Semiconductor Update—1988

Recovery: Fact or Fiction?

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The Dun & Bradstreet Corporation

Semiconductor Update—1988
Recovery: Fact or Fiction?

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San Jose, California

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The Dun & Bradstreet Corporation

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SEMICONDUCTOR UPDATE--1988

RECOVERY: FACT OR FICTION?

Agenda

7:30 A.M.	Registration
8:15 A.M.	Introduction
8:30 A.M.	Semiconductor User Issues
	• End-market forecast • Purchasing trends
9:00 A.M.	Semiconductor Equipment and Materials Forecast
	• Capital spending forecast • Technology trends
9:30 A.M.	World and Regional Industry Status
10:00 A.M.	Break
10:30 A.M.	Semiconductor Product Update
	• MPUs, MCUs, MPRs, and DSPs • Memories • ASICS
12:00 NOON	Adjourn

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Corporate Affiliates

Dun & Bradstreet

Technical Data Resources

A.C. Nielsen

Focus Research, Inc.

Dun's Marketing Services

Extensive information resources

Dataquest

Sustained growth and profitability since establishment in 1971

Dataquest

AT&T Bell Laboratories
AT&T International
AT&T Technologies, Inc.
Advanced Micro Devices, Inc. (AMD)
Alan Patricof Associates
Ameritech
Apple Computer, Inc.
Arthur Andersen & Company
Arthur Young & Company
Aston-Tate, Inc.
BULL
Bank of America
Bell Canada
Bridge Communications, Inc.
British Telecom
Burroughs Corporation
Businessland Inc.
CAE, Inc.
CIT-Alcatel
Cadnetix Corp.
Calma Company
Canon, Inc.
Chase Manhattan Bank
Compugraphic Corporation
Computerland
Corona Data Systems
Crocker Bank
Data General Corporation
Epson (UK), Ltd.
Ericsson Information Systems AB
Fairchild Semiconductor
First Boston Venture Capital
Ford Motor Company
Fuji Electronics Co., Ltd.
Fujitsu Microelectronics
GMF Robotics
GTE Communication Systems
General Electric Japan Ltd.
General Motors Company
Gestetner Corporation
Gigabit Logic
Harris Corporation
Hayes Microcomputer Products, Inc.
Hewlett-Packard Company
Hitachi Koki Co., Ltd.
Honeywell Inc.
IBM Corporation
Image Technology
Ing C. Olivetti & C. S.p.A.
Intel Corporation
Iomega Corporation
Keytronics
Lear Siegler, Inc.
Mayfield Fund
Memorex Corporation
MicroPro International Corporation
Minolta Corporation
Mitsubishi Corporation
Mostek Corporation
Motorola Inc.
Mouse Systems Corporation
NBI Inc.
NCR Corporation
NEC America
National Semiconductor Corporation
Network Equipment Technologies
Nippon Telegraph & Telephone
Nixdorf Computer AG
Northern Telecom
Octel Communications Corp.
Olivetti
Perkin-Elmer Corporation
Plessey Semiconductors Ltd.
Priam Corporation
Price Waterhouse
Prime Computer, Inc.
Printronix, Inc.
Pyramid Technology Corp.
Qume Corporation
RCA Corporation
ROLM Corporation
Rank Xerox France
Samsung Semiconductor Co.
Saxin Corporation
Sharp Corporation
Siemens AG
Signetics Corporation
Silicon Compilers Inc.
Sperry Corporation
Stromberg-Carlson Corp.
Sun Microsystems, Inc.
Tatung Company
Teknowledge, Inc.
Tektronix, Inc.
Telrad Ltd.
Texas Instruments Ltd.
Thomson CSI
Triumph-Adler AG
VLSI Technology, Inc.
Visual Technology Inc.
Wang Laboratories, Inc.
Zitel Corporation
ZyMOS Corporation

Dataquest serves more than 2,500 clients

Dataquest

Industry Services

Asian Semiconductor and Electronics Technology Service

Business Computer Systems

CAD/CAM

CIO Advisor

Computer Storage

Copying and Duplicating

Display Terminal

Electronic Printing

Electronic Publishing

Electronic Typewriter

Electronic Whiteboards

European Semiconductor

European Telecommunications

Gallium Arsenide

Graphics and Imaging

Imaging Supplies

Japanese Semiconductor

Manufacturing Automation

Office Systems

Personal Computer

Semiconductor

Semiconductor Application Markets

Semiconductor Equipment and Materials

Semiconductor User Information

Software

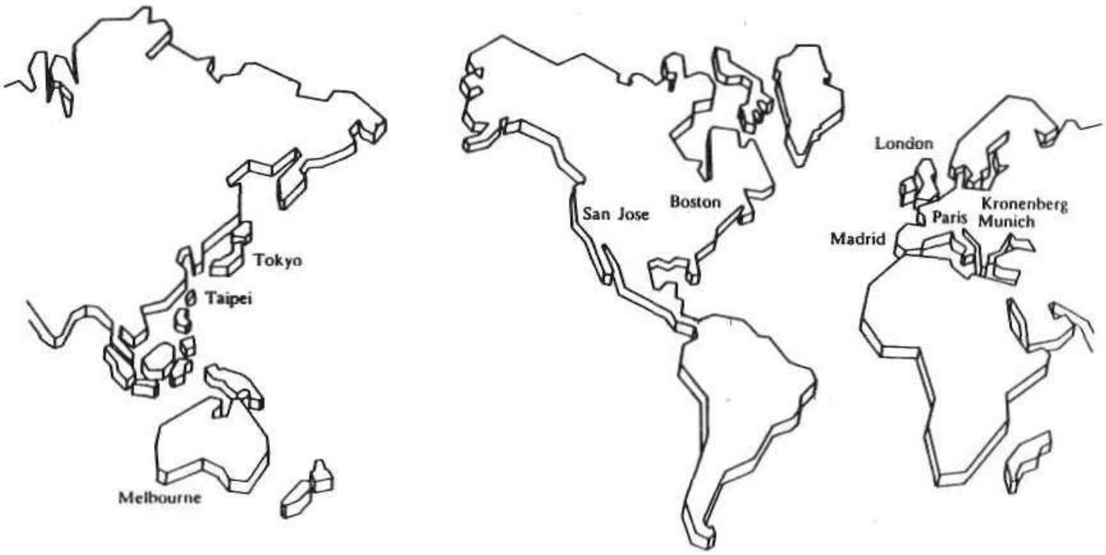
Technical Computer Systems

Telecommunications

Western European Printer

And covers more than 25 industry service areas

Dataquest



Internationally, with ten offices
and representatives in four continents

Dataquest

Services originate from Dataquest's headquarters in San Jose, California

Dataquest

Over 260 industry-experienced staff members

Dataquest

Operating Principles

Partnership Oriented

Conservative/Realistic

Industry Experience Perspective

Confidentiality

Responsible

Client success
is Dataquest's goal

Dataquest

Research Methodology Principles

Application Oriented

Cross-industry Perspective

Industry Contacts

Constant Updating

Realistic

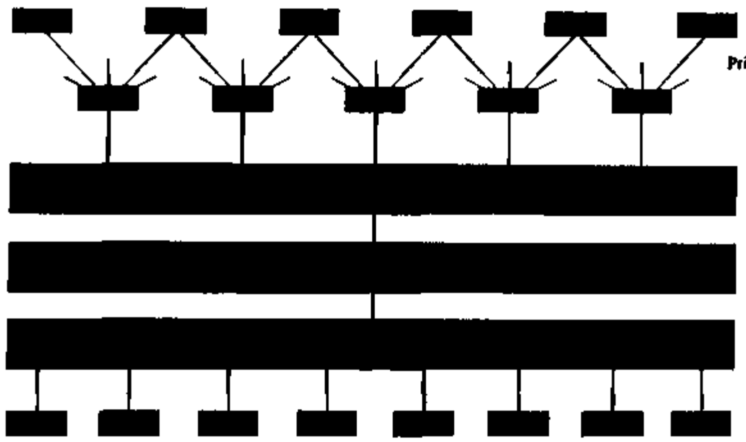
Travel/On-Site

Primary Research

Comprehensive decision support information

Dataquest

Research Methodology



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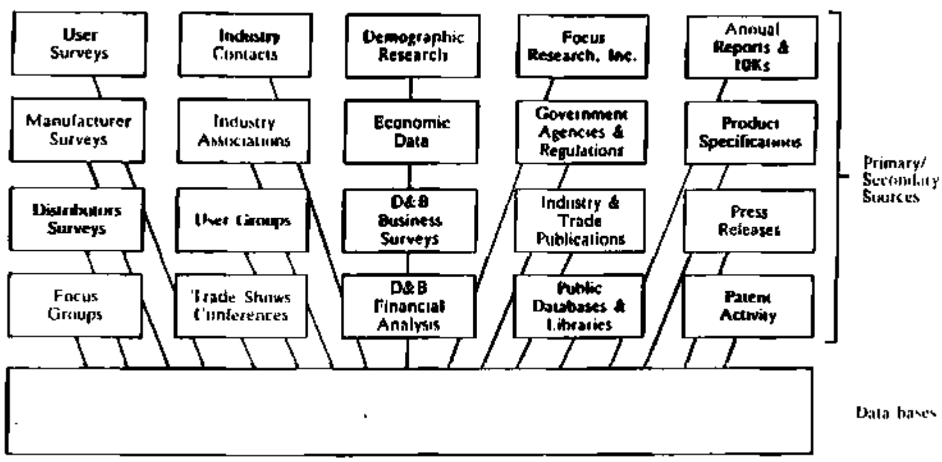
Research Methodology



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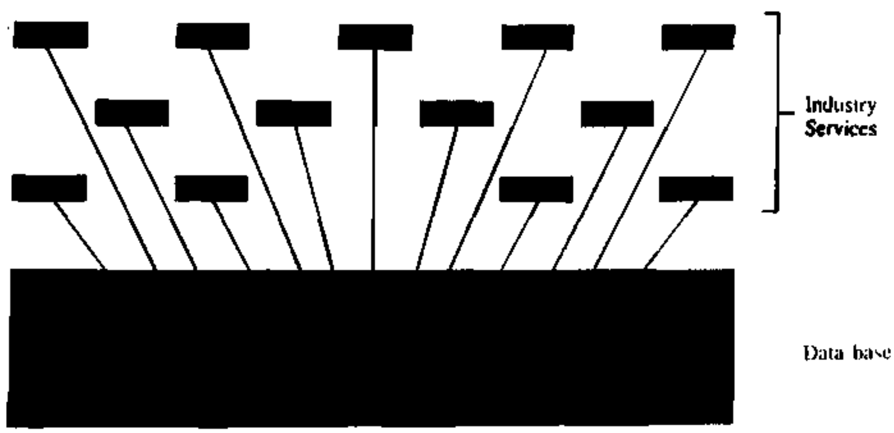
Integrated Data base



A complete perspective
on the high technology
industries

Dataquest

Industry Analysis

Applications

Technologies

Companies

Products

Environments

Markets

Industry Grouping

	Information Systems	Semiconductors	Industrial Automation	Office Equipment	Peripheral
Business Computer Systems	x				
CAD/CAM			x		
Computer Storage					x
Copying and Duplicating				x	
Display Terminal					x
Electronic Printer					x
Electronic Publishing	x				x
Electronic Typewriter				x	
Electronic Whiteboard				x	
European Semiconductor		x			
European Telecommunications	x				
Gallium Arsenide		x			
Graphics	x		x		
Imaging Supplies				x	
Japanese Semiconductor		x			
Manufacturing Automation			x		
Office Systems	x				
Personal Computer	x				
Semiconductor		x			
Semiconductor Application Markets		x			
Semiconductor Equipment and Materials		x			
Semiconductor User Information		x			
Software	x				
Technical Computer Systems	x				
Telecommunications	x				
Western European Printers					x

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Industry Services

Comprehensive Industry
Data base

Inquiry privilege

Research Newsletters
and Bulletins

Annual 3-day conferences

Research library access

Custom consultation
and research

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Focus Reports

Highly detailed landmark publications

Dataquest

Directory Products

Specification Guides and Who's Who Directory

Dataquest

Newsletters

General-overviews and analysis of industry developments

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Financial Services Program

In-depth due diligence resource for the venture capital and banking community

Dataquest

Strategic Executive Service

A business opportunity and technology advisory program

APPLICATION MARKET TRENDS AND OPPORTUNITIES

Presented By:

Semiconductor Users and Applications
Dataquest Incorporated

- Application market trends
- Procurement survey results
- System trend's impact on semiconductors

APPLICATION MARKET TRENDS

NORTH AMERICAN ELECTRONIC EQUIPMENT FORECAST

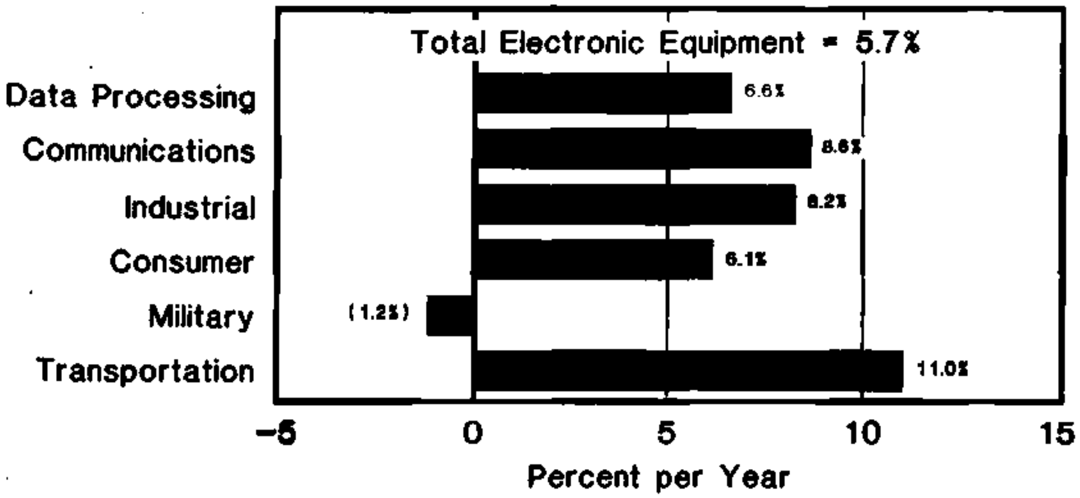
(Billions of Dollars)

	1986	1987	Percent Change 1986-1987
Data Processing	$ 89.5	$ 95.2	6.4%
Communications	25.0	27.1	8.4%
Industrial	32.9	35.4	7.6%
Consumer	17.0	18.4	8.2%
Military	49.7	47.5	(4.4%)
Transportation	9.6	10.8	12.5%
Total	$223.7	$234.4	4.8%

Source: Dataquest

NORTH AMERICAN ELECTRONIC EQUIPMENT FORECAST

Compound Annual Growth Rate, 1986–1991



Source: Dataquest

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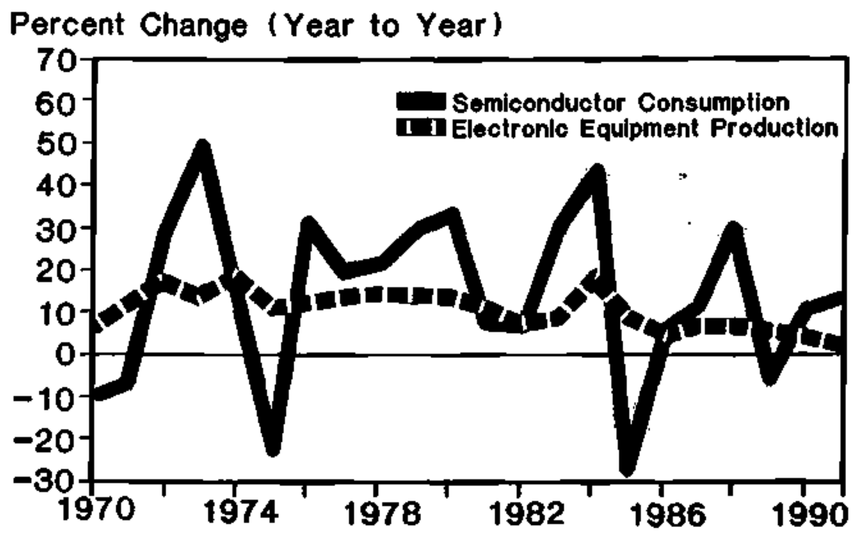
COMPARISON OF NORTH AMERICAN SEMICONDUCTOR CONSUMPTION AND ELECTRONIC EQUIPMENT PRODUCTION



Source: Dataquest

DATAQUEST'S FASTEST-GROWING NORTH AMERICAN MARKETS

(Millions of Dollars)

Equipment	1987 Market Size	1987 S/C Tam	CAGR (1987-1991)
1. Optical Disk Drives	163	17.0	77.8%
2. Single-User Enhanced Computers	2,550	157.0	30.0%
3. Cellular Mobile Radio Equipment	1,445	74.0	25.7%
4. Voice Messaging	260	14.3	25.0%
5. Private Packet Data Networks	335	22.0	22.0%

Source: Dataquest

DATAQUEST'S FASTEST-GROWING NORTH AMERICAN MARKETS (Continued)

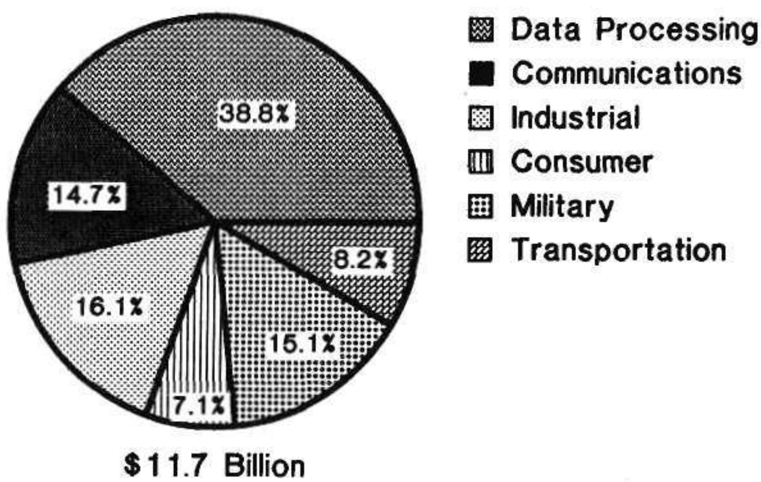
(Millions of Dollars)

Equipment	1987 Market Size	1987 S/C Tam	CAGR (1987-1991)
6. Integrated Voice/Data Workstations	170	22	21.0%
7. Videoteleconferencing	103	8	19.9%
8. Modems	1,818	208	19.1%
9. Robot Systems	646	32	19.1%
10. Graphics Terminals	1,700	121	16.2%

Source: Dataquest

ESTIMATED 1987 NORTH AMERICAN SEMICONDUCTOR CONSUMPTION BY APPLICATION MARKET

Percent of Total Dollars



Source: Dataquest

PROCUREMENT SURVEY RESULTS

Semiconductor users expect to increase semiconductor purchases by 13.6 percent in 1987.

1986 DISTRIBUTION PURCHASES

Average Percent of Total

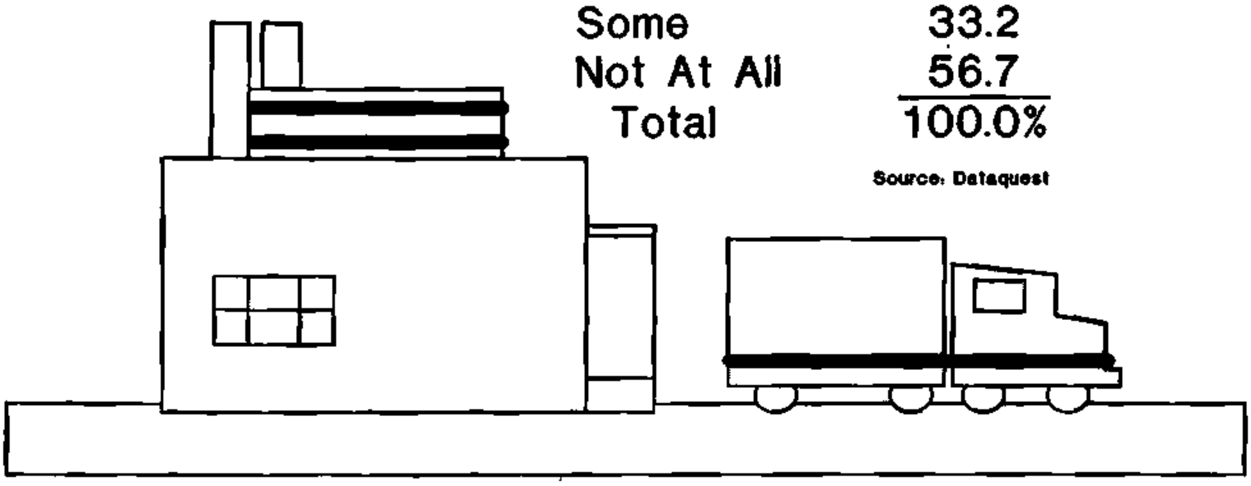
Total Distribution Purchases	12.7%
Data Processing	9.0%
Communications	10.3%
Industrial	29.0%
Consumer	11.4%
Military	43.0%
Transportation	1.9%

Source: Dataquest

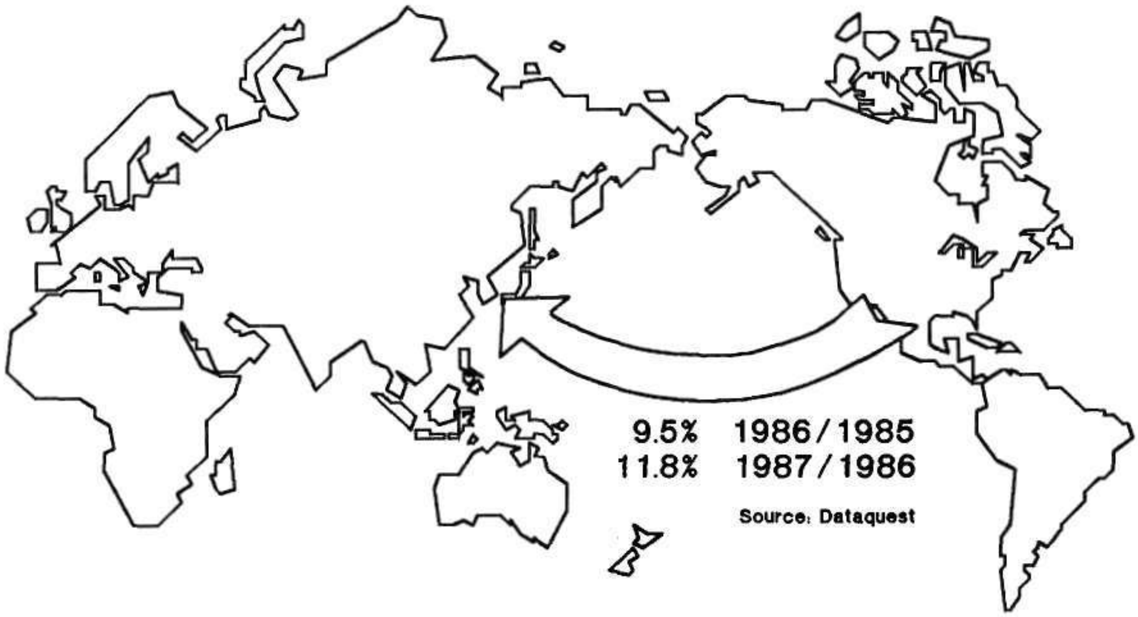
ANTICIPATED SHIFT TO OFFSHORE PRODUCTION

	1986
A Great Deal	10.1%
Some	33.2
Not At All	56.7
Total	100.0%

Source: Dataquest



ESTIMATED PERCENT OF U.S. SEMICONDUCTOR CONSUMPTION MOVING OFFSHORE



WHY THE MOVEMENT?

