

*10th Annual*

# **SEMICONDUCTOR**

*Conference*

**The Semiconductor Horizon:  
Silicon Desert or High-Tech Oasis?**

*October 6-8, 1994*

*Palm Springs, California*

**DataQ**

**When it comes to semi-conductors, the horizon is a hazy one. Sales and profits have been strong, but change is in the wind. Exactly what lies ahead for chip manufacturers and users? Is it a silicon desert — or the next high-tech oasis?**

The semiconductor industry has been on a roll. Demand has remained strong, worldwide sales have continued to grow, and profit margins for manufacturers have held steady. But nothing lasts forever—especially in high-tech segments as fast-moving and as volatile as those in semiconductors. Emerging new applications requiring new chip designs, explosive new markets such as interactive TV, potential shortages in 4MB and 16MB DRAMs as well as logic devices, and headline-making joint ventures are all poised to toss the industry into a whirlwind of change and innovation.

For suppliers and purchasers of today's leading-edge chip technologies, it's a time for strategic positioning and planning. How will you transform tomorrow's pitfalls into opportunities for your company's growth and market leadership? Which standards, architectures, and joint ventures should you support—and which should you abandon? For which new applications should your company commit millions of dollars in new chip R&D? And how can you ensure the software support you need for your next generation of semiconductors?

## **Are you positioned to take advantage of tomorrow's semiconductor opportunities — or will you be left behind?**

In 1994, there will be only *one* opportunity to gain a comprehensive, crystal-clear look at the horizon in semiconductors. It's being held on October 6-8, in beautiful Palm Springs, California. And it's an event you simply can't afford to miss.

- Prominent executives from major vendors will join Dataquest's preeminent analysts in providing hard facts, objective analysis, and bold predictions about dramatic future events in semiconductors and what they'll mean to you.
- Dataquest's latest market forecasts will highlight the hottest future areas of growth in semiconductors as well as pricing and distribution issues—and how both suppliers and users alike can optimize their success in these "hot spots!"
- Informative panels and sessions will cover key trends and emerging applications in the marketplace today and tomorrow, including future semiconductor contract manufacturing strategies, wireless communications, PC architectures, and multimedia delivery methods.

To help celebrate 20 years of semiconductor industry expertise, Dataquest invites you to join us at our Semiconductor Celebrity Golf Tournament featuring celebrity guest and PGA pro Bob Rosburg. Tee off is Saturday, October 8! A portion of the proceeds from this benefit tournament will be donated to the Institute of International Education. We've also put together some exciting day activities during the conference for spouses looking for some fun in the sun in Palm Springs.

*See registration page for details on Semiconductor Celebrity Golf Tournament and other activities.*

*20th Annual*

**It's more than a conference — it's a celebration!**

# A G E N D A

## *day One*

### **October 8**

- 7:00 am - 8:15 am  
**Registration and Continental Breakfast**
- 8:15 am - 8:45 am  
**Welcome and Conference Overview**
- 8:45 am - 9:00 am  
**President's Remarks**  
Judith H. Hamilton, President and CEO,  
Dataquest
- 9:00 am - 9:45 am  
**Keynote Address**  
Gary L. Tooker, Vice Chairman, CEO,  
Motorola, Inc.
- 9:45 am - 10:15 am  
**The Semiconductor Outlook:  
Where are the Surprises?**  
Gene Norrett, Corporate Vice President and  
Director, Semiconductor Group, Dataquest
- 10:15 am - 10:45 am  
**Coffee/Networking Break**
- 10:45 am - 12:15 pm  
**Food Chain Forecasts:  
The Dataquest Vision**  
MPRs and MPUs  
MCUs  
Memories  
ASICs  
Analog and Mixed-Signal ICs  
Pricing Trends  
Capital Spending/Equipment Forecasts  
Asia/Pacific Markets and Forecast
- 12:15 pm - 2:00 pm  
**Luncheon**
- 2:00 pm - 2:30 pm  
**Solutions for the 10+ Million Transistor  
Chip**  
Walden C. Rhines, President and CEO,  
Mentor Graphics Corporation
- 2:30 pm - 4:30 pm  
**FORUM**  
**PC 2000: Chaos or Control**
- 6:00 pm  
**Cocktails and Barbecue**

### **Capital Spending/Equipment Forecasts**

*Clark J. Fuhs, Senior Industry Analyst, Semiconductor Equipment, Manufacturing, and Materials Service*

### **Asia/Pacific Markets and Forecast**

*Daniel Heyler, Senior Industry Analyst and Manager, Semiconductors Asia/Pacific*



Walden C. Rhines

### **Solutions for the 10+ Million Transistor Chip**

*Walden C. Rhines, President and CEO, Mentor Graphics Corporation*

What will be the future trends in design methodologies and tools necessary to create the most advanced chips of tomorrow.

### **PC 2000: Chaos or Control**

Moderator:

*Jerry Banks, Director/Principal Analyst, Microcomponents Service, Dataquest*

Panelists:

*George N. Alexy, Senior Vice President, Marketing, Cirrus Logic, Inc.*

*Hugh Barnes, Senior Vice President, General Manager, Portable PC Division, Compaq Computer Corporation  
Speaker to be announced, IBM*

*D. Craig Kinnie, Corporate Vice President and Director, Intel Architecture Development Laboratories, Intel Corporation*

*Carl Stork, Director, Windows Platform Definition and Business Development, Microsoft Corporation*



George N. Alexy



Hugh Barnes

The destiny of the semiconductor industry is inextricably linked to the destiny of the PC. What will the PC of the future look like—and how can your business share in its success? Our experts will debate a number of wide-ranging possibilities in this interactive forum.

- What controls the future destiny of PCs—hardware or software?
- Can the x86 architecture outrun RISC—or does it even matter?
- Which microperipheral vendors can afford to support multiple architectures?
- Who will demand higher performance in a PC—the home or office user?
- Are we entering an era of software consolidation with only two or three major operating systems? How will that influence microprocessor buying decisions? Which horse will you put your money on?



D. Craig Kinnie



Carl Stork

**day Two**    **October 7**



Joseph Grenier



D. Tony Stelliga



Michael J. Hames



Koichi Nishimura



Bernard Vonderschmitt

## **Welcome and Day Two Overview**

*Joseph Grenier, Vice President, Semiconductor Manufacturing, Applications, and Procurement Group, Dataquest*

## **Wireless Communications: The Second Revolution Unfolds**

Moderator:

*Gregory L. Sheppard, Director/Principal Analyst, Semiconductor Application Markets (SAM) Worldwide, Dataquest*

Panelists:

*Emmett B. Hume, Senior Vice President, Strategic Marketing and Business Development, Nationwide Wireless Network (NWN)*

*Speaker to be announced, Nokia*

*D. Tony Stelliga, Vice President, General Manager, Telecom Products Division, LSI Logic Corporation*

*Michael J. Hames, Vice President, Semiconductor Group, Worldwide DSP Manager, Texas Instruments*

*Robert S. Sellinger, Director, PCS, AT&T Network Wireless Systems*

According to some estimates, more than a half-billion people worldwide will be communicating over wireless links by the year 2005. How will we get there from here? This informative forum examines the semiconductor opportunities for companies like yours in PCMCIA cards, handsets, and associated technologies.

- What is the projected ramp-up for digital cellular standards?
- What form will the new PCS/PCN technologies and services take—and what are their rollout plans?
- What kinds of chips will the personal communicators of the future require?
- Will one or two data communications standards become mainstream? What will that mean to you?

## **Future Manufacturing Strategies: Make or Buy?**

Moderator:

*Clark J. Fuhs, Senior Industry Analyst, Semiconductor Equipment, Manufacturing, and Materials Service, Dataquest*

Panelists:

*David N.K. Wang, Senior Vice President, Worldwide Business Operations, Applied Materials, Inc.*

*John T. Dickson, Vice President, Integrated Circuits, AT&T Microelectronics*

*Koichi Nishimura, Ph.D., President and CEO, Solectron Corp.*

*Donald W. Brooks, President, TSMC*

*Bernard V. Vonderschmitt, President and Co-Founder, Xilinx, Inc.*

Contract manufacturing is strengthening its foothold in the semiconductor industry as more companies seek strategies for optimizing profitability and market success. Yet the success of a semiconductor company can ride on the relationship with its outsource partner.

## **Welcome & Conference Overview**

*Gene Norrett, Corporate Vice President and Director, Semiconductor Group, Dataquest*

## **President's Remarks**

*Judith H. Hamilton, President and CEO, Dataquest*

## **Keynote Address**

*Gary L. Tooker, Vice Chairman and CEO, Motorola, Inc.*

The impact of tomorrow's wireless communications capabilities on business, society, and each of our individual lives promises to be enormous. Mr. Tooker will give us an insider's look at the next 10 years in wireless communications and the ramifications on the entire electronics food chain, from semiconductors to components to systems. He'll also discuss the emerging wireless service industry.

## **The Semiconductor Outlook: Where are the Surprises?**

*Gene Norrett, Corporate Vice President and Director, Semiconductor Group, Dataquest*

What are the overall market rankings in the semiconductor industry today? Who's winning and who's losing? Shipments of memories, microprocessors, and more—where do they stand, and where are they heading? Mr. Norrett will present Dataquest's overview of the industry.

## **Food Chain Forecasts: The Dataquest Vision**

Dataquest's annual forecasts, predictions, and analyses on various segments of the semiconductor market. Known for their strong opinions and accurate forecasts, our analysts will tell you what's hot, what's not, and what promises to be at the center of tomorrow's new markets.

### **MPRs and MPUs**

*Kenneth A. Lowe, Director/Principal Analyst, Microcomponents Service*

### **MCUs**

*Jerry Banks, Director/Principal Analyst, Microcomponents Service*

### **Memories**

*Jim Handy, Director/Principal Analyst, MOS Memories*

### **ASICs**

*Bryan Lewis, Senior Industry Analyst, ASIC Worldwide*

### **Analog and Mixed-Signal ICs**

*Gary J. Grandbois, Director/Principal Analyst, Semiconductors Worldwide*

### **Pricing Trends**

*Mark Giudici, Director/Principal Analyst, Semiconductor Procurement Service*



Judith H. Hamilton



Gary L. Tooker



Gene Norrett



Jerry Banks



Mark Giudici

# **A G E N D A**

## **day Two**

### **October 7**

- 7:00 am - 8:15 am  
**Continental Breakfast**
- 8:15 am - 8:30 am  
**Welcome and Day Two Overview**
- 8:30 am - 10:30 am  
**FORUM**  
**Wireless Communications: The Second Revolution Unfolds**
- 10:30 am - 11:00 am  
**Coffee/Networking Break**
- 11:00 am - 12:30 pm  
**FORUM**  
**Future Manufacturing Strategies: Make or Buy?**
- 12:30 pm - 2:00 pm  
**Luncheon and Featured Speaker**  
**Funding Opportunities Along the Superhighway**  
William R. Hambrecht, Founding Partner, Chairman, and Co-CEO, Hambrecht & Quist Group
- 2:00 pm - 2:30 pm  
**Can the Chip Market Live without the PC?**
- 2:30 pm - 4:30 pm  
**FORUM**  
**PCs vs. TVs: Catering to the Couch Potato**
- 4:30 pm  
**Conference Ends**

## **day Three**

### **October 8**

- 6:45 am  
**Clinic with PGA pro Bob Rosburg**
- 7:30 am  
**Dataquest's Semiconductor Celebrity Golf Tournament with Bob Rosburg**  
**Marriott's Desert Springs Golf Course**



This fact-filled forum explores the following questions:

- Who's using foundries for semiconductor contract manufacturing—and how have the relationships evolved?
- How can manufacturing capacity and design security be ensured to eliminate potential capacity shortages?
- How can you grow a fabless business that gains market share?
- Will the outsourcing business grow to adequately support niche companies specializing as foundries?

### **Funding Opportunities Along the Superhighway**

*William R. Hambrecht, Founding Partner, Chairman, Co-CEO, Hambrecht & Quist Group*

Venture capital and specifically Hambrecht & Quist has played a vital role in the growth of the semiconductor and electronics industry. With the advent of the information superhighway, there are a number of ways to invest in these opportunities. Mr. Hambrecht will give us his insights into the companies that are on the superhighway fast track.

### **Can the Chip Market Live Without the PC?**

*Gregory L. Sheppard, Director/Principal Analyst, Semiconductor Application Markets (SAM) Worldwide, Dataquest*

*Dale L. Ford, Industry Analyst, Semiconductor Application Markets (SAM) Worldwide, Dataquest*

You may have the greatest semiconductor technology in the world, but if there's weak demand for it, you'll undoubtedly fail. Here, two Dataquest experts will take a crystal-ball look at the applications that will fuel semiconductor sales in the future. Where is tomorrow's hottest niche applications growth and how can you capitalize?

### **PCs vs. TVs: Catering to the Couch Potato**

Moderator:

*Jim Handy, Director/Principal Analyst, MOS Memories, Dataquest*

Panelists:

*Geoffrey S. Roman, Vice President, Technology and New Business Development, General Instrument Corporation*

*Doug Dunn, Chairman and CEO, Philips Semiconductors*

*Ichiro Fujitaka, Vice President, Systems Application Engineering, and General Manager, Microcomputer Semiconductor Business Unit, NEC Electronics Inc.*

*Robert Luff, Chief Technical Officer, Broadband Communications Group, Scientific-Atlanta, Inc.*

*Larry Thorpe, Vice President of Advanced Dev., Sony Electronics*

*Theodore M. Hoff, Senior Vice President and General Manager, Fox Interactive*

The PC vs. TV "battle for interactivity" promises to be one of the most explosive new market dramas as we head into the 21st century. Which will drive and control television's future interactivity functions—the PC or the TV? In short, does your semiconductor company sell to a Compaq or a Sony? Do not miss this forum!

- What's happening with content providers and content deliverers?
- Which standards will emerge—and why?
- Will PCs and cable boxes merge into a hybrid?
- Price, ease of use, and the consumer's comfort zone—how vital will these be to your future success?



William R. Hambrecht



Gregory L. Sheppard



Doug Dunn



Robert Luff



Theodore M. Hoff

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## CELEBRITY GOLF



**Bob Rosburg,  
PGA Pro**



Designed by Ted Robinson, Marriott's sweeping Desert Springs Golf Course is the host of the annual Frank Sinatra Celebrity Golf Tournament. It's also the site of our Semiconductor Celebrity Golf Tournament on Saturday, October 8, featuring PGA pro and ABC golf commentator, Bob Rosburg. Join us for a day of relaxation on one of Palm Springs' most prestigious courses!

Help your game with tips from a pro and you'll help foster international relations, too!

We're happy to announce that a portion of the proceeds from the Semiconductor Celebrity Golf Tournament will be donated to the Institute of International Education on behalf of Dataquest and Marriott's Desert Springs Resort & Spa. Based in New York City, the Institute is the United States' largest nonprofit educational and cultural exchange agency.

Saturday, October 8:           6:45 am – Clinic with Bob Rosburg  
  7:30 am – Tee off

Green fees, shared cart, luncheon, and prizes – \$245



### **Plus....**

**Your opportunity to shoot a hole-in-one and drive away in a brand new Mazda Miata Convertible!**

### **Spouse Programs for Sight-Seeing and Star-Gazing!**

Celebrate our 20th Annual Semiconductor Conference by bringing your spouse for some fun in the sun. Each day offers an exciting, action-filled program for those not attending the conference!

#### **Aerial Tramway and Desert Star Search**

Includes tram ascent with breathtaking views from 8,500-foot Mt. San Jacinto. You'll also "star gaze" by the homes of Bob Hope, Marilyn Monroe, Elvis Presley, and many more!  
October 6, 9:00 am—1:00 pm, \$38 (Program A)

#### **Palm Springs Desert Museum and Shopping**

Includes tour of an exquisite museum highlighting the best in visual arts, performing arts, and natural sciences. And wait until you try the shopping along Palm Canyon Drive!  
October 7, 9:30 am—1:00 pm, \$32 (Program B)

## 20th Annual Semiconductor Conference

October 6-8, 1994 • Palm Desert, California

Registration by FAX: please complete this form and fax to (805) 298-4388 or mail it to the address below. Your confirmation will be sent to you by mail. (For additional conference registrations, please copy this form.)

Please print or type clearly to ensure correct spelling on conference materials.

Last Name		First Name	
Title			
Company (full company name as it will appear in print)			
Street		Mail Stop	
City	State	Zip	
Telephone		Fax	

### Registration Fees:

Conference	Client	Non-Client
Early Bird Rate	\$1,075	\$1,255
After Sept. 9, 1994	\$1,195	\$1,395

### Transcripts

Conference Attendee	\$295
Non-Attendee	\$495

### Optional Programs

<input type="checkbox"/> Semiconductor Celebrity Golf Tournament	\$245
<input type="checkbox"/> Spouse Program A	\$38
<input type="checkbox"/> Spouse Program B	\$32
<input type="checkbox"/> Spouse Dinner	\$70

Spouse Name \_\_\_\_\_

### Method of Payment:

- Purchase Order # \_\_\_\_\_  
 Check by mail  
 MasterCard     American Express     Visa

Card # \_\_\_\_\_

Expiration Date \_\_\_\_\_

Name (as it appears on card) \_\_\_\_\_

Signature (registration not valid without signature) \_\_\_\_\_

### Group Rate:

Register three and receive a fourth registration free — compliments of Dataquest.

### Note:

Payment must be received by September 9, 1994 to qualify for the Early Bird Discount. All payments must be received prior to conference.

Call us at (714) 476-9117 to find out how your tournament fee may be tax deductible.

If minimum of 25 is not met on each spouse program, program may be cancelled.

### Cancellation Policy:

Cancellations received up to two weeks prior to the conference date are subject to a \$100.00 cancellation fee. Cancellations received within two weeks of the conference date are subject to payment in full. Substitutions may be made in writing up to one week prior to the conference. Nonattendance is subject to full payment.

### Hotel Information:

Marriott's Desert Springs Resort & Spa, 74855 Country Club Drive, Palm Desert, CA 92260  
For accommodations, contact reservations at: Tel: (619) 341-2211 or (800) 228-9290

Rooms are limited, so please call or fax the hotel reservations desk as soon you register for the conference. Mention that you are with the Dataquest Conference for special rate.

