Japanese Semiconductor Industry Conference

April 11–12, 1988
Hotel Century Hyatt
Tokyo, Japan

Dataquest

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1290 Ridder Park Drive
San Jose, California 95131-2398
(408) 437-8000
Telex: 171973
Fax: (408) 437-0292

Sales/Service Offices:

UNITED KINGDOM
Dataquest UK Limited
13th Floor, Centrepoint
103 New Oxford Street
London WC1A 1DD
England
01-379-6257
Telex: 266195
Fax: 01-240-3653

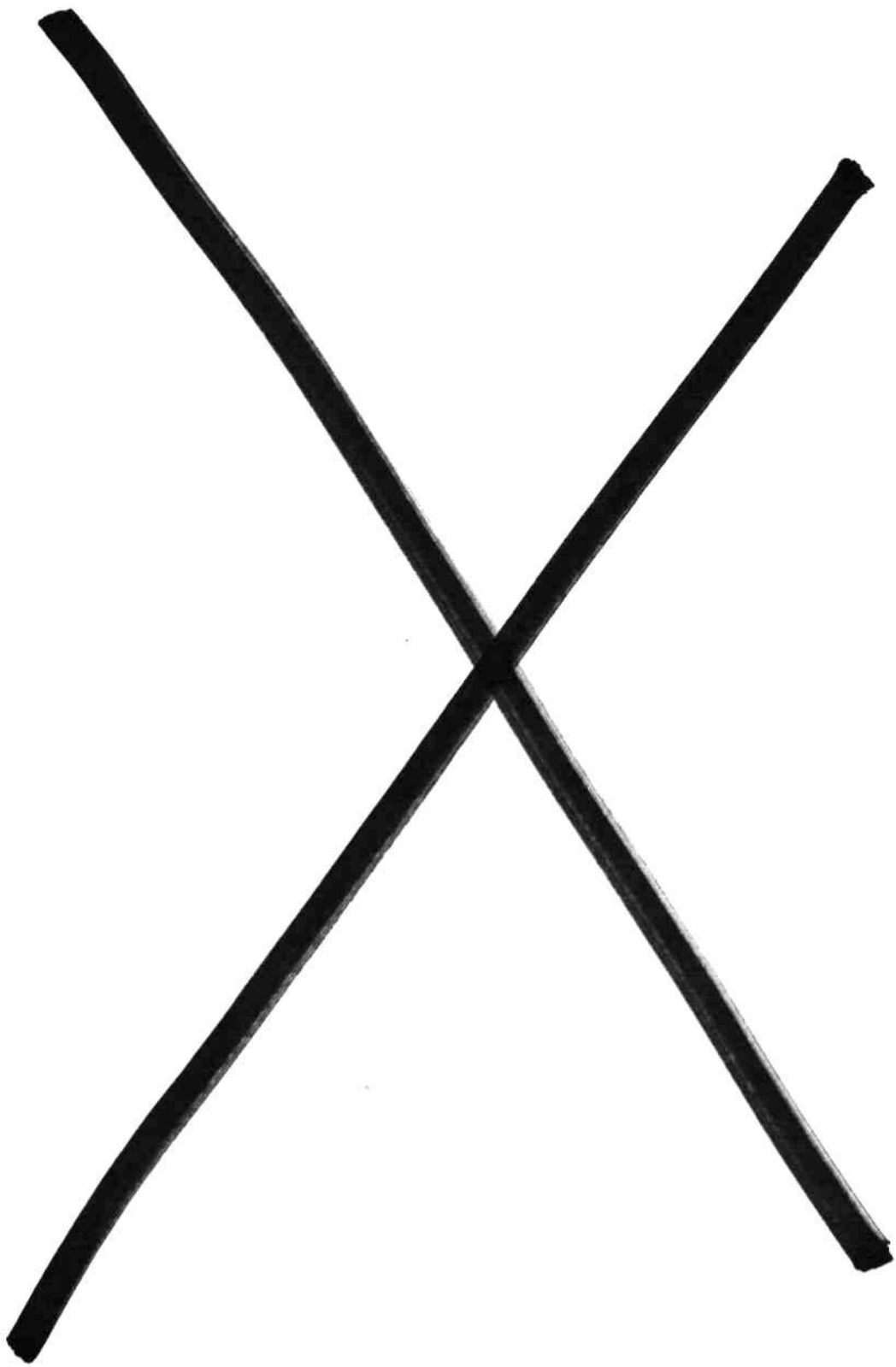
FRANCE
Dataquest SARL
Tour Gallieni 2
36, avenue Gallieni
93175 Bagnolet Cedex
France
(1)48 97 31 00
Telex: 233 263
Fax: (1)48 97 34 00

EASTERN U.S.
Dataquest Boston
1740 Massachusetts Ave.
Boxborough, MA 01719
(617) 264-4373
Telex: 171973
Fax: (617) 263-0696

GERMANY
Dataquest GmbH
Rosenkavalierplatz 17
D-8000 Munich 81
West Germany
(089)91 10 64
Telex: 5218070
Fax: (089)91 21 89

JAPAN
Dataquest Japan, Ltd.
Taiyo Ginza Building/2nd Floor
7-14-16 Ginza, Chuo-ku
Tokyo 104 Japan
(03)546-3191
Telex: 32768
Fax: (03)546-3198

KOREA
Dataquest Korea
63-1 Chungjung-ro, 3Ka
Seodaemun-ku
Seoul, Korea
(02)392-7273-5
Telex: 27926
Fax: (02)745-3199



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1988 JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE

Japan's New International Role: Competition and Cooperation

April 11–12, 1988
Hotel Century Hyatt
Tokyo, Japan

MONDAY, April 11

8:30 a.m.	**Registration**	*Banquet Lobby*
9:30 a.m.	**Welcome** Manny Fernandez President Dataquest Incorporated	*Century Room*
10:00 a.m.	**Japanese Industry Outlook** Osamu Ohtake Director, Japanese Components Group Dataquest Japan Limited	*Century Room*
10:30 a.m.	**World Semiconductor Outlook** Gene Norrett Corporate Vice President and Division General Manager Component Division Dataquest Incorporated	*Century Room*
11:00 a.m.	**Who's Winning?** Warren Earl Davis Vice President Semiconductor Industry Association	*Century Room*
11:30 a.m.	**INSEC's Activities to Date** Masato Nebashi President International Semiconductor Cooperation Center (INSEC)	*Century Room*
12:00 Noon	**Lunch**	*Momoyama*
1:30 p.m.	**Luncheon Speech** Atsuyoshi Ouchi Vice Chairman of the Board and Representative Director NEC Corporation	*Century Room*
2:00 p.m.	**Status of Japan-U.S. Semiconductor Trade Problems** Yokio Honda Director, Industrial Electronics Division Machine and Information Industries Bureau Ministry of International Trade and Industry (MITI)	*Century Room*
2:30 p.m.	**The Asian Age is Coming** Tom Wang Director, Asian Components Group Dataquest Incorporated	*Century Room*
3:00 p.m.	**Break**	
3:30 p.m.	**Analysis of European Electronics Technology** Jürgen Knorr Senior Vice President, Components Group Semiconductor Division Siemens AG	*Century Room*
4:00 p.m.	**Submicron Technology: Market Impacts** Hiroyuki Mizuno Managing Director, Member of the Board Matsushita Electric Industrial Co., Ltd.	*Century Room*

(Continued)

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4:30 p.m. **Perspective on Semiconductor Applications** ..... *Century Room*
David G. Norman
Research Analyst
Semiconductor User and Applications Group
Dataquest Incorporated

5:00 p.m. **Cocktails** ..... *Sky Room*

TUESDAY, April 12

9:00 a.m. **Future Trends of 32-Bit TRON Microprocessors** ..... *Century Room*
Kazuo Kimbara
Board Director, Group Executive
Electronic Devices Group
Hitachi, Ltd.

9:30 a.m. **Joint Venture Strategies** ..... *Century Room*
Murray A. Goldman
Senior Vice President and General Manager
Microprocessor Products Group
Motorola Incorporated

10:00 a.m. **Leading ASIC Technologies** ..... *Century Room*
Gordon Campbell
Chairman and Chief Executive Officer
Chips and Technologies

10:30 a.m. **Break**

11:00 a.m. **Emerging Technologies in the 1990s** ..... *Century Room*
Sheridan Tatsuno
Senior Industry Analyst
Japanese Semiconductor Industry Service
Dataquest Incorporated

11:30 a.m. **Silicon and Epitaxial Wafers: Status and Future** ..... *Century Room*
Taro Sugawara
Executive Vice President
Shin-Etsu Handotai Co., Ltd.

12:00 Noon **Lunch** ..... *Momoyama*

1:30 p.m. **Future Trends of the World Memory Market** ..... *Century Room*
Victor de Dios
Senior Industry Analyst
Semiconductor Industry Service
Dataquest Incorporated

2:00 p.m. **Japanese Semiconductor Equipment Industry: Status and Future** ..... *Century Room*
Kazunori Hayashi
Industry Analyst
Japanese Semiconductor Industry Service
Dataquest Japan Limited

2:30 p.m. **Closing Remarks** ..... *Century Room*
Masahiro Miyagawa
Executive Vice President
Dataquest Japan Limited

Conference Adjourns

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JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE
EVALUATION QUESTIONNAIRE

Tokyo, Japan
April 11–12, 1988

Thank you for attending our Japanese Seminconductor Industry Conference. Would you please assist us in planning our next conference by completing and returning this questionnaire?

1. Please rate each presentation on a scale of 1 to 10 (where 10 is highest in terms of your approval):

	CONTENT (1 to 10)	DELIVERY (1 to 10)	COMMENTS (Use reverse side if necessary)
Ohtake, Japanese Industry Outlook			
Norrett, World Semiconductor Outlook			
Davis, Who's Winning?			
Nebashi, INSEC's Activities in the Past Year			
Honda, Status of Japan-U.S. Semiconductor Trade Problems			
Wang, The Asian Age Is Coming			
Knorr, Analysis of European Electronics Technology			
Mizuno, Submicron Technology: Market Impacts			
Norman, Perspective on Semiconductor Applications			
Kimbara, Future Trends of 32-Bit TRON Microprocessors			
Goldman, Joint Venture Strategies			
Campbell, Leading ASIC Technologies			
Tatsuno, Emerging Technologies in the 1990s			
Sugawara, Silicon and Epitaxial Wafers: Status and Future			
de Dios, Future Trends of the World Memory Market			
Hayashi, Japanese Semiconductor Equipment Industry: Status and Future			

2. At our next conference, would you prefer more or less of the following types of speakers?

	More	Less
Dataquest speakers	☐	☐
Speakers from large semiconductor companies	☐	☐
Speakers from small semiconductor companies	☐	☐
Speakers from semiconductor users	☐	☐
Speakers from distributors	☐	☐

(over)

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3. Please suggest other types of speakers you might like to hear: _____

_____

4. How would you rate the conference facilities (1 to 10)?

   Location _____ Guest Rooms _____ Meals _____ Meeting Rooms _____ Recreational Facilities _____

5. Where would you like next year's conference to be held? _____

6. Topics that would be of interest to you for the next JSIS conference: _____

_____

_____

7. Comments: _____

_____

_____

8. Your primary interest in the semiconductor industry is as a:

   Manufacturer _____ User _____ Other _____
   (Please specify)

_____
Name and Company (optional)

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JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE
April 11 through 12, 1988
Tokyo, Japan

Final List of Attendees

ADC Corporation	Hiroji Asahi, Executive Managing Director
A.I.G. Investment	Koichi Hasegawa
AMRO Bank	Hanso Idzerda, Senior Vice President
APRIL K.K.	Akinori Kama, General Manager
AT&T	Roman Kowalchuk, Manager, Intellectual Property Licensing & Management A. K. Lagarde, Director, Intellectual Property Licensing & Management
Acer Incorporated	Alan Chang
Advanced Micro Devices Japan Ltd.	Stephen Donovan, General Manager
Advanced Micro Devices, Inc.	Jerry Lynch, Director, Strategic Programs & Southeast Asia Sales
Advantest Corporation	Shinpei Kamata, Managing Director, Sales Division Katsuaki Minami, Director, ATE Sales Division
Alps Electric Co., Ltd.	Shoji Igari
American Embassy, Tokyo	Michael Hegedus, Commercial Attache, Foreign Commercial Service

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Anelva Corporation	Hideo Mito, General Manager, Planning Office
Asahi Kasei Microsystems Co., Ltd.	Seiji Azuma, Vice President Takeshi Hosaka, Vice President Makoto Watanabe, General Manager Akira Yomiyama, President
Asahi Research Center	Yoshihiko Nagasato, Senior Researcher
ASCII Corporation	Ryoichi Kurata, Marketing & Planning Director, Systems Products Division Kenichi Takahashi, Vice President, Systems Products Division
Bank of Tokyo	Naoya Ochi
Bearing International Investment	Fujio Ikezoe
Boston Consulting Group K.K.	Richard E. Foyston
Bussan Electronics Systems Technology Inc.	Saburo Maruchi, Director
Canon Inc.	Yoichi Hirabayashi, General Manager, Semiconductor Division
Capital Research International	Masaaki Abe, Investment Analyst
Chips and Technologies, Inc.	Gordon A. Campbell, Chairman & Chief Executive Officer
Citicorp International	James Ashley, Research Department
Crestronics Co., Ltd.	Katsuhiko Ohara, President
Dai Nippon Printing Co., Ltd.	Osamu Matsuoka, Manager, Micro Products Division, Engineering Department

Dai Nippon Printing Co., Ltd.	Iwao Yamabe, Executive Director & President, Micro Products Division
Daikin Industries, Ltd.	Yukio Mori, Manager, Marketing Business Planning Division
Dai Tokyo Investment Management Co.	Koichi Serikawa
Daihyaku Life	Masanobu Nakagawa
Daito Life Insurance	Hiroshi Fujise
Data I/O Japan Co., Ltd.	Masanobu Kawaminami, President Koji Shinoda, Sales Manager
Dataquest Incorporated	Elisabeth Blaetterman, Dataquest Associate, JSIS Manny Fernandez, President David Norman, Research Analyst, SAM Gene Norrett, Corporate Vice President & Division General Manager Frank Sammann, Senior Vice President, Sales & Client Services J. H. Son, Manager, ASETS Sheridan Tatsuno, Senior Industry Analyst, JSIS Tom Wang, Associate Director, ASETS Victor de Dios, Senior Industry Analyst, SIS
Dataquest Japan, Ltd.	Kaz Hayashi, Industry Analyst, JSIS Satoko Hoshizaki, Customer Service Satoko Kaji, Customer Service Takashi Kimura, Assistant Marketing Manager Technology Infomation Division Masahiro Miyagawa, Executive Vice President Max Nanseki, Director of Marketing Technology Information Division Hideaki Nemoto, Reseach Associate, JSIS Osamu Ohtake, Director, JSIS Keiko Sakimura, Research Assistant, Information Systems Group Hiroshi Tatejima, Marketing Manager Nanako Yamane, Research Coordinator, JSIS

Diamond Investment	Yoji Tamemae
Eaton Corporation	Dean Wagner, Asian Operations Manager, Semiconductor Equipment Department
European Silicon Structures	Colin Clifford, Director, International Business Development
Fidelity International	Magoyuki Oshitani
Ford Motor Company (Japan) Ltd.	James E. Chiang, Liaison Project Manager, Electrical & Electronics Division
Fuji Electric Company, Ltd.	Toshio Hoshino, General Manager, Marketing Electronic Group IC
Fuji Electronics Co., Ltd.	Kunio Ikisu, President
Fuji Photo Film Company, Ltd.	Yuzo Mizobuchi, Manager, Micro-Electronics Research Office
Fuji Xerox Company, Ltd.	Shunsuke Tomiyama, Associate Director, Electronic Imaging & Device Research Lab.
Fujitsu Microdevices Ltd.	Akira Honma, Manager, Engineering Department
Fujitsu, Ltd.	Toshiyuki Hani, Manager, Semiconductor Marketing Division Yoshisuke Kondo, General Manager, Systems LSI Marketing Division Masaichi Shinoda, General Manager, Advanced Planning Division
Fukoku Life Insurance	Kei Yoshizawa
Genus, Inc.	Donald P. Baumann, Vice President, Sales
Government of Alberta	Richard Paquette, Director, Electronics

Graphic Design Lab. K.K.	Isamu Ishikawa, President
HOYA Corporation	Shunji Hasegawa, Director, General Manager Electronics Division
Harris K.K.	Tsuyoshi Kobayashi, President
Hitachi Metal, Ltd.	Hiroshi Maekawa, Manager, Corporate Sales Administration Division
Hitachi Research Institute	Noboru Akiyama Mamoru Morita, Vice President Sakushi Nishioka Hideo Takemoto, President
Hitachi, Ltd.	Kiyoshi Hojo Kazuo Kimbara, Board Director Hiromichi Koshikawa, Assistant Manager, Marketing & Planning Department, Electronic Devices Group Shigeo Kubo, Assistant Manager, Marketing & Planning Department, Electronic Devices Group Akira Mizuno, Manager, Device Development Center Kiyoshi Uragami, Manager, Stragetic Business Operation, Semiconductor & Integrated Circuit Division Hajime Yasuda, Department Manager, Strategic Product Planning, Semiconductor & Integrated Circuit Division
Hosei University	Toru Hara, Professor, Electronic Engineering
Hyundai Electronics Industries	M. B. Chung
IBM Japan, Ltd.	Minoru Nayuki, Manager of DMP Device/Module Products
IBM World Trade Asia Corporation	S. J. Park

INSEC	Toshio Kitamura, Managing Director Masato Nebashi, President
Institute for Information Industry	C. W. Chen, Manager
Intel Corporation	Jacques J. Voye, Internation Account Marketing Manager, ASIC Division
Intel Japan, K.K.	Tetsuro Fujii, Market Researcher, President Office Takashi Tomizawa Seiichiro Watanabe, Manager, TDC
Ishikawajima-Harima Heavy Industries, Co., Ltd.	Atsuo Matsumoto, Manager, Mechatronics Products Development Department Makoto Nishimura, Manager, New Business Development Division Masaya Tanaka, Manager, Technical Planning Department
JEOL Ltd.	Kazuhiko Moriya, Section Manager Semiconductor Equipment Division
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Kanematsu-Gosho Ltd.	K. Atsumi, Assistant Manager, Technical Engineering Department Takahiro Shuda, Associate General Manager Technical Engineering Department
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Koa Kasai Investment Management	Hideji Kayahara

Kodak Japan K.K.	Howell A. Hammond, Vice President, Director of R&D
Koito Manufacturing Company, Ltd.	Tomizo Saida, Manager, Research & Development Department
Komatsu Electric Metals Co., Ltd.	Tetsuzo Kanaya
Konica Corporation	Harutsune Baba, General Manager, R&D Center
Kyocera Corporation	Kaichiro Odagawa, Director, LSI Design Division Masami Terasawa, General Manager R&D, Semiconductor Parts Division
LSI Logic K.K	Keisuke Yawata, President
MITI	Yukio Honda, Industrial Electronics Division Kazunori Suzuki
Marubeni HYTECH Co., Ltd.	Kouichi Ando, Director, Semiconductor Equipment Division Hiroomi Nakazato
Matsushita Electric Industrial Co., Ltd.	Yoshiharu Kusuda, General Manager, Corporate Industry Sales Division Hiroyuki Mizuno, Managing Director Koichiro Shoda, Councilor, Semiconductor Research Center
Matsushita Electronics Corporation	Kazuo Fujii, Assistant Manager, Corporate Planning Department Masaichi Kubo, Director, Semiconductor Group Osamu Osaki, General Manager, Corporate Planning Department
Meiji Life Insurance	Shinsuke Takamiya

Mitsubishi Chemical Industries, Ltd.	Fumiho Tokumitsu
Mitsubishi Corporation	Hisatoshi Hagiwara
Mitsubishi Electric Corporation	Koichi Kamahara, Assistant Manager, Kitaitami Works, Semiconductor MP Bujirou Kobayashi, Senior Managing Director, Electronic Device Group Fumiaki Miyoshi, Assistant to Manager, Semiconductor Marketing Research Hideaki Shibata Takeshi Yamaguchi, Assistant to Manager, Semiconductor Marketing Research
Mitsubishi Trust & Banking	Mutsumi Matsushita Tori Sato Kei Yanagisawa
Mitsui & Co., Ltd.	Norio Kuroki, Assistant Manager, II Infomation Processing System Department Tadahiko Shiomura, General Manager, II Infomation Processing System Department
Mitsui Mutual Life Insurance Co.	Yo Murakami
Mitsui Petro Chemical Industries, Ltd.	Hirohiko Miyake, Director, High-Performance Materials & Products Planning Department
Miyazaki Oki K.K.	Choji Inoue, Director, Production Control Department
Morgan Trust Bank	Charles Kimball, Vice President Hideki Shigenobu
Motorola Semiconductors HK Ltd.	S. W. Cheung, Senior Business Manager, Integrated Circuits
Motorola, Inc.	Murray Goldman, Senior Vice President & General Manager, Microprocessor Group Marg Goldman

NCB Investment Management Co.	Hideki Sotokawa
NEC Corporation	Isao Baba, Supervisor, Semiconductor Marketing Division, Planning Department Yukio Miyamoto, Manager, C&C Systems Development Yujio Nishimura Shinji Ohba, General Manager, Semiconductor 2nd Sales Division Dr. Yuji Okudo, General Manager, Microelectronics Research Lab. Dr. Atsuyoshi Ouchi, Vice Chairman of the Board Hajime Sasaki, Vice President, Electron Device Group Kyozo Shimizu, Chief Engineer, Semiconductor Group Dr. Daizaburo Shinoda, Vice President Kazuhiro Todokoro, Chief Researcher, Strategic Marketing Department, Semiconductor Group Planning Office Akitake Tsuda, Manager, Strategic Marketing Department, Semiconductor Group Planning Office Nobuaki Yamaguchi, General Manager, International Electron Devices Marketing Promotion Division Shigeo Yamamoto, Chief Engineer
NIKON Corporation	Takaharu Kawada
NIMIC Inc.	Hiroshi Saito, President
National Semiconductor Japan, Ltd.	Ron Livingston, Director, Marketing President Office Takuya Ogawa, Marketing Director, Marketing Division William Watoson, President
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Nihon Digital Equipment Corporation	Zenkichi Kitajima

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Nippon Life Insurance Co.	Satoshi Yamashita
Nippon Mining Co., Ltd.	Keishi Namikawa, General Manager R&D Group Business Planning Department
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Nippon Precision Circuits Ltd.	Akira Ota, Managing Director
Nippon Steel Corporation	Fumihiko Dai, General Manager, Electronics & Information Systems
Nippon Telegraph & Telephone Corp.	Minpei Fujinami, Senior Research Engineer, Manufacturing Systems Technology Lab Kazuyoshi Matsuhiro, Senior Research Engineer, LSI Lab Takayoshi Nakashima, Senior Research Engineer, LSI Development Lab. Michiharu Tabe, Senior Manager, Research Planning Department, LSI Lab
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Nissei BOT Investment	Masahiro Iwaki
Nissei Sangyo Co., Ltd.	Hiroshi Goto, Assistant Manager, Electronic Devices Technical MKT Akihiro Nozaki, General Manager, Electronic No. 1 Marketing Division
Nissin Electric Co., Ltd.	Masatoshi Harada, Deputy General Manager, Ion Equipment Division Sadao Tsuji, Manager, Beam Technology Equipment Marketing Department Teizo Yasui, Managing Director

Oki Electric Industry Co., Ltd.	Seiichi Aratani, Senior General Manager, Electronics Devices Group Tadao Higashi, Deputy General Manager Electronic Devices Group Yoshiyuki Honjyo, General Manager, Strategic Planning Department Yasuro Kunori, Manager, Marketing Promotion Department Electronic Devices Group Kouichi Naitoh, Assistant Manager, Marketing Promotion Department Electronic Devices Group Koichi Nakagawa, General Manager, Sales Engineering Department, Electronic Devices Group Sumiko Takeyasu
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Osaka Sanso Kogyo, Ltd.	Michael Solomon, General Manager, Electronic Gases Division
Perkin-Elmer Corporation	M. Azam Ali, Assistant Director, International Marketing
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Ricoh Company, Ltd.	Shigezo Gomi, Assistant Manager, Business Planning Office, Electronic Devices Division Hiroshi Nabetani

Ryosan Company Limited	Tatsuo Ui, Director, Executive Vice President Marketing & Sales Division
SGS-Thomson Microelectronics	Antony Watts, Director, Strategic Planning
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Saitama Bank Ltd.	Shigeo Kusakabe
Sanyo Electric Co., Ltd.	Moriya Fukuse, Department Manager, Marketing Department, Sales Division Masaaki Yamamuro, Engineering Assistant Councel, Semiconductor Business Headquarters
Seiko Epson Corporation	Kimio Takemori
Seiko Instruments Inc.	Yasunori Ebihara, Divison Manager Semiconductor Divsion
Seiyu Investment Managment, Inc.	Kenzo Ogata
Semi Japan	Shigeru Nakayama, Executive Director
Semiconductor Industry Association	Warren Davis, Vice President
Sertek Laboratories Inc.	Ronald Chwang
Sharp Corporation	Hiroaki Mattori, General Manager, Product Planning Department No. 1 IC G Hajime Nakajima, Assistant Supervisor, IC Group Product Planning Department No. 1 Sakan Yamada, Assistant Manager IC Gr. Product Planning Department No. 1
Shin-Etsu Chemical Co., Ltd.	Taro Sugawara Takehide Sugimura, General Manager Electronic Materials Department

Shin-Etsu Chemical Co., Ltd.	Shinichi Takei Sumio Washino
Shinko Electric Industries Co., Ltd.	Taizo Abe, Director & General Manager, Development & Engineering Division
Shrowder Investment	D. H. Kraff
Siemens AG	Jurgen Knoor, Senior Vice President, Components Group, Semiconductor Division
Siemens K.K.	Masatoshi Sato, Manager Industry Analys Corporate Planning
Signetics Japan, Ltd.	Kyuzaemon Funaki, Senior Managing Director Sales No. 1
Singapore Technology Corporation	John Hambridge, General Manager
Sony Corporation	Michio Araii Hatsumi Hamada, Assistant Manager, Strategic Planning Department Semiconductor Group Masahiro Takahashi, Senior General Manager, Semiconductor Group Seiichi Watanabe, General Manager, Research & Development Division, Semiconductor Group
Sumigin Bankers Investment	Masayuki Kubota
Sumitomo Heavy Industries Ltd.	Eijiro Toyota, Chief Engineer, Business Development Department
Sumitomo Metal Industries, Ltd.	Shigeo Sugawara, Manager, Semiconductor Equipment Department
Sumitomo Mutual Life Insurance	Kazuyuki Mori
Taiyo Kobe Bank	Tomoaki Imai

Taiyo Kobe Bank Investment	Toshiyuki Omae
Tatung Company	C. H. Lin
Technova Inc.	Sachiko Akatsuka
Telefunken Electronic GmbH	Haruo Ogino
Texas Instruments Japan, Limited	Hiroshi Tsuchiya, Supervisor, Marketing & Planning Hideo Yoshizaki, Chairman of the Board
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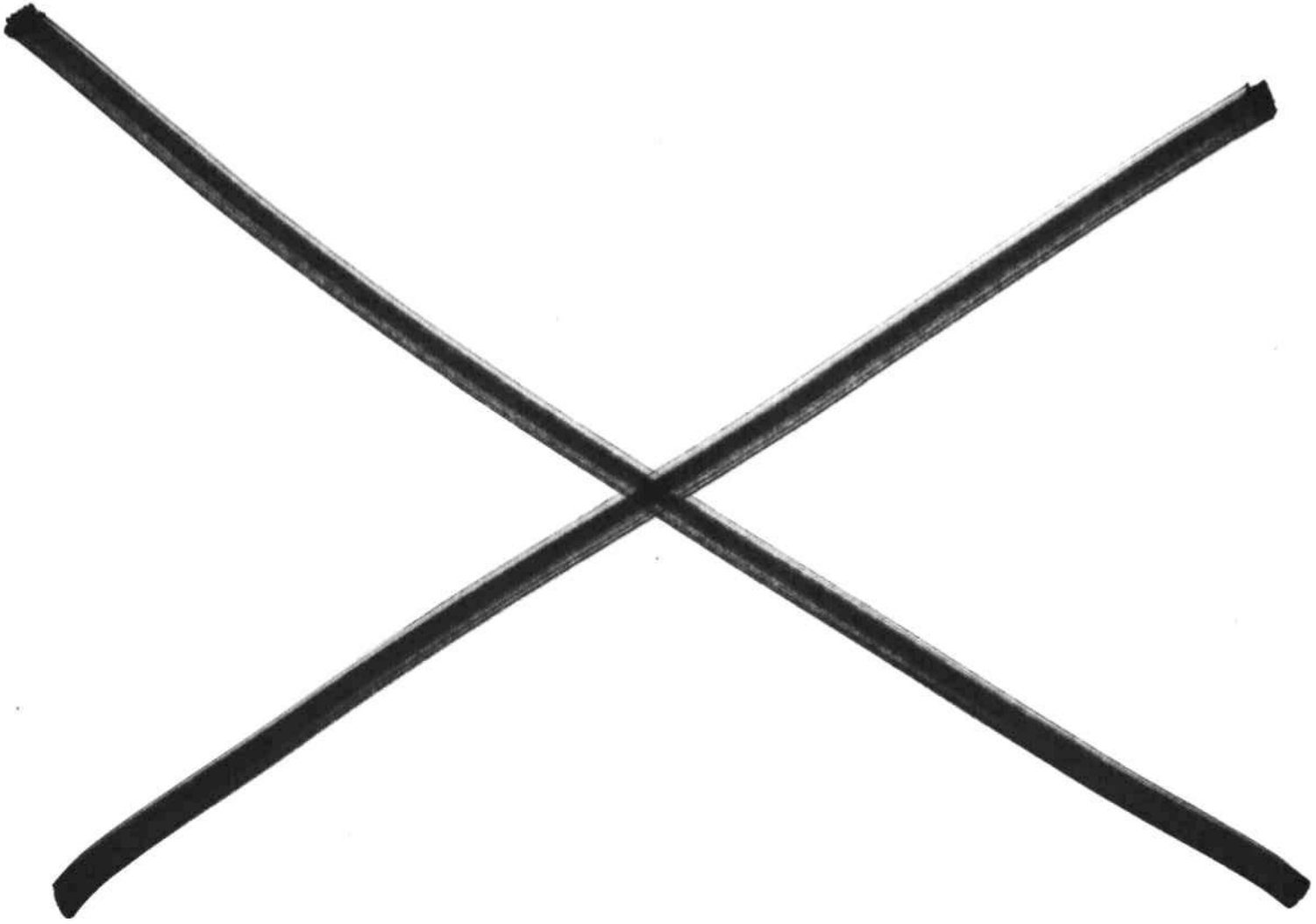
The Fuji Bank, Ltd.	Seiji Aoki, Manager, Industries & Corporate Research Division
The Industrial Bank of Japan	Koichi Hasegawa Makoto Tamaki
The Long-Term Credit Bank Investment	Masaro Igarashi
The Mitsui Trust & Banking Co., Ltd.	Masato Fujita Tsuneo Kojima Koichi Ogura
The Yasuda Mutual Life Insurance Co.	Nobuhiro Kawa
Tokio Marina MC Asset Management	Takahiro Ishizuka
Tokyo Electric Co., Ltd.	Fumio Takei, Director
Tokyo Electron Limited	Hiroyuki Horie, Manager, SPE Planning Department, SPE Division Susumu Ichikawa Ken Muroi

Tokyo Electron Limited	Hiroshi Ikeda Hiroshi Odani Kazuhiro Yazaki, Deputy General Manager Corporate Planning Department
Tokyo Juki Industrial Co., Ltd.	Yan Furushima, Director, Division Manager Electric Equipment Division
Tokyo Musen Kizai K.K.	Kouji Hasegawa, Manager Electronics Device Department
Tokyo Systems Laboratories Inc.	Hiroshi Konno, Executive Vice President
Tomen Electronics Corporation	Yasuyuki Fukuda, Director
Toshiba Corporation	Masayuki Ishibashi Haruo Katada Koji Kodama Yasuo Morimoto Hidetada Neishi
Union Carbide Corporation	Shinzo Ishida, Marketing Manager Fumiki Ohya, International Sales Manager S. Ishida
Unisys Japan Limited	Yuh Fujiwara, Manager, JIPO George Shima, Director, Technology Liaison
VLSI Technology, Inc.	Gib Gibson, Director, International Business Development
Victor Company of Japan, Ltd.	Shigenori Iwakuma, Senior Staff Researcher R&D Planning Department Research
Wacker Chemicals East Asia, Ltd.	Herbert Rauh, Technical Manager Chemitronic Division
YAMAHA Corporation	Kazukiyo Ishimura, Director/General Manager Electronics Group Takatoshi Okumura, Manager Digital System Laboratories

YAMAHA Corporation	Shigemitu Yamaoka, Supervisor, Design Section Semiconductor Division
Yamada Seisakusho Co., Ltd.	Tsutomu Kitamura
Yasuda Fire & Marine Insurance	Kazuo Tamayama
Yasuda Trust & Banking	Takenobu Kobayashi
Yokogawa Hewlett-Packard	Kenji Mutaguchi



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JAPANESE INDUSTRY OUTLOOK

Osamu Ohtake
Director
Japan Components Group
Dataquest Japan Limited

Mr. Ohtake is the Tokyo-based Director of Dataquest's Japanese Components Group and Director of the Japanese Semiconductor Industry Service. He is responsible for strategic research on technologies, markets, products, and manufacturers. Prior to joining Dataquest, Mr. Ohtake worked for 10 years as a reporter, and most recently as Components Group Manager, for Dempa Shimbun, a daily electronics industry newspaper published in Japan. He has also authored reports on the Japanese VLSI project and on the semiconductor materials and equipment markets. A native Japanese, Mr. Ohtake is a graduate of Tokyo Denki University, where he specialized in Communications.