1. Lower manufacturing and labor costs
2. Price and quality
3. Competition
4. Manufacturing moving offshore
5. Buying subassemblies offshore
6. Manufacturing already offshore
7. Technology no longer available in United States
8. Increased production
9. Merging divisions
10. Trade agreement

A DOZEN MAJOR PURCHASING ISSUES

1. Pricing
2. Availability/lead times
3. Quality/reliability
4. On-time delivery
5. FMVs/trade agreement
6. Cost control
7. Inventory
8. Surface mount
9. New products/product obsolescence
10. ASICs
11. Offshore manufacturing and procurement
12. Just-in-time delivery

SURVEY SUMMARY

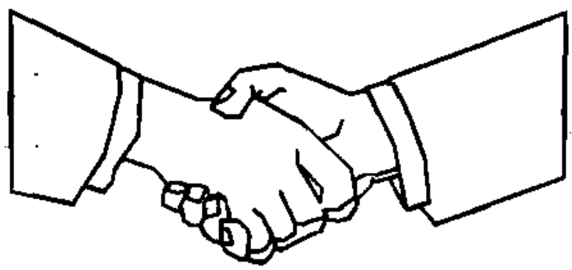
- Users expect moderate growth in purchases.
- Shifts in electronic equipment production offshore may have long-term implications for domestic semiconductor consumption.
- Inventories are being affected by changing operations.
- Users are dealing with significant business issues that are a function of a competitive global marketplace.

SHORT-TERM OUTLOOK

WORKING PARTNERSHIPS ARE CRUCIAL

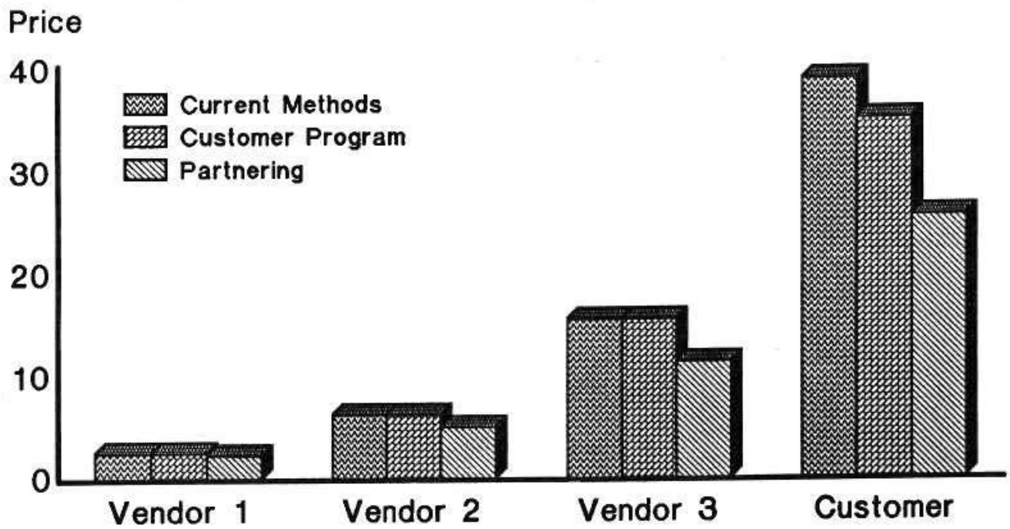
- Users need to:
  - Protect market
  - Access technology
  - Control costs

in a win–win environment with their suppliers.



THE BENEFITS OF PARTNERSHIPS

Managing Supply Line Costs



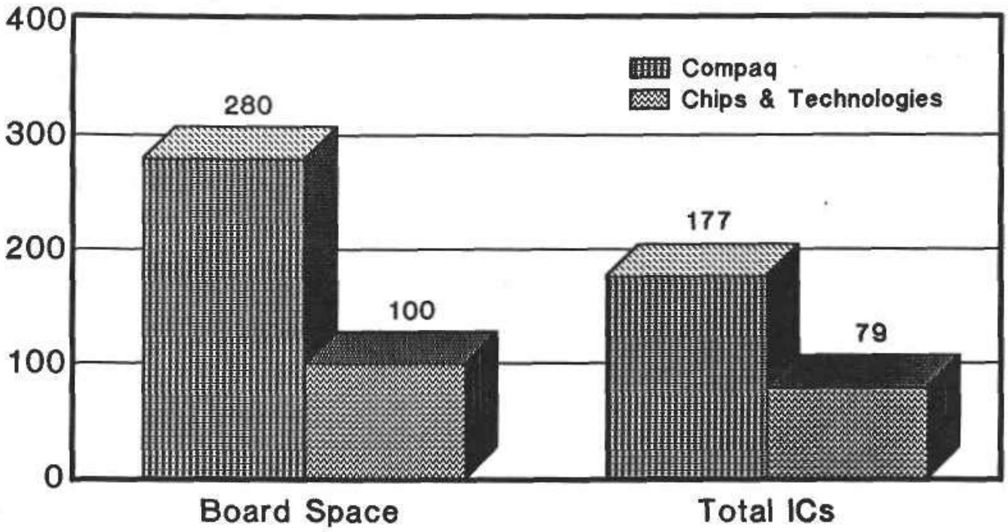
Source: Dataquest

SYSTEM TRENDS IMPACT ON SEMICONDUCTORS

RECENT PC ANALYSES

- Compaq 386 vs. the clone approach
- IBM's PS/2 – how the PC family has evolved

COMPAQ VS. CHIPS & TECHNOLOGIES: 32-BIT PC COMPARISON



Source: Dataquest

80386-BASED PERSONAL COMPUTERS

Evolution of Semiconductors in PCs
Integrated Approach

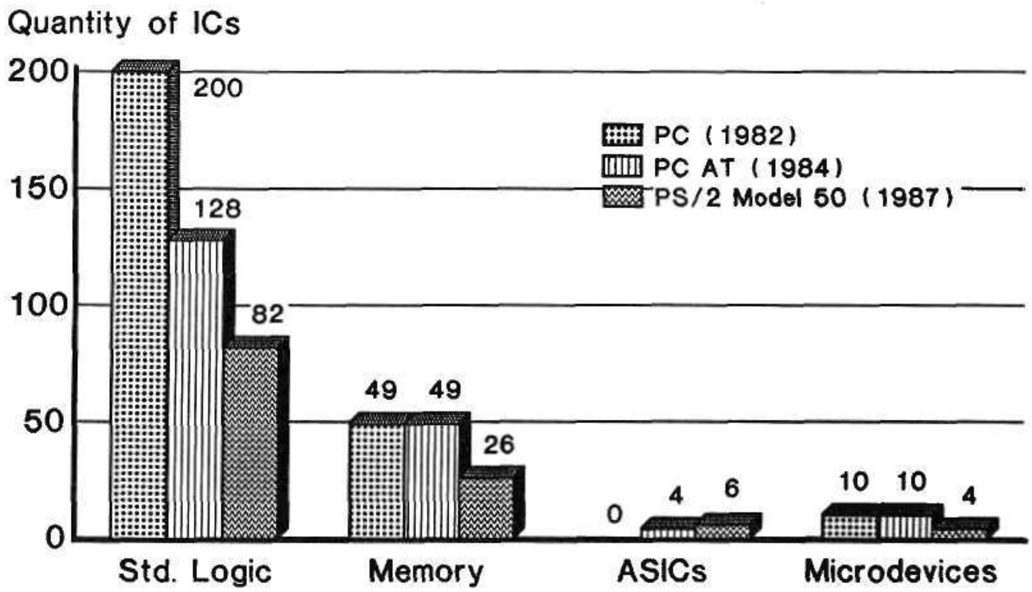
Content Breakdown	
Std. Logic	31
Memory	38
Micros	2
ASICs	8
Total	79

ASIC Functions:

- Bus control
- Page/interleave control
- Address bus interface
- Data bus interface
- Control signal buffers
- Integrated peripherals controller

Source: Dataquest

IBM PERSONAL COMPUTER SYSTEM EVOLUTION



Source: Dataquest

IC EVOLUTION IN IBM PERSONAL COMPUTERS

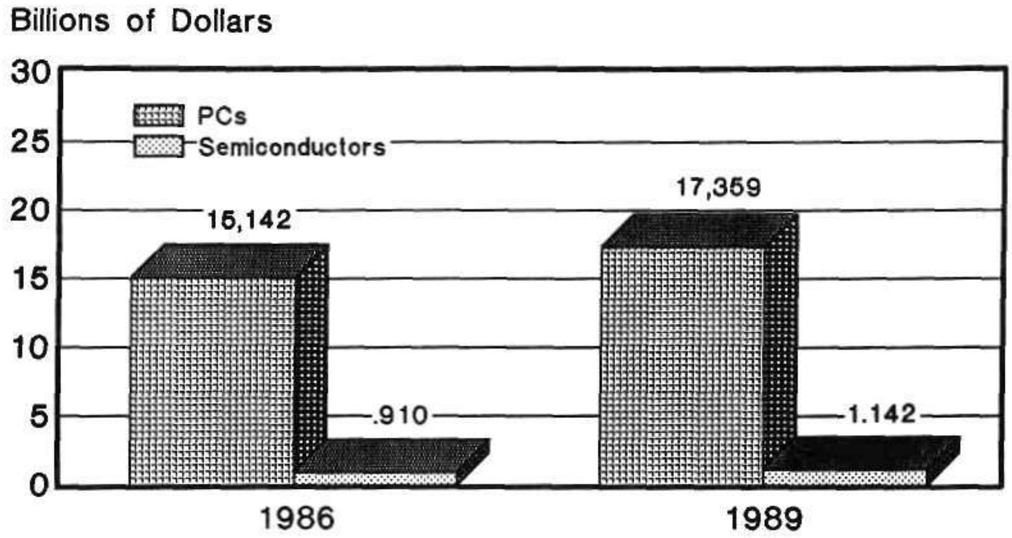
	IBM PC	PC AT	PS/2 Model 50
Total ICs	250	181	118
Std. Logic	200	128	82
Memory	41	41	26
RAM	256K	512K	1MB
Microdevices	9	9	4
Microprocessor	8088-4	80286-6	80286-10
8259A Interrupt Controller	x	x	x
8237 DMA Controller	x	x	
8253 Counter/Timer	x	x	
8255A I/O Port	x	x	
6845 CRT Controller	x	x	
D765 Floppy Controller	x	x	X
8250 Async Comm Controller	x	x	
ASICs	0	4	6

Source: Dataquest

IMPLICATIONS FOR IC MANUFACTURERS

- High growth for ASICs
  - Motherboard
  - Peripheral controllers
  - Value-added features
- High growth for memory
  - Static RAMs
  - ROMs
- Decreasing share for SSI/MSI devices

U.S. PC/SEMICONDUCTOR CONSUMPTION REVENUE FORECAST



Source: Dataquest

SEMICONDUCTOR EQUIPMENT AND MATERIALS

Markets and Technologies Status 1987

Prepared by

Semiconductor Equipment and Materials Service

Dataquest Incorporated

AGENDA

- Semiconductor production and capital spending
- Manufacturing capacity and new plants
- Fabrication equipment: forecast and status
- Silicon and epitaxial wafers: forecast and status

SEMICONDUCTOR CONSUMPTION FORECAST

(Billions of Dollars)

	1986	1987	1988	1991	CAGR 1986-1991
U.S.	10.2	12.0	14.8	18.3	12.4%
Japan	12.4	13.7	15.6	22.8	13.0%
Europe	5.5	6.8	8.3	10.8	14.4%
ROW	2.9	4.2	5.5	7.0	19.3%
Total	31.0	36.7	44.2	58.9	13.7%
Annual Growth (%)	24.9%	18.1%	21.1%	N/A	

N/A = Not applicable

Source: Dataquest

SEMICONDUCTOR PRODUCTION FORECAST

(Percent of Total)

	1986	1987	1988	1991	CAGR 1986–1991
U.S.	46.1	46.2	45.9	48.1	15.8%
Merchant	32.9	33.1	33.0	33.9	
Captive	13.2	13.1	12.9	14.2	
Japan	42.3	41.9	41.8	38.9	12.9%
Europe	9.8	10.2	10.5	11.0	17.5%
ROW	1.8	1.7	1.8	1.9	16.3%

Source: Dataquest

CAPITAL SPENDING FORECAST

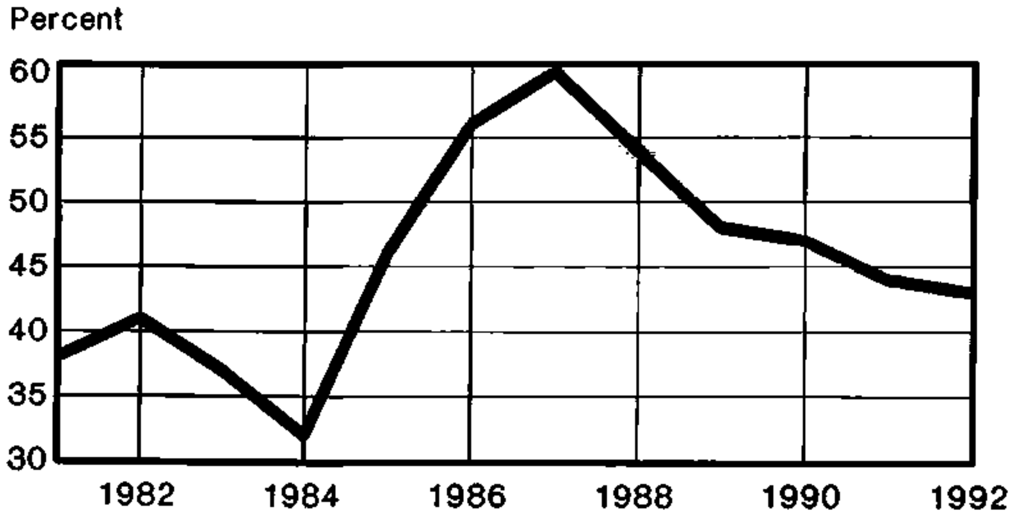
(Millions of Dollars)

	1986	1987	1988	1991	CAGR 1986-1991
U.S.	2,560	2,916	3,752	4,963	14%
Japan	1,754	1,688	2,026	4,893	23%
Europe	670	764	965	1,405	16%
ROW	275	406	648	969	29%
Total	5,260	5,774	7,337	12,230	18%
Growth (%)	(29.8)	9.8	27.1	N/A	N/A

N/A = Not applicable

Source: Dataquest

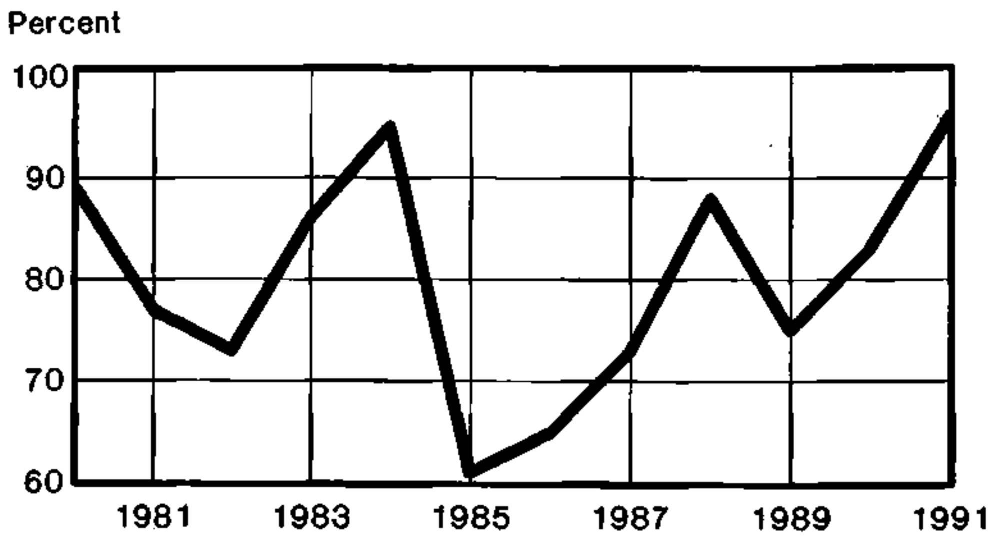
ESTIMATED CAPTIVE CAPITAL SPENDING AS PERCENT OF NORTH AMERICAN MERCHANT CAPITAL SPENDING



Source: Dataquest

ESTIMATED CAPACITY UTILIZATION

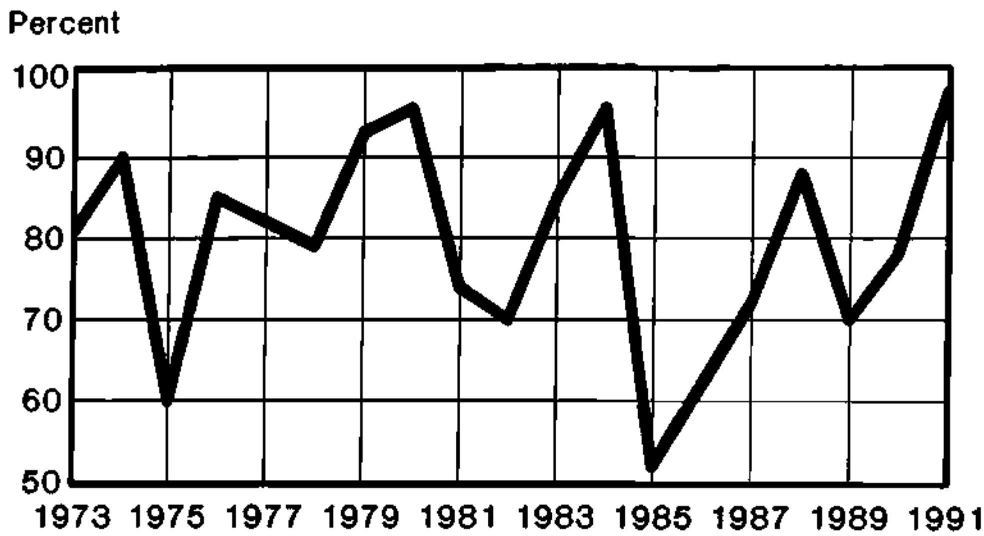
World



Source: Dataquest

ESTIMATED PERCENT OF CAPACITY

North America

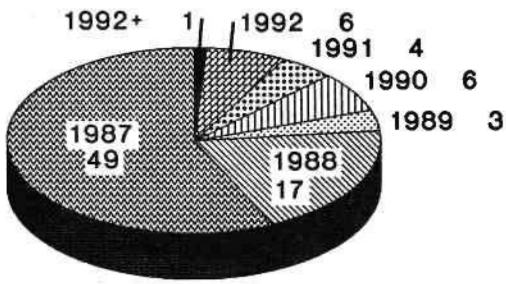


Source: Dataquest

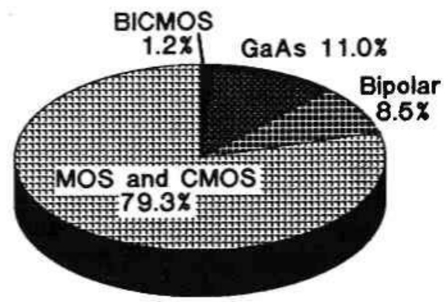
FORECAST U.S. FABRICATION PLAN

Strategic Planning

86 Planned Constructions



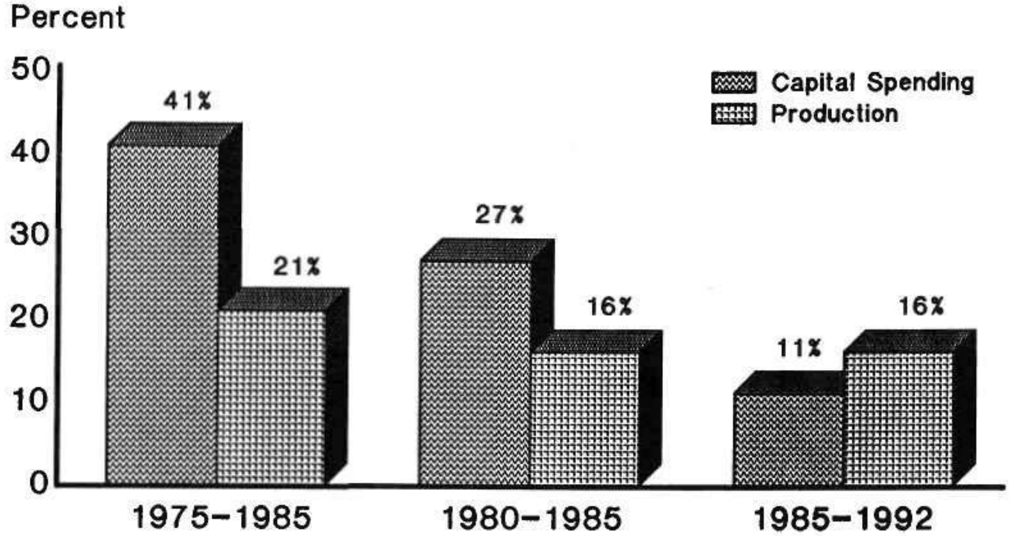
By Year



By Technology

Source: Dataquest

DECLINING CAGR
CAPITAL SPENDING VS. PRODUCTION



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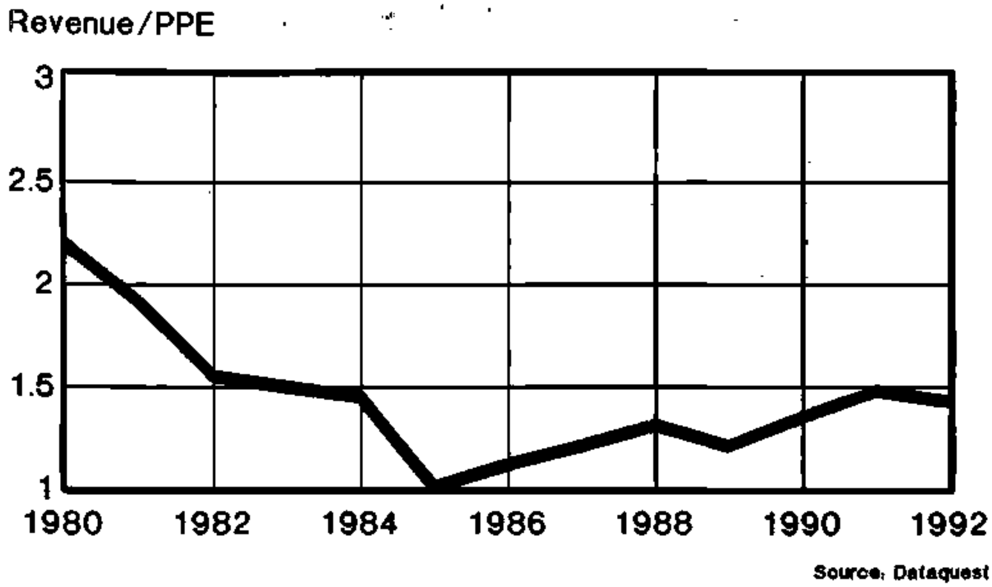
REVENUE/PPE
WORLDWIDE INSTALLED BASE



JAPAN 1989-92
A TOUGH SITUATION

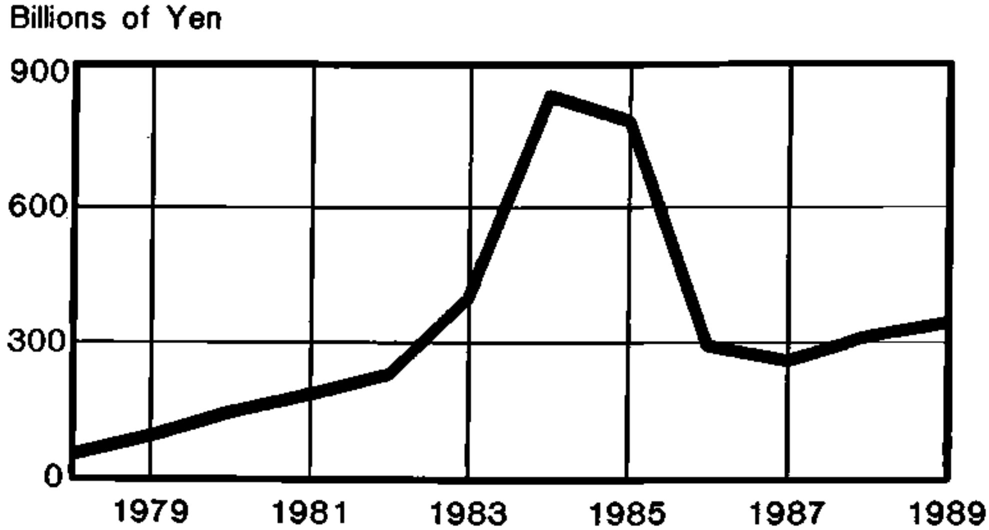
Where's the capacity?