### Conference Registration Desk:

Toll Free (U.S.): 800 • 457 • 8233 Fax: 805 • 298 • 4388 Tel: 805 • 298 • 3262

Make checks payable to Market Makers and send to: Dataquest Incorporated  
26524 Golden Valley Road, Suite 401, Santa Clarita, CA 91350

REGISTRATION

## **Worldwide Offices**

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Fax: (81) 3 5566 0425

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8000 Munich 80, Germany  
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Fax: (4989) 930 3277

Tour Franklin  
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92042 Paris la Défense, France  
Tel: (33141) 25 1800  
Fax: (33141) 25 1818

Suite 3806, Trade Tower  
159 Samsung-dong  
Kangnam-gu, Seoul 135-729, Korea  
Tel: (822) 551 1331  
Fax: (822) 551 1330

# **Dataquest**

 a company of  
The Dun & Bradstreet Corporation

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*SEMICON/West Seminar—Status 1994*

**Dataquest Seminar  
July 20, 1994  
San Francisco Marriott  
San Francisco, California**

Dataquest

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July 1994



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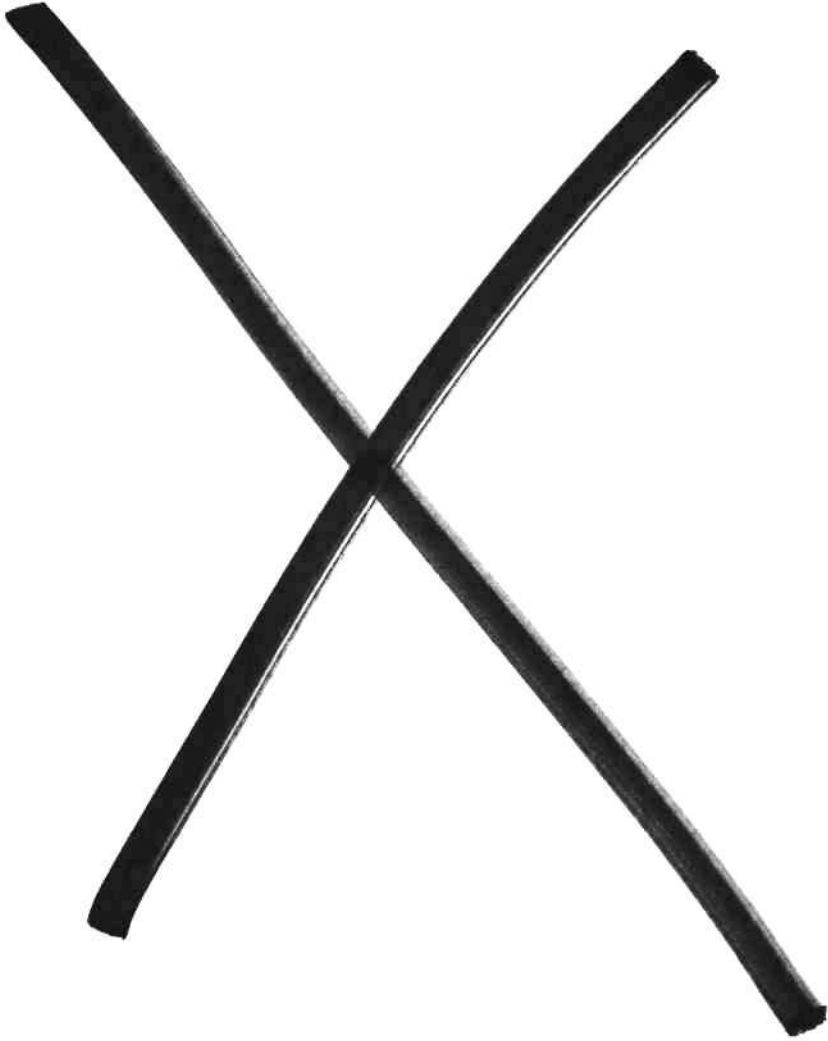
**Agenda**

**Conference Evaluation**

**Attendees**

**Presentations**

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## **SEMICON/West Seminar—Status 1994**

San Francisco Marriott, 55 Fourth Street

San Francisco, California

July 20, 1994

- 7:30-8:00 a.m. **Registration and Continental Breakfast** \_\_\_\_\_ Foyer
- 8:00 a.m. **Welcome** \_\_\_\_\_ Buena Vista Room  
*Joseph Grenier*  
Vice President, Semiconductor Manufacturing and Applications Service  
Semiconductors Group  
Dataquest Incorporated
- 8:10 a.m. **Wafer Fab Equipment Forecast: How Long Will the Boom Last?** \_\_\_\_\_ Buena Vista Room  
*Clark Fuhs*  
Senior Industry Analyst, Semiconductor Equipment, Manufacturing, and Materials Service  
Semiconductors Group  
Dataquest Incorporated
- 8:40 a.m. **The Interplay between IC Process Trends and Advanced Equipment** \_\_\_\_\_ Buena Vista Room  
*Calvin Chang, Ph.D.*  
Industry Analyst, Semiconductor Equipment, Manufacturing, and Materials Service  
Semiconductors Group  
Dataquest Incorporated
- 9:10 a.m. **Semiconductor Fabs: Why, Where, and What?** \_\_\_\_\_ Buena Vista Room  
*Näder Pakdaman*  
Senior Industry Analyst, Semiconductor Equipment, Manufacturing, and Materials Service  
Semiconductors Group  
Dataquest Incorporated
- 9:40-10:00 a.m. **Break** \_\_\_\_\_ Foyer
- 10:00 a.m. **Chips, Chips, and More Chips—Toward a \$200 Billion IC Market** \_\_\_\_\_ Buena Vista Room  
*Ron Bohn*  
Senior Industry Analyst, Memories Worldwide  
Semiconductors Group  
Dataquest Incorporated
- 10:30 a.m. **PC and Mobile Computing: What's Hot for the Desktop?** \_\_\_\_\_ Buena Vista Room  
*Philippe de Marcillac*  
Director and Principal Analyst, Personal Computers Worldwide  
Computer Systems and Peripherals Group  
Dataquest Incorporated
- 11:00 a.m. **Semiconductor Market Opportunities in China—  
Will China Become the Next Asian Semiconductor Power?** \_\_\_\_\_ Buena Vista Room  
*Jingsheng Huang*  
Market Research Analyst  
Research Operations Group  
Dataquest Incorporated
- 11:30 a.m. *Seminar Concludes*

X

Thank you for attending SEMICON/West 1994. Your thoughts and comments regarding this event are an important part of our process to continually improve the value provided through our seminar program. Please help us by taking a few moments to complete this questionnaire.

<i>this section optional</i>	Name: _____	Title: _____
	Company Name: _____	Tel: _____
	Nature of company's primary activity: _____ _____	

Where did you originally hear about this seminar?  Brochure  Fax  Telephone  Other \_\_\_\_\_

How satisfied are you overall that the seminar met these objectives:

	<u>very</u> <u>satisfied</u>				<u>not very</u> <u>satisfied</u>
	1	2	3	4	5

What topics/issues would you like to see addressed at future seminars? Please list.

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General Comments:

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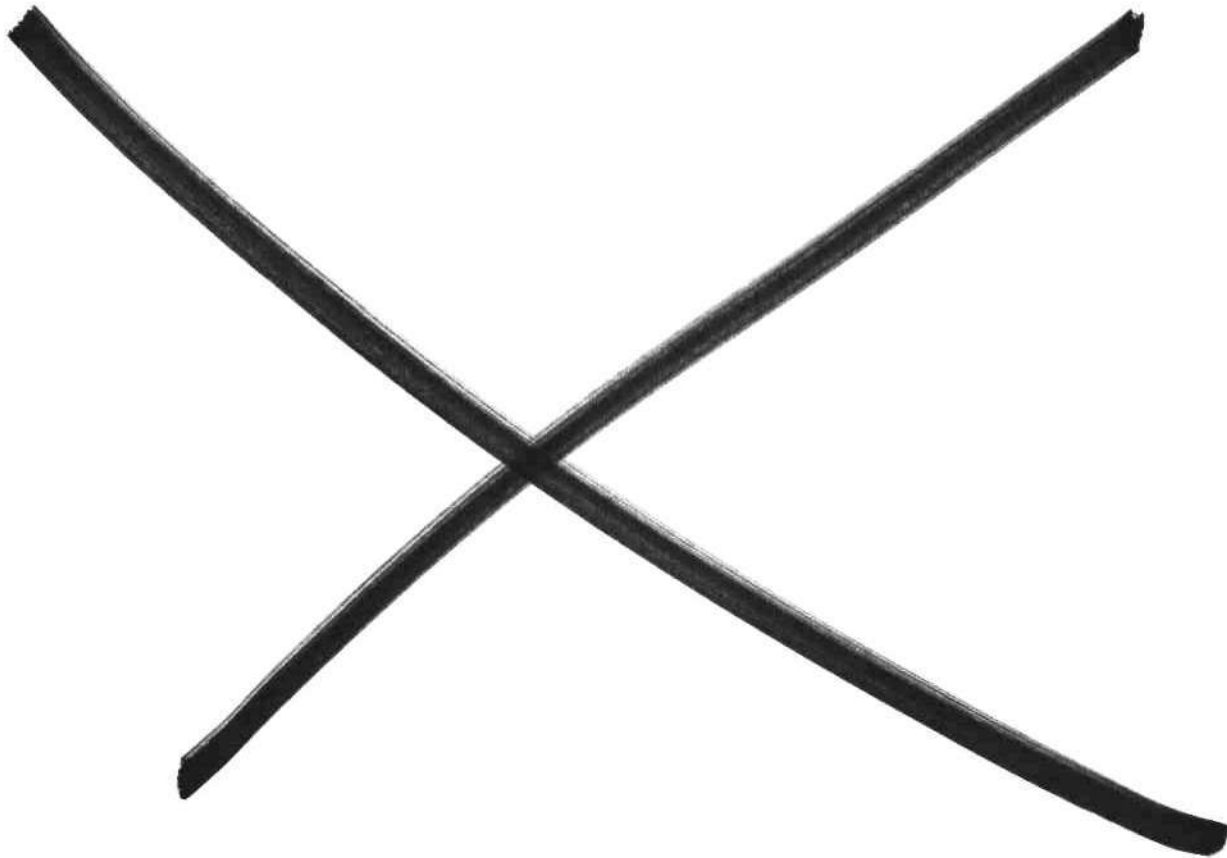
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# SEMICON/West 1994

Please evaluate the sessions by circling your rating:

	Presentation					Content					did not attend
	excellent		poor			excellent		poor			
<b>Wafer Fab Equipment Forecast: How Long Will the Boom Last?</b> Clark Fuhs	1	2	3	4	5	1	2	3	4	5	<input type="radio"/>
<b>The Interplay between IC Process Trends and Advanced Equipment</b> Calvin Chang, Ph.D.	1	2	3	4	5	1	2	3	4	5	<input type="radio"/>
<b>Semiconductor Fabs: Why, Where, and What?</b> Näder Pakdaman	1	2	3	4	5	1	2	3	4	5	<input type="radio"/>
<b>Chips, Chips, and More Chips—Toward a \$200 Billion IC Market</b> Ron Bohn	1	2	3	4	5	1	2	3	4	5	<input type="radio"/>
<b>PC and Mobile Computing: What's Hot for the Desktop?</b> Philippe de Marcillac	1	2	3	4	5	1	2	3	4	5	<input type="radio"/>
<b>Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?</b> Jingsheng Huang	1	2	3	4	5	1	2	3	4	5	<input type="radio"/>



## Attendees

### **ABN AMRO Bank, N.V.**

Bob Hartinger  
*Group Vice President*  
Case Lebbeus  
*Vice President*

### **ACSI, Inc.**

Richard Brewer  
*President, CEO*

### **AG Associates/CVD**

Donald Yoshikawa  
*Marketing Manager*

### **Analog Devices, Inc.**

Cate Thomas  
*Director, Strategic Programs*

### **Anderson DeBartolo Pan**

Stewart Startt  
*Marketing Director*

### **Applied Materials**

Cheryl Blalock  
*Purchasing Manager*  
Dana Ditmore  
*President, North America*  
Steve Lindsay  
*President, Applied Materials Europe*  
Michael Musson  
*Director, Investor Relations*  
Edith Ong  
*Technology Program Director*  
Katherine Pilewskie  
*Senior Industry Analyst*  
Deborah Robinson  
*Market Analyst*  
Richard Tauber

### **ASM Lithography**

Jim Greeneich  
*Vice President, Strategic Marketing*  
Franki D'Hoore  
*Strategic Marketing Manager*

### **Bank of America**

Steve Parry  
*Vice President*

### **Bank of Boston**

Mary Frances Galligan  
*Director*  
Lee Merkle  
*Assistant Vice President*  
Debra Staiger  
*Assistant Vice President*

### **Bank of California**

Bill Bloore  
*Assistant Vice President*

### **Canon, Inc.**

Ogiso Mitsutoshi  
*General Manager*

### **Cisco Systems, Inc.**

Robert Vellios  
*Commodity Specialist*

### **Comdisco Electronics Group**

Steven Grundon  
*Executive Vice President*  
Paul Edstrom  
*Director of Technology*  
Douglas Fritch  
*Assistant Credit Manager*  
Michael Herman  
*President*  
Michael Mardesich  
*Director of Technology*

### **Computer Reseller News**

Greg Quick  
*Sr. Editor*

### **Concept Systems Design, Inc.**

Alan Carbonaro  
*Vice President*  
Jim Mezey  
*President*  
Chuck Smith

### **Cupertino National Bank**

Tom Jorgensen

Harry Kellogg

*Executive Vice President*

### **Daifuku U.S.A., Inc.**

Ron Smith  
*Assistant Manager*

### **Dataquest Incorporated**

Ron Bohn  
*Senior Industry Analyst, Memories Worldwide, Semiconductors Group*  
Calvin Chang, Ph.D.  
*Industry Analyst, Semiconductor Equipment, Manufacturing, and Materials Service, Semiconductor Group*  
Philippe de Marcillac  
*Director and Principal Analyst, Personal Computers Worldwide, Computer Systems and Peripherals Group*  
Clark Fuhs  
*Senior Industry Analyst, Semiconductor Equipment, Manufacturing, and Materials Service, Semiconductors Group*  
Joseph Grenier  
*Vice President, Semiconductor Manufacturing and Applications Service, Semiconductors Group*  
Jingsheng Huang  
*Market Research Analyst, Research Operations Group*  
Nader Pakdaman  
*Senior Industry Analyst, Semiconductor Equipment, Manufacturing, and Materials Service, Semiconductors Group*

### **Daymarc**

Kevin Brennan  
*Product Manager*

### **Demer IR Counsel**

Robin Mechlowitz  
*Consultant*

### **Disco Hi-Tec America**

Marc Caltabiano  
*Product Specialist*  
Tommy Weiss  
*Marketing Manager*

### **Dow Corning Corporation**

Keith Michael  
*Manager, Electronics Business*

## Attendees

### Dupont Polymers

Greg Pfister  
*Industry Manager*

### E.T. Systems, Inc.

Dale Scott  
*Vice President/General Manager*

### Eaton Corporation

Robert Klimm  
*General Manager*

### Edwards High Vacuum Intl.

Robert Adams  
*Vice President of Marketing*

### EKC Technology Inc.

Gene Goebel  
*Vice President*

### Electronic Business Asia

Tom McHale

### Empak International

Bob Hays  
*Vice President, Sales and Marketing*

### ESI

Russell Schlager  
*Product Marketing Manager*

### ESTEK Corp.

Gene Bates  
*Director Marketing*

### Etec Systems, Inc.

Gary VanNice  
*Product Marketing Manager*

### FSI International

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*Sales Forecast Analyst*  
Laureen Walker  
*Marketing Manager*

### Fusion Semiconductor

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*Vice President*

### Gasonics, Inc.

Lou Ferrone

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Carmen Gellineau  
*Market Analyst*  
Richard Gumbrecht  
Jane Holland  
*Manager-High Tech Assets*  
Keith Kaseta  
*Portfolio Administration Rep.*  
Benjamin Lu  
*Residual Analyst*  
Melissa Reinke  
*Vice President, Marketing Analysis*

### General Scanning, Inc.

Joseph Verderber  
*President, TLSI Division*

### Hewlett-Packard Company

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*Market Analysis*  
Konrad Young

### InfoWorld

Jill Welch  
*Analyst*

### Intel

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*Program Manager*  
Yih-Shyong Luh  
*Senior Industry Analyst*  
Yumiko Takamori  
*Senior Industry Analyst*  
Jacques Vuye  
*Manager*

### Jiji Press

Mike Yukawa  
*Report*

### Keithley Instruments

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*General Manager-Semiconductor*  
Tom Mego  
*Engineering Manager*  
Rolf Olson  
*Marketing Manager*  
Gary Pinkerton  
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### Kobe Steel USA, Inc.

Mike Goto  
*Director*  
Paul Miller  
*Director, New Business Development*

### L'Air Liquide

Thierry Genot  
*Corporate Marketing Manager*

### Lam Research

Roger Emerick  
*President and CEO*  
Henk Evenhuis  
*Senior Vice President, CFO*  
Joe Ploshay  
*Sales Business Manager*  
Carolyn Schwartz  
*Investor Relations Manager*  
Larry Stewart  
*Vice President*

### Laporte Electronic Chemicals

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*Regional Director*  
Robert Stokell  
*Managing Director*

### LSI Logic Corporation

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### MacWeek

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*Technical Analyst*

### Markem Corporation

David Landry  
*Manager*

### Mattson Technology

Brad Mattson  
*President*

### Microlithography World

M. David Levenson

### Microprocessor Report

Bruce Koball  
*Contributing Editor*

## Attendees

### Millipore Corporation

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*Senior Market Manager*  
George Davison  
*Senior Market Manager*  
Gary Nadeau  
*Director Sales and Marketing*  
James Ogg  
*Market Manager*  
Gerald Walle  
*Vice President and General Manager*

### Mosaid Systems Incorporated

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*VP, Sales and Marketing*

### MRC

Edward Emy  
*Director, Corporate Marketing*

### NCR-AT&T Global Info. Solutions

Tim McCarthy  
*Assistant Vice President*

### NEC Electronics, Inc.

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*Manager, Corporate Planning*

### Netherlands Foreign Investment

Onno van de Stolpe  
*Area Director*

### NewMedia

Becky Waring  
*Executive Editor/Products*

### Newsbytes News Network

Ian Stokell  
*Managing Weekday Editor*

### Novellus Systems, Inc.

Tom Bowman  
*Vice President, Marketing*

### Nupro Company

Michael Valentine  
*Product Manager*

### OnTrack Systems, Inc.

Jerry Cutini  
*Executive Vice President*

### OS/2 Magazine

Alexander Antoniadis  
*Assistant Editor*

### Pall Corporation

Frank Stamatatos  
*Marketing Manager*

### Praxair

Thomas Nelson  
*Process Manager, Electronics*  
Azita Sharif  
*Applications Engineer*

### Prism Technologies, Inc.

Bobby Greenberg  
*President*

### Quality Semiconductor Inc.

Chun Chiu  
*Chairman and CEO*  
Paul Gupta  
*President and CEO*

### Radian Corporation

Ann Kuffner  
*Program Manager*

### Read-Rite

Steve Kirkwood

Dennis Kragelund  
*Equipment Specialist*

### Robertson Steplers & Company

Gus Richard  
*Junior Analyst*

### RoiTech

Michael Hess  
*President*

### Rudolph Research

Richard Budzinski  
*Director of Sales*

### RVSI

Earl Rideout  
*Vice President/General Manager*

### SAES Pure Gas, Inc.

Francesco Della Porta  
*CEO*

### Samsung Semiconductor, Inc.

J.R. Lee  
*Planning Manager*

### Schumacher

Lita Shon  
*Technical Marketing Manager*

### Sematech

Dick Deininger  
*Director of National Resource*  
James Ownes  
*Chief Operating Officer and Exec. VP*  
Ray Vora  
*Equipment Analyst*  
Conrad Sorenson  
*Process Materials Manager*

