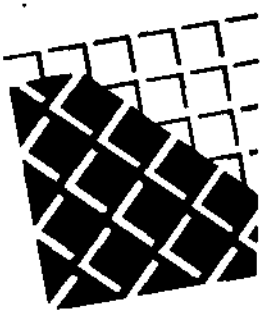
1989

The Eighth Annual SEMICON/West Seminar: Status 1989



May 24
The Dunfey Hotel
San Mateo, California

Sponsored by Dataquest's
Semiconductor Equipment and Materials Service

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The Eighth Annual SEMICON/West Seminar: Status 1989

The world semiconductor and semiconductor equipment industries have recently enjoyed healthy growth, but there are signs that both of these industries are slowing down. This year's seminar will present a snapshot of these industries as they are today along with Dataquest's forecasts for the next several years.

To accomplish this, Dataquest analysts will focus on the following topics:

- General industry outlook
- Electronic equipment demand
- Semiconductor demand
- ASICs as technology drivers
- A comparison of U.S. and Japanese fabs
- Worldwide capital spending
- Semiconductor equipment and materials trends
- Japanese semiconductor equipment market

This morning seminar will offer an opportunity for executives, strategic planners, R&D managers, and financial analysts to better understand the dynamically changing business environment of the semiconductor equipment and materials industries.

Agenda

Registration and Continental Breakfast—7–8 a.m.

- ***Welcome and Introduction***
  Joseph Grenier
  Director
  Semiconductor Equipment and Materials Service
- ***Semiconductor Demand: Forces, Forecast, and Fears***
  Mel Thomsen
  Director
  Strategic Analysis
- ***Technology Drivers: Present and Future***
  Krishna Shankar
  Industry Analyst
  Semiconductor Equipment and Materials Service

- ***A Comparison of U.S. and Japanese Fabs***
  Mark Reagan
  Research Analyst
  Semiconductor Equipment and Materials Service

  Break

- ***Capital Spending and Capacity Utilization: Overcapacity?***
  George Burns
  Industry Analyst
  Semiconductor Equipment and Materials Service

- ***Wafer Fab Equipment Industry—Status 1989***
  Joseph Grenier
  Director
  Semiconductor Equipment and Materials Service

- ***Silicon Markets and Technology***
  Dr. Peggy Marie Wood
  Industry Analyst
  Semiconductor Equipment and Materials Service

- ***Japanese Equipment Markets***
  Kaz Hayashi
  Industry Analyst
  Semiconductor Equipment and Materials Service/Japan

  Adjourn

Seminar Information

Location

Dunfey San Mateo Hotel, 1770 South Amphlett Blvd. San Mateo, California 94402, telephone (415) 573-7661

Seminar Fees

Fees for the Semiconductor Equipment and Materials Service SEMICON/West Seminar are:

- Subscriber (or designee) from SEMS client company ..... No Charge
- Each additional attendee from any Dataquest client company $95.00
- Each attendee from a nonclient company $145.00

Registration

- *The registration deadline is Friday, May 19, 1989.*

Please register as soon as possible by completing in full and returning the registration form. Confirmation of your registration will be mailed to you. For attendees outside the United States, please include a fax or telex number for your confirmation.

Cancellation Policy

- *Cancellation deadline is May 19, 1989.*

Registrants who either cancel after May 19, 1989, or who do not attend will be assessed a $25 service charge unless they send a replacement. Notice of cancellation must be made to the Dataquest Conference Department, (408) 437-8245. You will be given a cancellation number when you call.

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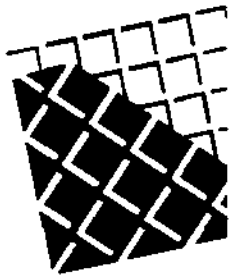

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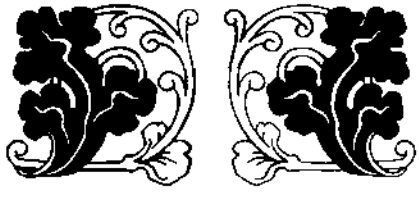

May 24, 1989

Dunfey San Mateo Hotel

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SEMICON/West Seminar
May 24, 1989
San Mateo, California

List of Attendees

AG Associates	Donald M. Yoshikawa, Product Manage
ASM Epitaxy	L. David Sikes, Vice President and General Manager
ASM International N.V.	Herbert Lakens, Director Marketing Arthur H. del Prado, President and Chief Executive Officer
ASM Lithography, Inc.	Doug Marsh, Vice President, Worldwide Sales
ASQ Technology, Inc.	Steve Lee, President
ATEQ Corporation	Georg Schacht, Marketing Manager
AVI Management Partners	Eugene Flath, General Partner
Acer International Corporation	Stephen Su, Vice President
Advanced Chemical Systems International Inc.	Richard Brewer, President & CEO
Advanced Mechanization, Inc.	Richard Bayani, Marketing Manager Jerry Sesta, Engineering Manager
Advanced Micro Devices, Inc.	C. Richard Deininger, Director, Manufacturing Technology Gary Heerssen, Vice President & Group Executive, Wafer Fabrication Ops Oolep Indreko, Director, Strategic Technology Planning

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Air Products & Chemicals, Inc.	Mark Fitzgerald Dennis Peavler, Manager, Strategic Development Robert Shay, Manager, Electronics R&D Andre M. Williams, Marketing Manager
AIRCO Electronic Gases	Jeffrey D. Eagles, Manager, Electronic Business Team
Align-Rite International Plc.	John P. Traub, Vice President
American Semiconductor Equipment Tech.	Greg Reyes, President and Chief Executive Officer
Anelva Corporation	Fukuta Muneshige, Senior Program Manager, Planning Office
Apple Computer, Inc.	Tom Calderwood, Manager of Metrics & Standards Terry Kaspar, Procurement Manager: Memory Mary Segesta, Procurement Specialist: ROM Marty Walt
Applied Materials Japan, Inc.	Seisaku Takata, Assistant Manager Marketing
Applied Materials, Inc.	Carol Bacchetti, Product Marketing Engineer Peter Hanley, Vice President & General Manager, Etch Products Division Dennis Hunter, Director, Corporate Development Grant Imper, Marketing Manager
Applied Micro Circuits Corporation	Donald E. Schrock, Vice President, Operations
Arthur Young & Company	Alton D. Page,

Ashland Chemical Company	J. A. Duquin, VP & Gen Mgr, Electronic & Lab Products
Asyst Technologies, Inc.	Richard A. Darlow, Director, Marketing
Autoclave Engineers Inc.	Robert Brown, Chief Operating Officer Thomas Guelcher, Vice President Corporate Development, CFO
BTU Engineering Corporation	Peter H. Goebel, Vice President
Bandgap Technology Corporation	Dominique Cone, Market Analyst
Bank of America	Judy Sanchez, Vice President
Bank of the West	Marsha M. Poenisch, Vice President
Bechtel National, Inc.	William D. Blackwell, Technical Director Chris R. Kniel, Manager, Project Operations
Branson International Plasma Corporation	Lou Perrone, Vice President, Marketing & Technology
CTI-Cryogenics	Michael Grandinetti, Director of Sales
Cirrus Logic, Inc.	Michael Canning, Vice President, Manufacturing
Citicorp North America, Inc.	Kevin Nater, Account Officer
Cybeq Systems	Kanegi Nagai, General Manager
Daifuku U.S.A. Inc.	Sam Nakajima, Manager, Sales
Dexter Corporation	Larry Baxter, Marketing Manager, Powder Products

Dynachem	Kerry Grimes, Director of Marketing Sales
E.I. DuPont de Nemours & Company	Neil Washburn, Development Specialist, Speciality Polym
ESI	Sandra L. Bayless, Product Specialist
Eaton Corporation	Gaylord Noblitt, Director, Marketing
Electronic Manufacturing News	John Krukowski
Equitable Lomas Leasing	Kim Atkins, AVP Vendor Program Steven Grundon, Vice President, Marketing Service Colleen Lusian, Assistant Vice President, Equipment Evaluation Ellie Sanchez, Market Research Manager
FSI International	Don Burkman, Vice President, Marketing & Development Walt Kalin, Director of Marketing Cindy Metzger, Marketing Communications Assistant Mary Jo Peters, Public Relations Coordinator
GCA Corporation	Robert Selzer, Technical Director, Advanced Applications Research, Development & Engineering
GSIC Special Investments	Jimmy Hsu, Assistant Director
General Signal Corporation	James Greed, Director, Technology Hiroshi Ishiwata, Sales & Marketing Manager
Genus, Inc.	Ron Dornseif, Director, Strategic Programs William W.R. Elder, President and Chief Executive Officer Robert McGeary, Director, SEMATECH & IBM Programs Ameeta Soni, Product Marketing Manager

Gould AMI Semiconductors	Joe O'Neill, Vice President, Sales
Hampshire Instruments, Inc.	Tom Kulczycki, Director, Sales & Marketing Moshe Lubin, President & CEO
Hewlett-Packard Company	Dick Eichenseer, Commodity Manager James K. Lee, Commodity Manager
High Yield Technology	Michele Klein, Vice President, Marketing
Honeywell Microswitch	Gary Tighe, Product Planner
Hualon Microelectronics Corporation	Chen Yong Lin, Process Manager
Hyundai Electronics America	H. K. Kim, Manager, Marketing Planning
IVS, Inc.	Hans F. Hoyer, President & CEO
Insystems, Inc.	Chris Billat, President Susan Billat, Vice President, Technology Development Anthony J. Carrozzo, National Sales Manager
Intel Corporation	Sarah Robinson, Senior Researcher Jacques J. Vuye, Manager, Strategic Research Group
Italtel	Franco Mammucari, Procurement Manager
J. C. Schumacher Company	Loren F. Sutherland, Director, Sales/Marketing
JEOL Ltd.	Tetsuyuki Itoh Kazuhiko Moriya, Section Manager Semiconductor Equipment Division

KLA Instruments Corporation	Robert Boehlke, Executive Vice President George Duebner, Product Marketing Engineer C. Keith Van Sickle, Product Marketing Manager
Keithley Instruments, Inc.	Gary A. Pinkerton, Product/Market Manager John Snyder, Product/Market Manager
Kobe Development Corporation	Kazuo Ogata, General Manager Takeo Tanaka, Secretary General
Komatsu Silicon USA Inc.	Steven Kawamoto, Vice President
Kyocera America, Inc.	Chuck E. DeMars, Vice President, Microelectronics Division David Grooms, Product Manager, Microelectronics Group
L'Air Liquide	Jean-Pierre Brevignon, Corporate Liaison Officer Jean-Francois Piffard, Electronics Corporate Marketing Manager
LFE Corporation	Ronald Nickerson, General Manager
LTX Europe Ltd	Paul Scrivens, Director
Lam Research Corporation	Steve P. DeOrnellas, Vice President, Marketing Joe Monkowski, President, CVD Division John Osborne, Senior Vice President, Strategic Development Bruce Rhine, Vice President, Marketing CVD Division
Liquid Air Corporation	Susan Schmertmann, Product Manager, Alphagaz Division

Lucky Advanced Materials, Inc.	J. S. Choo, Senior Managing Director S. K. Hahn, President
Marubeni Hytech Co., Ltd.	Yasuhiko Morita, General Manager, Semiconductor Equip Division
Marubeni International Electronics	Koichi Ando, Vice President
Micrion Corporation	William M. McMakin, President
Microelectronics Technology Company	Akira Miura, President & General Manager
Millipore Corporation	Chris Lavin, Product Manager James Ogg, Microelectronics Marketing Manager Gerald Y. Walle, Vice President & General Manager
Motorola Semiconductor, Inc.	Don Tolliver, Contamination Manager
N. B. K. Corporation	Dr. Kaz Augusa, Director, Quality Assurance Tetsho Miyhzhki, Philip Yin, Vice President, Sales & Marketing
NCR Corporation	Andy McKelvey, Division Director of Manufacturing
NEC Corporation	Ken Kunitomo, Director, Corporate Planning Group
Nikon Corporation	Shigemasa Hisatsugu, Managerial Staff, Ind. Supplies & Equipment Division Takao Naito
Nikon Inc.	Connie Hewitt, Regional Manager Jack Isaacson, Field Sales Manager, Hi-Tech Instruments

Nikon Precision, Inc.	Richard Fallon, Marketing Product Line Manager
Oak Technical Inc.	Murray Collette, President
Olin Hunt Specialty Products, Inc.	Joe Daltner, Director, Marketing
Orasis Corporation	Robert Welch, President, CEO
Osaka Sanso Kogyo, Ltd.	Michael Solomon, General Manager
Oxford Partners	Eric Schiffer, Associate
Pall Ultrafine Filtration Corp	Reed Sarver, Electronics Sales Manager
Perkin-Elmer Corporation	Keen Kossoudji, Western Regional Marketing Manager Charles Symborski, Director, Marketing Randall M. Young, Manager, Marketing
PlanTek	Larry Campbell, Senior Vice President
Plaser Corporation	Behrooz Ataee, President & CEO
Price Waterhouse Technology	Annette Adler, Senior Manager Louise Claeys, Information Specialist Ellen Stover, Business Analyst
Processing Technology (1988) Limited	Rick B. Desbrisay, President
Prometrix Corporation	Paul Covec, Director, Marketing
Prudential-Bache Capital Funding	Mark Bode, Associate Account Officer
Prudential-Bache Securities	Lou Gerkin, Managing Director Chad Keck, Managing Director

Quantum Corporation	Marc E. Beckman, Purchasing Manager Lonnie Blackwell, Supplier Engineer Romano Ed, Buyer, Planner
Rosenberg Capital Management	Huachen Chen, Analyst Walter Price, Analyst
Ross-Dove Company, Inc.	Bruce W. Leister, National Account Executive
SAMES	Paul Kruger, Manager, Engineering
SEH America, Inc.	Parker Brinson, Director, Sales and Marketing Isao Iwashita, President
Schlumberger Technologies	Steve Harari, Vice President, Marketing North America
SEMI	Tonya Maudlin, Data Collection Administrator
Semiconductor Systems	Mark Siegel, President
SiSCAN Systems	Gerry Leever, Marketing Manager
Singapore Economic Development Board	Lit-Cheong Chong, San Francisco Center Director
Software Express	Craig Pilgrim, President & CEO
Solid State Technology Magazine	Sid Marshall, Editor
Standard Microsystems Corporation	Frank Wanlass, Chief Scientist
Sumitomo Eaton Nova Corporation	Wagner Dean, Director
Taiwan Semiconductor Manufacturing Corp.	Klaus C. Wiemer, President

Tegal Corporation	Craig Keith, Comptroller Corey J. Mullins, Marketing Manager
Tel America, Inc.	Kazuhiko Nakamura, Executive Vice President
Temescal	R. J. Hill, Director, Technology
Tescon America Inc.	Raymond Phillips, Vice President, Operations
Tokyo Electron, Ltd.	Akira Inoue, Senior Managing Director
U.S. Semiconductor Corporation	William Closser, President, CEO
ULVAC	Ted Pappas, National Sales Manager
Union Carbide Corporation	Randy O'Brien, Business Manager
Union Carbide Industrial Gases Inc.	William R. Couch, Senior Applications Engineer Bill Schmeh, Region Sales Manager Thomas L. Singman, Marketing Manager
United Microelectronics Corporation	Eric Chen, Product Planning Manager James Wu, Test Engineer
Varian Extrion	Michael Pippins, Product Manager
Varian Associates	Steve Jensen, General Manager, Thin Film Technology Thomas D. Sege, Chairman and Chief Executive Officer R. Bruce Thayer, Marketing Manager
Veriflo Corporation	Burt Lancaster, Vice President, Marketing

Westech Systems, Inc.	Tom Tucker, President
Xynetics	Gordon C. Westwood, Vice President

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Annette Adler	Price Waterhouse Technology
Koichi Ando	Marubeni International Electronics
Behrooz Ataee	Plaser Corporation
Kim Atkins	Equitable Lomas Leasing
Kaz, Dr. Augusa	N. B. K. Corporation
Carol Bacchetti	Applied Materials, Inc.
Larry Baxter	Dexter Corporation
Richard Bayani	Advanced Mechanization, Inc.
Sandra L. Bayless	ESI
Marc E. Beckman	Quantum Corporation
Chris Billat	Insystems, Inc.
Susan Billat	Insystems, Inc.
Lonnie Blackwell	Quantum Corporation
William D. Blackwell	Bechtel National, Inc.
Mark Bode	Prudential-Bache Capital Funding
Robert Boehlke	KLA Instruments Corporation
Jean-Pierre Brevignon	L'Air Liquide
Richard Brewer	Advanced Chemical Systems Int'l Inc.
Parker Brinson	SEH America, Inc.
Robert Brown	Autoclave Engineers Inc.
Don Burkman	FSI International
Tom Calderwood	Apple Computer, Inc.
Larry Campbell	PlanTek

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Michael Canning	Cirrus Logic, Inc.
Anthony J. Carrozzo	Insystems, Inc.
Eric Chen	United Microelectronics Corporation
Huachen Chen	Rosenberg Capital Management
Lit-Cheong Chong	Singapore Economic Development Board
J. S. Choo	Lucky Advanced Materials, Inc.
Louise Claeys	Price Waterhouse Technology
William Closser	U.S. Semiconductor Corporation
Murray Collette	Oak Technical Inc.
Dominique Cone	Bandgap Technology Corporation
William R. Couch	Union Carbide Industrial Gases Inc.
Paul Covec	Prometrix Corporation
Joe Daltner	Olin Hunt Specialty Products, Inc.
Richard A. Darlow	Asyst Technologies, Inc.
Chuck E. DeMars	Kyocera America, Inc.
Steve P. DeOrnellas	Lam Research Corporation
Wagner Dean	Sumitomo Eaton Nova Corporation
C. Richard Deininger	Advanced Micro Devices, Inc.
Rick B. Desbrisay	Processing Technology (1988) Limited
Ron Dornseif	Genus, Inc.
George Duebner	KLA Instruments Corporation
J. A. Duquin	Ashland Chemical Company
Jeffrey D. Eagles	Airco Electronic Gases
Romano Ed	Quantum Corporation

Dick Eichenseer	Hewlett-Packard Company
William W.R. Elder	Genus, Inc.
Richard Fallon	Nikon Precision, Inc.
Mark FitzGerald	Air Products & Chemicals, Inc.
Eugene Flath	AVI Management Partners
Steven Francis	Brent Chemicals International PLC
Lou Gerkin	Prudential-Bache Securities
Peter H. Goebel	BTU Engineering Corporation
Michael Grandinetti	CTI-Cryogenics
James Greed	General Signal Corporation
Kerry Grimes	Dynachem
David Grooms	Kyocera America, Inc.
Steven Grundon	Equitable Lomas Leasing
Thomas Guelcher	Autoclave Engineers Inc.
S. K. Hahn	Lucky Advanced Materials, Inc.
Peter Hanley	Applied Materials, Inc.
Steve Harari	Schlumberger Technologies
Gary Heerssen	Advanced Micro Devices, Inc.
Connie Hewitt	Nikon Inc.
R. J. Hill	Temescal
Shigemasa Hisatsugu	Nikon Corporation
Hans F. Hoyer	IVS, Inc.
Jimmy Hsu	GSIC Special Investments
Dennis Hunter	Applied Materials, Inc.

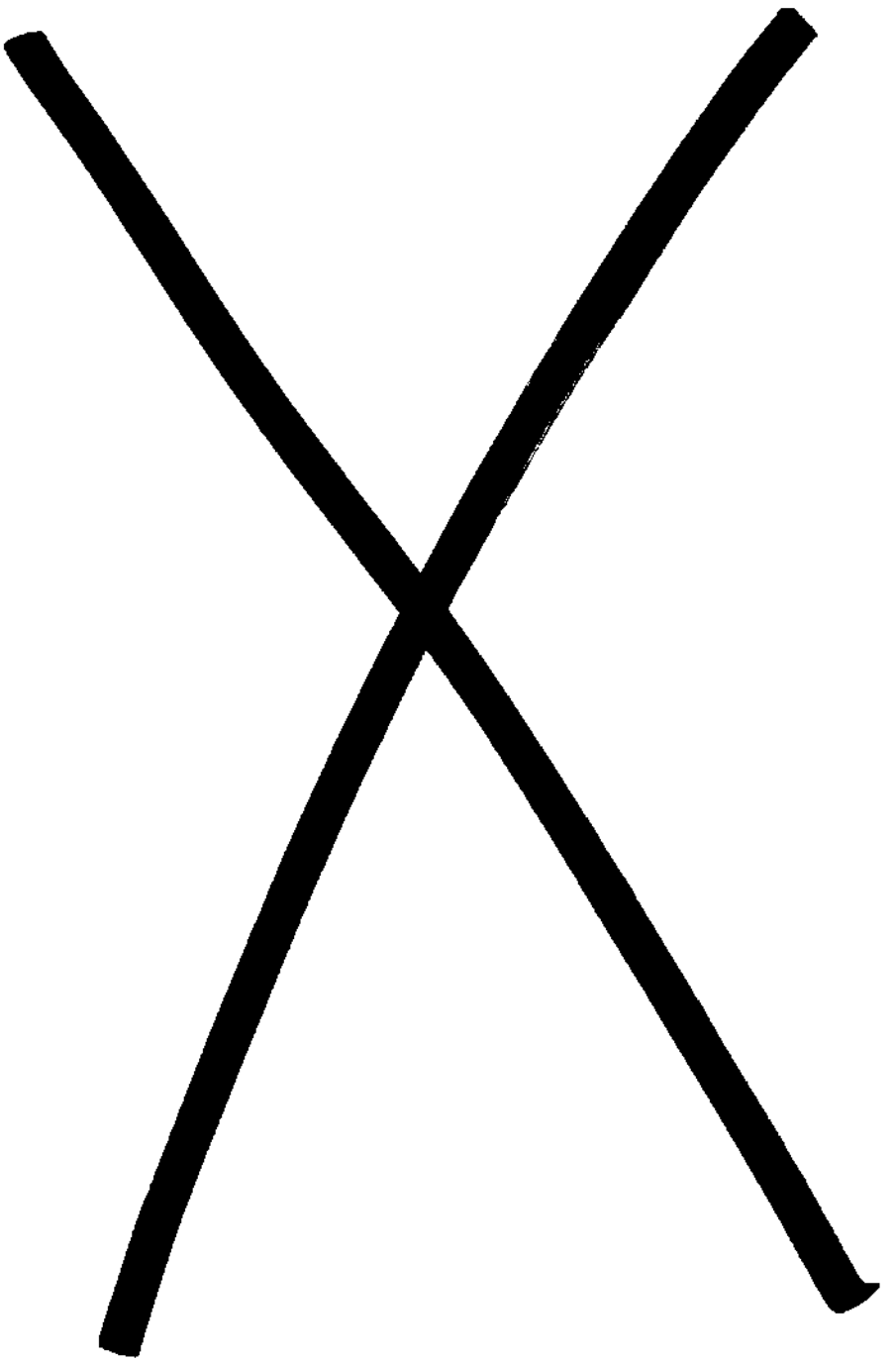
Grant Imper	Applied Materials, Inc.
Oolep Indreko	Advanced Micro Devices, Inc.
Akira Inoue	Tokyo Electron, Ltd.
Jack Isaacson	Nikon Inc.
Hiroshi Ishiwata	General Signal Corporation
Tetsuyuki Itoh	JEOL Ltd.
Isao Iwashita	SEH America, Inc.
Steve Jensen	Varian Associates
Walt Kalin	FSI International
Terry Kaspar	Apple Computer, Inc.
Steven Kawamoto	Komatsu Silicon USA Inc.
Chad Keck	Prudential-Bache Securities
Craig Keith	Tegal Corporation
H. K. Kim	Hyundai Electronics America
Michele Klein	High Yield Technology
Chris R. Kniel	Bechtel National, Inc.
Keen Kossoudji	Perkin-Elmer Corporation
Paul Kruger	SAMES
John Krukowski	Electronic Manufacturing News
Tom Kulczycki	Hampshire Instruments, Inc.
Ken Kunitomo	NEC Corporation
Herbert Lakens	ASM International N.V.
Burt Lancaster	Veriflo Corporation
Chris Lavin	Millipore Corporation
James K. Lee	Hewlett-Packard Company

Steve Lee	ASQ Technology, Inc.
Gerry Leever	SiSCAN Systems
Bruce W. Leister	Ross-Dove Company, Inc.
Chen Yong Lin	Hualon Microelectronics Corporation
Moshe Lubin	Hampshire Instruments, Inc.
Colleen Lusian	Equitable Lomas Leasing Co.
Franco Mammucari	Italtel
Doug Marsh	ASM Lithography, Inc.
Sid Marshall	Solid State Technology Magazine
Tonya Maudlin	Semiconductor Microelectronics Int'l
Robert McGeary	Genus, Inc.
Andy McKelvey	NCR Corporation
William M. McMakin	Micrion Corporation
David W. McMullen	AMP Incorporated
Cindy Metzger	FSI International
Akira Miura	Microelectronics Technology Company
Tetsho Miyhzhki	N. B. K. Corporation
Joe Monkowski	Lam Research Corporation
Yasuhiko Morita	Marubeni Hytech Co., Ltd.
Kazuhiko Moriya	JEOL Ltd.
Corey J. Mullins	Tegal Corporation
Fukuta Muneshige	Anelva Corporation
Kanegi Nagai	Cybeq Systems
Takao Naito	Nikon Corporation
Sam Nakajima	Daifuku U.S.A. Inc.

Kazuhiko Nakamura	Tel America, Inc.
Kevin Nater	Citicorp North America, Inc.
Ronald Nickerson	LFE Corporation
Gaylord Noblitt	Eaton Corporation
Randy O'Brien	Union Carbide Corporation
Joe O'Neill	Gould AMI Semiconductors
Kazuo Ogata	Kobe Development Corporation
James Ogg	Millipore Corporation
John Osborne	Lam Research Corporation
Alton D. Page	Arthur Young & Company
Ted Pappas	ULVAC
Dennis Peavler	Air Products & Chemicals, Inc.
Lou Perrone	Branson International Plasma Corporation
Mary Jo Peters	FSI International
Raymond Phillips	Tescon America Inc.
Jean-Francois Piffard	L'Air Liquide
Craig Pilgrim	Software Express
Gary A. Pinkerton	Keithley Instruments, Inc.
Michael Pippins	Varian Extrion
Marsha M. Poenisch	Bank of the West
Walter Price	Rosenberg Capital Management
Greg Reyes	American Semiconductor Equipment Tech.
Bruce Rhine	Lam Research Corporation
Sarah Robinson	Intel Corporation
Ellie Sanchez	Equitable Lomas Leasing Co.