JAPAN
THE SHORT TERM, 1987-88
A TOUGH SITUATION

- Trade friction
- Yen shock
- Overcapacity
- Pacific Rim competition
- U.S. DRAM reentry

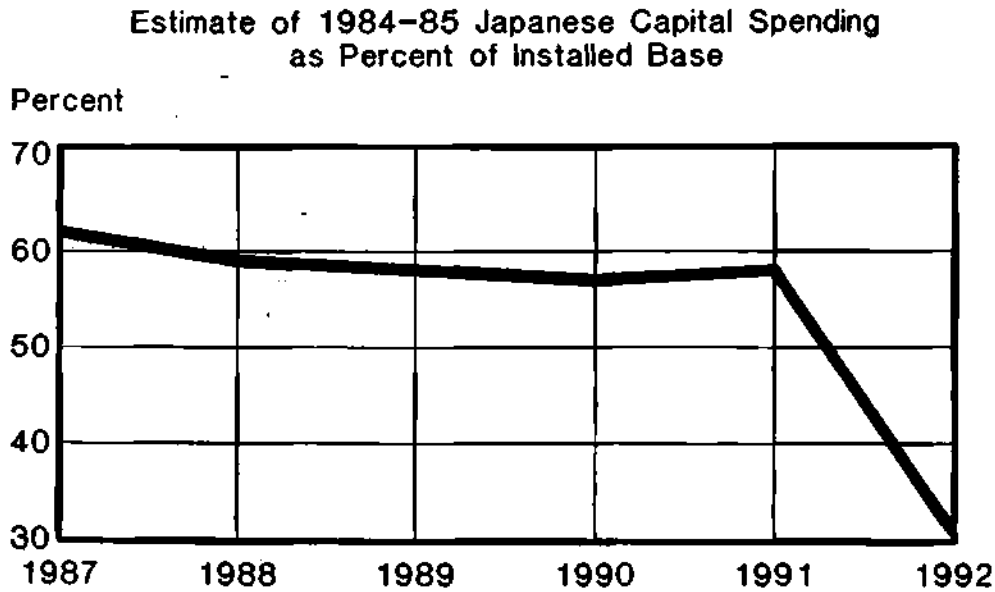
THE BULGE IN THE PYTHON

Estimated Japanese Capital Spending



Source: Dataquest

CAMEL AS PERCENT OF INSTALLED BASE



Source: Dataquest

ESTIMATED JAPANESE CAPITAL SPENDING

	1983	1984	1985	1986	1987
Yen	399	848	793	293	260
Dollars	1,698	3,578	3,332	1,754	1,688
Percent Change Yen	74%	113%	(6%)	(63%)	(11%)
Percent Change Dollars	84%	111%	(7%)	(47%)	(4%)

Source: Dataquest

ESTIMATED JAPANESE CAPITAL SPENDING

	1988	1989	1990	1991	1992
Yen	312	359	538	753	1,008
Dollars	2,026	2,330	3,495	4,893	6,543
Percent Change Yen	20%	15%	50%	40%	34%
Percent Change Dollars	20%	15%	50%	40%	34%

Source: Dataquest

FABRICATION EQUIPMENT CONSUMPTION FORECAST

(Millions of Dollars)

	1986	1987	1988	1991	CAGR 1986-1991
Lithography	659	771	963	1,436	16.8%
Etch and Clean	504	545	687	983	15.9%
Deposition	585	661	823	1,225	16.7%
Implant	200	265	342	498	17.1%
Process Control	403	463	594	857	16.6%
Other Equipment	515	579	700	995	14.1%
Total	2,866	3,284	4,109	5,994	16.2%
Growth (%)	(11.4%)	14.6%	25.1%	N/A	

N/A = Not applicable

Source: Dataquest

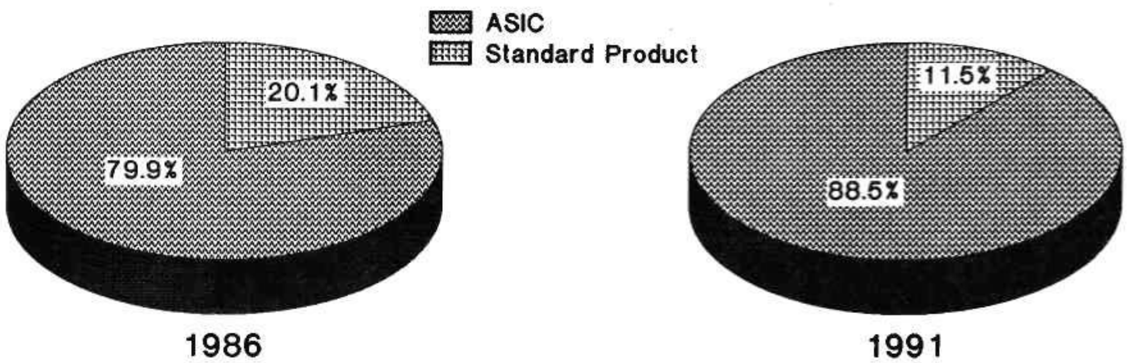
LITHOGRAPHY

The One-Micron Molehill

- Optical steppers for 64-Mbit DRAM
  - Excimer laser through 0.3 micron
  - Direct write a niche at best
- Excimer steppers
  - GCA VHSIC prototype
  - Cymer excimer source (start-up)
- The ASIC effect
  - Quick turn/quick set-up
  - 90% of masks by 1991
  - Ateq/optical PG

TOTAL MASTER MASKLAYERS

Standard Product vs. ASIC



Master layers growing at 11.4% CAGR
Number of flashes growing at 43.9% CAGR

Source: Dataquest

THIN-FILM DEPOSITION

- Total deposition market down 11% from 1984
  - CVD down 26%
  - PVD up 3%
- Competitive status
  - ASM holds 15% of CVD market
  - Ulvac holds 22% of PVD market
  - Varian holds 18% of PVD market

Source: Dataquest

CVD STRATEGIES

- Dielectrics
  - Applied
  - Novellus
  - Focus
  - SVG/Anicon
- Refractories
  - Genus
  - Varian
  - Ulvac
  - Spectrum

IMPLANT MARKETS

- Total market down 56% from 1984
  - High current down 61%
  - Medium current down 56%
- Competition
  - Veeco abandoned market
  - Applied/ASM new entrants
  - Varian has 40% of market share
  - Eaton has 33% of market share

Source: Dataquest

IMPLANT TRENDS

- Medium current will be strong
- High–voltage market: a new frontier
- Productivity paramount: set–up time, reliability, throughput

EPITAXY MARKET

- Total market down 56% from 1984
- Competition
  - AMT holds 70% of market
  - Gemini has 23% of market

Source: Dataquest

EPITAXY TRENDS

- CMOS on epi
  - Slow to come
  - Primarily silicon suppliers
  - 4 Mbit DRAMs
- New systems
  - Applied 7010
  - Gemini Tetron One
  - Epsilon – introduction in October

ETCH AND STRIP

- Market down 25% from 1984
- Competition
  - Applied gains share: 31% of market
  - Branson/IPC hold 31% share of strip
  - Tegal gains on Lam: 13% vs. 12%
- Trends
  - Process opportunity: trench and refractory metals
  - Single-wafer strip: replace wet and barrel strip

Source: Dataquest

AUTOMATION ISSUES

Automation on Hold

- Reduced capital spending
- Low capacity utilization
- Need to justify return on investment
- Evaluation of next-generation automation

FAB EQUIPMENT MARKET SHARES

(Percent of Total)

	1984	1985	1986
Total market ($M)	3,121	2,755	2,077
Perkin Elmer		6.3	7.1
Applied Materials	4.9	4.6	5.9
Varian	6.8	6.5	5.7
Nikon	6.2	4.8	5.1
GCA	7.3	4.8	4.2
Ulvac	1.9	2.5	3.7
Thermco	2.7	3.5	3.5
General Signal	3.7	3.6	3.4
Eaton	5.2	5.3	2.8
Anelva	2.3	2.8	2.1

Source: Dataquest

WORLDWIDE MERCHANT SILICON COMPANY MARKET SHARE, 1985

(Millions of Dollars)

Company	Silicon and Epitaxial Wafer Sales	Percent Share
Shin-Etsu Handotai	$ 310.0	24.5%
Wacker	205.0	16.2
Osaka Titanium Company	160.0	12.6
Monsanto	137.0	10.8
Japan Silicon	128.0	10.1
Komatsu Electronic Metals	116.0	9.2
Others	210.5	16.6
Total	$1,266.5	100.0%

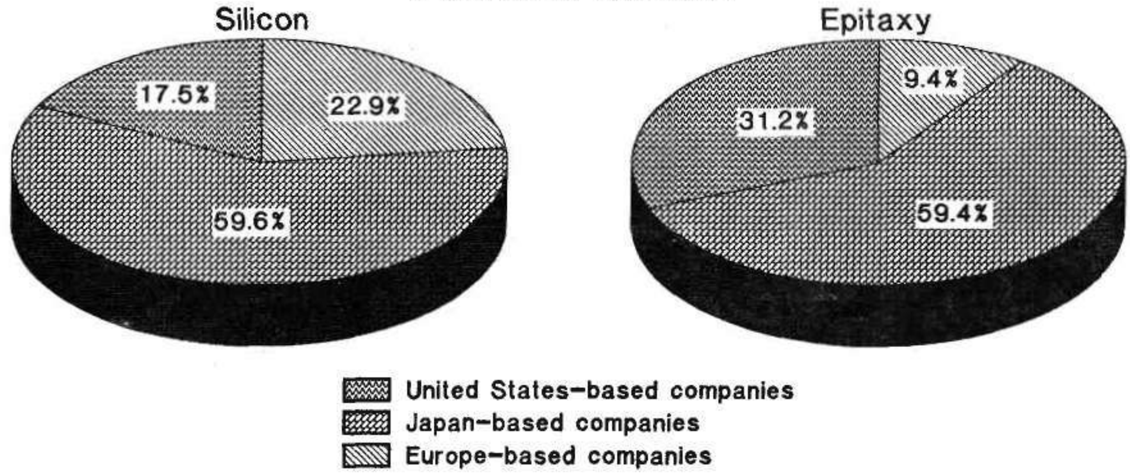
Source: Dataquest

ACQUISITIONS

1985	Nippon Kokan K.K.	→	Great Western Silicon
1985	Kawasaki Steel	→	NBK
1986	Mitsubishi Metal	→	Siltec
1986	Osaka Titanium	→	U.S. Semiconductor
1987	Union Carbide	→	Eastman Kodak's Photoresist Operation

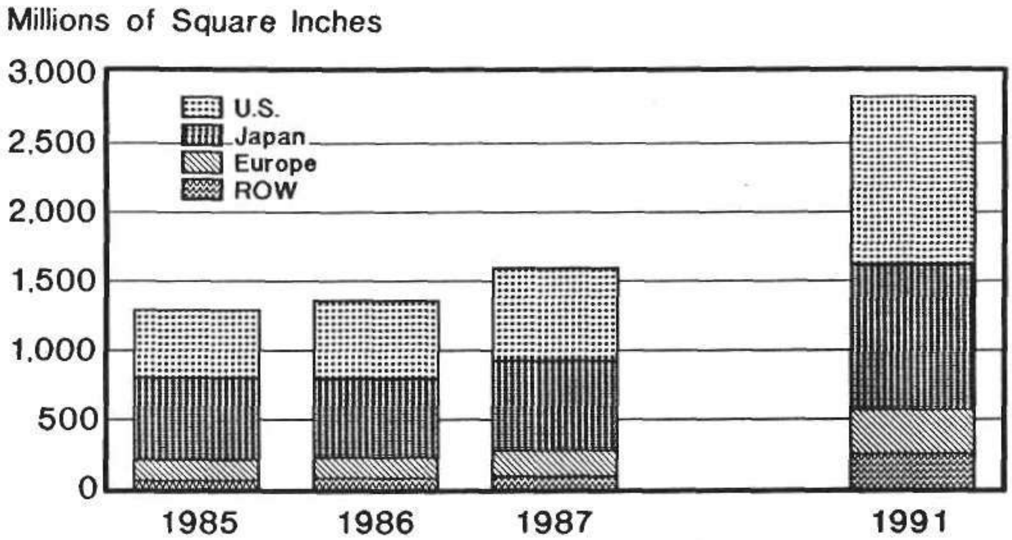
SILICON AND EPITAXIAL WAFER MARKETS
1985

Merchant Supplier Base
(Percent of Revenue)



Source: Dataquest

ESTIMATED SILICON AND EPITAXIAL WAFER CONSUMPTION

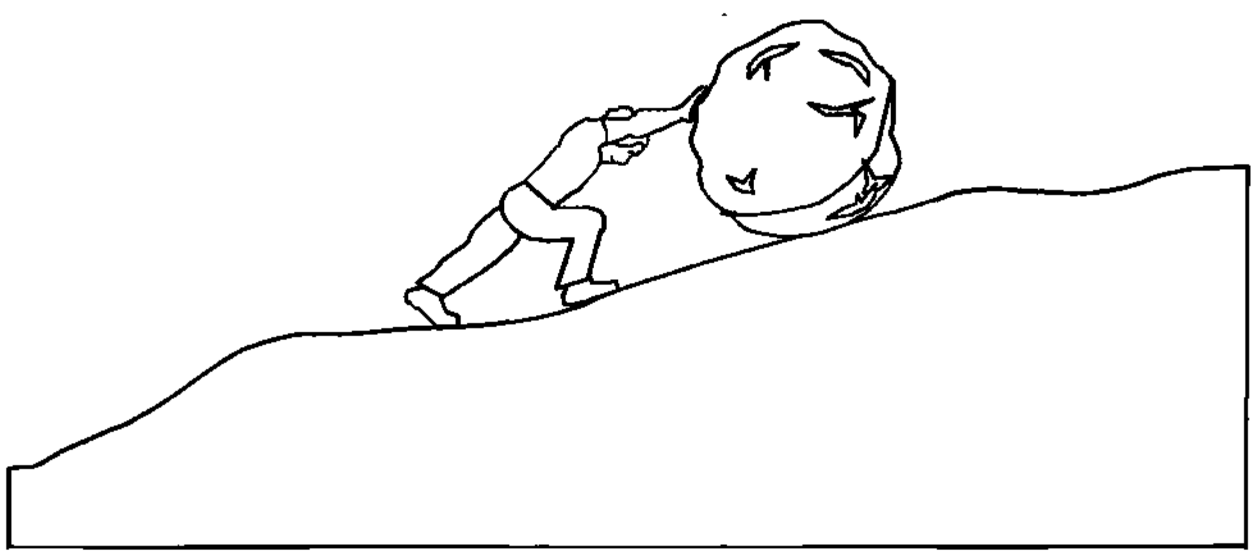


Source: Dataquest

SAFETY ISSUES

- Photoresist
  - Safe solvents
- Specialty Gases
  - Toxic gas "scrubbers"
    - Mitsubishi's Toxoclean System
    - AZ Guardian
    - Liquid Air's Toxic Gas Adsorber

SISYPHUS
Maturity After Globalization



WORLD SEMICONDUCTOR OUTLOOK

Semiconductor Industry Group
Dataquest Incorporated

FIRST HALF 1987
SIGNIFICANT HAPPENINGS

- Book-to-bill rising
- Profits improving
- Trade sanctions
- Consolidation
- New product explosion
- Defense Science Board recommendation
- Sematech founding

1986 TOTAL SEMICONDUCTOR RANKING

1986 Rank	1985 Rank	Company	1985 ($M)	1986 ($M)	Percent Change
1	1	NEC	1,984	2,638	33.0%
2	4	Hitachi	1,671	2,305	37.9%
3	5	Toshiba	1,468	2,276	55.0%
4	2	Motorola	1,830	2,025	10.7%
5	3	Texas Instruments	1,742	1,782	2.3%
6	6	Philips-Signetics	1,068	1,356	27.0%
7	7	Fujitsu	1,020	1,310	28.4%
8	10	Matsushita	906	1,204	32.8%
9	11	Mitsubishi	642	1,138	77.2%
10	8	Intel	1,020	991	(2.8%)

Source: Dataquest

1986 TOTAL MOS RANKING

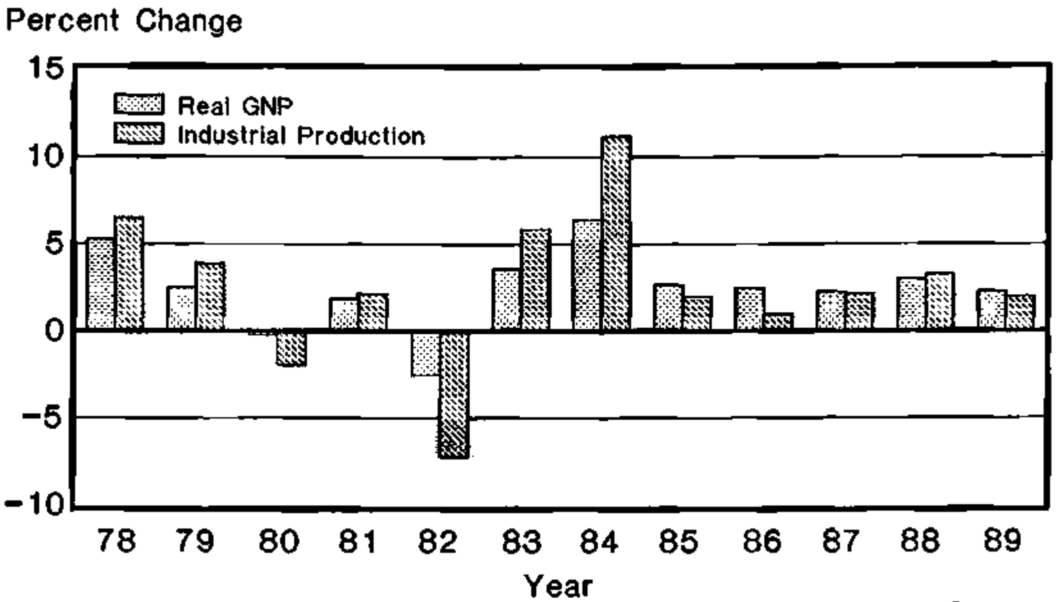
1986 Rank	1985 Rank	Company	1985 ($M)	1986 ($M)	Percent Change
1	1	NEC	1,174	1,615	37.6%
2	3	Hitachi	852	1,167	37.0%
3	4	Toshiba	736	1,106	50.3%
4	2	Intel	998	970	(2.8%)
5	6	Fujitsu	631	791	25.4%
6	5	Motorola	668	727	8.8%
7	10	Mitsubishi	323	569	76.1%
8	7	Texas Instruments	522	475	(9.0%)
9	11	Matsushita	269	386	43.4%
10	12	Oki	264	372	40.9%

Source: Dataquest

1987 OVERVIEW

STATUS OF REGIONAL MARKETS

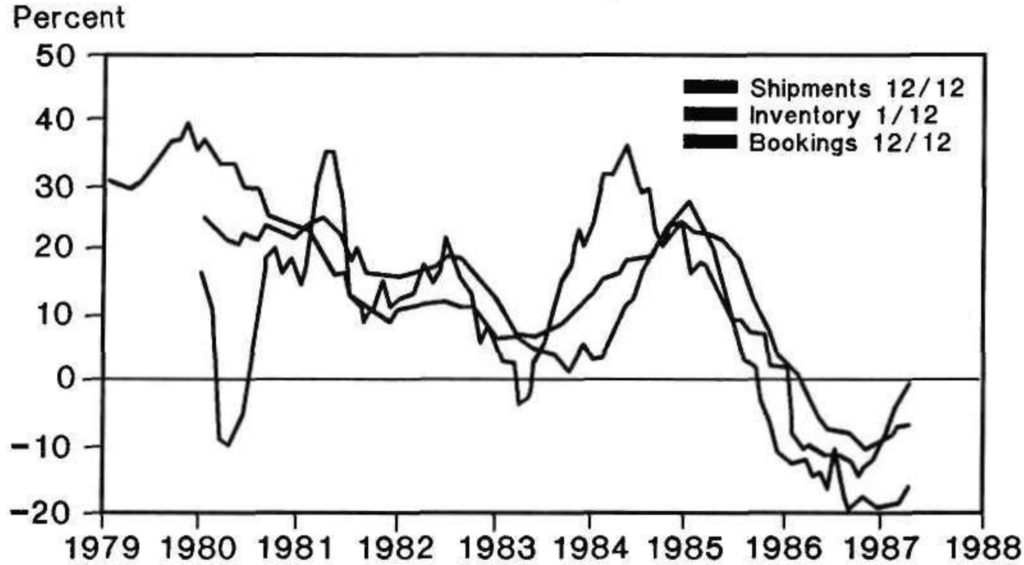
U.S. ECONOMIC INDICATORS



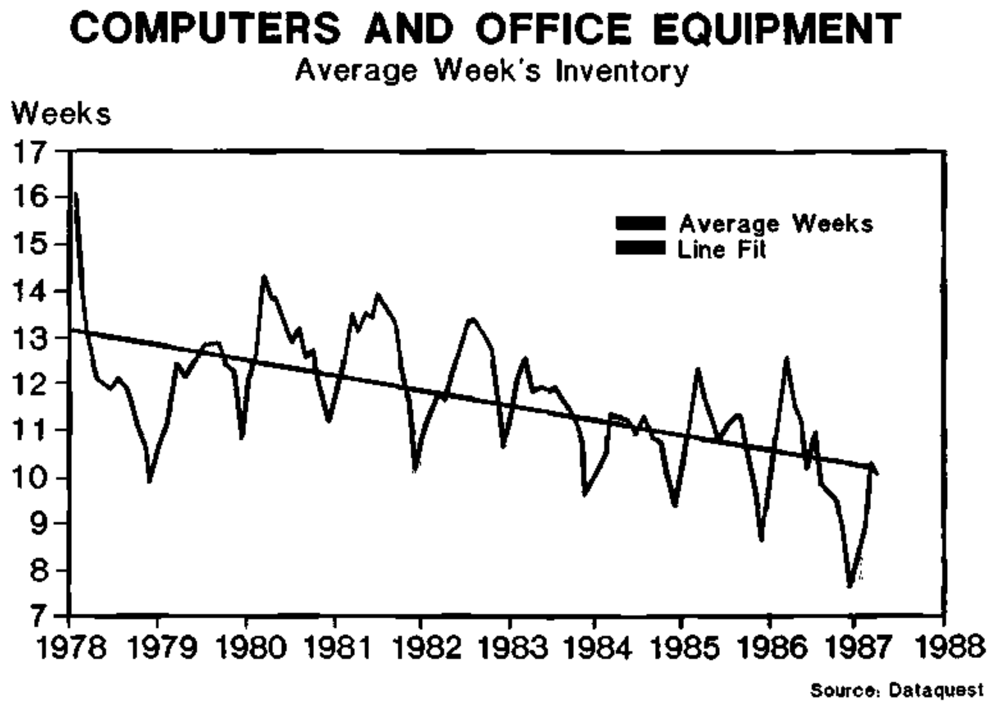
Source: Dataquest

U.S. COMPUTERS AND OFFICE EQUIPMENT

Rate of Change

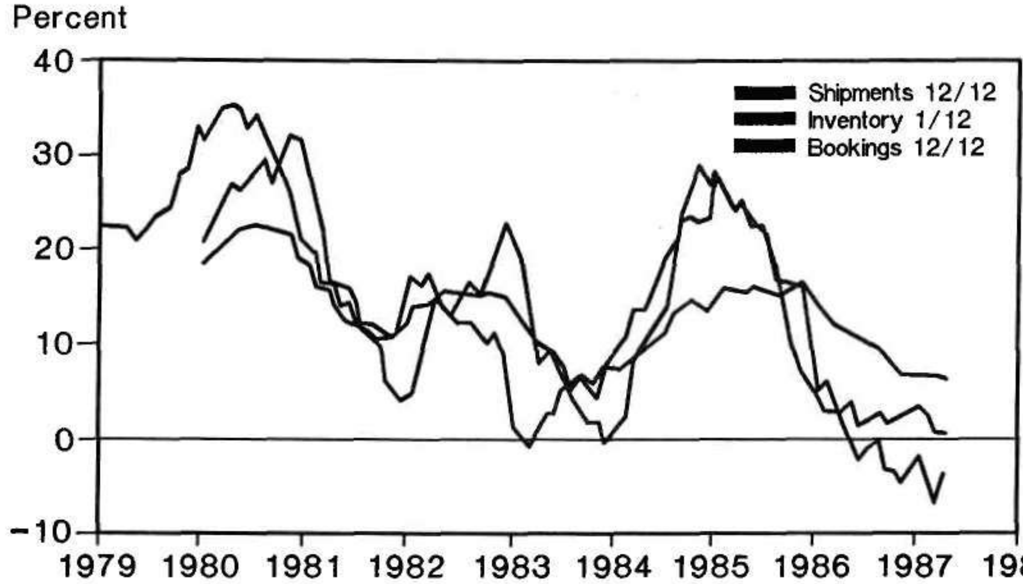


Source: Dataquest

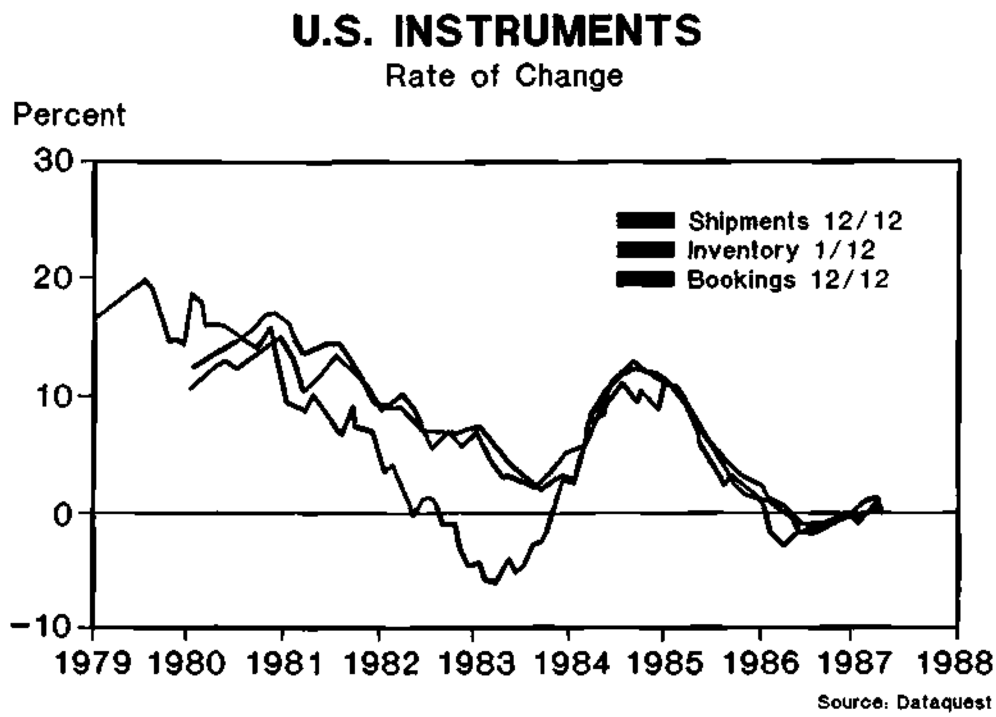

COMPUTERS AND OFFICE EQUIPMENT
Average Week's Inventory
Weeks
17
16
15
14
13
12
11
10
9
8
7
Average Weeks
Line Fit
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
Source: Dataquest