### Siemens Components, Inc.

Tom Sennhauser  
*Director of Marketing*

### Silicon Valley Group

Rick LaFrance  
*Vice President, Marketing*

### Siliconix

Mike Chang  
*Senior Director*

### Siltex Corporation

Arden Anderson  
*Director*

### Solectron

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*Senior Analyst*  
Larry Supan  
*Worldwide Commodity Manager*

### Solitec Wafer Processing, Inc.

William Parrette  
*President, CFO*

### Sony Microelectronics

Armando Iturralde  
*Engineer*

### Sumitomo Sitix Corporation

Akihiko Tamura  
*General Manager, Intl. Marketing*



---

## Attendees

### **Sutro & Company**

Susan Barney  
*Analyst*

### **SVG Lithography Systems Inc.**

Victor Bunze  
*Director, Marketing*

### **Swagelok Company**

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*Marketing Manager-Far East*

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*Vice Chairman*  
Talat Hasan  
*Vice President*  
Jon D. Tompkins  
*President/CEO*

### **Texas Instruments**

Ashwin Shah  
*Director, Semiconductor Process  
Ctr.*  
Perry Skelton  
*FAB Design Manager*

### **Therma-Wave, Inc.**

Dr. W. Lee Smith  
*Vice President, Marketing*

### **Toshiba America Elect. Components**

Allan Cox  
*Vice President, Technology*

### **Ultratech Stepper, Inc.**

Daniel Berry  
*Senior Vice President*  
Sue Billat  
*Contractor-Benchmark Strategies*  
Joe Nava  
*Vice President, Worldwide Sales*

### **Union Bank**

John Hein  
*Senior Vice President and Manager*

### **UNIX Review**

Andrew Binstock  
*Editor-in-Chief*

### **U.S. Department of Commerce**

Paul Barry  
*Trade Specialist*  
Marge Donnelly  
*Director*

### **USL Capital**

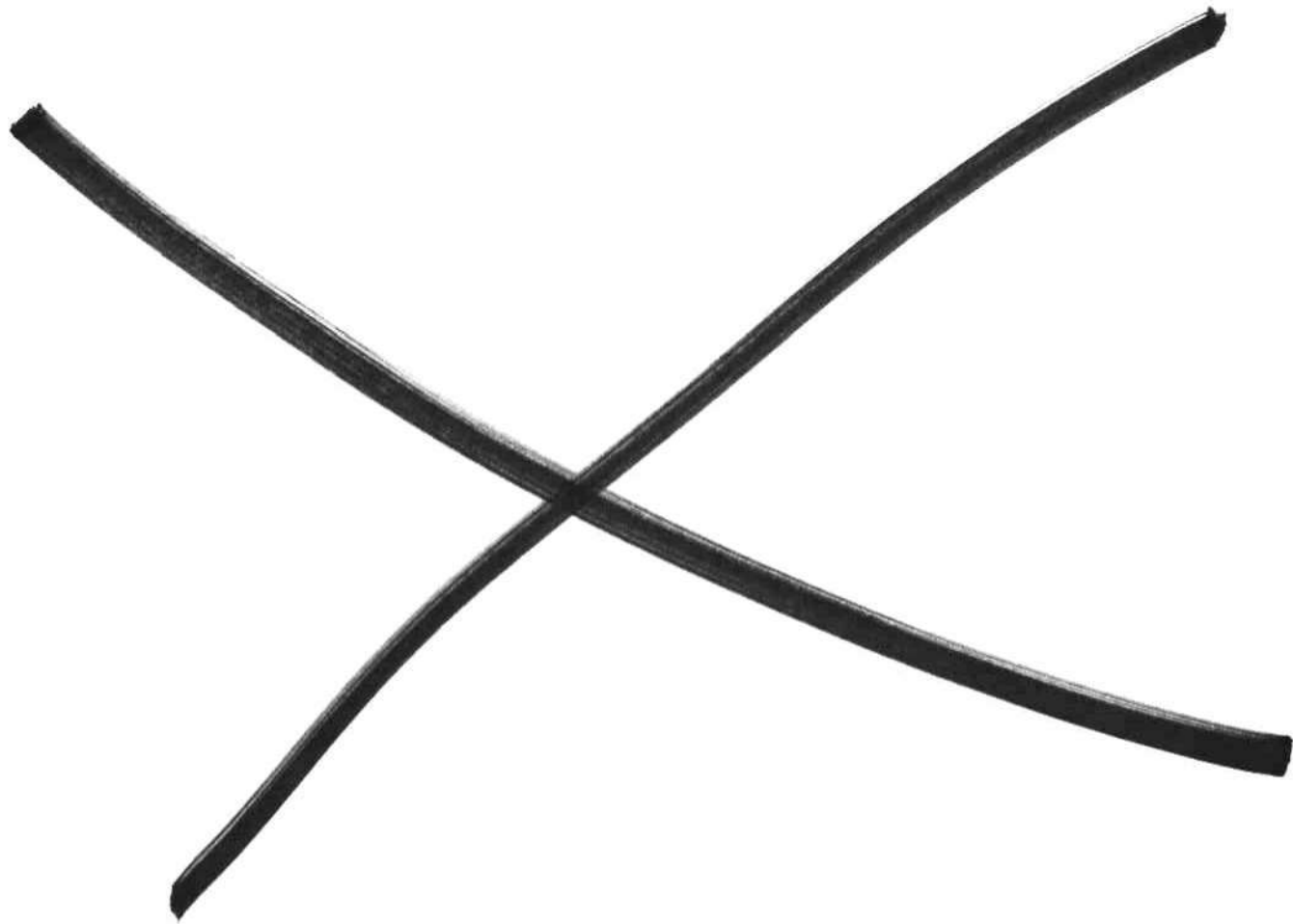
Colleen Lusian  
*Manager, Residual Group*

### **Varian**

Van Vo  
*Project Coordinator*

### **Watkins-Johnson Company**

Kurt Lightfoot  
*Director, Marketing*



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**Joseph Grenier**

*Vice President*

*Semiconductor Manufacturing and Applications Service*

*Semiconductors Group*

*Dataquest Incorporated*



Mr. Grenier is Vice President of Dataquest's Semiconductor Manufacturing and Applications group. He is responsible for managing the research activities of the Semiconductor Equipment, Manufacturing, and Materials service; the Semiconductor Application Markets service; and the Semiconductor Procurement service. In addition, he is responsible for promoting consulting activity and new product ideas for the Worldwide Semiconductors group.

Prior to joining Dataquest, Mr. Grenier was Product Marketing Manager at GCA Corporation where he managed marketing activities for the reactive ion etch program. He was also International Marketing Manager at GCA and was responsible for the overseas marketing of wafer-processing equipment. Previously, he worked as a Product Manager at Varian Associates/Instrument Division, as a Systems Engineer at the USAF Satellite Test Center, and as a Test Engineer at General Motors' Noise Vibration Laboratory.

Mr. Grenier received a B.S.E.E. degree from the University of Detroit and an M.B.A. degree from the University of Santa Clara.

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**Notes:**


**Notes:**

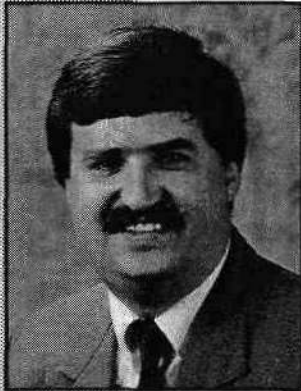

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## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

### Clark J. Fuhs

*Senior Industry Analyst  
Semiconductor Equipment, Manufacturing, and Materials Service  
Semiconductors Group  
Dataquest Incorporated*

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Mr. Fuhs is a Senior Industry Analyst for Dataquest's Semiconductor Equipment, Manufacturing, and Materials service in the Semiconductors group. He is responsible for research and analysis of semiconductor materials and trends in IC manufacturing techniques along with forecasting capital spending and the wafer fab equipment market.

Prior to joining Dataquest, Mr. Fuhs was Strategic Marketing Manager for Genus Inc., a manufacturer of advanced chemical vapor deposition (CVD) and high energy ion implantation equipment. During his 10 years at Genus, he held positions of Product Manager, several responsibilities in Product Marketing, and Process Engineer in the metal CVD group. In his most recent position, Mr. Fuhs was responsible for correlating process techniques with demand for equipment and materials. He has been involved with the Modular Equipment Standards Committee of SEMI, a trade organization, as chairman of a task force, authoring a standard. His experience also includes Chevron Oil, where he was a Process Engineer in the Richmond, California, refinery responsible for the hydrogen manufacturing plant.

Mr. Fuhs earned a B.S. degree in Chemical Engineering from Purdue University in West Lafayette, Indiana, and received an M.B.A. degree from the University of California at Berkeley.

## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

### Agenda

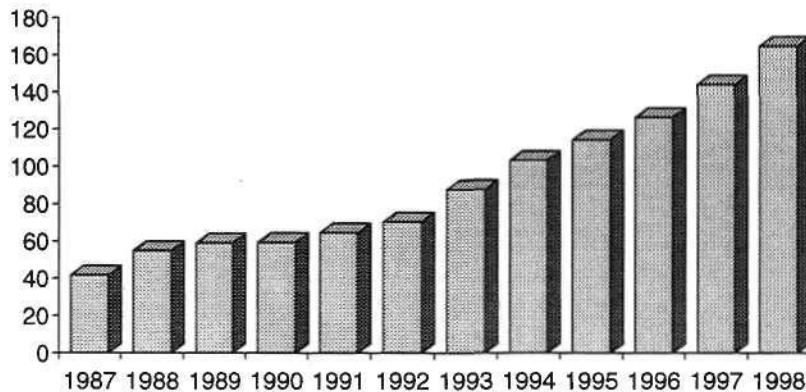
- Semiconductor production
- Capital spending trends and drivers
- Wafer fab equipment forecast
- Has underinvestment been corrected?
- Enter the 200mm wafer era

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G4003792

### Estimated Semiconductor Production Worldwide

Billions of Dollars



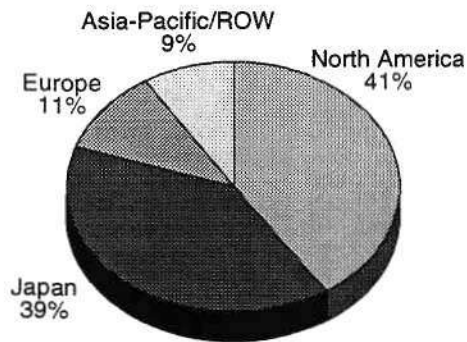
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Source: Dataquest

## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

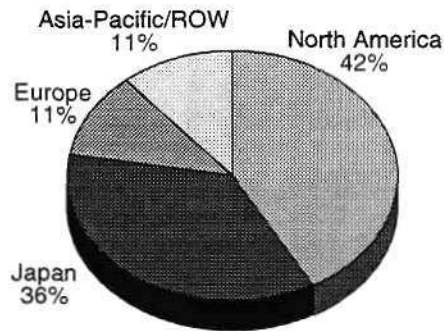
### Regional Semiconductor Production Trend



1993 Production = \$87.7 Billion

**Dataquest**

G4003794



1998 Production = \$164.7 Billion

Source: Dataquest

### Capital Spending Summary

- Worldwide growth of 36.6 percent
- Asia/Pacific and Japan leading the way
- Japanese companies
  - Investing heavily despite the domestic economy
  - Filling the empty buildings with equipment
- North American investment sustained
- Second-tier companies participating in every region

**Dataquest**

G4003795



## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

### Capital Spending Drivers

- DRAMs, DRAMs, and DRAMs
  - Korean spending up 75 percent
  - Incremental Japanese spending concentrated on 16Mb DRAM
- Foundry capacity
  - Evolution of dedicated contract manufacturing
  - Taiwan and Singapore spending triples to \$1.2 billion
- Logic/ASIC demand spurring North American strength
- Second-tier company profitability

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G4003796

### Top 10 Capital Spenders in 1994

1994 Rank	1993 Rank		1994 Projected Spending (\$M)	Percentage Change from 1993
1	1	Intel	2,300	35
2	2	Motorola	1,470	34
3	7	Samsung	1,000	59
4	3	Hitachi	954	23
5	5	Fujitsu	924	32
6	6	NEC	845	21
	4	Toshiba	845	17
8	12	Goldstar	800	100
9	8	Texas Instruments	780	43
10	9	SGS-Thomson	750	56

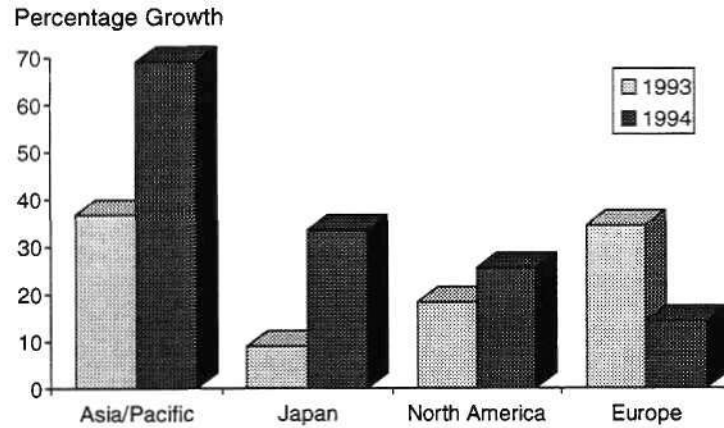
**Dataquest**

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Source: Dataquest

# Wafer Fab Equipment Forecast: How Long Will the Boom Last?

## Regional Capital Spending Summary

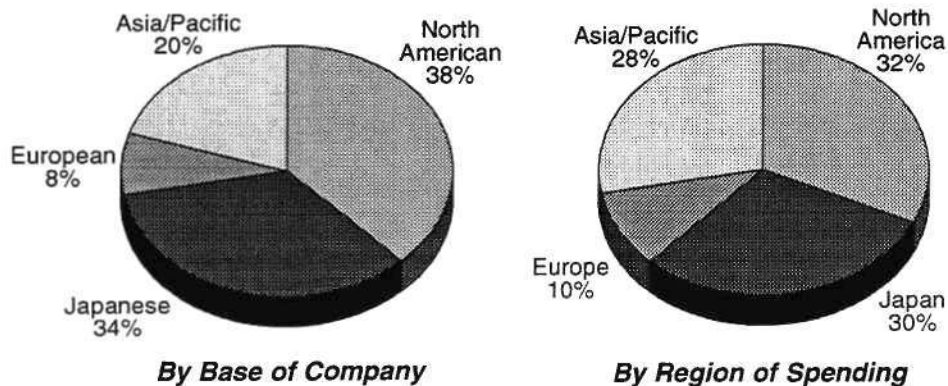


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## 1994 Regional Capital Spending



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Source: Dataquest

## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

### 1994 Wafer Fab Equipment Market Summary

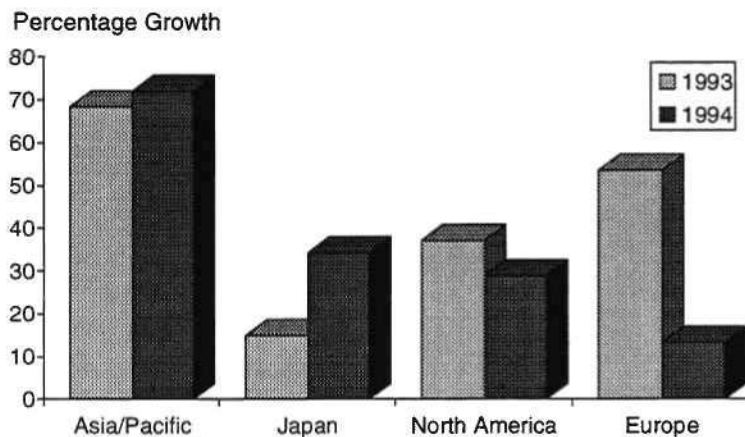
- Completed a strong year 1993—up 35%
- This year will be stronger
- Forecasting growth of 37 percent in a range of 35 to 45
- DRAM-sensitive segments will be favored
  - Steppers and track
  - Tube CVD
  - High voltage and high current implant
  - Polysilicon etch
  - Diffusion

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Source: Dataquest

### Regional Wafer Fab Equipment Summary



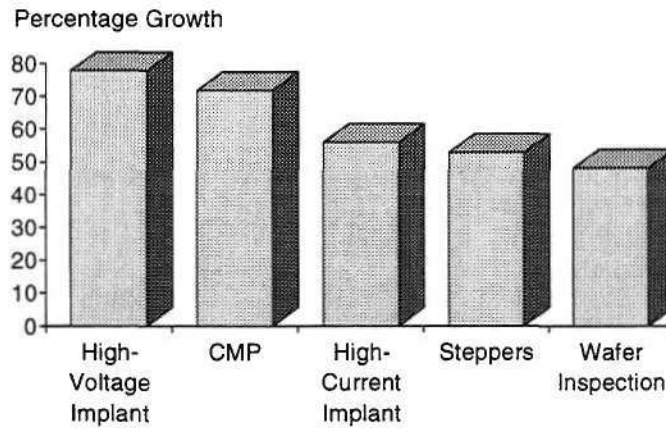
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Source: Dataquest

## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

### Fastest-Growing Equipment Segments in 1994

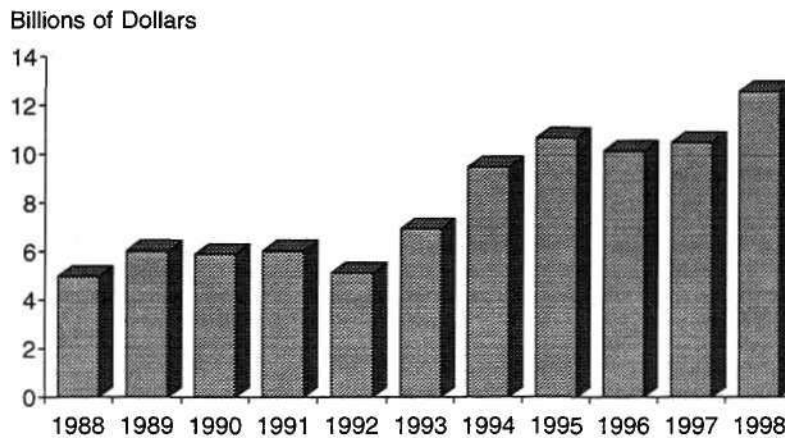


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G4003802

Source: Dataquest

### Worldwide Wafer Fab Equipment Forecast



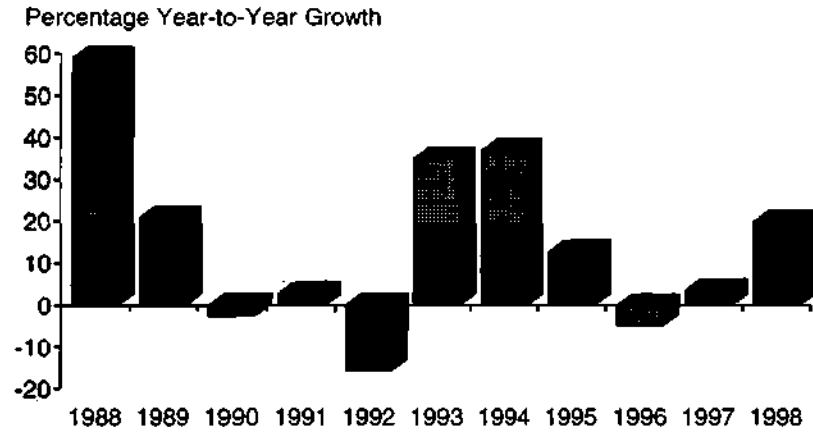
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G4003803