Judy Sanchez	Bank of America
Reed Sarver	Pall Ultrafine Filtration Corp
Georg Schacht	ATEQ Corporation
Eric Schiffer	Oxford Partners
Bill Schmeh	Union Carbide Industrial Gases Inc.
Susan Schmertmann	Liquid Air Corporation
Donald E. Schrock	Applied Micro Circuits Corporation
Paul Scrivens	LTX Europe Ltd
Thomas D. Sege	Varian Associates
Mary Segesta	Apple Computer, Inc.
Robert Selzer	GCA Corporation
Jerry Sesta	Advanced Mechanization, Inc.
Robert Shay	Air Products & Chemicals, Inc.
Mark Siegel	Semiconductor Systems
L. David Sikes	ASM Epitaxy
Thomas L. Singman	Union Carbide Industrial Gases Inc.
John Snyder	Keithley Instruments, Inc.
Michael Solomon	Osaka Sanso Kogyo, Ltd.
Ameeta Soni	Genus, Inc.
Ellen Stover	Price Waterhouse Technology
Stephen Su	Acer International Corporation
Loren F. Sutherland	J. C. Schumacher Company
Charles Symborski	Perkin-Elmer Corporation
Seisaku Takata	Applied Materials Japan, Inc.
Takeo Tanaka	Kobe Development Corporation

R. Bruce Thayer	Varian Associates
Gary Tighe	Honeywell Microswitch
Don Tolliver	Motorola Semiconductor, Inc.
John P. Traub	Align-Rite International Plc.
Tom Tucker	Westech Systems, Inc.
C. Keith Van Sickle	KLA Instruments Corporation
Jacques J. Vuye	Intel Corporation
Gerald Y. Walle	Millipore Corporation
Marty Walt	Apple Computer, Inc.
Frank Wanlass	Standard Microsystems Corporation
Neil Washburn	E.I. DuPont de Nemours & Company
Robert Welch	Orasis Corporation
Gordon C. Westwood	Xynetics
Klaus C. Wiemer	Taiwan Semiconductor Mfg. Corp.
Andre M. Williams	Air Products & Chemicals, Inc.
James Wu	United Microelectronics Corporation
Philip Yin	N. B. K. Corporation
Donald M. Yoshikawa	AG Associates
Randall M. Young	Perkin-Elmer Corporation
Arthur H. del Prado	ASM International N.V.



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THE EIGHTH ANNUAL SEMICON/WEST SEMINAR:
STATUS 1989

May 24, 1989
Dunfey San Mateo Hotel
San Mateo, California

7:00 a.m. to
8:00 a.m. Registration and Continental Breakfast

8:00 a.m. Seminar Begins

Welcome and Introduction
Joseph Grenier
Director
Semiconductor Equipment and Materials Service
Dataquest Incorporated

Semiconductor Demand:
Forces, Forecast, and Fears
Mel Thomsen
Director
Strategic Analysis
Dataquest Incorporated

DRAMs and ASICs as Technology Drivers
Krishna Shankar
Industry Analyst
Semiconductor Equipment and Materials Service
Dataquest Incorporated

A Comparison of Japanese and U.S. Fabs
Mark T. Reagan
Industry Analyst
Semiconductor Equipment and Materials Service
Dataquest Incorporated

Break

(Continued)

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Capital Spending:
Stability Achieved
George Burns
Industry Analyst
Semiconductor Equipment and Materials Service
Dataquest Incorporated

Wafer Fab Equipment Industry Status 1989
Joseph Grenier
Director
Semiconductor Equipment and Materials Service
Dataquest Incorporated

Silicon Wafers:
Existing Markets and Future Opportunities
Dr. Peggy Marie Wood
Industry Analyst
Semiconductor Equipment and Materials Service
Dataquest Incorporated

Japanese Equipment Markets
Kaz Hayashi
Industry Analyst
Semiconductor Equipment and Materials Service
Dataquest Japan Limited

12:00 Noon Adjourn

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1989 SEMICON/WEST SEMINAR
QUESTIONNAIRE

In order to continually improve the Semiconductor Equipment and Materials SEMICON/West Seminar, we need to better understand your information needs. Please help us by completing the following questionnaire. We would appreciate it if you would list your company name

_____

1. Is your company a Dataquest client? ____Yes ____No

2. Which of the following best describes your company's primary activities?

   _____Semiconductor manufacturer

   _____Semiconductor equipment supplier

   _____Semiconductor materials supplier

   _____Other_____
   (Please specify)

3. Which of the following best describes your position/title?

   _____CEO, President, Vice President

   _____Strategic Planning/Business Development

   _____Sales and Marketing Management

   _____Product Development/R&D/Engineering Management

   _____Other_____
   (Please specify)

4. How did you learn about this seminar?

   _____The brochure was mailed directly to me

   _____Someone in my company gave me the brochure

   _____Someone from Dataquest called me

   _____Other_____
   (Please specify)

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5. Please list your main reasons for attending this seminar:

_____

_____

	Highest				Lowest
6. How well did the seminar meet your objectives?	1	2	3	4	5

7. In the future, should the length of this seminar be:
_____Shorter _____Longer _____The same?

8. What speeches were the most important to you?

_____

_____

9. What speeches were the least important to you?

_____

_____

10. Topics you would like to hear about at next year's seminar:

_____

_____

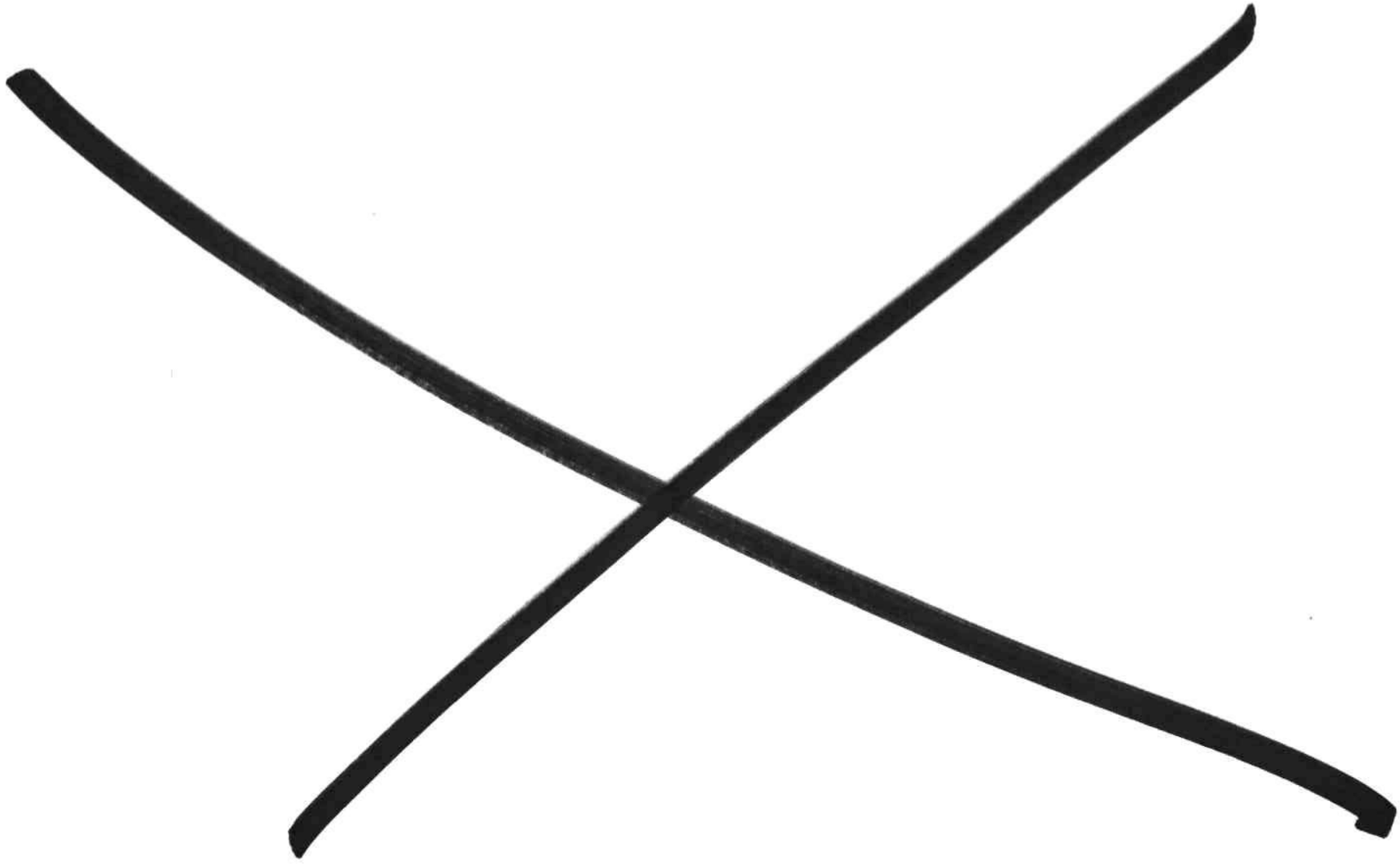
11. Please use this space for your comments on any aspect of our seminar:

_____

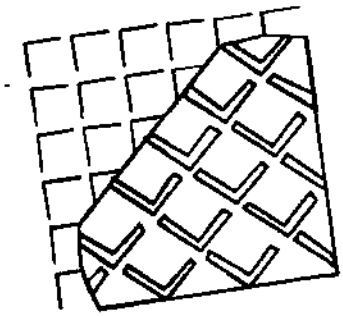
_____

_____

Name_____
(Optional)



Dataquest's Annual
SEMICON/West Seminar
May 24, 1989



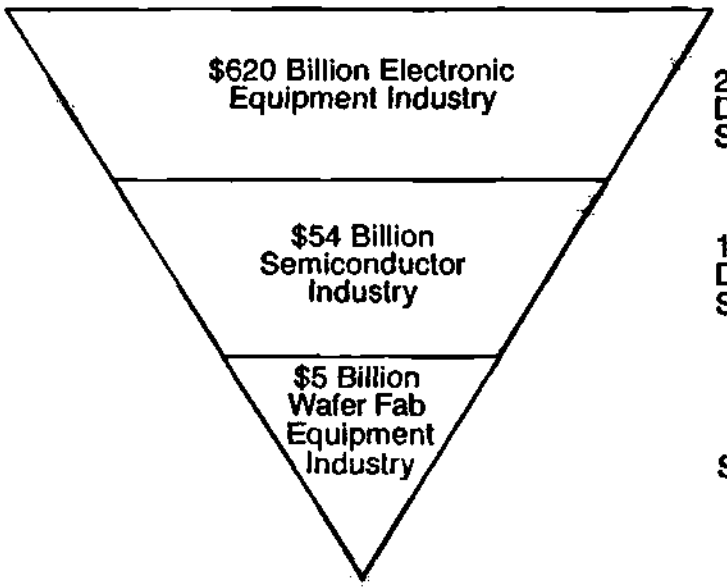
SEMICON/WEST SEMINAR 1989

JOSEPH GRENIER

Director
Semiconductor Equipment and Materials Service
Dataquest Incorporated

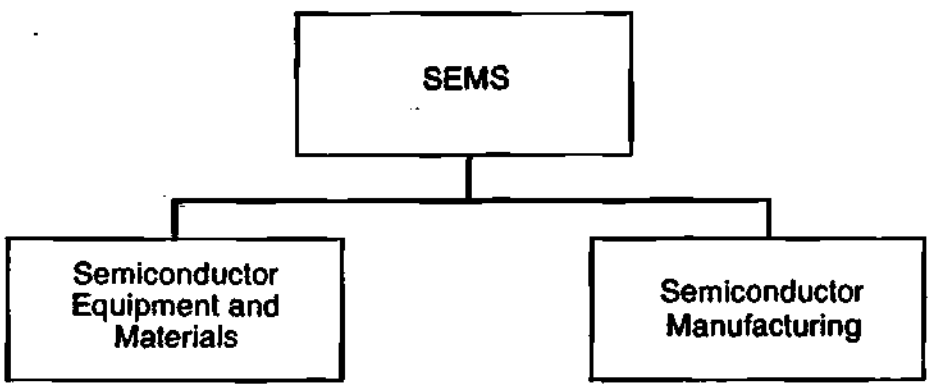
Dataquest Incorporated, a company of The Dun & Bradstreet Corporation
1290 Ridder Park Drive, San Jose, CA 95131-2398 / (408) 437-8000 / Telex 171973 / Fax (408) 437-0292

ELECTRONICS INDUSTRY FOOD CHAIN
1988 MARKETS



Source: Dataquest

SEMICONDUCTOR EQUIPMENT AND MATERIALS SERVICE



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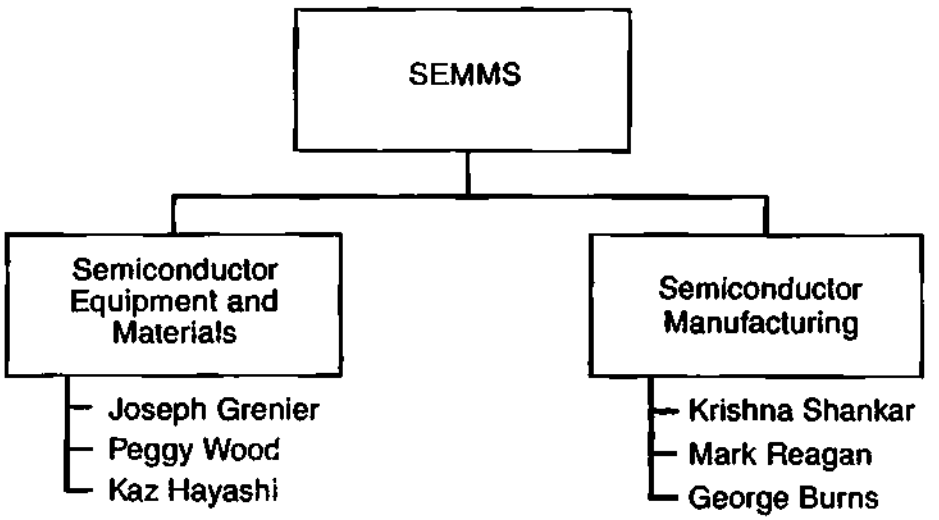
SEMICONDUCTOR EQUIPMENT, MATERIALS, AND MANUFACTURING SERVICE



AGENDA

1. Semiconductor Demand: Forces, Forecast, and Fears
2. Technology Drivers: Present and Future
3. A Comparison of U.S. and Japanese Fabs

   Coffee Break

4. Capital Spending and Capacity Utilization: Overcapacity?
5. Wafer Fab Equipment Industry -- Status 1989
6. Silicon Markets and Technology
7. Japanese Equipment Markets

   Adjourn

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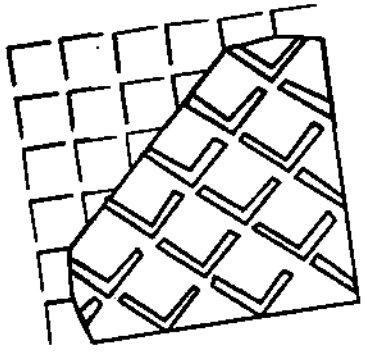


SEMICONDUCTOR DEMAND: FORCES, FORECAST, AND FEARS

MEL THOMSEN
Director, Strategic Analysis
Dataquest Incorporated

Dataquest Incorporated, a company of The Dun & Bradstreet Corporation
1290 Ridder Park Drive, San Jose, CA 95131-2398 / (408) 437-8000 / Telex 171973 / Fax (408) 437-0292

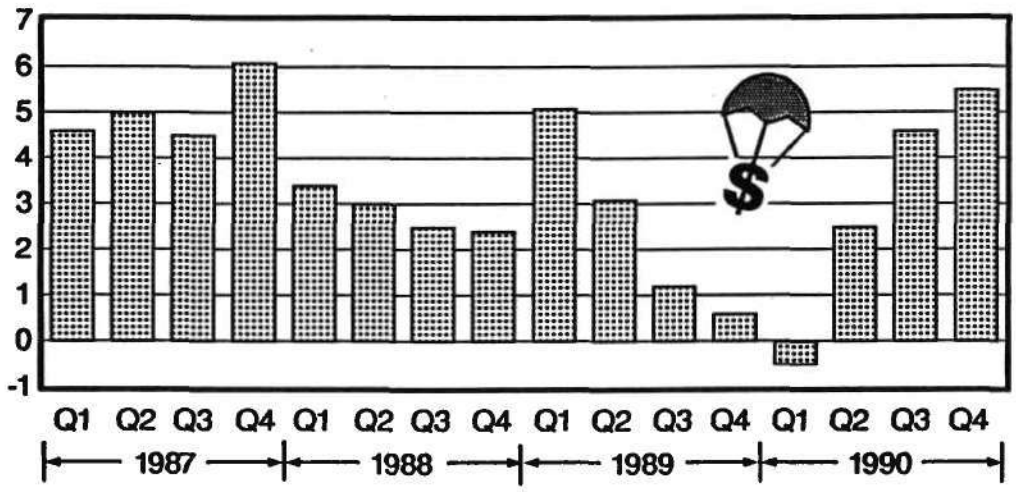
SEMICONDUCTOR DEMAND: FORCES, FORECAST, AND FEARS

Forces

- Economic
- International trade
- Semiconductor industry trends
- Company performance
- Inventory levels

ESTIMATED UNITED STATES GNP GROWTH RATE

Percent Change (SAAR)



Source: Dun & Bradstreet

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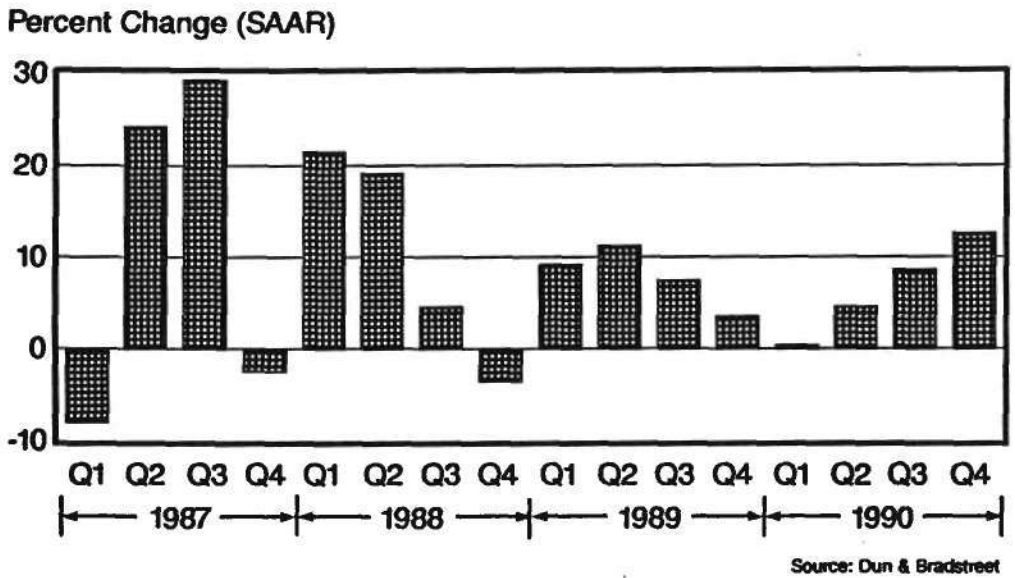
ESTIMATED CHANGE IN EQUIPMENT FIXED INVESTMENT

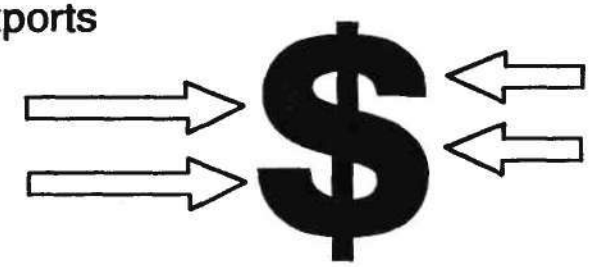


Source: Dun & Bradstreet

[05153006.IMG 05/03/90:THO]

ECONOMIC FORCES

- Slower U.S. growth, but no recession
- Most companies will maintain or increase capital spending
- Caution over higher interest rates
  - Higher cost of capital
  - Pressure on exports



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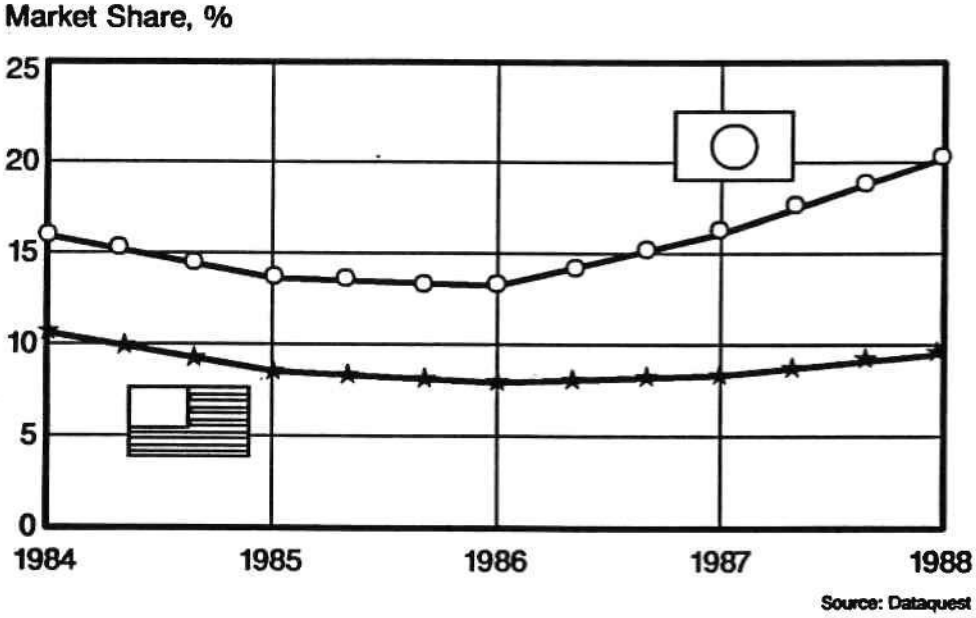
SEMICONDUCTOR DEMAND: FORCES, FORECAST, AND FEARS

Forces

- Economic
- International trade
- Semiconductor industry trends
- Company performance
- Inventory levels

THE MARKET SHARE BATTLE



Source: Dataquest

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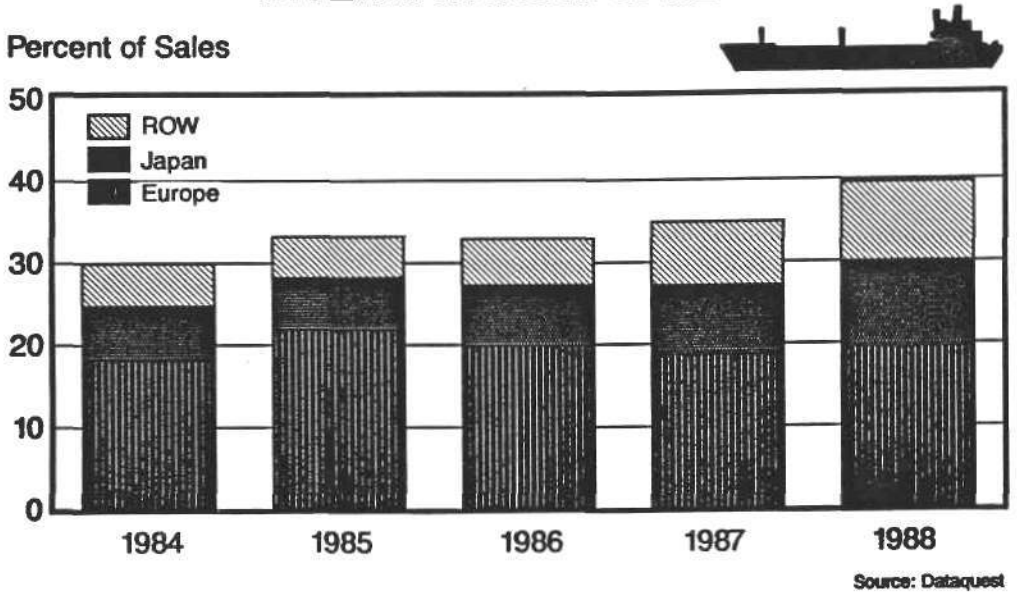
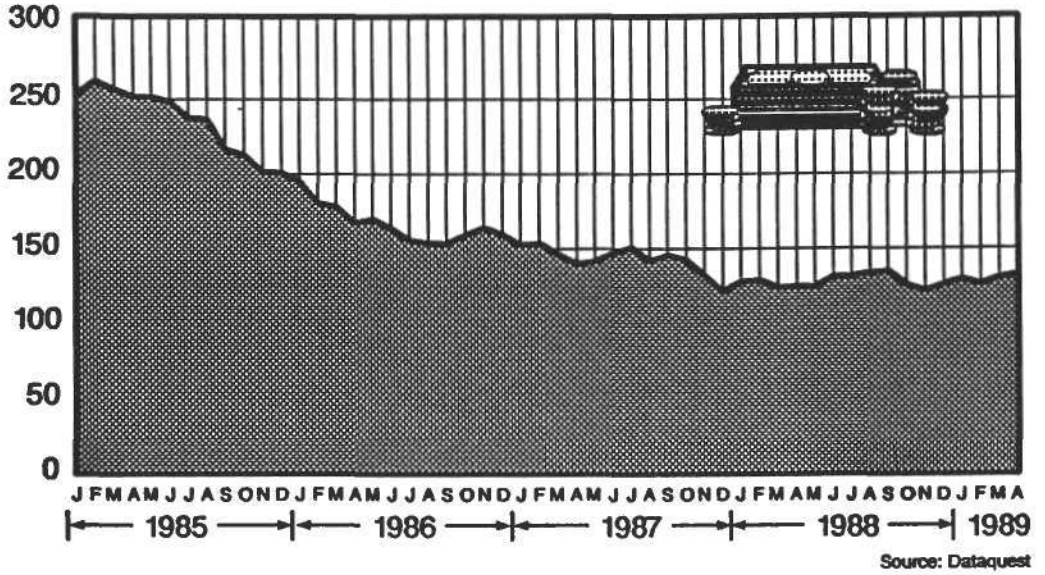
U.S. SEMICONDUCTOR INTERNATIONAL SALES



Source: Dataquest

YEN-TO-DOLLAR EXCHANGE RATE

January 1985 to April 1989



Source: Dataquest

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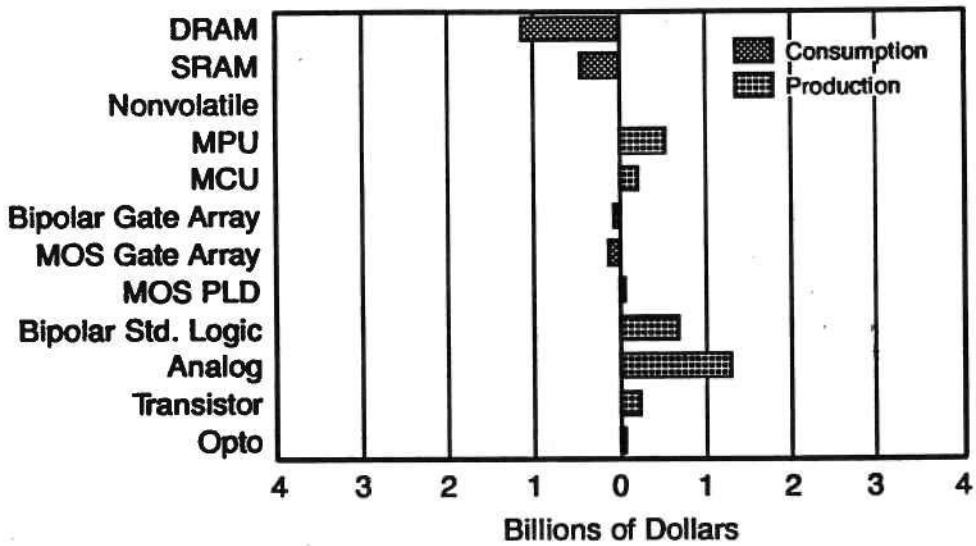
UNITED STATES SEMICONDUCTOR

