease Obligation	4,713	1,731	1,997	2,186	NA
Accrued Expenses	10,863	7,654	3,492	6,365	3,908
Income Taxes	7,558	4,963	3,694	2,887	3,792
Other Current Liabilities	6,838	5,171	7,162	3,271	2,518
Total Current Liabilities	33,514	23,718	18,600	16,925	14,436
Deferred Charges/Inc.	1,028	903	815	538	NA
Long-Term Debt	1,726	6,439	8,170	9,003	NA
Total Liabilities	36,268	31,060	27,585	26,466	21,112
Common Stock Net	62,352	50,683	46,186	45,281	44,379
Retained Earnings	61,179	38,999	22,583	13,130	4,228
Other Liabilities	NA	NA	NA	(234)	(346)
Shareholder Equity	123,531	89,682	68,769	58,176	48,260
Total Liabilities and Net Worth	159,799	120,742	96,354	84,642	69,372

*Unaudited for 1992
NA = Not applicable
Source: Linear Technology, Dataquest (August 1992)

Table 2
Linear Technology Corporation Income Statement (in Thousands of Dollars)

Fiscal Year Ending	6/30/92*	6/30/91	7/1/90	7/2/89	7/3/88
Net Sales	119,440	94,152	75,620	64,722	51,325
Cost of Sales	49,505	41,778	36,048	31,216	24,765
Gross Profit	69,935	52,374	39,572	33,506	26,560
Expenses					
Research and Development	12,344	10,219	7,763	6,088	4,779
Selling General and Administrative	21,996	19,096	16,619	14,948	11,465
Operating Income	35,595	23,059	15,190	12,470	10,316
Interest Income	3,931	4,419	3,762	3,615	2,362
Interest Expense	(1,038)	1,256	1,460	1,490	1,352
Income before Income Taxes	38,488	26,222	17,492	14,595	11,326
Provision for Income Taxes	13,471	9,283	6,191	5,693	4,416
Net Income	25,017	16,939	11,301	8,902	8,916

*Unaudited for 1992
Source: Linear Technology, Dataquest (August 1992)

fast-growing mixed-signal technology represents slightly more than 20 percent of the company's analog market revenue.

The information in Table 3 reveals that amplifiers and voltage regulators are the company's two largest analog product markets, followed by special-function analog, voltage reference, and interface circuits. Linear Technology ranks 19th for 1991 among worldwide suppliers of linear ICs. Dataquest estimates that Linear Technology's worldwide analog IC revenue broke the $100 million revenue barrier during calendar year 1991.

Product Strengths and Weaknesses

This section steps through a critical examination of Linear Technology's market strengths and weaknesses and related threats and opportunities. The predominant competitive threat derives from the much broader product lines and the greater technical service and support capabilities of competitors such as Analog Devices, Motorola, National Semiconductor, and Texas Instruments.

Linear Technology has consistently and profitably managed this "giant competitor" risk since the start-up days by targeting specialized analog requirements that the giants tend to overlook. The full product portfolio includes high-performance operational amplifiers, voltage references, voltage regulators, switching regulators, and voltage converters, comparators, filters, instrumentation amplifiers, data conversion circuits, interface circuits, analog switches, and special analog function circuits.

Some of the opportunities have already been described, such as medium-term prospects in the global industrial, computer, and telecommunications markets. However, Linear Technology's real

Table 3
Linear Technology Corporation
Calendar Year 1991 Estimated Revenue, by Product Type

	Company Revenue (%)	Worldwide Ranking
Amplifiers	22	11
Voltage Regulator	22	6
Voltage Reference	13	1
Comparator	5	10
Special Function	16	11
Automotive	2	15
Data Converter	5	22
Telecom	3	40
Interface	12	7
Total Revenue ($M)	105	19

Source: Dataquest (August 1992)

opportunity continues to rest in a relentless search for systems' unsatisfied analog needs.