Source: Dataquest

# Wafer Fab Equipment Forecast: How Long Will the Boom Last?

## Wafer Fab Equipment: Year-to-Year Percentage Changes

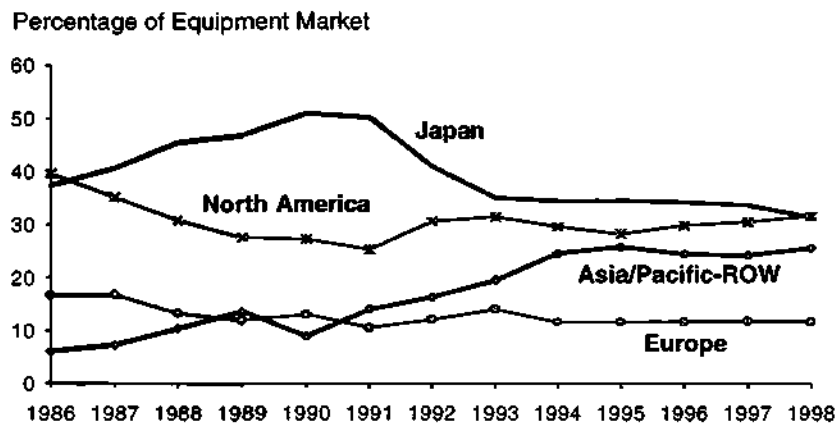


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## Wafer Fab Equipment Market by Region



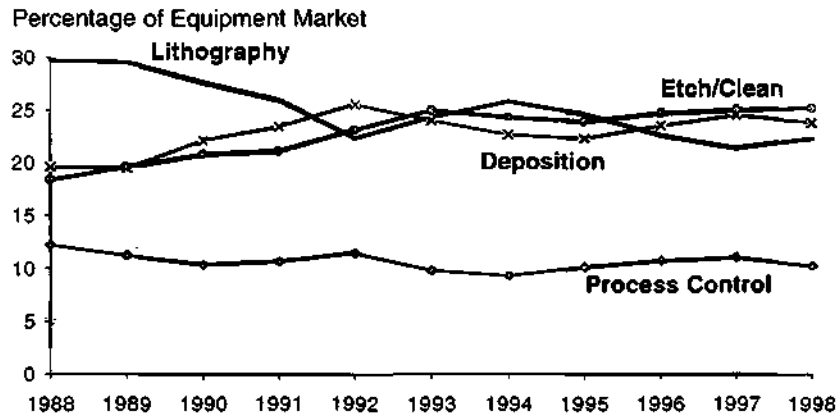
**Dataquest**

G4003805

Source: Dataquest

## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

### Equipment Segment Trends and Forecast



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Source: Dataquest

### Wafer Fab Equipment Forecast: Summary

	1994	1995	1996
Wafer Fab Equipment (\$M)	9,463	10,660	10,132
Growth (Percent)	37	13	-5
Regional Growth (Percent)			
North America	29	8	0
Japan	34	13	-6
Europe	13	12	-4
Asia/Pacific-ROW	72	18	-10

Dataquest

G4003807

Source: Dataquest

## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

### *Overinvestment versus Underinvestment: Methodology*

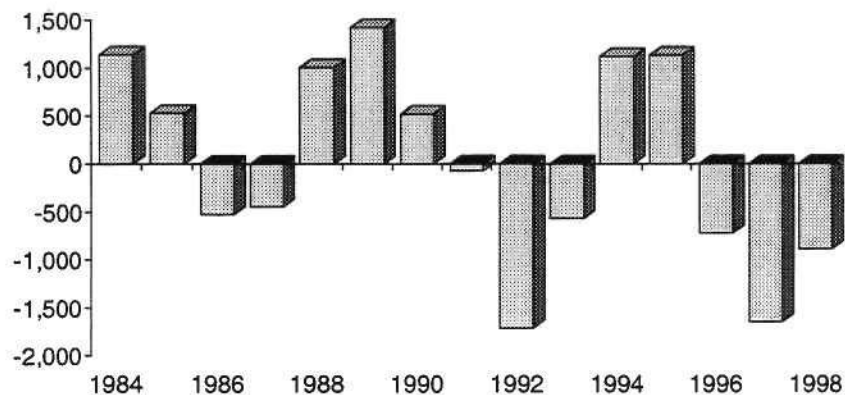
- Objective: quantify degree of capacity constraint/excess
- Long-term growth rates for semiconductors and wafer fab equipment are correlated
- Industry cycles through over- and underinvestment
- Net cumulative investment equals zero over time
- Model developed correlating historical information
  - Results presented are calculations from established forecast
  - No predictive component from this methodology included in forecast model

**Dataquest**

G4003808

### *Dollar Value Over- and Underinvestment in Equipment*

Millions of Dollars



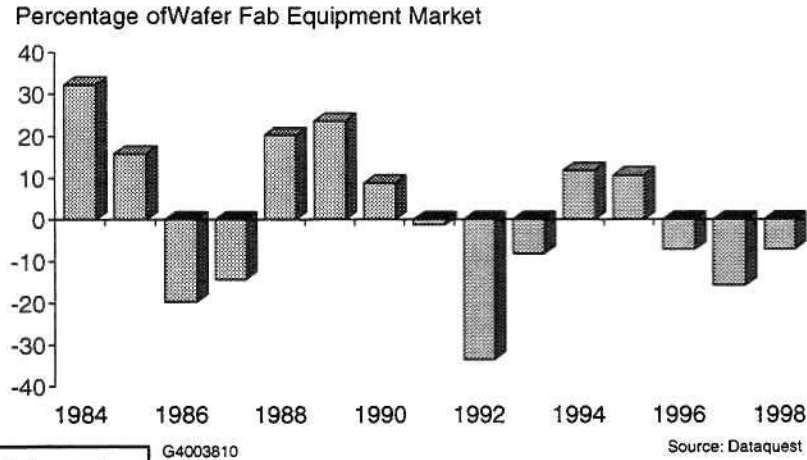
**Dataquest**

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Source: Dataquest

## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

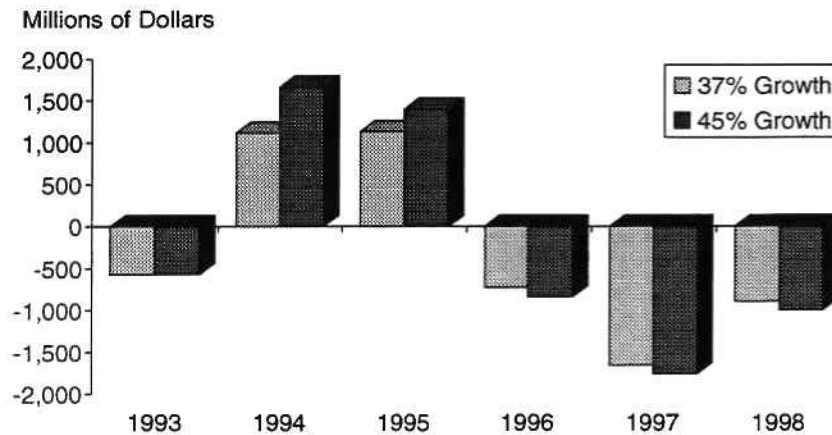
### Over- and Underinvestment as a Percentage of Equipment Market



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### Net Dollar Value Investment: 37% versus 45% Equipment Growth in 1994



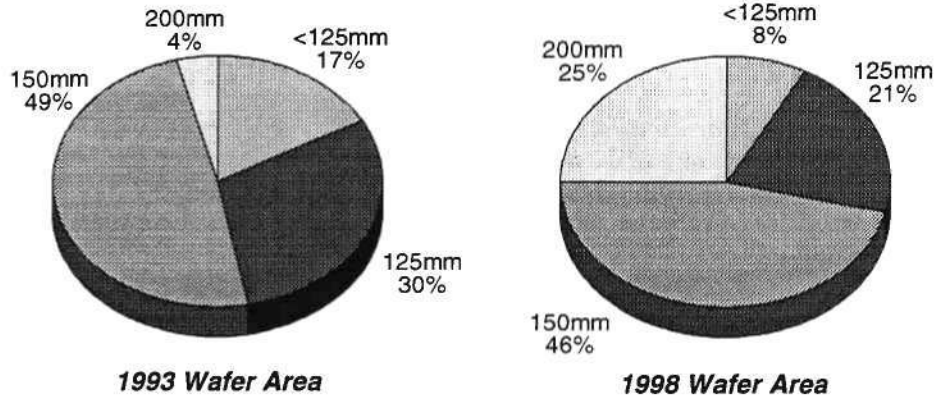
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## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

### Wafer Size Distribution Forecast: 200mm Ramp Becomes Reality



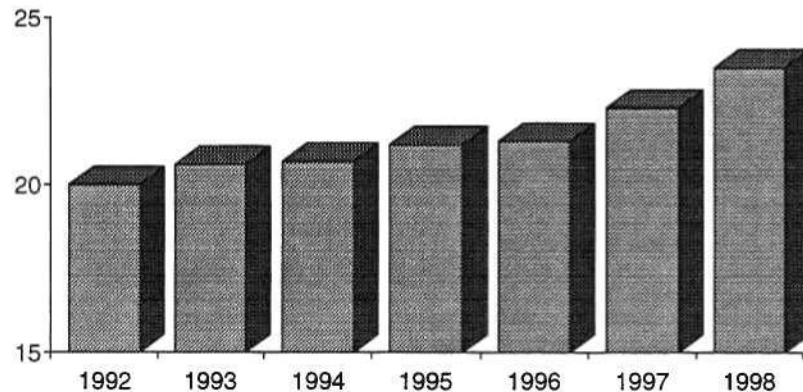
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Source: Dataquest

### Test/Monitor Wafers Seeing Higher Use as 200mm Diameter Increases

Percentage Silicon Area



Dataquest

G4003813

Source: Dataquest

## Wafer Fab Equipment Forecast: How Long Will the Boom Last?

### Summary

- 1994 will be the peak growth year for equipment
- DRAM expansion frenzy is in full swing
- Asia/Pacific and Japan are leading the way
- Momentum will mean growth in 1995
- By the end of the year, semiconductor manufacturers will be at least \$1.1 billion overinvested in equipment
- Look for a modest decline in 1996 with a flat 1997
- Next spending cycle starts in late 1997 into 1998

**Dataquest**

G4003614

Source: Dataquest

### Acknowledgments

- Kunio Achiwa
- Terrance A. Birkholz
- Calvin Chang
- Joe Grenier
- Dan Heyler
- Sarah Jacob
- Mario Morales
- Näder Pakdaman
- Yoshihiro Shimada

**Dataquest**

G4003615





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## The Interplay between IC Process Trends and Advanced Equipment

### Calvin Y. Chang

*Industry Analyst*

*Semiconductor Equipment, Manufacturing, and Materials Service*

*Semiconductors Group*

*Dataquest Incorporated*



Mr. Chang is an Industry Analyst in the Semiconductor Equipment, Manufacturing, and Materials service of the Semiconductors group.

Prior to joining Dataquest, Mr. Chang performed research on the kinetic studies of deposition and etch processes in semiconductor fabrication at Stanford University. His research led to numerous publications in the areas of LPCVD, PECVD, sputter etch, and high-density plasma processes. Mr. Chang also has a diverse range of experiences that include semiconductor process development, CAD tools design (the Boeing Co.), and corporate strategic planning.

Mr. Chang earned B.S. degrees, with distinction, in Physics, Mathematics, and Computer Science from the University of Washington and a Ph.D. in Materials Science and Engineering with a minor in Electrical Engineering from Stanford University (Summer 1994).

## The Interplay between IC Process Trends and Advanced Equipment

### *IC Process Trends...*

- Common technology drivers
  - Lithography
  - High-density etch
  - Wafer size
  - Mix-and-match manufacturing
- Technology roadmap divergence
  - Microprocessors
  - DRAM

**Delquest**

04003807

### *... and Equipment Trends*

- Performance
  - Process specifications
- Cost of ownership
  - Equipment cost
  - Productivity: throughput and yield
  - Reliability
  - Maintenance
  - User-friendliness: software

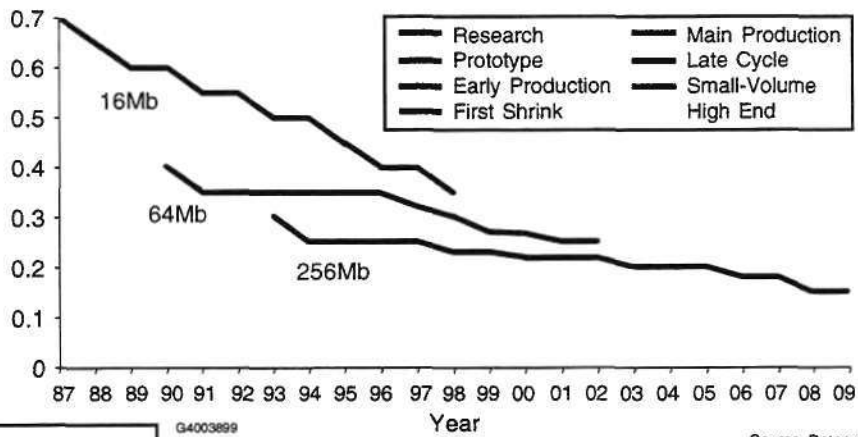
**Delquest**

04003808

# The Interplay between IC Process Trends and Advanced Equipment

## Lithography

Feature Size (Microns)



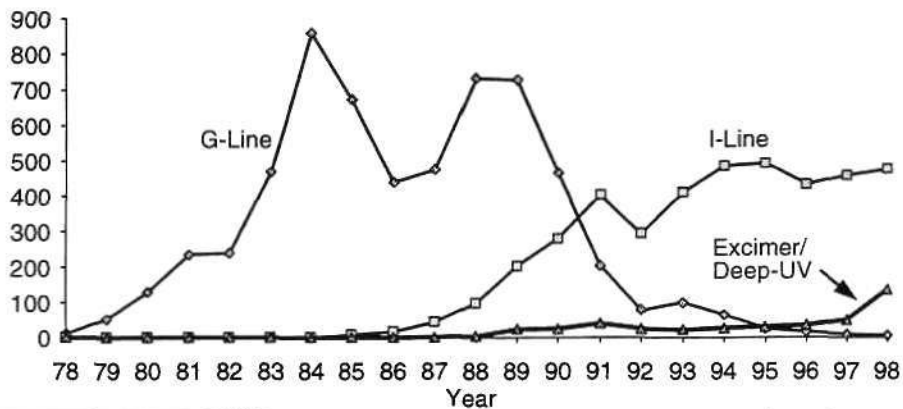
Dataquest

G4003899

Source: Dataquest

## Lithography Will Be I-Line and Some Deep-UV

Units



Dataquest

G4003900

Source: Dataquest

## The Interplay between IC Process Trends and Advanced Equipment

### *High-Density Plasma Is the Way of the Future for Dry Etch*

- High-density plasma reactors
  - Low-pressure, high ion density
  - ECR, Helicon, TCP, ICP, HRe
  - Selectivity and microloading
  - Poly etch: DRAM applications
  - Oxide and metal etch: logic applications
- System issues
  - Higher equipment cost
  - Software sells equipment

**Discontinued**

04003901

### *Mix-and-Match Manufacturing Is a Viable Cost-Control Solution*

- Realistic solution to abating escalating equipment costs
  - Lithography: a key strategy with growing implementation
  - Etch: high-density and low-density etch
- Mix:
  - High-end equipment for critical processes
  - A combination of high-end and lower-cost equipment

**Discontinued**

04003902



## The Interplay between IC Process Trends and Advanced Equipment

### *Match Is Essential to Mix-and-Match*

- Match: equipment compatibility
  - Lithography: alignment and field size
  - Etch: environmental
  - User-specific "matchability" information

**Datquest**

G4003903

### *Next Wafer Size Is Critical for the Future of the Equipment Industry*

- Wafer sizes
  - 300mm (+ 125%) → 400mm (+ 300%)?
  - 350mm (+ 200%)?
- There is no consensus
  - Consensus among equipment, materials suppliers, and device manufacturers a must

**Datquest**

G4003904

## The Interplay between IC Process Trends and Advanced Equipment

### *Next Wafer Size? Who's Going to Pay for It?*

- Costs/risks/benefits analysis
  - Wafer costs, process uniformity, equipment development
  - Benefits: larger die and more units per wafer
- Equipment development
  - Development will be long and costly
  - Multinational organization of industry consortia taking leadership
  - Cost sharing

**Deloitte**

G4003805

### *Microprocessor and DRAM Have Different Technology Requirements*

- Microprocessor/logic
  - Multilevel interconnection
  - Planarization, metallization material and processes
- DRAM
  - Capacitor structure and dielectric materials

**Deloitte**

G4003906

## The Interplay between IC Process Trends and Advanced Equipment

### *Microprocessor Roadmap*

- Multilevel interconnection
  - Driving forces
    - Increasing device packing density
    - Signal routing: performance
- Planarization
  - Limited by lithography depth of focus
  - Decoupling local from global planarization

**Delmont**

G4002907

### *Local Planarization Is Filling Gaps*

- Local planarization: gap fill
  - Dep/etch/dep
  - SOG and new SOG
  - HDP oxide (simultaneous dep/etch)
  - APCVD/SACVD oxide
- New materials
  - Material properties
    - Moisture resistance, breakdown voltage, low dielectric constant

**Delmont**

G4002908

## The Interplay between IC Process Trends and Advanced Equipment

### *Global Planarization Is by CMP... and Some SOG?*

- Chemical mechanical polishing (CMP)
  - Critical technology enabler
  - Explosive growth potential
    - Equipment sales grew by 160% in 1993
    - Few vendors
  - In production but technical problems abound
    - Process characterization and calibration
    - End-point detection, pad conditioning, slurries
    - Process ownership currently resides with device manufacturers
- SOG beyond 0.5-micron ?