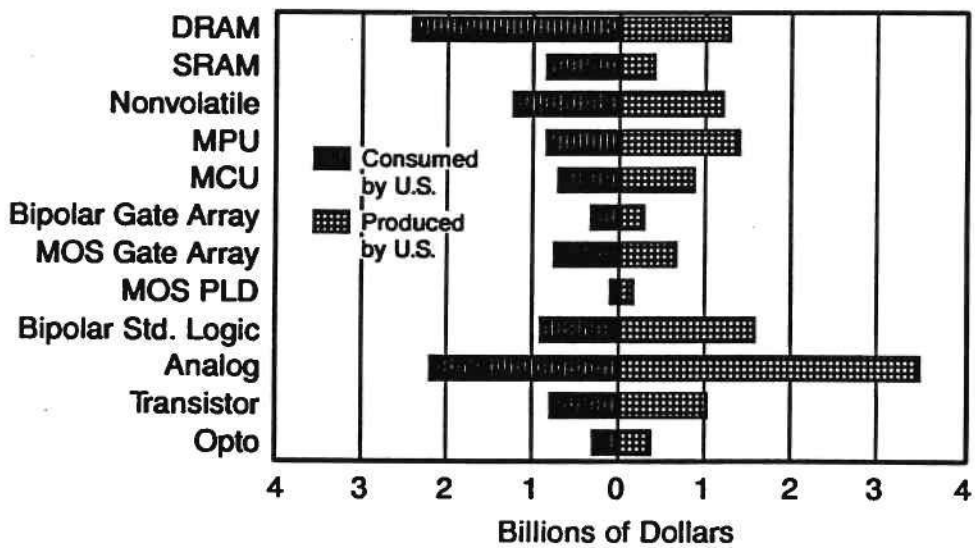
Difference between Consumption and Production



Source: Dataquest

UNITED STATES SEMICONDUCTOR

Consumption/Production Profile



Source: Dataquest

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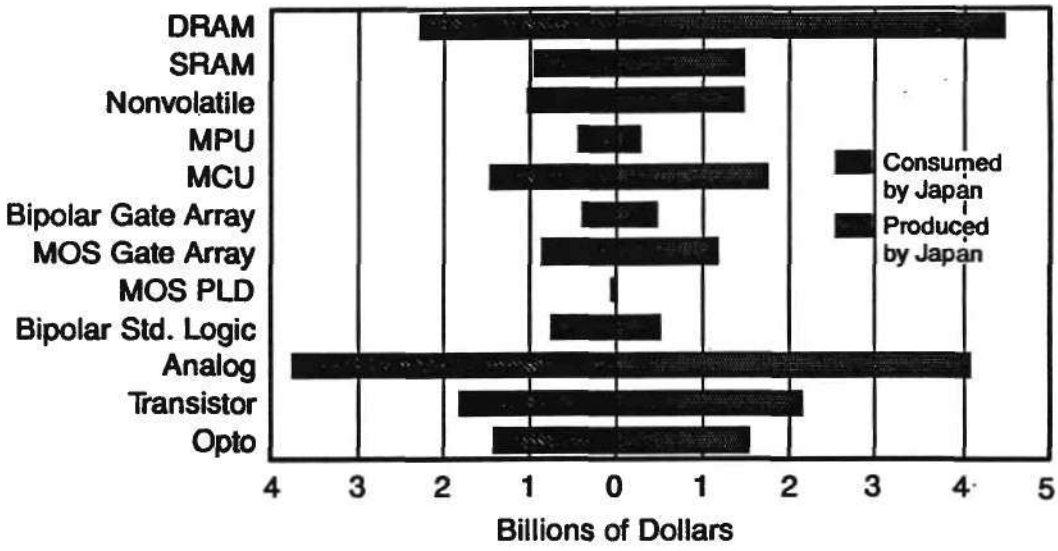
JAPANESE SEMICONDUCTOR

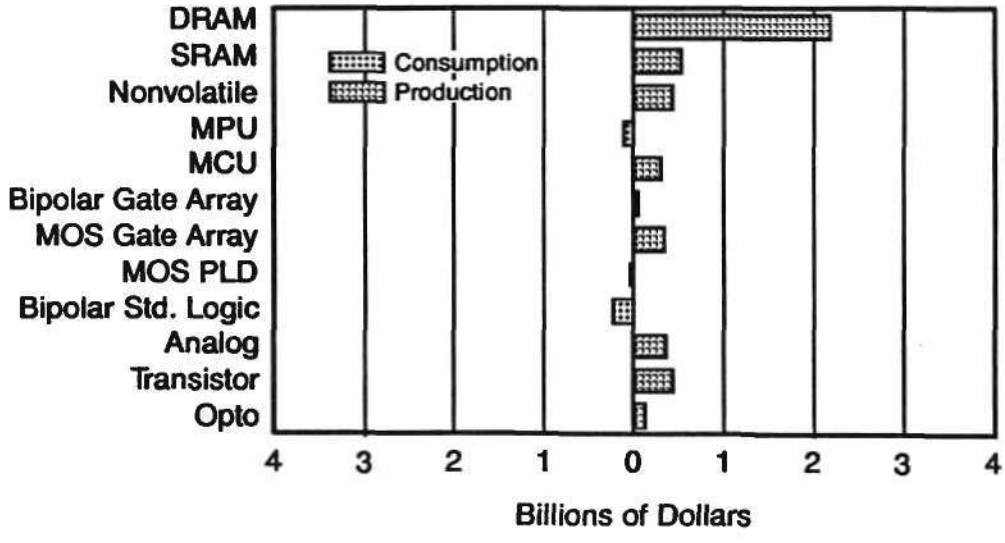
Consumption/Production Profile



Source: Dataquest

JAPANESE SEMICONDUCTOR

Difference between Consumption and Production



Source: Dataquest

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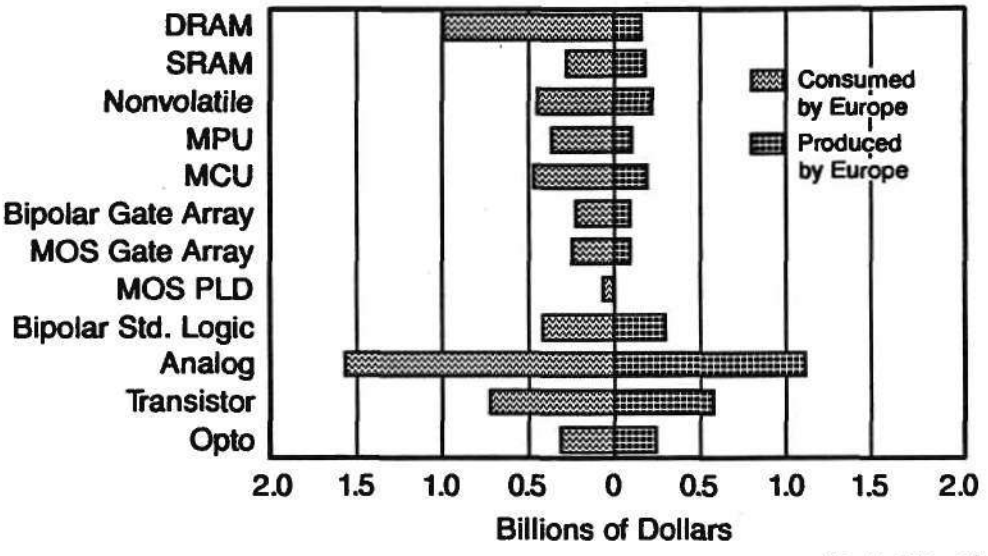
EUROPEAN SEMICONDUCTOR

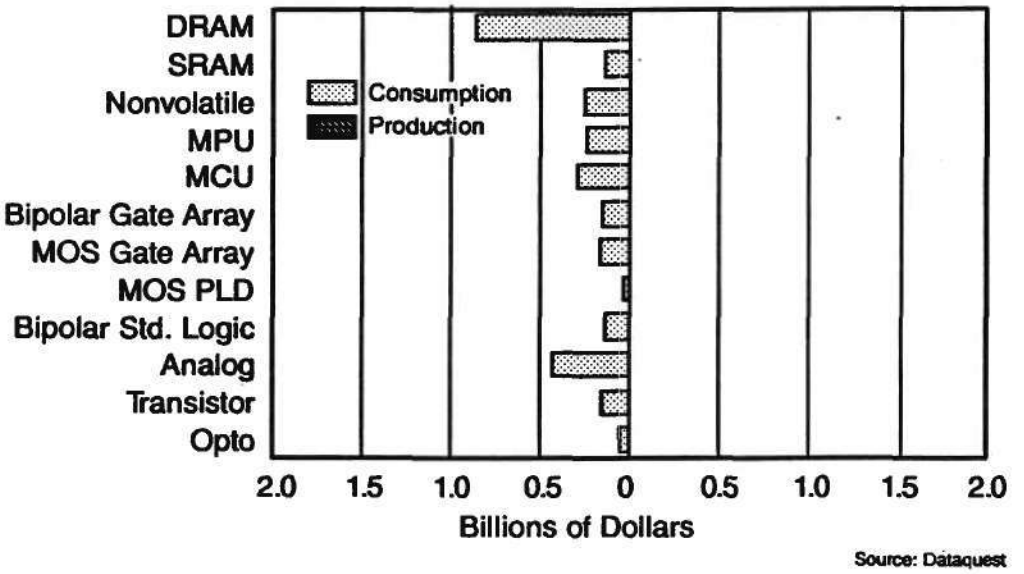
Consumption/Production Profile



Source: Dataquest

EUROPEAN SEMICONDUCTOR

Difference between Consumption and Production



Source: Dataquest

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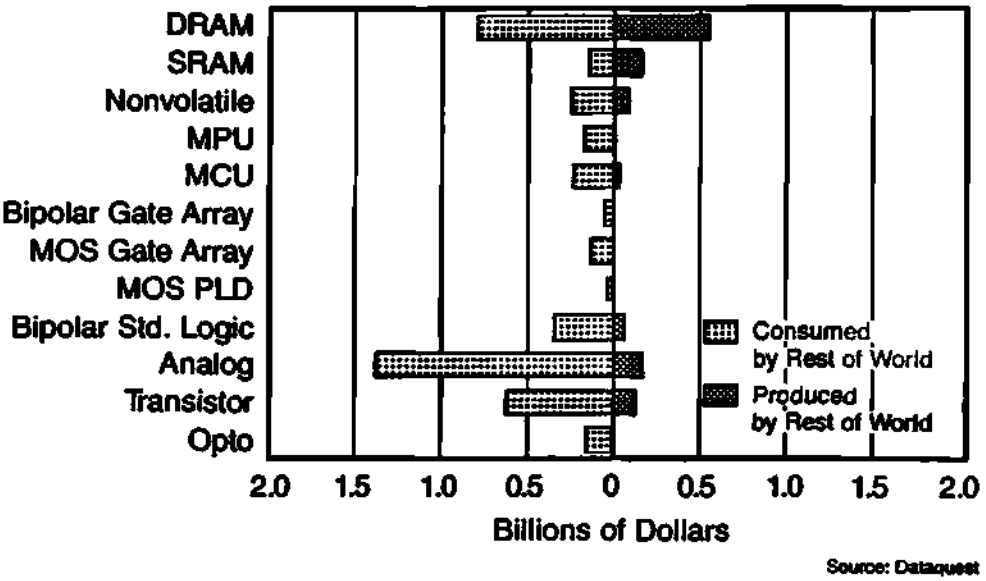
REST OF WORLD SEMICONDUCTOR

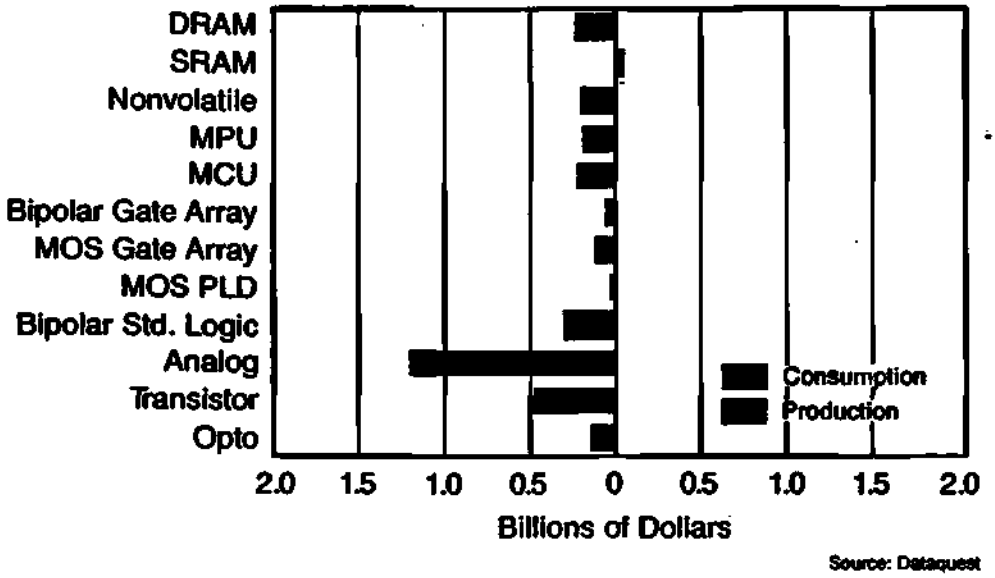
Consumption/Production Profile



Source: Dataquest

REST OF WORLD SEMICONDUCTOR

Difference between Consumption and Production



Source: Dataquest

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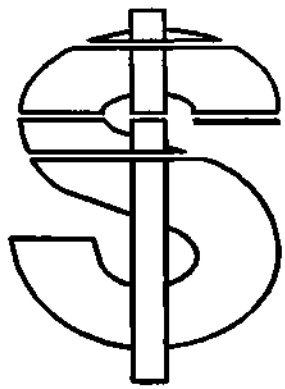
WHERE DO THEY GET THEIR REVENUE?

North American Companies
(Percent of 1988 Revenue)



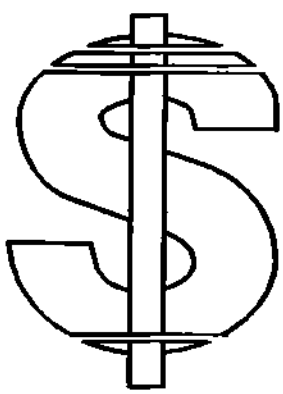
9.6% ROW
19.7% Europe
10.4% Japan

60.4% North America

Source: Dataquest

WHERE DO THEY GET THEIR REVENUE?

Japanese Companies
(Percent of 1988 Revenue)



9.8% ROW
5.7% Europe

71.8% Japan

12.8% North America

Source: Dataquest

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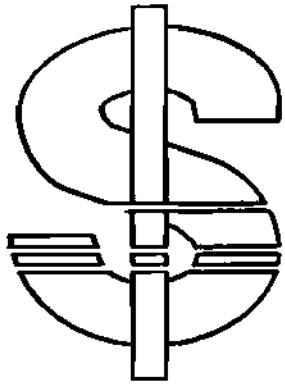
WHERE DO THEY GET THEIR REVENUE?

ROW Companies
(Percent of 1988 Revenue)



54.2% ROW

11.7% Europe
4.4% Japan
29.7% North America

Source: Dataquest

SEMICONDUCTOR DEMAND: FORCES, FORECAST, AND FEARS

Forces

- Economic
- International trade
- Semiconductor industry trends
- Company performance
- Inventory levels

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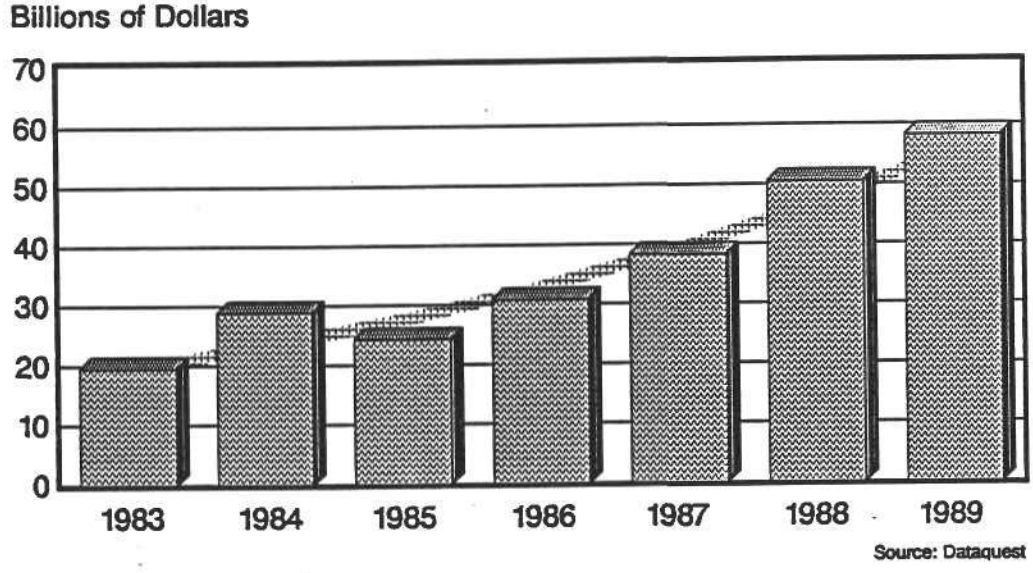
WORLDWIDE SEMICONDUCTOR SHIPMENT FORECAST



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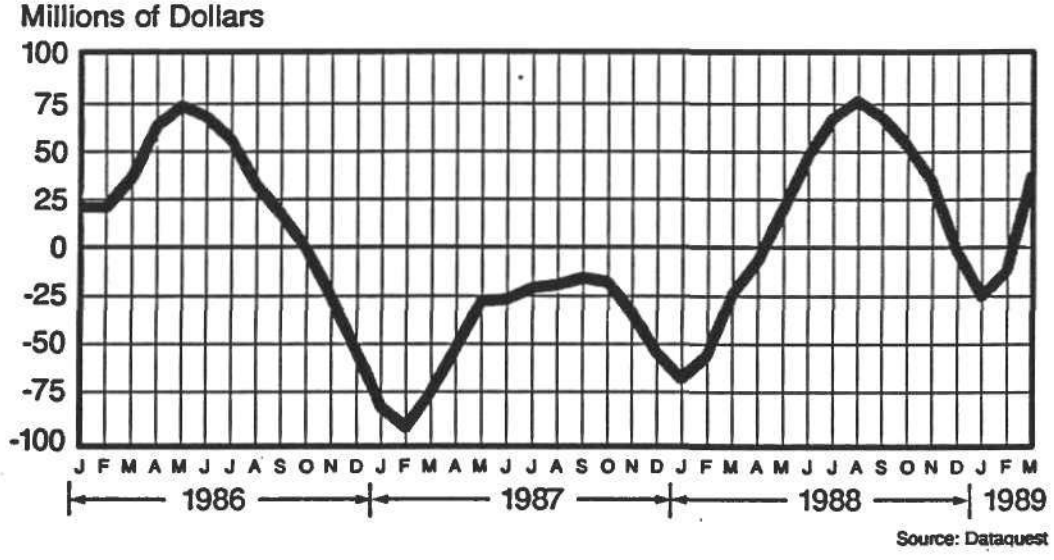
AVERAGE NORTH AMERICAN SEMICONDUCTOR SALES RELATIVE TO LONG-TERM TREND



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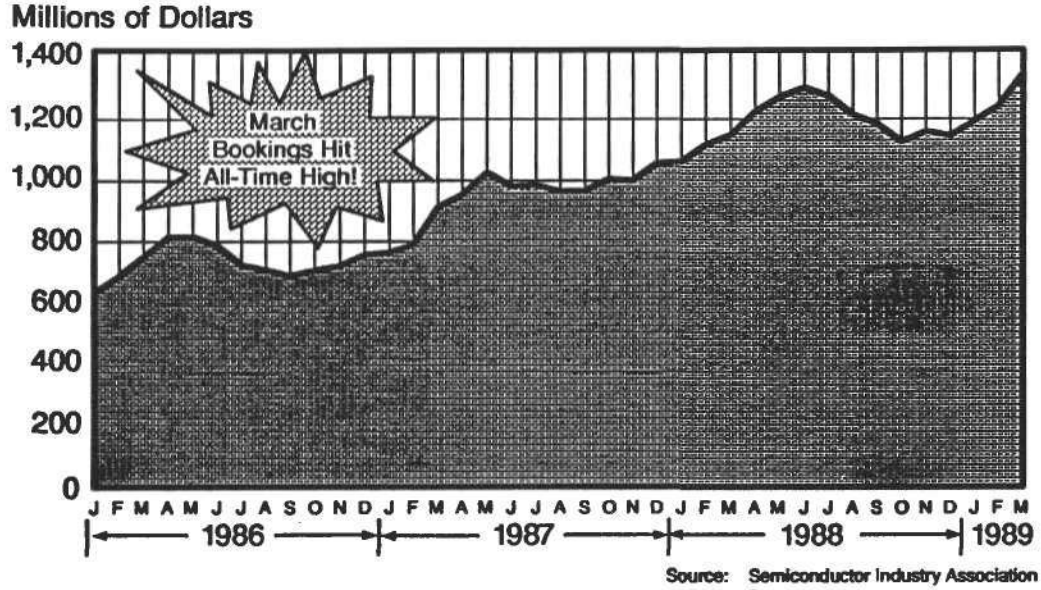
NORTH AMERICAN SEMICONDUCTOR THREE-MONTH AVERAGE BOOKINGS

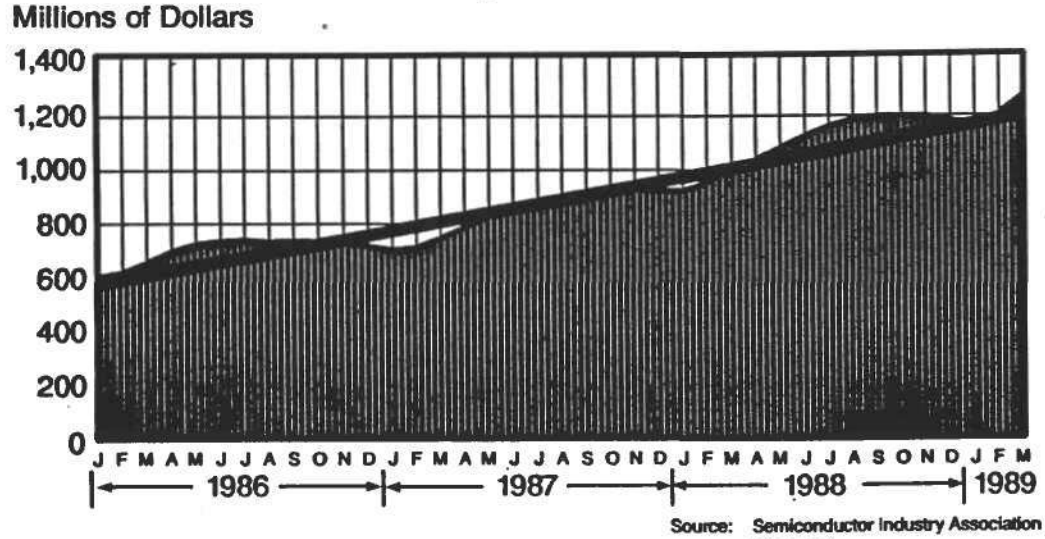


Source: Semiconductor Industry Association
Dataquest

[B5153026.IMG 05/03/89:THO]

AVERAGE NORTH AMERICAN SEMICONDUCTOR SALES

Long-Term Trend



Source: Semiconductor Industry Association
Dataquest

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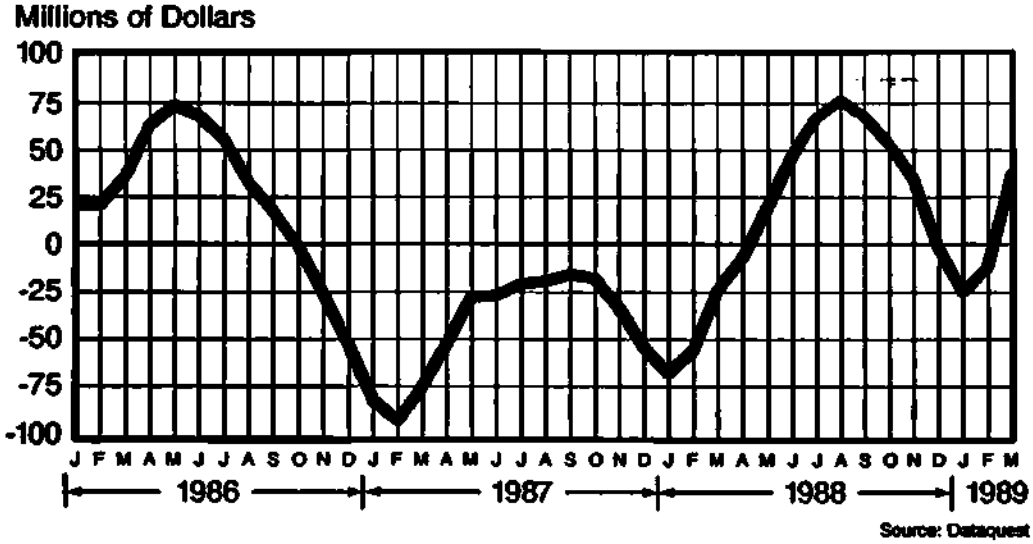
AVERAGE NORTH AMERICAN SEMICONDUCTOR SALES RELATIVE TO LONG-TERM TREND



Source: Dataquest

SEMICONDUCTOR DEMAND: FORCES, FORECAST, AND FEARS

Forces

- Economic
- International trade
- Semiconductor industry trends
- Company performance
- Inventory levels

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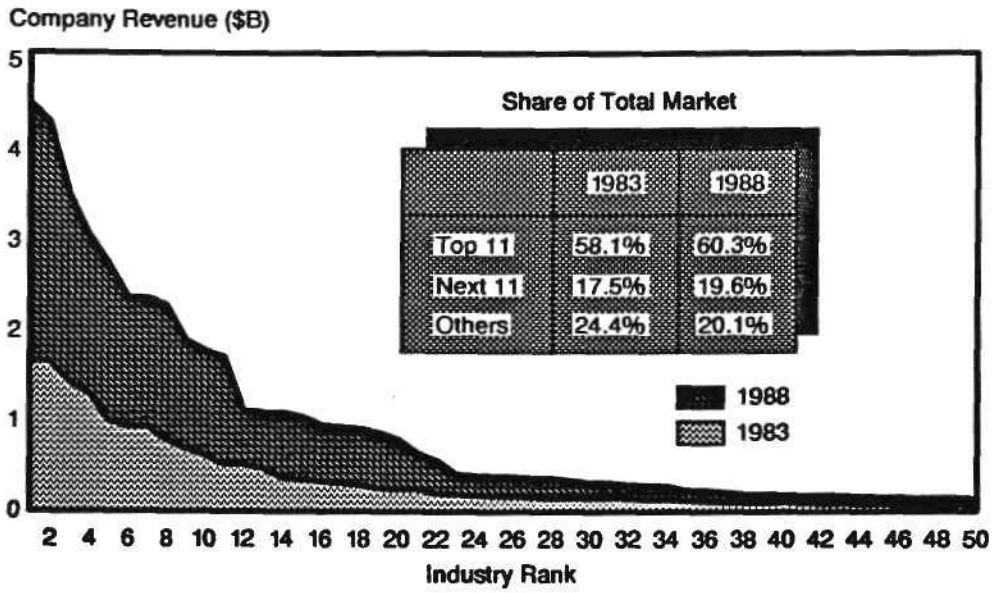
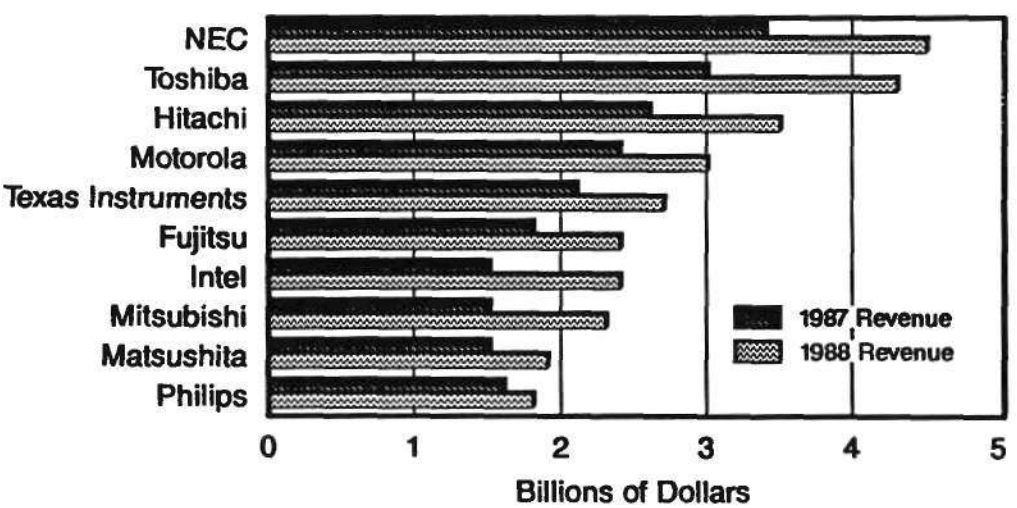
CONCENTRATION OF POWER