Key Points on Strategic Alliances and R&D

In assessing Linear Technology's competitive strengths and weaknesses, two key points should be noted. First, Linear Technology has no strategic alliances in effect. This reflects current market strength that serves as a wild card option should long-term market conditions change unexpectedly. An alliance with TI terminated in April 1991. Nor is the company currently embroiled in any major patent or related legal actions.

The second point is that Linear Technology typically spends an estimated 10 percent of revenue on research and development (R&D) efforts, which take place at facilities in Milpitas, California and Singapore. This level of R&D spending likely will be maintained over the long term in order for the company to maintain its edge in serving the specialized niches of the analog marketplace.

Under the aegis of industry legend Bob Dobkin, analog engineering expertise propels the R&D effort. Linear Technology had more than 50 analog engineers at the headquarters facility during fiscal year 1991.

Operational Amplifiers

As shown in Table 3, Linear Technology ranks 11th among worldwide suppliers of operational amplifiers. Top-ranked suppliers include Analog Devices and National Semiconductor—which have shares of slightly more than 10 percent—as well as Harris and Texas Instruments, with shares of just less than 10 percent.

Linear Technology does not compete against industry titans such as National Semiconductor and TI in the commodity op amp business. Rather, it focuses on circuits that Linear Technology claims offer lowest noise or else universal precision. Voltage levels range from 5V to 15V as well as the emerging 3V devices targeted for battery applications.

The refrain in the analog product/market evaluations that follow will sound similar because Linear Technology's competitive strategy basically holds across the product board—to bypass industry giants in order to profitably serve high-performance segments.

Voltage Regulators

Table 3 reveals that the company ranks sixth worldwide in the voltage regulator marketplace. The top-ranked companies are National Semiconductor and Motorola, each with a share of 15 percent or more. TI ranks third with a 7 percent stake.

Linear Technology's competitive line includes low dropout linear regulators and switch mode regulators, a growing segment that targets switch mode power supplies. The product line includes high-speed pulse width modulator controllers.

Special Function

The information in Table 3 shows that Linear Technology ranks 11th among suppliers of special-analog function ICs. SGS-Thomson holds more than one-third of the market share. Hitachi has garnered a 9 percent stake of the market; Philips and National Semiconductor follow with 5 percent shares, with TI just behind.

This segment allows for potentially lucrative returns—independent of market share—if a supplier such as Linear Technology can serve systems demanding specialized analog requirements. In segments such as this, analog engineering expertise combines with considerable customer hand-holding in order to precisely "tweak" circuits in line with systems' specialized needs.

Voltage Reference

As shown in Table 3, Linear Technology ranks as the world's leading supplier in the small-voltage reference segment. Other leading suppliers in this somewhat fragmented market include Sanyo, Analog Devices, Matsushita, Mitsubishi, GEC Plessey, and TI.

Linear Technology's approach is to achieve what it views as the industry benchmark-setters on parameters such as lowest long term drift.

Interface

Table 3 depicts Linear Technology's seventh-place ranking worldwide in the interface circuit market. TI commands nearly one-third of the market. National Semiconductor holds 17 percent of the market, followed by Toshiba and Motorola.

Data Converter

The information in Table 3 shows that Linear Technology ranks 22nd among suppliers of data converters. Analog Devices remains the market kingpin by far with almost one-third of market share. Brooktree—which is noted for its video DACs—ranks second, with National Semiconductor and Burr-Brown next.

Although Linear Technology offers some impressive and presumably reasonably profitable 8-bit, 10-bit, and 12-bit converters, the supplier has not made the level of penetration that was originally expected. Linear Technology commands a respectable 5 percent share of this attractive market, but not only does Analog Devices remain the market leader by far, but also a host of small suppliers such as Brooktree and Burr-Brown command more market attention than does Linear Technology.