**Dataproject**

04003906

### *Metallization Will Likely Be PVD with CVD Gaining Greater Interest...*

- Interconnect deposition
  - Hot or reflow PVD Al/Si/Cu metallization
- Barrier and adhesion layer
  - Step coverage at 0.35-micron and below
    - CVD TiN and Ti
- Contact/via plugs
  - CVD W

**Dataproject**

04003910

## The Interplay between IC Process Trends and Advanced Equipment

### *... and Some Using Copper?*

- Copper
  - Still in research stage
    - Complex processing issues
      - Diffusion barrier
      - No dry etch
  - Process development cost

**Datquest**

G4003911

### *Intermetal Dielectric— Will It Still Be Oxide?*

- Oxide is robust except dielectric constant
  - Other materials?
    - Parylene, polyimide, teflon
- Damascene process
  - More oxide etch and less metal etch
  - Less metal patterning, less ARC
  - Oxide etch becomes more critical
    - Selectivity, etch stop required?
    - Microloading, pattern sensitivity

**Datquest**

G4003912

## The Interplay between IC Process Trends and Advanced Equipment

### *Besides CD, DRAM Roadmap Is Mostly about Capacitor Material and Structure*

- Dielectric materials
  - High dielectric constant is a must at 256Mb
  - Process feasibility
- Capacitor cell structure
  - Stacked capacitor is primary design for 16Mb and beyond

**Datquest**

G4003913

### *Other DRAM-Sensitive Technologies*

- Vapor phase cleaning
- $WSi_x$  CVD
  - DCS replaces silane
    - Step coverage and lower fluorine content
- High-voltage implant at 0.5-micron and beyond
  - Retrograde wells
  - Buried layer

**Datquest**

G4003914

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## The Interplay between IC Process Trends and Advanced Equipment

### *Dataquest Conclusions*

- Equipment trends today and the future
  - Performance and cost-of-ownership
- Cost control: mix-and-match moves beyond lithography
- Wafer size: looking for leadership
- Roadmap divergence: MPU/DRAM
- MPU/logic/ASIC: planarization and metallization
- DRAM: capacitor structure and dielectric materials

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04009/15







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## **Semiconductor Fabs: Why, Where, and What?**

### **Näder Pakdaman**

*Senior Industry Analyst  
Semiconductor Equipment, Manufacturing, and Materials Service  
Semiconductors Group  
Dataquest Incorporated*



Mr. Pakdaman is a Senior Industry Analyst for Dataquest's Semiconductor Equipment, Manufacturing, and Materials service in the Semiconductors group. He is responsible for research and analysis of semiconductor equipment and trends in IC manufacturing techniques with a specific focus on the lithography segment.

Prior to joining Dataquest, Mr. Pakdaman was at IBM T.J. Watson Research Center and IBM East Fishkill. His responsibilities included fast optoelectronic testing and qualification of advanced optical lithography systems.

Mr. Pakdaman has B.S. degrees in Mathematics and Physics and an M.S. degree in Electrical Engineering from Purdue University. He was a doctoral candidate at Columbia University in Applied Physics prior to joining Dataquest.

## Semiconductor Fabs: Why, Where, and What?

### Why All the New Fabs?

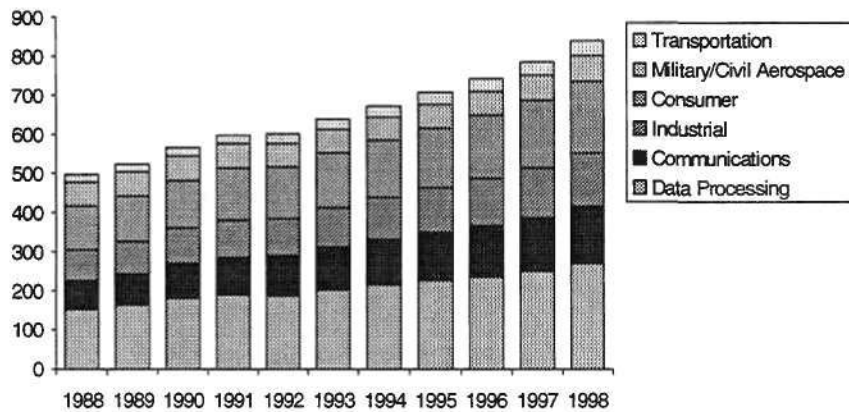
- Worldwide electronic market
- MPU production
- PCs
- DRAM
- Capital spending
  - Patterns of spending
  - Fabless/foundry influence

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### Worldwide Electronic Equipment Production Revenue Forecast

Billions of U.S. Dollars



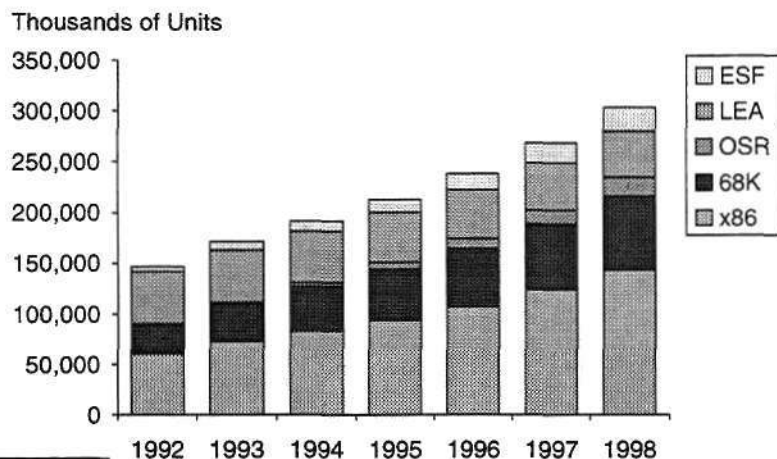
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Source: Dataquest

## Semiconductor Fabs: Why, Where, and What?

### MPU Product Forecast



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Source: Dataquest

### Digital Microcomponent

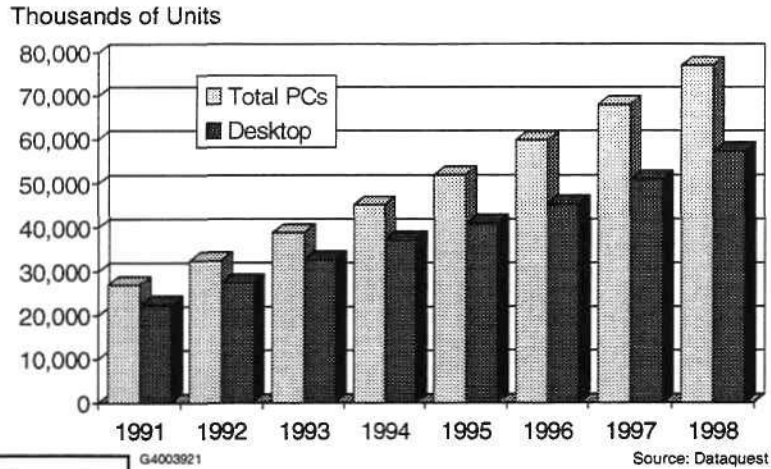
- Microprocessor (MPU)
  - Market controlled by Intel, other players are supply constrained
  - 8-inch wafer driver in logic
  - High-end geometries will be  $<0.5\mu\text{m}$  in 1995
- Microcontroller (MCU)
  - Market controlled by Motorola, and is supply constrained
  - 1.2- to  $1.6\mu\text{m}$  geometries, some will go to  $0.9\mu\text{m}$
  - Migration from 8-bit to 16-bit
- Microperipheral (MPR)
  - Market is fragmented, demand-constrained
  - High-volume gate arrays
  - 0.8- to  $1\mu\text{m}$  geometries

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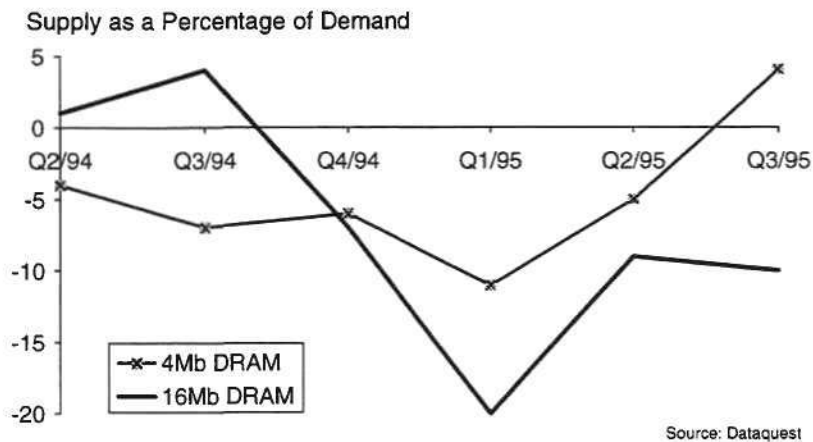
## Semiconductor Fabs: Why, Where, and What?

### PC Unit Forecast



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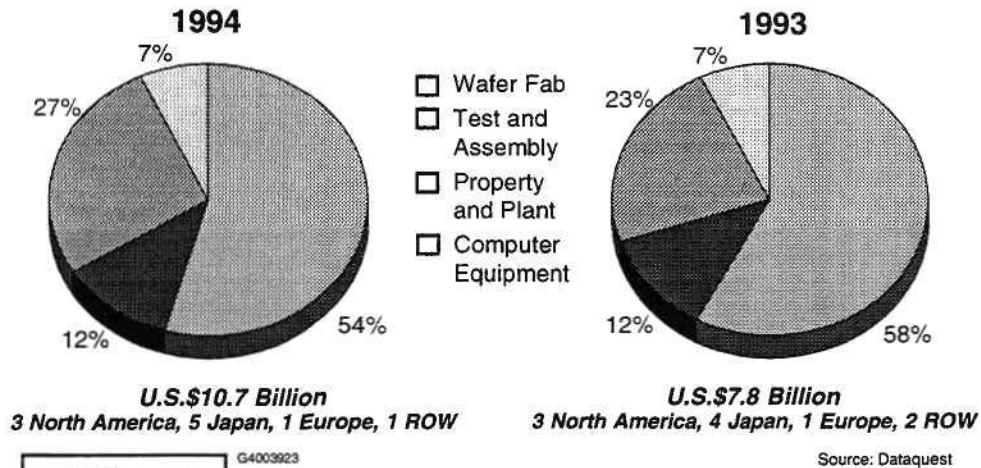
### DRAM Supply versus Demand: The Scenario Six Months Ago



Dataquest

## Semiconductor Fabs: Why, Where, and What?

### Capital: What Did the Top 10 Spenders Do?



### Ramp-Up Patterns

- North America
  - Start with pilot and gradual ramp-up
- Japan
  - A commodity manufacturer in transition
  - Recently has built massive empty shells and ramp-up as demand dictates
- Europe
  - Many expansions as capital spending has increased
- ROW
  - Massive spending in all areas, new facilities
  - Dynamic, could fluctuate with demand shifts

## Semiconductor Fabs: Why, Where, and What?

### *A Rising Star: Fabless/Foundry*

- Fabless companies' share of worldwide semiconductor revenue:
  - 3.7% (1993) to 5.0% (1998)
- Approximately 30% of this revenue will go to foundries
- ROW is the most foundry-sensitive region
- Taiwan and Singapore capital spending:
  - U.S.\$400 million (1993) to U.S.\$1.2 billion (1994)
  - Higher percentile in nonwafer fab equipment

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### *Where Are the 8-Inch and 6-Inch?*

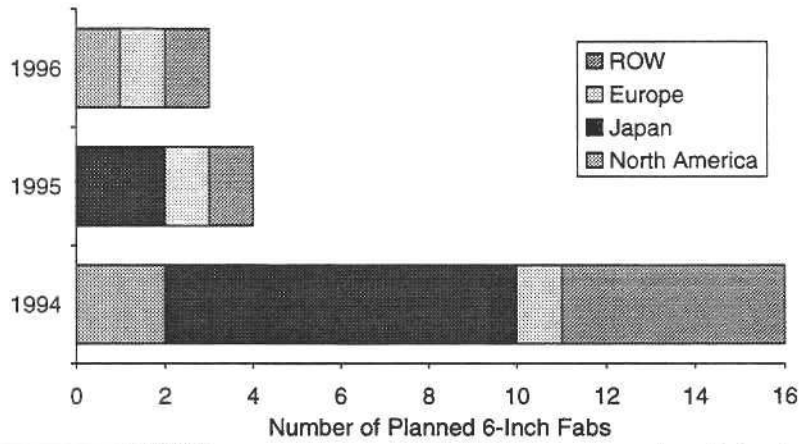
- 6-inch planned fabs
- 8-inch past, present, and future
- 6-inch and 8-inch capacity comparison

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## Semiconductor Fabs: Why, Where, and What?

### 6-Inch Planned Fabs

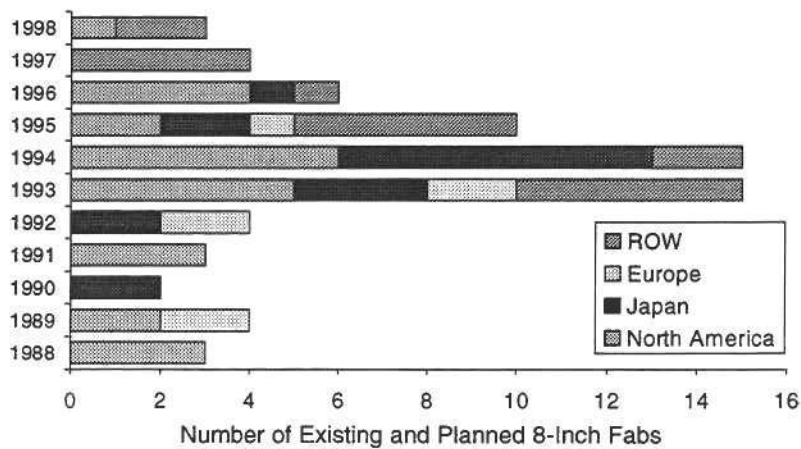


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Source: Dataquest

### 8-Inch Fabs



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Source: Dataquest



## Semiconductor Fabs: Why, Where, and What?

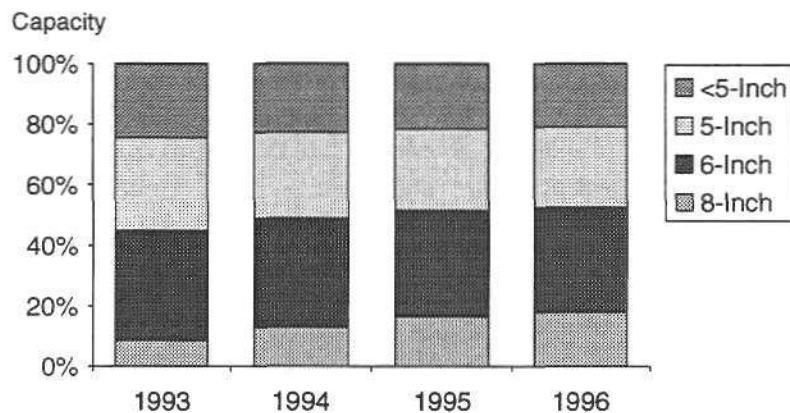
### Notes on 6-Inch and 8-Inch Fabs

- 6-inch fabs
  - There will be more capacity expansions than new fabs
  - Most activity is in the low end
  - Expect ROW activity to be much higher
- 8-inch fabs
  - Our window is more clear through 1995
  - Today's scenario shows ROW highly active beyond 1995
  - Expect upgrades as 8-inch matures

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### Fab Capacity by Wafer Size



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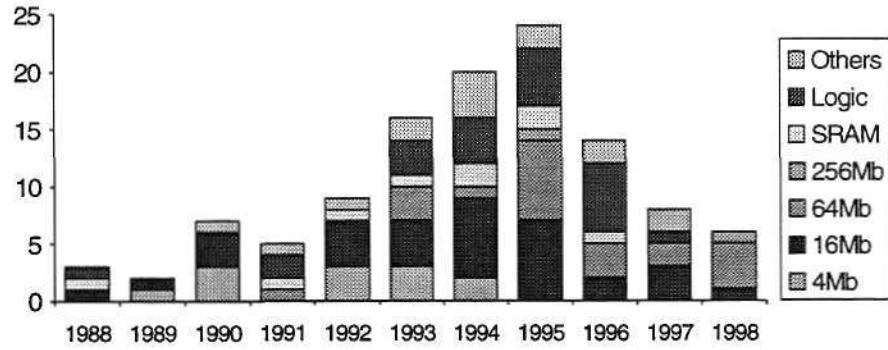
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Source: Dataquest

## Semiconductor Fabs: Why, Where, and What?

### What Are the 8-Inch Product Lines?

Number of Lines per Year

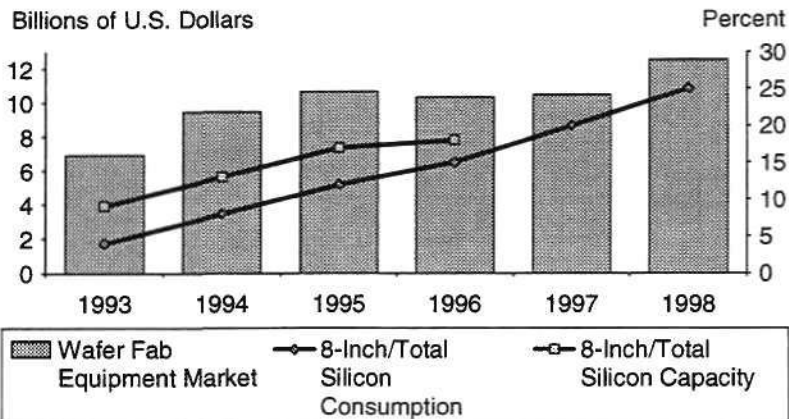


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Source: Dataquest

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### All in One... Pattern Recognition



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Source: Dataquest

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## Semiconductor Fabs: Why, Where, and What?

### *A Glimpse of the Future*

- End-user market is strong
- 8-inch will be gaining ground on 6-inch after 1994
- Expansions of 8-inch fabs have begun
- North American logic driving 8-inch fabs
- Japan is clearly on the upswing for 16Mb and...
- Asia/Pacific is a region to watch for equipment purchase in 1995
- Capital spending/capacity/consumption comparison show tight capacity developing in 1997

**Dataquest**

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### *Contributors*

- Kunio Achiwa
- Jerry Banks
- Terry Birkholz
- Calvin Chang
- Dale Ford
- Clark Fuhs
- Mark Giudici
- Ken Lowe
- Mario Morales
- Nhat Pham



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## **Chips, Chips, and More Chips—Toward a \$200 Billion IC Market**

### **Ronald A. Bohn**

*Senior Industry Analyst  
Memories Worldwide  
Semiconductors Group  
Dataquest Incorporated*



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Mr. Bohn is a Senior Industry Analyst for Dataquest's Semiconductor Memories Worldwide service. He is responsible for research and analysis in semiconductor memory pricing, supplier, and product technology trends including DRAMs and flash ICs. His responsibility includes strategic planning, competitive analysis, and consulting projects. He works with securities companies, banks, and other members of the financial community on semiconductor trends and also tracks world trade, intellectual property, and related legal trends for their impact on the electronics industry. At Dataquest he has forecast pricing of more than 100 semiconductor products.

Mr. Bohn has written a series of reports on benchmarking and has assessed semiconductor life cycles from a component engineering perspective. This research served as a basis for Dataquest's PC "teardown" cost analysis. At Dataquest, he has also served as the analyst tracking semiconductor trends in the interactive CD-ROM player and PCMCIA markets.

Prior to joining Dataquest in the mid-1980s, Mr. Bohn assessed worldwide electronic markets on a macro- and microeconomic basis for a market research company. He served as International Market Research Manager for the Korea Trade Center in the United States and has financial, legal, and government experience.

Mr. Bohn received a B.A. degree from Cornell University, an M.B.A. degree from the University of California at Berkeley, and a J.D. degree from the Hastings College of Law.