Dataquest Incorporated
JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE
April 11-12, 1988
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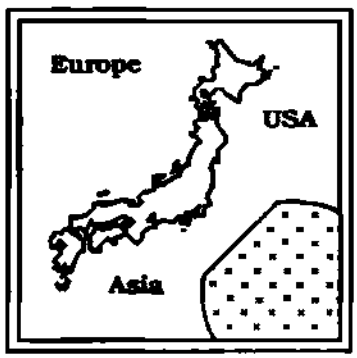

Japan's New International Role:
Competition and Cooperation

JAPANESE INDUSTRY OUTLOOK

OSAMU OHTAKE

Director
Japanese Components Group
Dataquest Japan Limited

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CONTENT

- Competition
- Cooperation
- Japan's new roles
- Conclusions

WORLD SEMICONDUCTOR SHARE

(Millions of Dollars)

	1977	1982	1987P
Japan	$1,736	$5,375	$17,800
Europe	1,015	1,929	4,000
North America	4,179	7,829	14,200
ROW	14	98	600
Total	$6,944	$15,231	$36,600

Source: Dataquest

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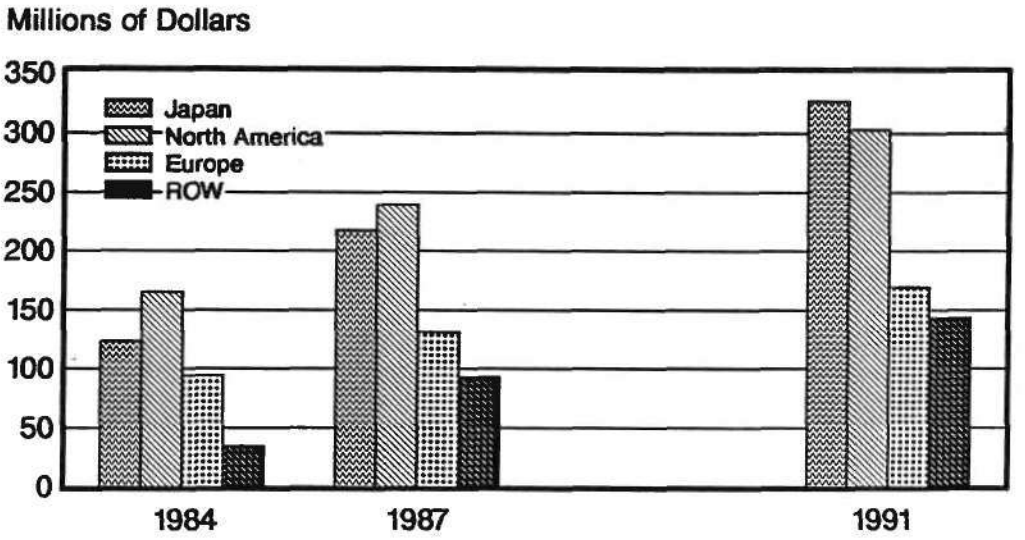
ESTIMATED ELECTRONICS EQUIPMENT SHIPMENTS



Source: Dataquest

PERCENTAGE OF PAPERS AT ISSCC

(By Country of Origin)

	1986	1987	1988
Japan	37%	44%	35%
Europe	10	13	11
North America	53	43	54
Total	100%	100%	100%

Source: Dataquest

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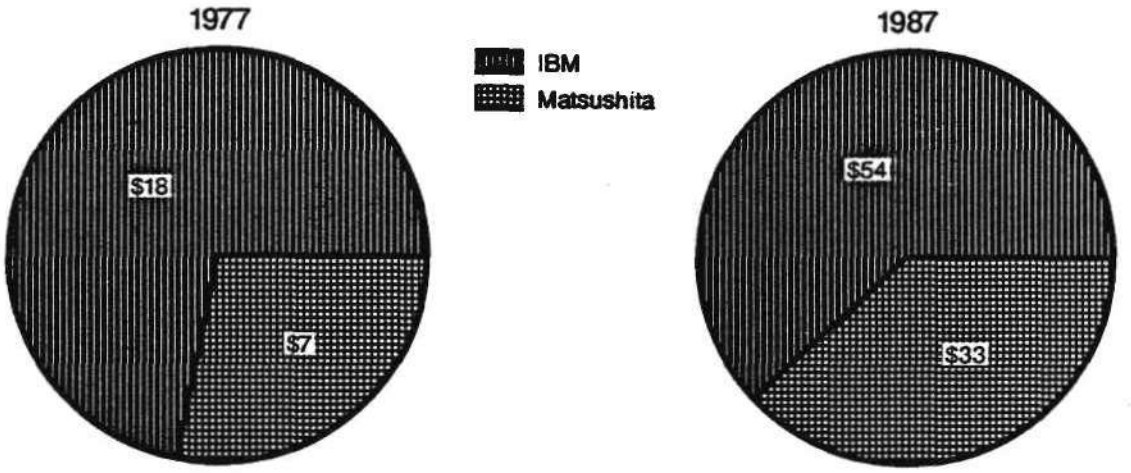
CHANGING THE WORLD

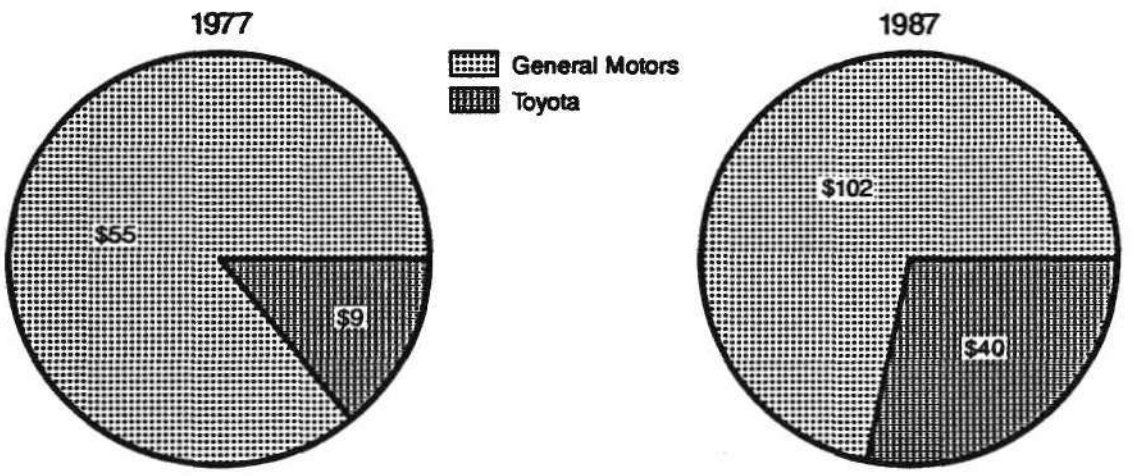
(Revenue, Billions of Dollars)



Source: Dataquest

CHANGING THE WORLD

(Revenue, Billions of Dollars)



Source: Dataquest

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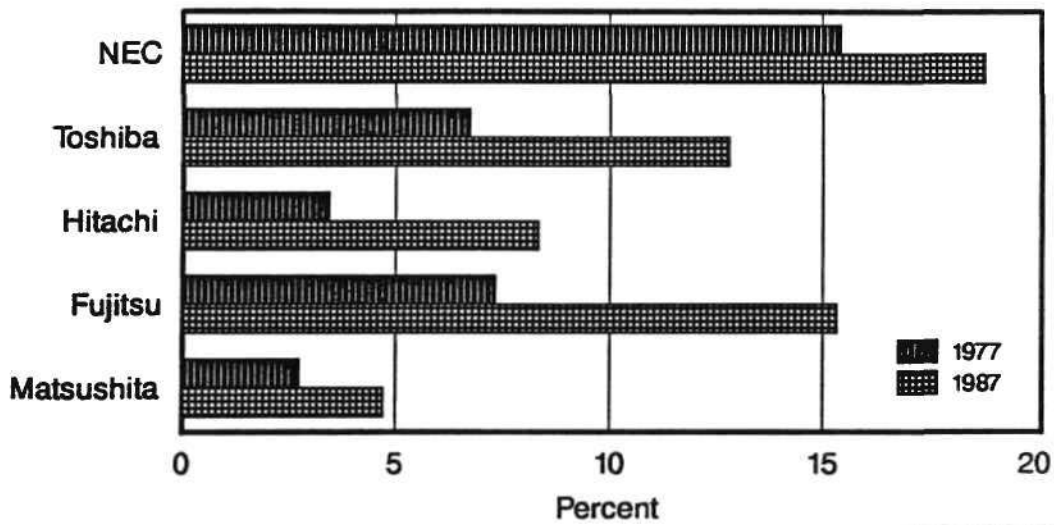
RATIO OF SEMICONDUCTOR REVENUE VS. TOTAL REVENUE



Source: Dataquest

COMPETITION: MEMORY JAPAN'S SHARE IN THE WORLD

(Percentage of Production Units)

	1982	1987
64K DRAM	66%	58%
256K DRAM	100%	65%
1Mb DRAM	N/A	98%

N/A = Not Applicable

Source: Dataquest

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COMPETITION: MICRO
JAPAN'S SHARE IN THE WORLD

(Percentage of Production Units)

	1982	1987
4-Bit MCU	72%	62%
8-Bit MCU	27%	45%
8-Bit MPU	23%	25%
16-Bit MPU	11%	30%

Source: Dataquest

COMPETITION: ASICs
JAPAN'S SHARE IN THE WORLD

(Percentage of Worldwide ASICs)

	1983	1987
ASIC Total	49%	42%
Gate Array	37%	47%
PLD	-	-
CBIC	5%	19%

Source: Dataquest

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COOPERATION: JOINT VENTURES

History of Joint Ventures in Japan

Year	Japanese Company	Partner	Status
1952	Matsushita	Philips	MEC
1960	NJRC	Raytheon	NEW JRC
1963	Kyosan	IR	Nihon IR
1968	Sony	TI	Discontinued
1972	TDK	Fairchild	Discontinued
1973	Alps Electric	Motorola	Discontinued
1985	Kawasaki Steel	LSI Logic	Nihon Semicon.
1987	Toshiba	Motorola	Tohoku Semicon.

Source: Dataquest

COOPERATION: JOINT VENTURES

Joint Ventures Outside Japan by Japanese Companies

Year	Japanese Company	Partner	Status
1971	Seiko	Micro Power	-
1971	Rohm	Exar	-
1985	Mitsubishi Electric	Westinghouse GE	Powerex -
1986	Sharp	RCA	Discontinued

Source: Dataquest

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COOPERATION: ALLIANCES

Japanese Semiconductor Strategic Alliances

	1980	1981	1982	1983	1984	1985	1986	1987
Semiconductor Makers								
Joint Ventures	1	1	5	3	11	32	16	30
Licensing Agreements	2	5	5	11	19	22	60	33
Equipment Manufacturers	0	5	12	8	26	17	25	15
Total	3	11	22	22	56	71	101	78*

*Preliminary

Source: Dataquest

NEW ROLE: PRODUCTION CONTROL

Advantages:	No dumping
	Positive aspects for suppliers with major market share
Disadvantages:	Negative impact on end users
	Negative consequences for Europe and ROW

Source: Dataquest

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NEW ROLE: MARKET ACCESS

Advantages:

- Reduced trade friction
- Less expensive imports due to high yen
- New technology and software

NEW ROLE: MARKET ACCESS

Disadvantages:

- Declining domestic market share (merchant and captive)
- Quality and lead time problems

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NEW ROLE: OVERSEAS PRODUCTION

Japanese Semiconductor Plants Outside Japan

Year	Company	Location	Status	Remarks
1967	Hitachi	Taiwan	Assembly	
1971	Rohm	U.S.	Full	Exar
1970	Sanyo	Brazil	Assembly	
1972	Sanyo	Korea	Assembly	Tokyo Silicon
	Hitachi	Malaysia	Assembly	
1974	Toshiba	Malaysia	Assembly	
1976	NEC	Malaysia	Assembly	
	NEC	Ireland	Assembly	
	Sanyo	Taiwan	Assembly	
1978	Matsushita	Singapore	Assembly	

(Continued)

NEW ROLE: OVERSEAS PRODUCTION

Japanese Semiconductor Plants Outside Japan

Year	Company	Location	Status	Remarks
1979	Toshiba	Mexico	Full	
1978	NEC	U.S.	Full	Electronic arrays
1980	Fujitsu	Ireland	Assembly	
1980	Hitachi	W. Germany	Assembly	
1981	Fujitsu	U.S.	Assembly	
1982	Toshiba	W. Germany	Assembly	
	NEC	U.K.	Assembly	
1984	NEC	U.S.	Full	Roseville, CA
	Sanyo	PRC	Assembly	

(Continued)

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NEW ROLE: OVERSEAS PRODUCTION

Japanese Semiconductor Plants Outside Japan

Year	Company	Location	Status	Remarks
1985	Mitsubishi	U.S.	Assembly	
1986	Fujitsu	Singapore	Assembly	

CONCLUSIONS

- Competition and cooperation will continue
- Industry needs to have win-win relationships
- Japan is expected to take on new roles in the world

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CONCLUSIONS

Japan's New Roles

- Behave as world leader
- No dumping
- Create new products and markets
- One-way exports are unacceptable
- Importance of market access

CONCLUSIONS

Japan's New Roles

- Technology transfer
- Overseas productions
- Joint ventures and alliances

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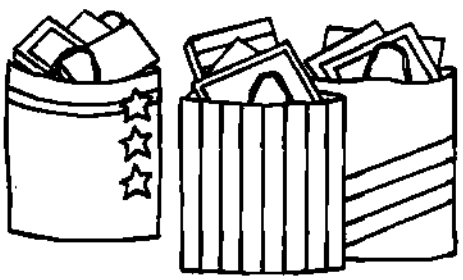
FAVORITE SHOPPING ITEMS

Japan	Cameras, camcorders, pocket TVs, and kimonos
France	Gucci, Hermes, Louis Vuitton, and wines
Germany	Mercedes, BMWs, Solingens, and cutlery
Italy	Shoes and belts
U.S.	Beef, hamburger, and chocolate



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Dataquest

a company of
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WORLD SEMICONDUCTOR OUTLOOK

Gene Norrett
Corporate Vice President and Division General Manager
Components Division
Dataquest Incorporated

Mr. Norrett is a Corporate Vice President of Dataquest and General Manager of its Components Division. In this capacity, he has direct responsibility for all U.S. research and coordinates European and Japan-based research. Prior to becoming Division General Manager, he founded Dataquest's Japanese Semiconductor Industry Service and was Acting Managing Director of Dataquest Japan K.K. Before joining Dataquest, Mr. Norrett spent 14 years with the Motorola Semiconductor Product Sector, serving in various marketing and management positions. He has traveled extensively in Japan, Hong Kong, Taiwan, Korea, China, and Europe. Mr. Norrett's educational background includes a B.A. degree in Mathematics from Temple University and an M.S. degree in Applied Statistics from Villanova University. He has also taken graduate courses in Marketing from Arizona State University.

Dataquest Incorporated
JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE
April 11-12, 1988
Tokyo, Japan

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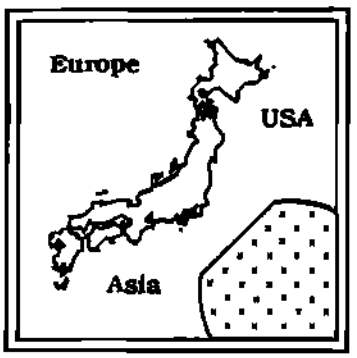

Japan's New International Role:
Competition and Cooperation

WORLD SEMICONDUCTOR OUTLOOK

GENE NORRETT

Corporate Vice President and Division General Manager
Components Division
Dataquest Incorporated

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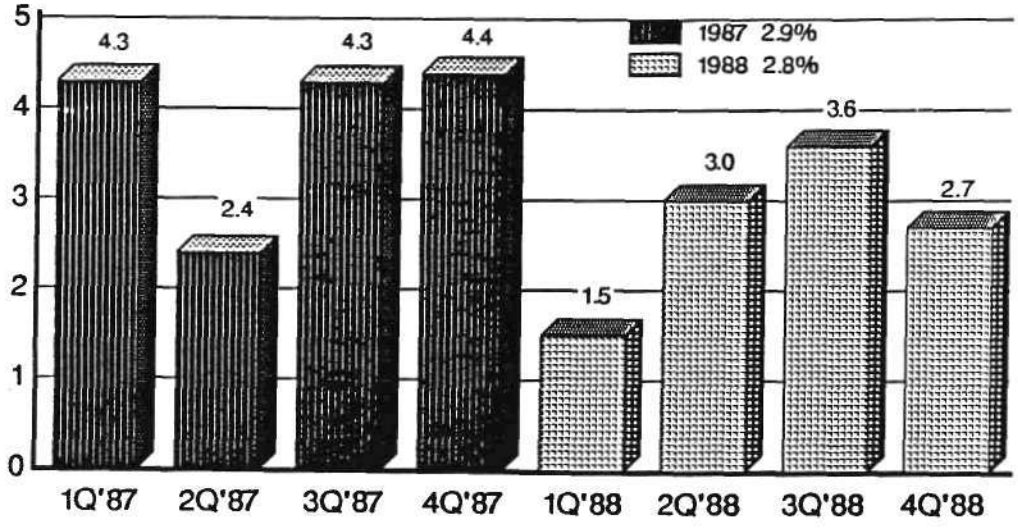
AGENDA

- Economics
- Electronics industry
- Semiconductor industry
- Forecast
- Summary

U.S. REAL GNP GROWTH

(Estimated Percent Change at Annual Rates)



Source: Dataquest

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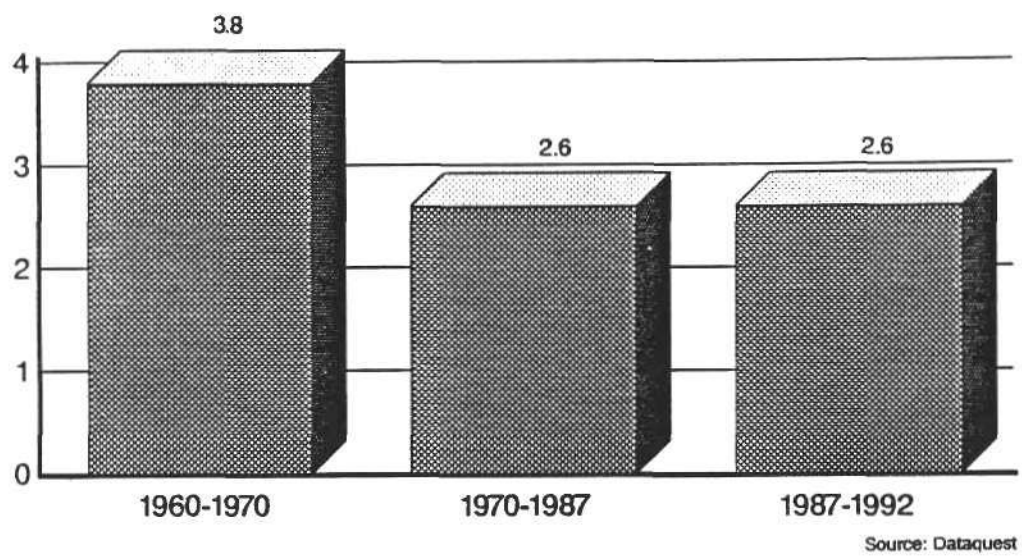
Recession Unlikely in 1988

U.S. REAL GNP GROWTH

(Estimated Percent Change at Annual Rates)



Source: Dataquest

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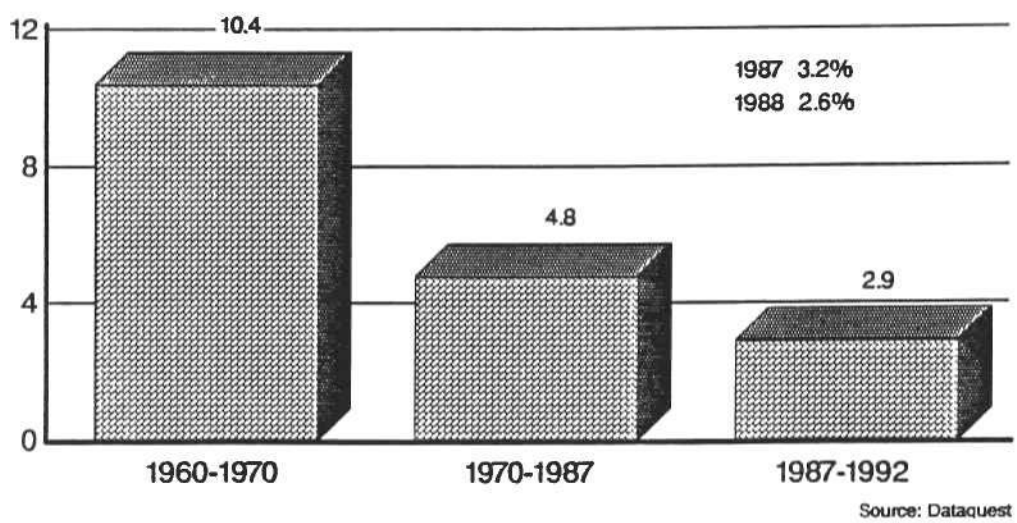
BENEFITS OF MODERATE GROWTH

- Lower inflation
- Lower dependence on foreign capital
- More stability

JAPAN: REAL GNP GROWTH

(Estimated Percent Change at Annual Rates)



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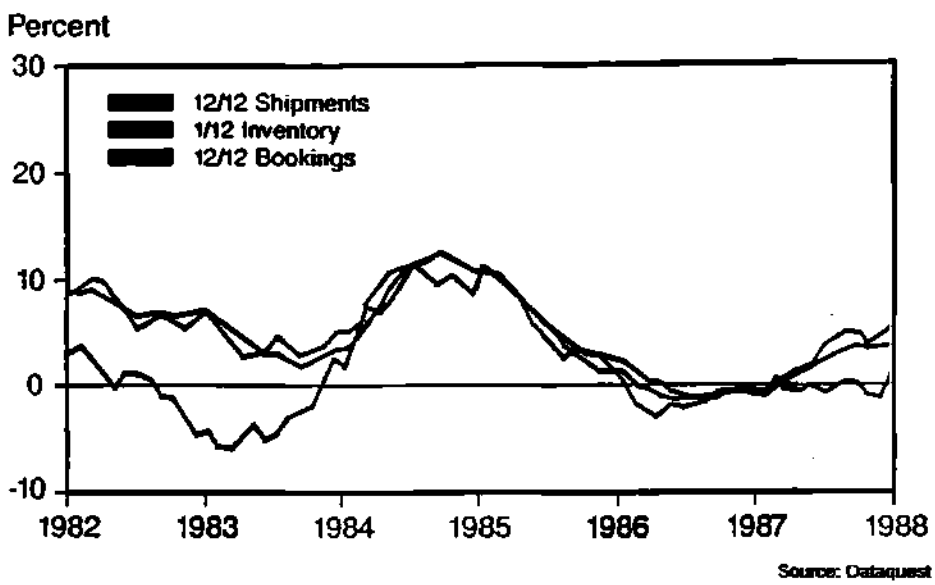
ELECTRONICS INDUSTRY

U.S. ELECTRONIC INSTRUMENTS

Rate of Change



Source: Dataquest

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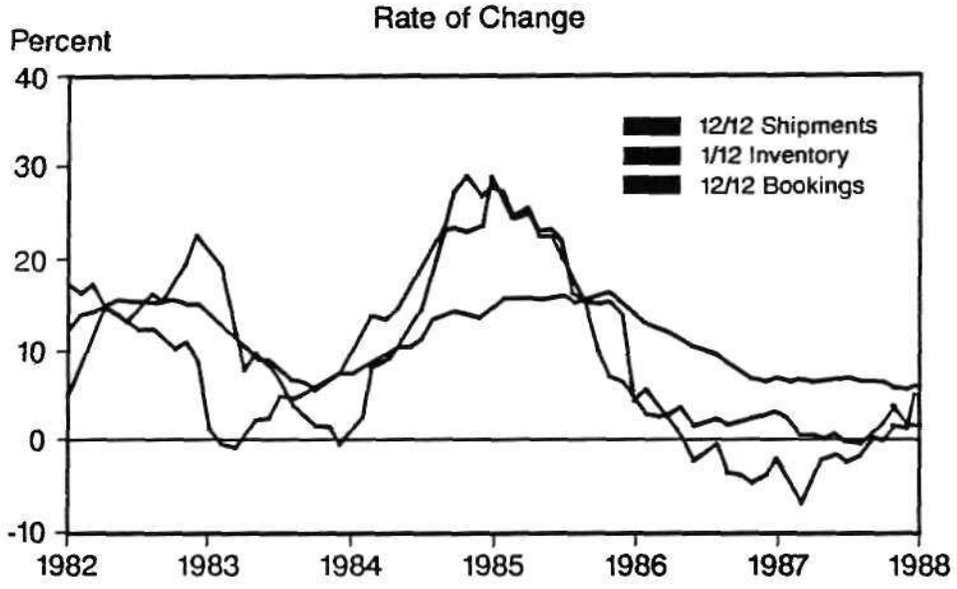
COMMUNICATIONS EQUIPMENT

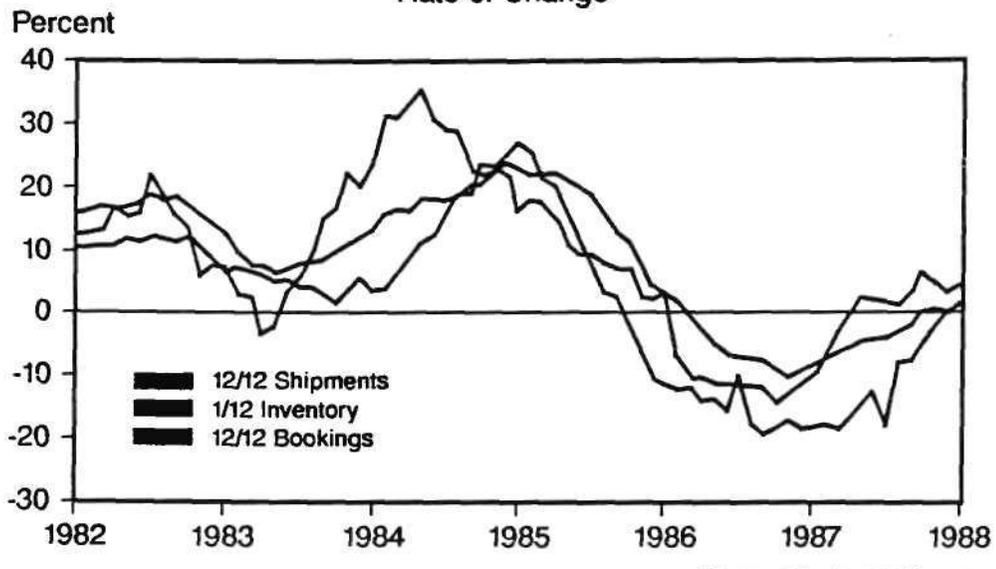
Rate of Change



Source: Department of Commerce
Dataquest

COMPUTERS AND OFFICE MACHINES

Rate of Change



Source: Department of Commerce
Dataquest

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U.S. PERSONAL COMPUTER MARKET

(Millions of Dollars)

	1987	1988	Percent Growth
Personal Computers	$19,725	$23,073	17.0%
Less than $1,000	1,244	1,340	7.7%
$1,000 to $5,000	13,958	15,718	12.6%
$5,000 to $10,000	4,523	6,014	33.0%

Source: Dataquest

NORTH AMERICAN ELECTRONIC EQUIPMENT FORECAST

(Billions of Dollars)

	1986	1987	Percent Change 1986-1987	1988	Percent Change 1987-1988
Data Processing	$ 92.3	$101.9	10.4%	$111.8	9.7%
Communications	24.9	27.0	8.1%	29.5	9.3%
Industrial	32.7	35.2	7.7%	39.1	11.1%
Consumer	17.0	18.4	7.9%	19.1	3.8%
Military	49.7	47.5	(4.4%)	46.9	(1.3%)
Transportation	9.6	10.8	12.8%	11.8	9.3%
Total	$226.2	$240.7	6.4%	$258.2	7.3%

Source: Dataquest

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SEMICONDUCTOR INDUSTRY

WORLD SCOREBOARD

Worldwide Semiconductor Market Shares
(Millions of Dollars)

1987 Rank	1986 Rank		1986 Sales	1987 Sales
1	1	NEC	2,638	3,193
2	3	Toshiba	2,276	2,939
3	2	Hitachi	2,307	2,781
4	4	Motorola	2,025	2,450
5	5	Texas Instruments	1,781	2,125
6	6	Fujitsu	1,365	1,899
7	8	Philips - Signetics	1,258	1,597
8	11	Intel	991	1,500
9	10	Mitsubishi	1,136	1,481
10	9	Matsushita	1,206	1,479

Source: Dataquest

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THE "REGIONS" SCOREBOARD

Semiconductor Revenue
(Billions of U.S. Dollars)
United States

		1986	1987	% Change
1	Motorola	1.309	1.684	21%
2	Texas Instruments	.845	.980	16%
3	Intel	.629	.910	45%
4	National/Fairchild	.832	.848	2%
5	AMD/MMI	.515	.613	19%

Source: Dataquest

U.S. MARKET STATUS

- Book-to-bill ratio for February = 1.18
- Backlogs rising rapidly
- Third quarter slump?
- Computer, communications, and automotive very healthy
- ASIC revolution
- DRAM shortage!!

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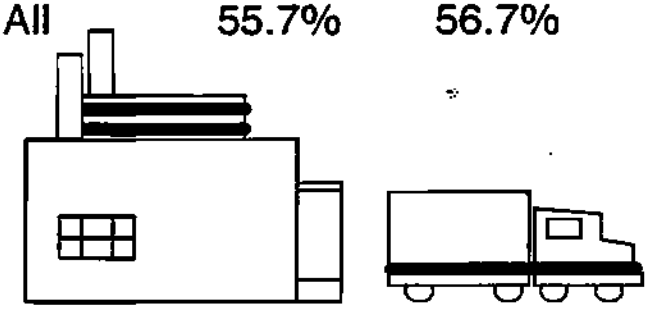
WHAT DID THEY SAY?

Anticipated Shift to Offshore Production

	1986	1987	1988
A Great Deal	8.4%	10.1%	3.3%
Some	35.9%	33.2%	34.0%
Not at All	55.7%	56.7%	62.7%



Source: Dataquest

EUROPEAN MARKET STATUS

- Book-to-bill ratio for February = 1.15
- DRAM shortage affecting medium-size OEMs
- Inventories increasing due to imbalances
- U.K. telecom and PC compatibles
- Audi/VW/MB refocusing product strategies
- Capital investments picture:

+	-
U.K.	Germany
Italy	
Spain	
France	

- France privatization

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JAPANESE MARKET STATUS

- Consumer electronics market down 8.4% (yen base, 1987/88)
- Industrial electronics up 4.1% (yen base, 1987/88)
- U.S. companies gaining share but very slowly
- 4M DRAM sampling in Q2
- Korea and Taiwan pushing for market access
- Toshiba ramping factories

ASIAN MARKET STATUS

- Total 1988 semiconductor consumption growth = >35%
- Korean and Taiwanese currencies appreciating
- PC manufacturers not getting 1M DRAMs
- Japanese factories up and running

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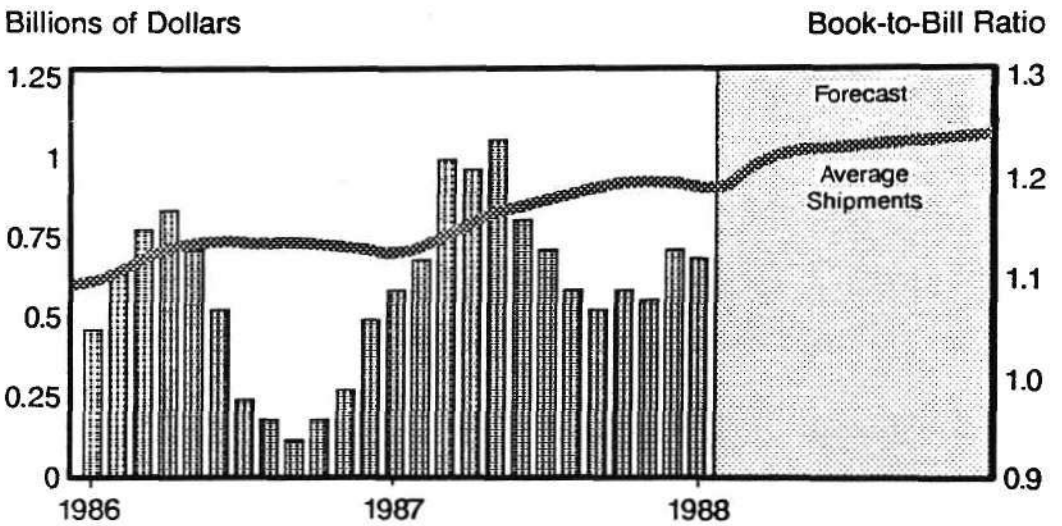
FORECAST

U.S. SEMICONDUCTORS

Three-Month Average Shipments and Book-to-Bill Ratio



Source: WSTS
Dataquest

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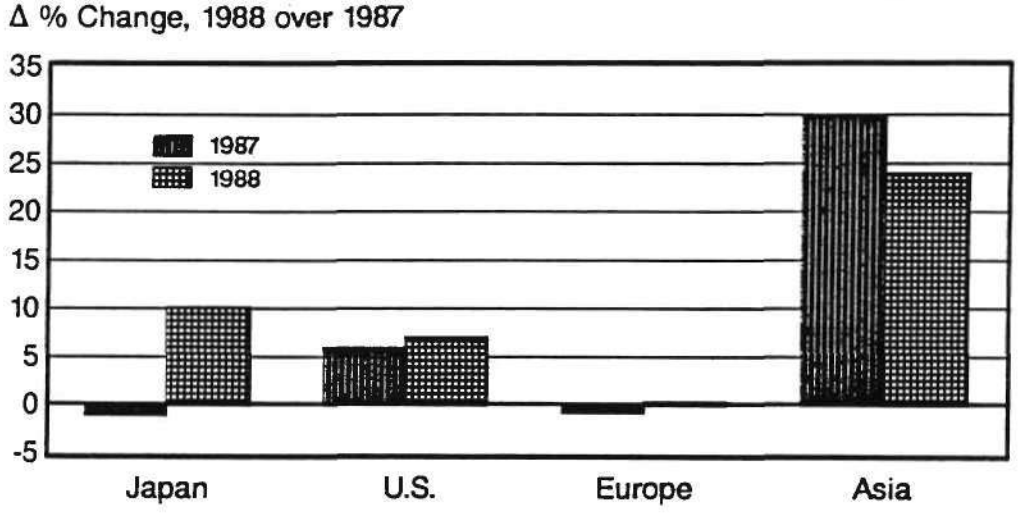
1988 ELECTRONICS MARKETS

World by Region

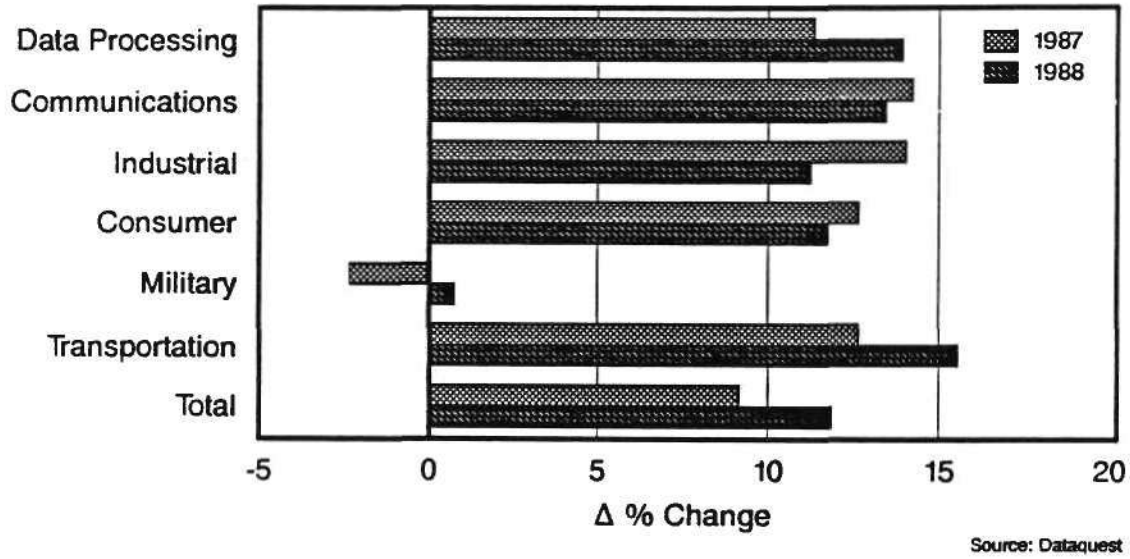


Note: Japan and Europe are in local currency to reflect appreciation of yen and ECU

Source: Dataquest

1988 ELECTRONICS MARKETS

World by Application



Source: Dataquest

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ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION

March 1987
Percent Change, U.S. Dollars

	1986	1987	1988
North America	6.2%	15.5%	23.9%
Japan	43.7%	15.9%	19.0%
Europe	17.2%	21.4%	19.9%
ROW	52.6%	35.5%	30.3%
Total World	24.8%	18.6%	22.0%

Source: Dataquest

ESTIMATED WORLDWIDE SEMICONDUCTOR CONSUMPTION

March 1988
Percent Change, U.S. Dollars

	1986	1987	1988
North America	6.2%	21.4%	21.1%
Japan	43.7%	19.4%	20.7%
Europe	17.2%	12.2%	14.0%
ROW	53.9%	62.1%	31.5%
Total World	24.9%	22.8%	21.1%

Source: Dataquest

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HIGH-GROWTH PRODUCTS

(Estimated Percent Growth)

	1987	1988
Micros Total	33%	23%
MPUs Total	63%	42%
32 bit	228%	121%
MCUs Total	32%	16%
16 bit	13%	139%
MPRs	26%	24%
ASIC Total	22%	23%
Gate Arrays	34%	32%
PLDs	35%	40%
CBICs (Cell-Based ICs)	36%	37%
Linear ICs	17%	19%
Digital ICs	29%	25%

Source: Dataquest

SOME EMERGING MARKETS

- Chip sets
  - PC system logic
  - Graphics
  - Disk controller
  - Modem/fax
  - Telecom (LAN, ISDN)
  - Micro Channel
- Linear ASIC
- Smart power

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SUMMARY

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Dataquest
a company of
The Dun & Bradstreet Corporation

WHO'S WINNING?

Warren E. Davis
Vice President
Semiconductor Industry Association

Mr. Davis is Vice President of the Semiconductor Industry Association (SIA), the trade organization that represents the American semiconductor industry. His focus has been international trade policy and more recently, policies and practices to enhance the industry's manufacturing competitiveness. Prior to joining the SIA, Mr. Davis taught courses at San Jose State University on international business finance and management of global enterprises. Earlier, he worked at Fairchild Camera and Instrument Corporation in a senior staff capacity, coordinating projects in strategic planning, international logistics and offshore manufacturing. Mr. Davis received a degree in Political Science from the University of Southern California and an M.S. degree in Business Administration from California State University at Sacramento. He has published several books and articles on the semiconductor industry.

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April 11-12, 1988
Tokyo, Japan

WHO'S WINNING?