U.S. COMMUNICATIONS EQUIPMENT

Rate of Change

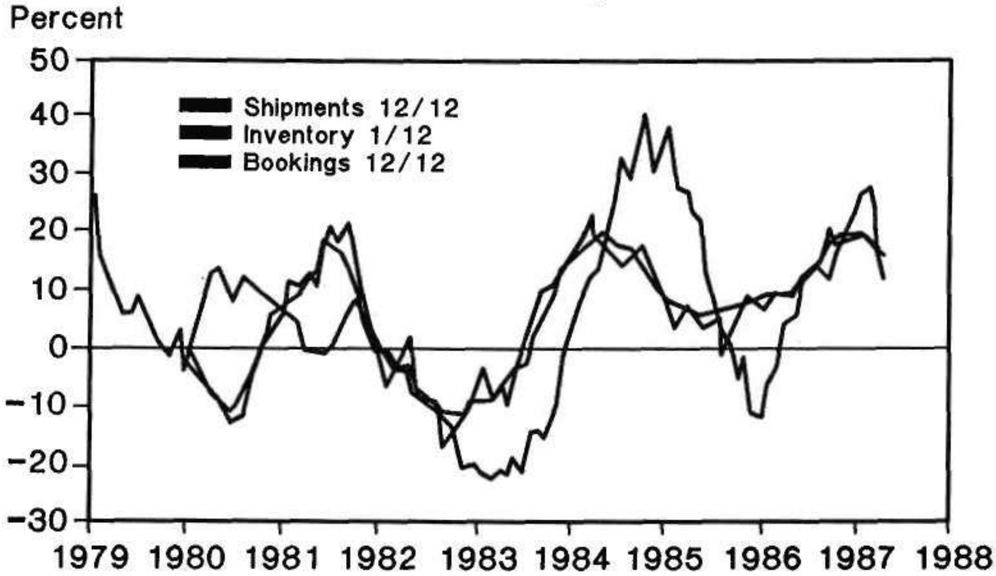


Source: Dataquest


U.S. INSTRUMENTS
Rate of Change
Percent
30
20
10
0
-10
Shipments 12/12
Inventory 1/12
Bookings 12/12
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
Source: Dataquest

U.S. RADIO AND TELEVISION

Rate of Change

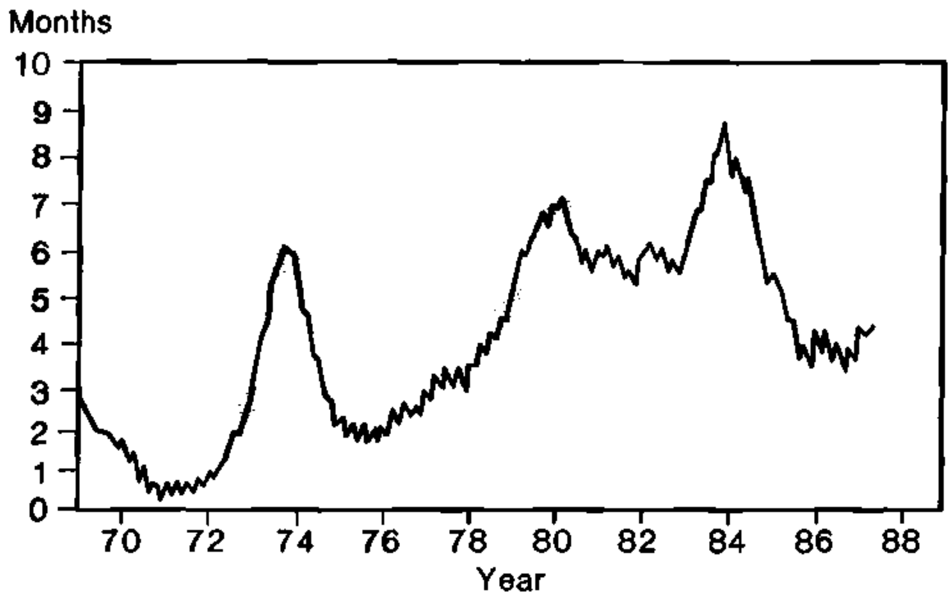


Source: Dataquest

U.S. MARKET STATUS

- Book-to-bill rising for six months
  - May = 1.26
- May bookings very strong, especially distribution
- Trade sanctions by U.S. government having an impact
- PC/workstation/telecom markets leading the recovery

U.S. SEMICONDUCTOR BACKLOG



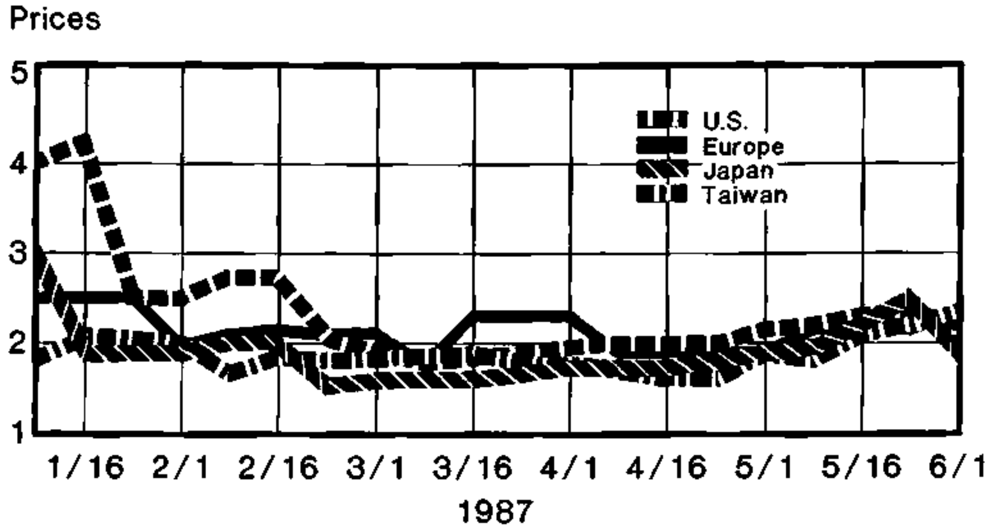
Source: WSTS
Dataquest

DQ MONDAY REPORT

- On-line analysis for DQ clients
  - Covers markets of U.S., Japan, Europe, Taiwan, Hong Kong, and Korea
- Biweekly updates
  - Regional market ASPs and lead times for 25 commodity semiconductor devices with pricing analysis
- 1K, 10K, and high-volume (>100K) prices
- Weekly market intelligence and analysis gathered from Dataquest researchers around the world

DQ MONDAY REPORT

256K DRAM Prices



Source: DQ Monday

MARKET SHARE

- U.S. manufacturers lost share of Japanese market in 1986
- Japanese manufacturers gained share of U.S. market in 1986
- In Q1 1987, U.S. manufacturers continued to lose share of Japanese market
- In Q1 1987, Japanese manufacturers continued to gain share of U.S. market
  - Biggest areas of gain:
    - MOS memory
    - MOS logic (excluding micro)
    - Discretes

Source: Dataquest

U.S. SEMICONDUCTOR COOPERATIVE EFFORTS

- Sematech
- SRC
- MCC
- VHSIC

WHAT IS SEMATECH?

- Independent corporation
- Annual budget $250 million
- 50/50% industry/government
- Develop equipment and processes for 1990 technologies
- Midsummer - site selection
- Full production by September 1988
- Total population 120 by end of 1987

STATUS OF SRC

- Founded in 1982
- 50 contracts at 40 universities – $18 million
- Have three university Centers of Excellence
- Good acceptance from industry and government

EUROPEAN MARKET STATUS

- Book–to–bill ratio rising for five months
  - May = 1.09
- Prices rising, especially for DRAMs
- Allocation of EPROMs
- ASIC products revolutionizing new system products
  - 1987 is crossover year
- SGS–Thomson merger

JAPAN MARKET STATUS

- VCR and TV production decreasing
- Inventory increasing in CDs, VCRs, MOS memories, and other MOS products
- Very large competition among manufacturers for survival
  - Sales and earnings down in last fiscal year for almost all

JAPAN MARKET STATUS

- U.S. manufacturers lost share in 1986
- Korean competition fierce in Asia
- Companies moving factories to Asia to offset impact of yen. Plans to double Asian production
- Capital spending will decrease for third year in a row

MARKET ACCESS

- 45 companies directed by MITI to procure foreign semiconductors
- 7 have announced their plans for doing so
- INSEC established in March to promote foreign imports

COMPANIES DIRECTED TO PROCURE FOREIGN SEMICONDUCTORS

	Consumer		Home		Industrial				
Company	Video	Audio	Automation	Others	Computer	EDP	Comm.	Ind.	Others
Aiwa		X				X	X		
Advantest								X	X
Akai Electric	X	X							
Alps Electric					X	X			
Alpine Electronics									X
Ando Electric								X	X
Anritsu								X	
Brother Industries				X		X			
Canon				X		X	X		X
Casio Computer	X			X	X	X	X		
Citizen Watch	X			X		X		X	

Continued

Source: MITI
Dataquest

COMPANIES DIRECTED TO PROCURE FOREIGN SEMICONDUCTORS

	Consumer				Industrial				
Company	Video	Audio	Home Automation	Others	Computers	EDP	Comm.	Ind.	Others
Clarion									X
Commodore Japan					X	X			
Fanuc								X	
Fuji Electric								X	X
General	X	X	X			X			
Fujitsu Ten									X
Fuji Xerox					X	X			
Iwatsu Electric							X	X	
JVC	X	X							
Kenwood		X					X	X	
Kokusai Electric						X	X		

Continued

Source: MITI
Dataquest

COMPANIES DIRECTED TO PROCURE FOREIGN SEMICONDUCTORS

	Consumer				Industrial				
Company	Video	Audio	Home Automation	Others	Computers	EDP	Comm.	Ind.	Others
Kyocera	X			X		X	X		
Minolta Camera				X		X			
NEC HE	X	X							
Nintendo				X					
Nippon Denshi Kiki									X
Nippondenso									X
Nippon Gakki		X		X					
Nippon Musen						X	X		
Nitsuko						X	X		
IBM Japan					X	X			
Orion Denki	X								

Continued

Source: MITI
Dataquest

COMPANIES DIRECTED TO PROCURE FOREIGN SEMICONDUCTORS

	Consumer		Home		Industrial				
Company	Video	Audio	Automation	Others	Computers	EDP	Comm.	Ind.	Others
Panafacom					X				
Pioneer	X	X						X	
Ricoh				X	X	X	X		
Sankyo Seiki Mfg.						X		X	
Sega Enterprises				X					
Seiko Epson					X	X		X	
Omron Tateisi						X			
Tokyo Electric					X	X			
UNISEF		X							
USAC Electronics					X	X			
Yokogawa Electric					X			X	
Yokogawa HP								X	X

Continued

Source: MITI
Dataquest

FOREIGN SEMICONDUCTOR PROCUREMENT ACTIVITIES BY JAPANESE USERS

Company	1986	1987	Remarks
NEC	18.0%	20.0%	AMD - largest U.S. vendor
Fujitsu	10.0%	12.0%	Procurement from Signetics and MMI
Oki	¥5.0B	¥5.5B	
Hitachi	N/A	50% and up	

N/A = Not available

Source: Dataquest

FOREIGN SEMICONDUCTOR PROCUREMENT ACTIVITIES BY JAPANESE USERS

Company	Activity
NEC	International procurement department
Toshiba	Semiconductor marketing development department
	Semiconductor #5 applied engineering department
	International semiconductor certification test center
Sharp	Sharp trading
Matsushita group	Import promotion committee

Note: Tentative names

Source: Dataquest

ASIAN MARKET STATUS

- Taiwan and Korea TAM growth estimated at 40 percent in 1987
- Computers and telecommunications booming
- 286 kits in big demand
- Korean and Taiwanese currencies strengthening
- Engineering centers in Taiwan, Korea, and Hong Kong growing
  - Fairchild, Motorola, NEC, and Philips
- ASETS launched March 15, 1987
  - Research centers to open in Korea, Taiwan, and Hong Kong in third and fourth quarters

Source: Dataquest

ASIA-PACIFIC CONSUMPTION

(Millions of Dollars)

	Korea		Taiwan		Total A/P	
	1986	1987	1986	1987	1986	1987
Discretes	132.0	179	112.0	149	516	712
Bipolar	286.9	384	307.6	454	1,229	1,780
MOS	187.0	291	252.7	325	985	1,463
Total	605.9	854	672.3	928	2,730	3,995

Source: Dataquest

MARKET FORECAST

ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION

(Billions of U.S. Dollars)

	1986				
	Quarter				
	1	2	3	4	Year
North America	2.3	2.6	2.6	2.6	10.2
Japan	2.7	3.0	3.4	3.2	12.4
Europe	1.3	1.4	1.4	1.4	5.5
ROW	0.5	0.7	0.8	0.8	2.9
Total World	6.9	7.8	8.3	8.1	31.0

Source: Dataquest

ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION

(Percent Change, U.S. Dollars)

	1986				
	Quarter				
	1	2	3	4	Year
North America	4.1%	13.2%	1.0%	(0.9%)	6.2%
Japan	11.4%	12.1%	13.7%	(5.6%)	43.7%
Europe	12.1%	5.5%	(2.0%)	1.0%	17.2%
ROW	16.1%	33.3%	10.5%	2.5%	53.9%
Total World	9.6%	12.9%	6.3%	(2.2%)	24.9%

Source: Dataquest

ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION

(Billions of U.S. Dollars)

	1987				
	Quarter				
	1	2	3	4	Year
North America	2.7	3.0	3.1	3.2	12.0
Japan	3.1	3.4	3.5	3.6	13.6
Europe	1.6	1.7	1.7	1.8	6.7
ROW	0.9	1.0	1.1	1.2	4.2
Total World	8.4	9.0	9.4	9.8	36.6

Source: Dataquest

ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION

(Percent Change, U.S. Dollars)

	1987				
	Quarter				
	1	2	3	4	Year
North America	4.2%	8.9%	4.0%	4.6%	18.0%
Japan	(2.7%)	7.2%	3.8%	2.9%	10.3%
Europe	10.9%	7.5%	2.5%	4.7%	21.4%
ROW	12.4%	9.2%	5.8%	7.5%	43.3%
Total World	3.4%	8.0%	3.9%	4.3%	17.9%

Source: Dataquest

ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION

(Billions of U.S. Dollars)

	1988				
	Quarter				
	1	2	3	4	Year
North America	3.4	3.6	3.7	3.8	14.4
Japan	3.7	3.9	4.1	4.2	16.0
Europe	1.9	2.0	2.0	2.2	8.1
ROW	1.2	1.3	1.4	1.5	5.5
Total World	10.2	10.8	11.3	11.7	44.0

Source: Dataquest

ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION

(Percent Change, U.S. Dollars)

	1988				
	Quarter				
	1	2	3	4	Year
North America	4.3%	6.3%	2.8%	2.7%	20.0%
Japan	2.9%	4.4%	6.4%	2.9%	17.1%
Europe	4.9%	5.9%	3.1%	5.1%	20.1%
ROW	6.6%	8.5%	6.7%	5.2%	31.6%
Total World	4.2%	5.8%	4.6%	3.5%	20.3%

Source: Dataquest

ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION

(Billions of U.S. Dollars)

	1986	1987	1988	1989	1990	1991
North America	10.2	12.0	14.4	14.3	16.0	18.2
Japan	12.4	13.6	16.0	16.7	19.0	22.8
Europe	5.5	6.7	8.1	8.2	9.2	10.8
ROW	2.9	4.2	5.5	5.2	5.9	7.0
Total World	31.0	36.5	44.0	44.2	50.1	58.8

Source: Dataquest

ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION

(Percent Change, U.S. Dollars)

	1986	1987	1988	1989	1990	1991
North America	6.2%	18.0%	20.0%	(1.2%)	11.9%	14.2%
Japan	43.7%	10.3%	17.1%	4.4%	14.3%	19.6%
Europe	17.2%	21.4%	20.1%	1.1%	12.7%	17.3%
ROW	53.9%	43.3%	31.6%	(6.1%)	14.9%	18.5%
Total World	24.9%	17.9%	20.3%	0.6%	13.3%	17.3%

Source: Dataquest

AREAS OF OPPORTUNITIES

MAJOR MARKET OPPORTUNITIES

Markets	5-Year CAGR*
32-bit PCs	53.0%
Digital TVs	30.0%
Smart Card Electronics	60.0%
Automotive Electronics	10.7%
Personal Communications	26.0%

* Measured in dollars

Source: Dataquest

HIGH-GROWTH SEMICONDUCTOR PRODUCTS

Product	Estimated CAGR 1986-1991
Cell-based ICs	38.6%
Specialty memories	38.2%
DSP chips	27.9%
Graphics chips	42.0%
32-bit MPUs	46.3%
8-bit MCUs (Smart cards)	50.0%
1Mb DRAMs	57.0%

Source: Dataquest

SEMICONDUCTOR GROWTH OPPORTUNITIES

- Smart cards and related electronic systems
- Digital TVs with VCRs
- Personal communication
- 32-bit PCs with speech recognition
- Automotive electronics

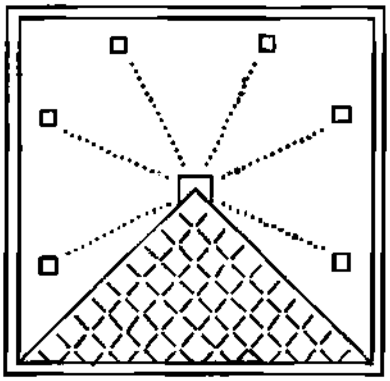
SUMMARY

SEMICONDUCTOR INDUSTRY SERVICE

Semiconductor Product Update

Prepared By:

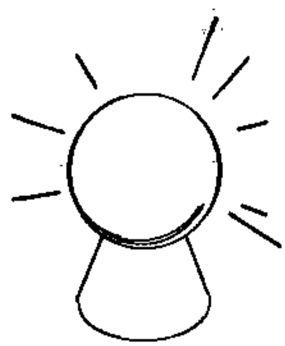
Semiconductor Industry Service
Dataquest Incorporated



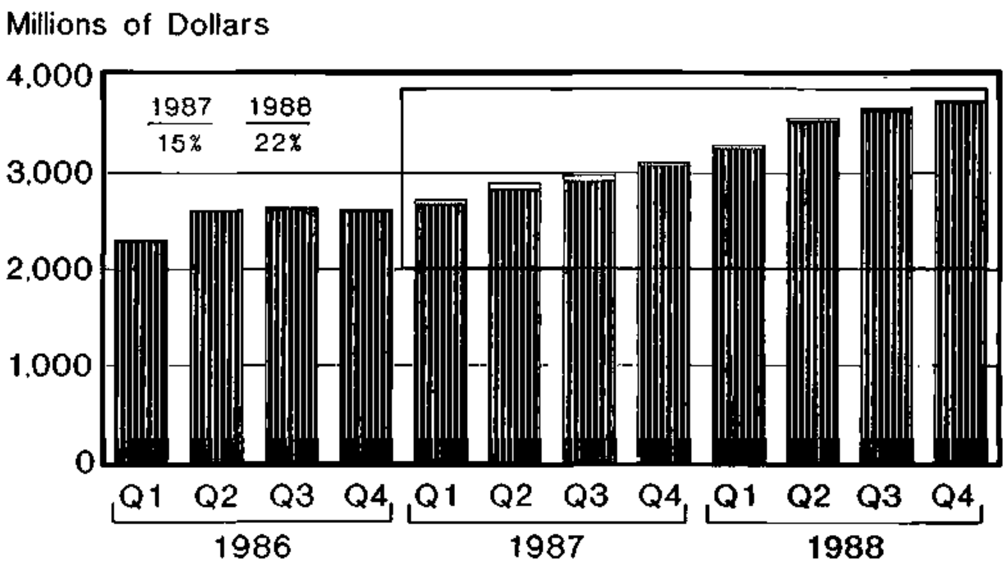
Recovery: Fact or Fiction?

Semiconductor Product Update

SEMICONDUCTOR FORECAST

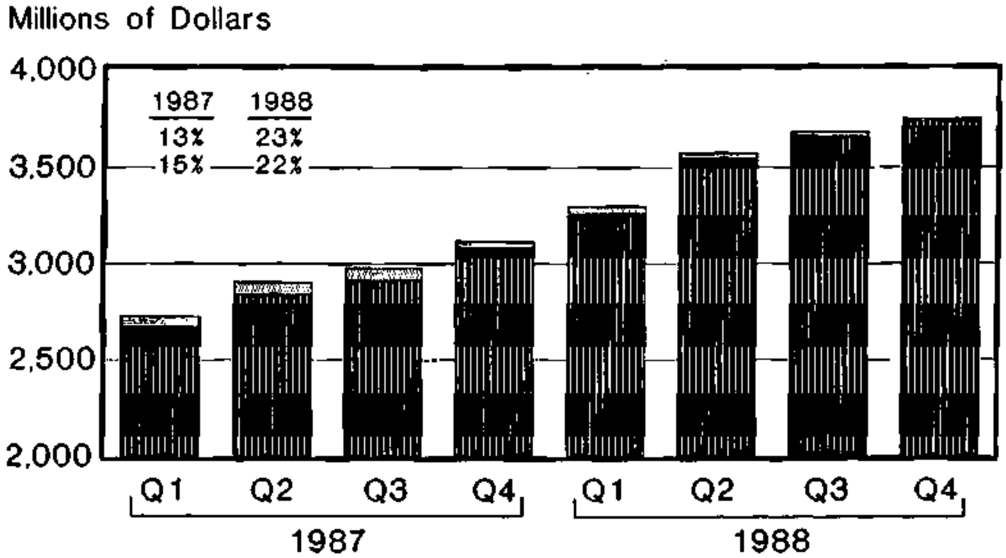


NORTH AMERICAN SEMICONDUCTOR CONSUMPTION



Source: Dataquest

NORTH AMERICAN SEMICONDUCTOR CONSUMPTION



Source: Dataquest

Recovery: Fact or Fiction?