## Chips, Chips, and More Chips—Toward a \$200 Billion IC Market

### Agenda

- The 1993 semiconductor market
- A look ahead to 1998-2000
- Road maps

Discussion

G4003266

### Three Main Points

**20** % semiconductor content

**& 200**

billion dollars in revenue for semiconductors

by the year **2000**

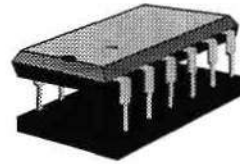
Discussion

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## Chips, Chips, and More Chips—Toward a \$200 Billion IC Market

### Highlights of 1993 Semiconductor Market

- 27.4% worldwide growth over 1992
- Memory and micro ICs account for 50% of semiconductors
- North American market grew by 31%
- Asia/Pacific-ROW market grew by 43%



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Source: Dataquest

### 1993 Worldwide Semiconductor Market Shares

1993 Rank	Company	1993 Market Share (%)	1993 Revenue (\$M)	1992 Revenue (\$M)	1992-1993 Growth (%)
1	Intel	9.3	7,970	5,091	57
2	NEC	7.2	6,141	4,869	26
3	Motorola	7.0	5,957	4,634	29
4	Toshiba	6.7	5,727	4,675	23
5	Hitachi	5.9	5,015	3,851	30
6	TI	4.8	4,083	3,087	32
7	Samsung	3.6	3,044	1,900	60
8	Fujitsu	3.4	2,928	2,533	15
9	Mitsubishi	3.3	2,823	2,213	28
10	IBM	2.9	2,510	-	-
	Others	24.8	39,263	32,407	22
Total with IBM		100.0	85,461	65,260	31.2
Total without IBM			83,131	65,260	27.4

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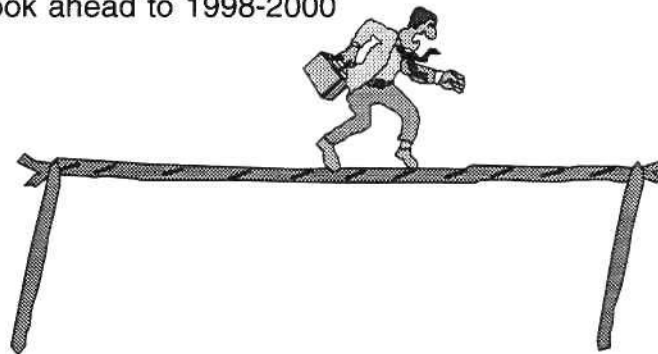
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Source: Dataquest

## Chips, Chips, and More Chips—Toward a \$200 Billion IC Market

### Agenda

- The 1993 market
- A look ahead to 1998-2000



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### What About the Silicon Cycle?

- Demand will stay strong through 1995
- Undercapacity for the foreseeable future
- Favorable economic outlook



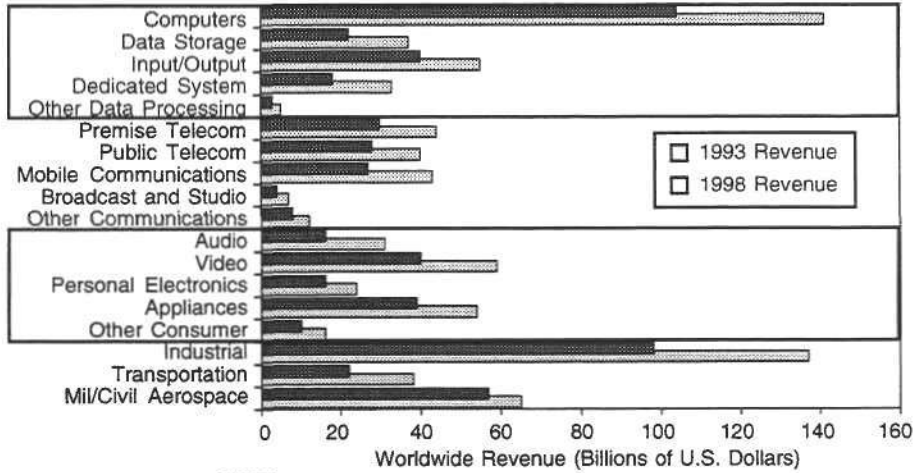
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# Chips, Chips, and More Chips—Toward a \$200 Billion IC Market

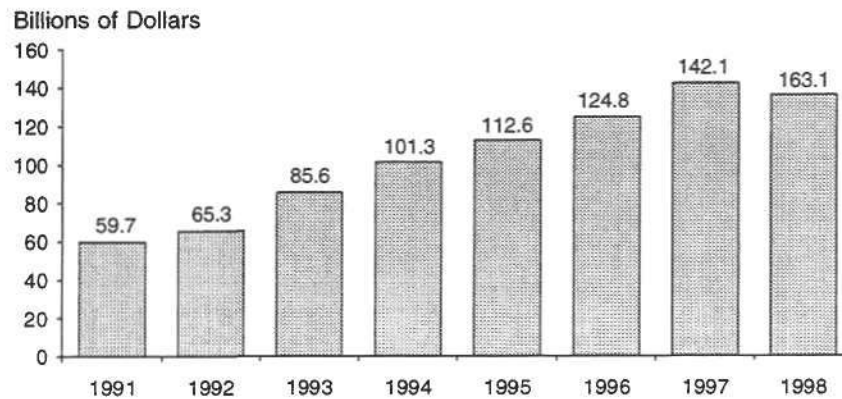
## Semiconductor Engines



G4003272

Source: Dataquest

## Worldwide Semiconductor Forecast



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Source: Dataquest

Dataquest

## Chips, Chips, and More Chips—Toward a \$200 Billion IC Market

### Forecast Assumptions

- Worldwide PC market growth (15%) drives market
- Japan will lose 4% of market per year to Asia/Pacific
- MPUs and memory SIMMs are increasingly added in local market (consumption spread among all 4 regions)
- MPR and MOS logic used on motherboard increasingly consumed in Asia/Pacific market

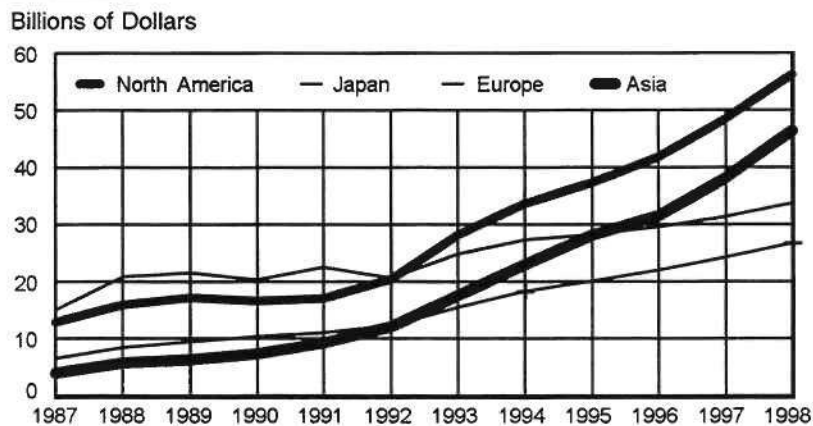


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Source: Dataquest

### Semiconductors by Region History/Forecast



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Source: Dataquest

## Chips, Chips, and More Chips—Toward a \$200 Billion IC Market

### *Highlights of Forecast*

- Asia/Pacific market passes Japan in 1995
- Microcomponents pass memory ICs in 1995
- Micros and memory ICs together will account for 60% of semiconductor market by 1998 (50% in 1993)

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Source: Dataquest

### *Agenda*

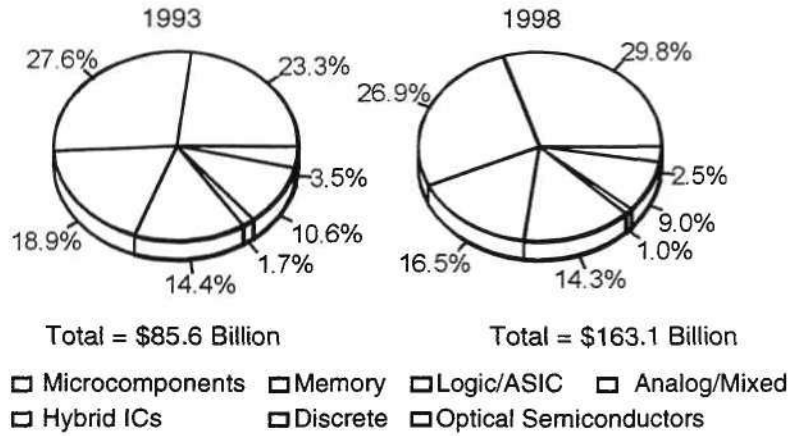
- Product road maps
- Microcomponents
- Memory

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# Chips, Chips, and More Chips—Toward a \$200 Billion IC Market

## Worldwide Forecast by Product



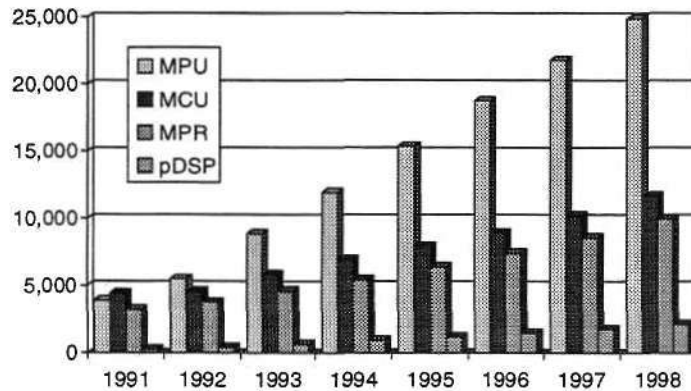
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Source: Dataquest

## Microcomponents Five-Year Forecast

Billions of Dollars



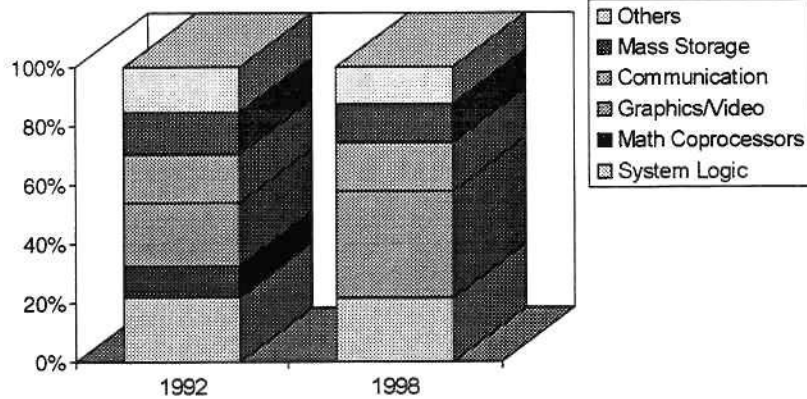
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Source: Dataquest

## Chips, Chips, and More Chips—Toward a \$200 Billion IC Market

### Microperipheral Product Forecast



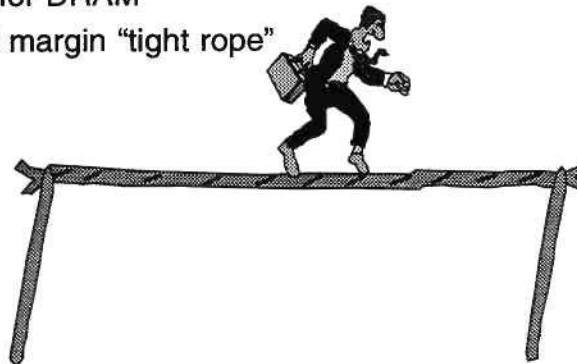
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Source: Dataquest

### Intel's on Top of the Hill

- Moore's law still applies
  - Except for DRAM
- Walk financial margin "tight rope"



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# Chips, Chips, and More Chips—Toward a \$200 Billion IC Market

## The DRAM Outlook

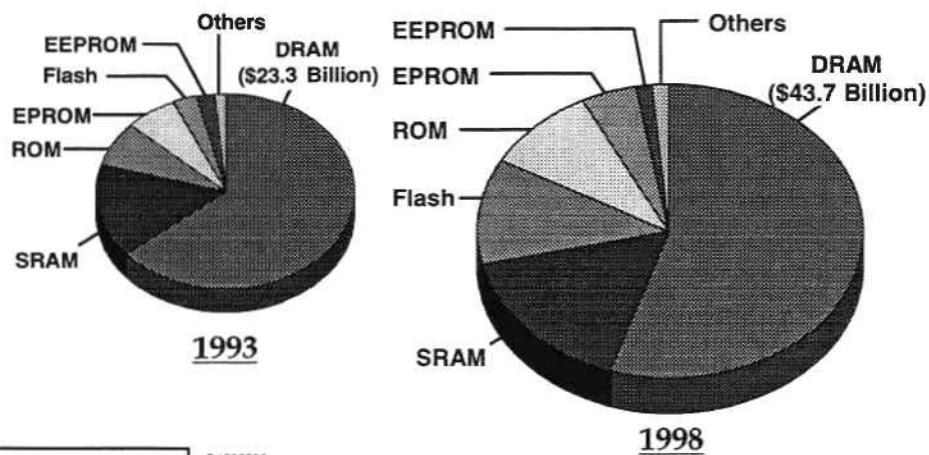
- PC market-driven
  - Strong through 1994—and 1995?
  - 70 million PCs by 1997
- New technologies
  - Extended Data Out (EDO)
  - Synchronous, Rambus, VRAM-replacement



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## MOS Memory Market, 1993-1998

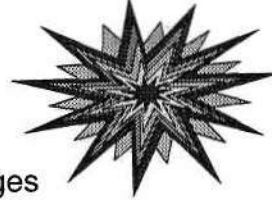


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## *Flash Memory Outlook*

- Technology standard battles
  - NOR versus NAND
  - Single versus multiple voltages
- Exploding market
  - 1993-1998: 47% annual growth rate
  - Applications profusion
  - Handheld system technology of choice



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## *Agenda*

- The 1993 semiconductor market
- A look ahead to 1998-2000
- Road maps

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## Chips, Chips, and More Chips—Toward a \$200 Billion IC Market

### *Dataquest Conclusion*

#### Semiconductor Industry—Megatrends 2000

- Total semiconductor market size: \$200 billion; total electronics industry: \$1 trillion
- \$5 billion to get into top 10 suppliers
- Asia/Pacific second largest market (\$50 billion), with China No. 1, followed by Taiwan and Korea
- Personal conferencing, personal communications, speech recognition appliances, virtual reality, home entertainment systems dominate the applications market

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Source: Dataquest





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## **PC and Mobile Computing: What's Hot for the Desktop?**

### **Philippe de Marcillac**

*Director and Principal Analyst  
Personal Computers Worldwide  
Dataquest Incorporated*



Mr. de Marcillac is the Director and Principal Analyst of Dataquest's PC Worldwide group. Prior to this he spent six years in Europe as Director and Principal Analyst for Dataquest's PC Europe and Dataquest's European Computer Systems and Peripherals group. He is responsible for the content and quality of Dataquest's PC services in North America, Europe, and Asia. He has managed projects involving extensive research into the European personal computer market and the vertical markets in Europe and also carried out detailed analysis of IBM 370 and UNIX environments. Mr. de Marcillac is also responsible for Dataquest's electronic delivery strategy and for the electronic data management system, *MarketView*.

Prior to joining Dataquest, Mr. de Marcillac was European Research Director for International Data Corporation (IDC), where he spent six years.

Mr. de Marcillac received an honors degree in Natural Sciences at Cambridge University, United Kingdom.

## PC and Mobile Computing: What's Hot for the Desktop?

### *The World Is Becoming a More Global Market*

- Free-trade zones are becoming established
- Regions, rather than countries, will dominate global thinking in the next 20 years
- Companies, too, are becoming much more global
- These trends affect all industries: high technology with its high rate of change will move fast
- Competition will become tougher

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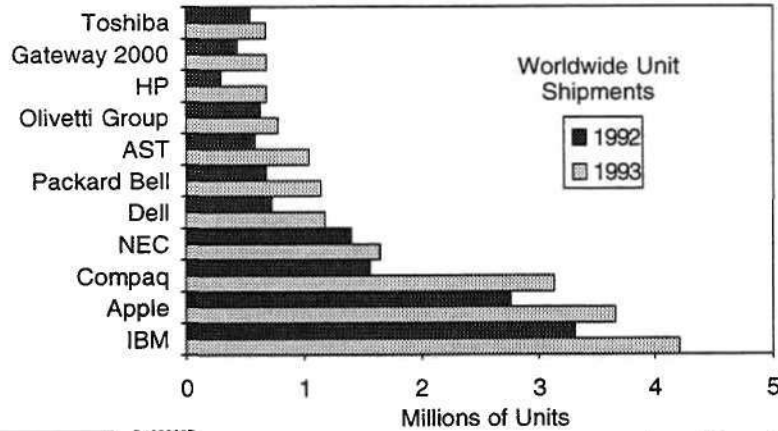
### *Worldwide Economies of Scale*

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## PC and Mobile Computing: What's Hot for the Desktop?

*A Million Units per Annum Is  
the Level to Aim for... for Now*



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Source: Dataquest

*Economies of Scale Are Increasing in  
Importance in the PC Business Model*

- In a return to earlier days, manufacturing economies of scale are sought after
- The million unit threshold will likely move up to 3 million quite fast
- Component pricing and availability are major factors at play here
- OEMs will continue to put pricing pressure on suppliers of materials



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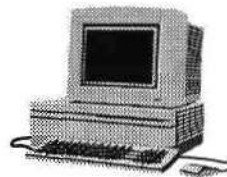
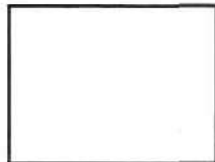
## PC and Mobile Computing: What's Hot for the Desktop?

### *Some Key Points for Our Industry*

- The economy affects both the demand side (investments and spending) and the supply side
- The recession in Japan will have a strong effect on our industry
- U.S. vendors are increasing their dominance as suppliers of finished goods
- Manufacturing locations and trends will modify to take best advantage of:
  - NAFTA and the EU
  - Logistics and supply of components/materials
  - Educated workforce vs. low wages

**Datamost**

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### *Moving On to the PC Industry...*

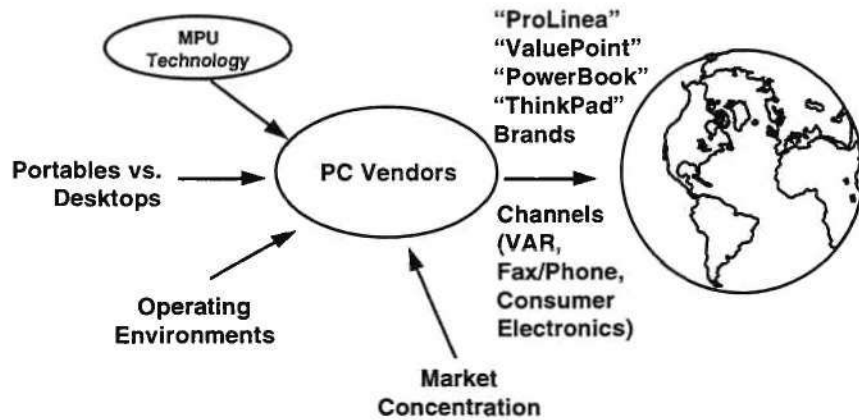


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## PC and Mobile Computing: What's Hot for the Desktop?