Source: Dataquest

TOP 10 SEMICONDUCTOR COMPANIES' WORLDWIDE REVENUE



Source: Dataquest

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[S5153031.IMG 05/03/89:THO]

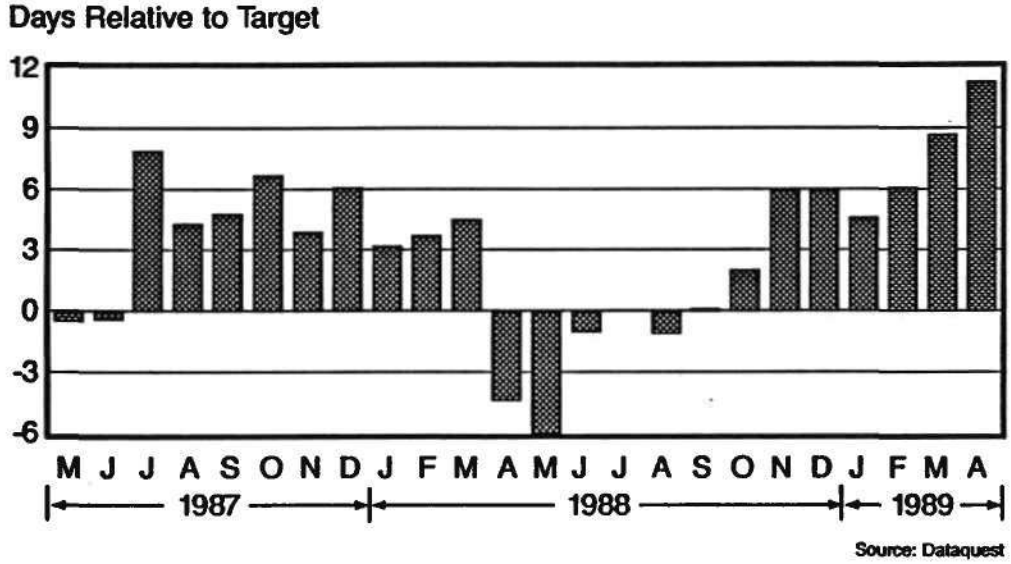
SEMICONDUCTOR DEMAND: FORCES, FORECAST, AND FEARS

Forces

- Economic
- International trade
- Semiconductor industry trends
- Company performance
- Inventory levels

[S5153032.IMG 05/03/89:THO]

DAYS OF SEMICONDUCTOR INVENTORY FOR ALL USERS



Source: Dataquest

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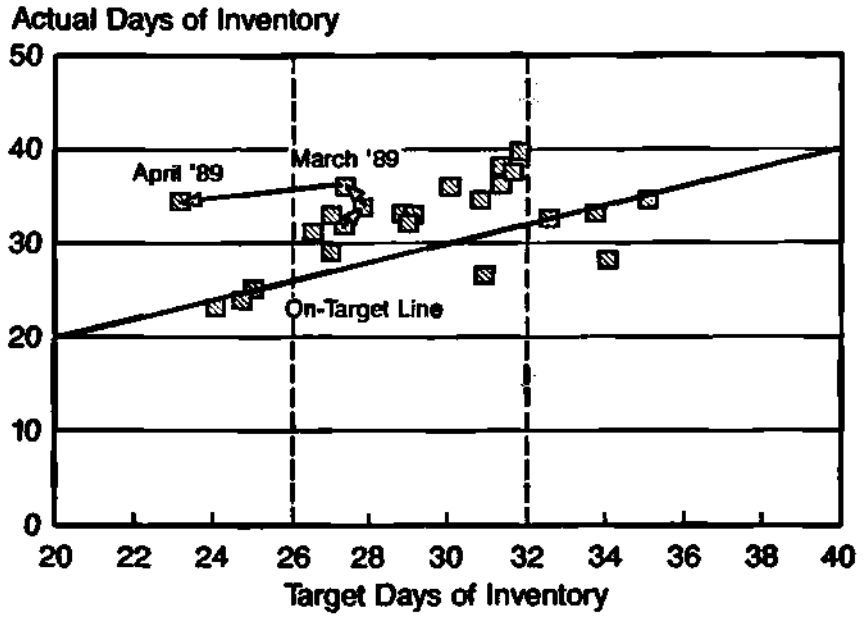
ACTUAL INVENTORY RELATIVE TO TARGET



Source: Dataquest

SEMICONDUCTOR DEMAND FORCES, FORECAST, AND FEARS

Forecast

- Buyers' expectations
- Important markets
- Emerging and fast-growing markets
- Semiconductor forecast
- Hot semiconductor products

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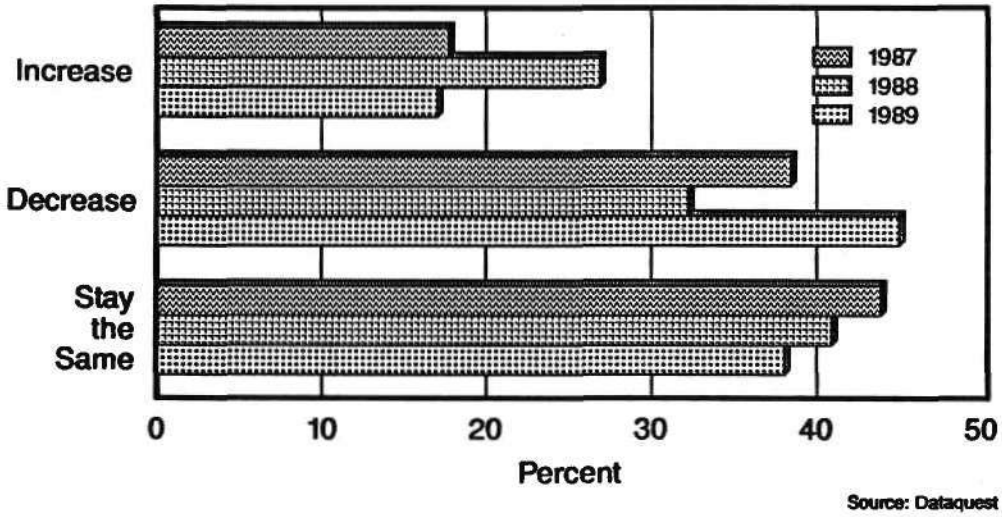
[85153040.IMG 05/03/80:THO]

BUYERS' EXPECTATIONS

Expected Change in Target Inventory Levels
(Percent of Total Respondents)



Source: Dataquest

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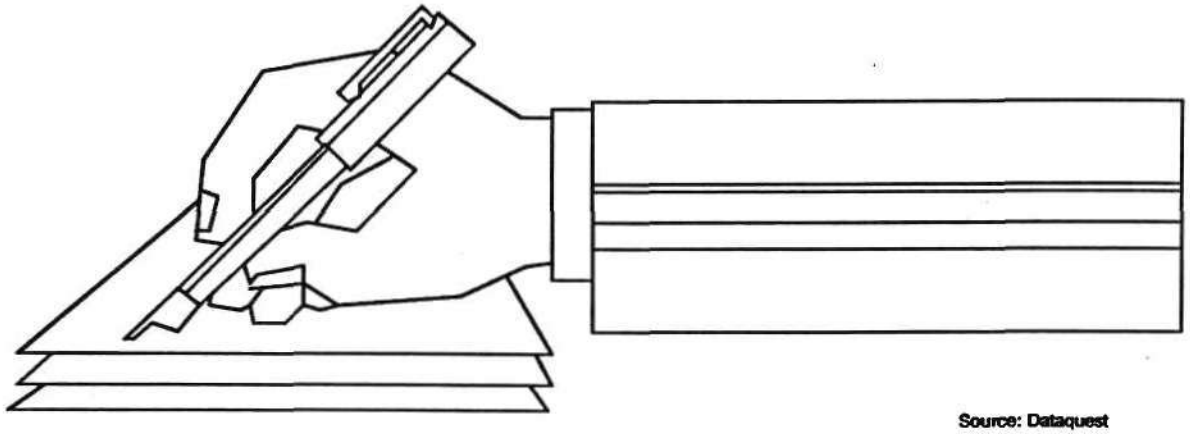
BUYERS' EXPECTATIONS

Users expect to increase semiconductor purchases by 17.8% percent in 1989



Source: Dataquest

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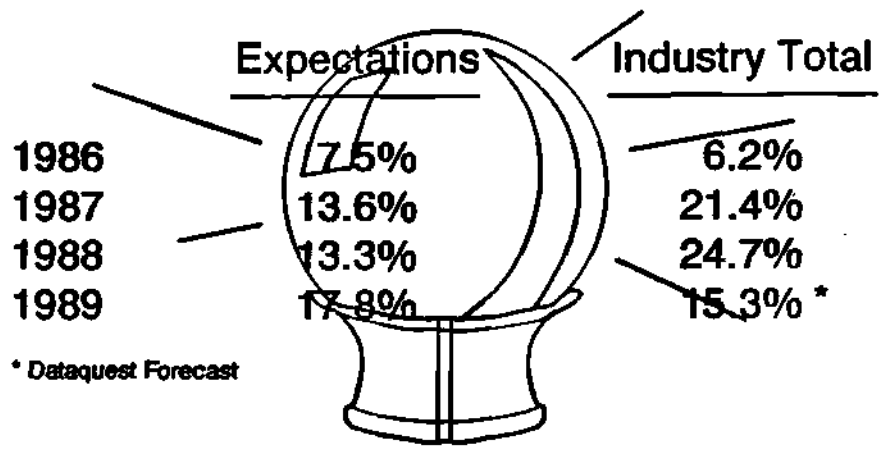
BUYERS' EXPECTATIONS

The Users' Track Record



* Dataquest Forecast

Source: Dataquest

SEMICONDUCTOR DEMAND FORCES, FORECAST, AND FEARS

Forecast

- Buyers' expectations
- Important markets
- Emerging and fast-growing markets
- Semiconductor forecast
- Hot semiconductor products

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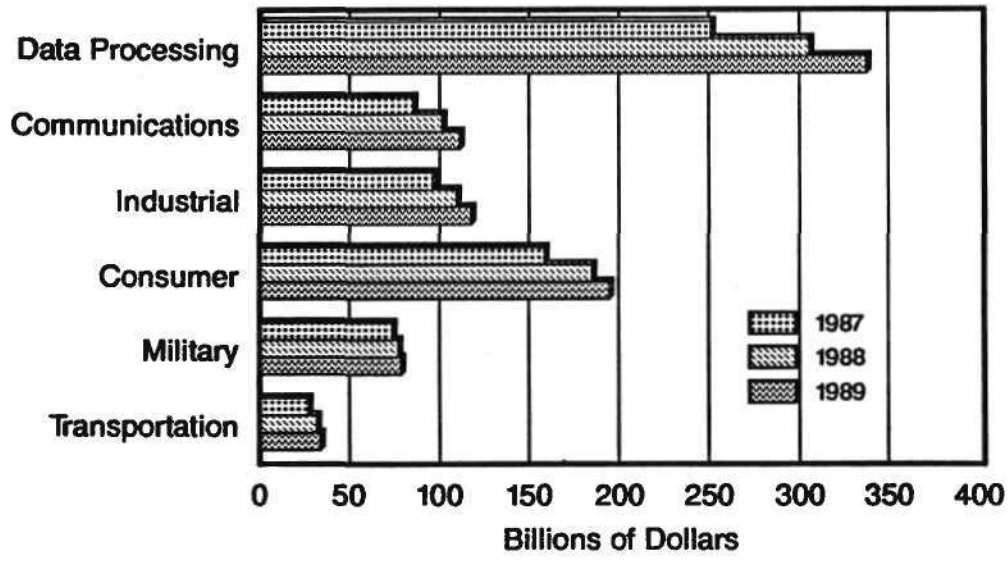
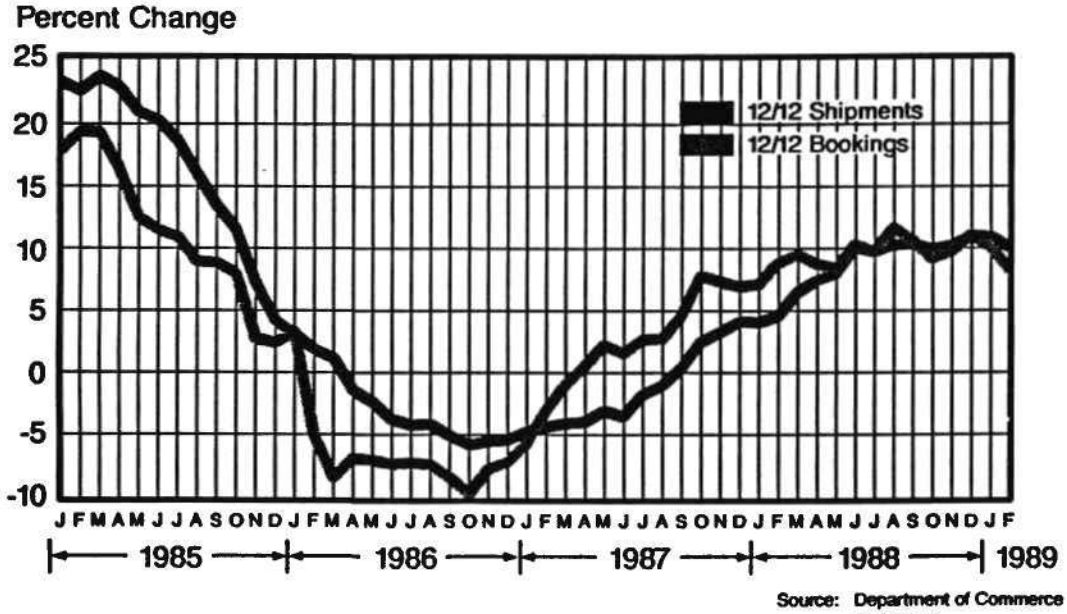
ESTIMATED WORLDWIDE ELECTRONICS MARKETS



Source: Dataquest

[85153043.IMG 05/05/89:THO]

U.S. COMPUTERS AND OFFICE EQUIPMENT



Source: Department of Commerce
Dataquest

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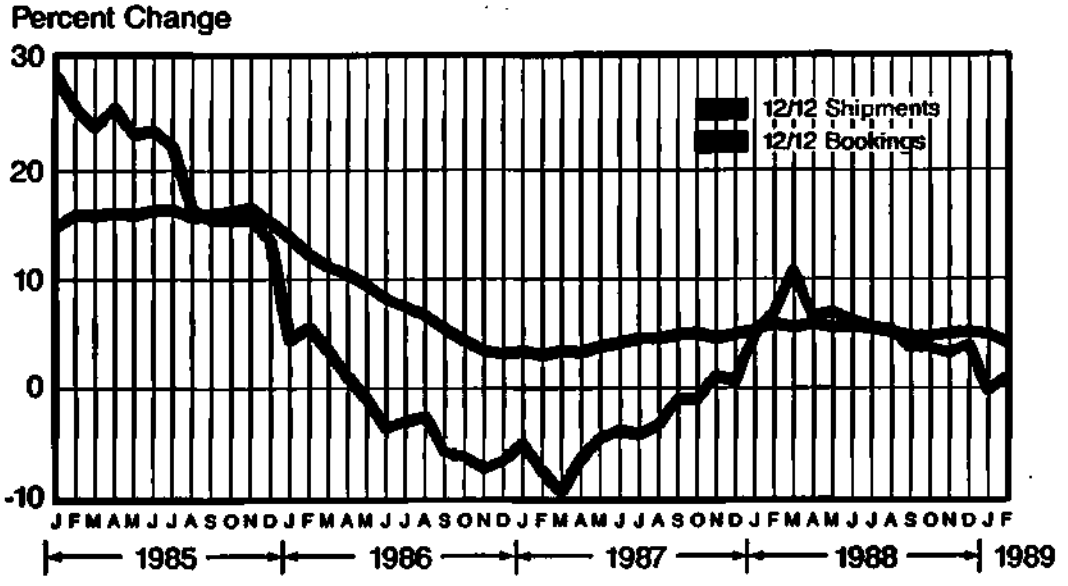
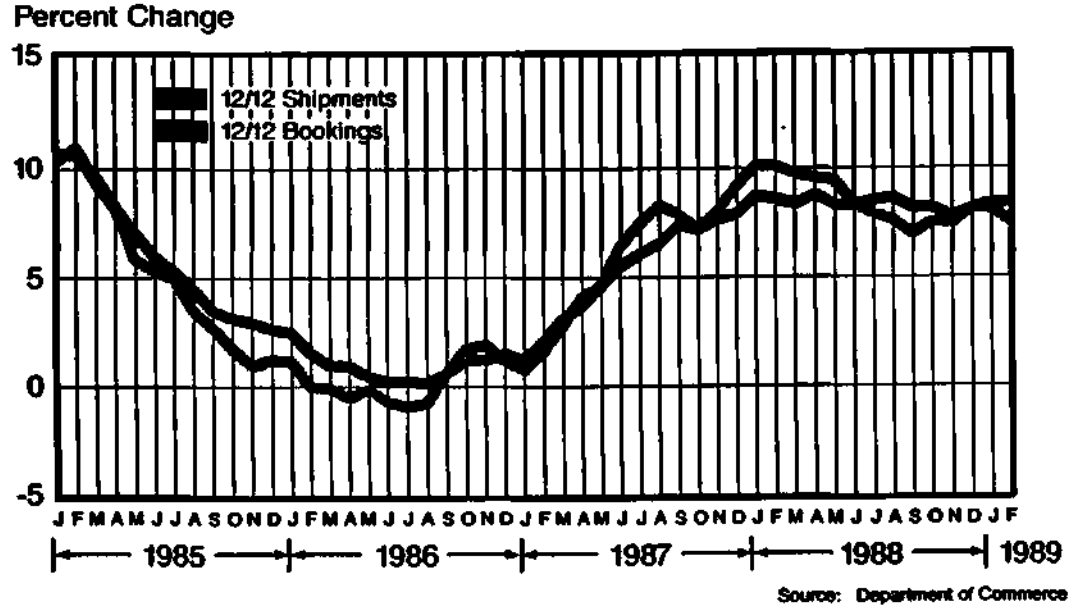
U.S. COMMUNICATIONS EQUIPMENT



Source: Department of Commerce
Dataquest

U.S. INSTRUMENTATION



Source: Department of Commerce
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SEMICONDUCTOR DEMAND FORCES, FORECAST, AND FEARS

Forecast

- Buyers' expectations
- Important markets
- Emerging and fast-growing markets
- Semiconductor forecast
- Hot semiconductor products

FASTEST-GROWING LARGE MARKETS

Estimated U.S. Revenue
(Millions of Dollars)

Segment	1988	1992	CAGR
Processing Terminals	0.1	1.0	86.7%
Optical Disk Drives	0.4	3.0	61.8%
Electronic Publishing	1.6	6.6	42.4%
3- to 4-Inch Disk Drives	3.7	14.2	39.5%
Workstations	1.9	4.8	25.6%
Factory Networks	0.7	1.7	23.9%
LAN Connections	2.4	5.4	22.4%
Cellular Radio	3.6	7.9	21.9%
Voice Messaging Systems	0.5	15.8	137.2%
3.5-Inch Floppy Drives	1.1	17.5	99.7%

Source: Dataquest

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SEMICONDUCTOR DEMAND FORCES, FORECAST, AND FEARS

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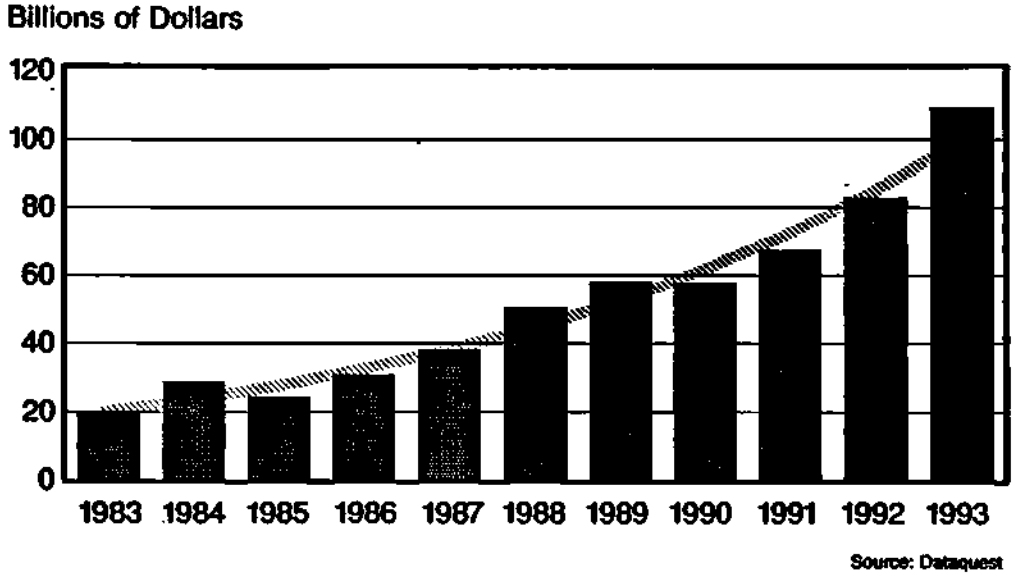
WORLDWIDE SEMICONDUCTOR SHIPMENTS HISTORY AND FORECAST



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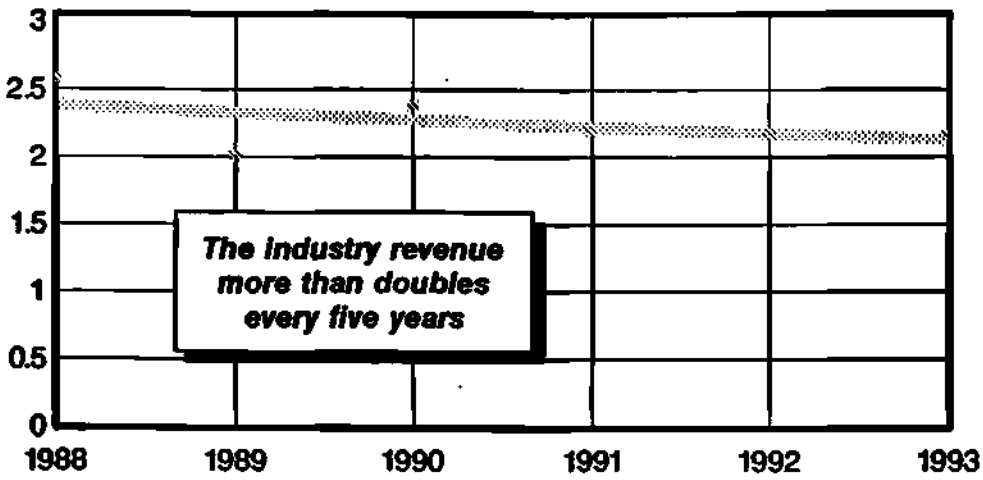
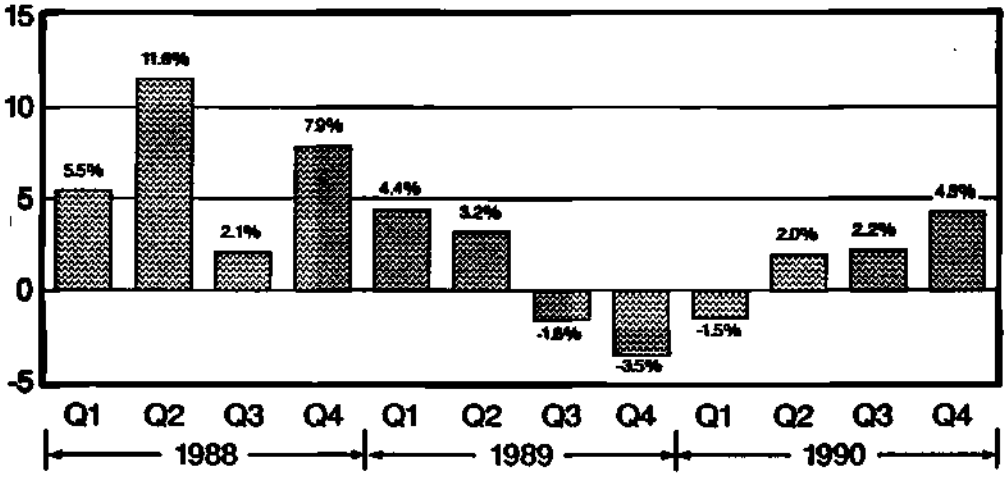
WORLDWIDE SEMICONDUCTOR CONSUMPTION FIVE-YEAR FORECAST GROWTH PATTERN



Source: Dataquest

WORLDWIDE SEMICONDUCTOR CONSUMPTION QUARTER-TO-QUARTER GROWTH RATES



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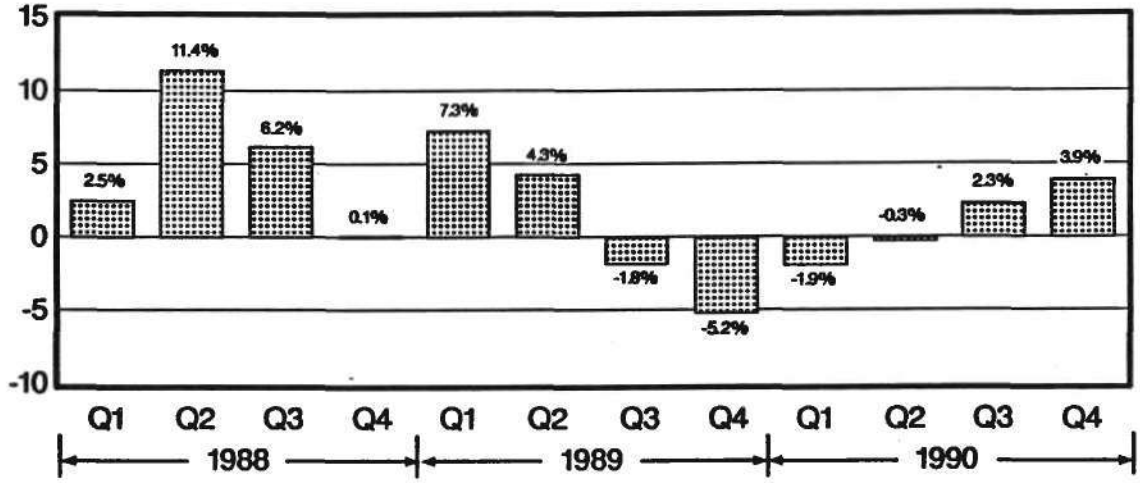
NORTH AMERICAN SEMICONDUCTOR CONSUMPTION QUARTER-TO-QUARTER GROWTH FORECAST