Semiconductor Product Update

MARKET ENVIRONMENT

MARKET ENVIRONMENT

Significant Happenings

- U.S. book-to-bill ratio of 1.26 for May is highest since May 1984
- Semiconductor prices are increasing
- Some parts are being allocated
- Some companies are operating near full capacity

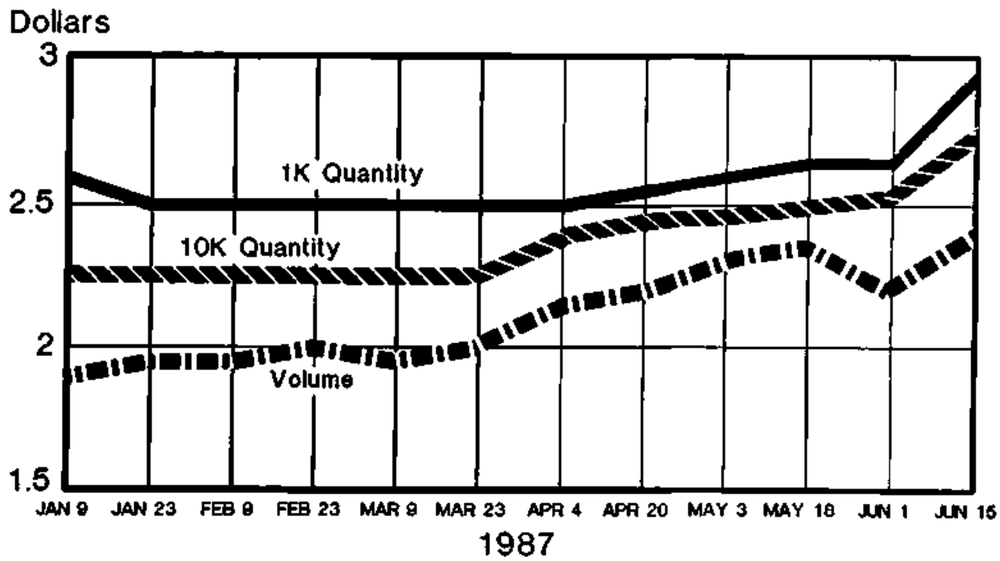
MARKET ENVIRONMENT

Significant Happenings

- Computer and office equipment sales promise sustained growth for semiconductors
- Companies return to profitability
- Worldwide capital spending up 10 percent in 1987
- Mergers and alliances continue

256K DRAM WEEKLY PRICING

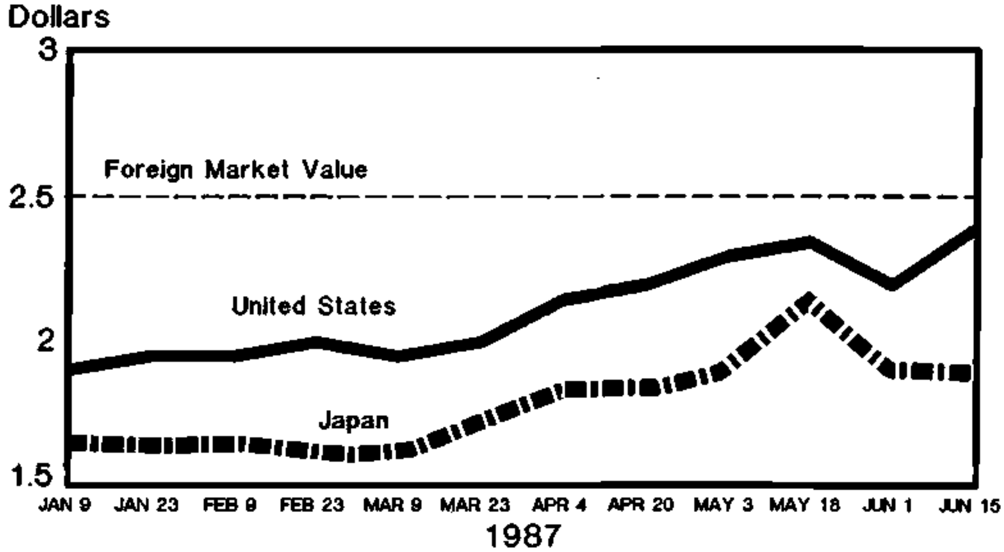
United States



Source: Dataquest

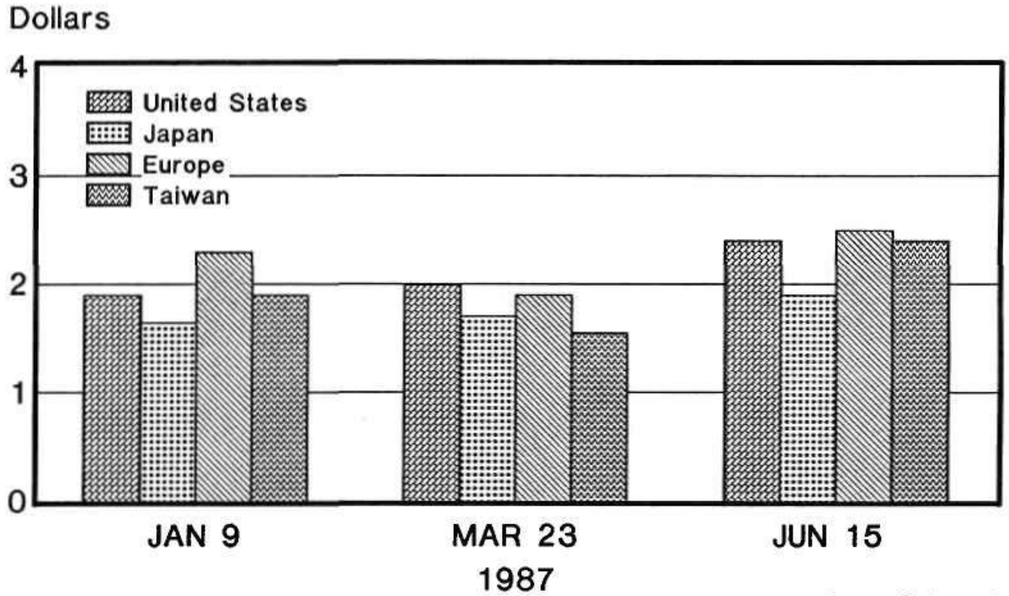
256K DRAM REGIONAL PRICING

United States and Japan



Source: Dataquest

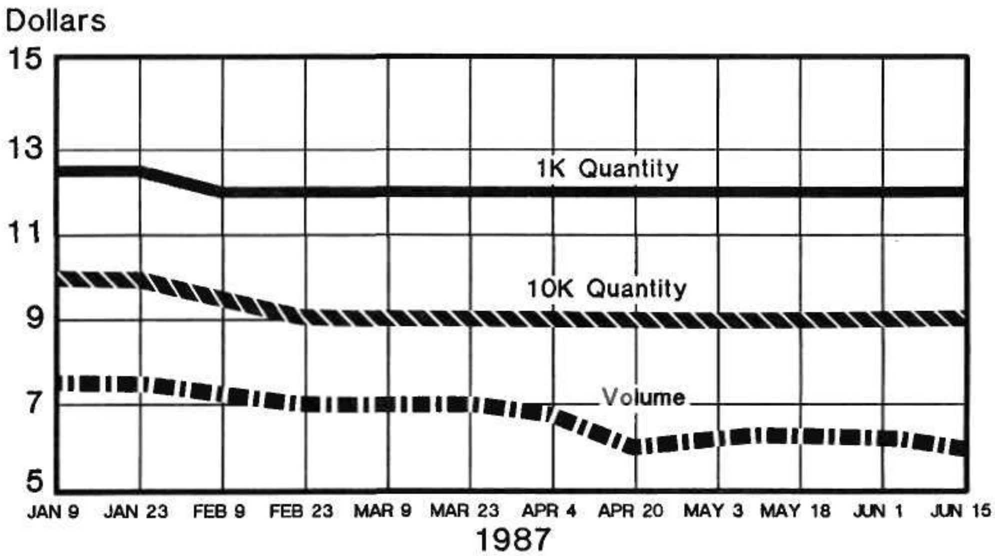
256K DRAM REGIONAL PRICING



Source: Dataquest

8086 MPU WEEKLY PRICING

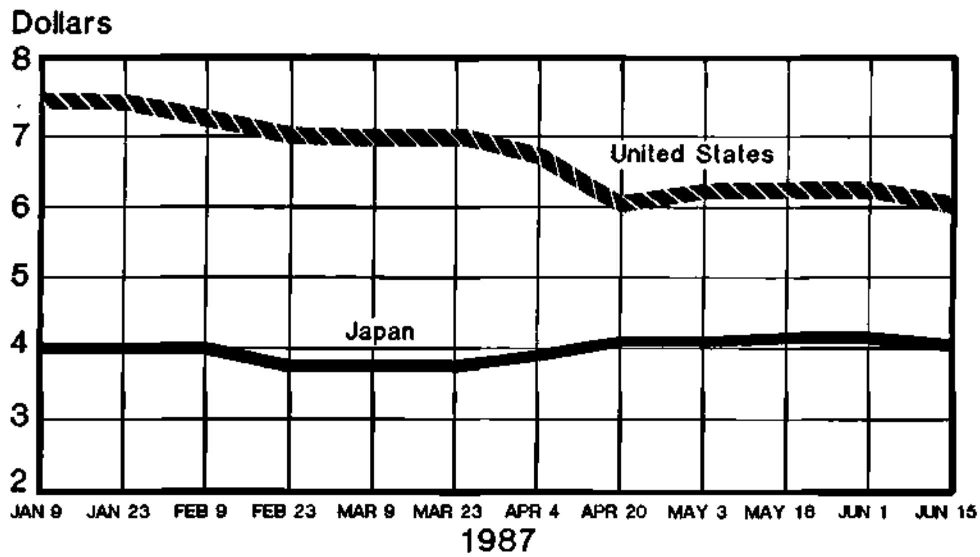
United States



Source: Dataquest

8086 MPU REGIONAL PRICING

United States and Japan

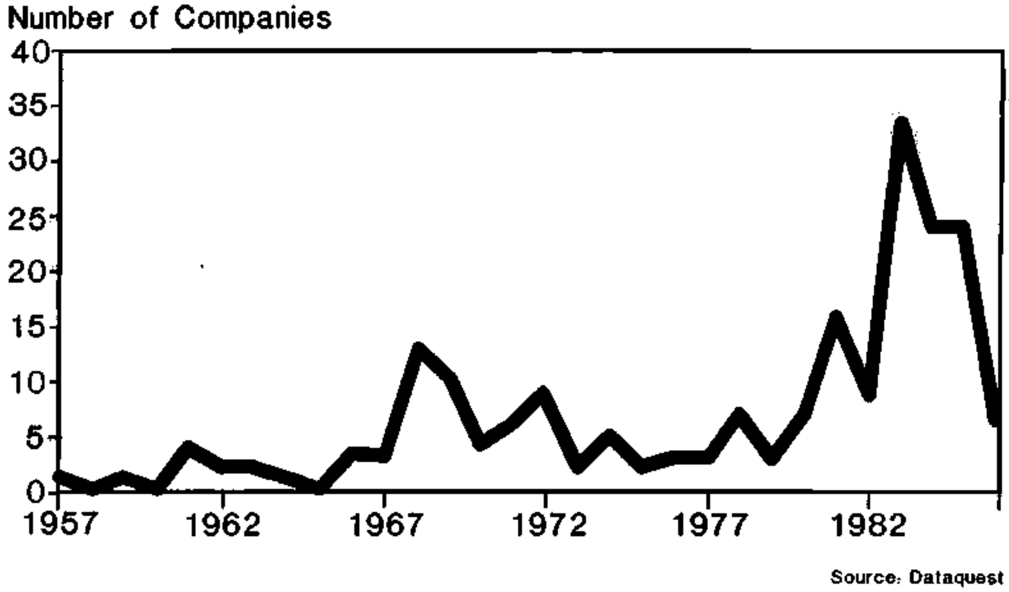


Source: Dataquest

SEMICONDUCTOR BOOK-TO-BILL RATIO

Source: Dataquest

FORMATION OF SEMICONDUCTOR COMPANIES 1957-1986

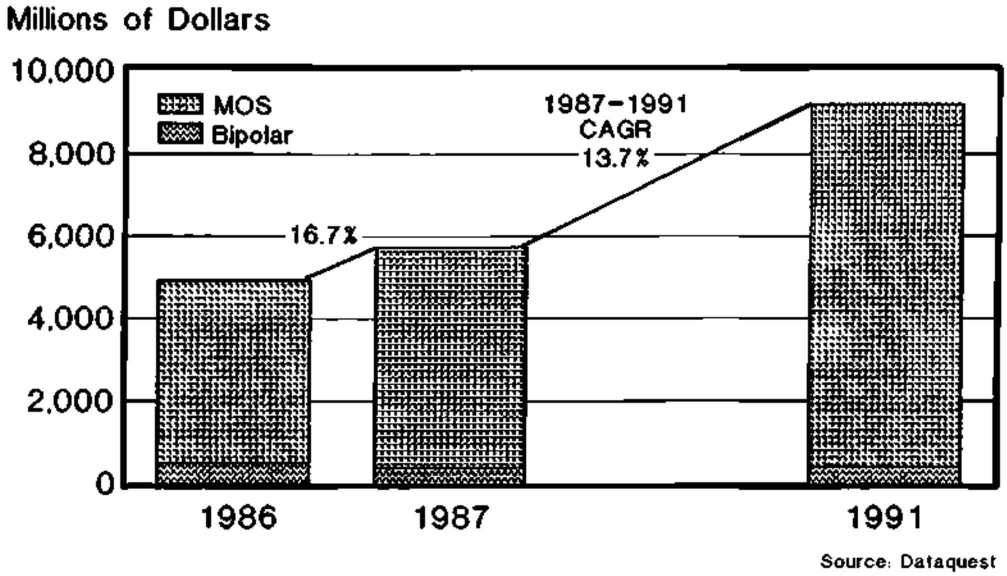


Recovery: Fact or Fiction?

Semiconductor Product Update

MEMORY UPDATE

MEMORY FORECAST
MOS AND BIPOLAR MEMORIES



MOS MEMORY FORECAST

(Millions of Dollars)

	1986	1987	1991	'86–'91 CAGR
DRAM	$2,102	$2,467	$4,360	15.7%
SRAM (<70ns)	353	446	763	16.7%
SRAM (>70ns)	450	550	876	14.2%
EPROM	910	1,052	1,616	12.2%
ROM	418	543	442	1.1%
EEPROM	139	231	638	35.6%
Others	55	65	100	12.7%
Total MOS Memory	$4,427	$5,354	$8,795	14.7%

Source: Dataquest

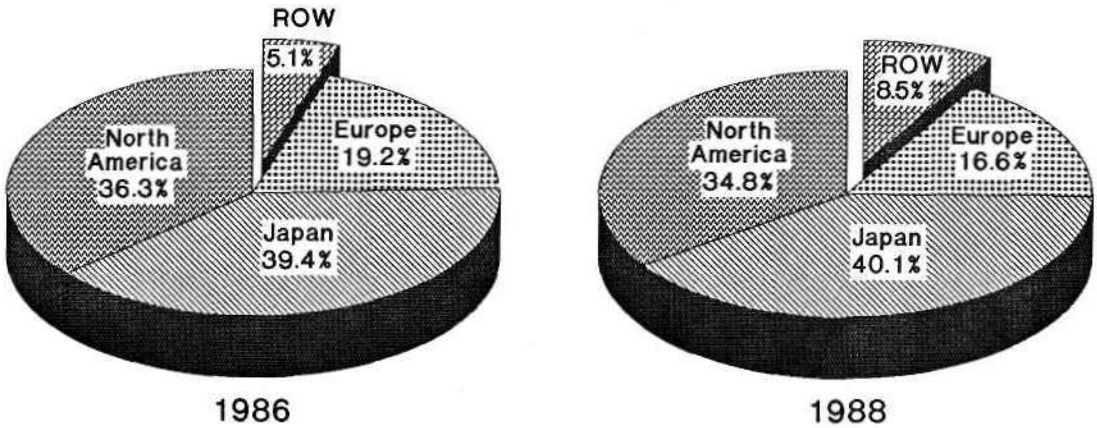
1986 MOS MEMORY MARKET SHARE ESTIMATES

(Millions of Dollars)

Top Vendors' Shares		
Hitachi	$814	18%
NEC	$586	13%
Fujitsu	$462	10%
Toshiba	$452	10%
Mitsubishi	$322	7%
Texas Instruments	$299	7%
Intel	$293	6%
AMD	$151	3%
Oki	$131	3%
Regional Shares		
United States	$1,253	28%
Japan	$2,963	65%
Europe	$ 230	5%
ROW	$ 106	2%

Source: Dataquest

CONSUMPTION SHIFT TO ASIA/PACIFIC REGION



Source: Dataquest

SPECIALTY MEMORY EXAMPLES

Enhanced Features	Zero-power RAM Hierarchical RAM
Special Features	Error-correction RAM Dual-port RAM Timekeeper RAM FIFO Encrypted EPROM Content-addressable memory
Application-Specific	Video RAM Cache TAG RAM Color-palette memory

MAJOR TECHNOLOGY TRENDS

- Submicron processes and 3-D cells: concern for density, speed, and packaging
- New technologies: BICMOS and GaAs
- Designing manufacturability into chip
- New product areas: specialty memories, flash EPROM/flash EEPROM, high-speed devices
- Packaging: SOJ, ZIP, PLCC, SOP, etc.

MAJOR MARKET TRENDS

- MOS memory expansion into bipolar market
- Specialty memories: expansion to new uses
- More product diversity and user options
- Increasing consumption in Asia/Pacific region
- Continuing government influence

CONTINUING GOVERNMENT INFLUENCE

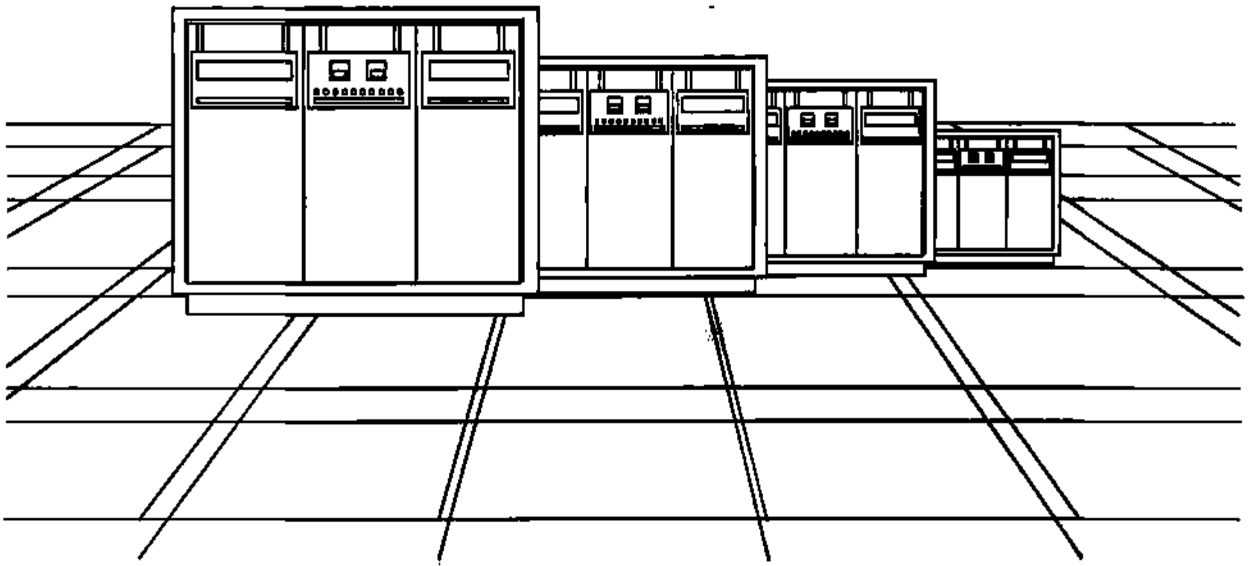
- U.S.–Japan semiconductor trade agreement
- Imposition of sanctions
- Changing conditions:
  - Japanese production cuts
  - Drying gray market
- Future impact on prices and supply

Recovery: Fact or Fiction?