By

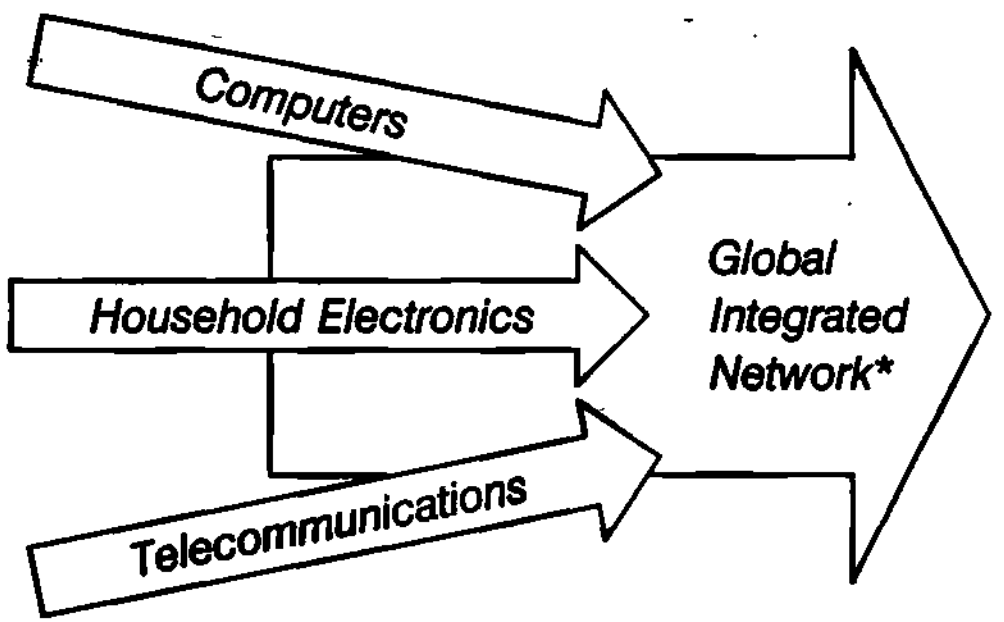
Warren Davis

Vice President

Semiconductor Industry Association

SIA

CONVERGENCE OF TECHNOLOGIES



**Digital Broadband Serves All Users: Office, Household, Factory*

SIA

Source: SIA

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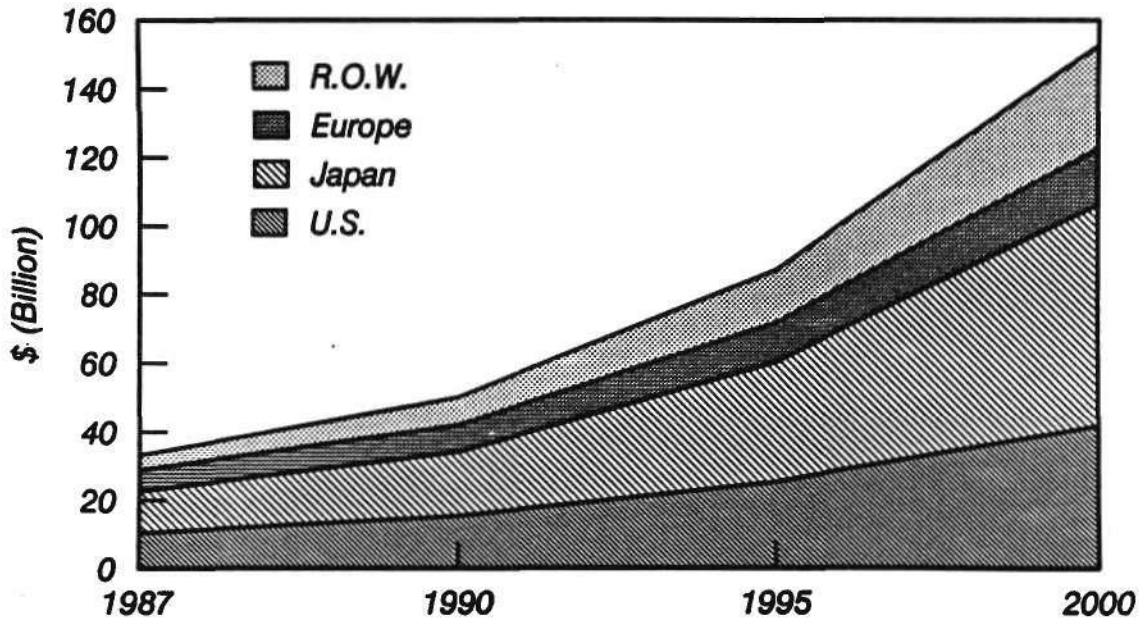
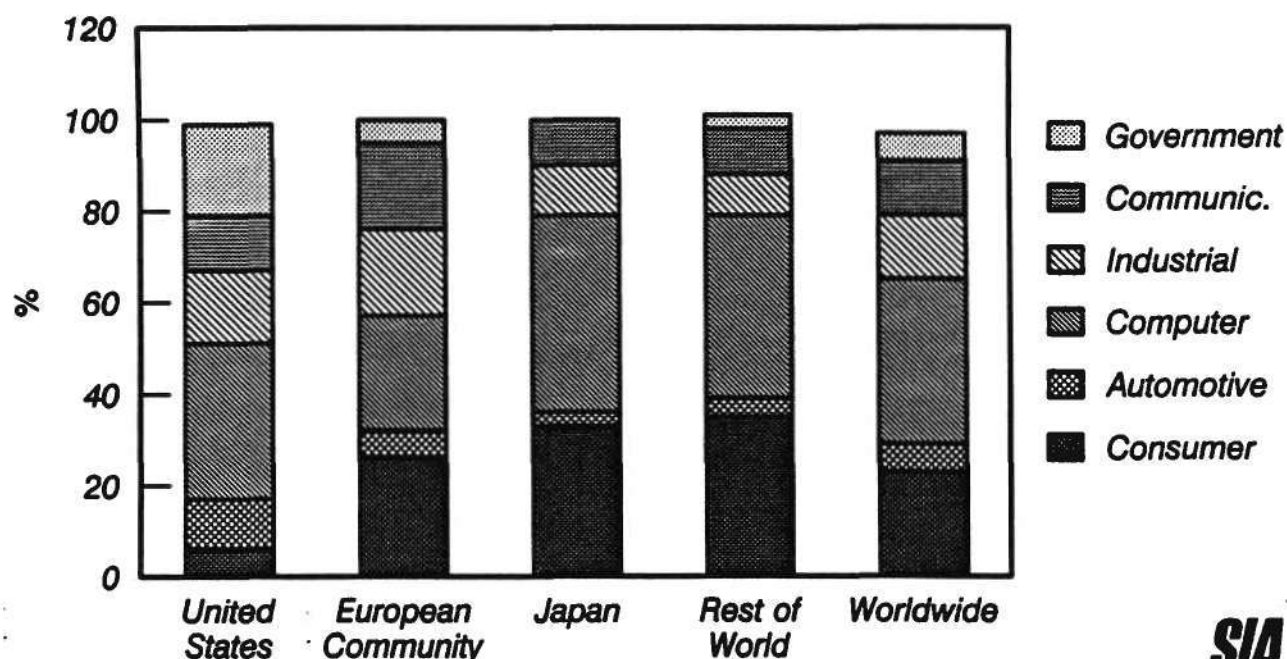
SEMICONDUCTOR CONSUMPTION FORECAST BY GEOGRAPHIC MARKET



SIA

Source: SIA

SEMICONDUCTOR CONSUMPTION - 1986 BY END USE/GEOGRAPHIC MARKET



SIA

Source: SIA

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TERMS OF COMPETITION

- *Governments Matter: GATT, Bilateral, National Policies*
- *New Manufacturing Paradigm: Flexible Response*
- *International Strategic Alliances*
- *Innovation: Auto Fab, Supercomputer on a Chip*
- *Production Sharing: Silicon Foundries*
- *New Competitive Parameters: International Standards*

SIA

WHO ARE THE PLAYERS?

- *Japan*
- *United States*
- *Europe*
- *Rest of World*

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JAPAN STRATEGY

- *Memory Thrust, Then Diversify to Semi-Custom and Custom*
- *Overseas Investment to Offset Yen Appreciation*
- *Heavy Dependence on U.S. Market*
- *Rapid Application of New Technologies*
- *Set National Standards, Then Use Marketpower to Impose Internationally*

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U.S. STRATEGY

- *Trade Policy Leadership*
- *Manufacturing Development Collaboration*
- *Restructure: Mergers, "Virtual" Integration*
- *Bring Product Strengths to Bear on All High Volume Customer Segments*

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EUROPE STRATEGY

- *Unification of EC - 1991*
- *Cooperation Between National Champions*
- *More Aggressive in International Markets*
- *Leverage on Under-Utilized Market Base in Western Europe*

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REST OF WORLD STRATEGY

- *Asian NICs (Korea, Taiwan):*
  - *Graduated to Technology - Intensive Capability*
  - *Emulate Japan Financial Model for High Powered Growth*
  - *Shifting Exports to Alternative Markets to Lessen Dependence on U.S. Market*

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REST OF WORLD STRATEGY (CONTINUED)

- *Asian City States (Singapore, Hong Kong):*
  - *Gravitational Pull from China*
  - *Incentives for Foreign Investments with High Technological Content*

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REST OF WORLD STRATEGY (CONTINUED)

- *Latin America (Brazil, Mexico):*
  - *Import Substitution Model*
  - *Limited Export Emphasis*

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REST OF WORLD STRATEGY (CONTINUED)

- *China*
  - *Seeks GATT Membership*
  - *Stressing Lowest Cost Assembly and Silicon Foundry Services*
  - *Gigantic Market/Technology Transfer Trade-Off*

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CRYSTAL BALL (1990s DIMLY PERCEIVED)

- *Commodity IC Manufacturing Shift to Asian NICs, China*
- *New International Division of Labor - Knowledge Worker Scarcity*
- *Global Information Services - International Consortia in Triad*

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CRYSTAL BALL (CONTINUED)

- *R&D Internationalized*
- *Leading IC Companies Reorganized for Design Creativity, Production Flexibility, "Augmented Product" Marketing*
- *GATT Rules Negotiated for Establishment of International Standards in Electronics*

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INSEC'S ACTIVITIES IN THE PAST YEAR

Masato Nebashi
President
International Semiconductor Cooperation Center

Mr. Nebashi is President of the International Semiconductor Cooperation Center and of the New Media Development Association. Previously, he was Vice President of the Interactive Basic Information System Development Corporation. Earlier, he held a variety of administrative positions with IBM Japan, Ltd., the VLSI Technology Development Association, the Agency of Industrial Science and Technology, and MITI. Mr. Nebashi received a B.S. degree in Electrical Engineering from Nagoya University.

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JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE
April 11-12, 1988
Tokyo, Japan

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TIME OF PUBLICATION

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Atsuyoshi Ouchi
Vice President of the Board and Representative Director
NEC Corporation

Dr. Ouchi is Vice President of the Board and Representative Director of NEC Corporation. He has been with NEC since 1942 and has held a variety of senior-level management positions over the past 20 years. He is a member of several electronics organizations and has received many awards and commendations. He has also written books, two of which are entitled Medical Electronic Circuits and Introduction to Microcomputers. Dr. Ouchi graduated from the Electrical Engineering Department, Faculty of Technology, Tokyo Imperial University and received a B.E. degree. He also received a D.E. degree from the University of Tokyo for research in the applications of negative impedance converters.

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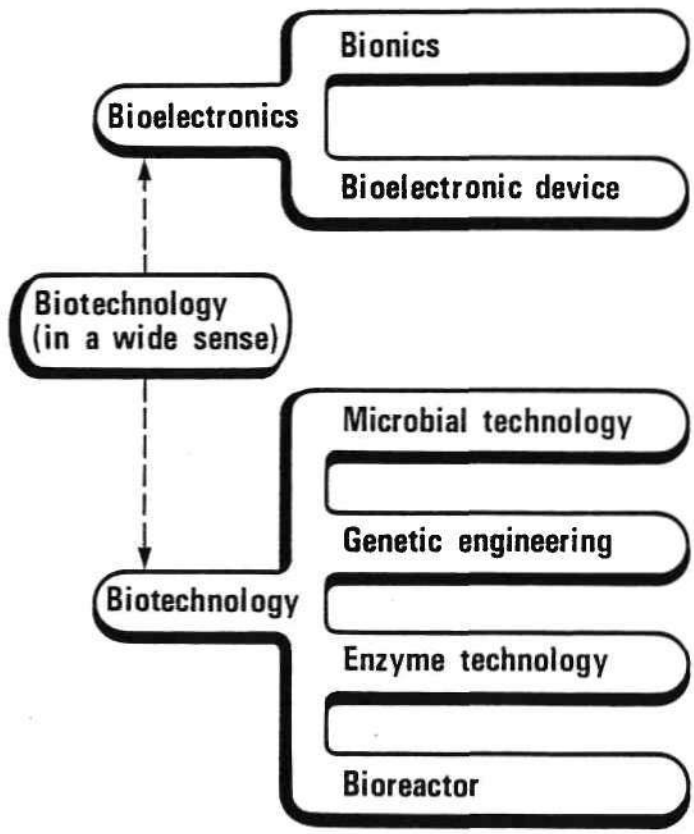
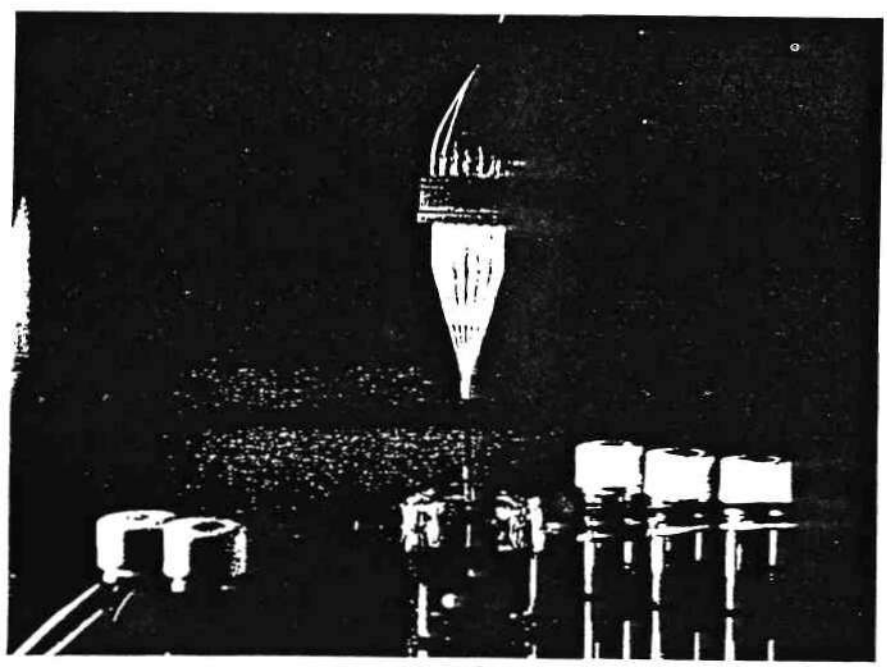
Field of Biotechnology and Bioelectronics



Biosensor



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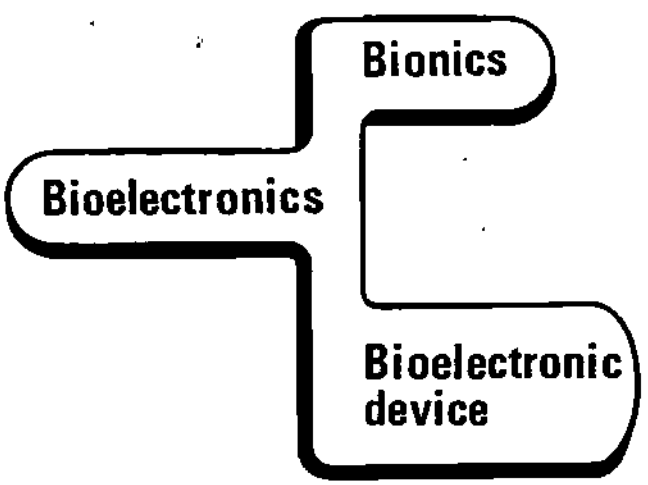
Process of Technological Innovations

	I	II	III	IV
Technological Innovations	Batteries• Electromagnets Steam Engines	Vacuum Tubes Telecommunications Electricity Internal Combustion Engines Machine Tools	Semiconductor •IC Computers Optical Communication Nuclear Power Jet Engines Robots	Molecular Devices• Quantum Effect Devices Artificial Intelligence Nuclear Fusion Maglev Trains
Materials	Smelted Metals	High Purity Materials Synthesized Materials	Semiconductors Functional Materials	High Tc Superconductors Biotechnology
Social Change	Industrial Revolution	Industrialization	Information Oriented Society	Software and Service Oriented Society



- artifitial intelligence
- pattern recognition
- self-organizing network
- neuron-like device
- molecular electric device
- olfactory sensor
- biosensor

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STATUS OF JAPAN-U.S. SEMICONDUCTOR TRADE PROBLEMS

Yukio Honda
Director, Industrial Electronics Division
Machine and Information Industries Bureau
Ministry of International Trade and Industry (MITI)

Mr. Honda is Director of the Industrial Electronics Division in the Ministry of International Trade and Industry (MITI). Since joining MITI in 1967, Mr. Honda has held a variety of positions including Technology Deputy Director of the Ocean Department Office, Agency of Natural Resources, and Information Industries Bureau; and Director of the Space Industry Office, Machine and Information Industries Bureau. Prior to being appointed to his present position, Mr. Honda was temporarily transferred to the Technological University of Nagaka as a professor for two years.

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THE ASIAN AGE IS COMING

Tom Wang
Director, Asian Components Group
Associate Director
Asian Semiconductor and Electronics Technology Service
Dataquest Incorporated

Mr. Wang is Director of Dataquest's Asian Components Group and Associate Director of the Asian Semiconductor and Electronics Technology Service. He is responsible for strategic research of the semiconductor and electronics industries of Korea, Taiwan, Hong Kong, Singapore, China, India, and other parts of Asia. Prior to joining Dataquest, Mr. Wang was employed at National Semiconductor as Applications Manager and Market Research Manager. Earlier, he worked as a Project Leader designing mainframes, personal computers, and disk drive controllers at several systems houses. He has also taught graduate courses at San Jose State University. Mr. Wang received B.S.E.E. and M.S.E.E. degrees from National Cheung Kung University in Taiwan, an M.S.E.E. degree from San Jose State University, and an M.B.A. degree from Golden Gate University in San Francisco. He has also completed courses toward a Ph.D at the University of California at Berkeley. In addition, he has published a textbook and 25 technical papers and is fluent in Mandarin, Cantonese, and Taiwanese.

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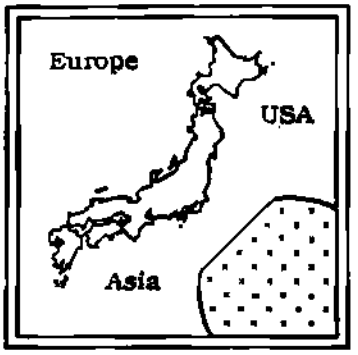

Japan's New International Role:
Competition and Cooperation

THE ASIAN AGE IS COMING

TOM WANG
Associate Director
Asian Semiconductor and Electronics
Technology Service
Dataquest Incorporated

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AGENDA

- Asian semiconductor industry outlook
- Semiconductor manufacturers in Asia
- Key issues in 1988
- Summary and conclusion

ASIAN SEMICONDUCTOR INDUSTRY OUTLOOK

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- Market growing drastically
- Competition increasing significantly
- Manufacturing moving offshore
- Business opportunities growing

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SEMICONDUCTOR CONSUMPTION

(Millions of U.S. Dollars)

	1985	1986	1987*
South Korea	$436	$624	$1,101
Taiwan	$496	$694	$1,171
Hong Kong	$334	$478	$ 806
Singapore	$271	$350	$ 590

* Estimated

Source: Dataquest

ESTIMATED SEMICONDUCTOR CONSUMPTION

(Billions of U.S. Dollars)

	1986	1987	1988	1992
ROW	$ 2.9	$ 4.9	$ 6.3	$11.8
Europe	$ 5.5	$ 6.8	$ 7.5	$11.9
Japan	$12.4	$14.5	$17.4	$27.5
United States	$10.2	$12.5	$14.2	$20.2

Source: Dataquest

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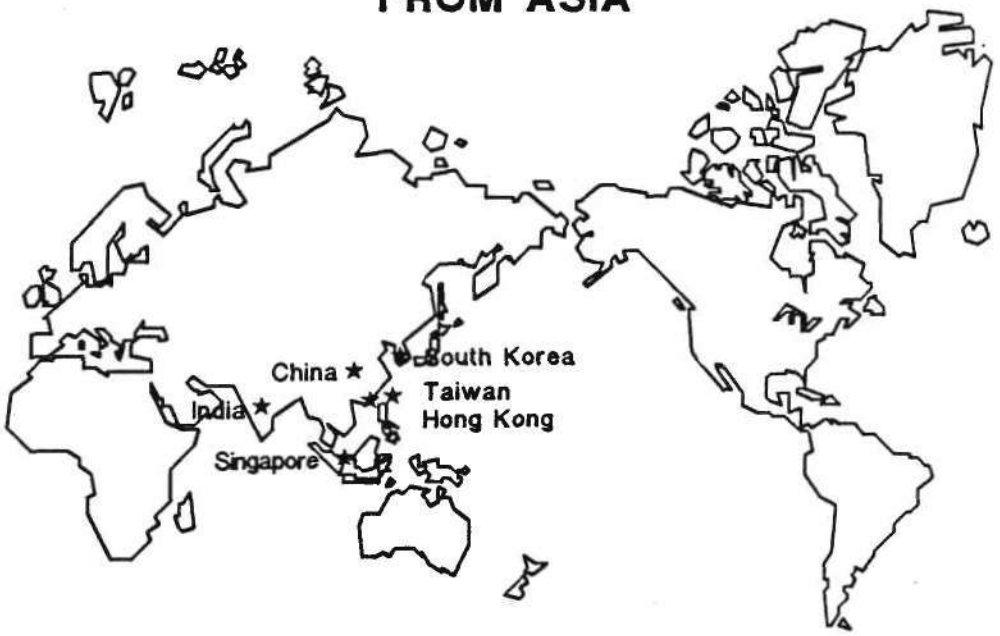
COMPETITION INCREASING SIGNIFICANTLY FROM ASIA



COMPETITION FROM THE 4 "Cs"

- Consumers
- Computers
- Communications
- Semi-Conductors

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SEMICONDUCTOR PRODUCTION

(Millions of U.S. Dollars)

Company	1986	1987*	Growth Rate
Samsung	$170	$317	86.5%
GoldStar	$ 48	$ 68	41.7%
KEC	$ 50	$ 78	56.0%
UMC	$ 68	$ 90	32.4%

* Estimated

Source: Dataquest

COMPETITION IN MEMORY CHIPS

	Samsung	GoldStar	Hyundai
1M DRAM			
Mass Production	2Q '88	3Q '88	4Q '88
Wafer Size	6"	6"	6"
Design Rule	1.2µm	1.2µm	1.2µm
Capacity (Wafer/Day)	100–600	600	300
4M DRAM			
Mass Production	3Q '89	3Q '89	3Q '89

Source: Dataquest

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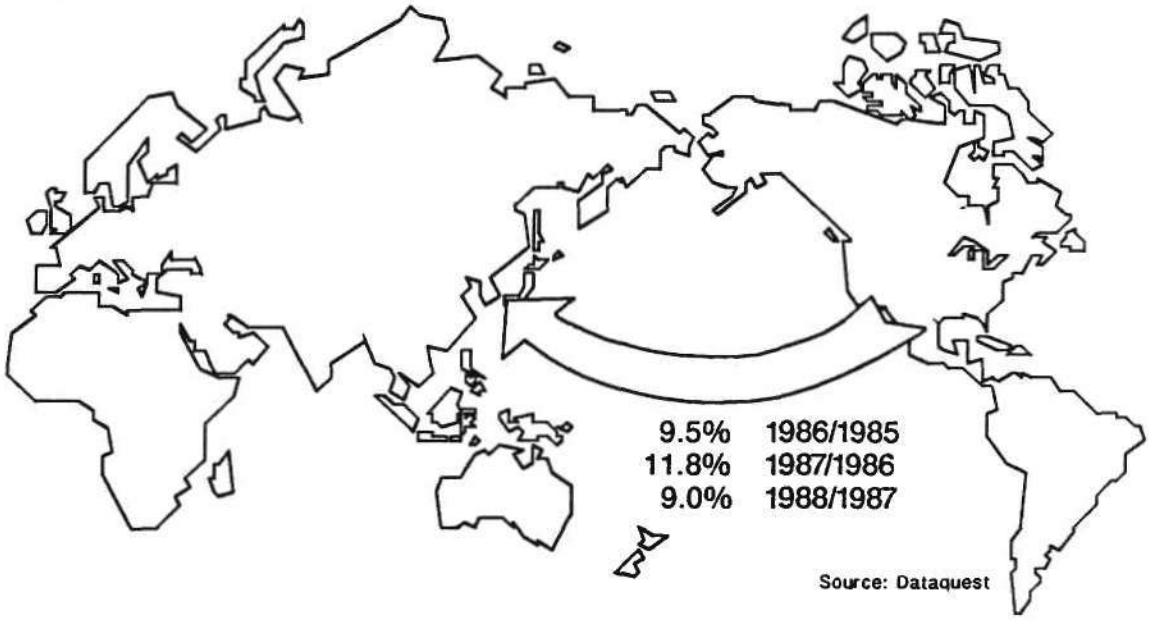
ESTIMATED PERCENT OF U.S. SEMICONDUCTOR CONSUMPTION MOVING OFFSHORE



MAIN REASONS FOR MOVING OFFSHORE

Before:

Low labor cost

Now:

Low labor cost + superior talent
+closeness to market

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FUNCTIONS OF OFFSHORE FACILITY

Before:
Assembly and testing

Now:
Design + fabrication + assembly and testing

OPPORTUNITY

Economic Growth
Real GDP Growth Rates (%)

	1986	1987*	1988*
Taiwan	11.0	10.1	7.3
South Korea	12.4	11.1	8.0
Hong Kong	11.0	12.6	8.9
Singapore	1.9	6.9	5.5
China	8.0	9.7	9.1
Japan	2.4	2.5	3.0
United States	2.2	3.1	2.8
Europe	2.5	2.2	2.0

* Estimated

Source: Dataquest

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OPPORTUNITY

High-Technology Business Opportunities

- Semiconductor manufacturing
- Semiconductor equipment and materials manufacturing
- Systems manufacturing
- Financial opportunities

SEMICONDUCTOR MANUFACTURERS IN ASIA

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SEMICONDUCTOR MANUFACTURERS - SOUTH KOREA

- Samsung
- Goldstar
- Hyundai
- Daewoo
- KEC

SAMSUNG

Sales	$316 million	Sales Channels	Asia - agents Europe - agents U.S. - reps/dist'rs. Big OEMers - direct
Rank	22		
Products	256K DRAMs - 25% 64K DRAMs - 20% CMOS Logic - 25% Linear ICs - 10% Transistors - 20%	New Products	1M DRAMs 512K EPROMs 256K SRAMs CTV/VTR ICs Codec/Combo
Capacity (Wafers/year)	4" BIP - 360,000 5" MOS - 600,000 6" MOS - 200,000		

Source: Dataquest

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GOLDSTAR

Sales	$69 million	Sales Channels	Asia - agents
			Europe - agents
Products	TTL - 30%		U.S. - reps/dist'rs.
	Gate arrays - 20%		Big OEMers - direct
	74HC/HCT - 10%		
	Hybrids - 30%	New Products	1M DRAMs
	Linear ICs - 10%		256K DRAMs
			2Kx8 SRAMs
Capacity	4" BIP - 200,000		8Kx8 SRAMs
(Wafers/year)	5" MOS - 250,000		Fast TTLs

Source: Dataquest

HYUNDAI

Sales	$40 million	Sales Channels	Asia - agents
			Europe - agents
Products	256K DRAMs - 50%		U.S. - reps/dist'rs.
	16K SRAMs - 15%		Big OEMers - direct
	Mask ROMs - 15%		
	MPUs - 10%	New Products	1M DRAMs
	Others - 10%		
Capacity	5" MOS - 120,000		
(Wafers/year)	6" MOS - 480,000		

Source: Dataquest

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DAEWOO

Sales	$10 million	Sales Channels	Asia - agents Europe - agents
Products	Audio ICs - 50% Custom - 50%		U.S. - reps/dist'rs. Big OEMers - direct
Capacity (Wafers/year)	4" BIP - 90,000	New Products	ICs for PC ICs for telecom

Source: Dataquest

KEC

Sales	$78 million	Sales Channels	Domestic - direct International - through Toshiba
Products	Transistors - 70% Linear ICs - 30%	New Products	Linear ICs
Capacity (Wafers/year)	4" BIP - 200,000		

Source: Dataquest

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SEMICONDUCTOR MANUFACTURERS - TAIWAN

- UMC
- ERSO
- TSMC
- Rectron
- Fine
- Others

UNITED MICROELECTRONICS CORPORATION (UMC)

Sales	$90 million	Sales Channels	U.S. - reps./dist'rs.
Rank	50	New Products	PS/2 Model 30 Chip Set SCSI Chips Modem Chip Set Data Communication Chips
Products	Microcomponent & Memory ICs - 36.7% Consumer ICs - 26.3% Telephone ICs - 18.4% Custom ICs - 18.6%		
Capacity (Wafers/Year)	4" MOS - 480,000 6" MOS - 120,000 (Available Nov. 1988)		

Source: Dataquest

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ELECTRONICS RESEARCH AND SERVICE ORGANIZATION (ERSO)

Sales	$30 million
Products	PC Chip Set Consumer ICs Custom ICs Combo

Source: Dataquest

TAIWAN SEMICONDUCTOR MANUFACTURING COMPANY (TSMC)

Product	Foundry
Capacity (Wafers/Year)	Fab I - 6" MOS - 120,000 Fab II - 6" CMOS - 360,000 (Available 1989)

Source: Dataquest

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SEMICONDUCTOR MANUFACTURERS - HONG KONG

- Hua Ko
- Elcap
- RCL

HUA KO

Products	Consumer ICs Custom ICs
Capacity (Wafers/Year)	4" MOS - 60,000

Source: Dataquest

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ELCAP

Products	EL6116 74HC/HCT Series Consumer ICs Custom ICs Gate Arrays (up to 3,000 gates) Packaging Service
Capacity (Wafers/Year)	4" CMOS - 60,000

Source: Dataquest

SEMICONDUCTOR MANUFACTURERS - SINGAPORE

- SGS-Thomson*
- HP
- Chartered

* Only SGS-Thomson is in production now

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SGS-THOMSON

Products	EPROMs Power Transistors Consumer ICs Microcomponent ICs
Capacity (Wafers/Year)	5" - 360,000

Source: Dataquest

CHARTERED SEMICONDUCTOR

6" wafer fab will be finished in early 1989.

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SEMICONDUCTOR MANUFACTURERS - CHINA

- Wuxi
- BETF
- Beijing Semiconductor Factories #3, 6, and 109
- Shanghai #5, 7, 14, and 19 Radio Components Factory
- Li shan
- Others

WUXI MICROELECTRONICS COMPLEX

Products

- Toshiba 5-chip set @ 5 million units/yr.
- Discrete semiconductor components (mostly for consumer electronics applications)
- 64K memories, 4-bit MCUs, and telecom devices in small quantities

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WUXI MICROELECTRONICS COMPLEX

Sales channels

- Not well developed, manufacturers almost entirely under exclusive agreement

Trends

- Capable of 3-micron technology
- Most production is of 4-inch wafers
- Future emphasis on telecom ICs, converters, and op amps

KEY ISSUES IN 1988

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KEY POSITIVE ISSUES IN 1988

- Government support
- Capital spending
- Partnerships/alliances
- Local demand
- Yen appreciation
- Manufacturing move to Asia
- GNP growth
- Technology perception
- Emerging market

KEY NEGATIVE ISSUES IN 1988

- Currency value appreciation
- Protectionism
- Competition from non-NICs
- U.S.-dependent industry

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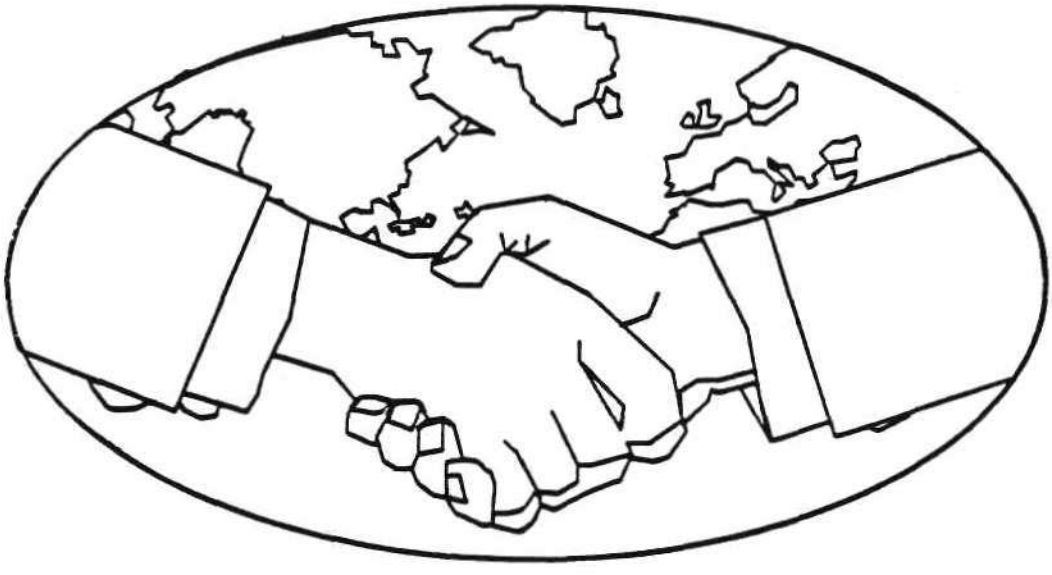
SUMMARY

- Asian semiconductor industry's worldwide influence will grow
- Asia will be worldwide leader in semiconductor consumption growth
- South Korea will be a significant DRAM producer
- Taiwan will become a major ASIC design center

Source: Dataquest

CONCLUSION



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ANALYSIS OF EUROPEAN ELECTRONICS TECHNOLOGY

Jürgen Knorr
Senior Vice President
Components Group
Semiconductor Division
Siemens AG

Mr. Knorr is Senior Vice President of the Components Group in the Semiconductor Division at Siemens AG. He has been with Siemens since 1957. Earlier positions have included corporate management for the Electrical Installation Equipment Division, the Lighting Systems Division, the Automotive Electronic Components Division, and the Electronics Contracting and System Business Division, and a variety of other management and engineering positions. Mr. Knorr received a Dipl.-Ing. from the Technische Universität Berlin, where he majored in Mathematics and Electrical Engineering.

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April 11-12, 1988
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As a member of Siemens corporation I feel (slide 1)
honoured to give a presentation analysing European Electronics Technology. It is not an easy task to speak as a citizen of one European country and as a manager of one European company on behalf of total Europe.
So you will understand that I cannot avoid answering some of the questions from a somewhat one-sided point of view, and that I will have to extrapolate certain lines of view. I nevertheless hope to be able to present to you a worthwhile overview on the trends of micro-electronics development in Europe. Last not least this might be the case because of inputs to my speech representing the opinions of the EECA, of which I am the vice-president.

Let us first ask the question:
What do we mean by the term "Europe"? (slide 2)
Well - perhaps you know "Rothenburg ob der Tauber", (slide 2a)
a romantic old town in the heart of Germany. It is one town out of many European towns with a long history and a past background of richness, based on handcraft and trade. This town is completely surrounded by a wall, for it used to be a state of its own. Insofar this town is representative for peculiarities which characterize all of Europe:
Europe is a conglomeration of many countries defending their individuality, their languages und their cultures. Hence Europe's technologies are diverse and driven by many kinds of creativities.

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The Europe which I am concerned with in my (slide 3)
presentation comprises only a small section of the map
of Europe *). It is the European Economic Community, and
because I am going to talk about electronics, only a group
of eight countries of the European Community with major
electronicsindustries is concerned: Belgium, Netherlands,
Luxemburg, Federal Republic of Germany, Italy, Spain, France
and Great Britain.
On this small, densely populated portion of Europe (slide 3a)
7 different languages are spoken, and the economic regions are
separated by borders, duty regulations and different technical
standards. Major mergers of industrial firms are made difficult
or even prevented by anti-trust laws. Some of these barriers
such as duty regulations are not expected to disappear until
1992, giving way also to more uniform standards, and thereby
paving the way to a completion of the internal market in
Europe.

To illustrate the current situation of Europe, I would like to
introduce some figures relating Europe within the triad.
Compared with Japan there are 2.4 as many people living
on a 5 x larger area in Europe, which means that in Japan
there are double as many people per sq.km.
In the USA the density of population is only 1/5 of that of
Europe. The industrial production/capita is in comparison
lower both to the USA (0.8 x) and Japan (0.6 x). This again

---

*) which extends up to the right edge of the slide.

is explained by substantial differences of the industry structures among the different member countries in the EEC. West-Germany's industrial production/capita e.g. equals the one of Japan and is higher than the one in the US.
But, above all, Europe's production in Electrical Engineering & Electronics/capita totals only to 30 % compared to Japan and only to 60 % of that of the USA.
This shows today's predominance of the US and Japan in the Electrical Engineering & Electronics sector.
Another way to explain these relations is to look at the production values and trade figures in the 3 regions, as shown in: (slide 4)
Europe imports more IC's than it produces - I will present more detailed figures later - and its IC-production only amounts to about 20 % of the IC production of Japan or the US, a figure which sums up to only 11 % of the world production.
On the other hand the IC consumption of Europe (slide 4a) is only 50 % of that of the USA and 40 % of Japan. In fact Europe imports 64 % of its IC consumption while Japan imports only 8 % and the US only 19 %; that means, that both countries are mainly export-oriented.
This indicates that Europe has recognized at a late stage the importance of building up its own microelectronics development and production.
Let us concern ourselves for a moment with the question: How did the Europeans get into this unsatisfactory situation?

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After all - Europe has a remarkable tradition of achievements in the historical development of semiconductors. Major physical theories, leading to decisive insights into the composition and behaviour of solid-state materials, paving the way into semiconductor technology, had their cradle in Europe. Names such as Rutherford, Niels Bohr, Sommerfeld and Heisenberg are representative for this period of time. Cognition of the material properties of germanium and silicon as well as the discovery of III/V-compounds were achieved in Europe since the early thirties, to a significant extent also by scientists working for Siemens, such as Schottky and Welker. (slide 5)

Even the development of today's processes for the production of semiconductor materials, including crystal pulling and refining, is largely based upon European patents, some of them coming directly from Siemens. However, since the invention of the transistor in the Bell-laboratories (1948) many development and applications of scientific findings including integrated circuit technology were taken over by the USA. Japan later succeeded to develop IC manufacturing technologies to remarkable perfection.

Since then Europe fell behind in the development of microelectronics. There are several reasons for this, one of them being the great successes of Europe in conventional electrical engineering with a special focus and strength in mechanical engineering, the automotive industry and communications. (slide 5a)

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Far more critical is that we didn't realize the fact that the share of electronics increased from 30 % of a small volume to 65 % of a much bigger volume.

Apart from these facts there are further considerations making a direct comparison of micro-electronics development in Europe, Japan and USA difficult: (slide 6)

Taking a look at the IC-markets by applications (1987) - here you see a comparison of Japan and Western Europe - reveals great differences in emphasis: While in Japan the entertainment- and consumer industry play a dominant role (50 % of the electronic market) -in the USA it would be data processing - in Europe the application sectors automotive-, industrial- and telecommunication - electronics prevail, together amounting to almost 50 % of the total electronic application market. These markets used to have a rather moderate rate of growth in the past, but are now forecasted to have an above-average market growth rate of between 18 and 23 % p.a. in the nineties!

Looking at the average IC-usage in these sectors of application - the parameter being the value of ICs used divided by the equipment value - another interesting characteristic of the European microelectronics market shows up: (slide 6a)

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On average, in data processing and entertainment the IC-share in value is more than twice as big than in those sectors, in which Europe has its strength: automotive-, industry- and telecommunications electronics.

These different application areas within the triad (slide 7) have necessarily led to substantial differences in the kind of ICs mainly produced,as is shown by the next slide: (slide 7a)

In the area of non-standard-ICs, Europe's IC production share is almost equivalent to that of Japan and USA, for example because the consumption of ASICs in telecom- and industrial electronics applications is large.

On the other hand, the standard-IC-business has traditionally been overwhelmingly dominated by the USA and Japan.

Which conclusion do we draw from this analysis?

1. The tradionally important market segments like the automotive industry, mechanical engineering and communications will remain important market segments in the age of microelectronics.
2. Corresponding to its product structure Europe is relatively strong in the important field of NON-Standard IC's.
3. Europe has a need to make up for the development and manufacturing of Standard IC's which are at the same time a "locomotive" for mass production.