Percent of Dollars



Source: Dataquest

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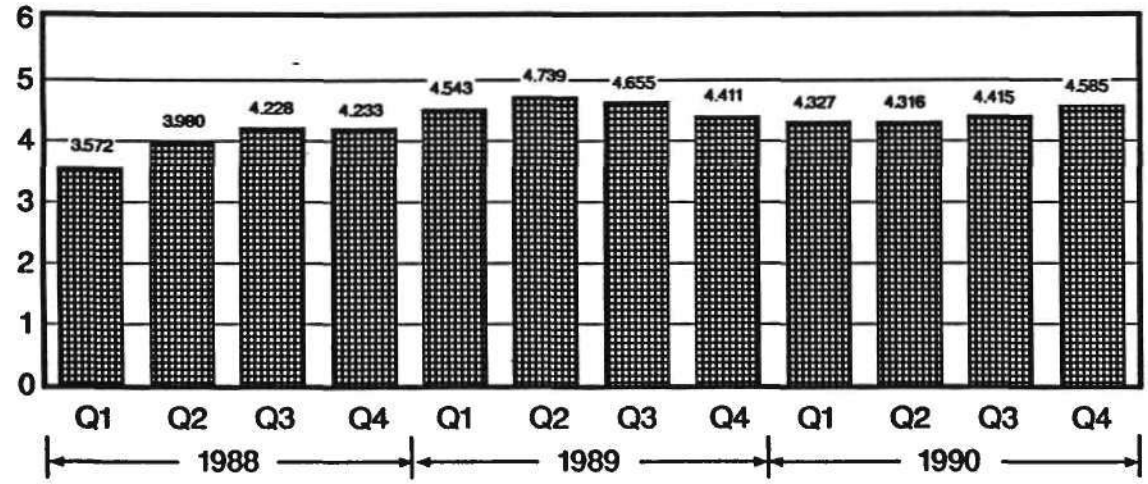
NORTH AMERICAN SEMICONDUCTOR CONSUMPTION QUARTERLY REVENUE FORECAST

Billions of Dollars



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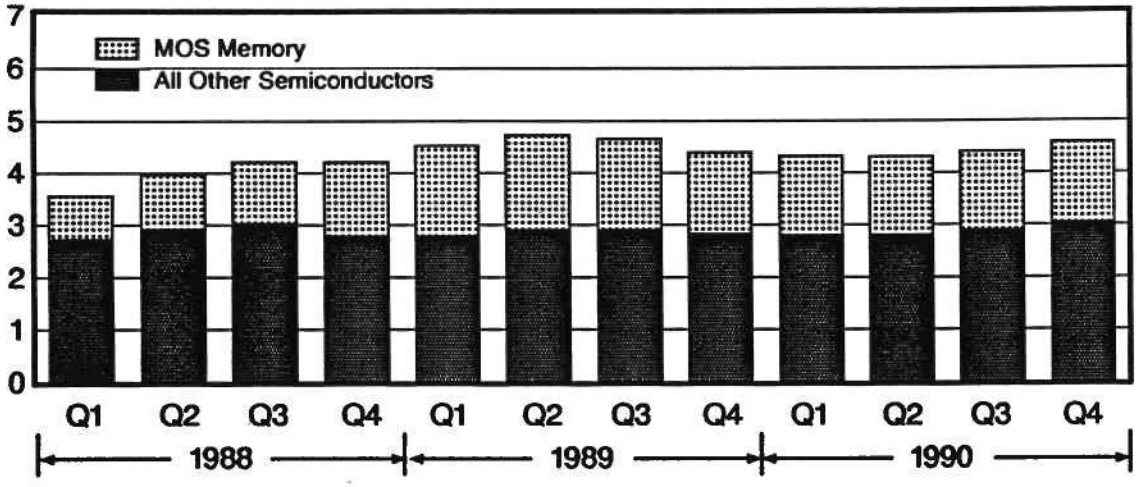
NORTH AMERICAN SEMICONDUCTOR CONSUMPTION QUARTERLY REVENUE FORECAST

Billions of Dollars



Source: Dataquest

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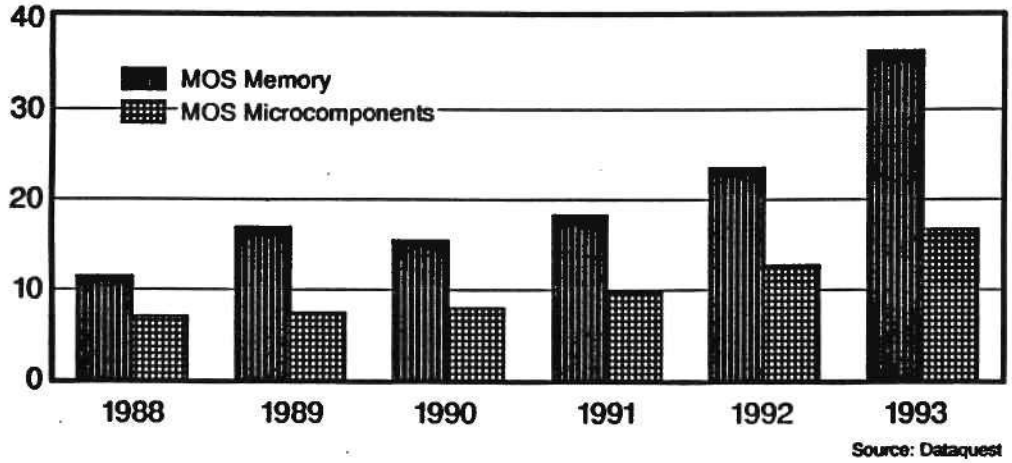
ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION MOS MEMORY AND MICROCOMPONENTS

Billions of Dollars



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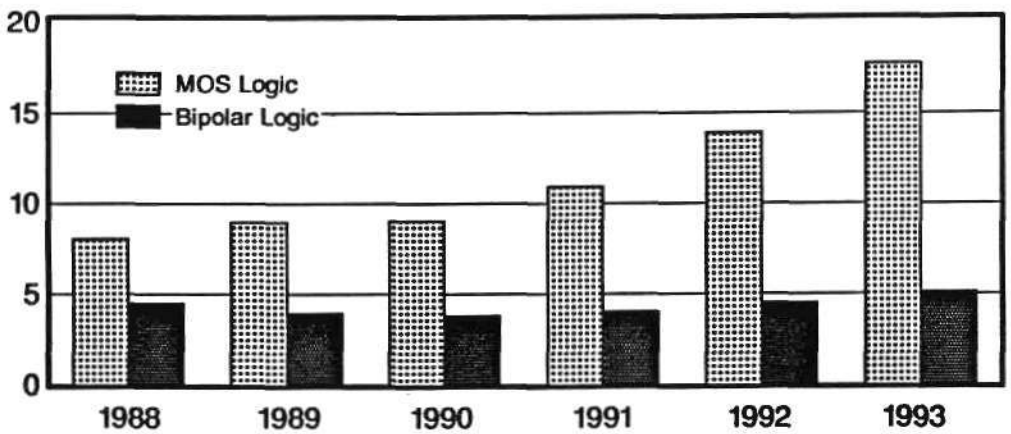
ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION MOS LOGIC AND BIPOLAR LOGIC

Billions of Dollars



Source: Dataquest

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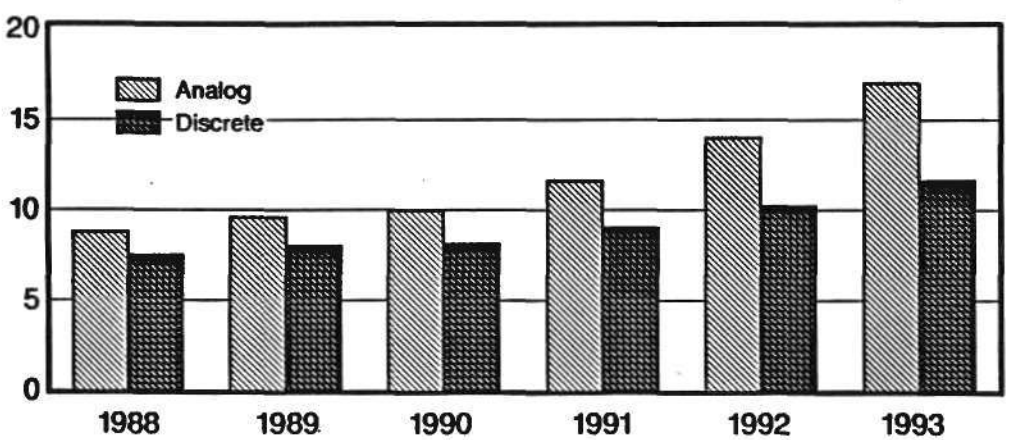
ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION ANALOG AND DISCRETE COMPONENTS

Billions of Dollars



Source: Dataquest

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SEMICONDUCTOR DEMAND FORCES, FORECAST, AND FEARS

Forecast

- Buyers' expectations
- Important markets
- Emerging and fast-growing markets
- Semiconductor forecast
- Hot semiconductor products

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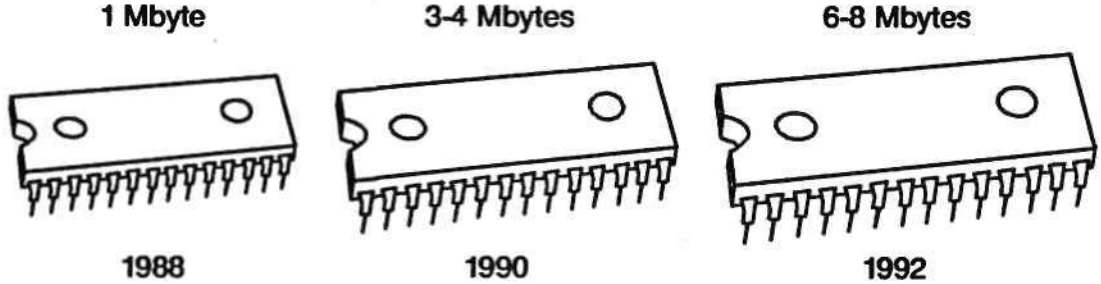
A DRAM-HUNGRY WORLD

Worldwide PC Memory Content Forecast



(Average memory content for new PCs shipped in a particular year)

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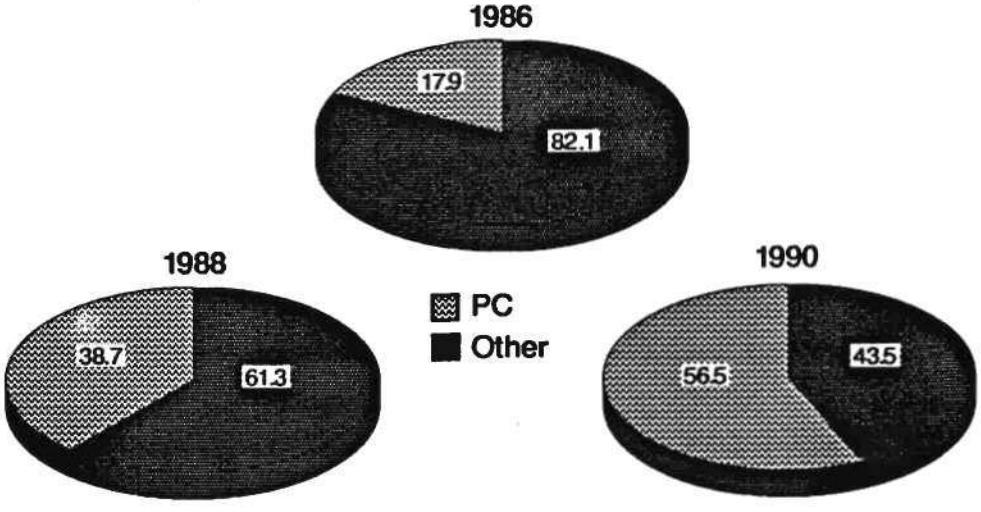
A DRAM-HUNGRY WORLD

Estimated PC DRAM Consumption as a Percentage of Worldwide DRAM Production



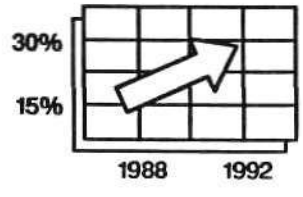
Source: Dataquest

[BS153063.IMG 05/04/89:THO]

HOT SEMICONDUCTOR PRODUCTS

(Millions of Dollars)

Product	1988	1992	CAGR
FIFO	56	142	26.2%
Video RAM	244	626	26.5%
Palette DACs	104	250	24.5%
High-Speed A/D Converters	115	260	22.6%
PC Chip Sets	397	775	18.2%
Switching Regulators	83	210	26.0%



Semiconductors with growth rates between 15 and 30 percent

Source: Dataquest

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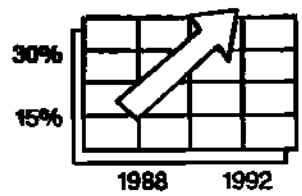
SUPER-HOT SEMICONDUCTOR PRODUCTS

(Millions of Dollars)

Product	1988	1992	CAGR
RISC Microprocessors	40	548	92.4%
BiCMOS SRAM w/ECL I/O	25	332	91.8%
BiCMOS Gate Arrays	56	598	78.5%
CMOS PLDs	177	971	53.0%
Digital Signal Processors	147	695	47.5%
High Performance Graphics	148	547	38.6%
32-Bit Microprocessors	835	2,745	36.5%
BiCMOS SRAM w/TTL I/O	65	214	34.9%



Semiconductors with growth rates greater than 30 percent

Source: Dataquest

CONCLUSIONS

- Long-term outlook (five years) is for aggressive growth
- Intermediate outlook (18 months) generally flat with some months slightly down. Computer market unsettled, causing great concern.
- Tighter inventory control and faster production cycles result in month-to-month variations in order rates
- Capacity generally not strained, resulting in high percentage of turns business
- Semiconductor manufacturers have low backlogs and low visibility to future business; consequently, cautious about future business

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All things considered, the current semiconductor market environment is more like a road with rocks, ruts, and potholes going up a mountain rather than a smooth ride like falling off a cliff.

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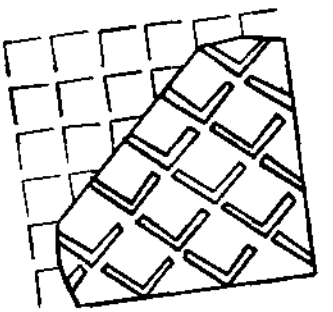

DRAMs AND ASICs AS TECHNOLOGY DRIVERS

KRISHNA SHANKAR

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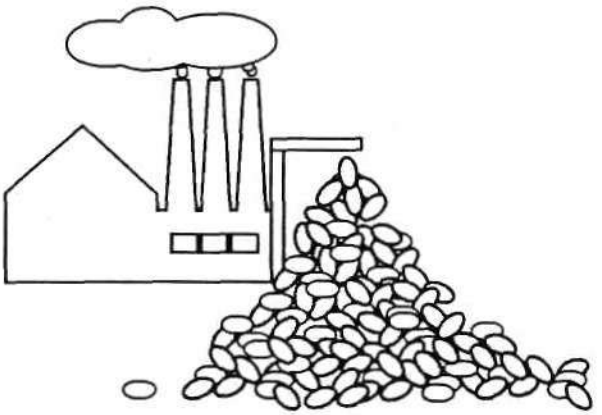
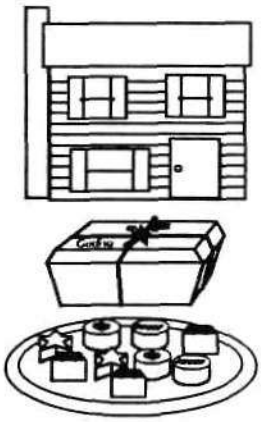
Is it easier to produce a million jelly beans than a box of Godiva chocolates?

The Jelly Bean Factory



The Candy Shoppe



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AGENDA

- Memory and ASIC markets
- Industry structure
- Semiconductor technology drivers
- DRAM technology and process equipment
- ASIC technology and process equipment
- Special ASIC process innovations
- Fab configuration
- Synergy and convergence
- Conclusions

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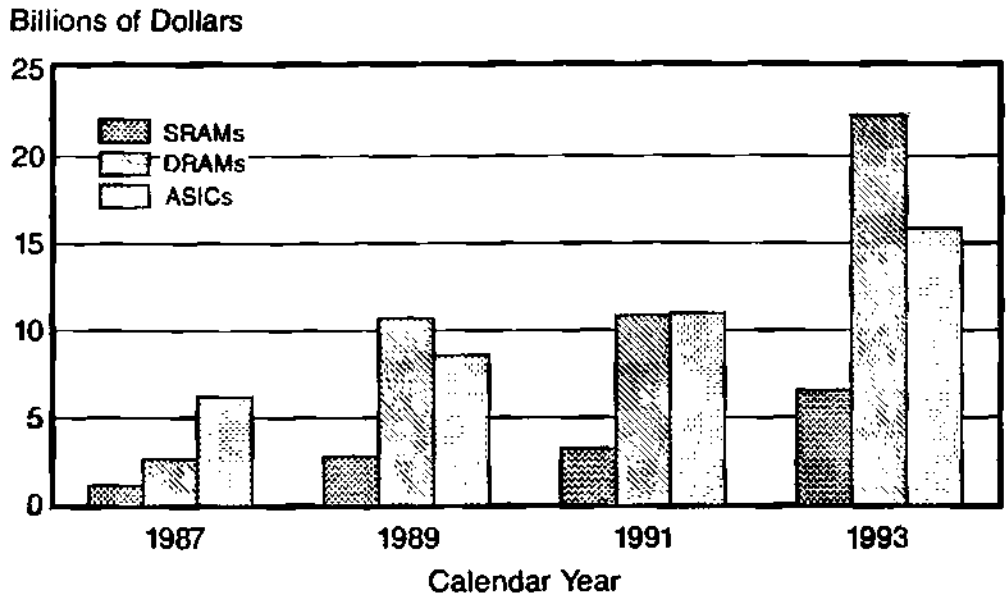
WORLD MEMORY AND ASIC MARKETS



Source: Dataquest

INDUSTRY STRUCTURE

DRAMs

- Capital intensive
- Oligopolistic structure
- Low product differentiation
- Vertically integrated companies
- One product per technology generation

ASICs

- Customer-service intensive
- Numerous competitors
- High product differentiation
- Small merchant companies and large captive companies
- Hundreds of low-volume products for each technology generation

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TECHNOLOGY DRIVERS

DRAMs	ASICs
High volume/low cost	Low-volume/time to market
Advanced device structures	Design automation
Submicron lithography	Multilevel interconnect
"Hardwired" automation	"Flexible" automation

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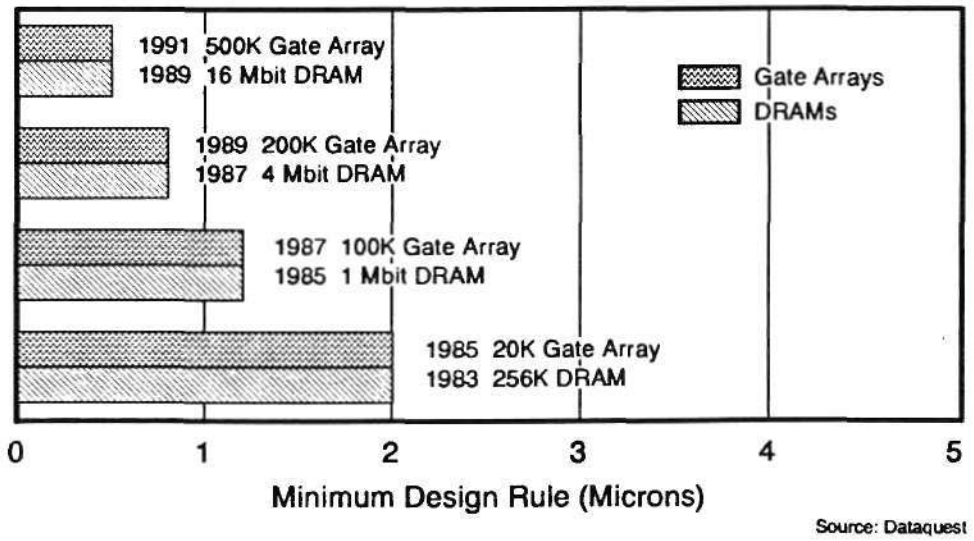
MINIMUM DESIGN RULES

Gate Arrays and DRAMs



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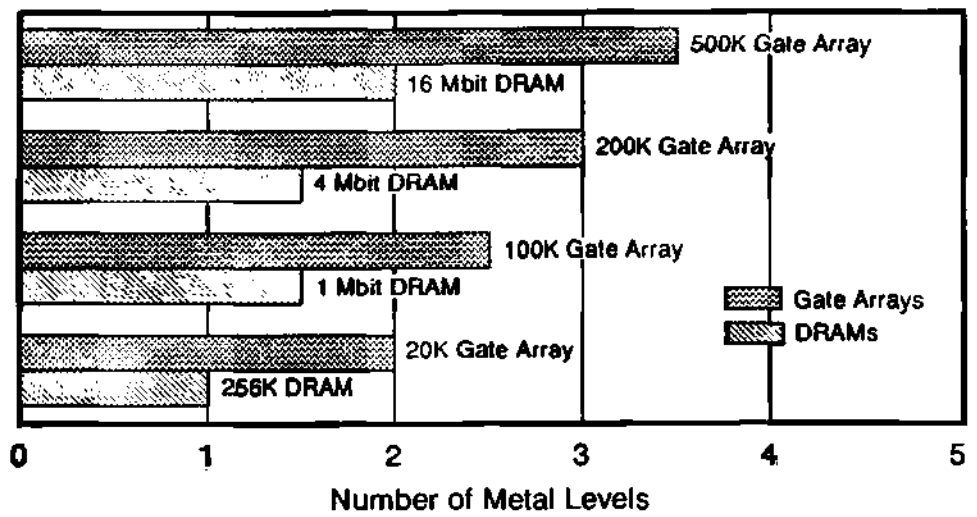
"AVERAGE" INDUSTRY METAL LEVEL

Gate Arrays and DRAMs



Source: Dataquest

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TYPICAL 4Mb DRAM TECHNOLOGY

Features	Process/Equipment Needs
⬭ High-quality EPI	Economical EPI process?
⬭ Retrograde wells	High-dose/high-energy implants
⬭ Deep capacitor trenches	High throughput, low RIE damage
⬭ Stacked capacitor	Conventional etch process
⬭ Oxide-nitride-oxide dielectric	Vertical furnace or RTP
⬭ Trench refill CVD oxide	TEOS conformal CVD reactors
⬭ 0.8-micron gate length	Submicron capability steppers

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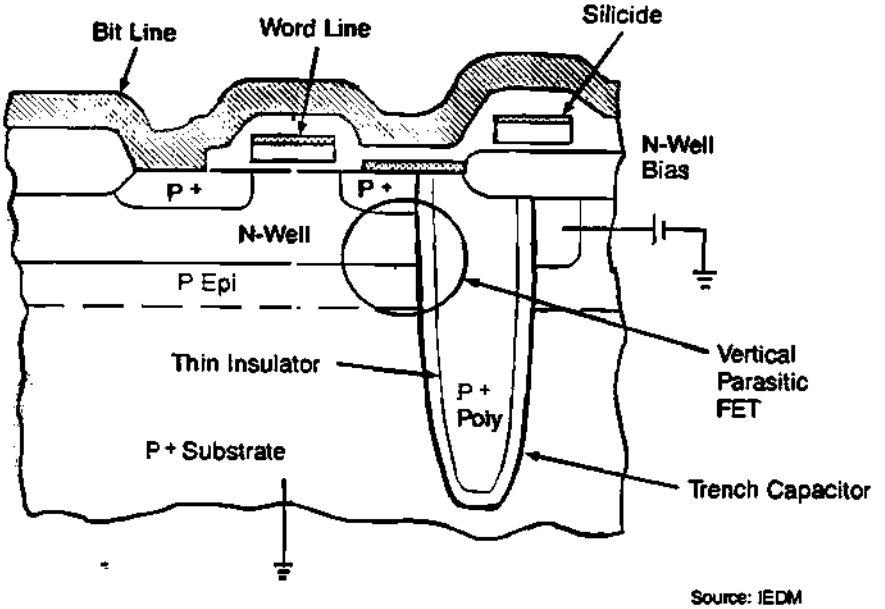
PROCESS STRUCTURE FOR IBM's 4Mb DRAM



Source: IEDM

TECHNOLOGY FOR 200K TRIPLE-METAL ASIC GATE ARRAY

Feature	Process/Equipment Need
Salicide	RTP titanium silicide
Local interconnect	RTP titanium nitride
Planarized CVD between metals	Spin-on-glass planarization or in-situ PECVD planarization
Contact and VIA plugs	Tungsten CVD
Triple-metal interconnect	High-resolution, defect-free interconnect patterning
Custom metallization option	Flexible photoetch process
Many product configurations	Quick-turn maskmaking; good reticle management

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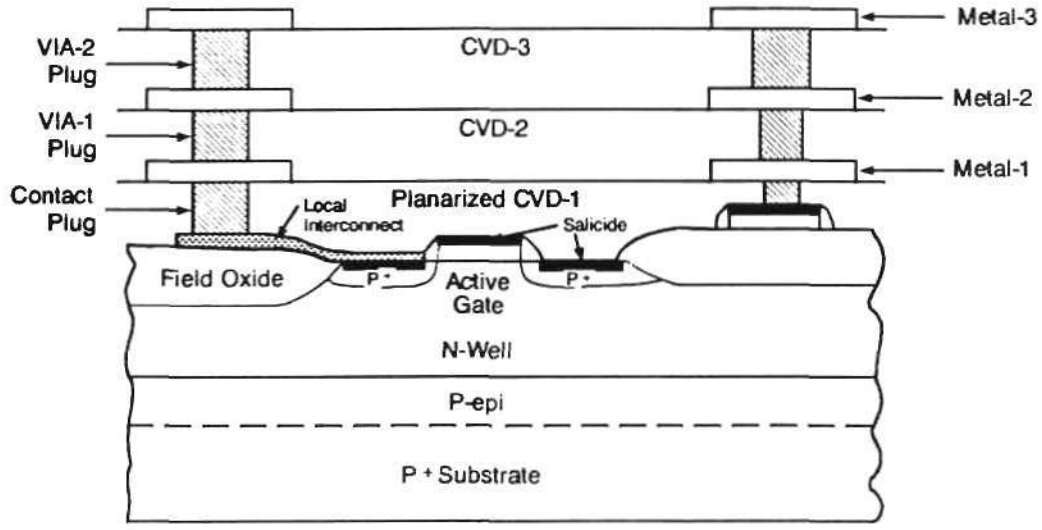
FUTURE CMOS 200K TRIPLE-METAL ASIC GATE ARRAY



Source: Dataquest

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ASIC PROCESS AND EQUIPMENT INNOVATIONS

- Laser-based interconnect patterning; quick-turn ASICs
- Focused ion beam tungsten direct-write interconnects
- E-beam lithography for maskless, direct-write ASICs
- Single-wafer etching and deposition systems
- Steppers with elaborate reticle management
- Multiproduct, computer-integrated manufacturing

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FAB CONFIGURATION

4Mb DRAM Fabs	ASIC Fabs
○ Maxifabs ($150M-$200M)	⛁ Minifabs ($20M-$50M)
○ High-volume, single product	⛁ Low-volume, multiproduct
○ Dedicated automation	⛁ Programmable automation
○ Serial "assembly line"	⛁ Autonomous lines in parallel
○ Fab organized by function	⛁ Fab organized by product
○ High throughput, dedicated steppers for each layer	⛁ Flexible steppers with low setup time
○ Mix of batch and single-wafer processing	⛁ Single-wafer processing equipment
	⛁ Portable/desktop fabs?