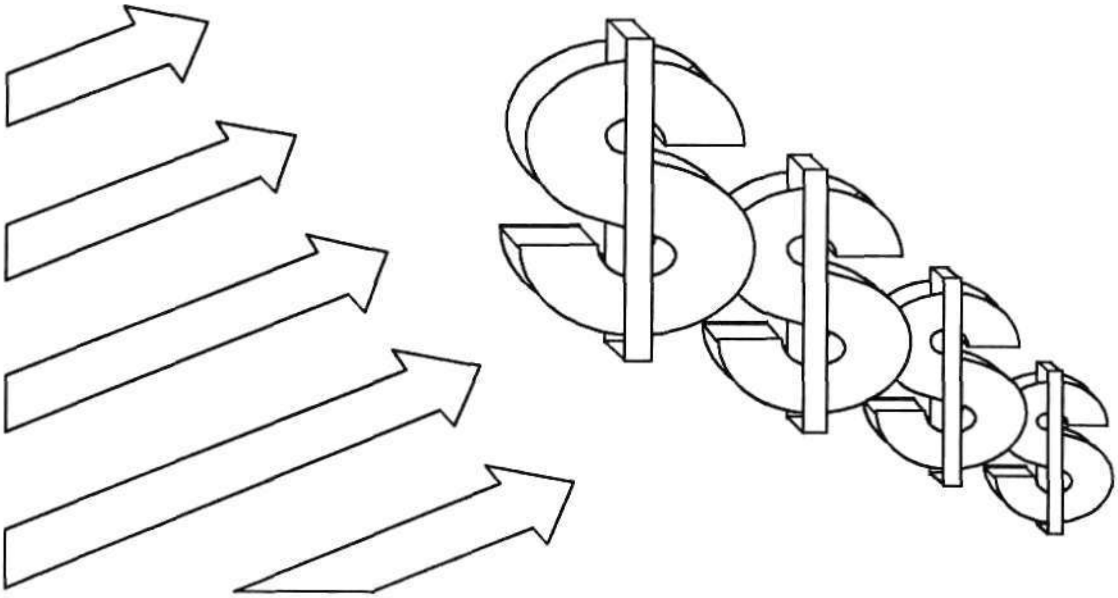
Semiconductor Product Update

APPLICATION-SPECIFIC IC UPDATE

The ASIC revolution is shrinking
the value of some industries



The cost per function
is falling almost as fast
as systems are growing

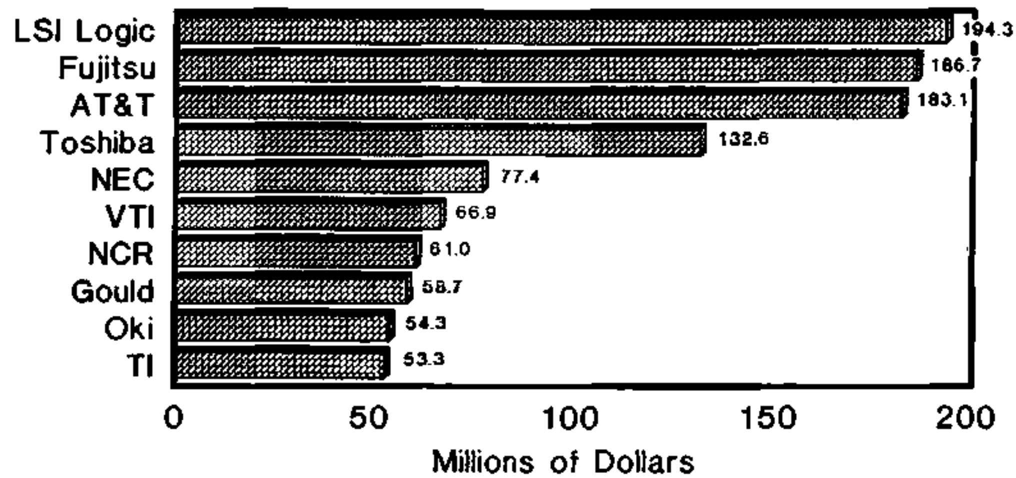


1987 WORLDWIDE ASIC SUPPLIERS

Programmable Logic	18
Cell-Based ICs	82
Gate Arrays	95

Source: Dataquest

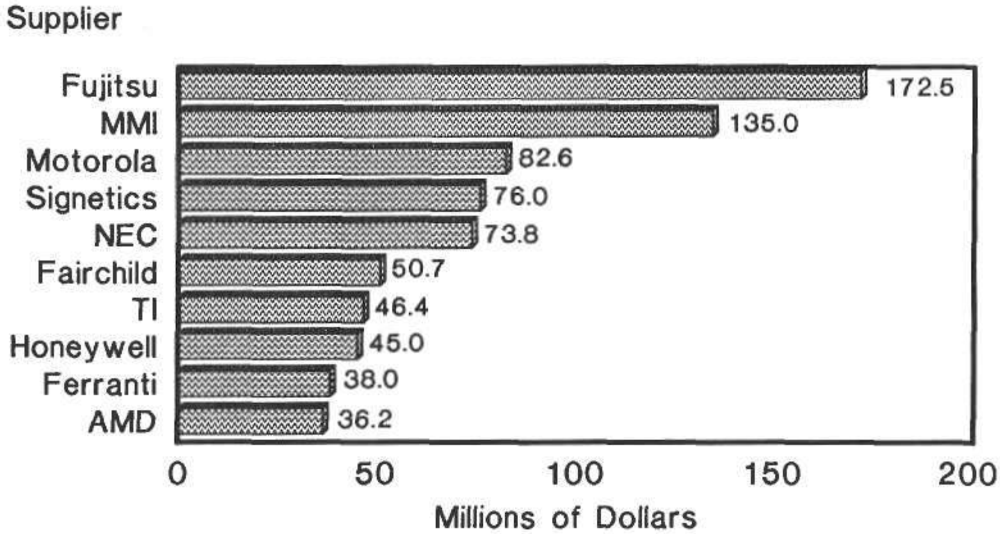
ESTIMATED WORLDWIDE ASIC SHIPMENTS BY TOP TEN SUPPLIERS - MOS



Note: Excludes full custom

Source: Dataquest

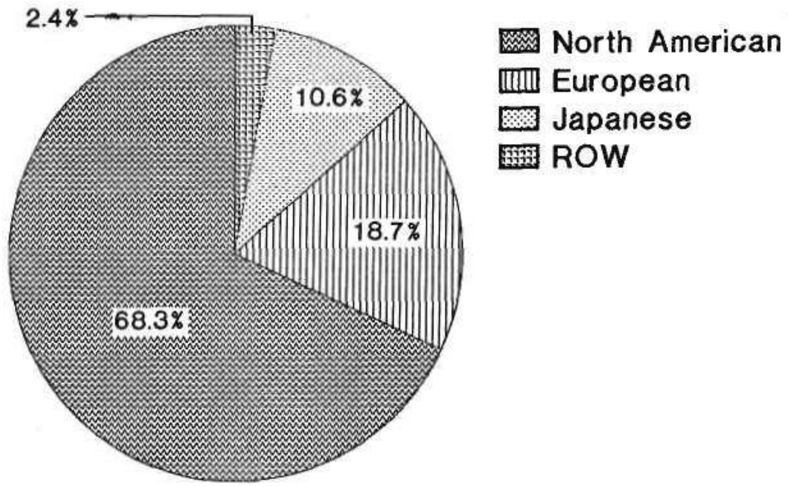
ESTIMATED WORLDWIDE ASIC SHIPMENTS BY TOP TEN SUPPLIERS - BIPOLAR



Note: Excludes full custom

Source: Dataquest

ESTIMATED WORLDWIDE ASIC SUPPLIERS BY REGION



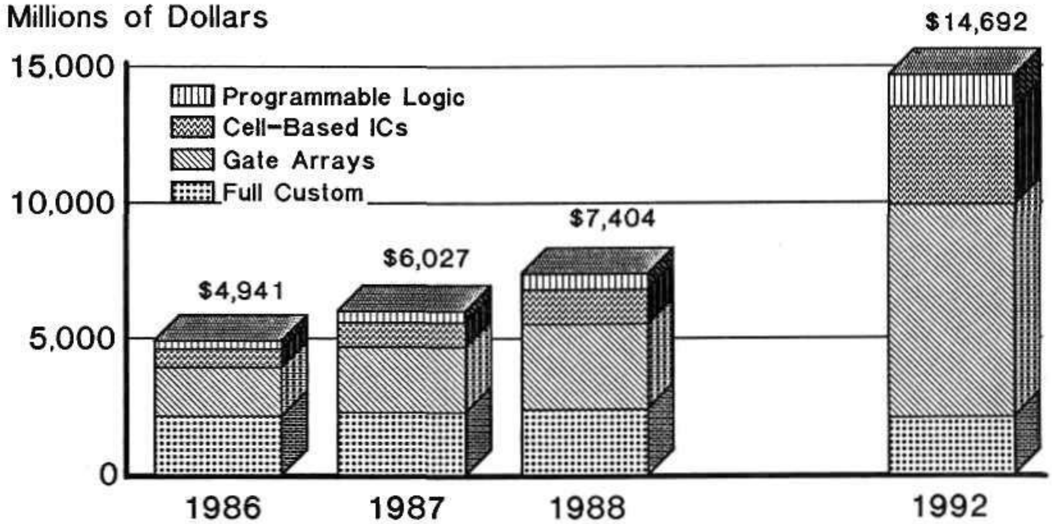
123 Suppliers

Note: Excludes full custom

Source: Dataquest

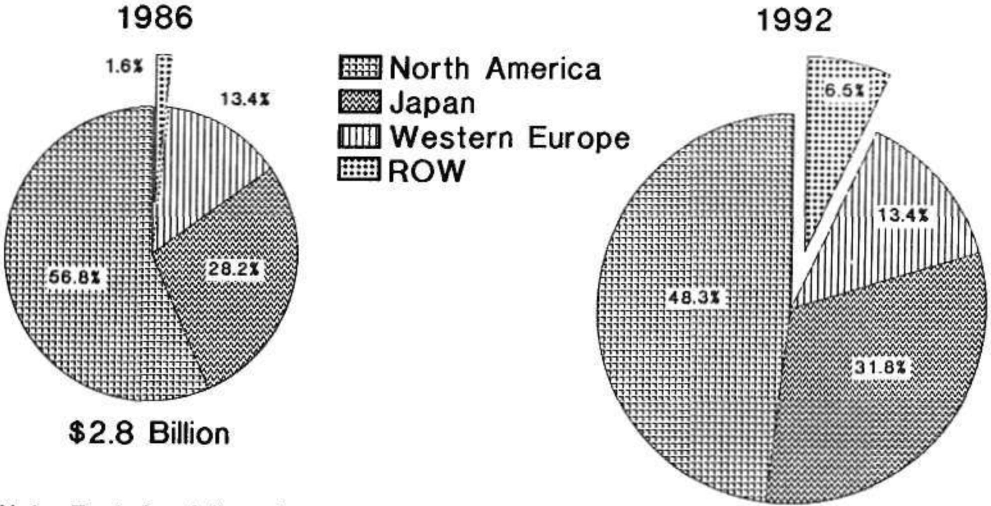
ESTIMATED WORLDWIDE ASIC CONSUMPTION

(Millions of Dollars)



Source: Dataquest

ESTIMATED WORLDWIDE ASIC CONSUMPTION BY REGION - TOTAL



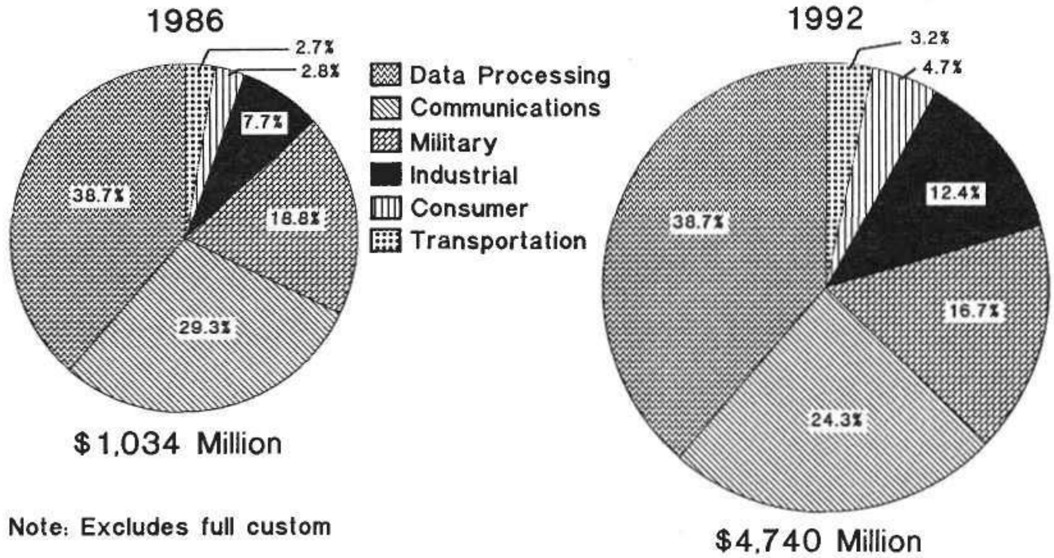
$2.8 Billion

$12.6 Billion

Note: Excludes full custom

Source: Dataquest

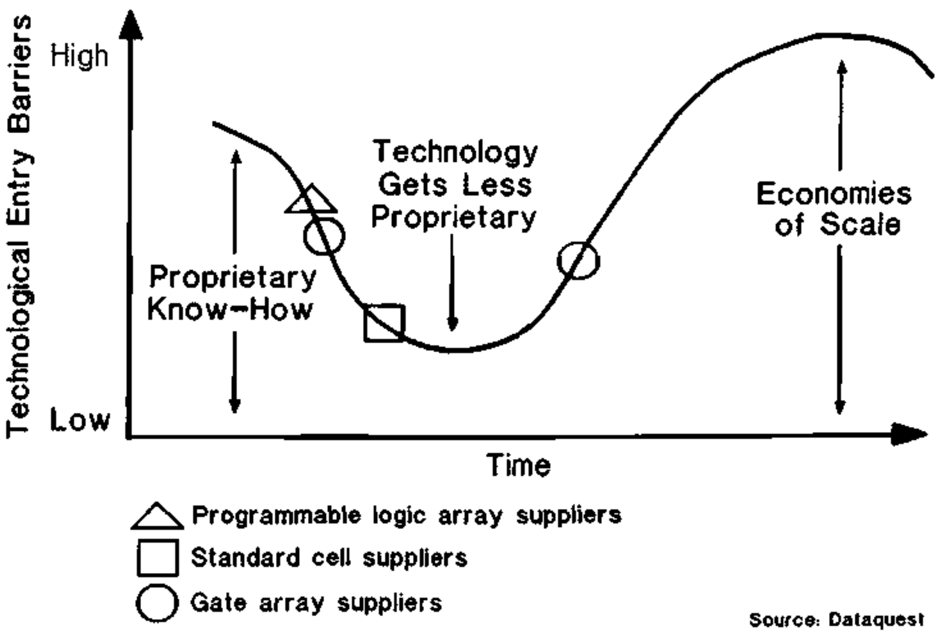
ESTIMATED NORTH AMERICAN ASIC CONSUMPTION BY APPLICATION MARKET - MOS



Note: Excludes full custom

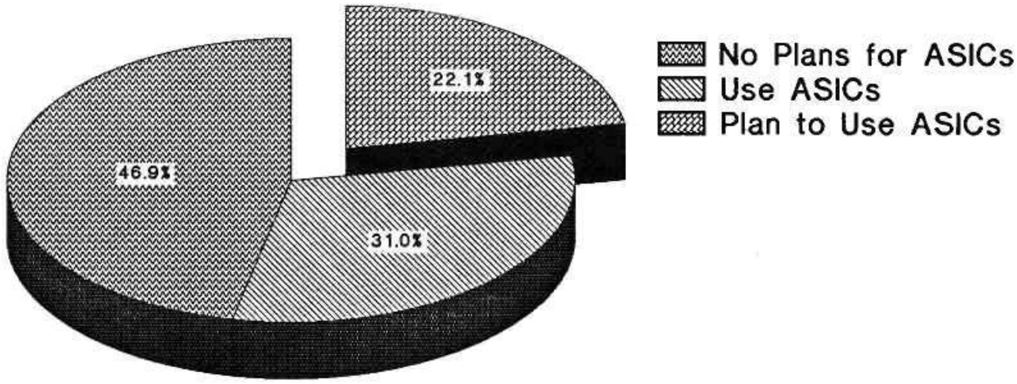
Source: Dataquest

ASIC TECHNOLOGY BARRIERS



Source: Dataquest

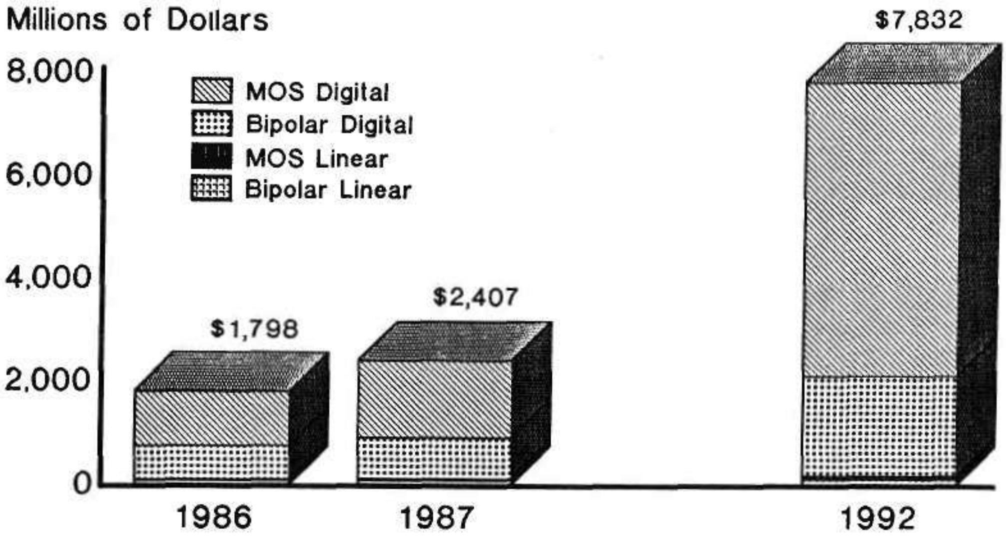
PROCUREMENT SURVEY RESULTS



Sample: 230 Purchasing Agents

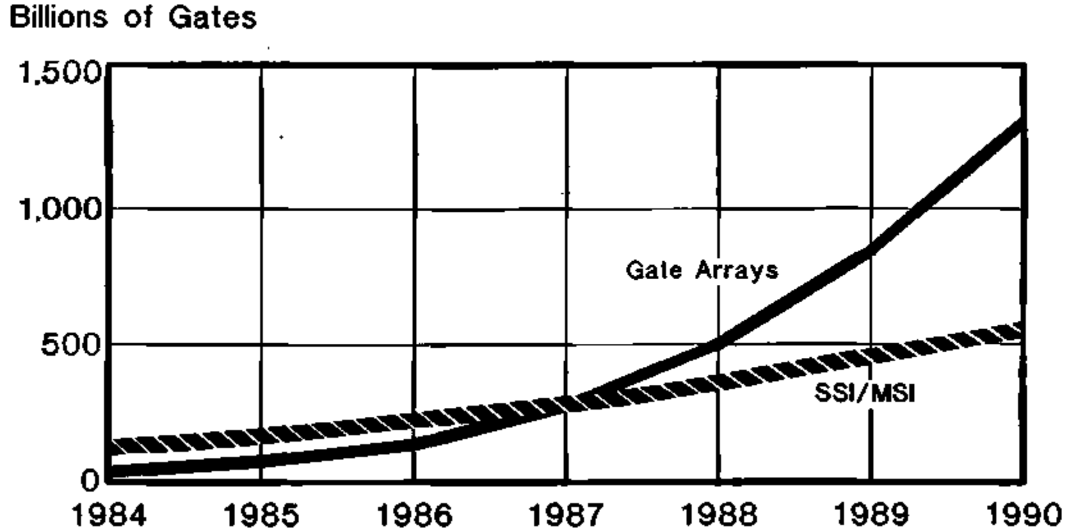
Source: Dataquest

ESTIMATED WORLDWIDE GATE ARRAY CONSUMPTION BY TECHNOLOGY



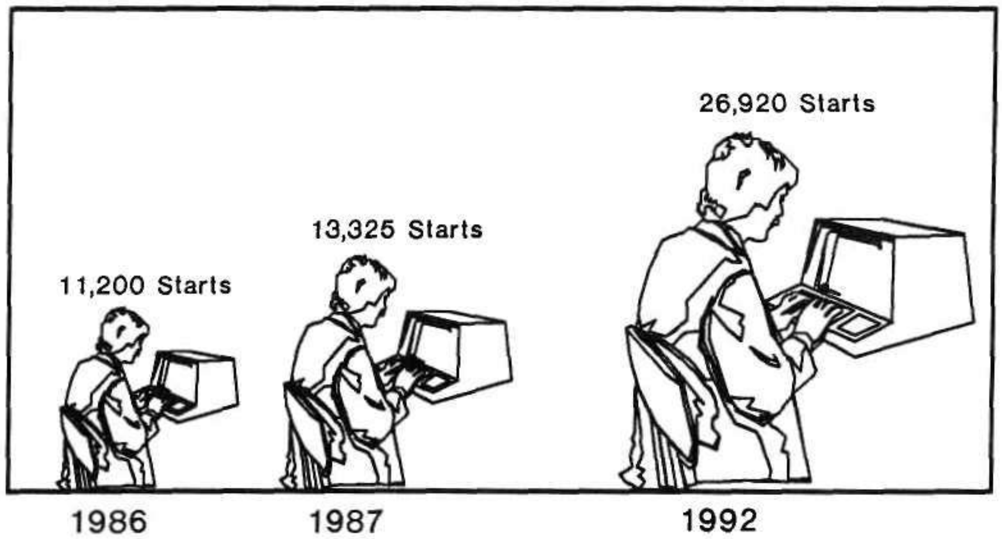
Source: Dataquest

EXPECTED IMPACT OF GATE ARRAYS ON SEMICONDUCTOR LOGIC FUNCTION SHIPMENTS



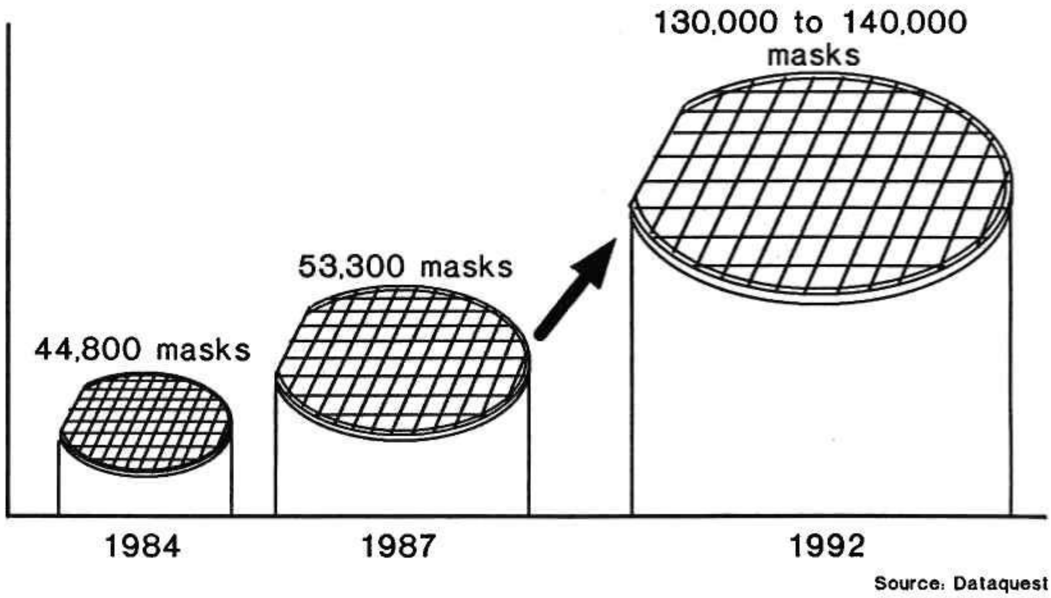
Source: Dataquest

ESTIMATED WORLDWIDE GATE ARRAY DESIGN STARTS

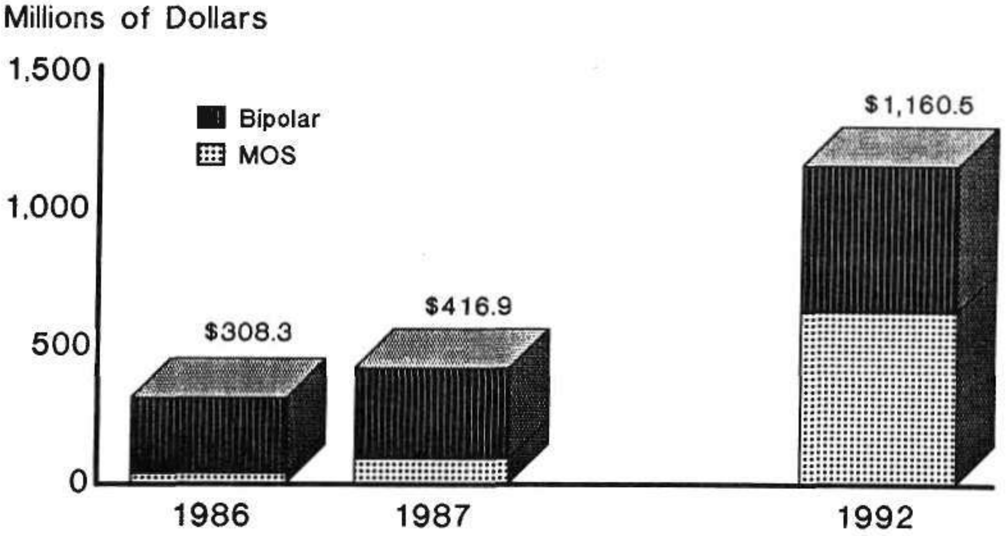


Source: Dataquest

ESTIMATED GATE ARRAY MASK CONSUMPTION



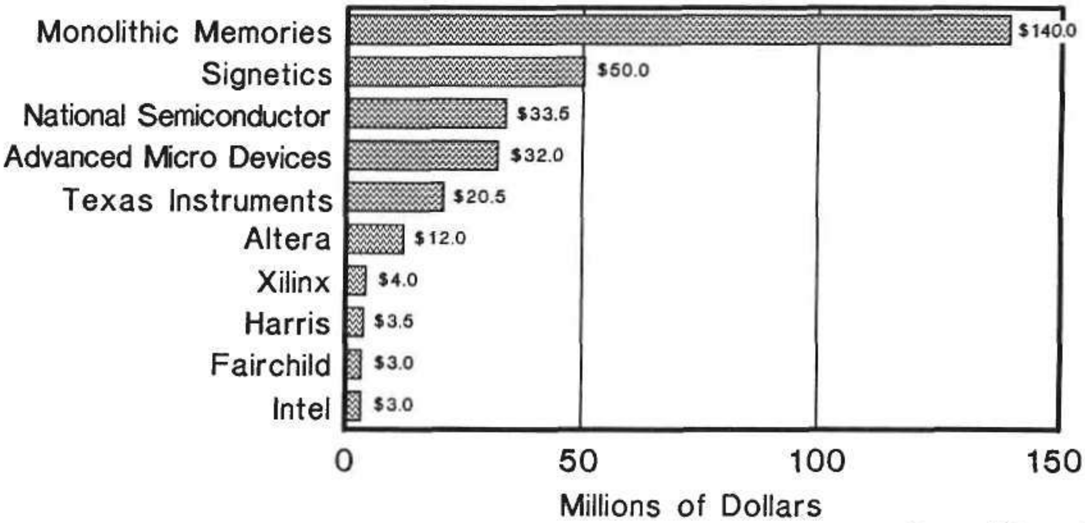
ESTIMATED WORLDWIDE PROGRAMMABLE LOGIC DEVICE CONSUMPTION



Source: Dataquest

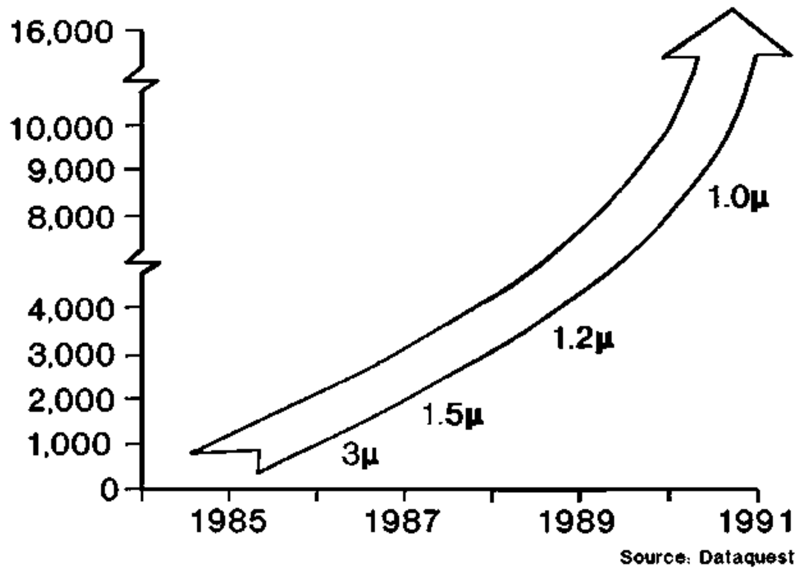
- PLDs will experience sharp price reductions
  - 1¢ to 0.5¢ per gate today
  - 0.4¢ to 0.3¢ per gate by 1988-89!