Now, what should the strategies of Europe be in the future? Permit me to now present the view of Siemens Corporation, as I am best acquainted with the strategy of this company.

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Siemens - a big company in the field of Electrical Engineering & Electronics - worldwide employs 360,000 people with sales of 28.5 billion US $. It is divided into 7 groups being represented in 123 countries: (slide 8)

Components
Energy and Automation
Electrical Installations and Automotive
Communication and Information Systems
KWU (Power Plants)
Medical Engineering
Telecommunication Networks and Security Systems

Siemens has concentrated on 3 major strategic areas: (slide 8a)

Network of the future
Office of the future
Factory of the future

In all these strategic growth sectors microelectronics is the key technology.

This is the reason why in 1984 we started a corporate project, named MEGA. (slide 9)

We have set ourselves the objective, by means of this project, to substantially reduce the lead of our competitors in this global business.

The key products of the MEGA Project are the 1M DRAM, the 4M DRAM and Logic IC`s, which are developed in the adequate technologies. (slide 9a)

The project included

- o the hiring and training of a highly qualified development- and manufacturing team
- o the setup and the installation of equipment for development and production halls with a cleanroom class of 10 and
- o the installation of design systems with data banks as well as CIM Systems.

After two years the cleanrooms had been completed and the production of the pilot and manufacturing lines started.

2 of those most modern halls are shown in: (slide 10)

There is a common cleaned air supply for both halls.

A cross section of the hall is shown in (slide 10a)

By an optimized technology a clean room class of better than 10 was achieved.

The filter efficiency is 99.99997 %.

The hall offers an effective area of about 2000 sq.m

In 1984, the catch-up race started; until now we have noticeably reduced the gap to our leading competitors.

Landmarks on this way are:

- o We are the only European manufacturer offering 1M DRAMs of own production on the market. (slide 11)
- o 4M DRAM development is well within schedule.
- o We have an acknowledged position in the leading group of logic circuit manufacturers. (slide 11a)

As an example I show you a photo of a 4M DRAM-sample and its specification. (slides 12 and 12a)

These are the short-term goals the Siemens corporation has set for itself. We are confident to achieve them.

Let me return to the point of view from the European microelectronics industry, asking the question: Which road will microelectronics pursue in the years to come?

- o We shall carefully try, not to let any new technological or design gaps come about.
- o In defining new objectives, we shall substantially take the economic particularities of Europe into consideration.

These I will briefly characterize by two illustrations:

- o The FRG is burdened by having (slide 13) the worldwide highest labor costs, due to its demanding social security system and low working hours.

- o The increase of average production costs per unit is high in Europe. (slide 13a) It is highest in France and Great Britain.

Our common European objective must therefore be (slide 14)

- o to improve the economy of microelectronics, which means reducing the costs per function.

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- by means of design-cleverness to get to fault-free, ingenious circuits designs in shorter time and thereby more economically.
- to achieve a maximum of production quality and flexibility through "intelligent" production lines, making use of CIM, robots and efficient equipment.

These objectives are more important to us than a reduction of the size of circuit structures at any cost. To achieve them will require enormous resources.

As Europeans we can pursue these objectives (slide 14a) successfully only by strengthening our own capabilities, through closer cooperation within semiconductor industries, by involving the equipment manufacturers and by cooperating with the materials producers. The completion of the internal market in Europe which is supposed to be realized by 1992, as I already mentioned, will be instrumental in accomplishing this purpose.

In addition the governments have agreed on common programs as ESPRIT and EUREKA, which fulfill the above goals and which are very successful.

The newest one is JESSI (Joint European Submicron Silicon) which will promote the European microelectronics manufacturers through coordination of activities and common initiatives.

I am sure, Siemens and all other ambitious European semiconductor manufacturers will cope with the challenge in microelectronics and close the gap to global competitors during the nineties.

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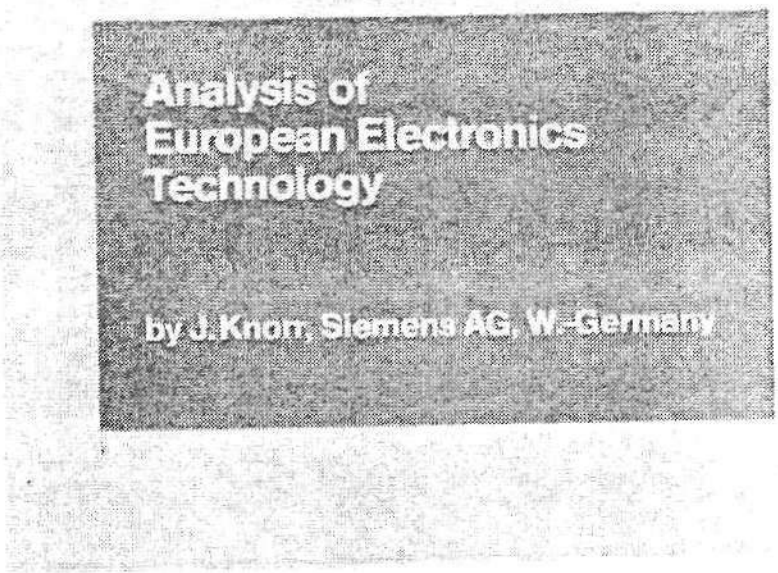
Analysis of
European Electronics
Technology
by J.Knorr, Siemens AG, W.-Germany

2

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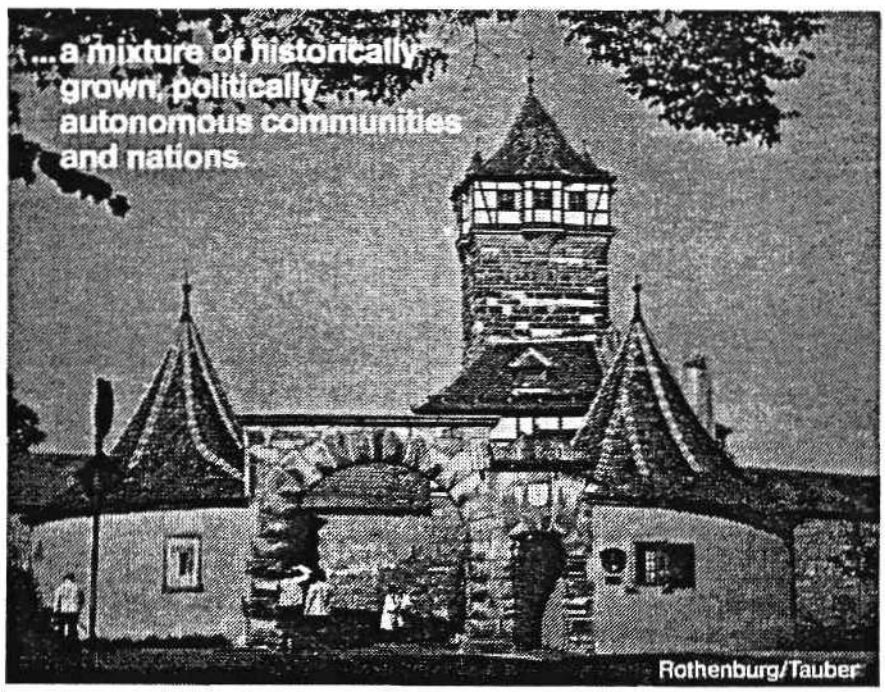

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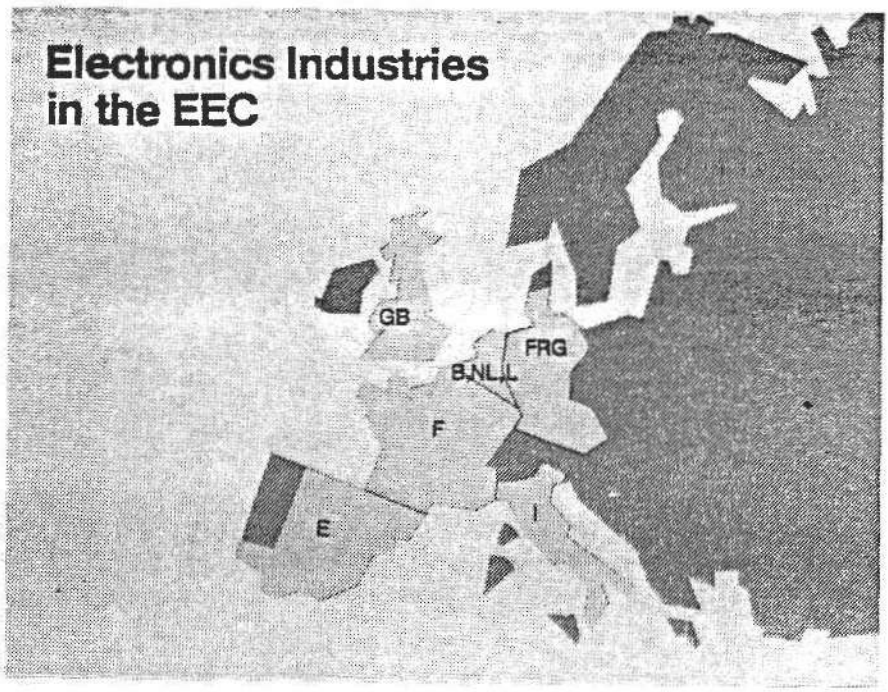

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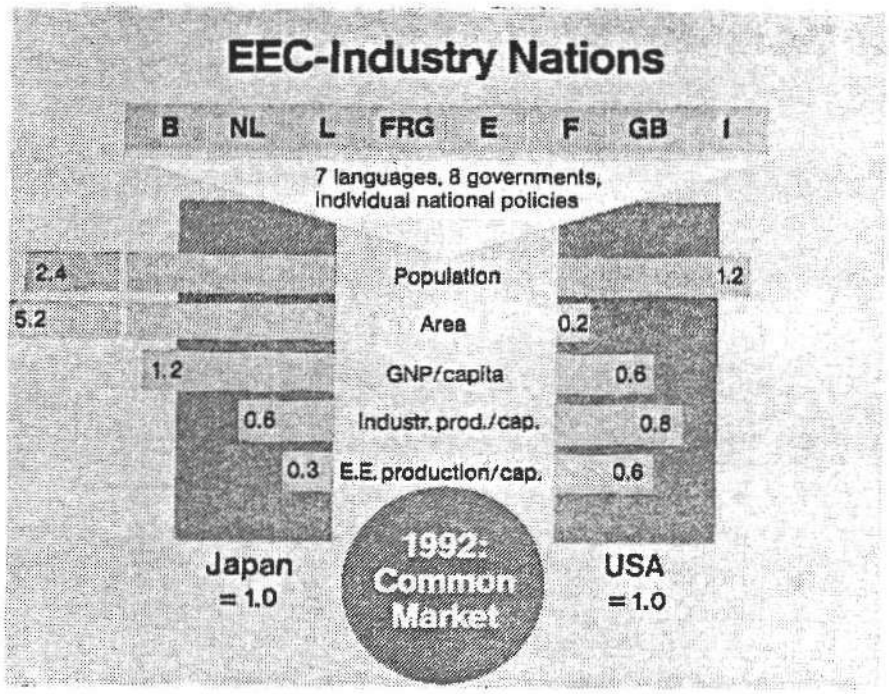

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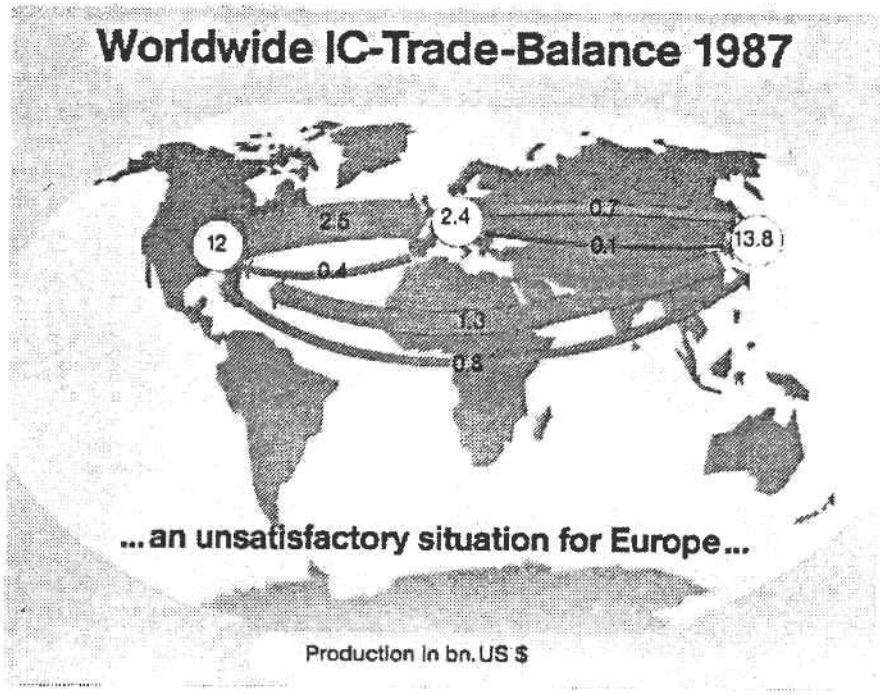

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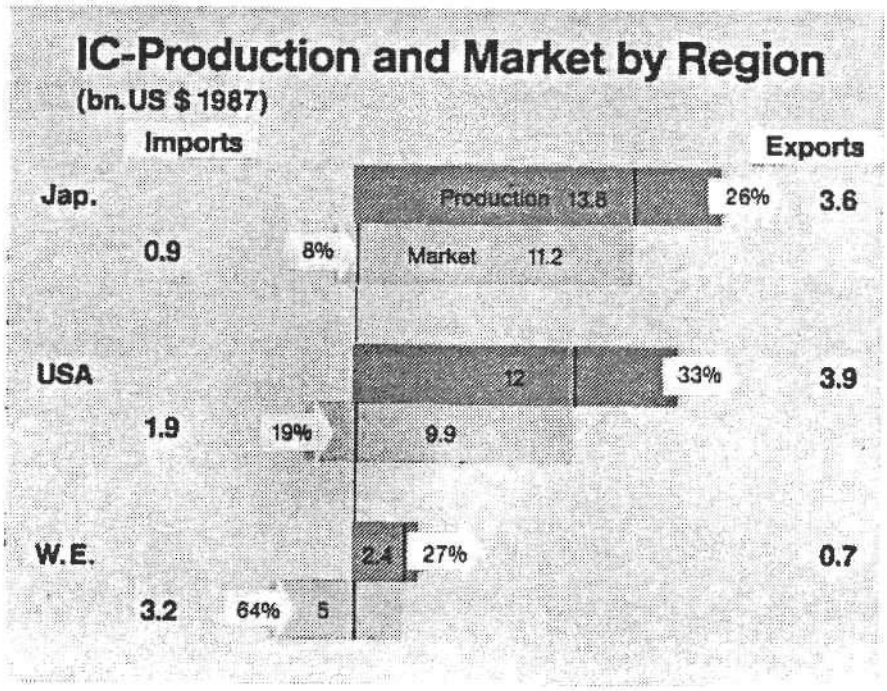

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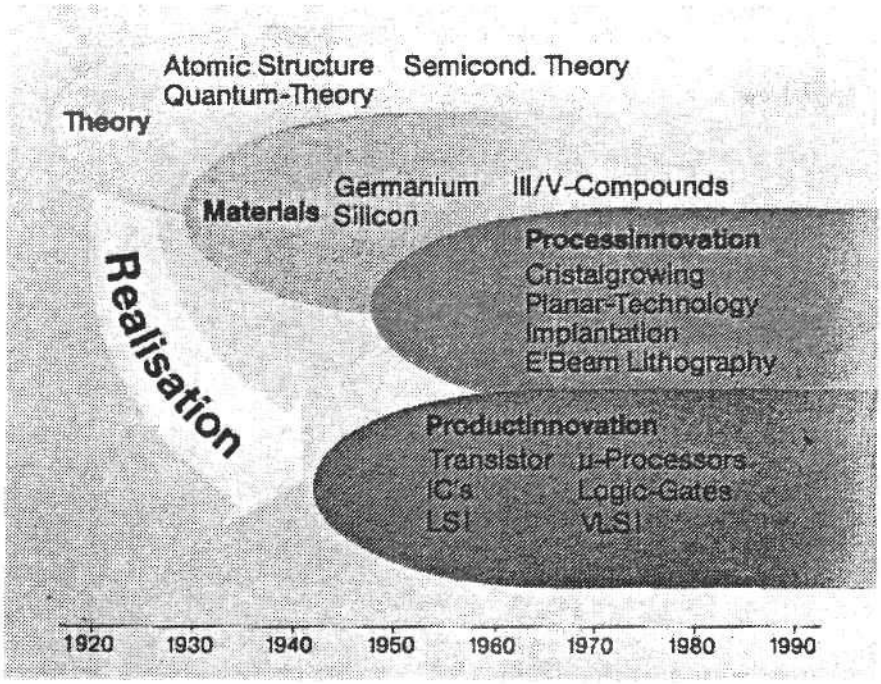

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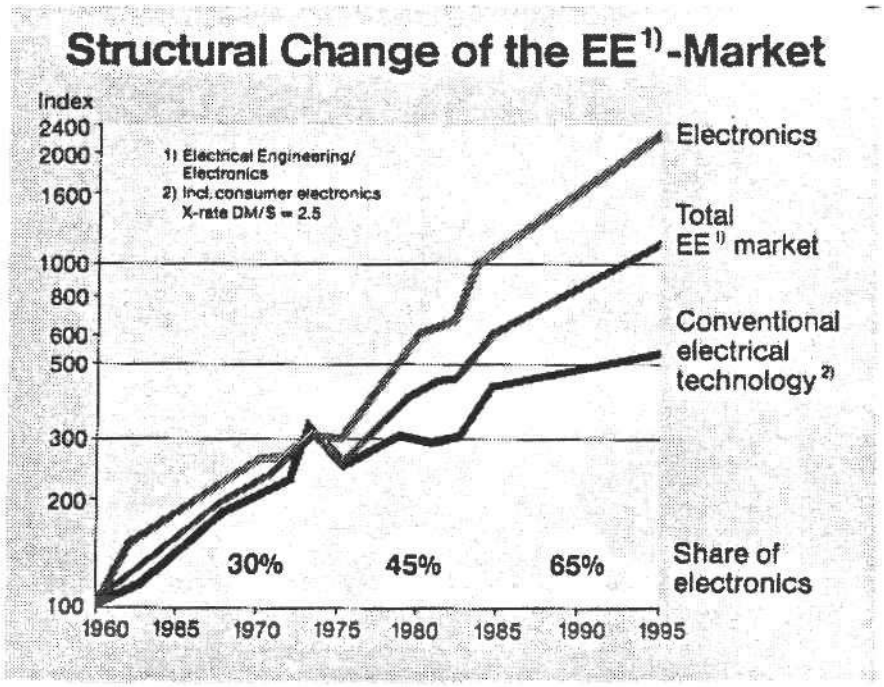

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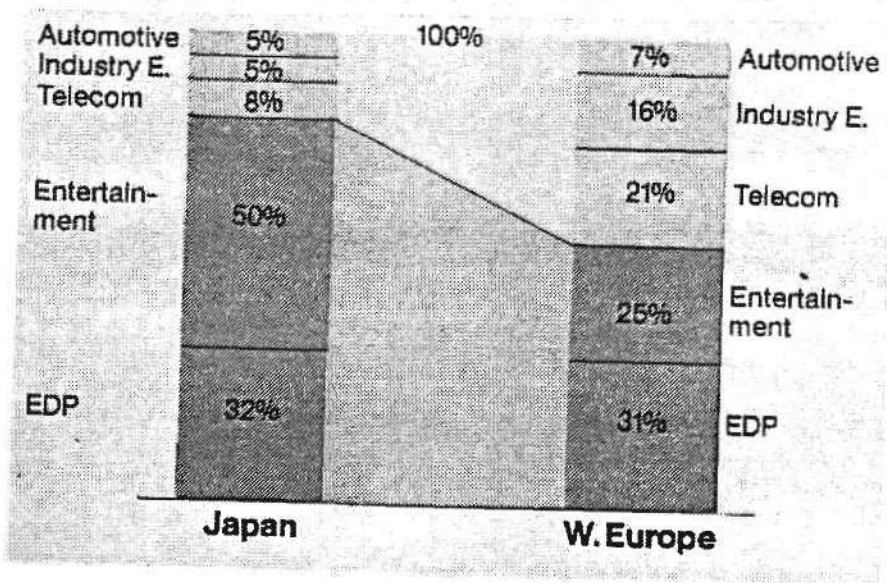
6

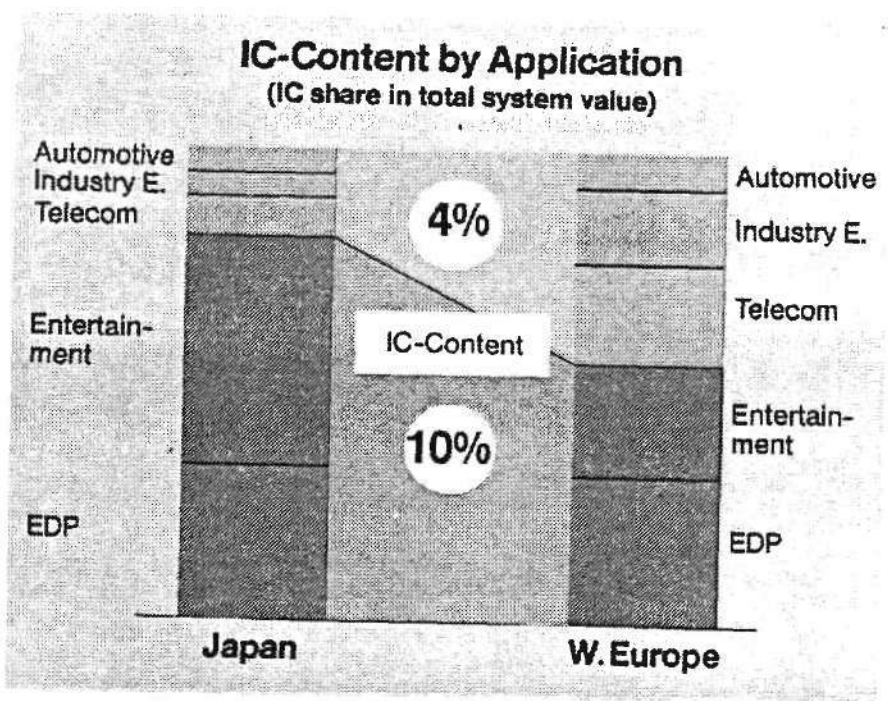
Structure of IC-Markets by Application



6a

IC-Content by Application

(IC share in total system value)



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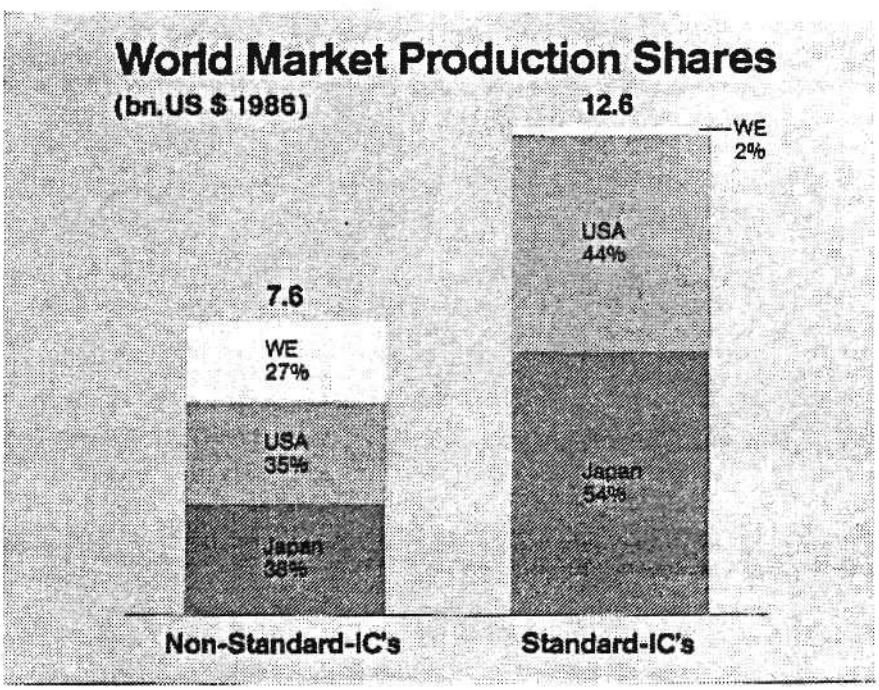
7

Different market structures within the TRIAD lead to substantial differences in production shares of IC-products

7a



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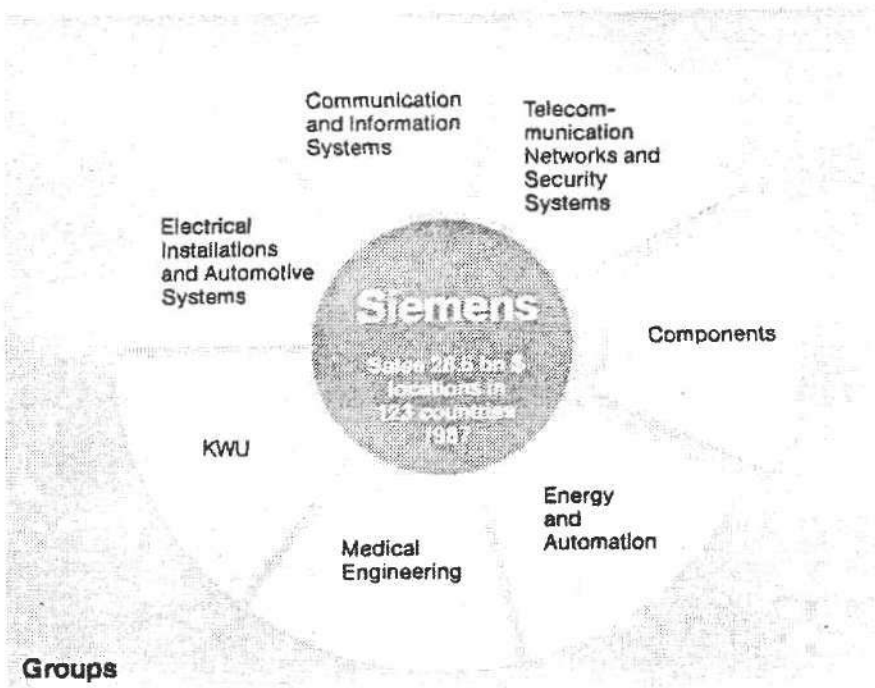

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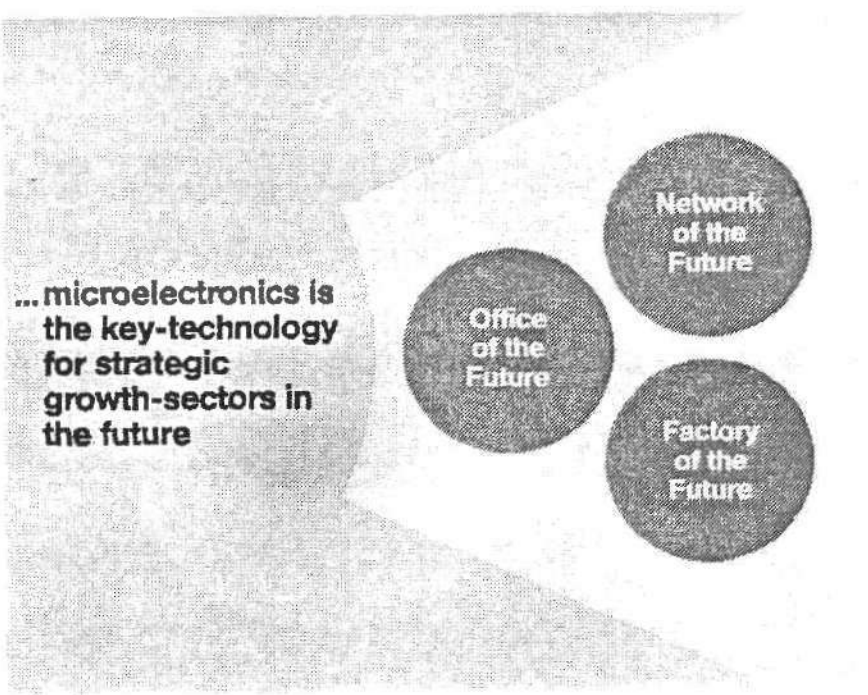

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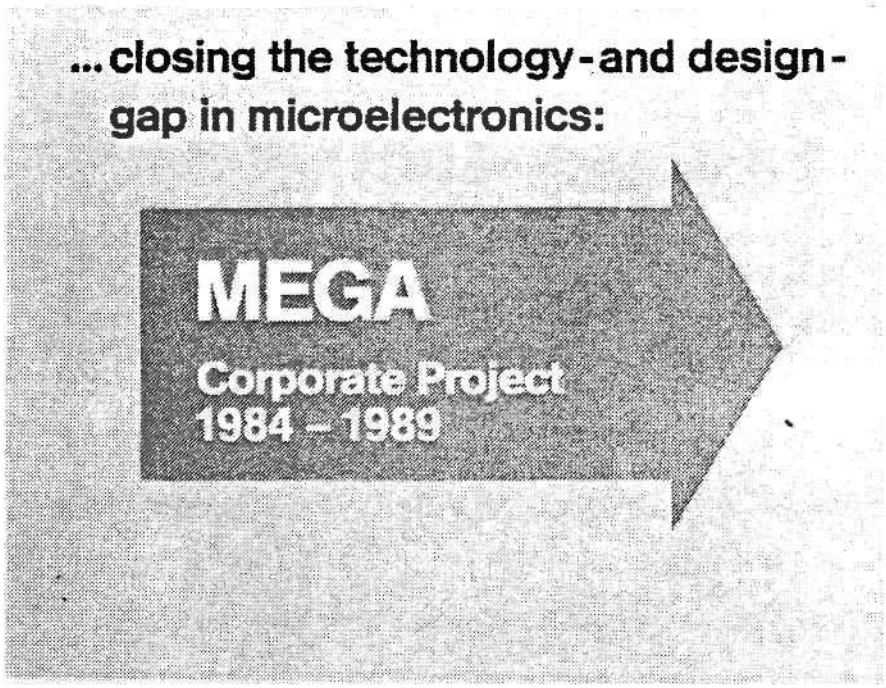

9a

Key-products	1 M DRAM	4 M DRAM
	M-Logic-IC's	
R & D – personnel (man-years)	800	1400
Investment (Mio. DM)	800	850
Facilities (Lab + Fab)	9700 m² Clean-rooms	
Design-tools	CAD-systems	

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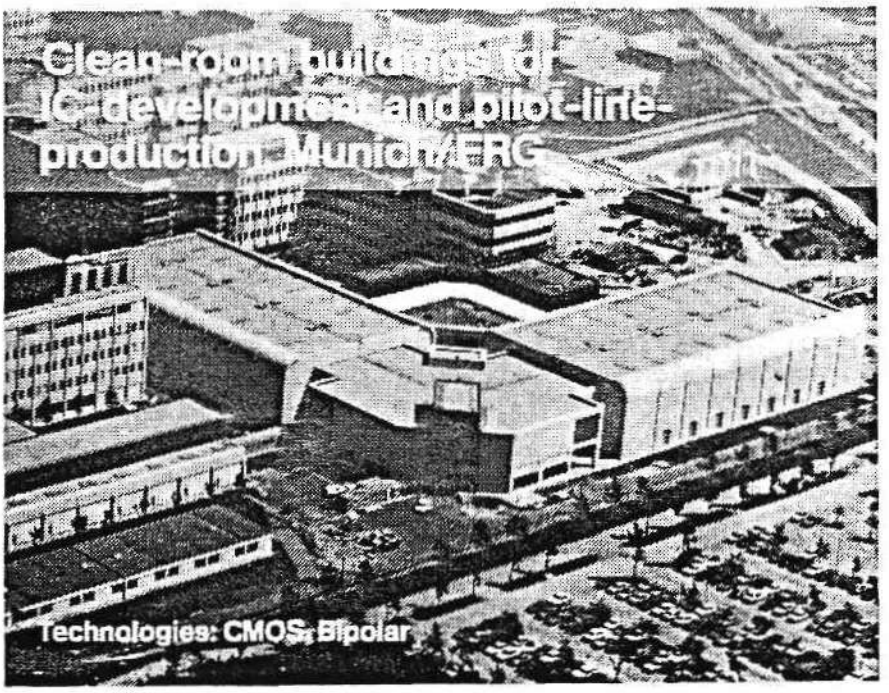

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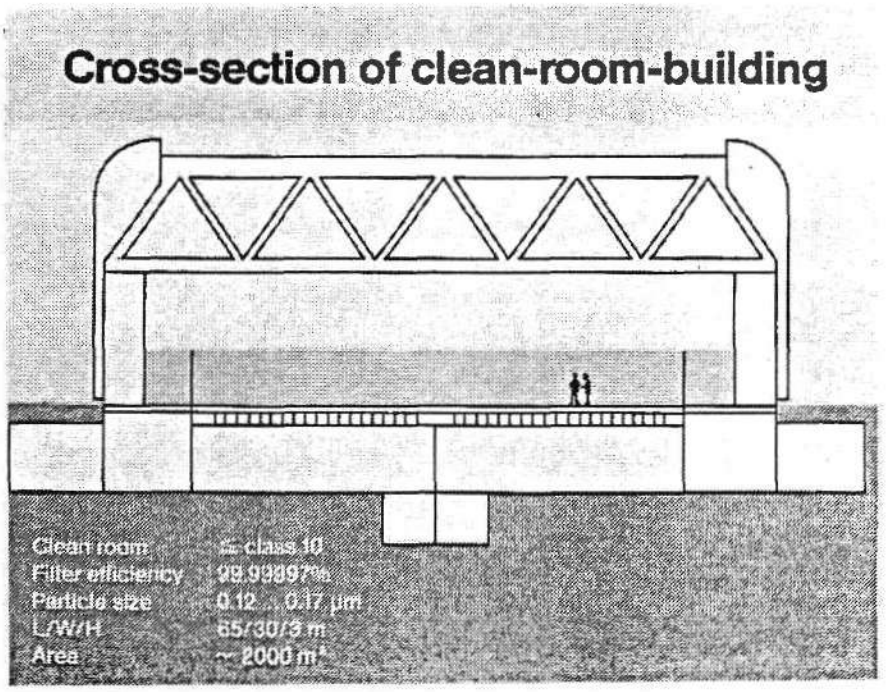

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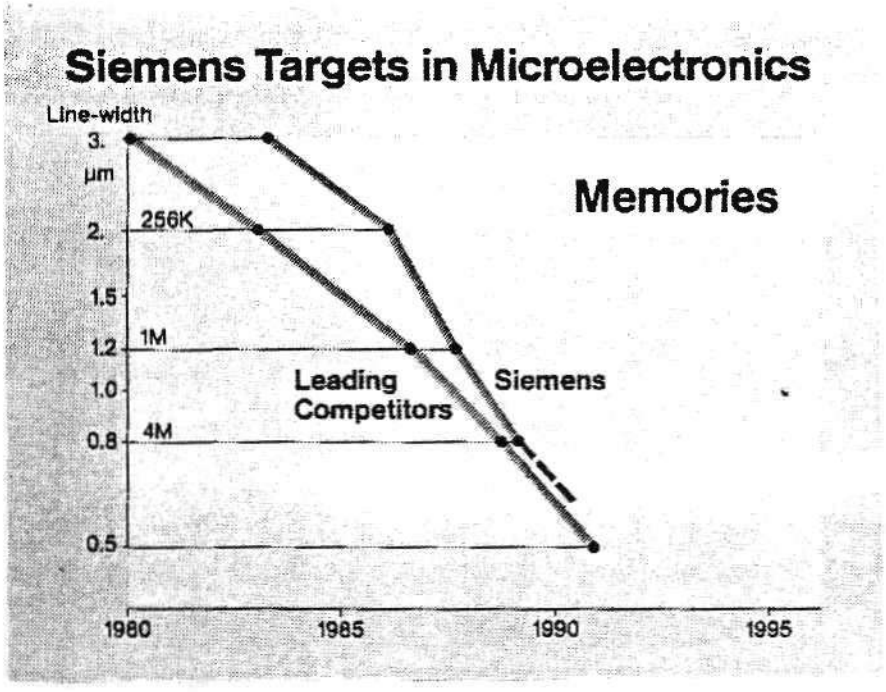

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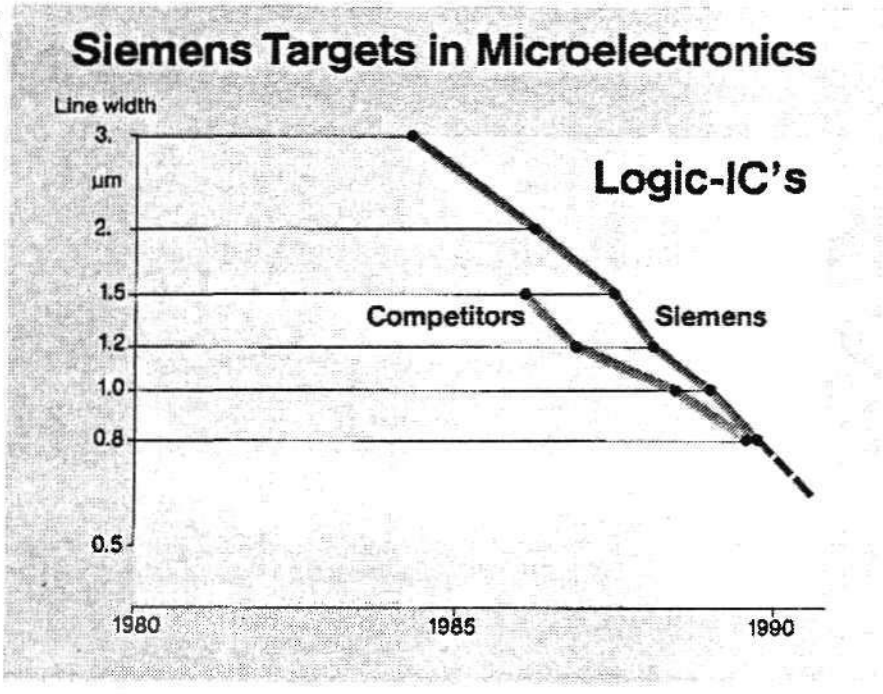