SYNERGY AND CONVERGENCE

- ASIC products with increasing on-chip SRAM memory
- Custom DRAMs and SRAMs for video, graphics applications
- Universal BiCMOS process for ASICs and high-speed SRAMs
- DRAM process trend toward 3-D silicon structure
- Multilevel interconnect technology now standard for ASIC and memory products
- Memory producers getting into ASIC manufacturing to balance fab capacity and offer one-stop shops
- Modular, reliable, flexible architecture equipment needed

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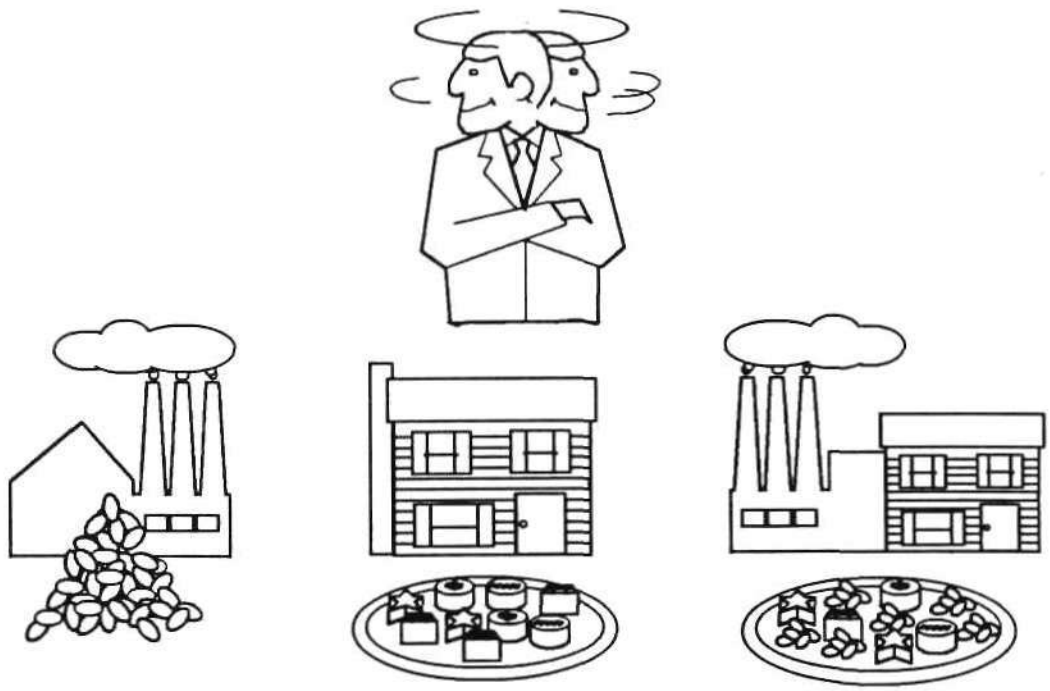
CONCLUSIONS

- DRAMs drive silicon device innovations and low-cost/high volume manufacturing
- ASICs drive design automation, multilevel interconnect technology, and flexible manufacturing
- Evolving synergy between memory (especially SRAMs) and ASIC processes
- Equipment design needs to be modular, highly reliable, and offer a "systems solution" to IC manufacturing
- Equipment and processes need to offer "open systems architecture"



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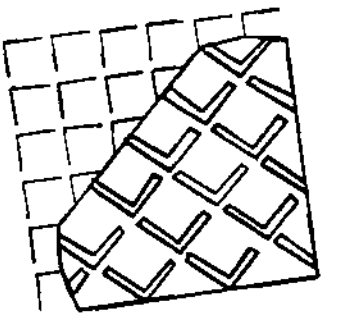

A COMPARISON OF JAPANESE AND U.S. FABS

MARK T. REAGAN

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AGENDA

- Current capacity analysis
- New fabs and 200mm-wafer activity
- Market response strategies

AGENDA

- Current capacity analysis

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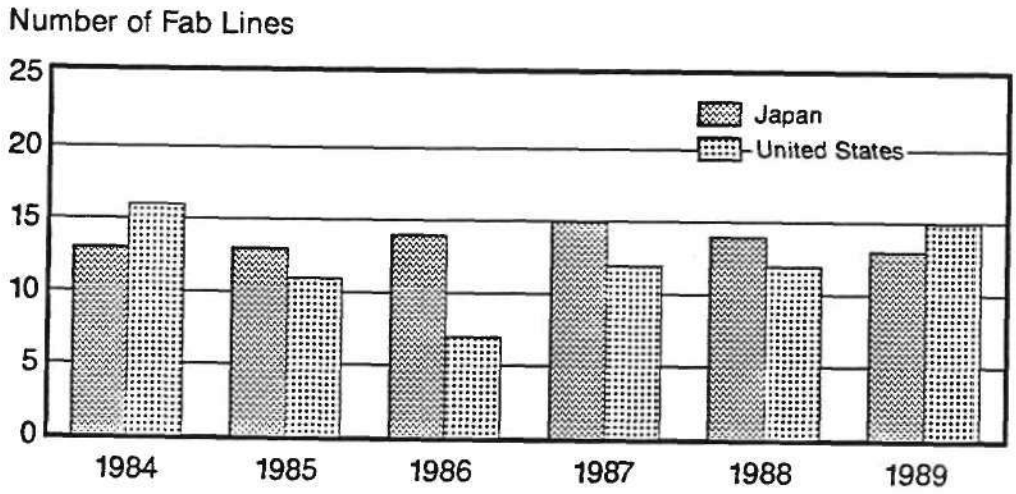
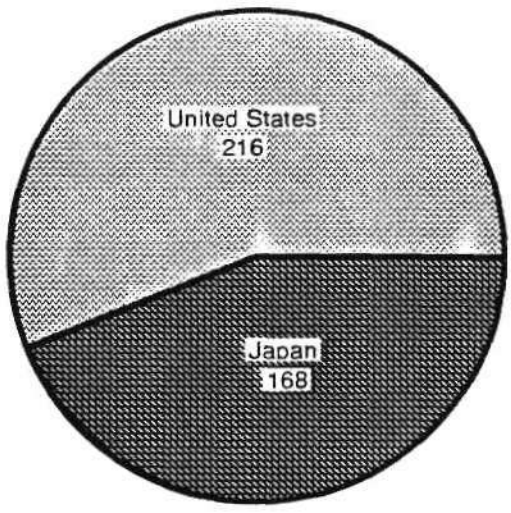
ESTIMATED SILICON PILOT AND PRODUCTION LINES

On-Shore Only



Source: Dataquest

SILICON-BASED FABS



Production Lines

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More Fabs In United States But Japanese Fabs Are Bigger

PRODUCT MIX

	Memory	MPU	Logic	ASIC	Other
Japan	39%	7%	6%	14%	34%
United States	25%	14%	8%	26%	27%

Source: Dataquest

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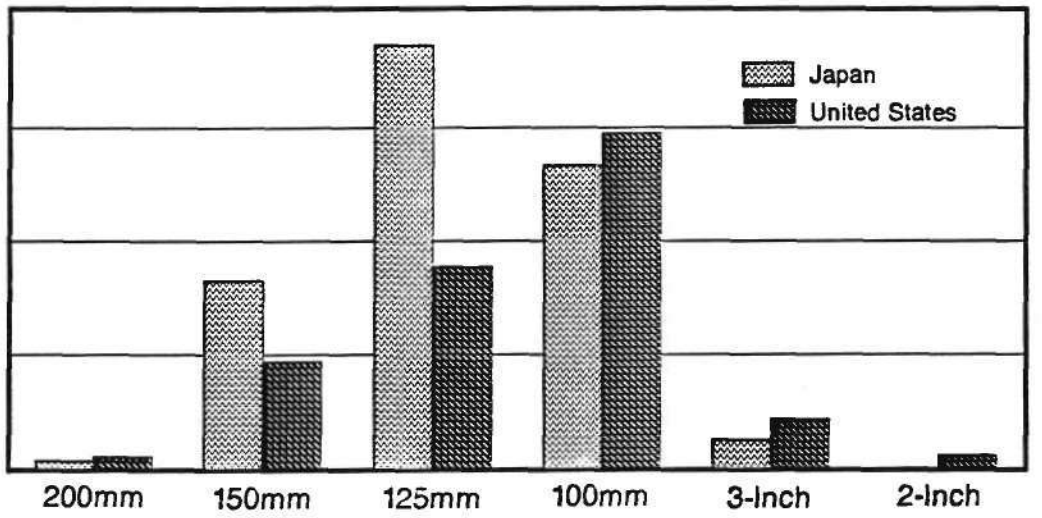
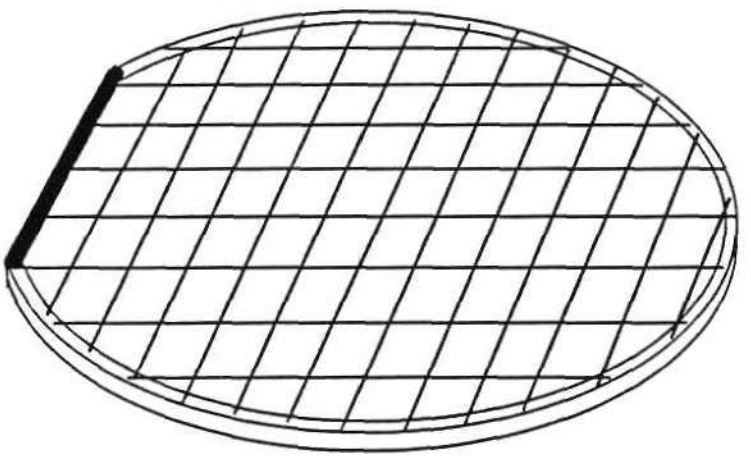
SILICON PILOT AND PRODUCTION LINES

Monthly Capacity by Wafer Size



Source: Dataquest

WAFER SIZE



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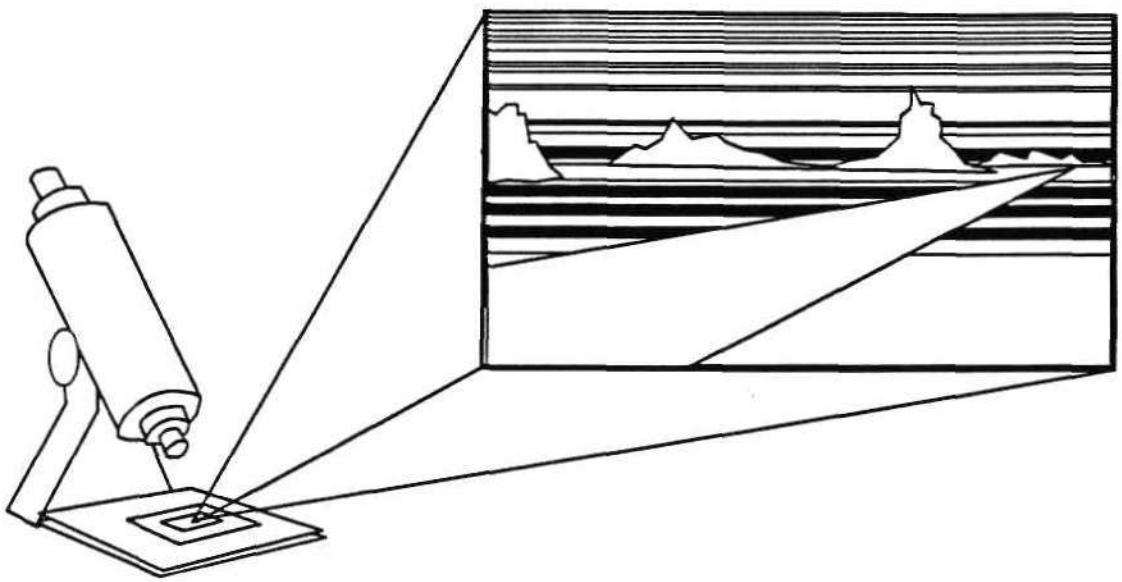
LINE GEOMETRIES



MICRON MIX

	≤1μ	≤1.5μ	≤2.0μ	≤2.5μ	≤3μ	≥3μ
Japan	26%	33%	27%	0	10%	4%
United States	18%	33%	23%	4%	12%	12%

Source: Dataquest

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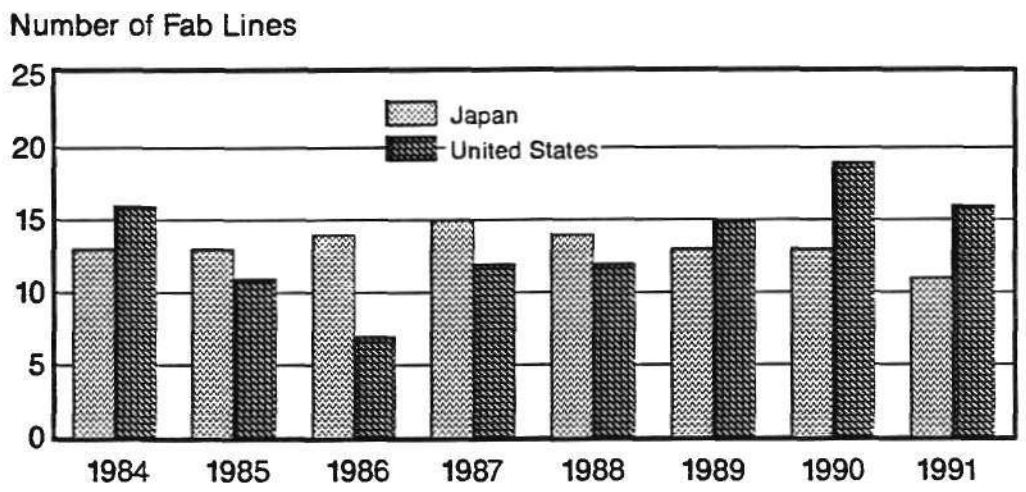
AGENDA

- Current capacity analysis
- New fabs and 200mm-wafer activity

ESTIMATED SILICON PILOT AND PRODUCTION LINES

Onshore Only



Source: Dataquest

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8-INCH PILOT AND PRODUCTION LINES

	Japan	United States
1987		IBM, Burlington
1988	NEC, Sagamihara	IBM, Burlington
	IBM, Yasu Works	
1989	Fujitsu, Mie	TI, Dallas
	TI, Hiji Plant	IBM, E. Fishkill
		IBM, Burlington
1990	Fujitsu, Iwate	IBM, Burlington
	Hitachi, Musashi	
	IBM, Yasu Works	
	NEC, Sagamihara	
	TI, Miho?	

8-INCH PILOT AND PRODUCTION LINES

	Japan	United States
1991	NEC, Chugoku	NEC, Roseville
	Toshiba, Oita	TI, Dallas
		Motorola, Oakhill?
		Tohoku Semiconductor?
1992		Intel, Rio Rancho
1993	NEC, Chugoku	
	Toshiba, Oita	

Source: Dataquest

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AGENDA

- Current capacity analysis
- New fabs and 200mm-wafer activity
- Market response strategies

FAB CONSTRUCTION TIMETABLE

	Permits and Planning	Break Ground to Complete Shell	Install Clean Room and Equipment	Turn On to Full Production
Japan	1 Year	7 Months	7 Months	6 to 9 Months
United States	5 Months	11 Months	11 Months	1 to 1 1/4 Years

Source: Dataquest

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TWO APPROACHES TO BUILDING A FAB

Japan	United States
- One-step shopping for architecture and engineering	- Hire a person to act as a contractor
- Established relationships among owner, contractor, and subcontractors	- Contractor uses bidding system
- Very little bidding	- Company may not have the same subcontractors building all fabs

(Continued)

TWO APPROACHES TO BUILDING A FAB

Japan	United States
- Less friction between subcontractors; teamwork	- Political friction
- Ergonomic coordination	- Get in each other's way
- Design and planning is completed before breaking ground	- Design as you build
- Changes usually are not allowed after ground is broken	- Delays due to internal conflicts and changes after the fact

(Continued)

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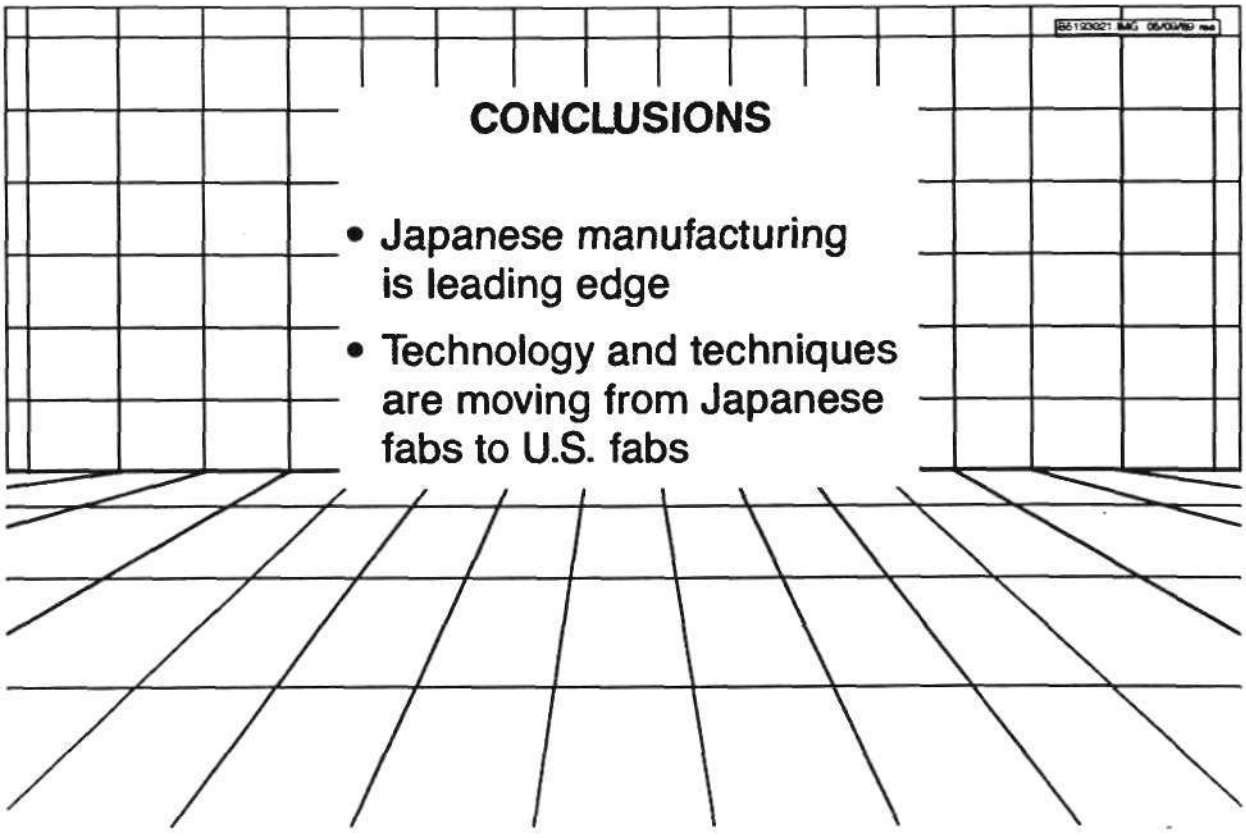
TWO APPROACHES TO BUILDING A FAB

Japan	United States
- Contractor is responsible from design to installation of equipment	- Contractor usually not involved in the whole process
- Contractor guarantees operating performance and equipment installation schedule	- Subcontractors point fingers at each other



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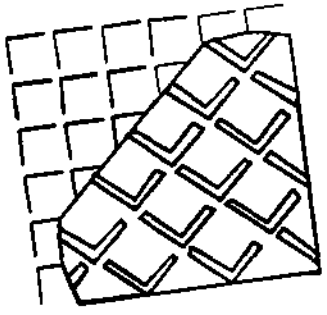

CAPITAL SPENDING: STABILITY ACHIEVED

GEORGE BURNS

Industry Analyst
Semiconductor Equipment and Materials Service
Dataquest Incorporated

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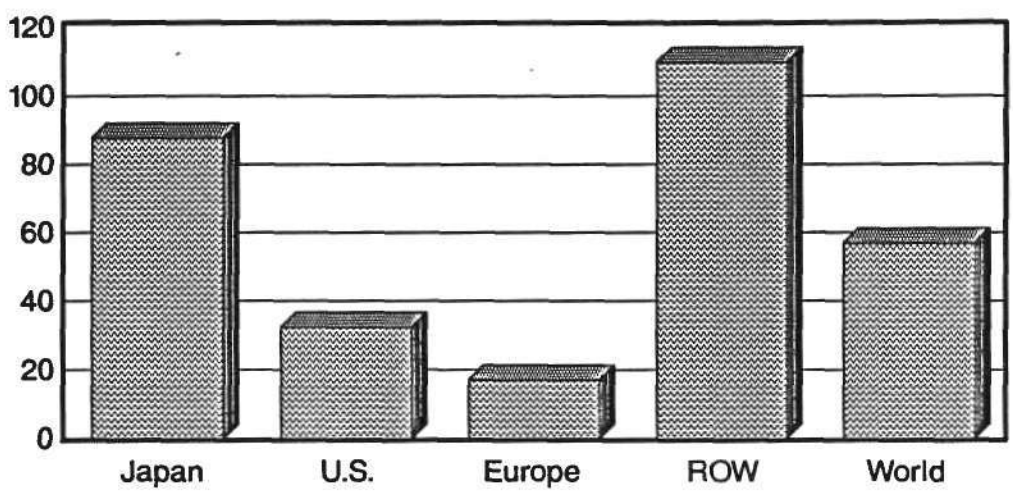
Happy days were here again
(what happened last year)

SEMICONDUCTOR CAPITAL SPENDING GROWTH IN 1988

Percent Change, 1987-1988



Source: Dataquest

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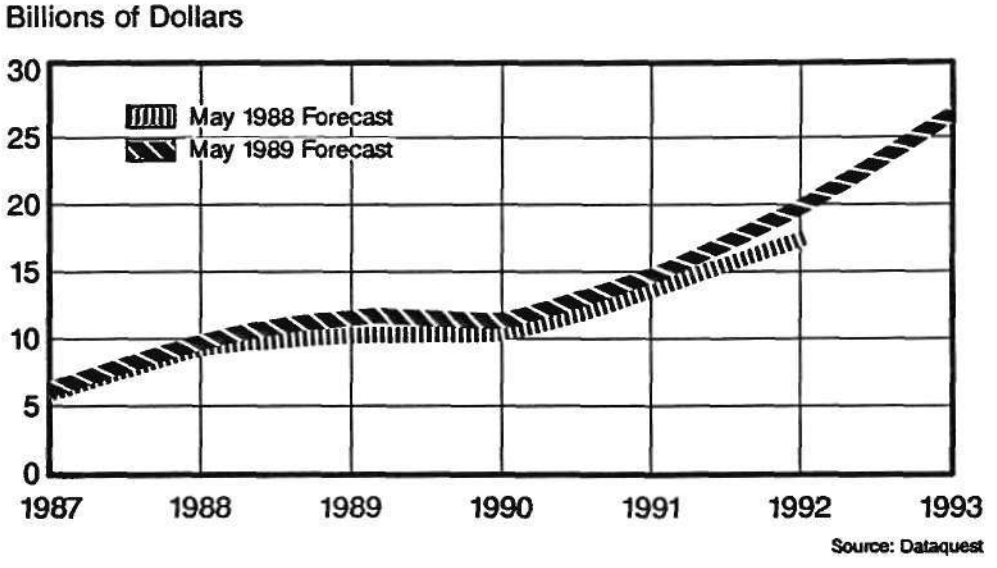
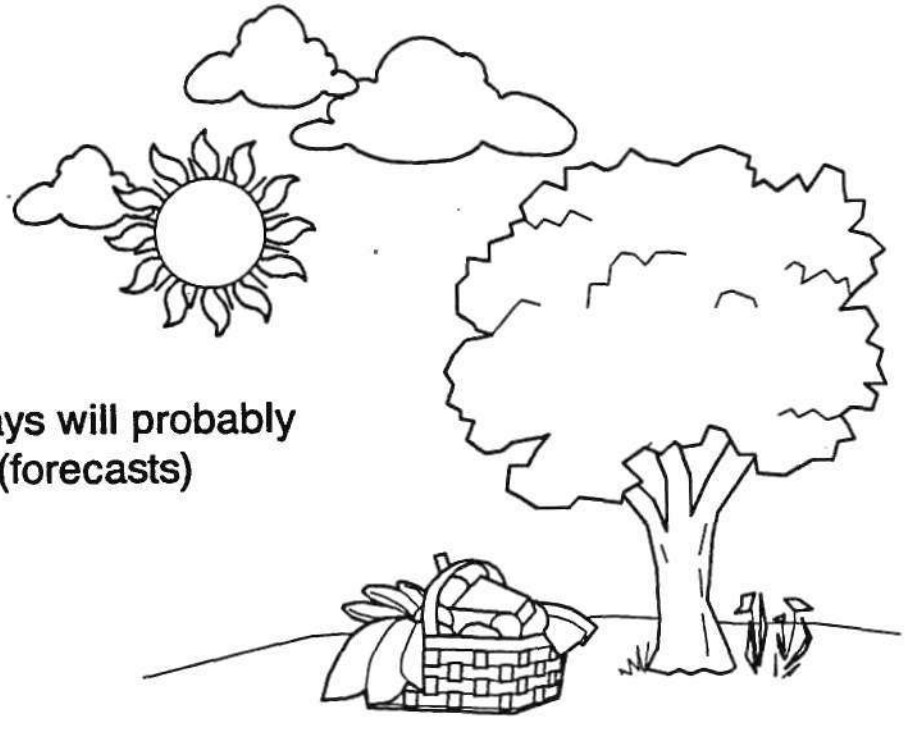
HOW DID WE DO?