### What's Hot for the PC Market in 1994—and Beyond?



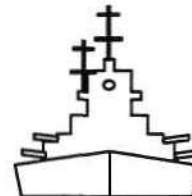
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### MPU Technology: The Pace Will Accelerate



- Intel's reaction against PowerPC will intensify in 1994
  - Agreement with HP for late 1990s
- Migration to Pentium will likely exceed even some of the recent optimistic forecasts
- But RISC architectures will make significant inroads
- PowerPC with Apple in 1994
- More vendors in 1994/1995



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*Apple Is a Key Factor in Determining  
the Pace of Success of RISC*

- Apple has launched its highly anticipated PowerPC products
- These products run Windows under emulation
- It appears that Apple will license its Mac OS—but when and how?
- Nevertheless, it is clear that Apple alone cannot break Intel's stranglehold on MPU technology
- By the late 1990s, even Intel will be using RISC technology extensively

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*A Number of Factors Are Necessary for  
RISC to Take Off in the Short Term*

- A leading vendor must adopt the architecture
- A viable OS must be available
- One or two further leading companies must follow
- What OS ??????

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## PC and Mobile Computing: What's Hot for the Desktop?

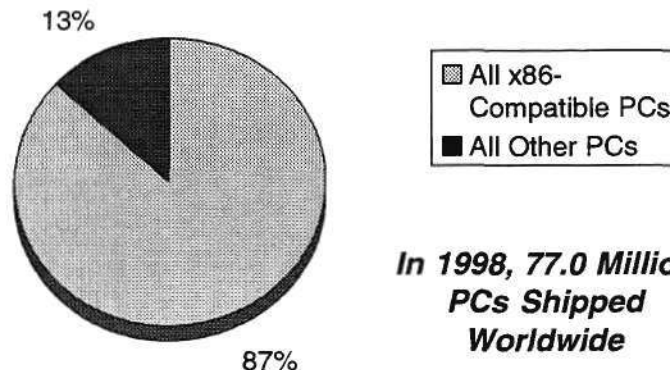
### *Within the RISC PC Environment PowerPC Will Dominate in the Mid-1990s*

- Apple "will ship up to 1 million units within one year of announcement"
- IBM and clones will accelerate at year-end into 1995
- Alpha will be a good technological alternative—but will not match PowerPC's volumes
- Other processors will be niche players
- However, outside of Apple, all RISC PCs will be affected by the slow pace of Windows NT
- Can RISC PCs break out of the server environment?

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### *Overall, Intel Is Likely to Remain Dominant—But...*



***In 1998, 77.0 Million  
PCs Shipped  
Worldwide***

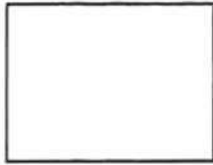
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Source: Dataquest



## PC and Mobile Computing: What's Hot for the Desktop?



### *Looking at Formats and the Portable Market...*



**Datquest**

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### *Portable PCs Are Starting to Look Very Attractive Again—At Last!*

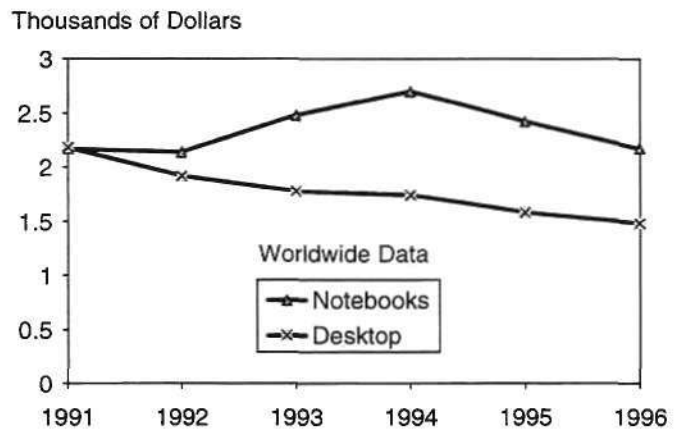
- Despite much media hype...
- Portables have made little progress against desktop/deskside PCs over the last two years!
  - Massive reductions in desktop prices
  - Color active matrix screen shortages
  - Performance vs. size/weight for portables
- Portable PCs have proved very popular in Japan but because of their form factor, not their portability!
- PCMCIA will help, but demand will be affected by high prices in 1994

**Datquest**

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## PC and Mobile Computing: What's Hot for the Desktop?

*Portable Average Selling Prices Have Increased Sharply...*

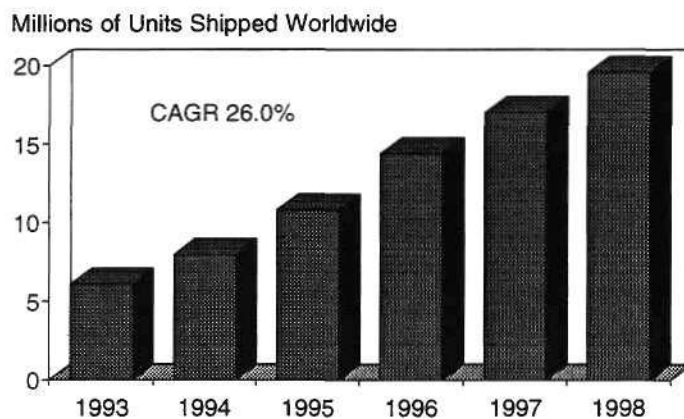


**Dataquest**

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Source: Dataquest

*Nevertheless, Demand for Portable PCs Is Set to Grow Fast*



**Dataquest**

G4003100

Source: Dataquest

## PC and Mobile Computing: What's Hot for the Desktop?

### *Improved Notebooks/Subnotebooks Will Drive Portable Demand*

- With improved performance, notebooks will start to approach the capabilities of the desktop
- Subnotebooks have been disappointing so far...  
A standard is needed
- But a new set of products in 1994/1995 will remedy the low user perception
- The PDA debate/hype affects the notebook/subnotebook market

**Deloitte**

G4003101

### *Overall, Desktop PCs Will Remain the Largest Portion of the Industry*

- Despite hype, desktop/deskside PCs still have a bright future
- They remain the lowest cost performance PC for the foreseeable future
- Performance issues vs. size/weight for portables
- Many users do not need mobility at the moment!

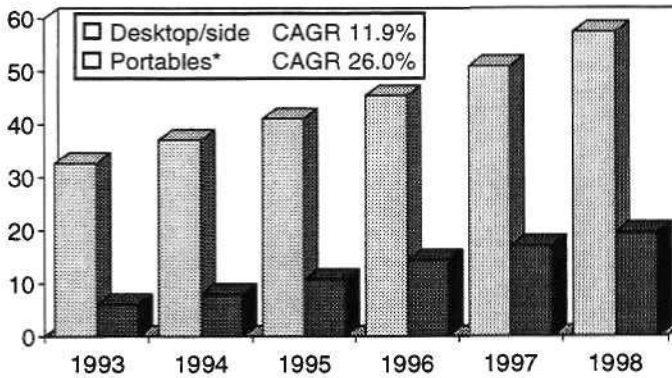
**Deloitte**

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## PC and Mobile Computing: What's Hot for the Desktop?

### *Portable PCs Grow Fast; But Desktop/Deskside PCs Still Dominate*

Millions of Units Shipped Worldwide



\* Include laptops, notebooks, and subnotebooks only

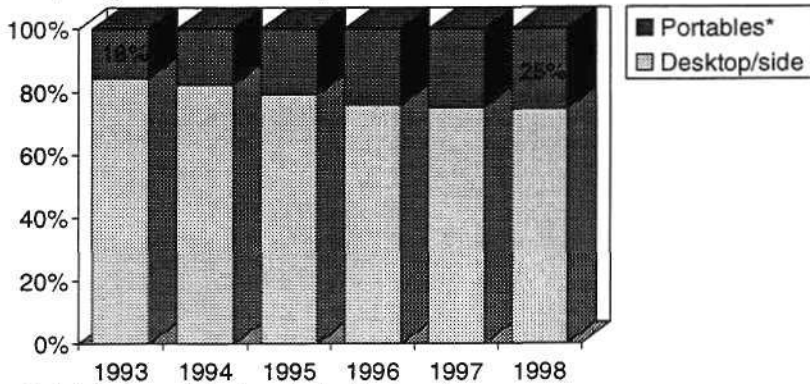
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Source: Dataquest

**Dataquest**

### *Portable PCs Grow Fast; But Desktop/Deskside PCs Still Dominate*

Percentage of Worldwide Shipments



\* Include laptops, notebooks, and subnotebooks only

G4003104

Source: Dataquest

**Dataquest**

## PC and Mobile Computing: What's Hot for the Desktop?

### *A New Opportunity: Consumer Markets*

- The consumer market is exploding, particularly within the United States
- Other regions will follow this trend
- This market is largely unpenetrated
- Consumers look for different price points and different levels of support
- Usage of PC brands and selected channels of distribution help vendors address these markets

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### *In Addition, New Markets Are Opening Up and Driving Demand*



Asia, Latin America, eastern  
Europe ... are starting to drive  
the worldwide market

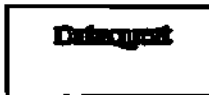
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## PC and Mobile Computing: What's Hot for the Desktop?



### *Marketing Issues: PC Brands*



G4003107

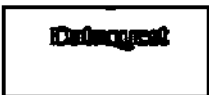


### *Branding of PC Products Will Intensify in Search of Market Share*

Branding is a natural part of the maturation of our market

- It permits better channel control
- It provides for a variety of price points
- It is useful both in developed markets and in emerging markets
- It allows a vendor to reach multiple user groups

“PS/2, ValuePoint, PS/1, ThinkPad,  
ProLinea, DeskPro/M, DeskPro/i”



G4003108

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## PC and Mobile Computing: What's Hot for the Desktop?



### *Branding Will Evolve in 1994*

- Branding will increase in both desktop and portable markets
- More vendors will use this approach—and for more ranges of products
- But how many brands should be used?
- The usage of branding will become more sophisticated
- Our industry will learn from other industries' experience in this field



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### *How Do Users Buy? And What Is the Future for Channels of Distribution?*

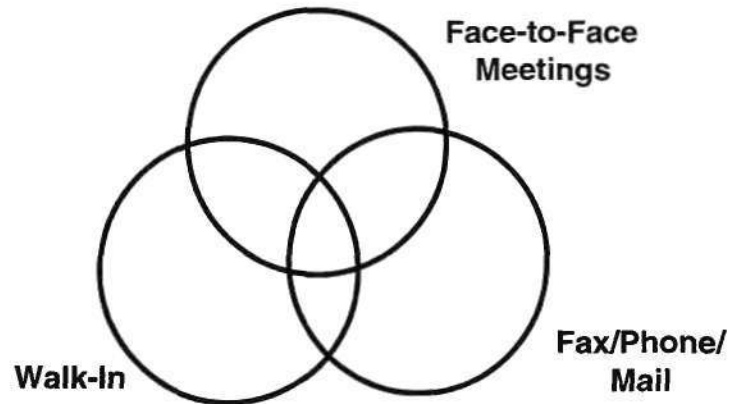


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## PC and Mobile Computing: What's Hot for the Desktop?

*In 1994, Users to Shift Buying Patterns*



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*Traditional PC Channels*



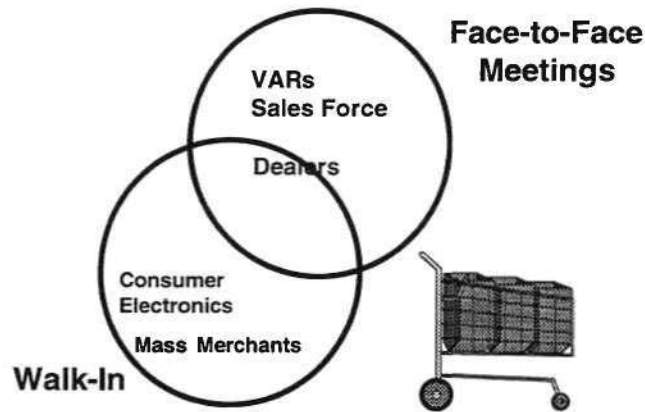
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## PC and Mobile Computing: What's Hot for the Desktop?

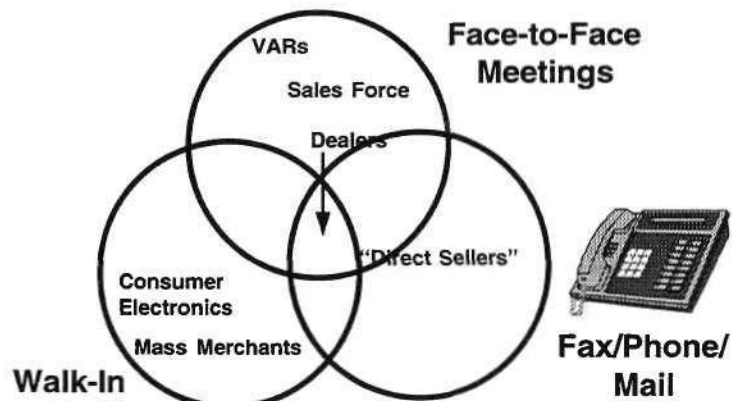
### *New Channels Opened Up New Customer Groups*



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### *Direct Sellers Influenced Buying Patterns*

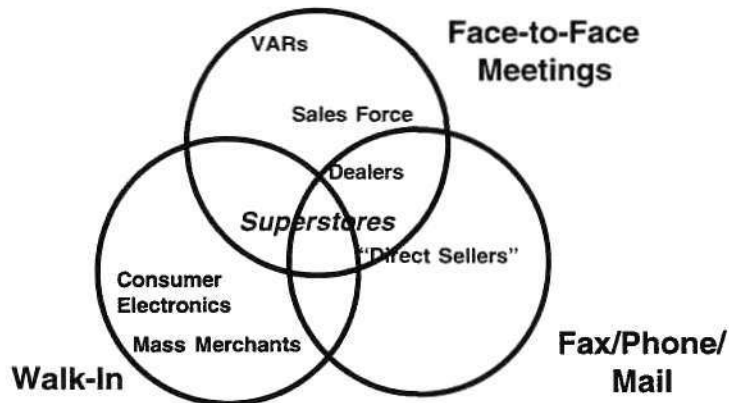


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## PC and Mobile Computing: What's Hot for the Desktop?

### *The "Superstore" Concept: Well Placed to Increase Market Share in 1994 and 1995*



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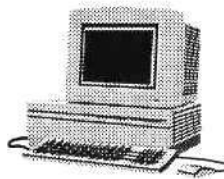
### *New Channels of Distribution Are Gaining in Importance*

- The distribution model is becoming more complex
- Distribution strategies must vary by region and even country in the world
- Expect retailing channels to become more sophisticated
- Superstore format accepted and progressing well in the United States, yet experimental in Europe
- Direct fax/phone/mail may have peaked in developed markets

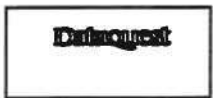
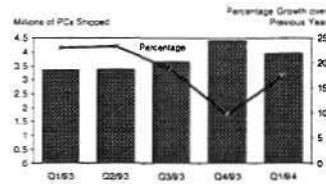
**Dataquest**

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## PC and Mobile Computing: What's Hot for the Desktop?

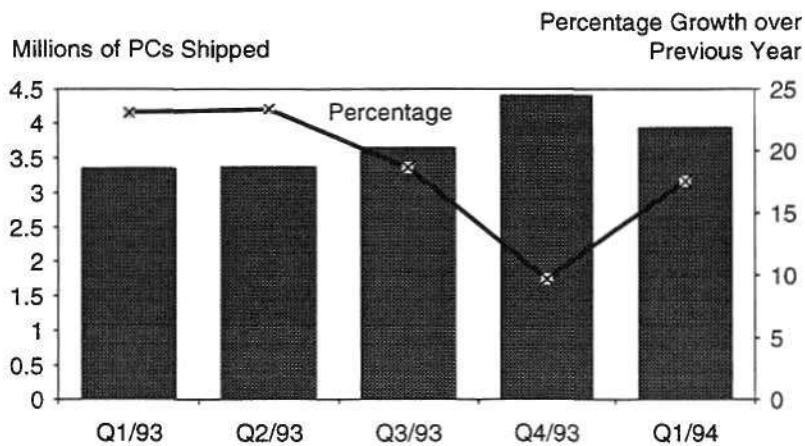


*Some of the Latest Data...*



G4003117

## *U.S. PC Market Quarterly Growth*



G4003118

Source: Dataquest

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## PC and Mobile Computing: What's Hot for the Desktop?

### *Conclusions*

- Technology will remain a major driving force—but there are many others
- Leading players will grab increased share, and the market will consolidate further
- Branding will be a key success factor
- The war will be won within the channels of distribution
- Price pressures will not abate
- There are many untapped markets and opportunities

**Deloitte**

G4003119





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## **Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?**

### **Jingsheng Huang**

*Market Research Analyst  
Research Operations Group  
Dataquest Incorporated*



Mr. Huang is a Market Research Analyst in the Research Operations group at Dataquest. His primary responsibility is the research on PC and workgroup business applications software and semiconductor equipment and materials. He is instrumental in Asia-related research, answering inquiries, consulting projects, and business development. He was also a member of the Dataquest team that regularly appears on KNTV in San Jose to comment on industry trends in the Silicon Valley.

Prior to joining Dataquest, he was a project manager at Freeman, Sullivan & Company in San Francisco, where he managed data analysis/processing for research projects on the power and medical industries. He also did a feasibility study on used-equipment market in China. While studying at Stanford University, Mr. Huang worked on projects on global economic development at the Hoover Institute. He also worked as a research associate at SRI International on a project on the economic competitiveness of Hong Kong by year 2000. Before Mr. Huang came to the United States in 1985, he taught English at Beijing Broadcasting Institute. In 1983, he co-led a study on value changes of Chinese young people for the Youth Research Institute of the Chinese Academy of Social Sciences. He was also a freelance reporter for China Daily.

Mr. Huang received an M.A. degree in Sociology/Organization Studies from Stanford University and a B.A. degree in English from the Beijing Foreign Studies University.

# Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

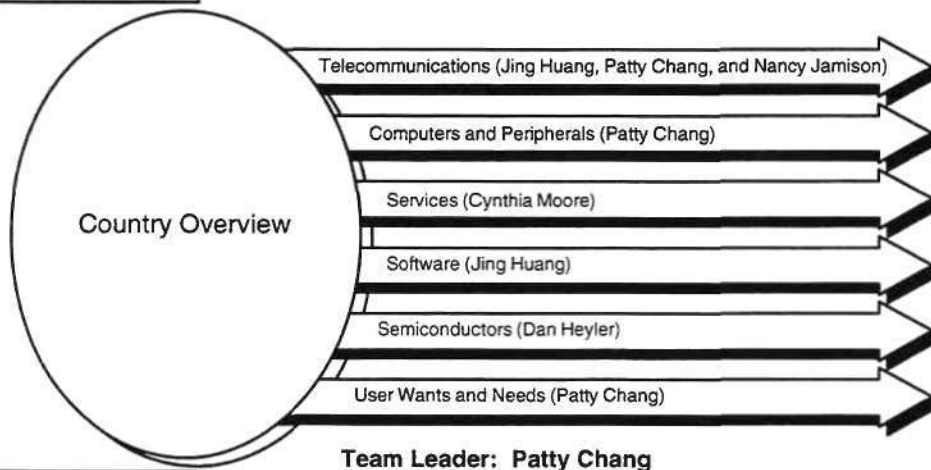
## Agenda

- Dataquest's China research
- The big picture
- Hot markets for products with ICs
- China's domestic semiconductor industry
- China strategies for device and equipment makers
- Dataquest conclusions

**Dataquest**

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## Dataquest's China Research: The Team



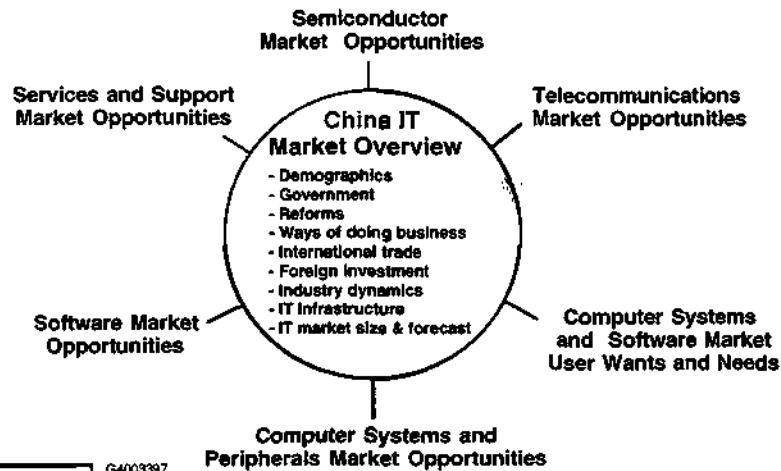
**Dataquest**

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## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

### Dataquest's China Research: Seven Reports



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### *The Big Picture: Some Basics*

Population:	1.2 billion
Geographic size:	As large as the United States
Civilization:	5,000 years old
1993 GDP:	\$549.1 billion
1993 total trade:	\$195.8 billion
1993 savings:	\$200.0 billion

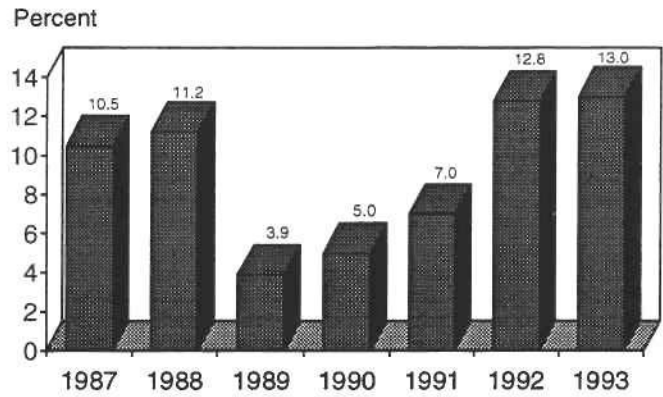
Source: Dataquest

**Dataquest**

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## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

### *The Big Picture: China GDP Growth*

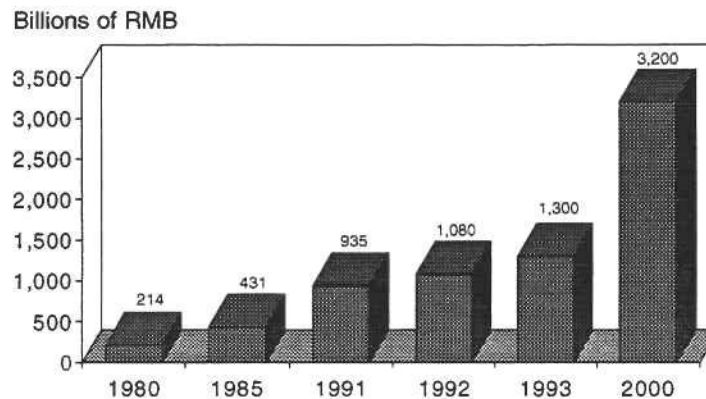


Source: PRC, Dataquest

**Dataquest**

G4003399

### *The Big Picture: Retail Sales in China*



Source: PRC, Dataquest

**Dataquest**

G4003400

## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

### *The Big Picture: Economic Growth*

- Economic reforms
- Economic cycles
- Inflation
- GATT
- A greater China

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### *The Big Picture: Political Stability*

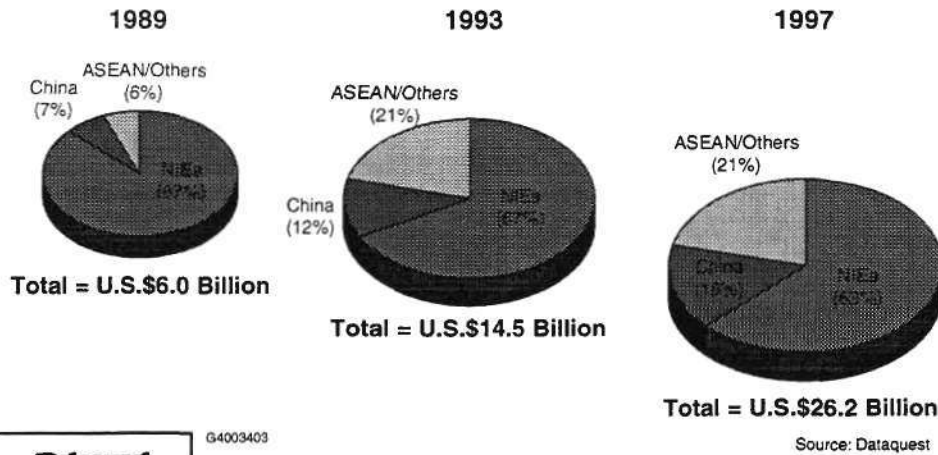
- Post-Deng Xiaoping China
- Ruling elite
- Decentralization
- Social unrest

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# Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

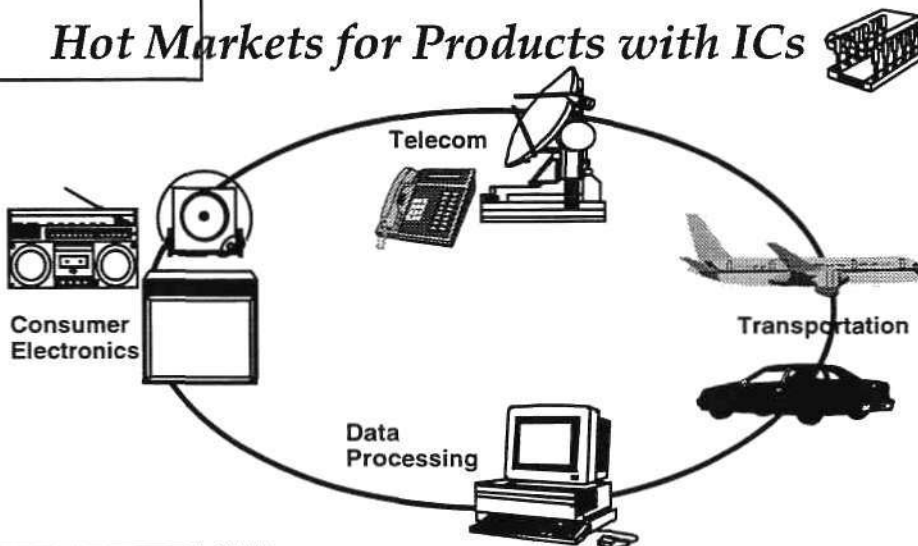
## Hot Markets: 1989 to 1997 Asia/Pacific Semiconductor Consumption within Region



**Dataquest**

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## Hot Markets for Products with ICs

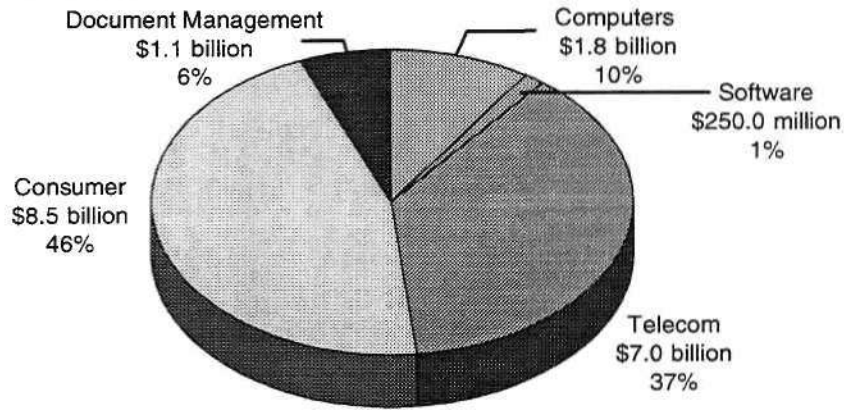


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## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

### *China's 1993 IT Market by Segment*



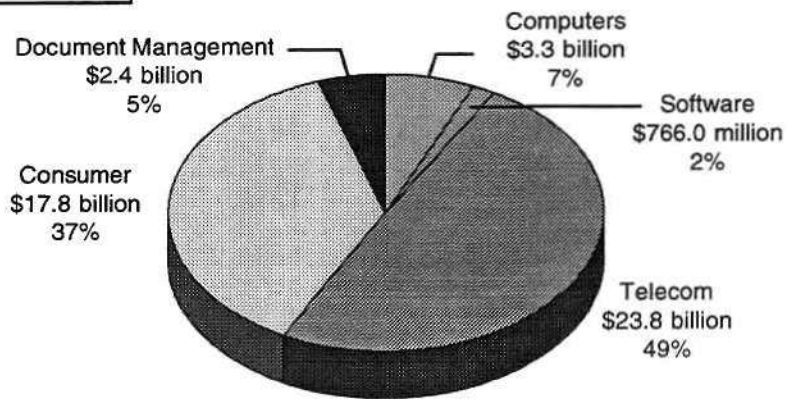
**Total = \$18.7 Billion**

**Dataquest**

G4003405

Source: Dataquest

### *China's 1997 IT Market by Segment*



**Total = \$48.03 Billion**

**Dataquest**

G4003406

Source: Dataquest

## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

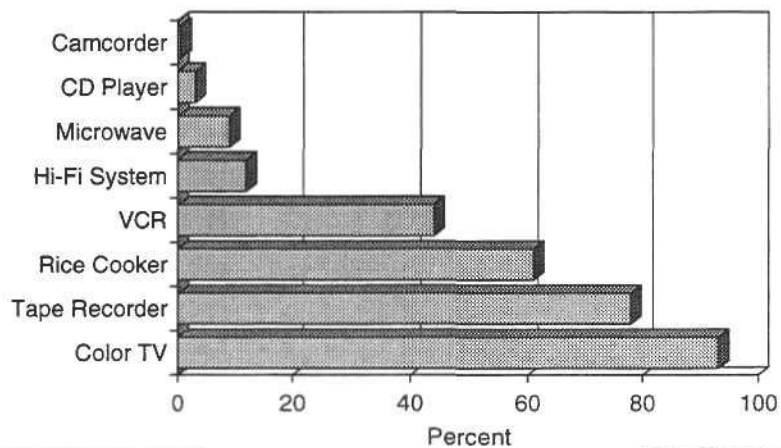
### Consumer Durables: Top Three

- 1970s: Bike, sewing machine, electric fan
- 1980s: TV, washing machine, refrigerator
- Early 1990s: VCR, motorcycle, telephone
- Late 1990s: AC, camcorder, PC

**Dataquest**

G4003407

### Consumer Appliances: Household Penetration in Shanghai, 1993



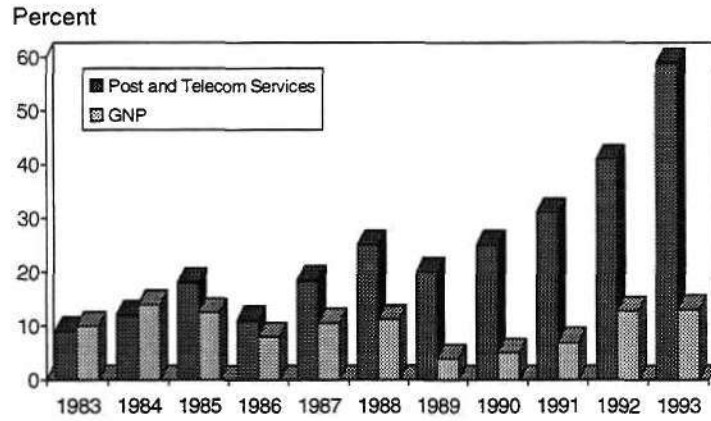
**Dataquest**

G4003408

Source: Dataquest

## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

### *Telecom: Growth Rates—China's GNP versus Post and Telecom Services, 1983 to 1993*

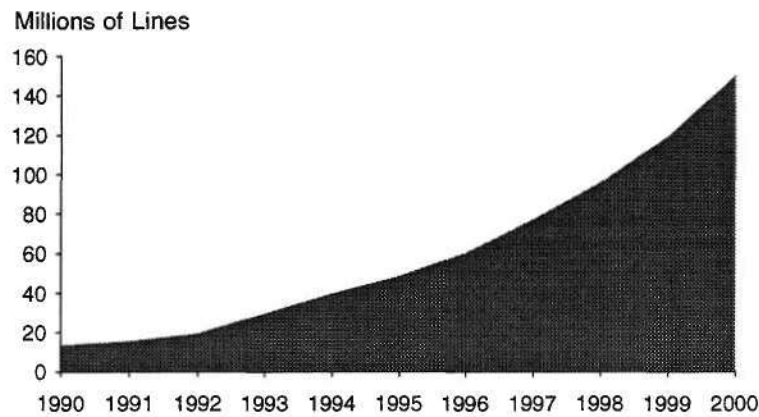


G4003409

Source: PRC, Dataquest

**Dataquest**

### *Telecom: Capacity of China's National Telephone Exchange, 1990 to 2000*



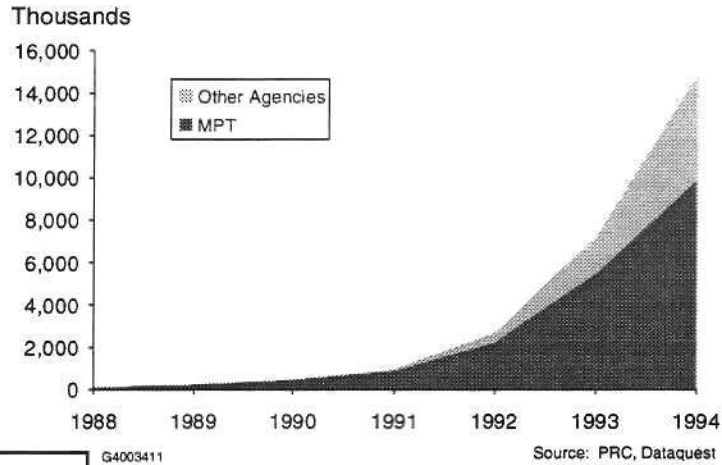
G4003410

Source: PRC, Dataquest

**Dataquest**

## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

### Telecom: Number of Paging Subscribers in China, 1990 to 1994

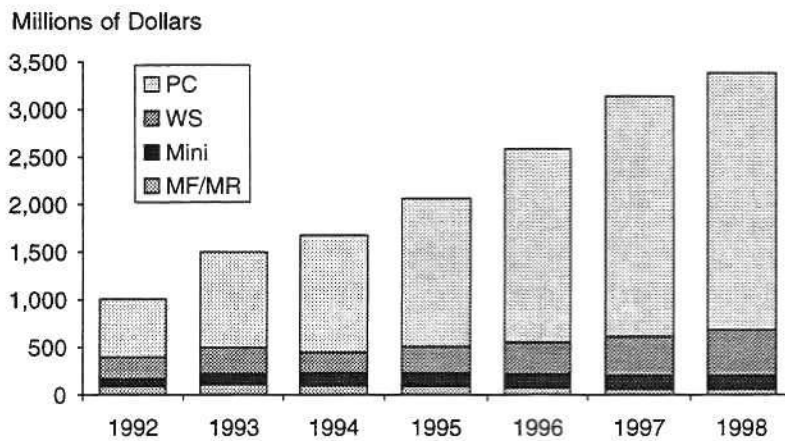


Dataquest

G4003411

Source: PRC, Dataquest

### China's Computers Market: Factory Revenue 1992-1998



Dataquest

G4003412

Source: Dataquest



## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

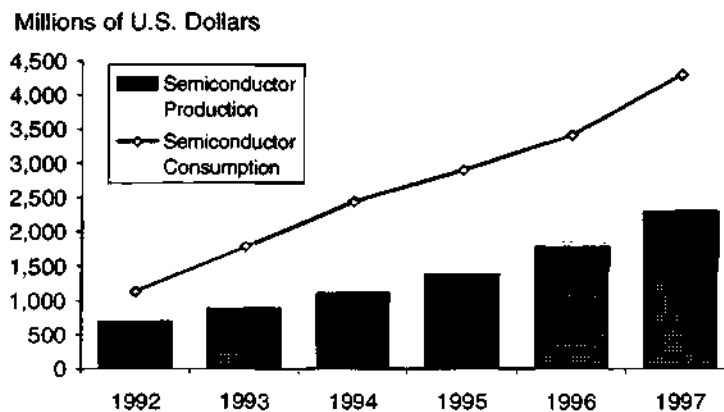
### Hot Markets: Vendor Profiles

- Foreign vendors: dominant in market share
  - Consumer electronics: Japanese
  - Telecom: European, North American, Japanese
  - Computers: United States, Taiwan/Hong Kong
- Sino-foreign joint ventures to get market access
- Weak Chinese domestic manufacturers

Dataquest

G4003413

### China Semiconductor Industry: Production Can't Meet Consumption



Dataquest

G4003414

Source: Dataquest

## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

### *China Semiconductor Industry: Foreign Companies*

- Shanghai Belling
- Shanghai Philips
- Shougang NEC
- Motorola in Tianjin
- Test/assembly plants

**Outlook**

G4003415

### *China Semiconductor Industry: Domestic Fabs*

- About 70 fab lines: small, low-end
- Low yield
- Most losing money
- Looking for way out
- A tale of two IC makers
  - Huajing
  - Huayue

**Outlook**

G4003416

## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

### *China Semiconductor Industry: Government Resolve?*

- National goals
- Getting short on capital
- Becoming short-sighted
- Government and university as businesses

**Deloitte**

G4009417

### *China's Play for Device Makers*

- Fabs for internal use for finished products for China
- Look outside China for chip sales
- Look inside China for test/assembly sites
- Donate old equipment to universities for training
- Make use of cheap software design engineers

**Deloitte**

G4009418

## Semiconductor Market Opportunities in China—Will China Become the Next Asian Semiconductor Power?

### *China's Play for Equipment Vendors*

- Look outside China for equipment sales
- Look inside China for software development contract
- Educate Chinese officials
- Don't get excited at "\$2 billion"
- Wait

**Dataquest**

G4003419

### *Dataquest Conclusions for the Next Five Years*

- Will China be a huge market for IC consumption? *Yes.*
- Will more test/sssembly plants move to China? *Yes.*
- Will the Chinese government invest billions in fabs?  
*No.*
- Will China become the next Asian semiconductor power? *No.*
  
- China and Taiwan: A comparison

**Dataquest**

G4003420