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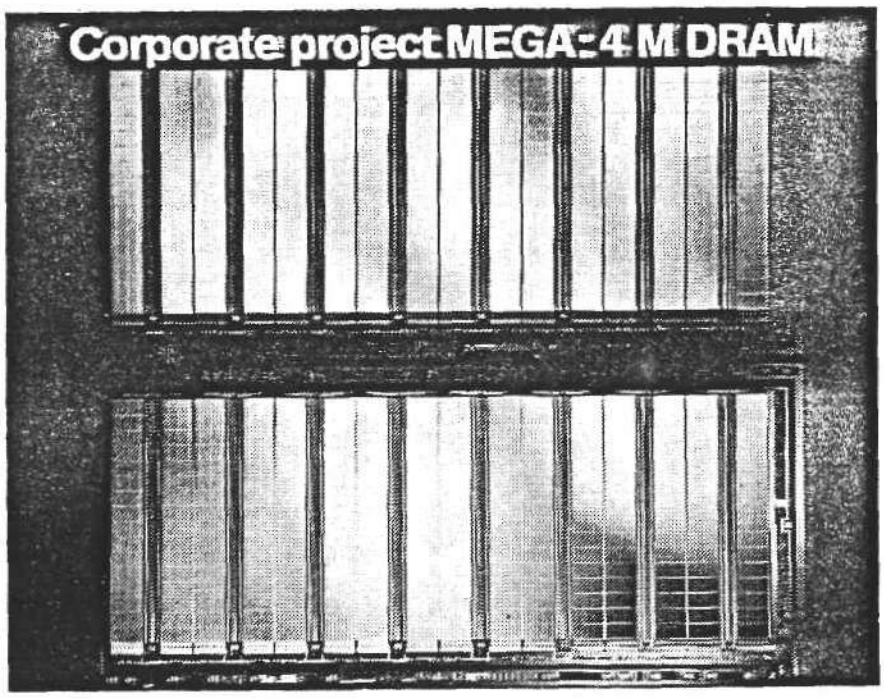

12a

Specification

Organization	4 M × 1 and 1M × 4
Technology	Advanced twin-tub CMOS 0.9 µm, FOBIC-cell, trench
Cell size	2.3 × 4.6 = 10.58 μm^2
Chip size	6.5 × 14.05 = 91.3 mm^2
Access/Cycle	70/150 ns at 5 V typical
Static column	45 ns cycle time at 5 V typical
Package	SOJ 350 mil 26/20
Modes	Static column, fast page mode (fuse option)
Test mode	8 bit, acc. to JEDEC

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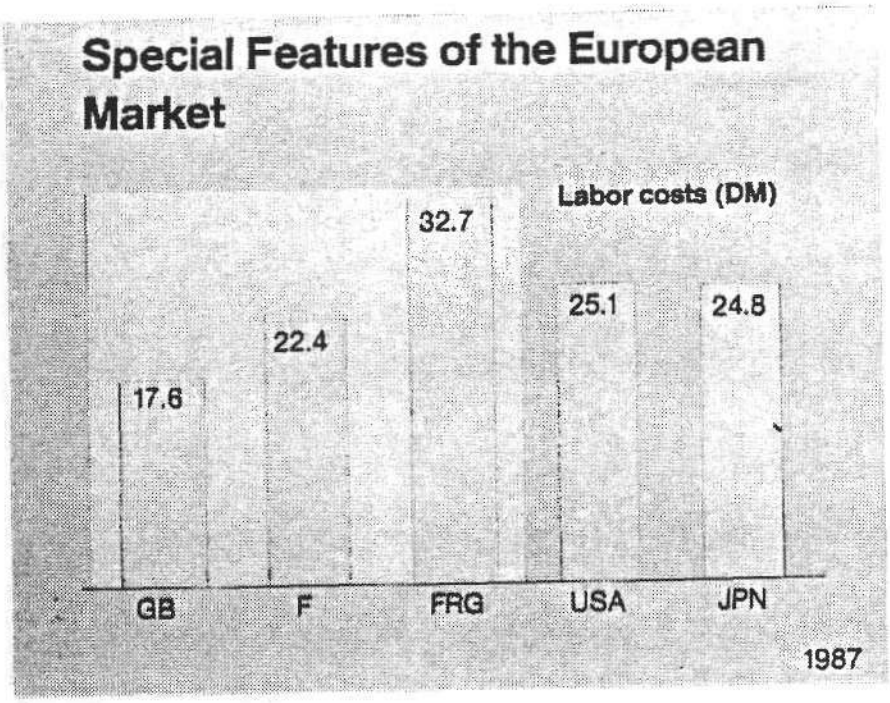

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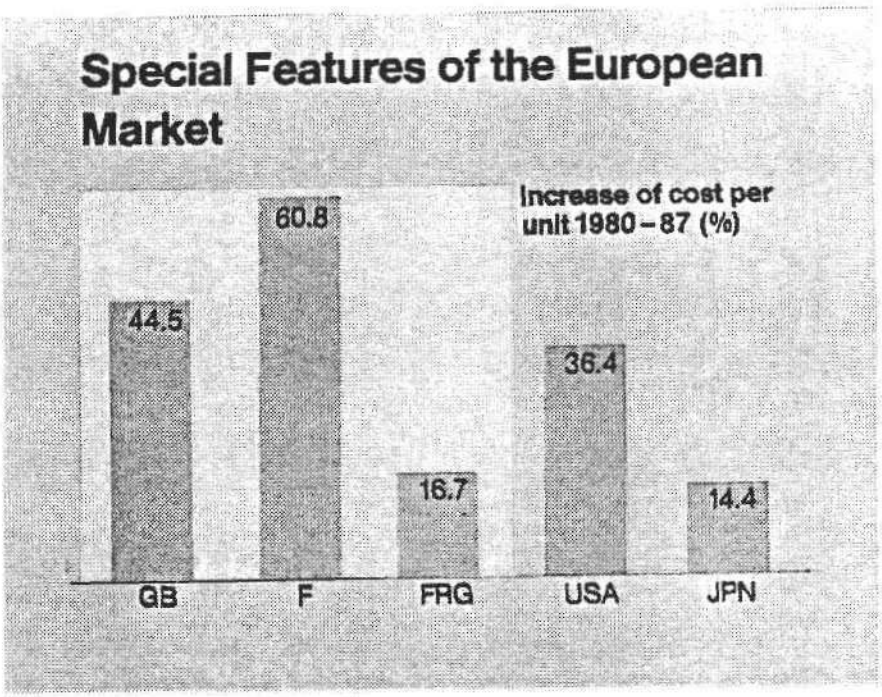

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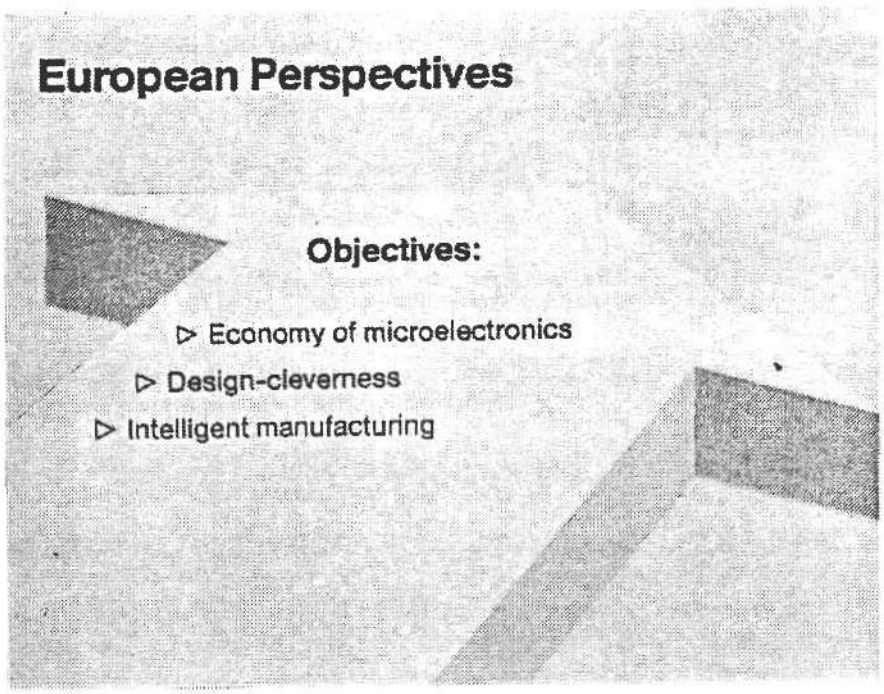

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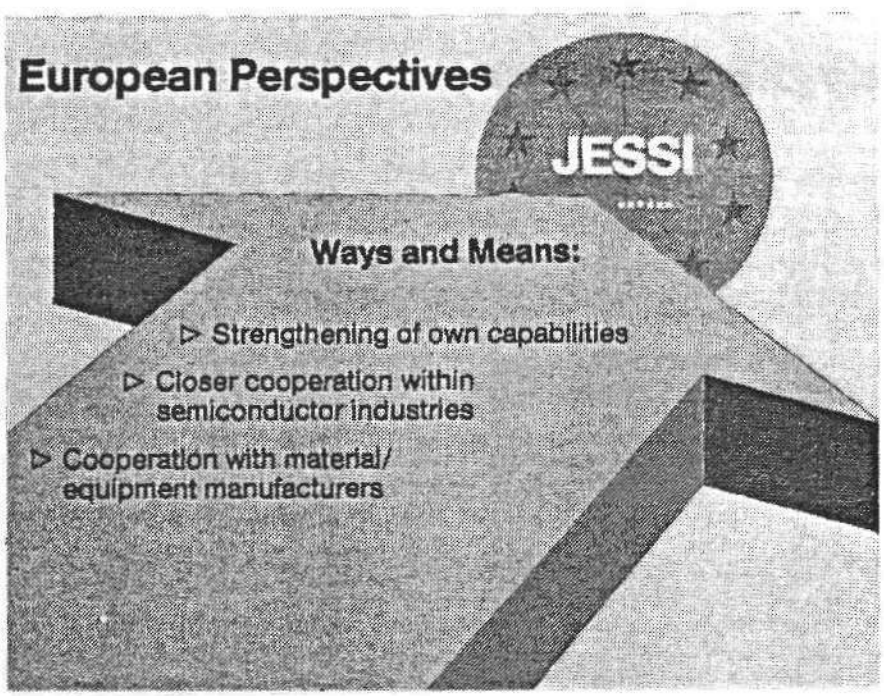

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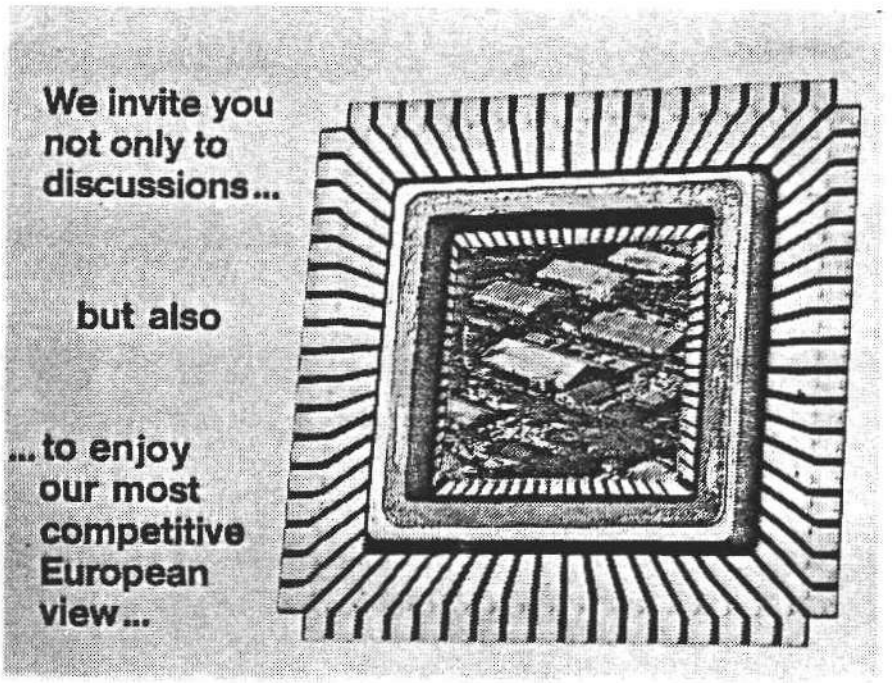

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SUBMICRON TECHNOLOGY: MARKET IMPACTS

Hiroyuki Mizuno
Managing Director, Member of the Board
Matsushita Electric Industrial Co., Ltd.

Dr. Mizuno is Managing Director and member of the board at Matsushita Electric Industrial Co., Ltd. He has worked for Matsushita since 1952, specializing in the research and development of silicon and GaAs devices. During his career at Matsushita, he has held a variety of management positions in both Matsushita Electronics Corporation (MEC), a subsidiary company specialized in making active electronic components, and Matsushita Electric Industrial Co., Ltd. (MEI). Dr. Mizuno received a B.S. degree in Physics and a Ph.D. degree from Kyoto University. He also studied at the University of Illinois for two years.

Dataquest Incorporated
JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE
April 11-12, 1988
Tokyo, Japan

IMPACT OF SUBMICRON TECHNOLOGY ON MARKET

Panasonic

WHY 16Mb DRAM ?

- DRAM IS A VEHICLE OF TECHNOLOGY
- SUBMICRON ERA

Panasonic

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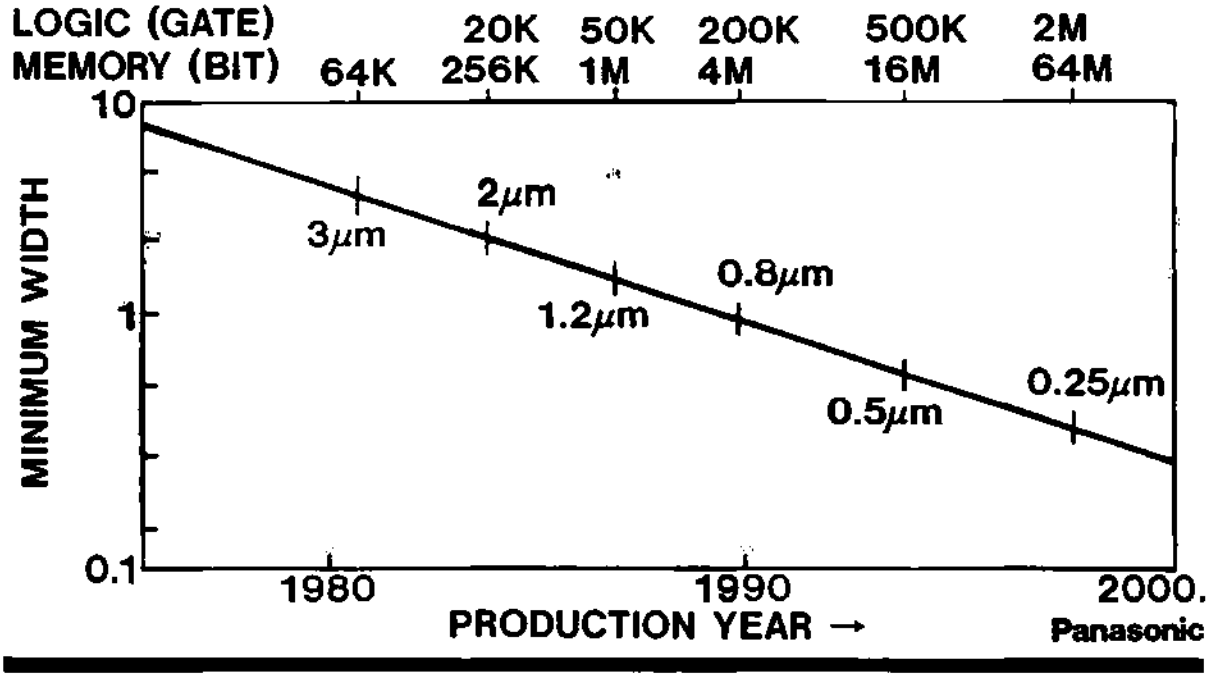
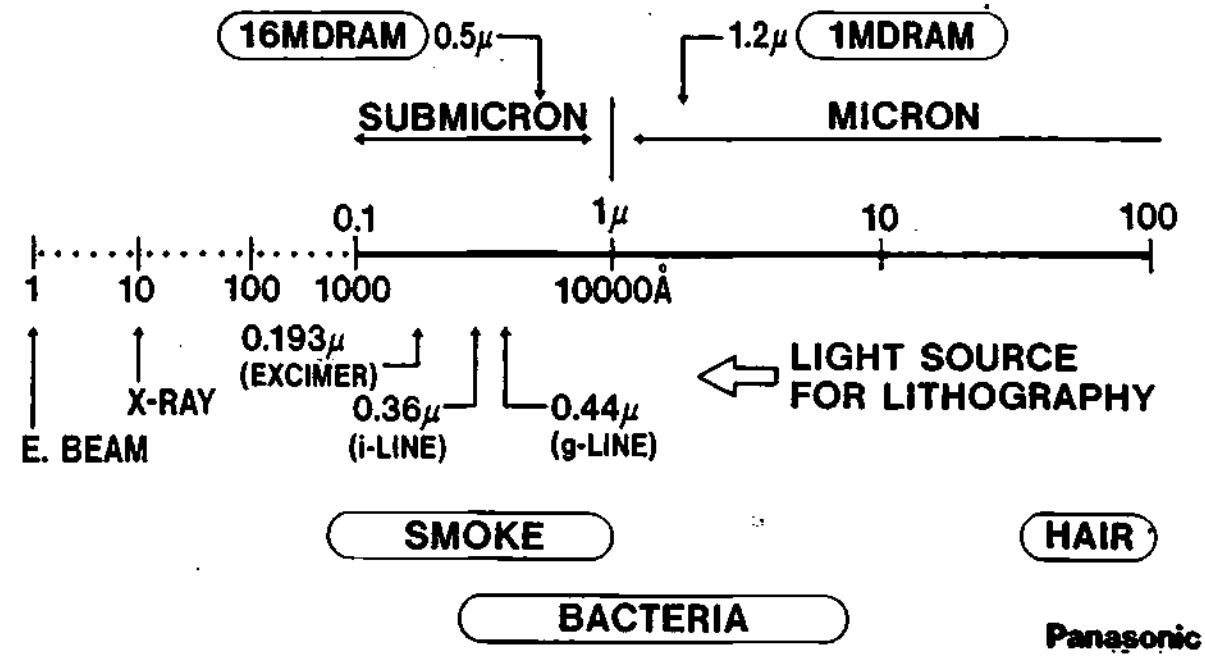
TREND OF SUBMICRON TECHNOLOGY



SCALE DOWN TO SUBMICRON



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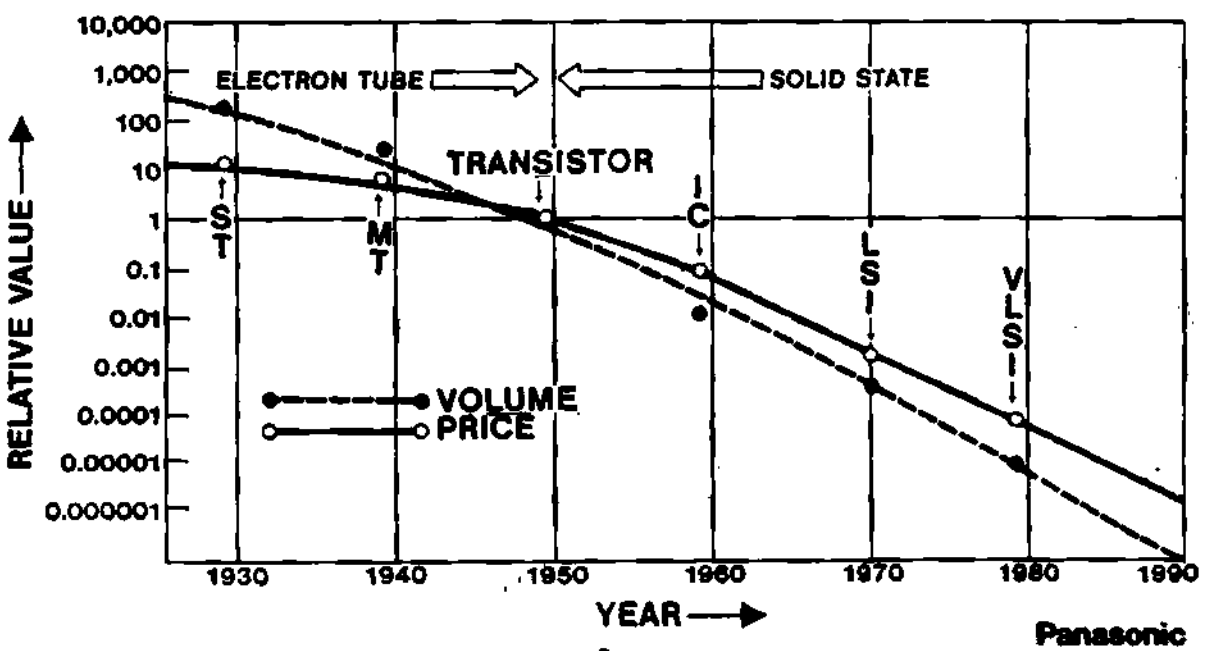
IMPACT OF SUBMICRON TECHNOLOGY ON ELECTRONICS

■SO FAR, WHAT HAPPENED ?

■THEN, WHAT WILL BE ?

Panasonic

PRICE AND VOLUME REDUTION OF ACTIVE ELECTRONIC COMPONENTS



Panasonic

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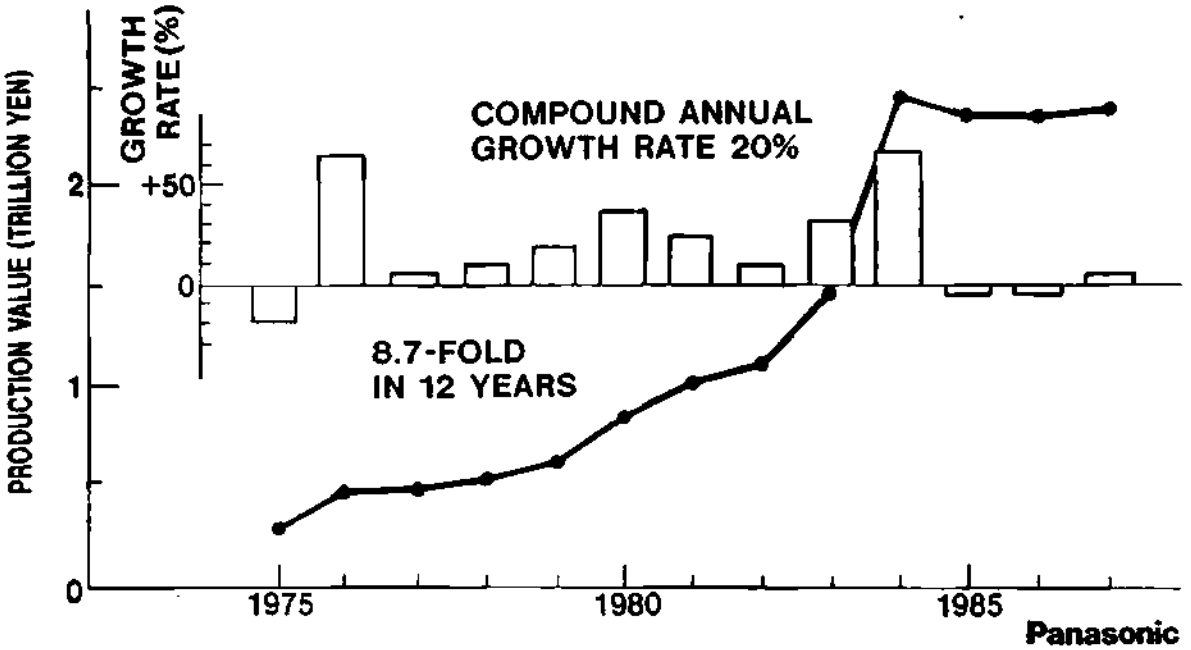
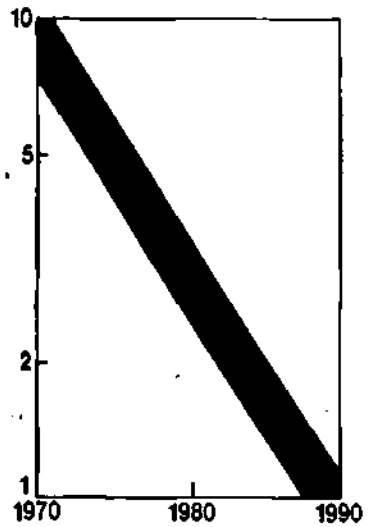
JAPAN'S SEMICONDUCTOR PRODUCTION

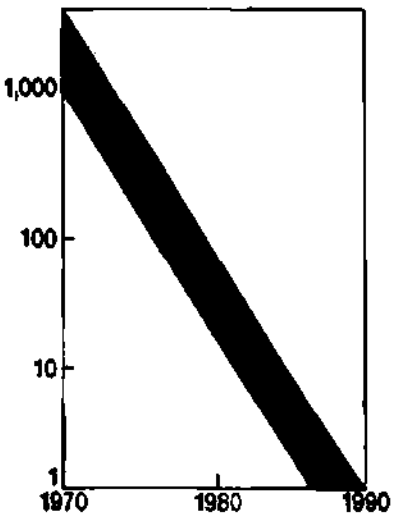


Panasonic

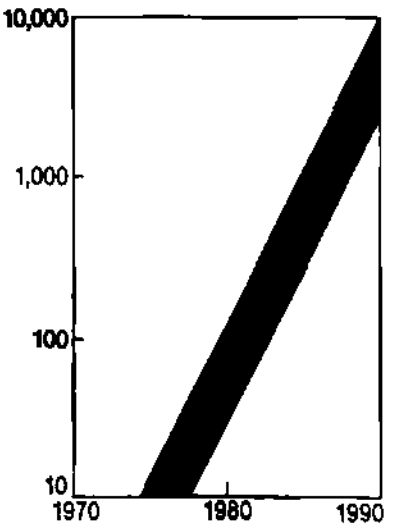
TREND OF MOS MEMORY



PATTERN LINE WIDTH IN MICROMETER



PRICE PER K BIT IN YEN



NUMBER OF COMPONENTS IN THOUTHAND

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TOWARD HOME INTELLIGENCE

■ TECHNOLOGY

■ INFRASTRUCTURE

- OPTICAL FIBER NETWORK
- SATELLITE SYSTEM

Panasonic

THEME

ALL INNOVATION SHOULD

FINALLY BURST IN

HOME APPLICATION MARKET

Panasonic

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IMPACT OF SUBMICRON TECHNOLOGY -1

■COMBINATION OF HOME ELECTRONICS AND COMPUTER

- •INTERACTIVE
- •BETTER INTERFACE
  hidden/domesticate/AI COMPUTER
- •HOUSE KEEPING/NURSING ROBOT
  speech/image recognition

Panasonic

IMPACT OF SUBMICRON TECHNOLOGY -2

■COMBINATION OF HOME ELECTRONICS AND COMMUNICATION

- • HOME BUS (HA) → ISDN
  information socket
- • STRONGER LINK TO SOCIETY
- • MAN-TO-MAN
  ENTERTAINMENT, INFORMATION
  EDUCATION, MEDICAL CARE
  especially of the aged

Panasonic

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CRITERIA OF HOME ELECTRONICS

- EASY TO HANDLE
- HIGH QUALITY
- VOLUME PRODUCTION
- LOW COST

Panasonic

THEN, WHAT WILL BE ?

- HIGH DEFINITION SYSTEMS
- CD-I
- OTHER IMPACTS

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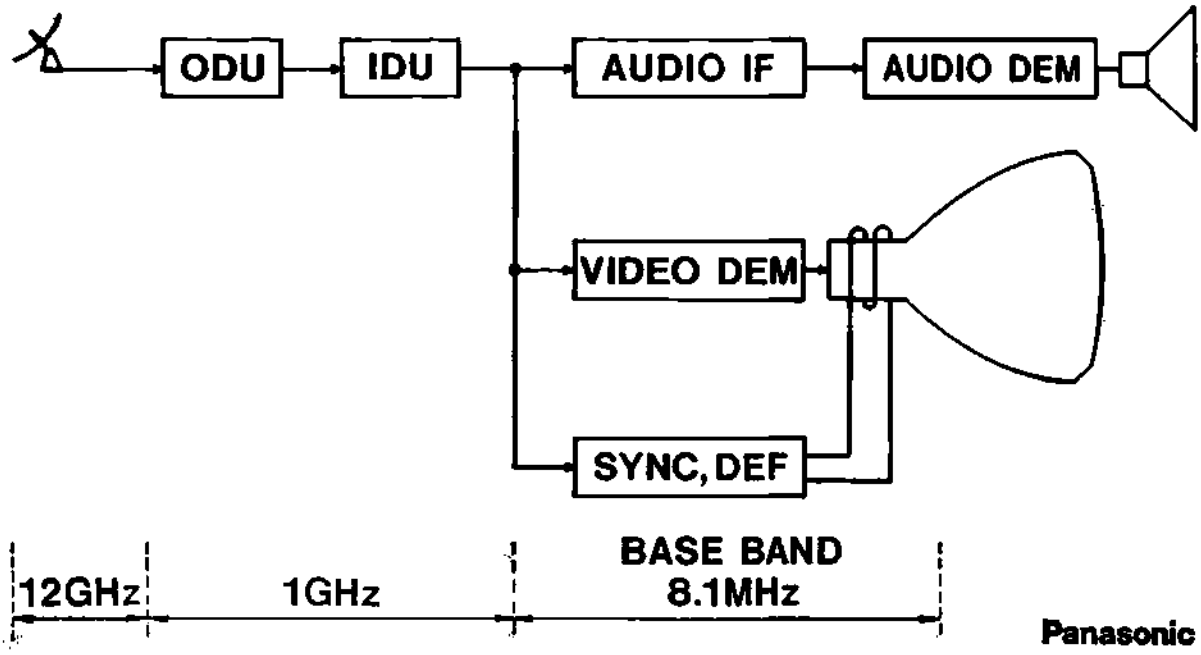
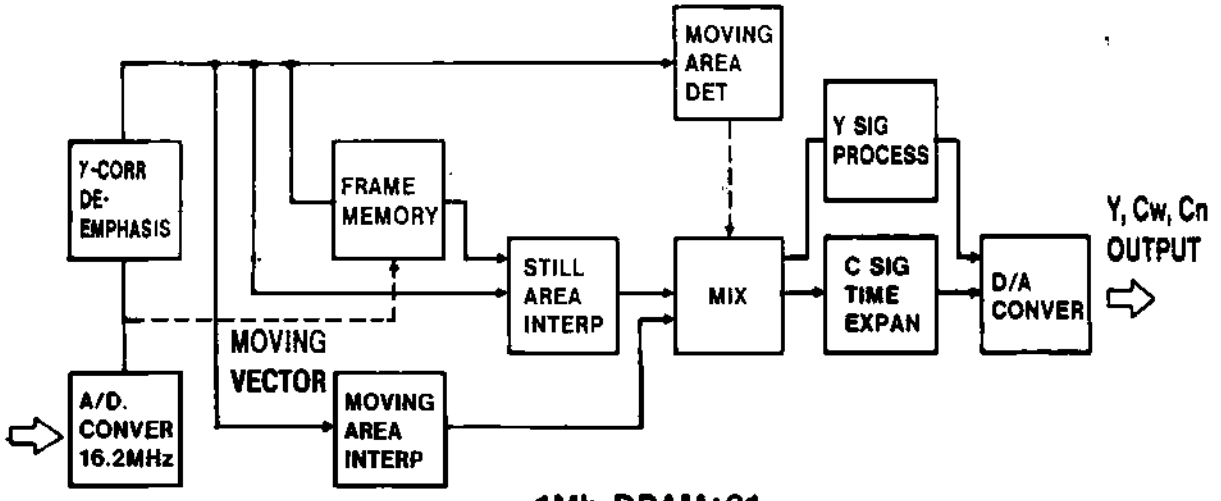
BLOCK DIAGRAM OF HD TV



Panasonic

VIDEO DEMODULATION OF HDTV (MUSE)



MUSE SIGNAL
BASE BANDWIDTH
8.1MHz

1Mb DRAM:31
A/D CONVERTER:1
D/A CONVERTER:3
DIGITAL FILTER:2

Panasonic

CD-I DIVERSITY

■AUDIO

(LEVEL)	(QUALITY)
•CD-PCM	ULTRA HiFi
•CD-I ADPCM	
A	LP
B	FM
C	AM

■VIDEO

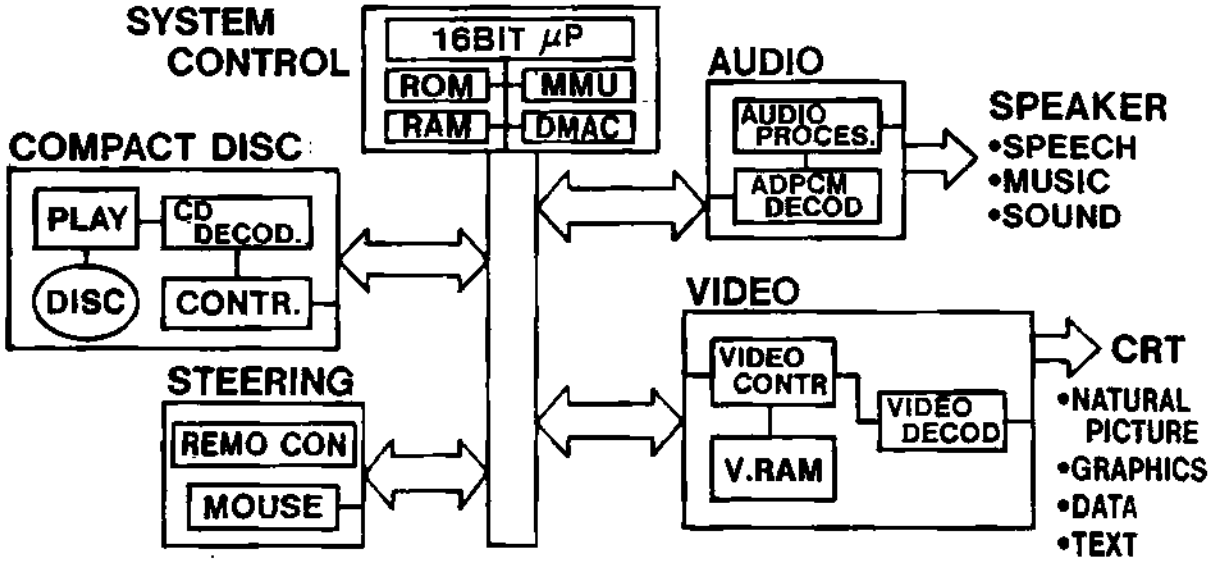
- •NATURAL PICTURE
- •GRAPHICS
  - RGB
  - CLUT 8
  - RLC (ANIMATION)

■INTERACTIVE

■SYNTHESIZE

Panasonic

CD-1 BLOCK DIAGRAM



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KEY SEMICONDUCTOR DEVICES IN CD-I

■PROCESSORS:

16 bit μC→system control.
Graphic processor
DSP→audio processor
8-bit/4-bit microcontrollers→mecha./remote

■MEMORIES:

8Mb DRAM→video RAM, main memory
3Mb Mask ROM→system control
Chinese chara. dictionary

■GATE ARRAYS:

90K gates→video decoder/controller
AD PCM decoder

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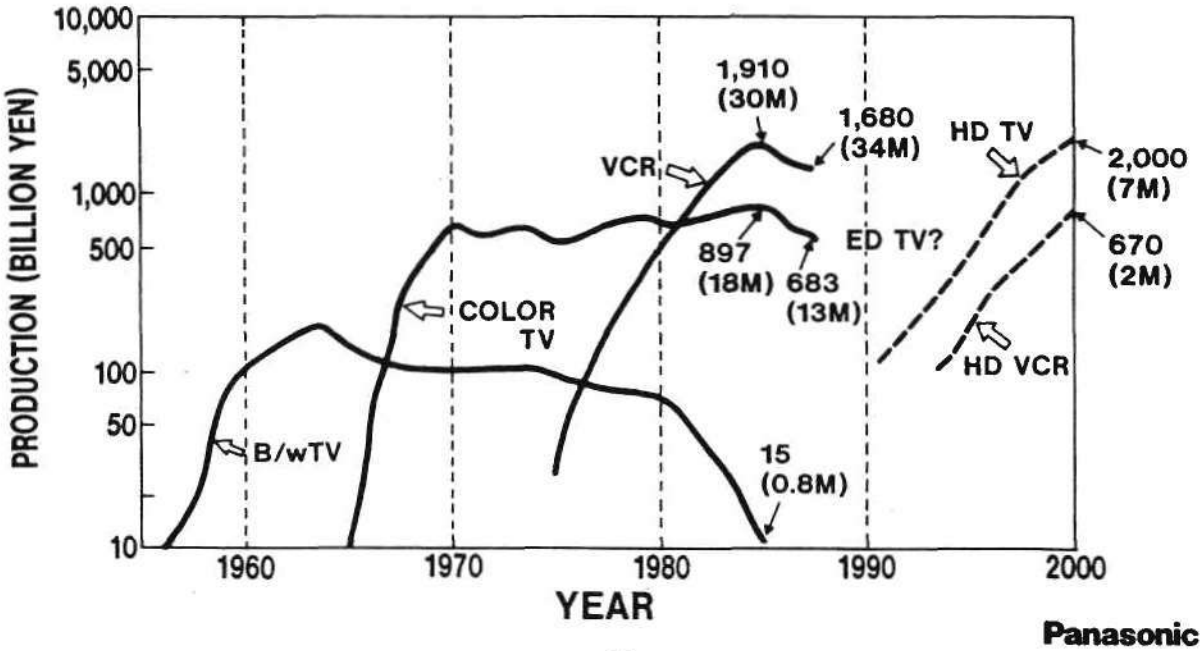
JAPAN'S PRODUCTION OF TV & VCR



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FURTHER···

■COMBINING STUDIES OF ORGANISM WITH VLSI TECHNOLOGY

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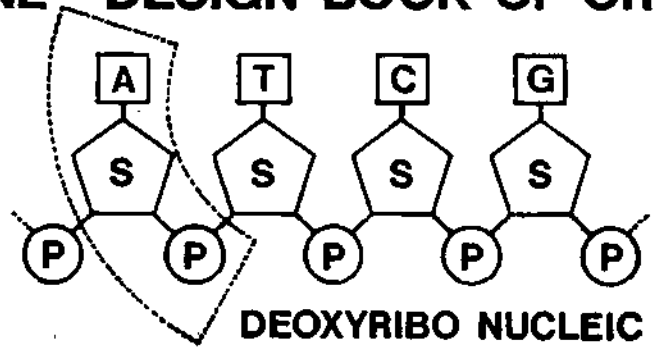
DNA & CELL

■GENE→DESIGN BOOK OF ORGANISM



DEOXYRIBO NUCLEIC ACID

Ⓟ PHOSPHATE: ⓢ SUGAR □ BASE

■RECOMBINANT DNA→STRUCTURING A DEVICE

■DNA IN A CELL→CUSTOM ROM IN A MICROCOMPUTER

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CONCLUSIONS

■SUBMICRON TECHNOLOGY OPENS THE GATE TO NEW ERA OF HOME ELECTRONICS.