Automotive

As shown in Table 3, Linear Technology ranks 15th among suppliers of analog automotive ICs. SGS-Thomson holds nearly 30 percent of this segment and is trailed by Motorola, National Semiconductor, Allegro MicroSystems, and TI.

Linear Technology faces fierce competition in this market. The company holds less than 1 percent market share. The customer base prefers larger suppliers. However, the automotive industry has been undergoing a restructuring process that opens a window of opportunity for Linear Technology in terms of system design-ins or perhaps strategic alliances. We should also note that when all of Linear Technology's analog IC revenue is aggregated, the automotive segment represents nearly 10 percent of the company's business—a good foundation for future penetration of this specialized segment.

Comparator

Table 3 depicts Linear Technology's 10th-place ranking worldwide in the comparator market. National Semiconductor commands nearly 20 percent of this market, followed by TI, NEC, Motorola, and Philips. Linear Technology's ever-familiar-sounding product line of comparators are high-performance devices that offer ultrahigh-speed or micropower capability.

Design Center Locations

As noted, the company has two design centers. The domestic North American facility is located in Milpitas, California.

A newer center was opened in Singapore during the second half of 1991.

Manufacturing Facilities

Linear Technology has two fabs in Milpitas, California (see Table 4).

The facility in Singapore performs metal-can assembly, test, marking, and other design functions. The expanding scope of operation will include direct shipping to customers. Singapore will become the Asian headquarters with construction of a 50,000-square-foot high-tech facility scheduled to start by the fourth quarter of 1992.

The first Milpitas fab was constructed in 1981 and supports an estimated $150 million of product sales. The new Milpitas fab can support an estimated $100 million of product sales—setting the stage for Linear Technology's move during this decade toward the goal of being a quarter-billion-dollar business.

Process Technology

Linear Technology emphasizes the versatility of its fab processing capability. The company offers 20 different process flows, which represent a variety of bipolar and linear CMOS processes. These competitive processes—which in effect are required for survival in the analog marketplace—include p-well silicon gate CMOS, n-well silicon gate CMOS, high-power bipolar, low-noise bipolar, high-speed bipolar, complementary bipolar, and high-voltage CMOS. These processes are clearly geared to serving high-speed, precision applications. Regarding military/aerospace applications, the company has earned JAN S level certification.

Table 4
Linear Technology Manufacturing Overview

	Operation Begin	Clean Room (Sq. Ft. Gross)*	Process Technology	Combined Wafer Start Capacity**	Wafer Diameter
Fab I	1982	18,000	CMOS M2, BiCMOS M2, Bipolar	15,000	4 Inches
Fab II	1992	*			

*Combined square footage for both Fab 1 and Fab 2
**Estimated maximum theoretical capacity per four-week month
Source: Dataquest (August 1992)

Dataquest Perspective

To answer the lead question in this profile, although it is unlikely that Linear Technology—or any company—can maintain such stellar financial performance throughout the 1990s, Dataquest believes that the supplier will continue to outpace the IC market. Dataquest certainly does not foresee the company stumbling and disappearing later this decade.

Carver Mead expects that complete analog solutions will be a driving force to market success during the 1990s—and Linear Technology's core of analog design expertise puts the company in position for global success. Linear Technology will flow with the market into low-voltage battery applications. One application focus likely will be power supplies for portable systems. Linear Technology will aim at producing complete 3V analog solutions. The company clearly faces a stiff challenge from competitors such as Analog Devices in the data converter marketplace and industry giants such as SGS-Thomson in the automotive arena.

Regardless, Linear Technology will continue to evolve with the market—in fact, lead the evolution to some extent—into the high-performance analog systems of the 1990s and beyond.

Dataquest's blunt assessment is as follows: as long as the core management and analog engineering teams remain relatively intact, Linear Technology should thrive during this decade. Five years ago, some Silicon Valley reporters and investment analysts queried the author of this report regarding major management/engineering defections from the company—and its impending demise. Dataquest did not see that scenario then—and we do not see it today.