ESTIMATED 1986 WORLDWIDE PROGRAMMABLE LOGIC DEVICE SHIPMENT REVENUE - TOTAL

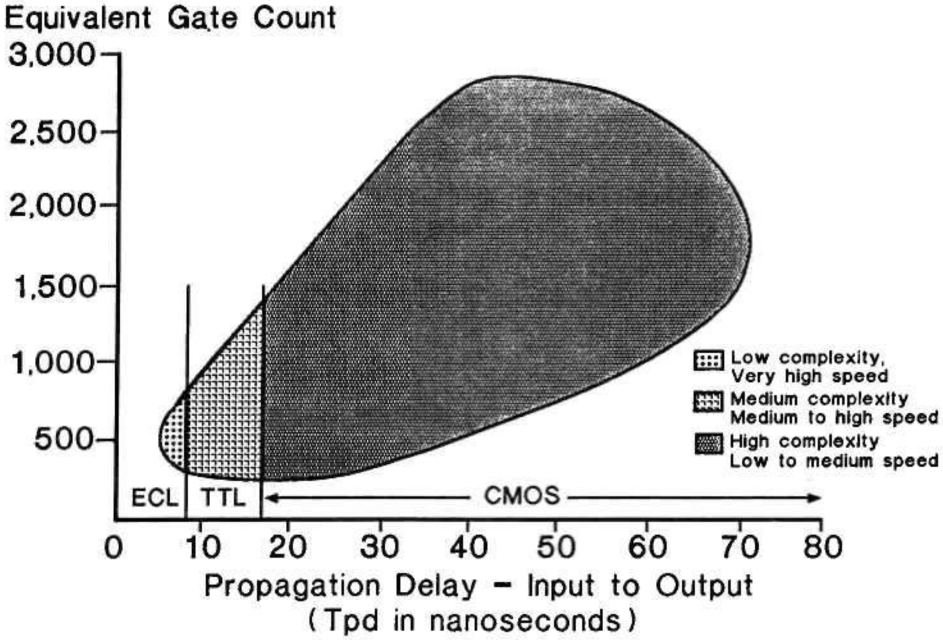


Source: Dataquest

CMOS PLD EQUIVALENT GATE COMPLEXITY

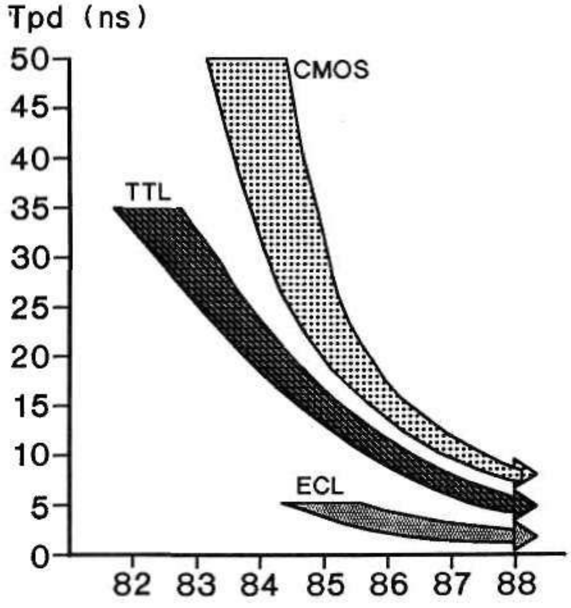


PLD GATE COUNT VS. PROPAGATION DELAY



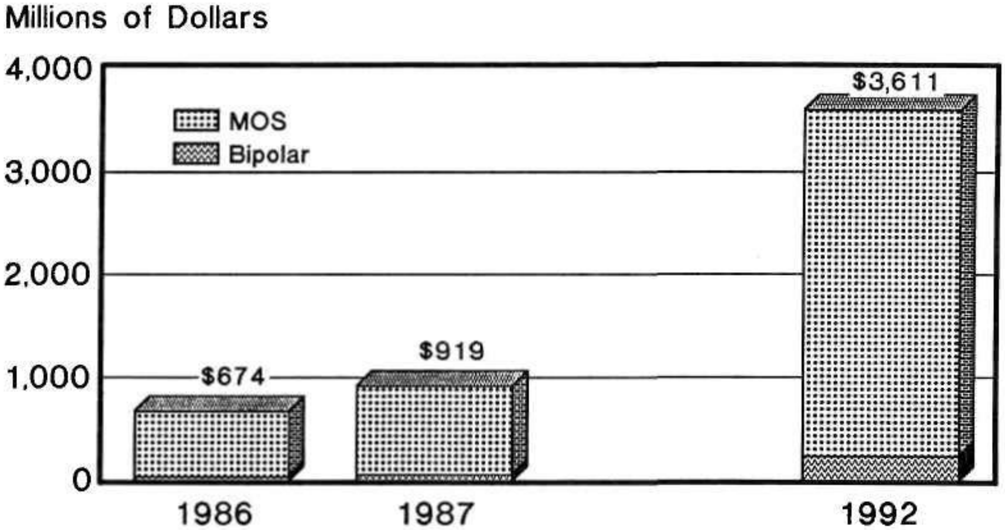
Source: Dataquest

ESTIMATED PLD SPEED TRENDS



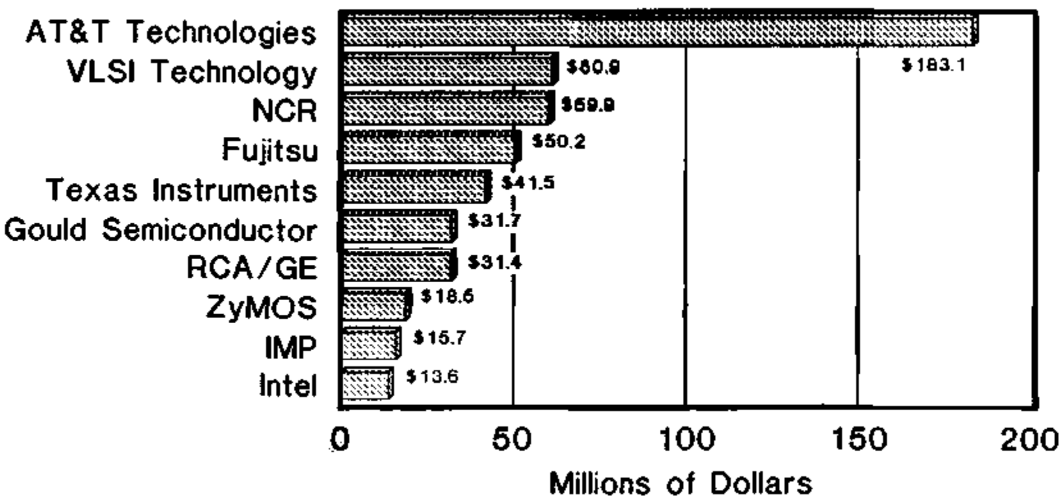
Source: Dataquest

ESTIMATED WORLDWIDE CELL-BASED IC CONSUMPTION



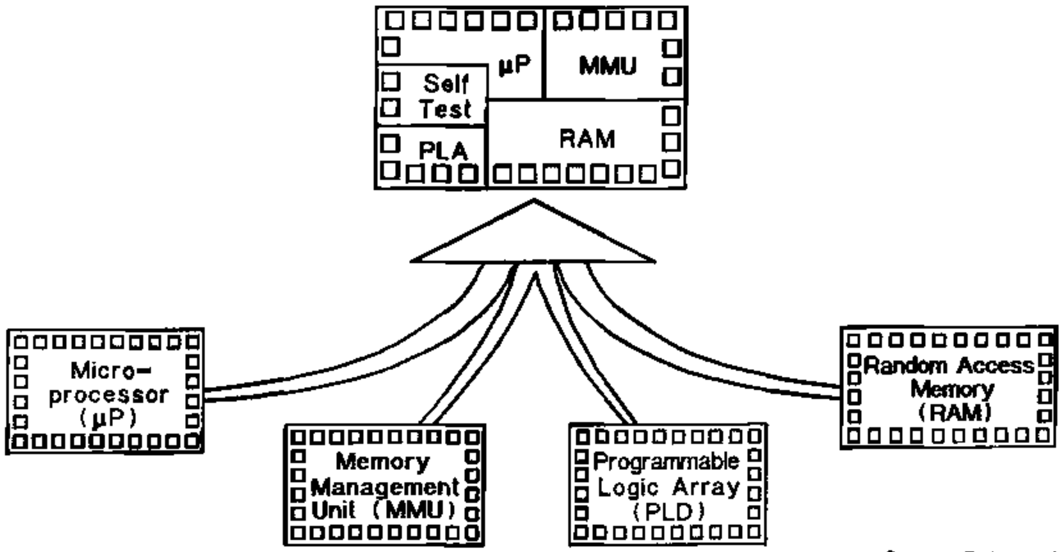
Source: Dataquest

ESTIMATED WORLDWIDE CBIC SHIPMENTS - TOTAL



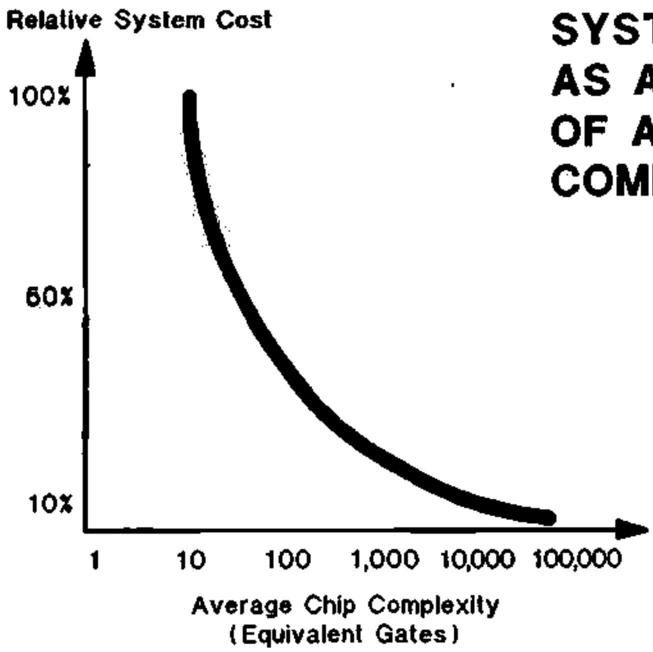
Source: Dataquest

ASIC TECHNOLOGY
BY END OF THE DECADE



Source: Dataquest

SYSTEM COST AS A FUNCTION OF AVERAGE CHIP COMPLEXITY



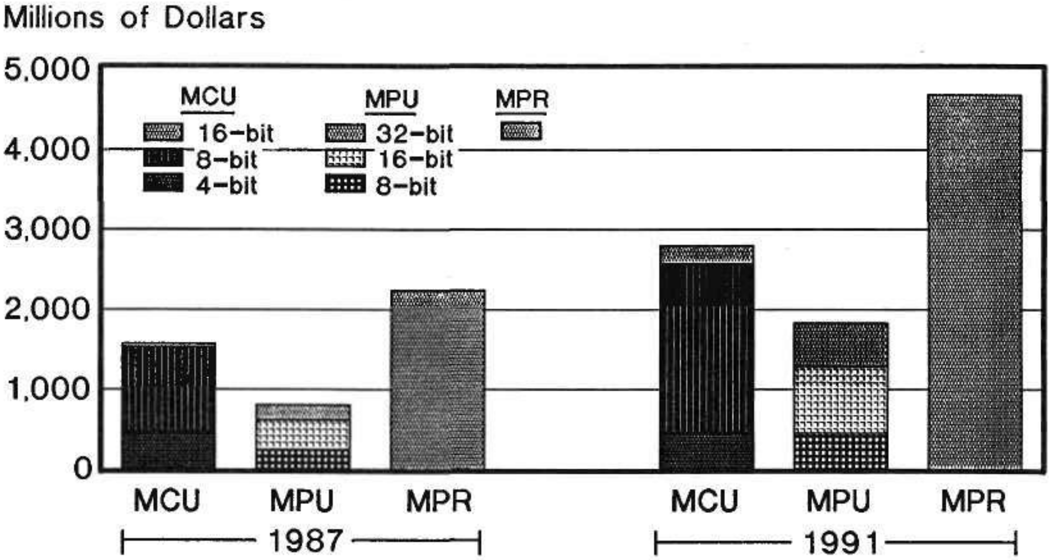
Source: Bogert/Thomas Research

Recovery: Fact or Fiction?

Semiconductor Product Update

MICROCOMPONENTS UPDATE

ESTIMATED WORLDWIDE MOS MICROCOMPONENT REVENUE



Source: Dataquest

ESTIMATED REGIONAL MOS MICROCOMPONENT CONSUMPTION

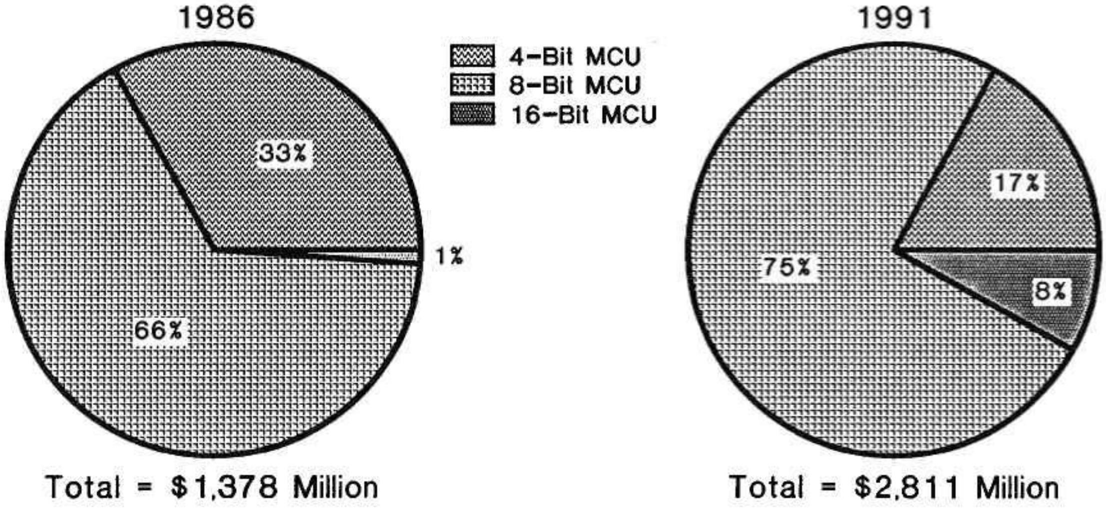
(Millions of Dollars)

	1987	1988	1989	1990	1991	1992
U.S.	1,566	2,018	2,075	2,376	2,825	3,469
Japan	1,921	2,346	2,350	2,855	3,897	5,066
Europe	726	936	1,005	1,253	1,718	2,250
ROW	424	570	605	725	910	1,180
Total	4,637	5,870	6,035	7,209	9,350	11,965

Source: Dataquest

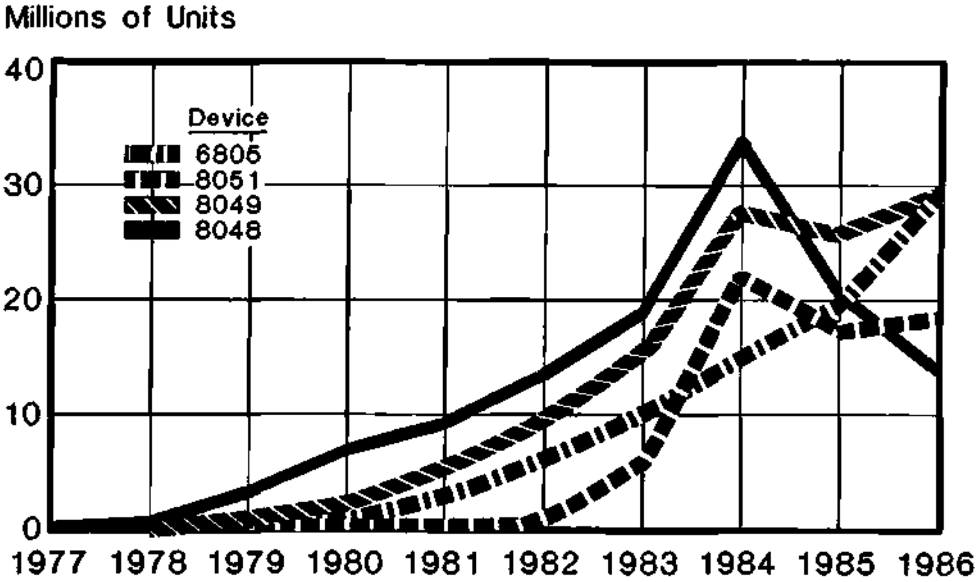
WORLDWIDE MICROCONTROLLER REVENUE FORECAST

(Millions of Dollars)



Source: Dataquest

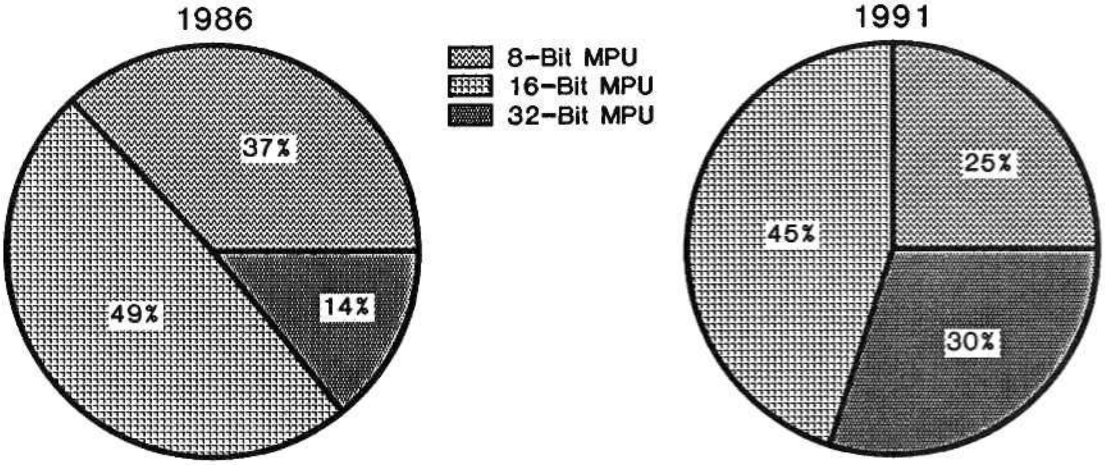
LEADING 8-BIT MCU SHIPMENTS



Source: Dataquest

WORLDWIDE MICROPROCESSOR REVENUE FORECAST

(Millions of Dollars)

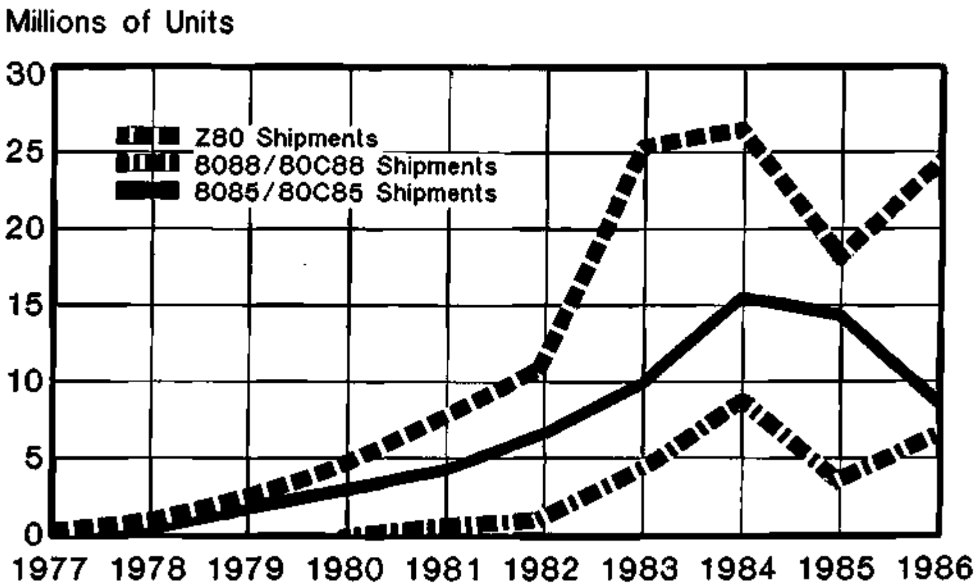


Total = $572 Million

Total = $1,835 Million

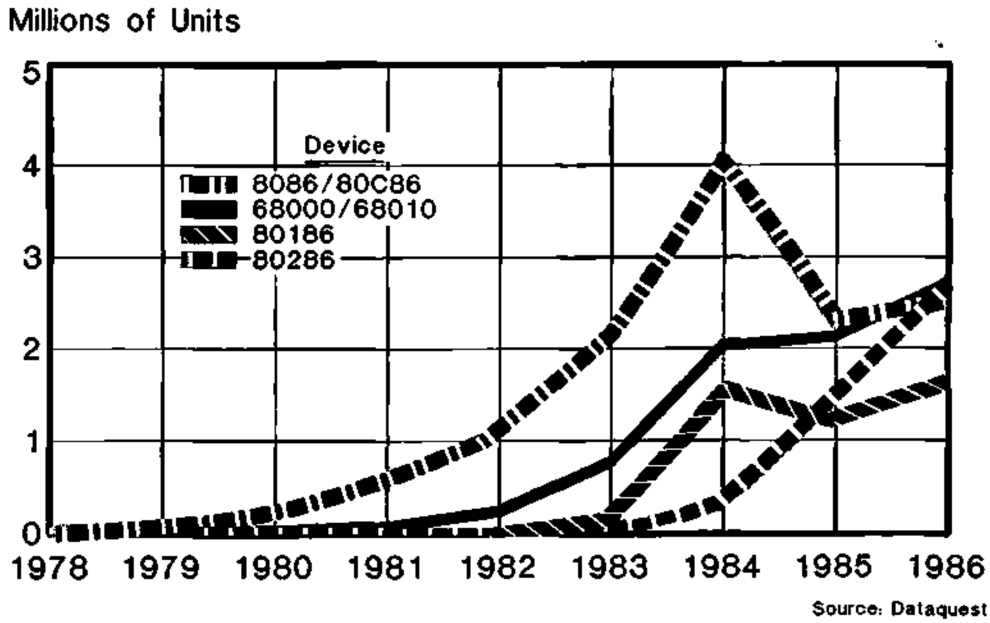
Source: Dataquest

LEADING 8-BIT MPU SHIPMENTS



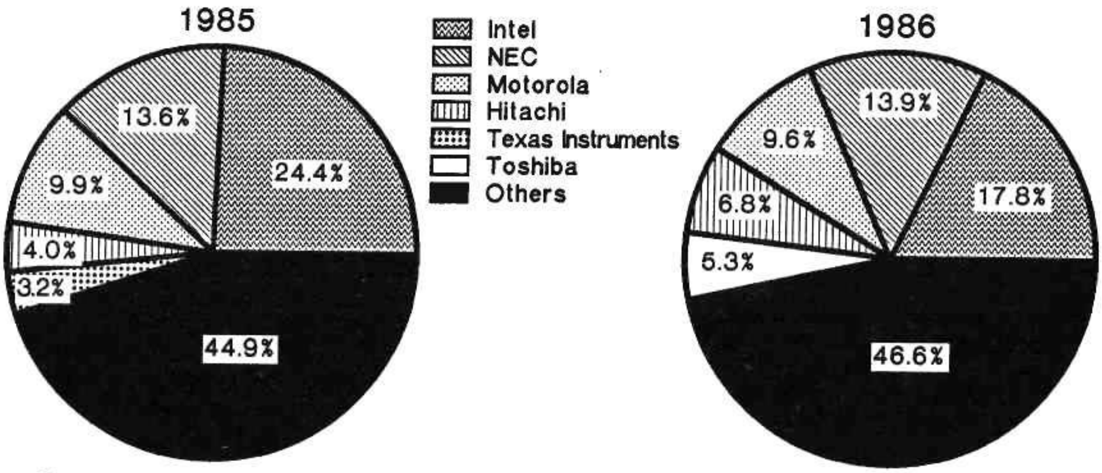
Source: Dataquest

LEADING 16-BIT MPU SHIPMENTS



TOP FIVE MICROPROCESSOR MANUFACTURERS

(Millions of Dollars)