- HOME ELECTRONICS WILL CONSUME MORE MEMORIES AND MICROCOMPUTERS.
- MERGENCE OF HOME ELECTRONICS COMPUTER, AND COMMUNICATION WILL BEGIN SOON.

■NEXT STAGE INNOVATION WILL BE PREPARED WITH STUDIES OF ORGANISM SYSTEM BASED UPON VLSI TECHNOLOGY.

Panasonic

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The Dun & Bradstreet Corporation

PERSPECTIVE ON SEMICONDUCTOR APPLICATIONS

David G. Norman
Research Analyst
Semiconductor User and Applications Group
Dataquest Incorporated

Mr. Norman is a Research Analyst for Dataquest's Semiconductor User and Applications Group. His responsibilties include researching the consumer electronics market, maintaining and enhancing the electronic equipment forecast data bases, and supporting Dataquest's Japanese Semiconductor Application Markets product in the United States. Mr. Norman's previous experience at Dataquest includes three months in the company's Tokyo office, where he assisted in developing the Japanese Semiconductor Application Markets product. Mr. Norman received a B.S. degree in Electrical Engineering from the University of California at Santa Barbara.

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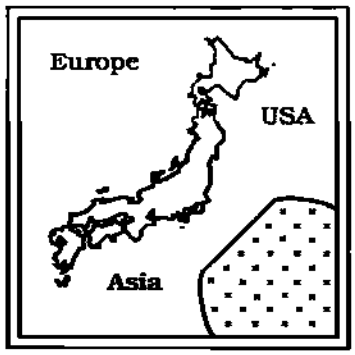
JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE
April 11-12, 1988
Tokyo, Japan



Japan's New International Role: Competition and Cooperation

PERSPECTIVE ON SEMICONDUCTOR APPLICATIONS

DAVID G. NORMAN

Research Analyst
Semiconductor User and Applications Group
Dataquest Incorporated

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AGENDA

- Worldwide electronics
- Regional electronics
  - Japan
  - North America
  - Europe
  - Rest of World
- Application market issues
- User issues

MAIN POINTS

- Critical markets
- Demand drivers
- Issues

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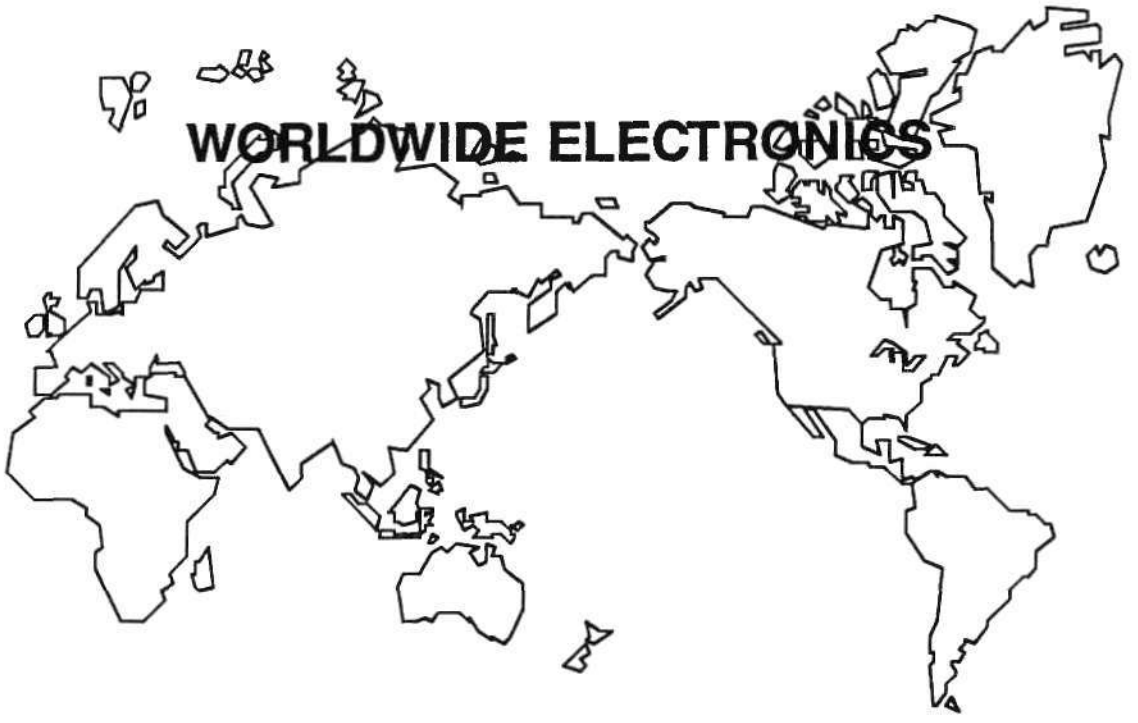
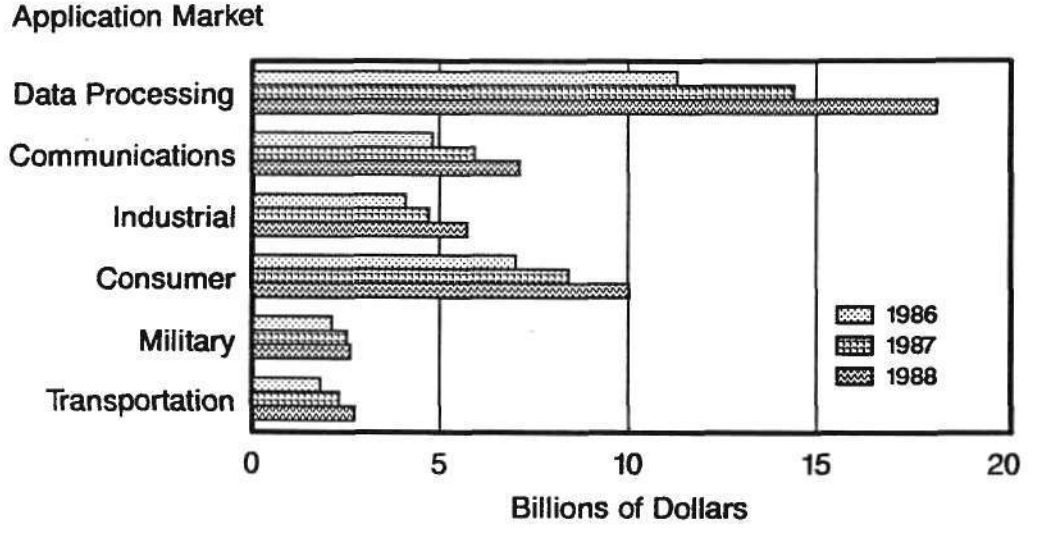


WORLDWIDE SEMICONDUCTOR CONSUMPTION

By Application Market



Source: Dataquest

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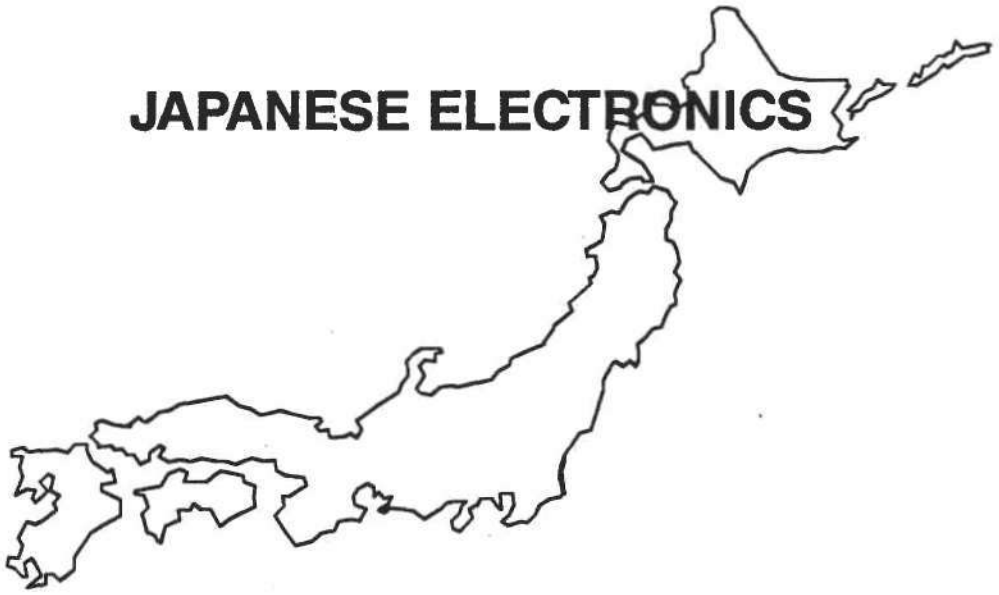
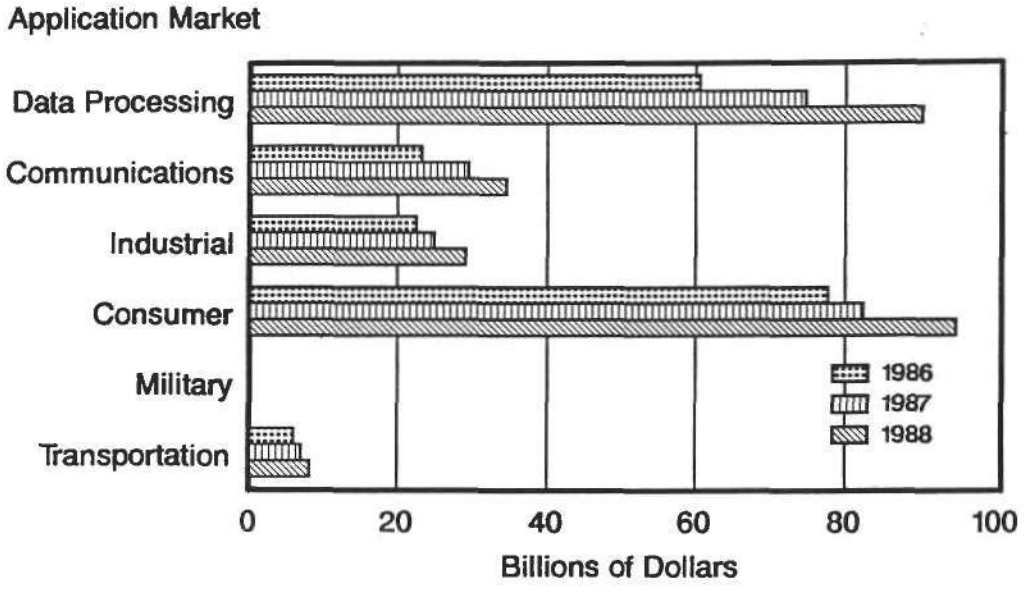
JAPANESE ELECTRONICS



JAPANESE ELECTRONICS PRODUCTION



Source: Dataquest

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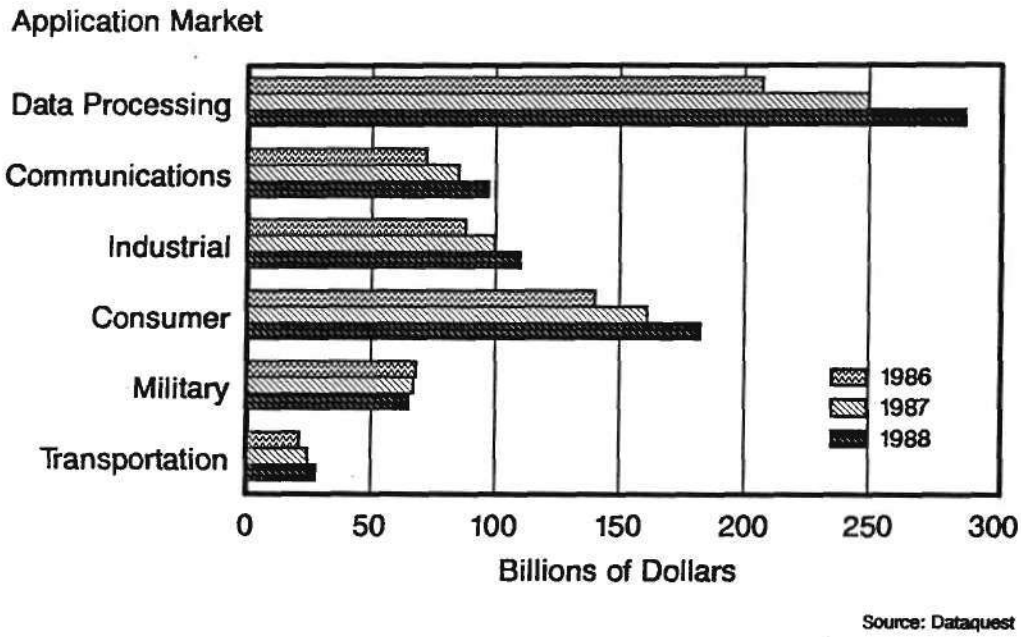
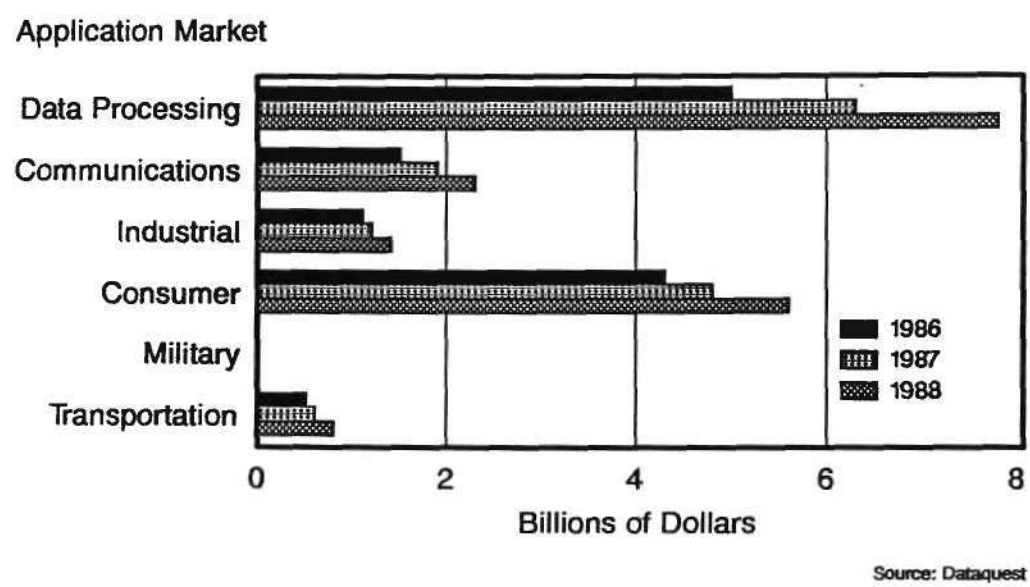
WORLDWIDE ELECTRONICS PRODUCTION



Source: Dataquest

JAPANESE SEMICONDUCTOR CONSUMPTION

By Application Market



Source: Dataquest

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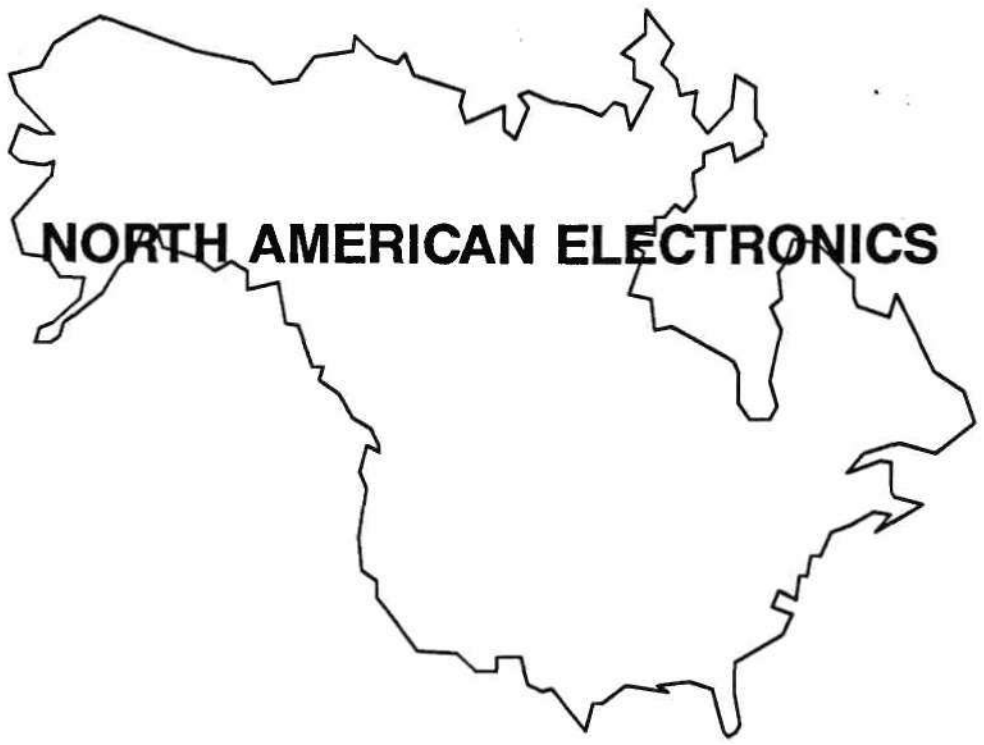
OUTLOOK FOR JAPAN'S MAJOR SEMICONDUCTOR MARKETS

(Billions of Dollars)

	1987	1991	CAGR 1987-1991
VCRs	$8.6	$11.1	6.6%
Mainframe	$8.1	$13.6	13.8%
Personal Computers	$2.6	$ 5.3	18.4%
Terminals	$5.0	$ 8.3	12.9%
Color TVs	$5.3	$ 7.1	7.6%

Note: Based on production value

Source: Dataquest



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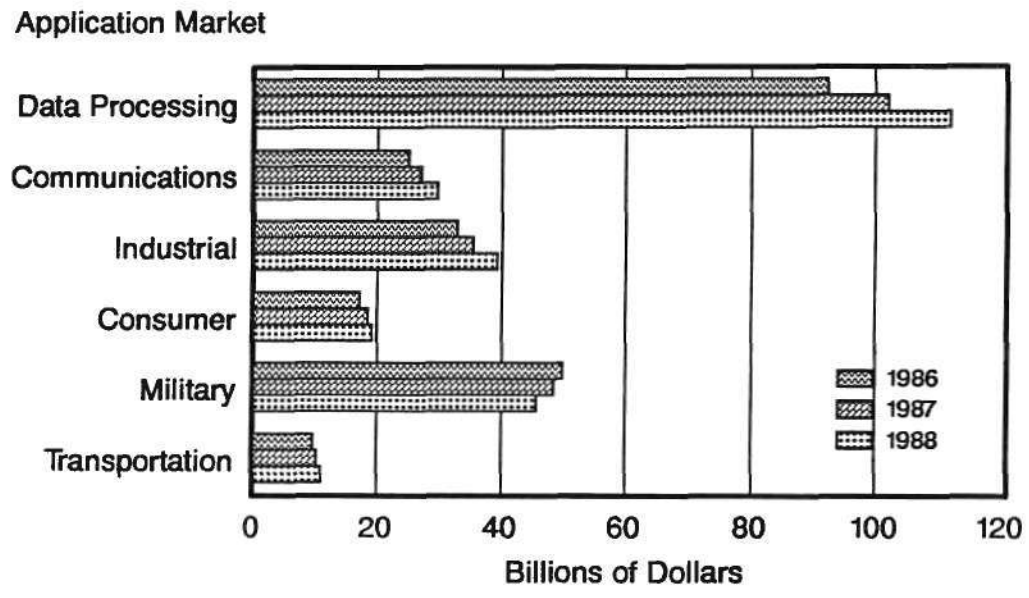
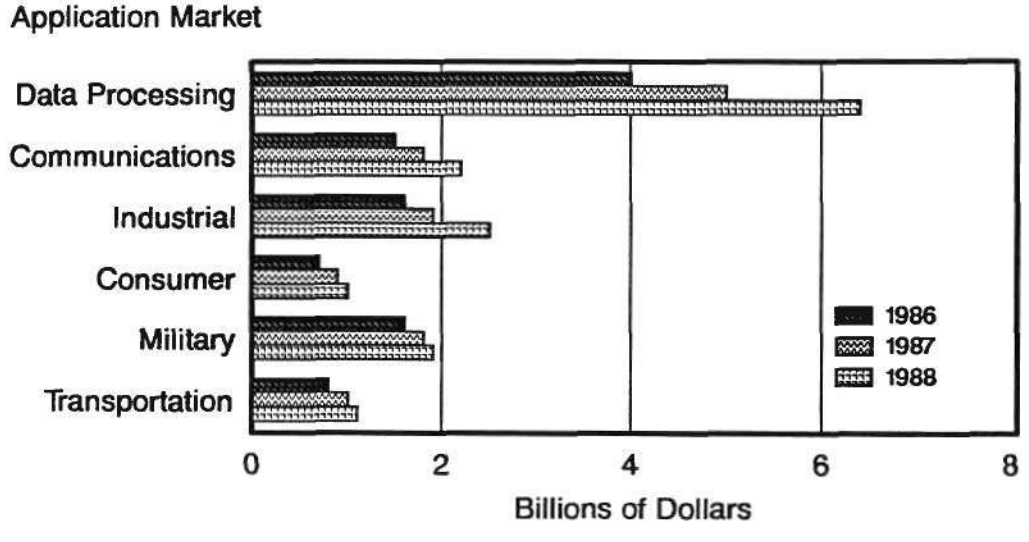
NORTH AMERICAN ELECTRONICS PRODUCTION



Source: Dataquest

NORTH AMERICAN SEMICONDUCTOR CONSUMPTION

By Application Market



Source: Dataquest

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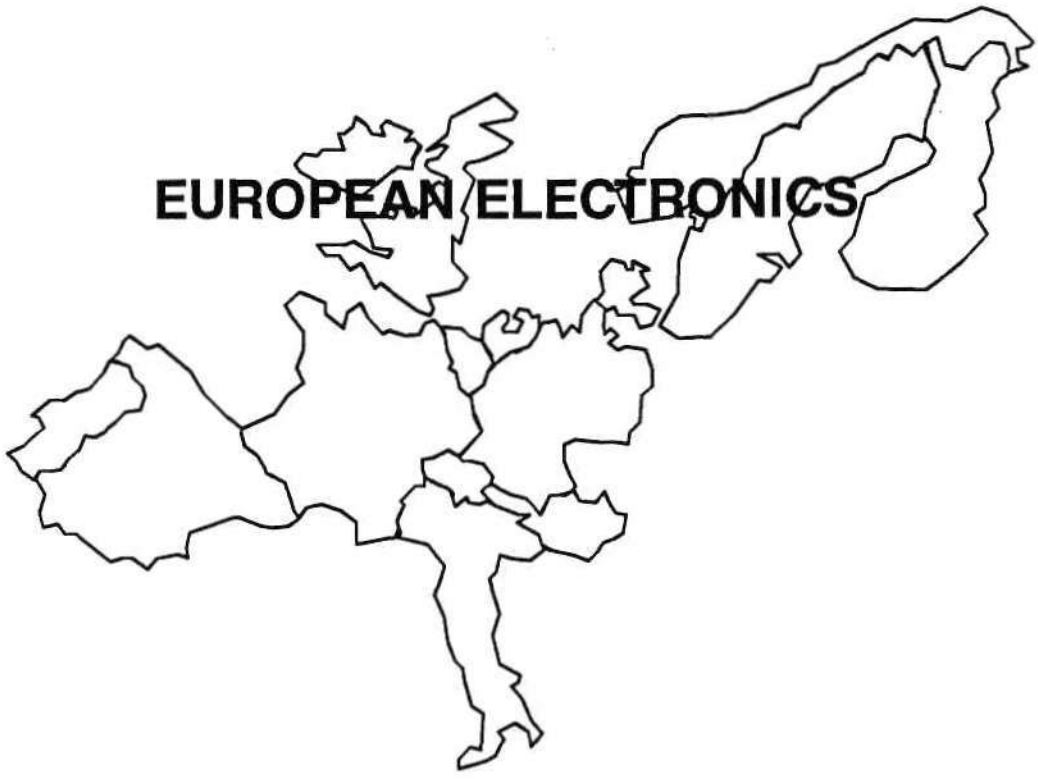
OUTLOOK FOR NORTH AMERICA'S MAJOR SEMICONDUCTOR MARKETS

(Billions of Dollars)

	1987	1991	CAGR 1987-1991
Personal Computers	$19.2	$26.3	8.2%
Automotive Power Train/ Engine Control	$ 3.2	$ 4.2	7.1%
Rigid Disk Drives	$17.3	$21.2	5.2%
Corporate Resource Computers	$13.6	$16.7	5.3%
Large Department Computers	$ 9.4	$12.3	6.8%

Source: Dataquest



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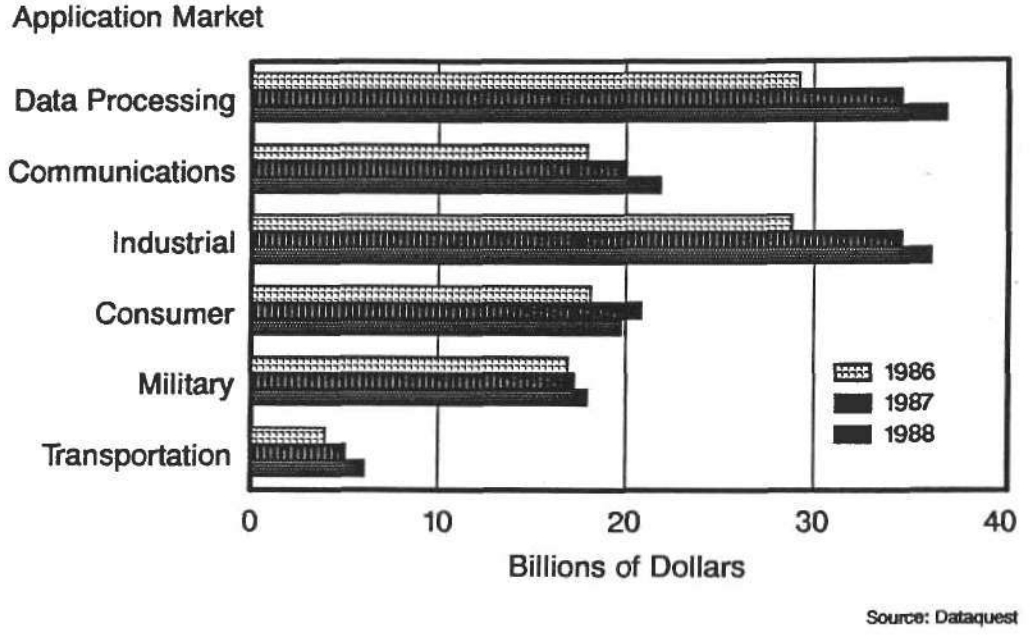
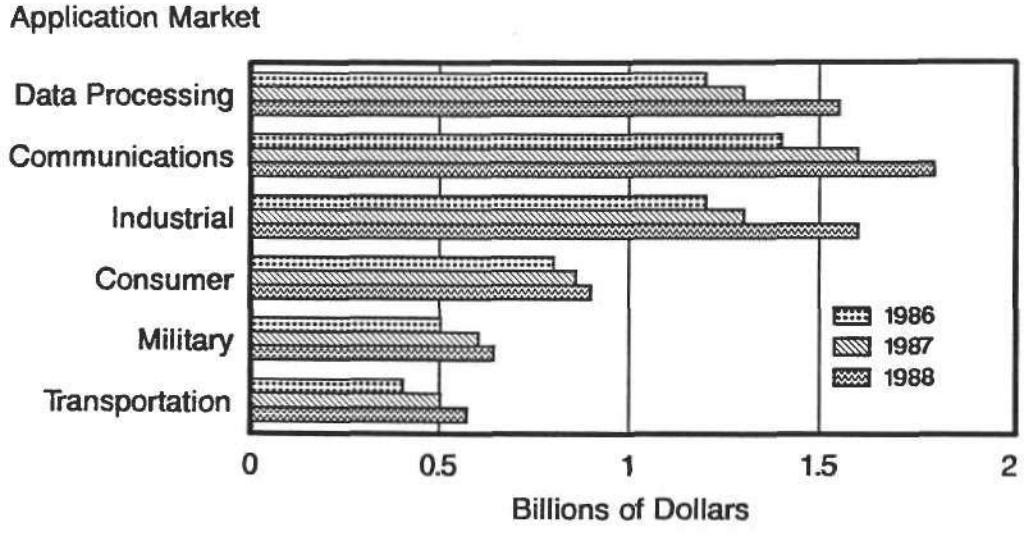
EUROPEAN ELECTRONICS PRODUCTION



Source: Dataquest

EUROPEAN SEMICONDUCTOR CONSUMPTION

By Application Market



Source: Dataquest

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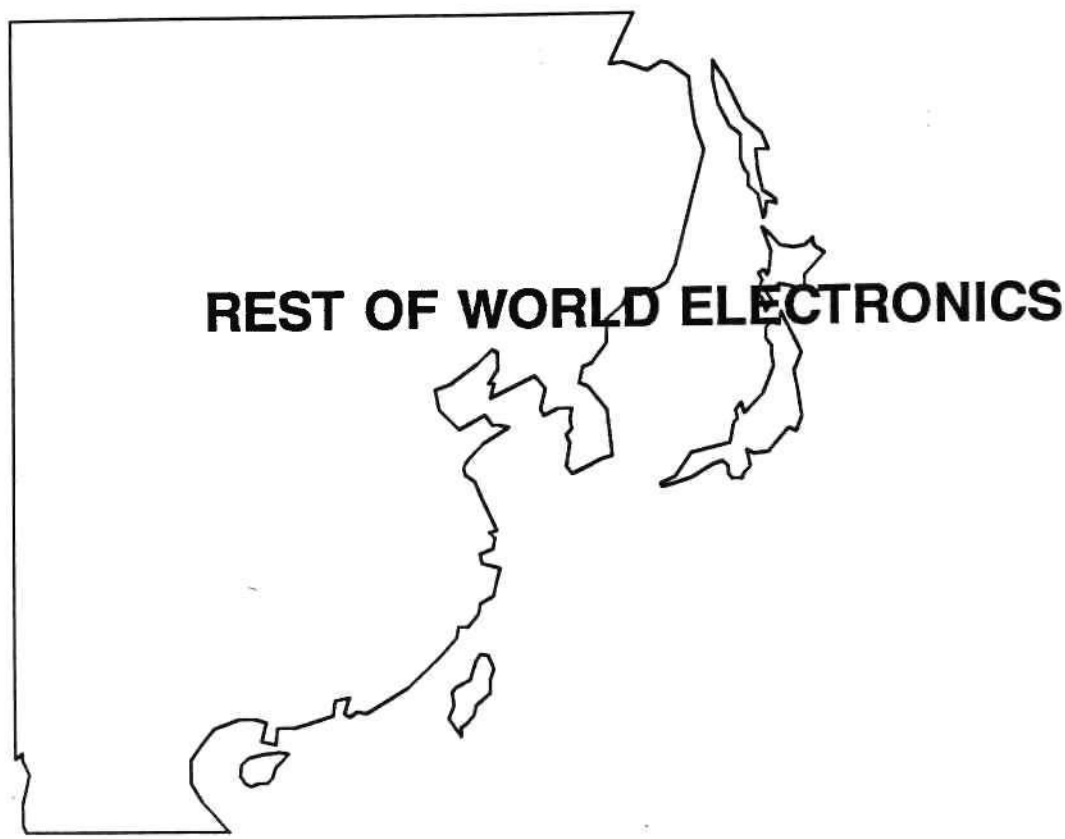
OUTLOOK FOR EUROPE'S MAJOR SEMICONDUCTOR MARKETS

(Millions of Dollars)

	1987	1991	CAGR 1987-1991
Compact Disk Players	$ 447	$ 730	13.0%
Personal Computers	$8,424	$11,645	8.4%
Automotive/Engine Control	$2,734	$ 4,278	11.8%

Source: Dataquest



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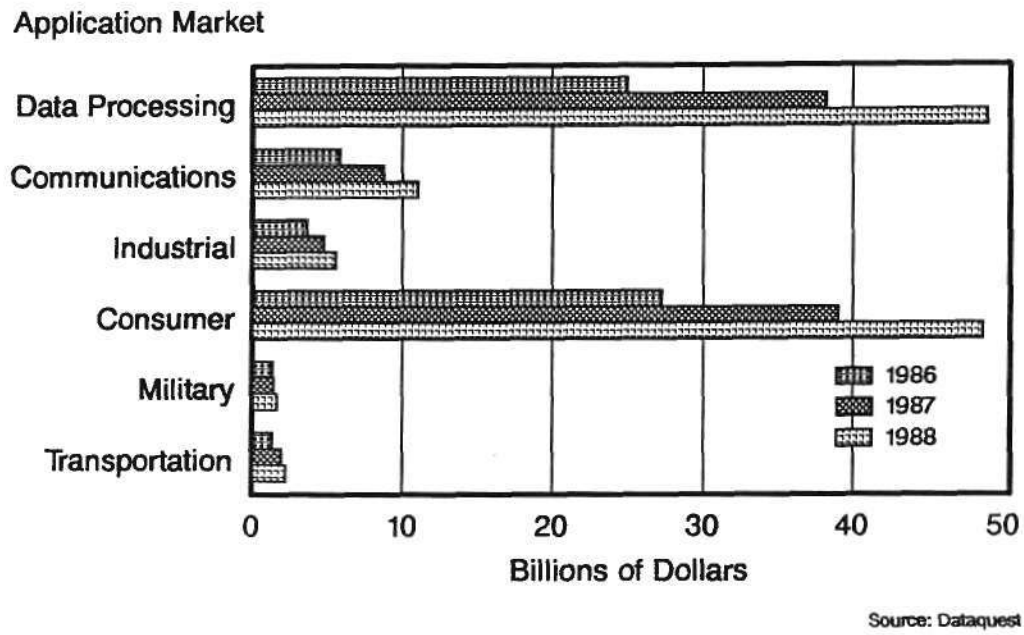
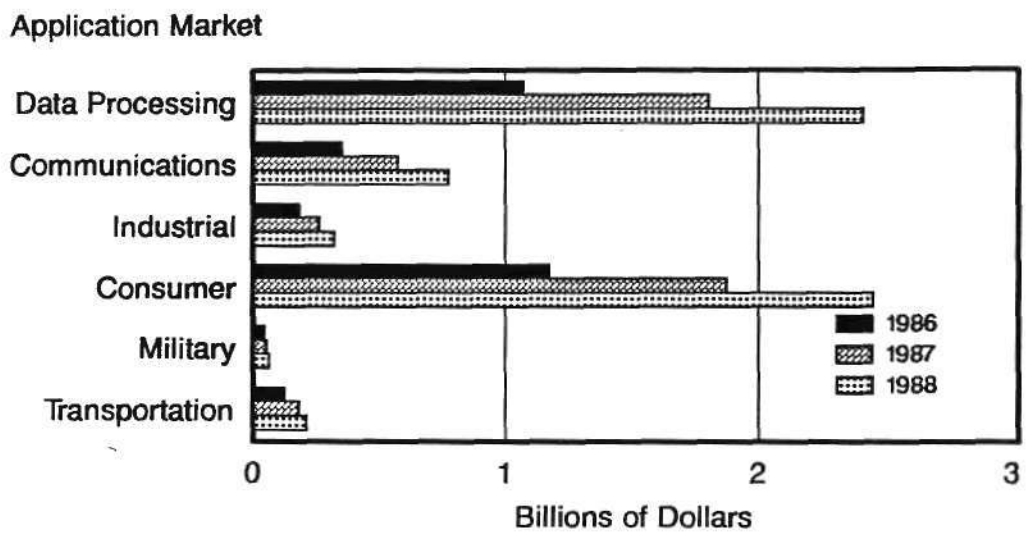
REST OF WORLD ELECTRONICS PRODUCTION



Source: Dataquest

REST OF WORLD SEMICONDUCTOR CONSUMPTION

By Application Market



Source: Dataquest

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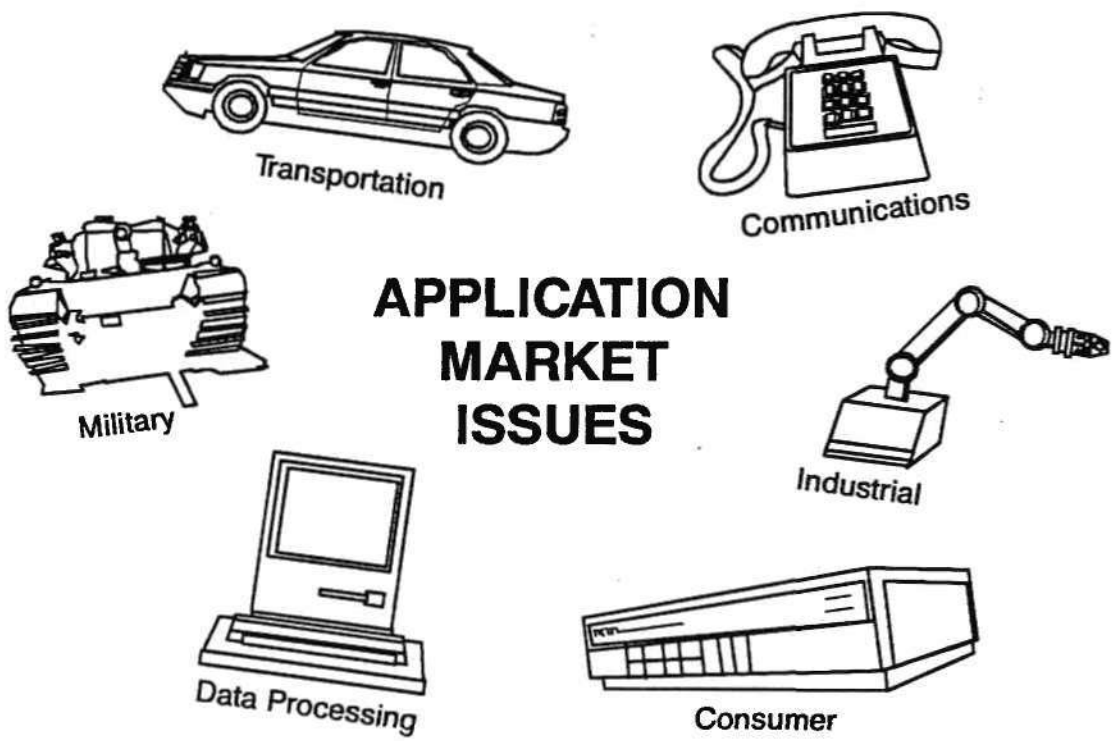
OUTLOOK FOR REST OF WORLD MAJOR SEMICONDCUTOR MARKETS

(Millions of Dollars)

	1987	1991	CAGR 1987-1991
Personal Computers	$ 931	$2,168	23.5%
TVs	$1,440	$1,937	7.7%
VCRs	$ 325	$ 518	12.3%

Note: Includes Republic of China, Hong Kong, and Singapore

Source: Dataquest



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DATA PROCESSING ISSUES

- Japan's new focus on the information processing industry
- Product availability:
  - Leading-edge memories and microprocessors
- IBM PS/2 clonability
- Acceptance of OS/2

COMMUNICATIONS ISSUES

- ISDN
- FDDI
- Upgrade analog to digital switching technology
- Integration of voice and data communications
- Connecting the desk

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INDUSTRIAL ISSUES

- Technology upgrade: move from analog to digital
- Network standards for manufacturing automation
- Islands of automation instead of centralized control
- Automation growth in industries other than automotive

CONSUMER ISSUES

- Base of manufacturing shifting
- Searching for the next VCR
- Only one major U.S.-based company exists
- Increased functionality to drive sales

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MILITARY ISSUES

- Slowing of Reagan era
- Upgraded programs
- Foreign dependency on technology
- Defense sharing (NATO, Japanese involvement)
- Keeping up with competition

TRANSPORTATION ISSUES

- Component reliability
- Emerging semiconductor applications:
  - Antilock braking
  - Electronic suspension
  - Airbags/seat restraints
  - Electronic steering
- Continued automotive semiconductor growth despite slowing auto production
- Semiconductor products to be integrated in near term:
  - 16-bit microcontrollers
  - Application-specific standard products
  - Power ICs

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WHAT'S ON THE USERS' MINDS?