Forecast Comparison



Source: Dataquest



Happy days will probably continue (forecasts)

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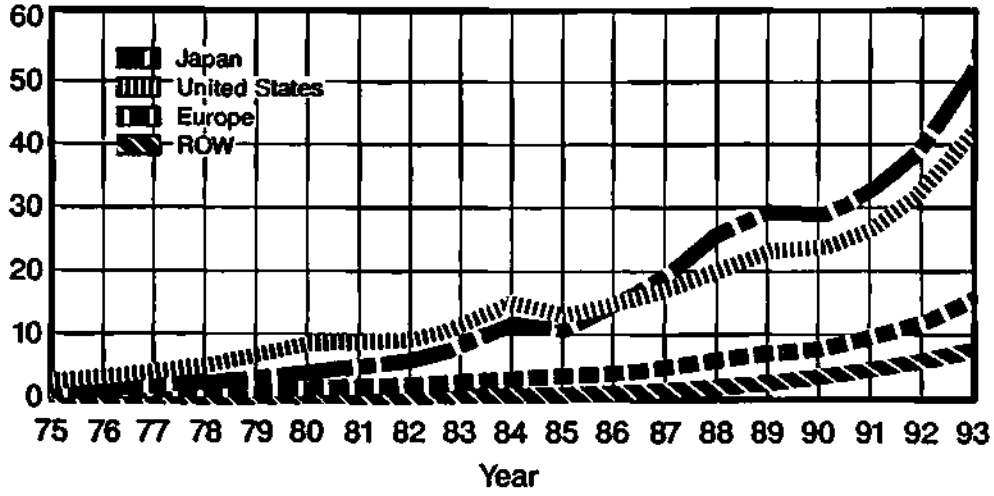
ESTIMATED SEMICONDUCTOR PRODUCTION BY REGION

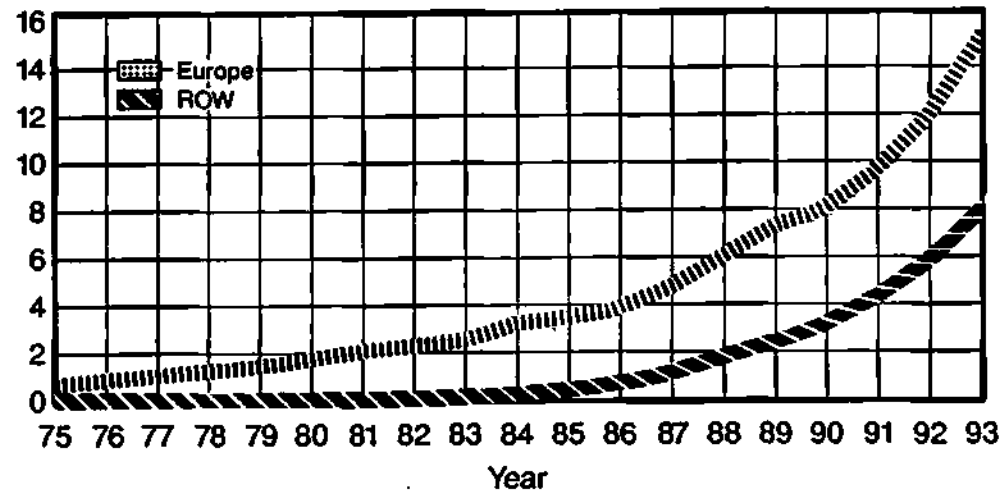
Billions of Dollars



Source: Dataquest

ESTIMATED PRODUCTION IN EUROPE AND ROW

Billions of Dollars



Source: Dataquest

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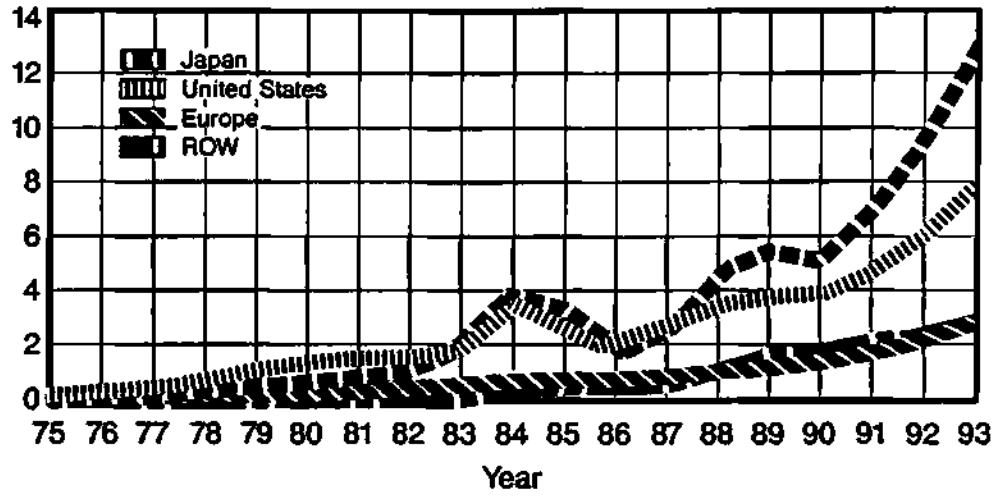
ESTIMATED CAPITAL SPENDING BY REGION

Billions of Dollars

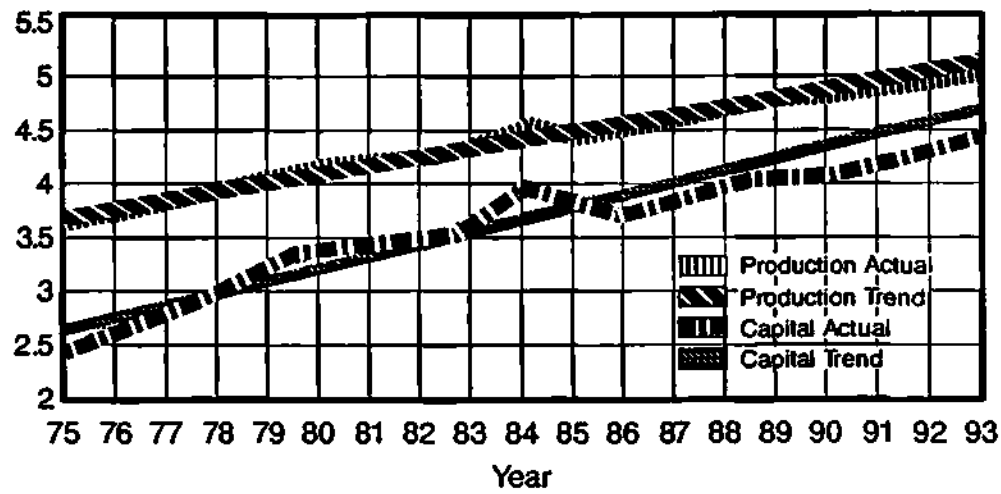


Source: Dataquest

CAPITAL SPENDING AND PRODUCTION

Actual vs. Trend

Log (Capital Spending and Production)



Source: Dataquest

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ROW GROWTH PLANS

Taiwan

- Hualon
- TSMC
- UMC
- Winbond

ROW GROWTH PLANS

Offshore Investment

- Chartered Semiconductor
- Motorola
- SGS/Thomson
- Sony
- Vitelic

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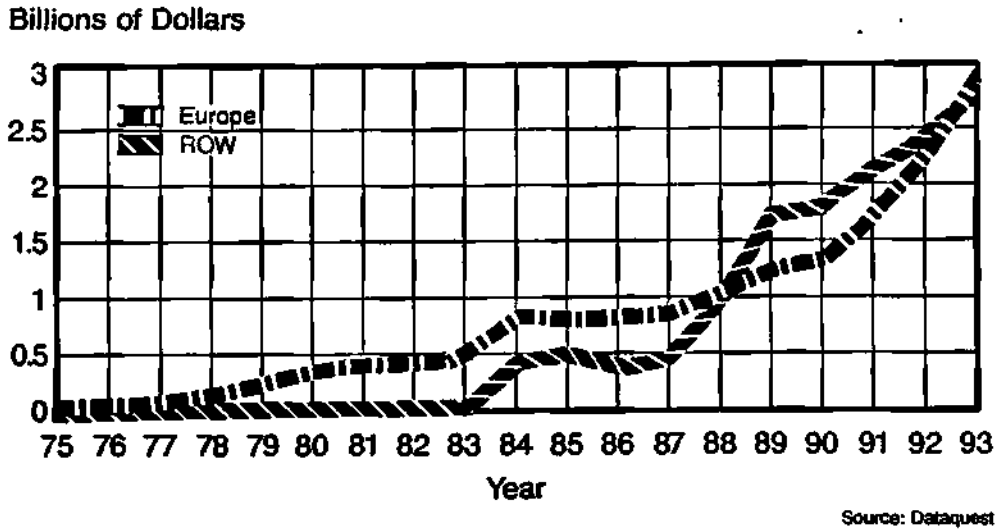
ESTIMATED CAPITAL SPENDING IN ROW AND EUROPE

Closing the Gap



Source: Dataquest

ROW GROWTH PLANS

Korea

- Goldstar
- Hyundai
- Samsung

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EUROPE 1992

- Production increase of $1 billion
- Fujitsu
- Hitachi
- Texas Instruments
- Toshiba
- ?????

But we should bring umbrellas

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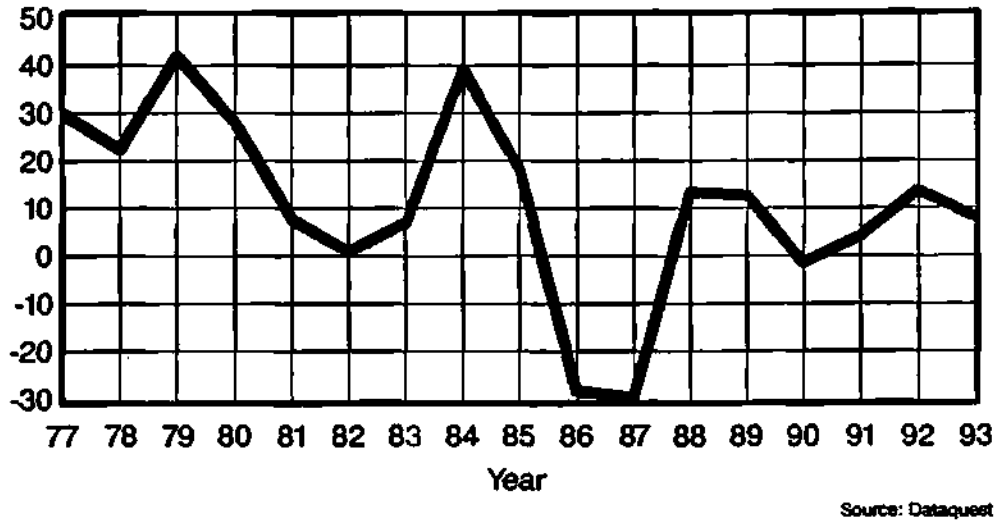
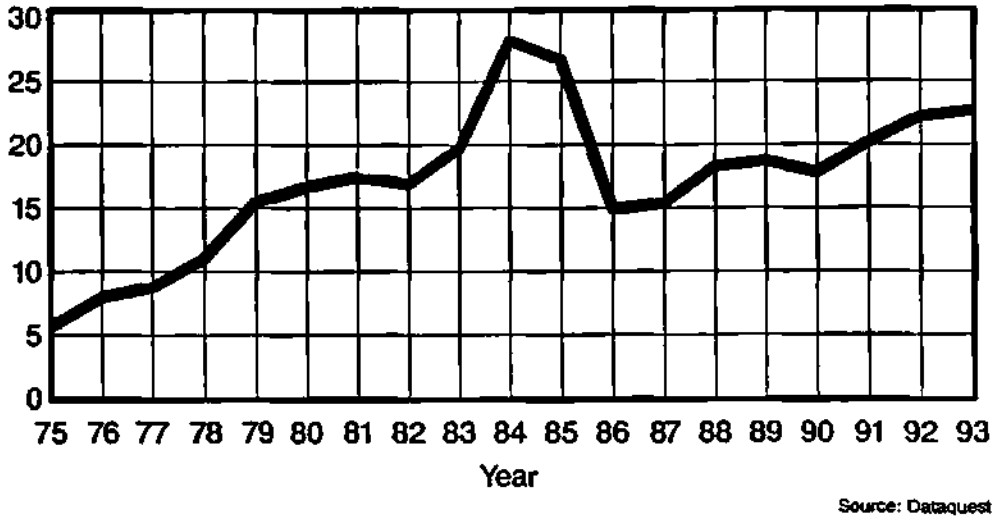
ESTIMATED CAGRs OF SEMICONDUCTOR REVENUE AND CAPITAL SPENDING



Source: Dataquest

ESTIMATED CAPITAL SPENDING AS A PERCENT OF REVENUE



Source: Dataquest

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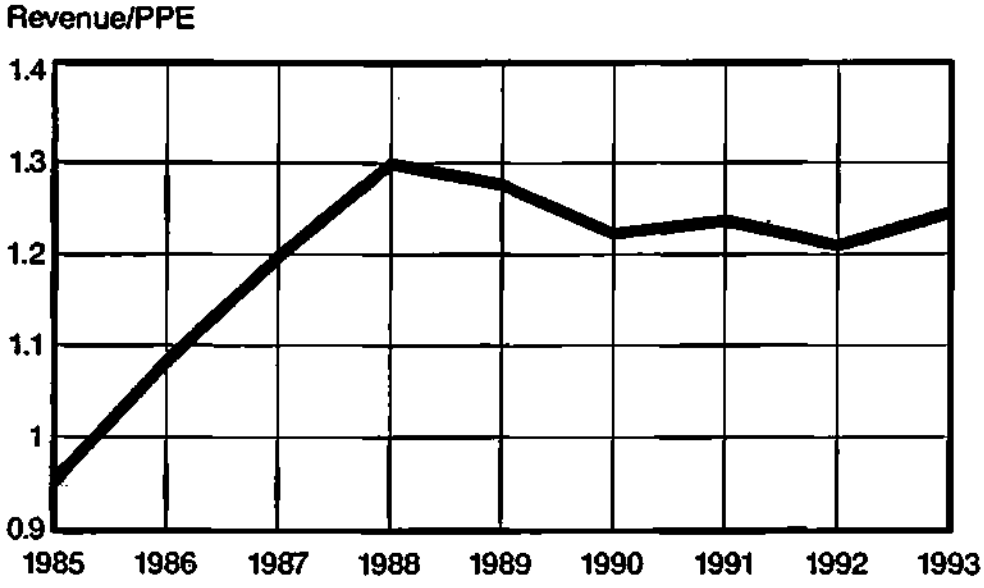
HIGHER CAPITAL SPENDING/REVENUE

- New technologies to master
- Increased equipment cost
- Increased fab costs

WORLD REVENUE/PPE FORECAST



Source: Dataquest

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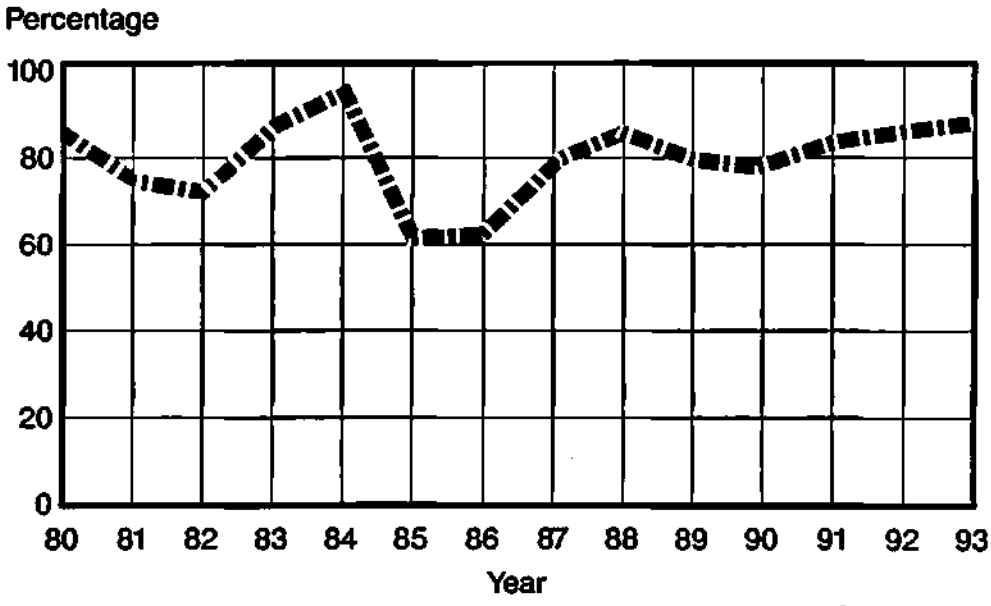
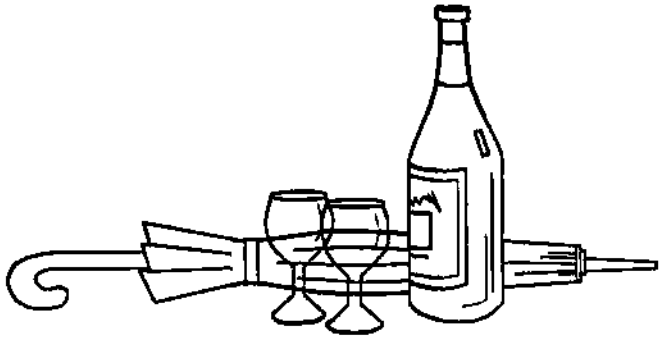
CAPACITY UTILIZATION FORECAST



Source: Dataquest

CONCLUSIONS

- Capital equipment cycles are becoming smoother
- However, potential exists for overcapacity in 1994 (keep your umbrella handy!)



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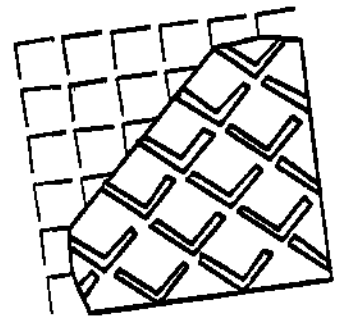

WAFER FAB EQUIPMENT INDUSTRY STATUS 1989

JOSEPH GRENIER

Director
Semiconductor Equipment and Materials Service
Dataquest Incorporated

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WORLDWIDE
WAFER FAB EQUIPMENT MARKET

(Millions of Dollars)

1987	1988	Growth
$3,158	$4,773	51%

Source: Dataquest

REGIONAL
WAFER FAB EQUIPMENT MARKET

(Millions of Dollars)

	1988	1988 Growth	1988 Share
Japan	$2,150	64%	45%
United States	1,545	42%	32
Europe	662	25%	14
ROW	416	81%	9
	$4,773	51%	100%

Source: Dataquest

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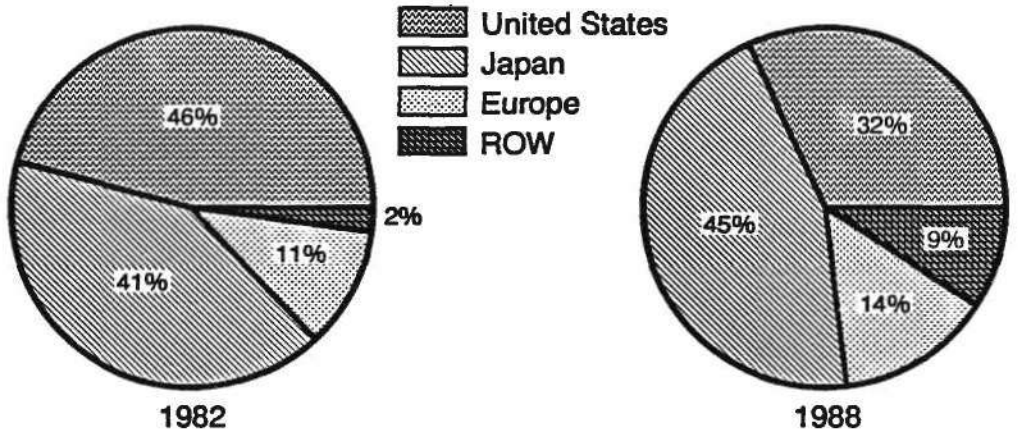
WAFER FAB EQUIPMENT MARKET

1982 versus 1988



Source: Dataquest

WAFER FAB EQUIPMENT COMPANIES WORLDWIDE REVENUE

(Millions of Dollars)

Companies by Rank	1988 Percent of Revenue
1-10	52.2%
11-20	18.0
21-30	9.4
31-165	20.4
	100.0%

Source: Dataquest

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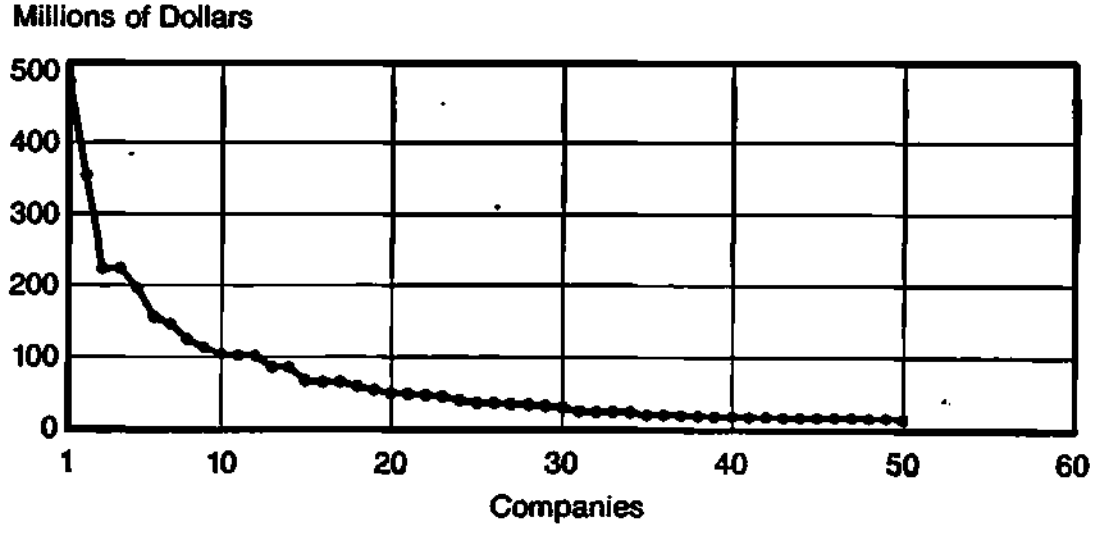
WAFER FAB EQUIPMENT COMPANIES

- >60% of the companies had revenue <$10M in 1988
- 12 companies had >$100M in 1988; only 4 did in 1986
- These 12 companies accounted for 57% of revenue
- 18% of the companies provided 80% of the revenue
- Concentration of power in wafer fab equipment industry

Source: Dataquest

WAFER FAB EQUIPMENT

Concentration of Power



Source: Dataquest

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WAFER FAB EQUIPMENT

1988 High-Growth Equipment Segments

Segment	Worldwide Growth	Japanese Growth	United States Growth
Implant	100%	145%	75%
Dry Etch	96%	144%	68%
CD/Wafer Inspection	78%	67%	82%
CVD	76%	98%	66%
Steppers	76%	99%	49%
Dry Strip	73%	93%	40%
Track	52%	94%	28%
Diffusion	51%	39%	120%
All Segments	77%	101%	62%

Source: Dataquest

STEPPERS 1988

(Units)

	1988 Growth
Japan	92%
United States	21%
Europe	15%
ROW	83%
Total World	55%

- Japan has largest installed base of steppers
- ROW installed 40% more steppers than Europe
- Japan/ROW accounted for >60% of stepper market

Source: Dataquest

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STEPPERS 1988

Concentration of Power
Market Share (Units)

Nikon	53%
Canon	18%
GCA	10%
ASM Lithography	6%

Source: Dataquest

LITHOGRAPHY EVENTS IN 1988

- Introduction of high-N.A. g-line lenses for 0.65-micron resolution
- At SPIE conference, g- and i-liners talked about 0.5-micron resolution
- Continued improvements in excimer laser steppers
- Perkin-Elmer announced Micrascan
- What's an X-ray?

Source: Dataquest

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CHEMICAL VAPOR DEPOSITION 1988

	Unit Growth	ASP($K)
Tube CVD	10%	$215
Nontube CVD	67%	$650

- 80% of the CVD market revenue growth in 1988 was due to nontube DVD
- Nontube CVD accounted for 64% of CVD market in 1988; 40% in 1985
- Tube CVD units have declined by 40%; revenue has increased by only 16%

Source: Dataquest

CHEMICAL VAPOR DEPOSITION 1988

Concentration of Power
Market Share (Revenue)

Nontube Reactors		Tube Reactors	
Applied Materials	32%	ASM International	47%
Watkins-Johnson	13%	BTU/Bruce	9%
Genus	12%	Tokyo Electron	7%
Novellus	8%		

Source: Dataquest

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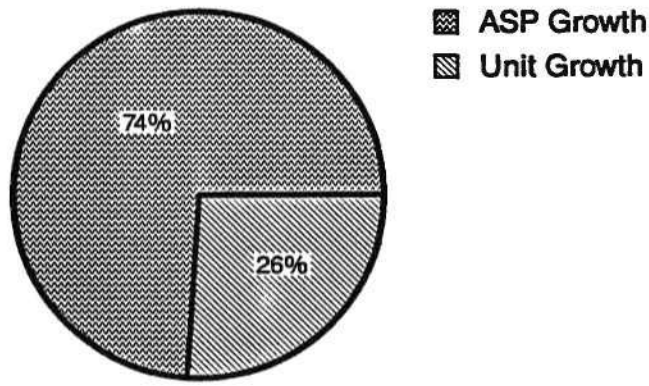
[B5323014.IMG 05/10/89:GRE]

CD/WAFER INSPECTION 1988

Market Growth = 78%

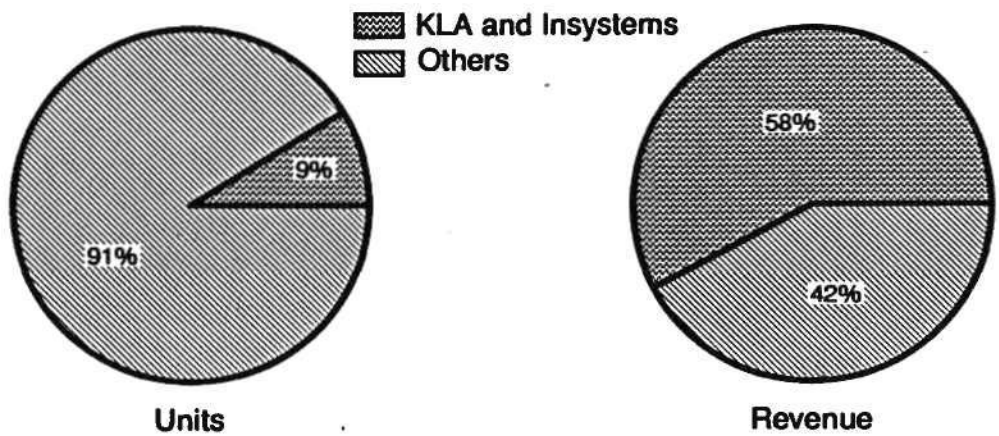


- Emphasis on submicron measurement capability
- Emergence of automated defect detection systems
- Result is very high ASP systems

Source: Dataquest

[B5323015.IMG 05/10/89:GRE]

AUTOMATED WAFER INSPECTION TOOLS 1988



Source: Dataquest

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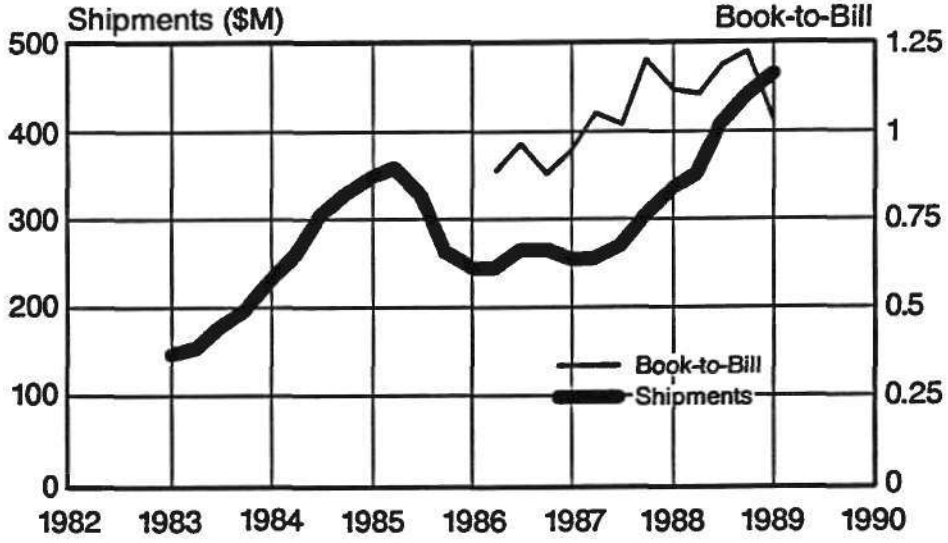
EQUIPMENT BUSINESS INDEX AND BOOK-TO-BILL