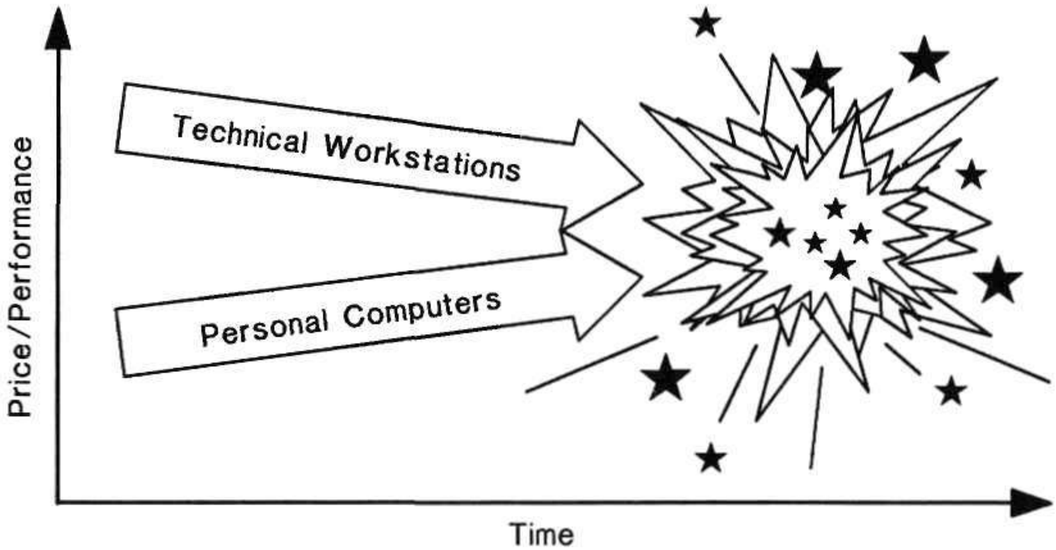
Total = $2,751 Million

Total = $3,525 Million

Source: Dataquest

32-BIT MICROPROCESSORS - MARKET ISSUES

Battle Between PCs and Workstations



Source: Dataquest

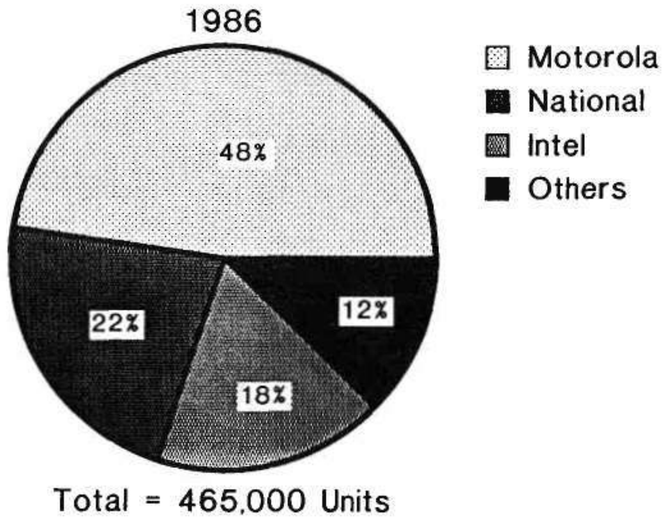
32-BIT MICROPROCESSORS - PLAYERS

Companies (Merchant)

Acorn	Mitsubishi
AMD	Motorola
AT&T	National
Fairchild	NEC
Fujitsu	TI
Hitachi	VLSI
Inmos	Technology
Intel	Zilog

ESTIMATED MARKET SHARE FOR MANUFACTURERS OF 32-BIT MPUs

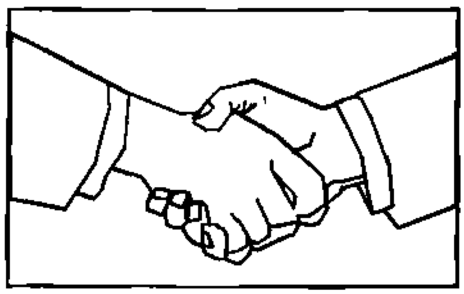
(Thousands of Units)



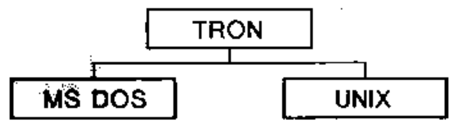
Source: Dataquest

32-BIT MICROPROCESSORS - ALLIANCES

- AT&T-Zilog
- National-Texas Instruments
- NEC-Sony, Sharp, Zilog
- Motorola-Thomson??
- Intel-IBM
- Other contenders?



JAPANESE TRON PROJECT



- Originality
- Open architecture
- No operating system fees
- Comprehensive standard optimizing TRON for various operating environments
- 43 companies now; 60 by fall 1987
- Proprietary 32-bit MPUs
  - Hitachi/Fujitsu/Mitsubishi
- IBM and NEC participation still unclear

MARKET TRENDS - MICROCOMPONENTS

- Market growth:
  - 27% in 1987 vs. 18% in total semiconductors
  - 23% CAGR 1987-1992 vs. 14% in total semiconductors
- Product growth areas: high-end components
- Extended product life cycles in more familiar products
- Strategic alliances key to long-term success

MICROCOMPONENTS - MARKET TRENDS

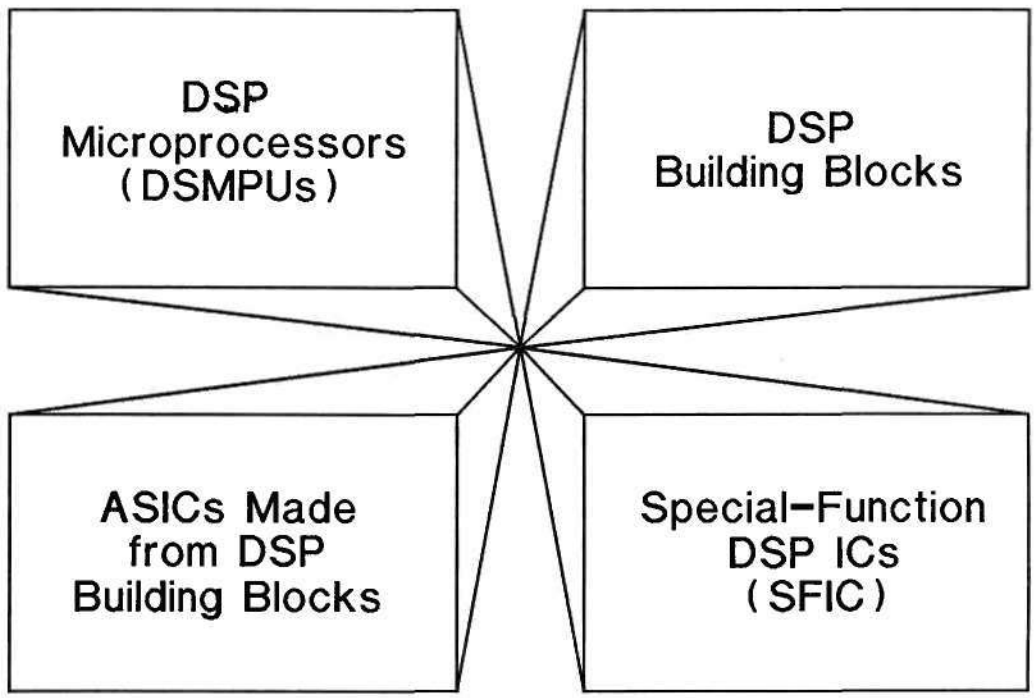
Integrate and Customize

- CMOS proliferating
- Higher levels of integration demanded
- "Customizing" approaches
- RISC versus CISC
  - RISC - optimized instruction set
  - Need for advanced compiler technology
- Special-purpose microprocessors targeting
  - RISC/graphics/video/DSP/AI

Recovery: Fact or Fiction?

Semiconductor Product Update

DIGITAL SIGNAL PROCESSING UPDATE


DSP
Microprocessors
(DSMPUs)
DSP
Building Blocks
ASICs Made
from DSP
Building Blocks
Special-Function
DSP ICs
(SFIC)

DSP PRODUCTS - 1986 REVIEW

(Millions of Dollars)

Product	Sales	Growth
Total DSP	$311	38.2%
DSP Microprocessors	62	82.4%
DSP Building Blocks	131	19.1%
ASICs Used for DSP	68	44.7%
Special-Function DSP ICs	50	47.1%

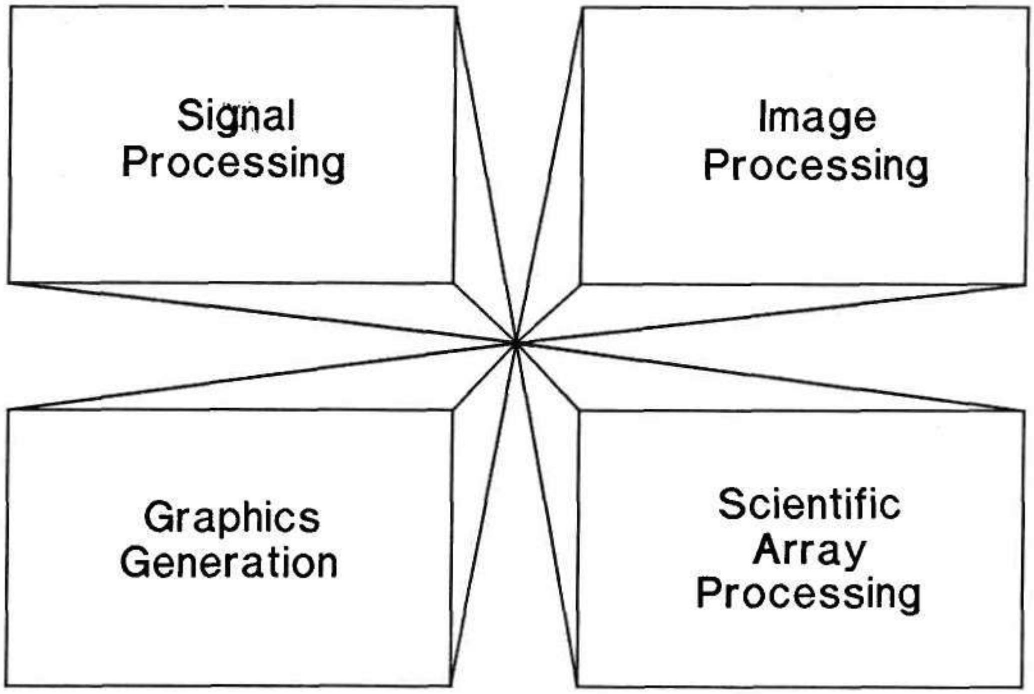
Source: Dataquest

1986 REGIONAL CONSUMPTION OF DSP PRODUCTS

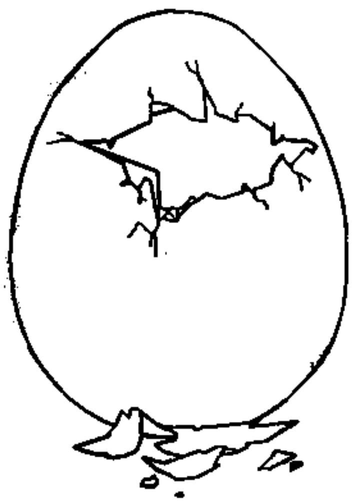
(Millions of Dollars)

Region	Sales	Growth
Total DSP	$311	38.2%
North America	133	33.0%
Japan	68	41.7%
Western Europe	69	38.0%
ROW	41	51.9%

Source: Dataquest


Signal Processing
Image Processing
Graphics Generation
Scientific Array Processing

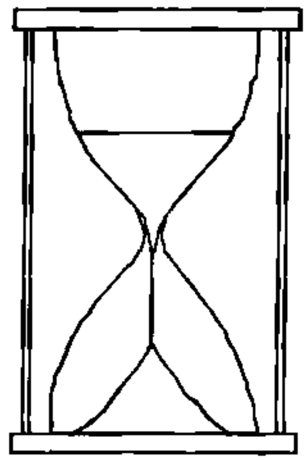
EMERGING DSP MARKETS



- ISDN networks
- Vocoders
- High-speed modems
- Cellular telephones
- Machine vision systems
- Medical diagnostic equipment
- Smart weapon systems

KEY DSP ISSUES

- Fledgling market
- Insufficient number of trained DSP engineers
- Lack of development system support
- Large number of competitors
- No strong second-source alliances



Recovery: Fact or Fiction?

Semiconductor Product Update

EMERGING TECHNOLOGY

BICMOS FORECAST ASSUMPTIONS

- No significant competitive technology is developed
- GaAs and ECL will compete vigorously for market share
- Significant technological progress is still to be made in GaAs and ECL
- BICMOS will get its share of new applications
- Zero standby power – the fundamental advantage of CMOS over NMOS and Bipolar

DIGITAL LOGIC

- Advantages
  - Bipolar speed
  - Zero standby power
  - Improved power/delay product
  - Good functional density
  - TTL output drive
- Products
  - Gate arrays
  - Other ASICs
  - Interface
  - Microprocessors

MIXED ANALOG AND DIGITAL

- Advantages
  - Bipolar offset voltages
  - MOS switches
  - Complex MOS logic
  - High output drive
- Products
  - A-to-D converters
  - Flash converters
  - Switched capacitor filters
  - Disk controllers
- Applications
  - Communications
  - Industrial
  - Transportation

SMART POWER

- Advantages
  - Logic/power combination
  - High voltage (sometimes kilovolts)
  - High power
- Products
  - Motor drive electronics
  - Auto data bus
  - Fluorescent lamp ballast
  - Switching power supplies
- Applications
  - Communications
  - Industrial
  - Transportation

BICMOS MARKET SHARE FORECAST

	1990	1995	2000
Share of CMOS	0.6%	2.0%	4.7%
Share of Linear*	0.4%	1.0%	2.2%
Share of Discrete**	0.3%	0.7%	1.5%

* Excludes bipolar/junction FET parts
** Excludes DMOS parts

Source: Dataquest

BICMOS CONSUMPTION FORECAST

(Millions of Dollars)

	1990	1995	2000
CMOS	$125	$1,039	$6,155
Linear*	$ 35	$ 166	$ 787
Discrete**	$ 20	$ 95	$ 450

* Excludes bipolar/junction FET parts
** Excludes DMOS parts

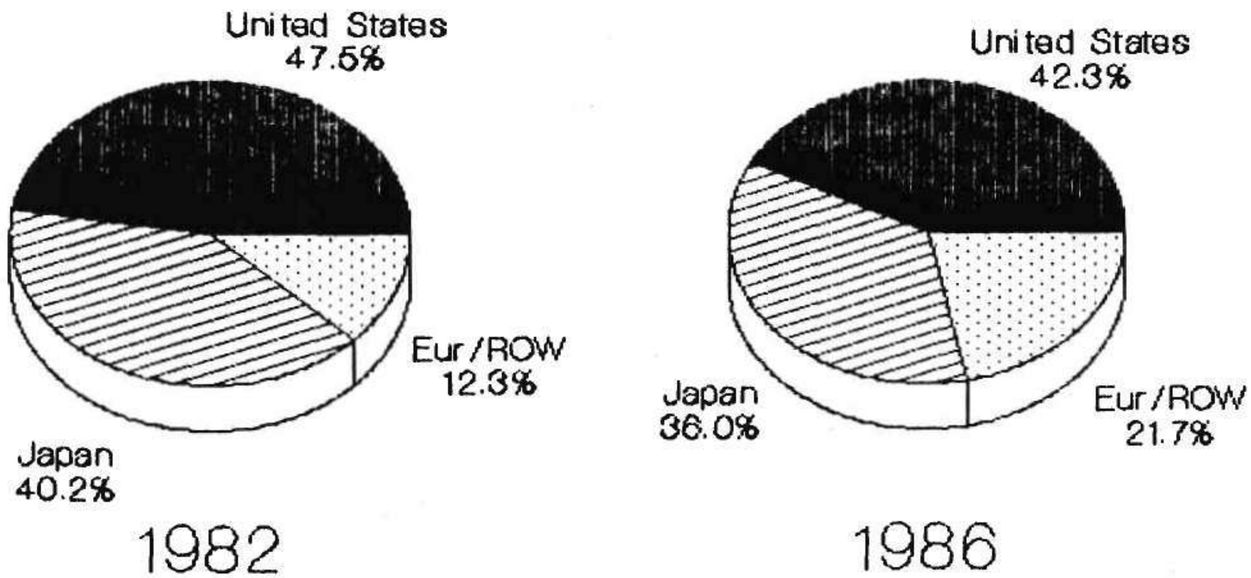
Source: Dataquest

Semiconductors' Midlife Crisis

1987 Semiconductor Industry Conference

October 18-21
The Pointe at Squaw Peak
Phoenix, Arizona

WORLD FAB EQUIPMENT
Regional Markets



Source: Dataquest

WAFER FAB EQUIPMENT MARKET
United States

	1982	1986
U.S. Companies	91%	82%
Japanese Companies	2%	9%
European Companies	7%	9%
Total	100%	100%

Source: Dataquest

WAFER FAB EQUIPMENT MARKET
Japan

	1982	1986
Japanese Companies	68%	78%
U.S. Companies	30%	18%
European Companies	2%	4%
Total	100%	100%

Source: Dataquest

WAFER FAB EQUIPMENT MARKET
Europe

	1982	1986
U.S. Companies	60%	61%
European Companies	34%	27%
Japanese Companies	6%	12%
Total	100%	100%

Source: Dataquest

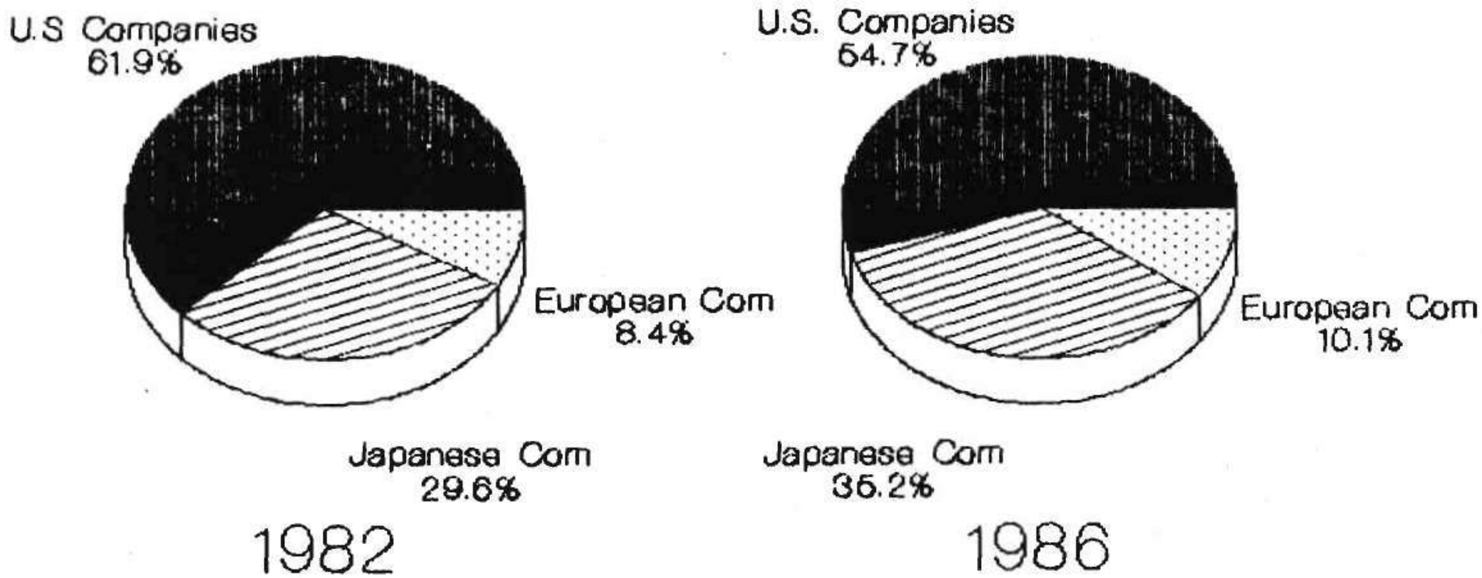
WAFER FAB EQUIPMENT MARKET
Rest of World

	1982	1986
U.S. Companies	79%	70%
European Companies	11%	7%
Japanese Companies	10%	23%
Total	100%	100%

Source: Dataquest

WORLD FAB EQUIPMENT

Company Shares



Source: Dataquest

U.S. COMPANY SALES OF WAFER FAB EQUIPMENT

U.S. Company Sales in:	1982	1986
United States	67%	62%
Japan	20%	12%
Europe	11%	18%
ROW	3%	8%
Total	100%	100%

Source: Dataquest

JAPANESE COMPANY SALES OF WAFER FAB EQUIPMENT

	1982	1986
Japanese Company Sales in:		
Japan	94%	79%
United States	3%	11%
Europe	2%	6%
ROW	1%	4%
Total	100%	100%

Source: Dataquest

U.S. EQUIPMENT COMPANIES' SHARE OF THE WORLD MARKET

	1982	1986
All Fab Equipment	62%	55%
Dry Etch	67%	73%
Epitaxy	70%	94%
RTP	---	76%
Ion Implantation	85%	70%
CVD	41%	53%

Source: Dataquest

U.S. EQUIPMENT COMPANIES' SHARE OF THE WORLD MARKET

	1982	1986
All Fab Equipment	62%	55%
Lithography	62%	48%
Track Equipment	72%	56%
PVD	63%	51%

Source: Dataquest

WAFER FAB EQUIPMENT TRENDS FORECAST

	1984	1986	1987	1988	1989	1990
Total Capital Spending	$8,424	$5,260	$5,774	$7,337	$7,337	$9,451
Lithography	100	67	72	90	90	116
Deposition	100	87	95	113	113	144
Etch	100	71	77	98	98	124
Ion Implantation	100	46	58	79	86	115
Diffusion	100	64	67	79	79	90

Source: Dataquest

CAPITAL SPENDING FORECAST

(Millions of Dollars)

	1986	1987	1988	1991	CAGR 1986-1991
U.S.	2,560	2,916	3,752	4,963	14%
Merchant	1,640	1,812	2,428	3,436	16%
Captive	920	1,104	1,324	1,527	11%
Japan	1,754	1,688	2,026	4,893	23%
Europe	670	764	965	1,405	16%
ROW	275	406	648	969	29%
Total	5,260	5,774	7,337	12,230	18%
Growth (%)	(29.8)	9.8	27.1	N/A	N/A

N/A = Not applicable

Source: Dataquest