WHAT'S ON THE USERS' MINDS?

The Major Issues

1986	1987
Pricing	Pricing
Quality/reliability	Availability/lead times
On-time delivery	Quality/reliability
Supply/availability/shortages	On-time delivery
JIT/inventory control	FMVs/trade agreement
Reducing vendor base	Cost control
Product obsolescence	JIT/inventory control
Second-sourcing	Surface mount
Forecasting	New products/obsolescence
	ASICs
	Offshore manufacturing and procurement

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CONCLUSIONS

- Critical markets for success:
  - Data processing
  - Consumer
- Demand drivers:
  - Personal computers
  - VCRs
- Issues:
  - Semiconductor availability
  - Technology dependence

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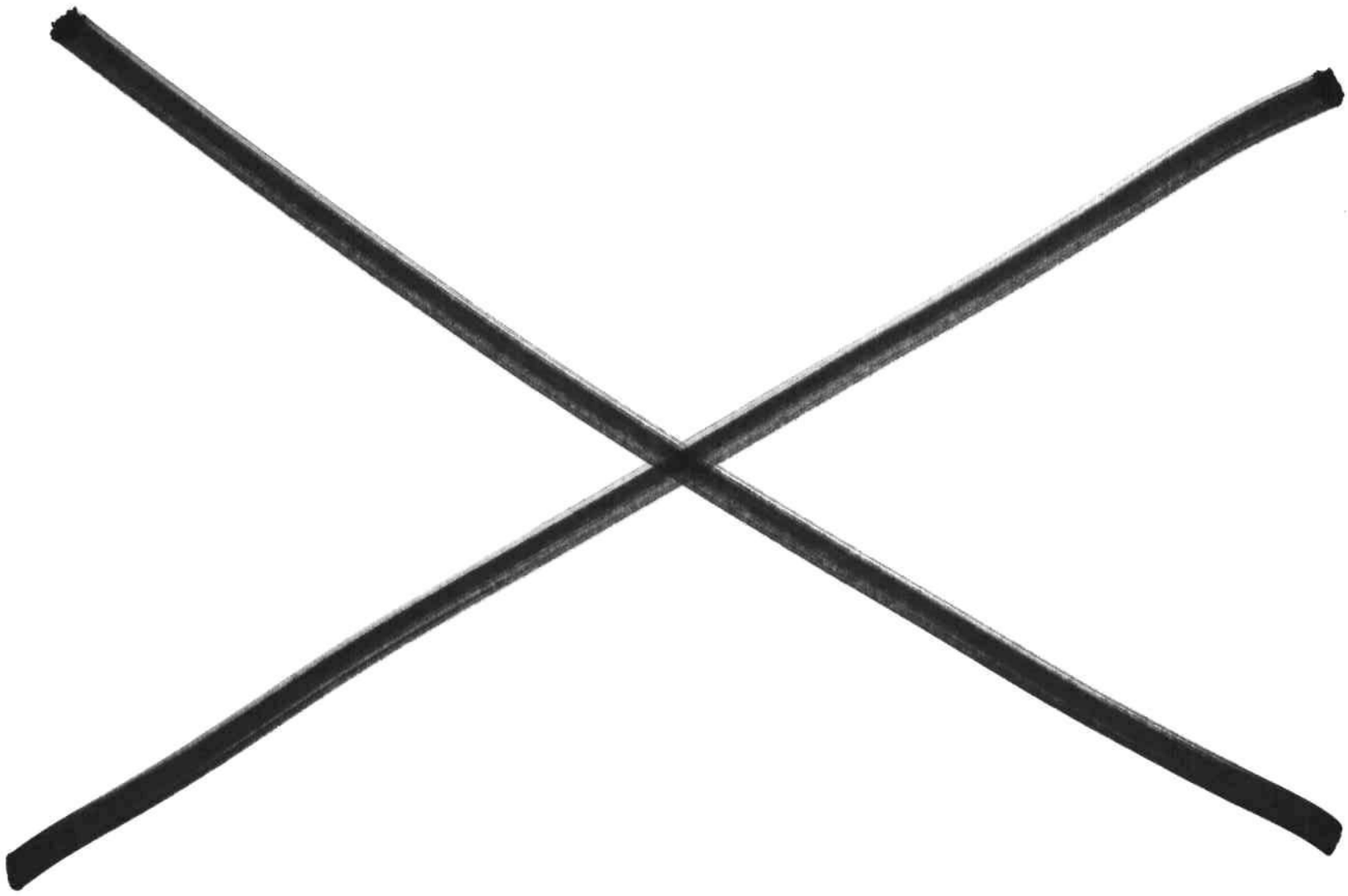

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FUTURE TRENDS OF 32-BIT TRON MICROPROCESSOR

Kazuo Kimbara
Board Director, Group Executive
Electronic Devices Group
Hitachi, Ltd.

Mr. Kimbara is Board Director and Group Executive of the Electronic Devices Group at Hitachi, Ltd. He is also Chairman of the TRON Association. At Hitachi, he is in charge of semiconductor devices and electron tube products. His previous positions at Hitachi have included General Manager of the Takasaki Works, General Manager of the Musashi Works, and General Manager of the Semiconductor and IC Division. Mr. Kimbara received a Bachelor of Engineering degree at the School of Engineering at Nagoya University.

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April 11-12, 1988
Tokyo, Japan

TRON SPECIFICATION 32 BIT MICROPROCESSOR AND ITS FUTURE TREND

KAZUO KIMBARA

HITACHI LTD.

OVERVIEW

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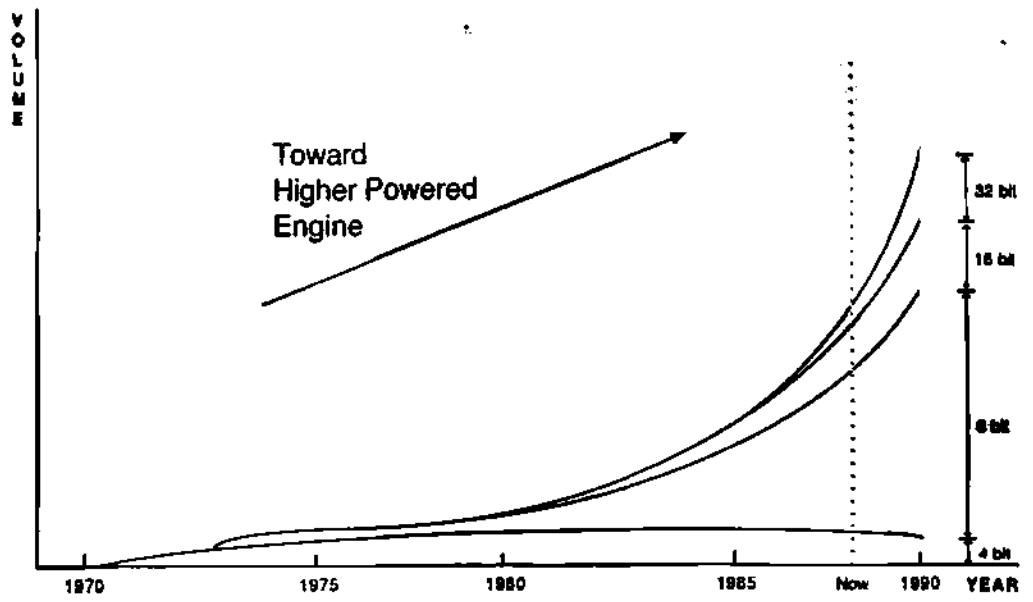
History of Microprocessor



Toward Higher Powered Engine

1. More memory size requested
   → needs for larger memory space
2. Faster data handling requested
   → needs for larger data length

Memory space			Data length	
4 bit μP	~	16 KB	4 bits	
8 bit μP	~	1 MB	4 – 16 bits	
16 bit μP	~	16 MB	4 – 32 bits	
32 bit μP	~	4 GB	4 – 64 bits	TRON architecture range
64 bit μP	>	4 GB	~ 64 bits	

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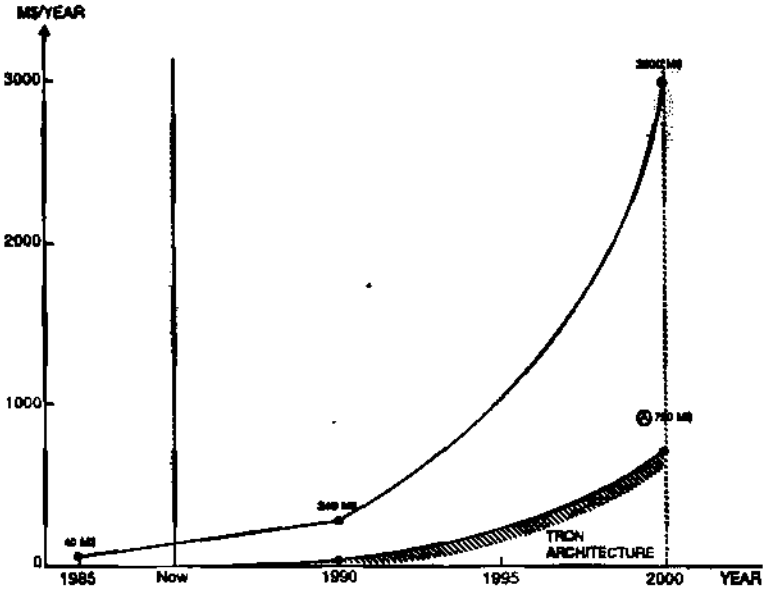
Market Forecast of 32 Bit Microprocessor



Ⓐ : 20 – 25% of total 32 bit is expected to be TRON ARCHITECTURE at 2000

Applications

- TRON spec Word Processor
- TRON spec Personal Computer
- TRON spec Work Station
- TRON spec Controller
- TRON spec Communication Processor

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TRON PROJECT

TRON Project

Basic Philosophy

- For more persons

  For easier man-machine communications

- Highest technology optimized in 1990's

- Architecture shall be put in public domain

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Man-Machine Interface

Commands the Architecture

TRON Project	Others
Man-machine Interface	MPU Architecture
↓	↓
Operating System	Operating System then Developed
↓	↓
MPU Architecture	Man-machine Interface

TRON (The Real-Time Operating System Nucleus)

- TRON Project
  - Started in June, 1984
  - Proposed and conducted by Dr. Ken Sakamura of Science Department of the University of Tokyo

- TRON Association
  - Started in June, 1986
  - Chairman: Mr. T. Yamamoto President of Fujitsu Ltd.
    Vice chairman: Mr. K. Kimbara Board Director of Hitachi LTD.
  - Over 100 companies participate in the association

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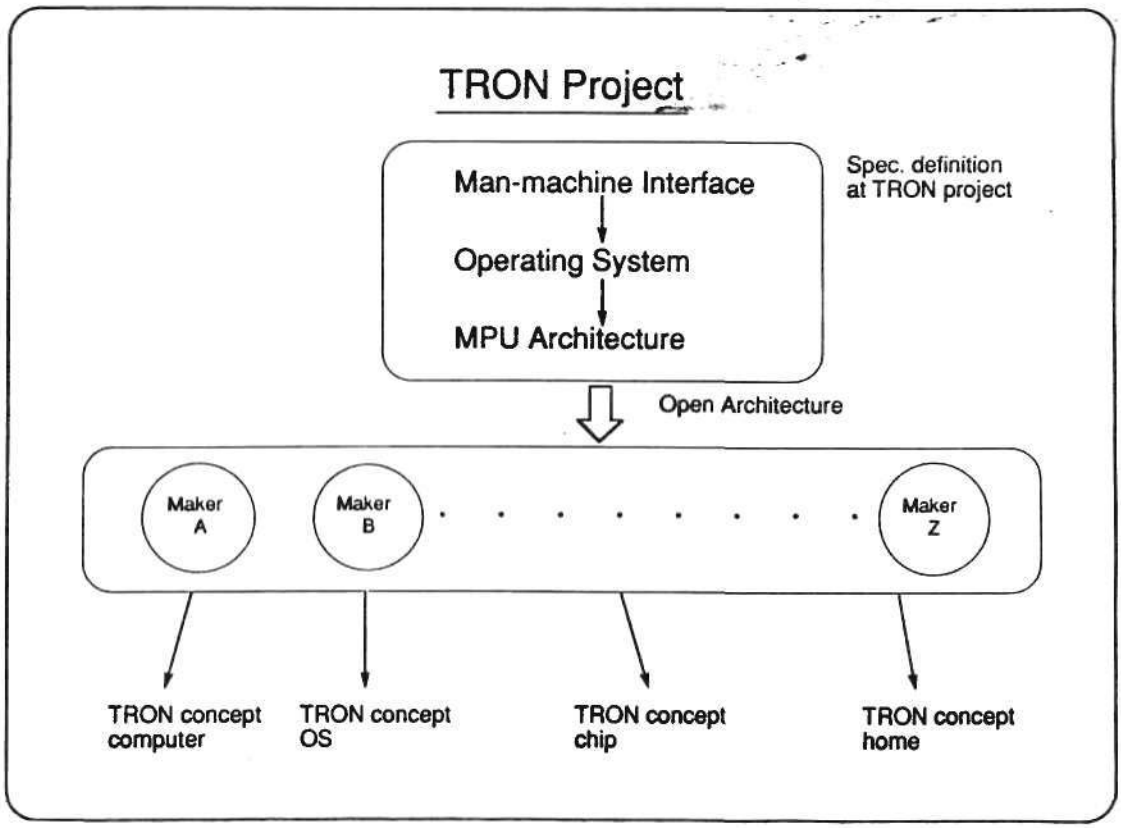

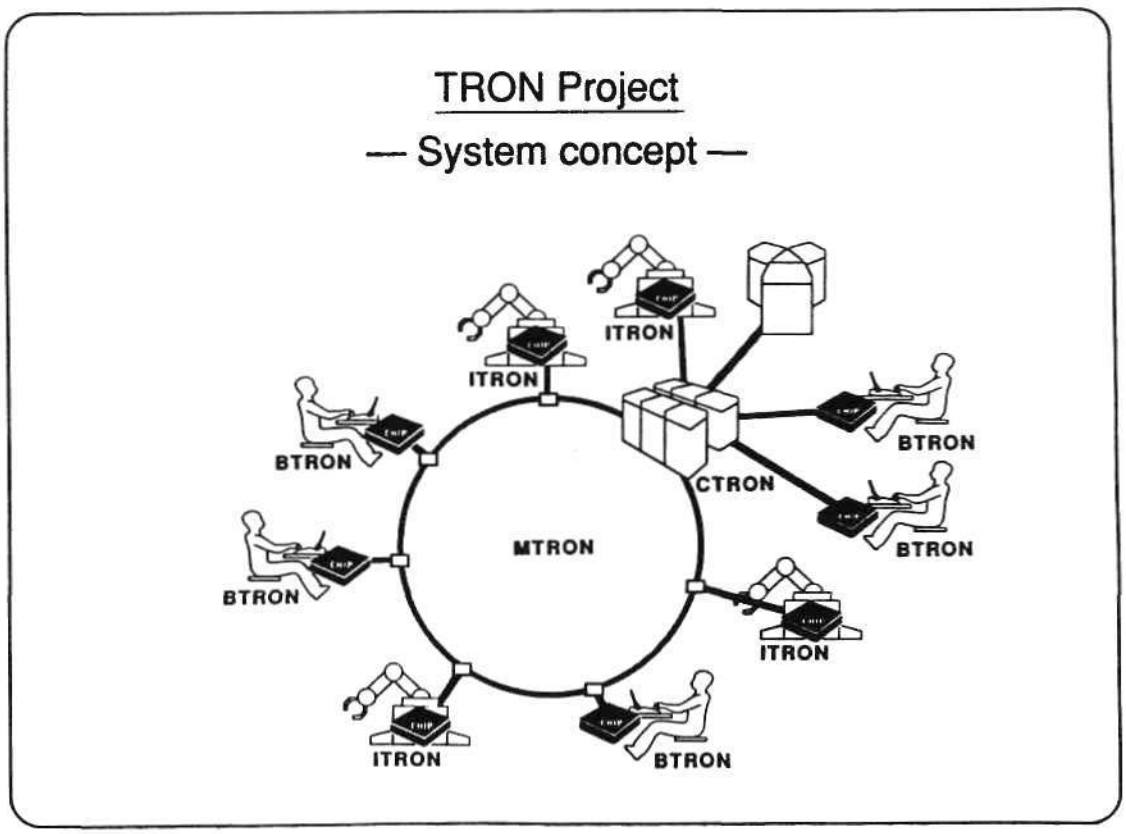

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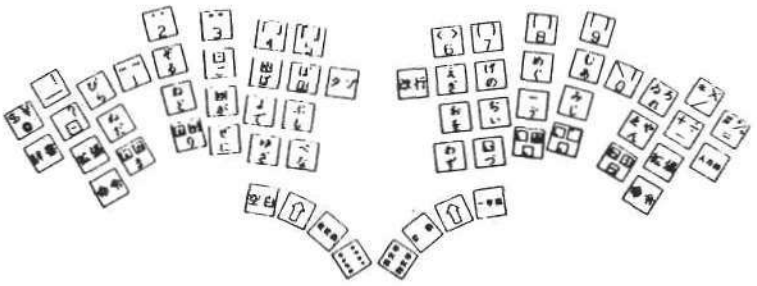
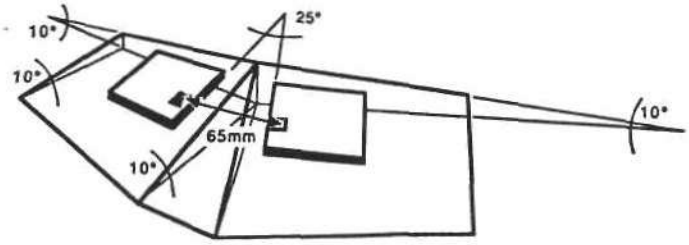
TRON Project

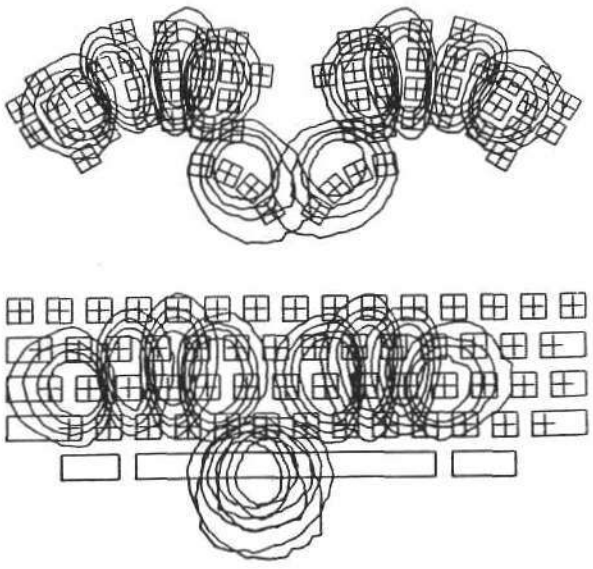
Keyboard





TRON Project

Finger Trace on a Keyboard



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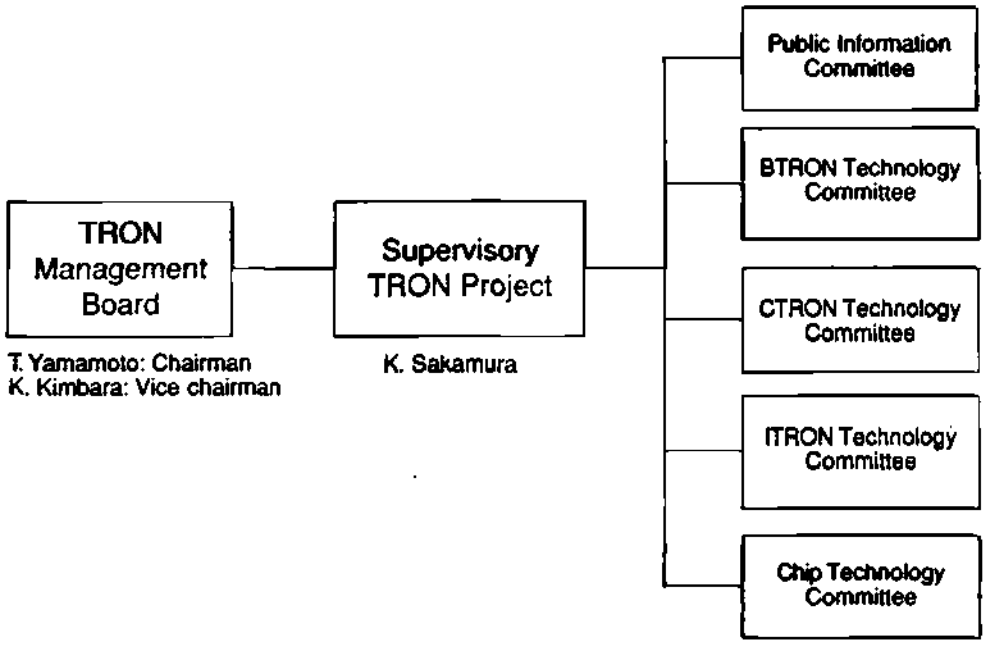
Organization of TRON Project



TRON Project

WHO and WHAT

WHO / WHAT	Board Members of TRON Association								
	H	F	Mi	T	N	Ma	O	NTT	
I	○	○	○		○				
B	○	○	○	○	○	○	○		
C	○	○	○	○	○		○	○	
M									
32 B MPU	**O**	**O**	**O**	○		○	○		

○ Developed or -ing

O GMICRO Family

Above table is composed of press and/or magazine news released by now

Nikkei Byte Feb. 1987
Asahi 29 Sept. 1987
Nikkei Sangyo 3 Sept. 1987

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TRON SPECIFICATION 32 BIT MICROPROCESSOR

TRON Spec Chip Architecture

- Fast response time
- Efficient handling of international languages
- Powerful graphic handling
- Well suited for
  - TRON spec operating systems
  - High level language
- Future expandability to 64 bit

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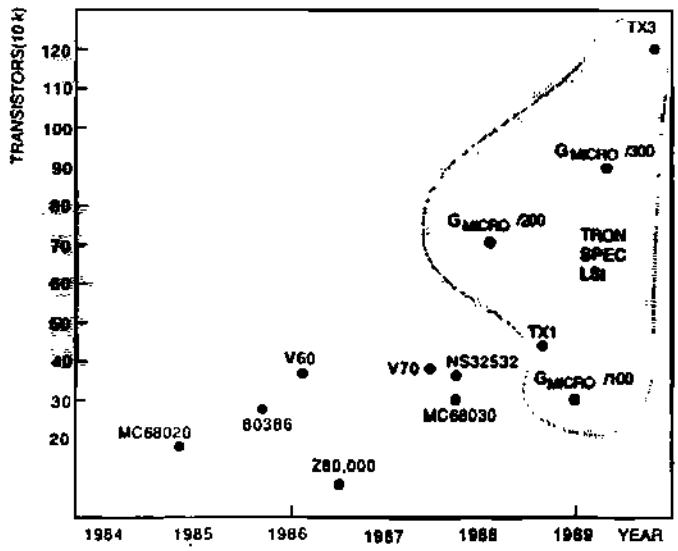
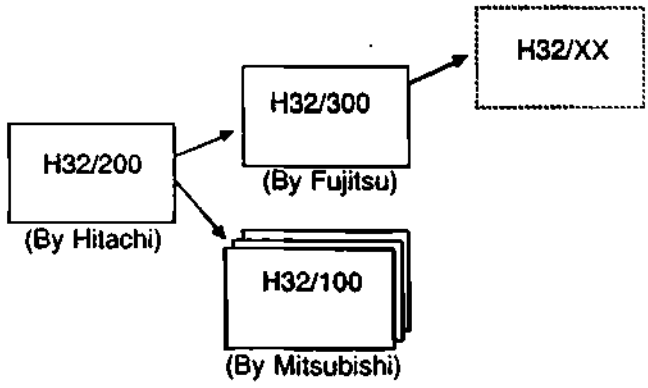
Trend of 32 Bit Microprocessors



Data by Nikkei Electronics

GMICRO Family Development

1. Global microprocessor family
2. Joint development;
   Hitachi, Fujitsu, Mitsubishi
3. TRON architecture
4. Family expansion plan



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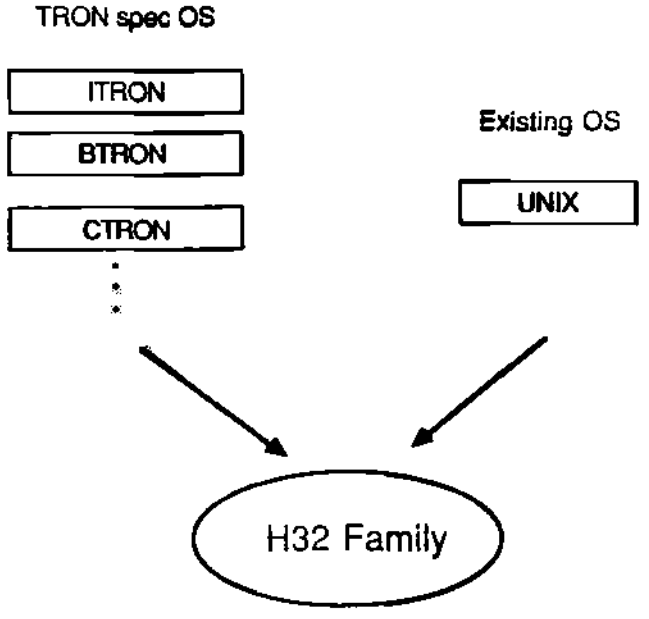
H32 Family Operating Systems



Specifications of H32 Family

	H32/100	H32/200	H32/300
Performance – EDN MIPS – Whetstone	 4.5 —	 6 4	 12 5≤
Coprocessor Interface	No	Yes	Yes
MMU on chip	No	Yes	Yes
On chip caches	No	Yes	Yes
Features	Strong bit map operation	High performance TRON spec chip	Enhanced BCD operation
Target Market	• μBTRON • I/O Controller • ASIC core	• EWS • Embedded controller • Communication processor	• EWS • Office machine • Super-minicon
Sample	'89/2Q	'88/2Q	'89/2Q

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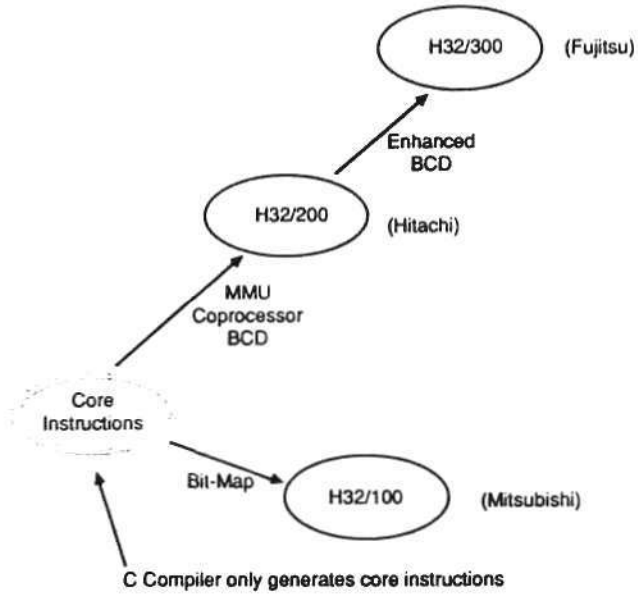
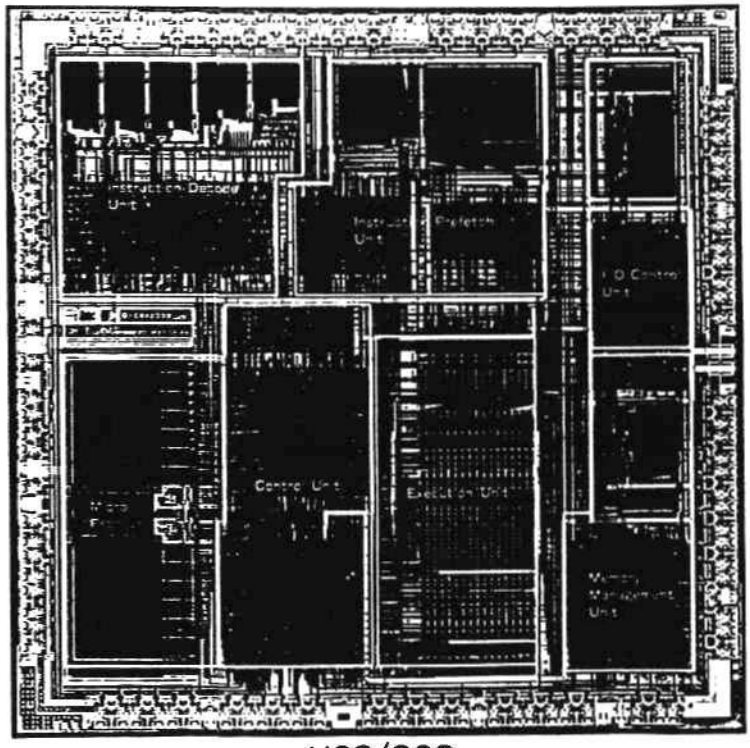
H32 Migration Path





H32/200

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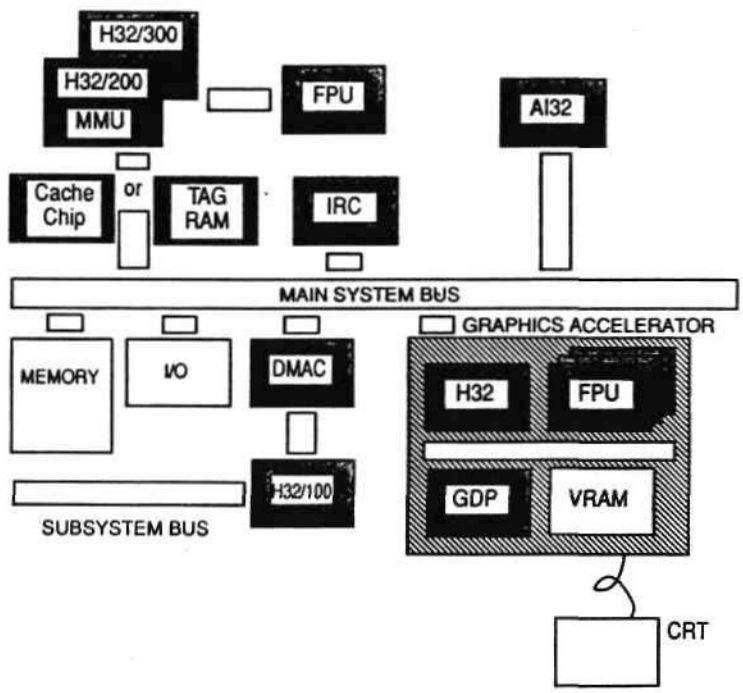
H32 Total System Development

- LSI
  - MPU
  - Peripherals
- Software
  - Assembler/utilities
  - High Level languages
    C/Modular II/Cobol/Fortran/...
- Hardware
  - In-circuit emulator
  - SBC family
- 3rd party development

H32 Family System Configuration



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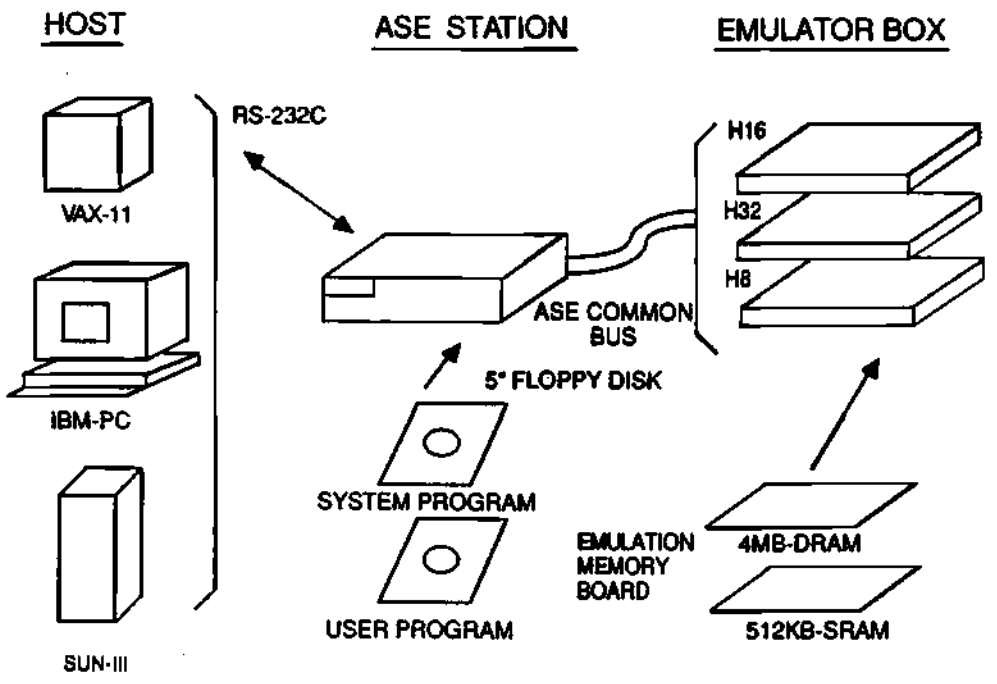
H32 Family
Peripherals - Shared Efforts

- FPU (Hitachi) — Floating Point Arithmetic Unit
- DMAC (Fujitsu) — Direct Memory Access Controller
- TAGM (Fujitsu) — TAG Memory
- CCM (Mitsubishi) — Cache Control and Memory
- IRC (Fujitsu) — Interrupt Request Controller
- AI32 (Hitachi) — Artificial Intelligent Coprocessor
- GDP (Hitachi) — Graphic Data Processor

ASE: Adaptive Systems Emulator



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Sampling Schedule

		'88/1Q	2Q	3Q	4Q	'89/1Q	2Q	3Q	4Q
LSI	H32/100						○		
	H32/200		○						
	H32/300						○		
	FPU				○				
	DMAC			○					
	IRC		○						
	TAGM	○							
	CCM				○				
	CPG			○					
Tool	Assembler		○						
	C		○						
	ASE (Emulator)				○				
	SBC				○				