Source: SEMI
Dataquest

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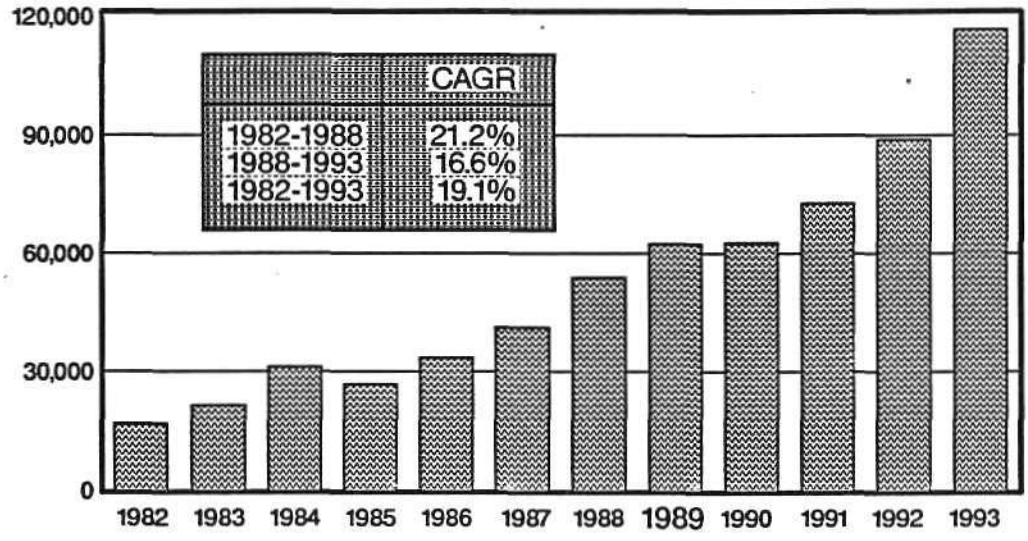
SEMICONDUCTOR PRODUCTION

(Millions of Dollars)



Source: Dataquest

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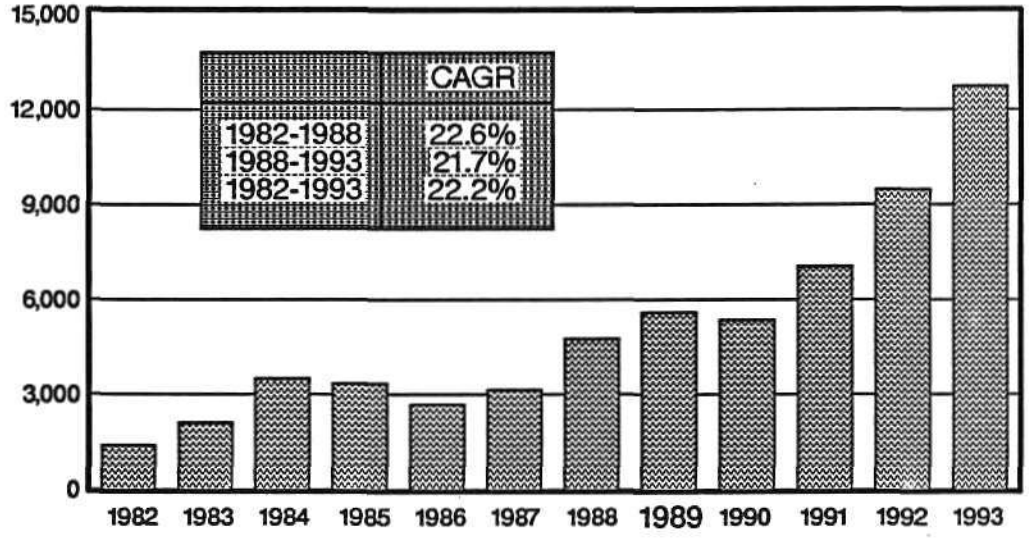
WAFER FAB EQUIPMENT

(Millions of Dollars)



Source: Dataquest

B5323019.IMG 05/10/89:GRE

SUMMARY

- Japan largest equipment market
- Concentration of power
- Wafer fab equipment up 18% in 1989
- Strong growth in 1991-1993

Source: Dataquest

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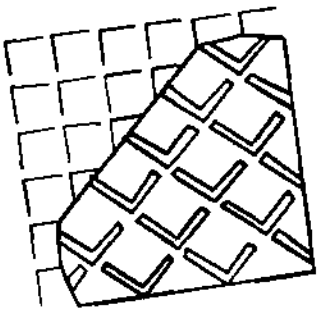

SILICON WAFERS: EXISTING MARKETS AND FUTURE OPPORTUNITIES

PEGGY MARIE WOOD, Ph.D.

Industry Analyst
Semiconductor Equipment and Materials Service
Dataquest Incorporated

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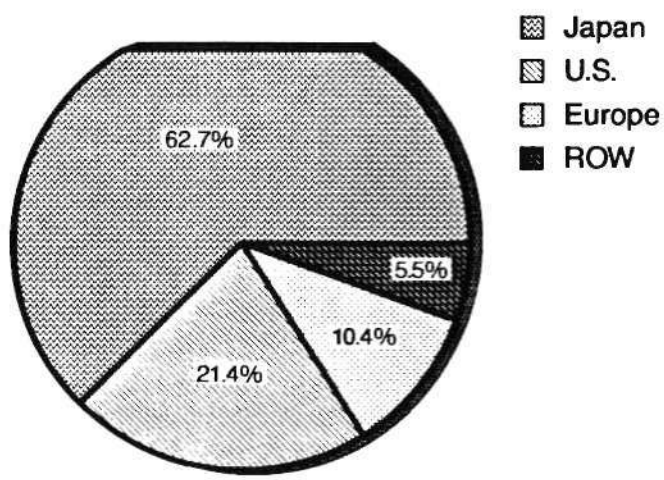
EXISTING MARKETS -- SILICON AND EPITAXIAL WAFERS

Agenda

- Market overview
- Wafer pricing update
- Looking ahead at 8"
- Acquisitions revisited

1988 MERCHANT SILICON AND EPITAXIAL WAFER MARKET BY REGION



Total = $2.16 Billion

Source: Dataquest

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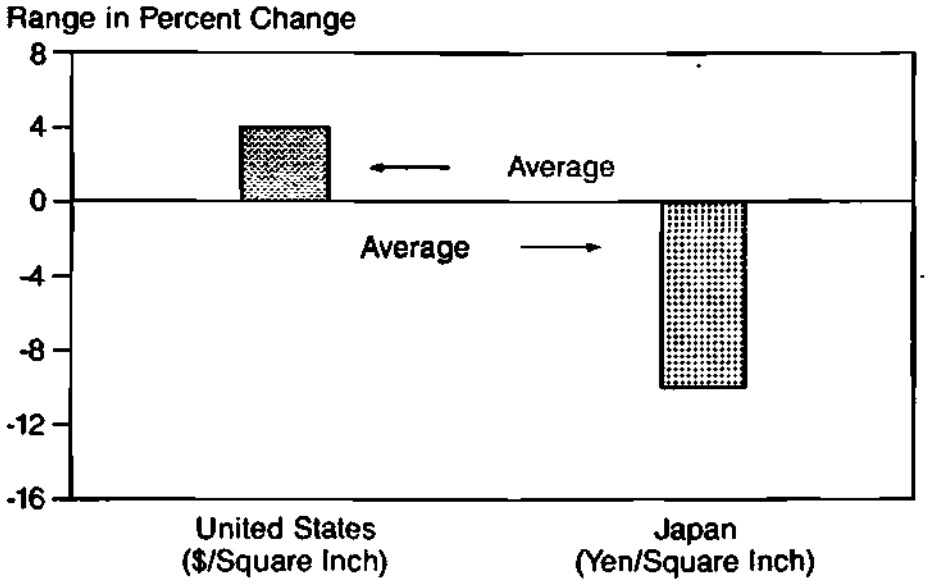
WAFER PRICING UPDATE

Polished CZ Wafers



Source: Dataquest

LOOKING AHEAD TO 8"

- 8" fab activity
- Wafer size forecast

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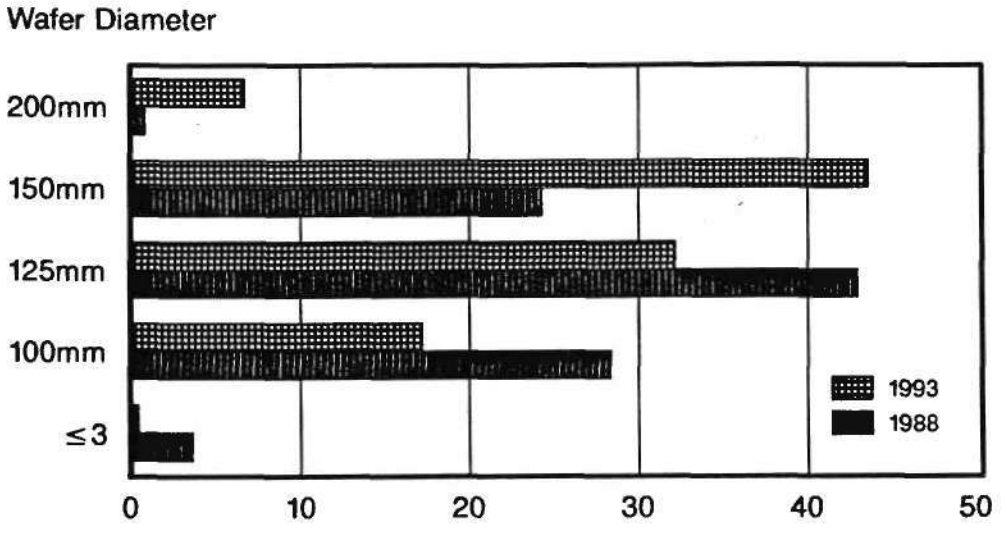
WORLDWIDE WAFER SIZE DEMAND

Percent Square Inches



Source: Dataquest

SILICON ACQUISITIONS REVISITED

Year	Company		Acquired By
1988	Monsanto Electonic Materials Company	←	Huels AG
1988	Cincinnati Milacron	←	Osaka Titanium Company
1987	Dynamit Nobel Silicon	←	Huels AG
1986	U.S. Semiconductor	←	Osaka Titanium Company
1986	Siltec Corporation	←	Mitsubishi Metal
1985	NBK Corporation	←	Kawasaki Steel

Source: Dataquest

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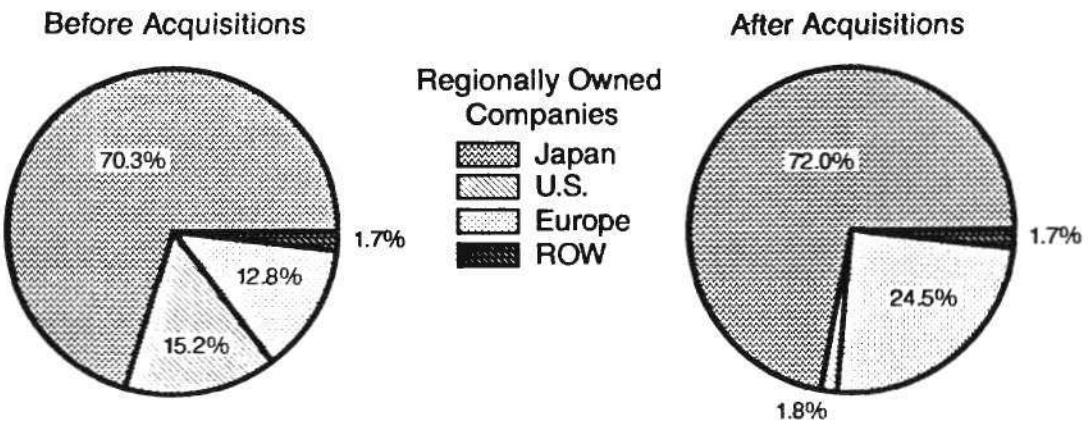
SHIFTING SHARE
IMPACT OF RECENT ACQUISITIONS

1988 = $2.16 Billion



Source: Dataquest

FUTURE OPPORTUNITIES -- SILICON ON INSULATOR

Agenda

- Advantages and applications
- SOI suppliers
- Technology overview
- Outlook

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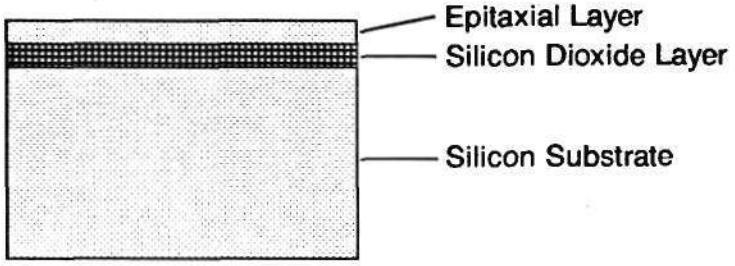
WHAT IS SOI?

SOI (silicon on insulator) wafers consist of a thin epitaxial layer of silicon on an insulating layer of silicon dioxide over a silicon substrate.



SOI ADVANTAGES

- High packing density/freedom from latch-up
- High-speed operation
- Inherent radiation hardness
- High-temperature operation
- High-voltage capability
- Standard silicon processing

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SOI APPLICATIONS

Military, aerospace, automotive, and telecommunications

- Fabricated devices include:
  - 3-GHz ring oscillator (Hughes)
  - Linear ICs (Silicon General)
  - 16K/64K CMOS SRAMs (TI)

SOI WAFER SUPPLIERS

Company	SOI Wafer Technology	Initial Technology Development
Applied Electron Corporation	EBZMR	Colorado State Univ., Fort Collins
Kopin Corporation	ISE/ZMR	MIT Lincoln Labs
Ibis Technology Corporation	SIMOX	Eaton Corporation
Spire Corporation	SIMOX	Spire, Texas Instruments

EBZMR = Electron-Beam Zone Melt Recrystallization
ISE/ZMR = Isolated Silicon Epitaxy/Zone Melt Recrystallization
SIMOX = Separation by IMplantation of OXygen

Source: Dataquest

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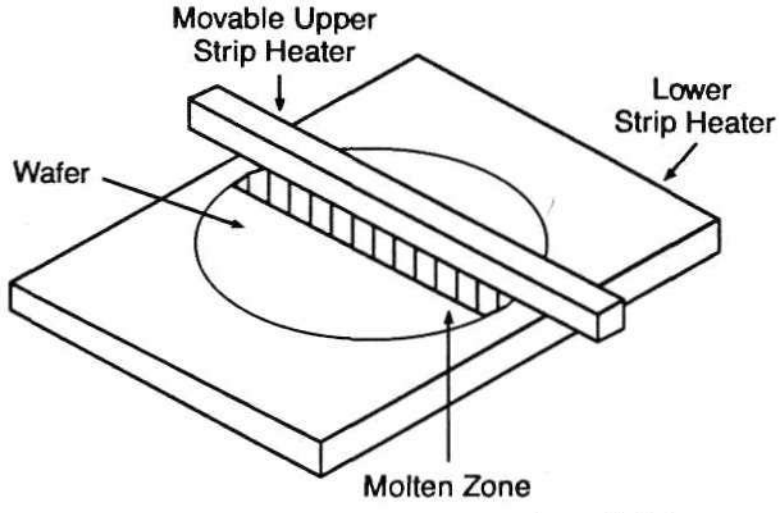
SOI TECHNOLOGY OVERVIEW

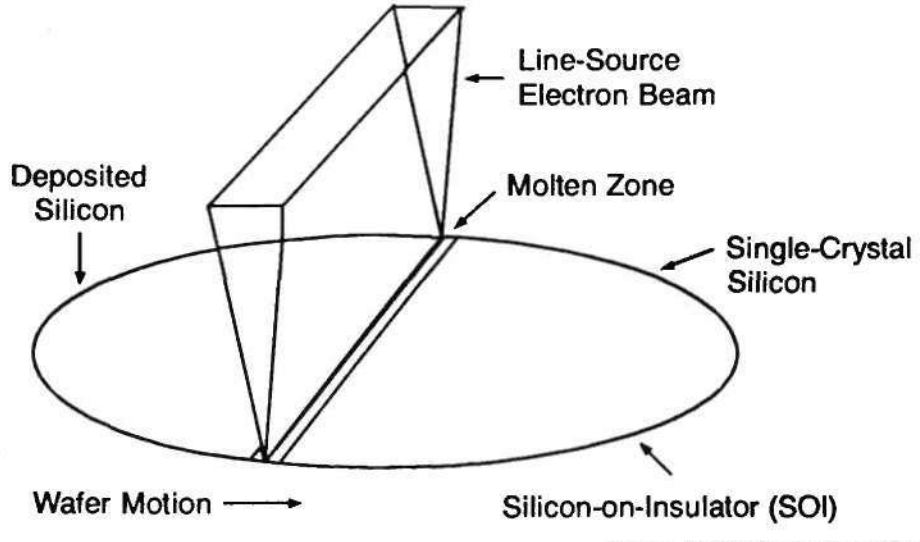
Isolated Silicon Epitaxy (ZMR)



Source: Kopin Corporation
Dataquest

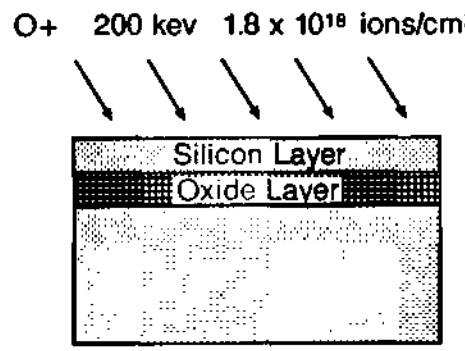
SOI TECHNOLOGY OVERVIEW

Electron-Beam ZMR



Source: Applied Electron Corporation
Dataquest

SOI TECHNOLOGY OVERVIEW
SIMOX



Source: Ibis Technology Corporation
Dataquest

SOI OUTLOOK

Moving Down the Learning Curve

- Lower defect densities
- Lower wafer prices

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SOI OUTLOOK

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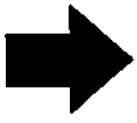

New Market Opportunities

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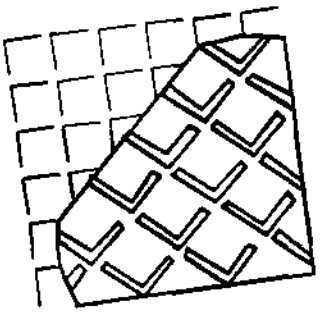
Dataquest's Annual
SEMICON/West Seminar
May 24, 1989



JAPANESE SEMICONDUCTOR EQUIPMENT MARKET STATUS

KAZ HAYASHI

Industry Analyst
Semiconductor Equipment and Materials Service
Dataquest Japan Limited

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AGENDA

- Semiconductor production analysis and forecast
- Capital spending analysis and forecast
- Fabrication equipment demand analysis
  - Lithography
  - Etch and clean
  - Deposition
  - Diffusion and rapid thermal processing (RTP)
  - Implantation
- Summary

ESTIMATED JAPANESE SEMICONDUCTOR PRODUCTION AND CAPITAL SPENDING 1984-1988

(Millions of Dollars)

	1984	1985	1986	1987	1988
Japanese Semiconductor Production	$12,007	$10,651	$14,686	$18,958	$25,903
Capital Spending	$3,900	$3,336	$1,850	$2,432	$4,568

Source: Dataquest

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ESTIMATED JAPANESE SEMICONDUCTOR PRODUCTION AND CAPITAL SPENDING 1989-1993

(Millions of Dollars)

	1989	1990	1991	1992	1993	CAGR 1988-93
Japanese Semiconductor Production	$29,632	$28,492	$32,537	$39,270	$51,536	15%
Capital Spending	$5,488	$4,972	$6,915	$9,439	$12,864	23%

Source: Dataquest

ESTIMATED JAPANESE COMPANY CAPITAL SPENDING

(Millions of Dollars)

	Calendar Year				
Company	1980	1981	1982	1983	1984
Fujitsu	$111				$ 485
Hitachi	93				506
Matsushita	89				464
Mitsubishi	36				274
NEC	133				544
Oki	53				110
Sanyo	36				135
Sharp	38				110
Toshiba	49				574
Others	0				468
Total	$638	$834	$921	$1,698	$3,671

Source: Dataquest

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ESTIMATED JAPANESE COMPANY CAPITAL SPENDING

(Millions of Dollars)

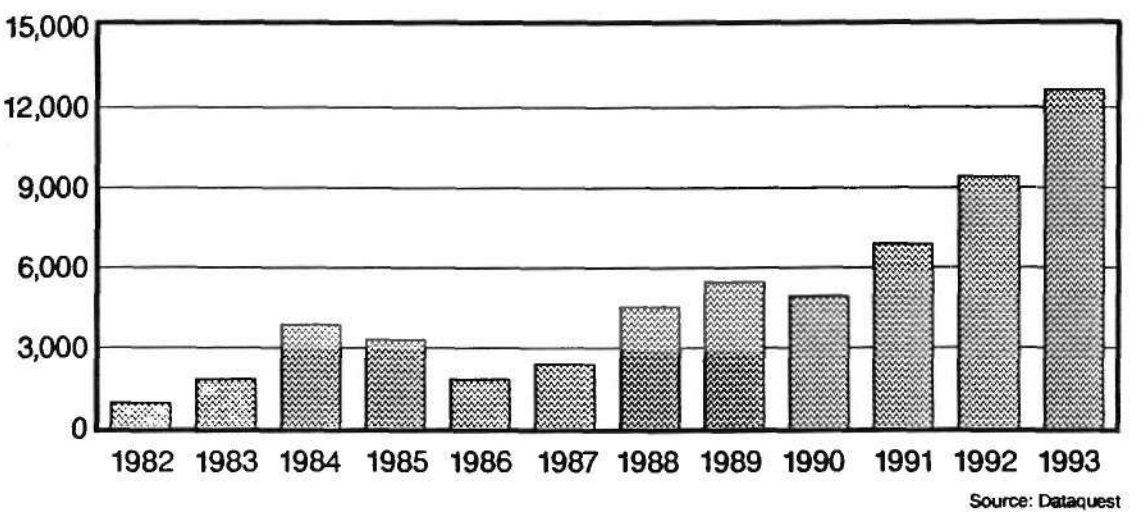
Calendar Year

Company	1984	1985	1986	1987	1988	1989	% Change 1988-1989
Fujitsu					$ 462	$ 462	0%
Hitachi					500	538	8%
Matsushita					385	462	20%
Mitsubishi					308	385	25%
NEC					423	538	27%
Oki					285	308	8%
Sanyo					223	269	21%
Sharp					269	346	29%
Toshiba					615	615	0%
Others					1,015	1,508	48%
Total	$3,671	$3,219	$1,766	$2,345	$4,485	$5,431	21%

Source: Dataquest

ESTIMATED JAPANESE CAPITAL SPENDING

(Millions of Dollars)



Source: Dataquest

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JAPANESE WAFER FAB EQUIPMENT MARKET

(Millions of Dollars)

1982	1988	CAGR
$580	$2,150	24.5%

Source: Dataquest

JAPANESE FABRICATION EQUIPMENT MARKET

(Millions of Dollars)

	1982	1988	CAGR 1982-1988
Etch and Clean	$ 76	$ 396	31.7%
Deposition	121	414	22.8%
Diffusion and RTP	48	129	18.0%
Implantation	48	220	28.9%
Total	$293	$1,159	25.7%

Source: Dataquest

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LITHOGRAPHY

(Millions of Dollars)

	1982	1988	CAGR 1982-1988
Contact/Proximity	$ 26	$ 4	(26.8%)
Projection Aligners	29	25	(2.4%)
Steppers	60	423	38.6%
Direct-Write E-Beam	28	67	15.7%
X-Ray	0	2	N/A
Automatic Photoresist Processing Equipment	28	120	27.5%
Total	$171	$641	24.7%

N/A = Not Available

Source: Dataquest

ETCH AND CLEAN

(Millions of Dollars)

	1982	1988	CAGR 1982-1988
Wet Process	$27	$ 92	22.7%
Dry Strip	10	59	34.5%
Dry Etch	42	245	34.2%
Total	$76	$396	31.7%

Source: Dataquest

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DEPOSITION

(Millions of Dollars)

	1982	1988	CAGR 1982-1988
Chemical Vapor Deposition	$ 43	$190	28.2%
Physical Vapor Deposition	46	126	18.3%
Silicon Epitaxy	32	98	20.6%
Total	$121	$414	22.8%

Source: Dataquest

DIFFUSION AND RTP

(Millions of Dollars)

	1982	1988	CAGR 1982-1988
Diffusion	$47	$122	18.1%
Rapid Thermal Processing	1	7	38.4%
Total	$48	$129	18.0%

Source: Dataquest

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ION IMPLANTATION

(Millions of Dollars)

	1982	1988	CAGR 1982-1988
Medium Current	$22	$ 59	17.9%
High Current	26	161	39.4%
High Voltage	<1	<1	N/A
Total	$48	$220	28.9%

N/A = Not Applicable

Source: Dataquest

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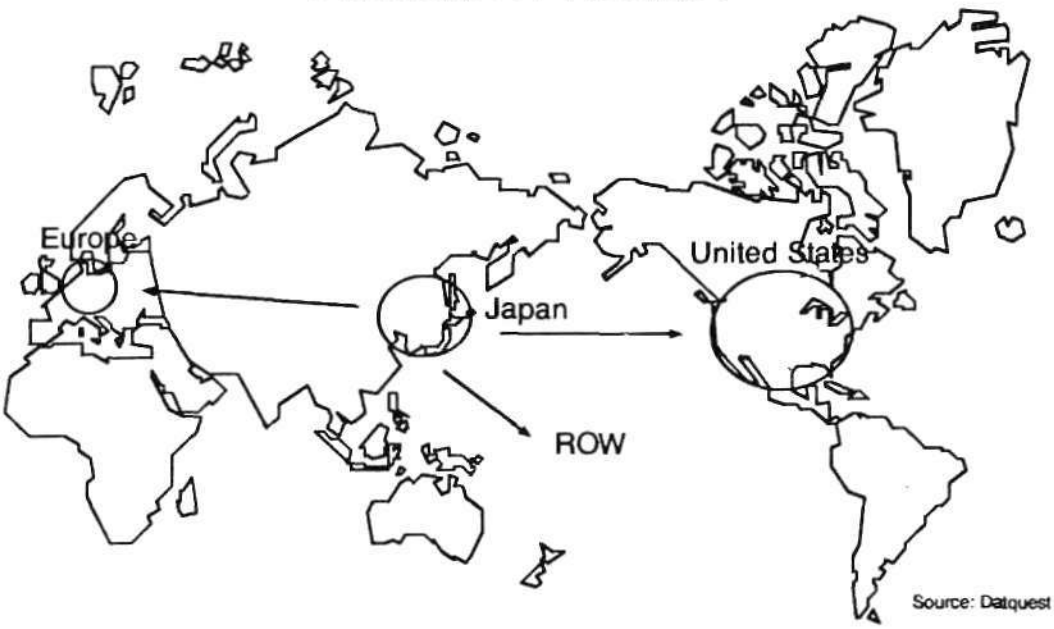
JAPANESE WAFER FAB PLANTS BY REGION



Source: Datquest

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SUMMARY

- Will continue to increase Japanese capital spending
- Will expand Japanese market shares for semiconductor equipment worldwide
- Will establish new fab lines worldwide

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