FUTURE TREND

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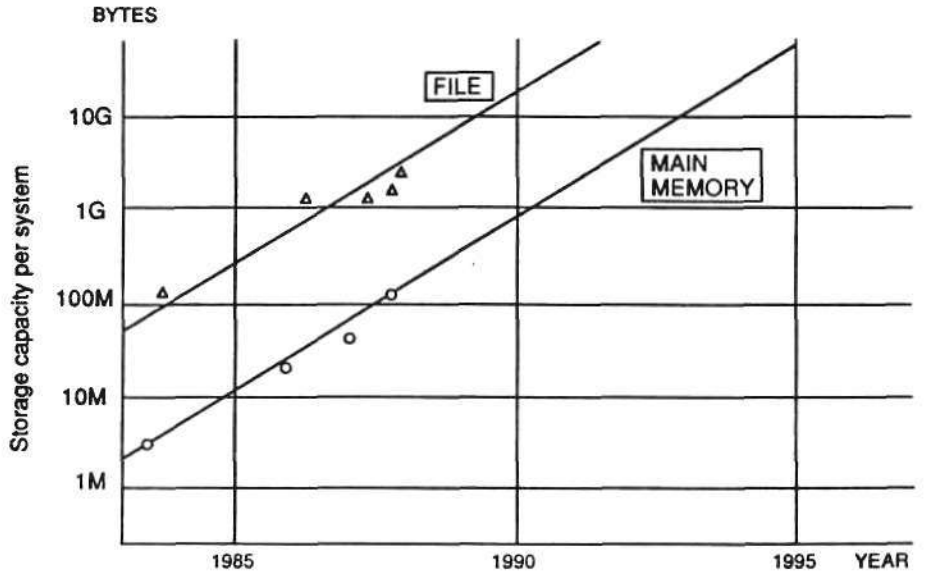
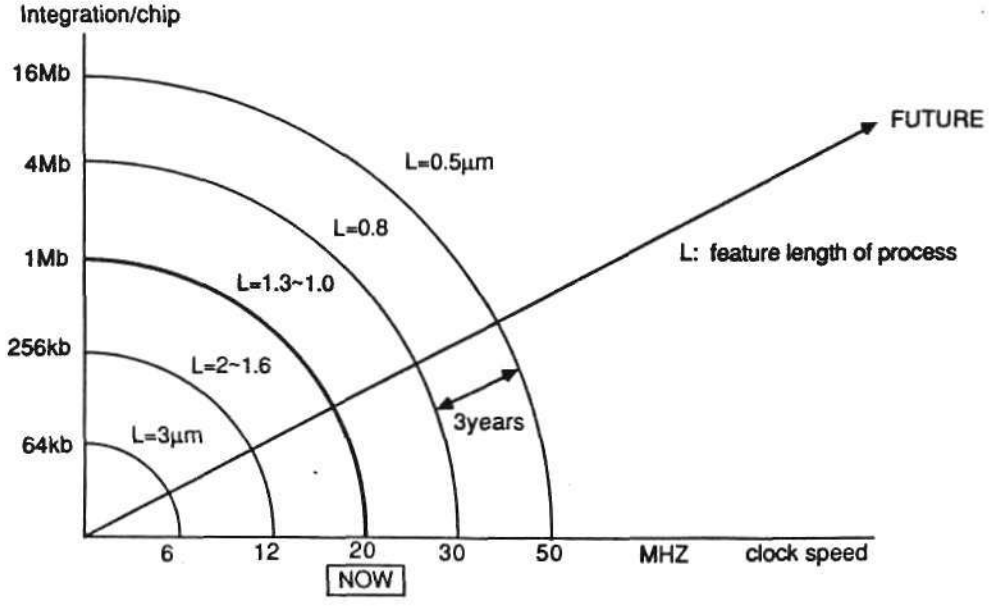
STORAGE CAPACITY TRENDS IN WORK STATION

– Larger memory size requests more powerful processors –



TECHNOLOGY PROGRESS

– Higher speed and integration –



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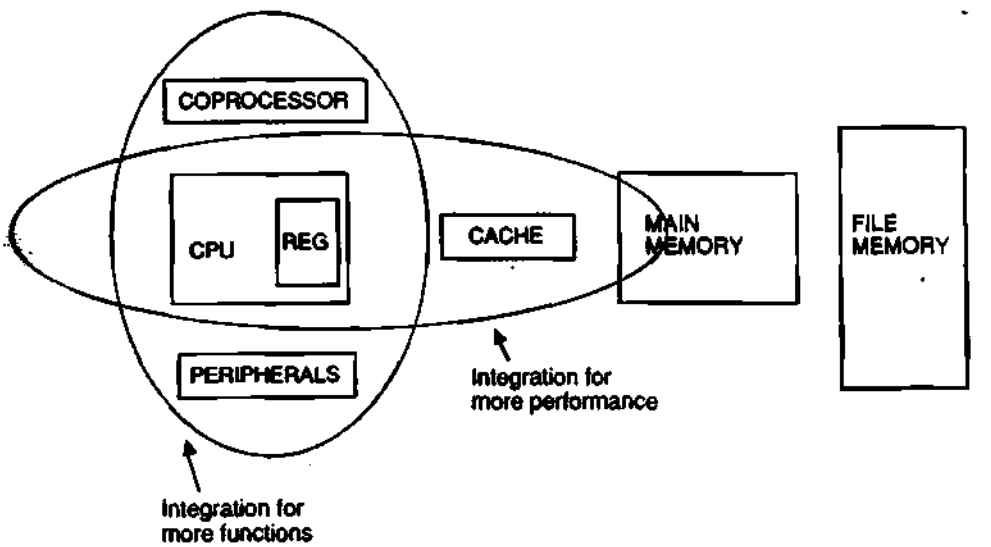
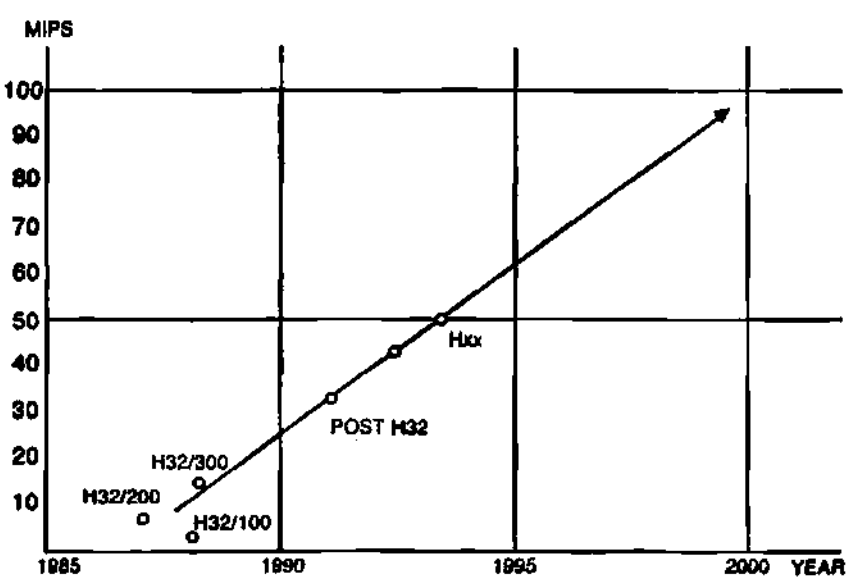
HIGHER INTEGRATION



HIGHER SPEED

– TARGET: 100MIPS BY TURN OF THE CENTURY –



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OTHER TOPICS

1. MULTI PROCESSOR SYSTEM

2. ARTIFICIAL INTELLIGENT ENGINE

3. FAULT TORELANT SYSTEM

Conclusions

- Hitachi participates in TRON project in several different areas.
- Major efforts are put on the development of H32 microprocessor family.
  Sharing developing man-power with Fujitsu and Mitsubishi.
- H32 microprocessor family will be introduced to the customers in this year, as a kit. with great performance advantages and unique features.

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JOINT VENTURE STRATEGIES

Murray A. Goldman
Senior Vice President and General Manager
Microprocessor Products Group
Motorola Incorporated

Dr. Goldman is a Senior Vice President and General Manager of the Microprocessor Products Group at Motorola. He has spent 27 years in the electronics industry, including 7 years at Bell Telephone Laboratories, 2 years at New York University, and the last 19 years at Motorola. His experience spans the areas of computer design, CAD, factory automation, and semiconductor production engineering. Dr. Goldman has managed Motorola's Microprocessor Products Operation for the past 12 years. He and his staff have provided the leadership to help create major industry standards with 8-, 16-, and 32-bit microprocessor products.

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JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE
April 11-12, 1988
Tokyo, Japan

Joint Venture Strategies

Murray Goldman

Sr. Vice President & General Manager

Microprocessor Products Group

Motorola

Why Joint Ventures?

- **Market penetration**
- **Reduce R&D expenditures**
- **Share complementary strengths**
- **Expand product portfolio**

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Complexities and Issues

- Culture differences
- Corporate philosophy
- Perceived value of intellectual assets
- Execution
- Win / Win agreement
- Trust ... Patience

Requirements for Entering Japanese Market

- Leadership product portfolio
- Top quality is mandatory
- Complete customer support
- Strong relationships
- Long term commitment
- Utilize local talent

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Motorola's Thrust into Japanese Market

- Leadership MPU products
- Superb quality
- Nippon Motorola
- Local capabilities
- Toshiba alliance

Toshiba Relationship

- Corporate cultures compatible
- Complementary strengths
  (Motorola MPUs and Toshiba RAMs)
- Joint factory
  - Engineering efficiency
  - Eases product transfer
  - Common process
  - Long term compatibility
  - Better serve local market
- Trust

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LEADING ASIC TECHNOLOGIES

Gordon A. Campbell
Chairman of the Board, President, and CEO
Chips and Technologies, Inc.

Mr. Campbell founded Chips and Technologies, Inc., in January 1985, and since then has served as the company's Chairman of the Board, President, and Chief Executive Officer. Prior to founding Chips, he was a founder of Seeq Technology, Inc., a semiconductor manufacturer, and served as that company's President and Chief Executive Officer for more than three years. Earlier, he served in various management positions at Intel Corporation, most recently as Marketing Manager, Special Products Division.

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April 11-12, 1988
Tokyo, Japan

CHIPS

Chips and Technologies, Inc.

Solutions for a Changing World

CHIPS

THE CHIPS MANAGEMENT TEAM

- FOUNDED IN JANUARY, 1985
- MANAGEMENT TEAM INCLUDES:

GORDON CAMPBELL	PRESIDENT AND C.E.O.
DADO BANATAO	V.P. & G.M. OF SYSTEMS LOGIC PRODUCTS
DAVE BOWMAN	V.P. OF SALES
MORRIS JONES	V.P. OF TECHNOLOGY
STEPHEN KAHNG	V.P. OF DESIGN SERVICES OPERATION
KEITH LOBO	V.P. OF MARKETING
GARY MARTIN	V.P. OF FINANCE & CFO
JUDY OWEN	V.P. OF GRAPHICS PRODUCTS
JIM STAFFORD	V.P. OF MANUFACTURING
RON YARA	V.P. OF BUSINESS DEVELOPMENT

- SENIOR DESIGN ENGINEERS WITH MICROCOMPUTER/MICROPROCESSOR EXPERIENCE FROM INTEL, AMD, FUJITSU, AMI, SEEQ, ETC.
- SYSTEMS-LEVEL DESIGN EXPERTISE AT SUCH COMPANIES AS DEC AND LEADING EDGE
- SENIOR CAE ENGINEERS WITH WORKING EXPERIENCE AT AMDAHL, IBM, HP, LSI, AND SILICON COMPILERS

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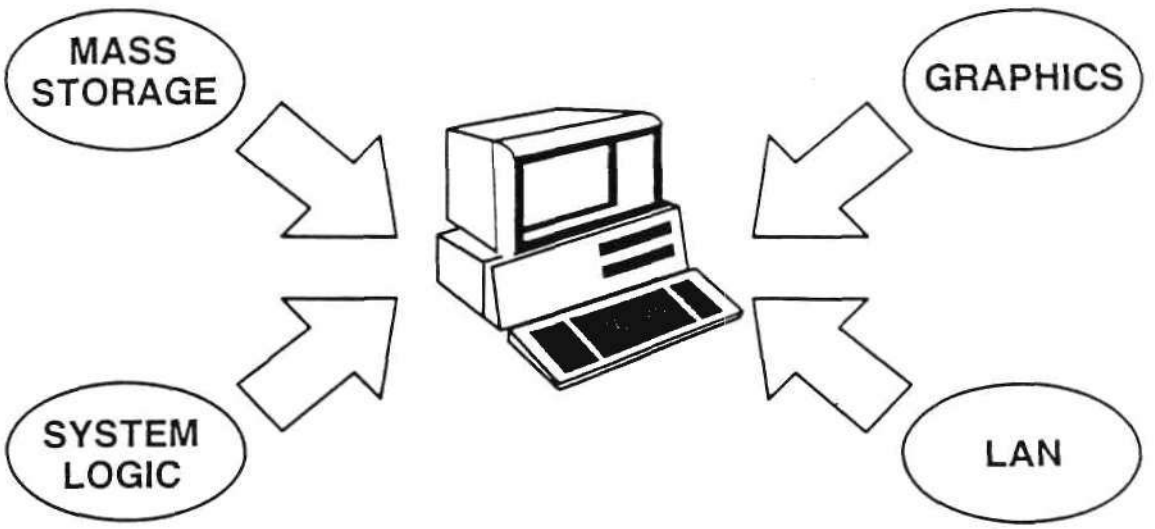
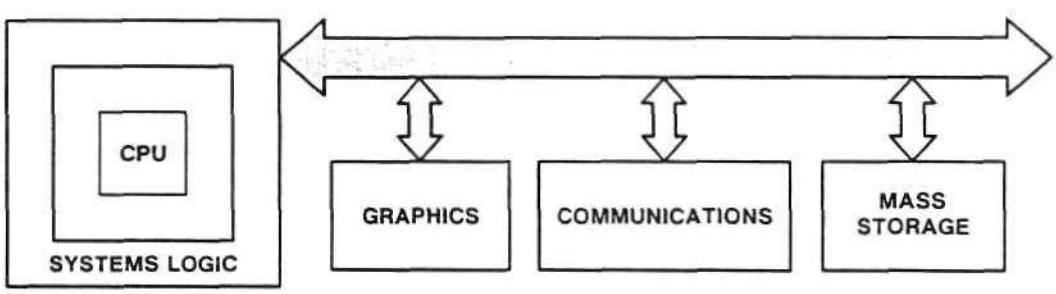


CHIPS AND TECHNOLOGIES SUPPLIES SYSTEM-LEVEL VLSI FOR HIGH PERFORMANCE IBM COMPATIBLES AND OTHER INDUSTRY STANDARD MICROCOMPUTER SYSTEMS

CHIPS

COMPLETE CHIPSet SOLUTIONS FOR MICROCOMPUTERS



CPU CONTROL MEMORY CONTROL SYSTEM PERIPHERALS I/O AND DMA CONTROL KEYBOARD INTERFACE	EGA VGA LCD CGA	3270 COMM SERIAL I/O PORTS	FLOPPY DISK INTERFACE

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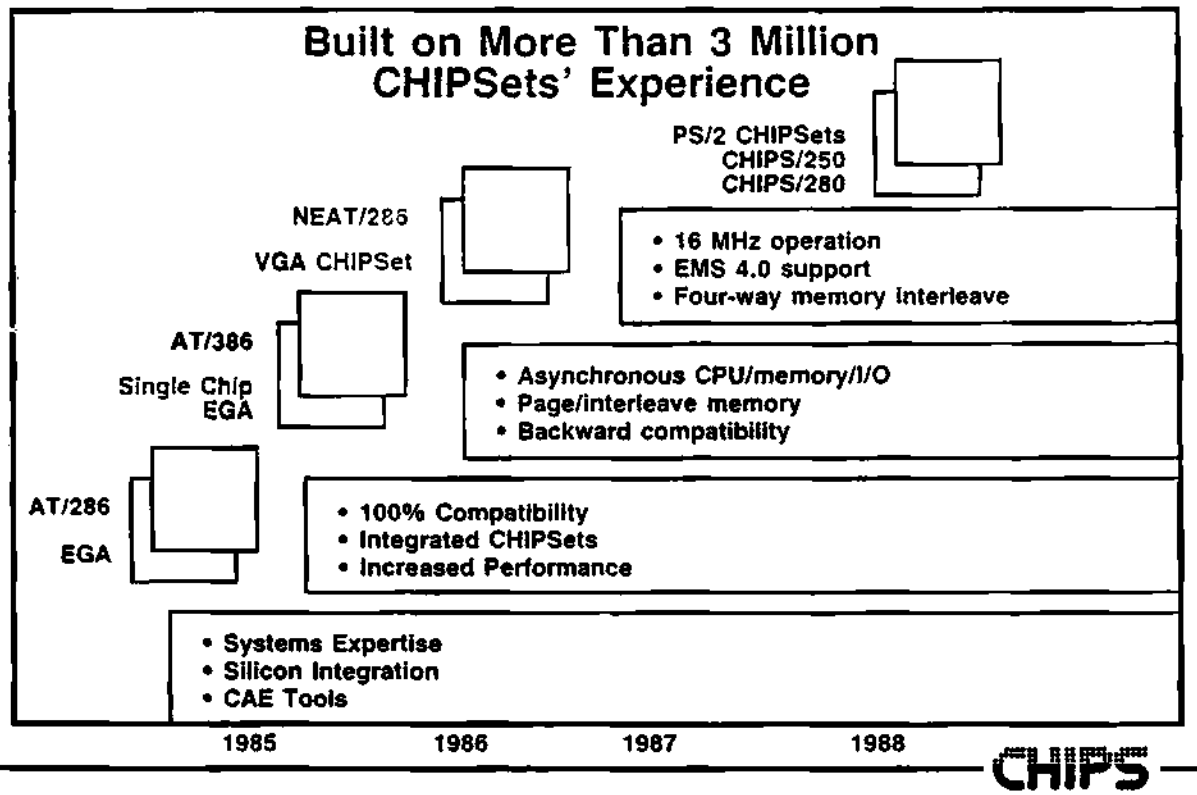

Manufacturing Strategy

- **UTILIZE SUBCONTRACT MANUFACTURING**
  - ✓ LEVERAGE VARIABLE COST STRUCTURE
    vs
    FIXED COST OF OWN FAB FACILITY
- **DESIGN WITH TECHNOLOGY INDEPENDENCE**
  - ✓ CAN USE BEST TECHNOLOGY FOR EACH APPLICATION
  - ✓ NO TECHNOLOGY DEVELOPMENT COSTS
- **FLEXIBILITY IN SUPPLY/CAPACITY**
  - ✓ MULTIPLE SOURCES OF SUPPLY
  - ✓ BEST PROCUREMENT COST STRUCTURE
  - ✓ FASTEST RAMPING CAPABILITY
  - ✓ LOWEST PROBABILITY OF PROBLEMS

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PERSONAL COMPUTER GENERATIONS

CPU/ MICROPROCESSOR	1st	2nd		3rd
				IBM PS/2
80386		386 SUPER AT 8 CHIP SET 40 CHIPS TOTAL 16,20,25 MHz	CACHE CONTROLLER	MODEL 80
80286	286 AT & IPC 6 CHIP SET 25 CHIPS TOTAL 6,8,10,12.5 MHz	ENHANCED AT HIGHLY INTEGRATED 6,8,10, 12,16 MHz	CACHE CONTROLLER	MODEL 60 MODEL 50
8088/86		SUPER XT HIGHLY INTEGRATED LAPTOP FEATURES 5,8,10 MHz		MODEL 30

CHIPS

CHIPS' STRATEGY FOR PS/2

- PROVIDE COMPLETE CHIPSet SOLUTIONS
  - COMPATIBILITY

PLUS

- PERFORMANCE
- INTEGRATION
- FUNCTIONALITY

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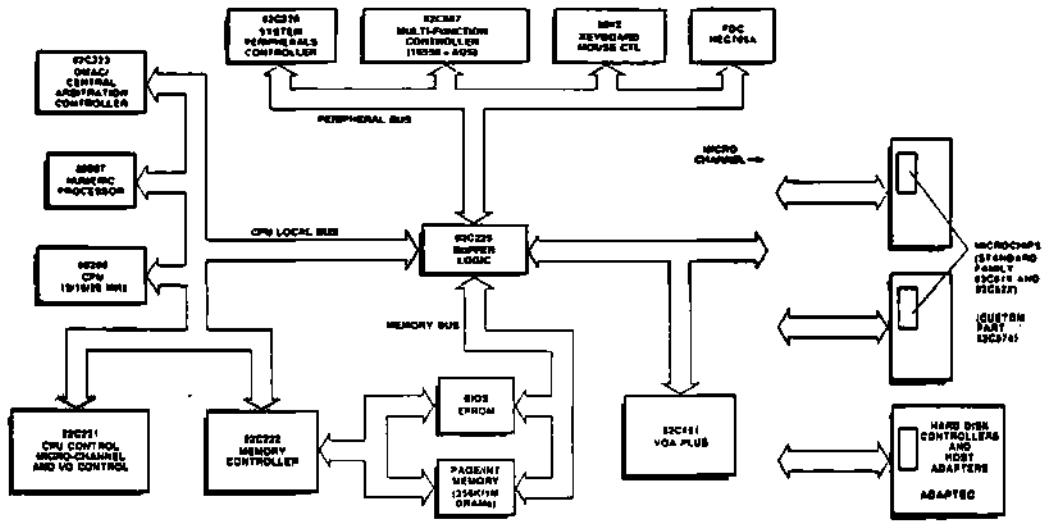
Meeting the Challenge: System Integration



CHIPS

CHIPS' "Plus" Scoreboard

- **Performance**
  - 2× faster than IBM Model 50
  - 50% higher Micro Channel memory bandwidth
  - 50% faster VGA memory & I/O cycles
- **Integration**
  - 66 versus 179 for the Model 80
  - 68 versus 119 for the Model 50
- **Functionality**
  - Asynchronous CPU/memory/DMA
  - Four-way interleaved memory
  - VGA with graphics cursor
  - Integrated EMS 4.0

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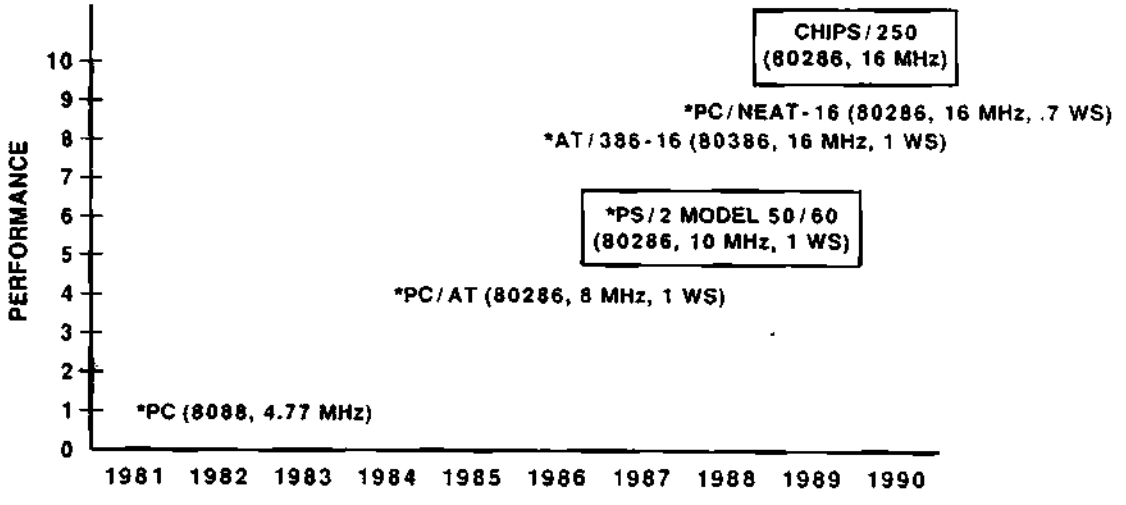
Introducing
CHIPS' PS/2 Family

Function	Model 50/60	Model 80
System Logic	CS8225	CS8238
Graphics	82C451/2	82C451/2
COMM/FD I/O	82C607	82C607
Micro Channel Adapter Interface	82C6XX	82C6XX
	CHIPS/250	**CHIPS/280**

CHIPS

MEETING THE CHALLENGE:
PERFORMANCE SUPERIORITY



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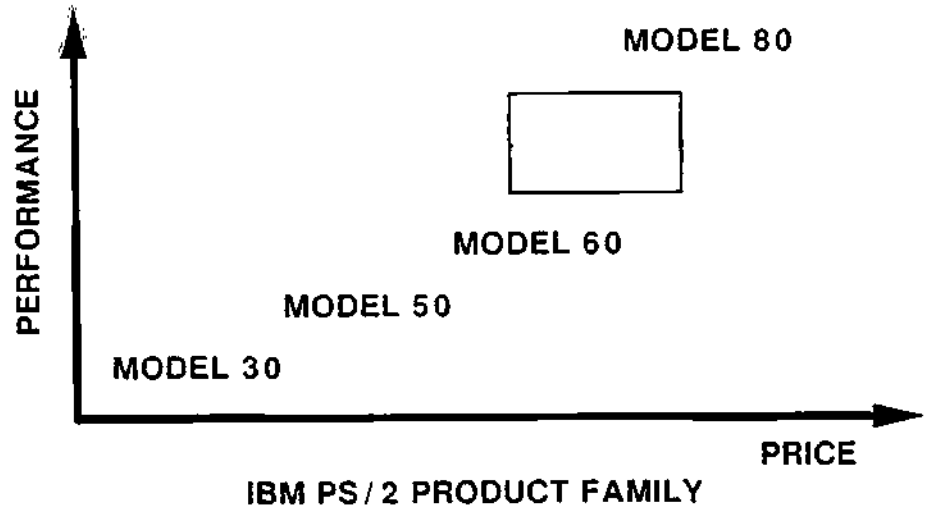
MEETING THE CHALLENGE: CHIPS/280 CREATES NEW MARKET SEGMENT



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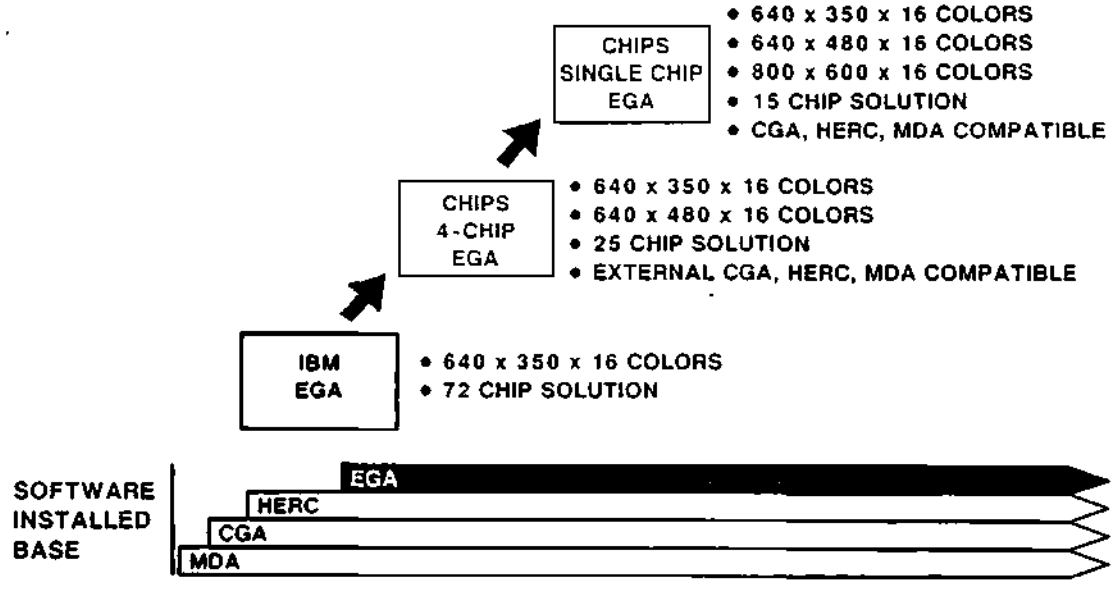
BUSINESS GRAPHICS EVOLUTION: EGA



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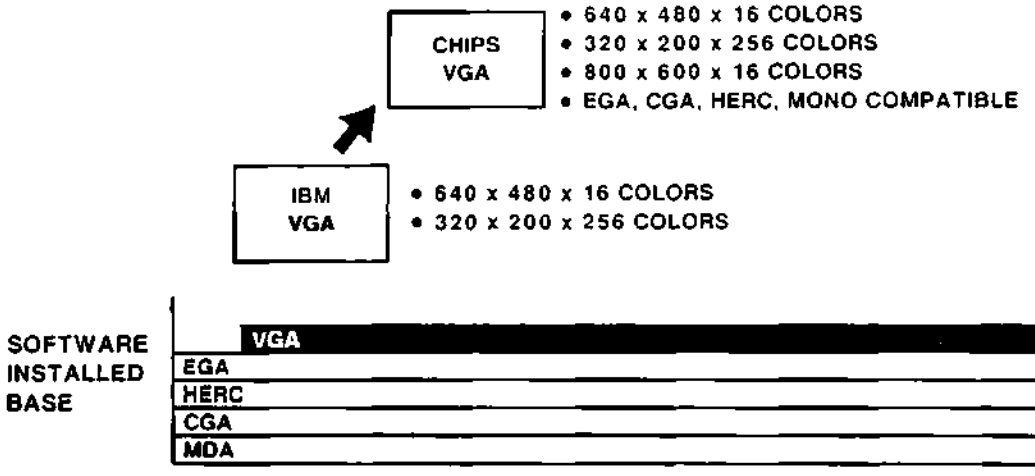
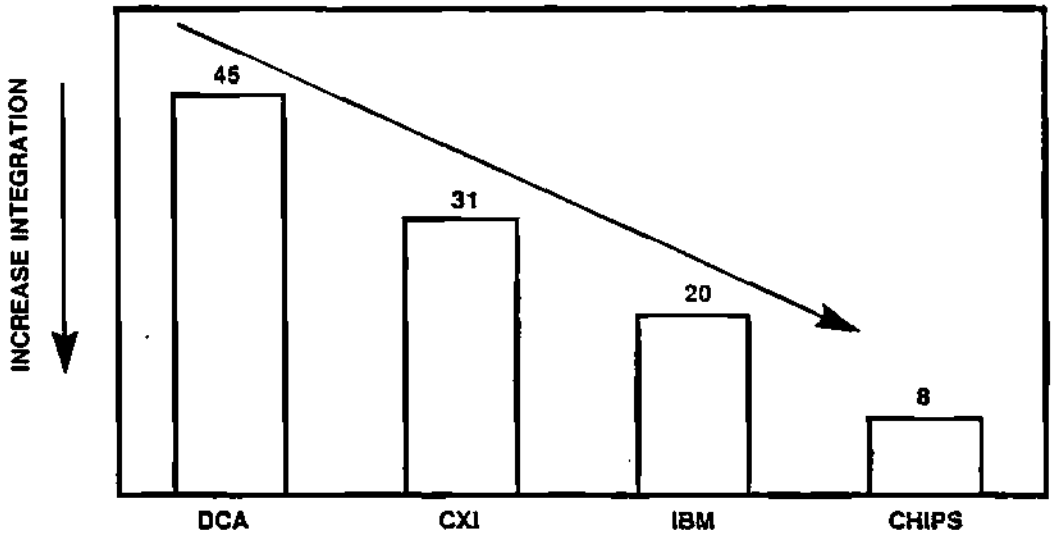
BUSINESS GRAPHICS EVOLUTION: VGA



CHIPS

3270 INTEGRATION



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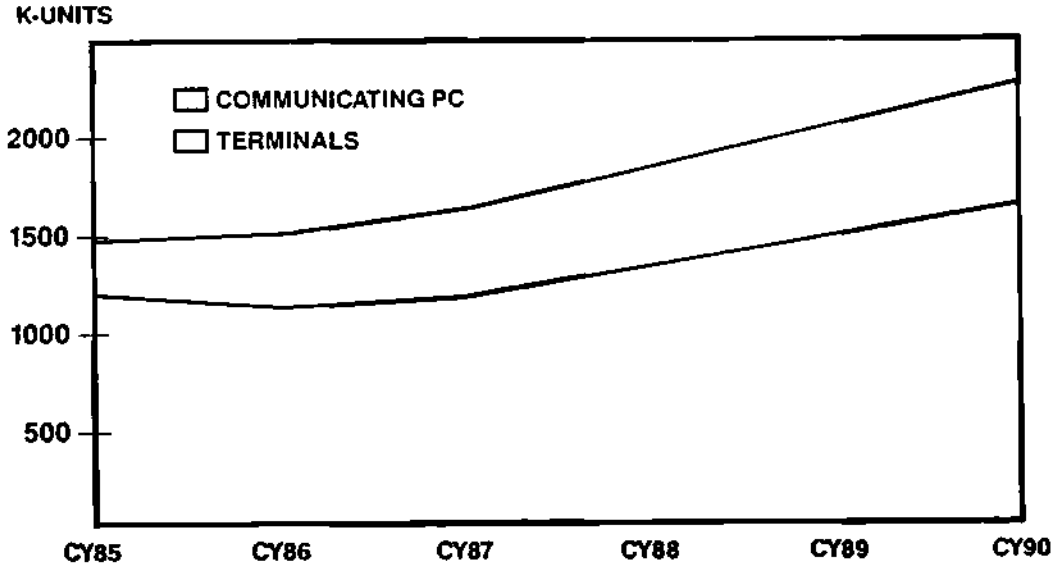
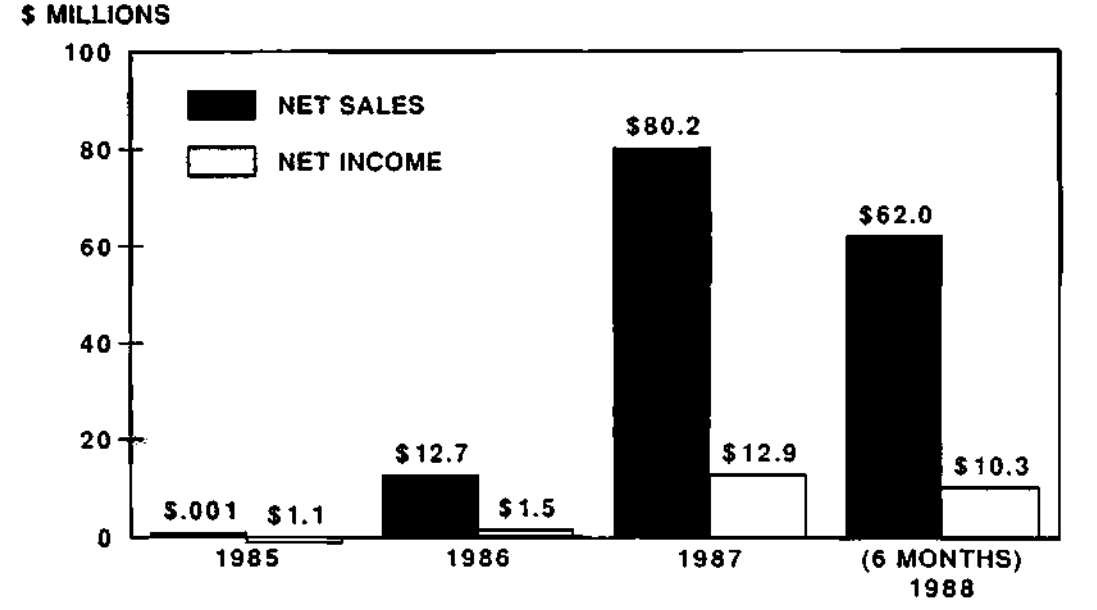
MARKET PROJECTIONS
3270



SOURCE: DATAQUEST

CHIPS

ANNUAL NET SALES AND NET INCOME



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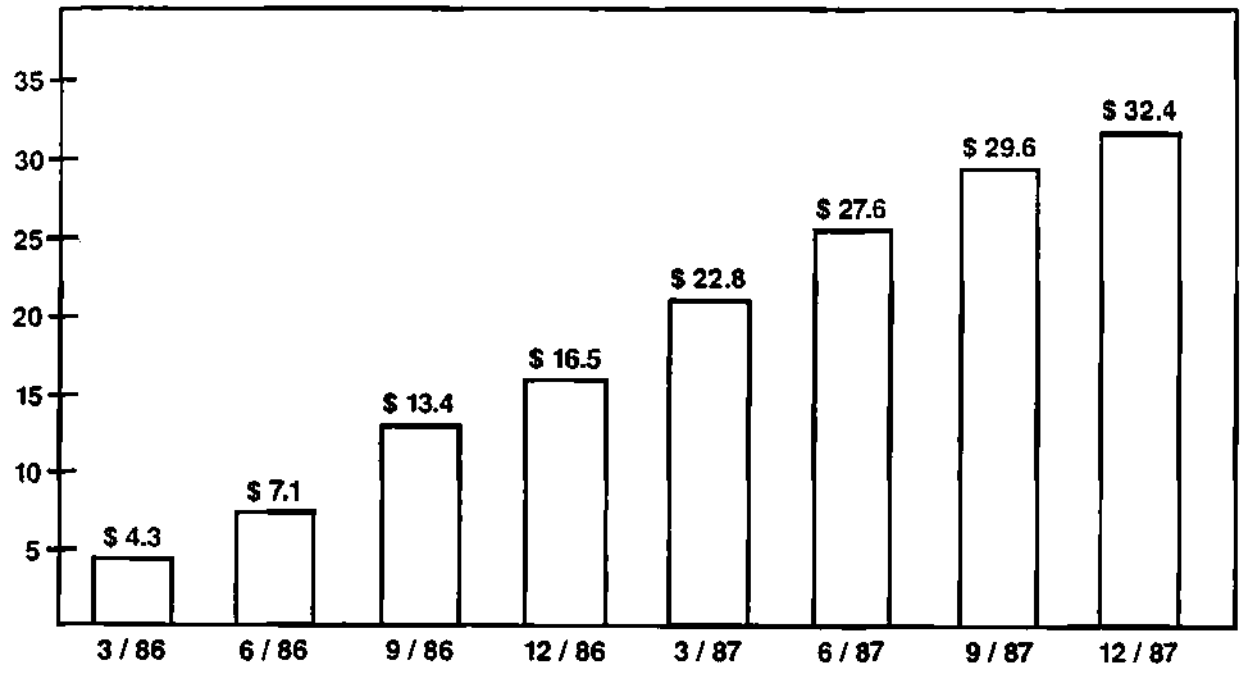
NET SALES

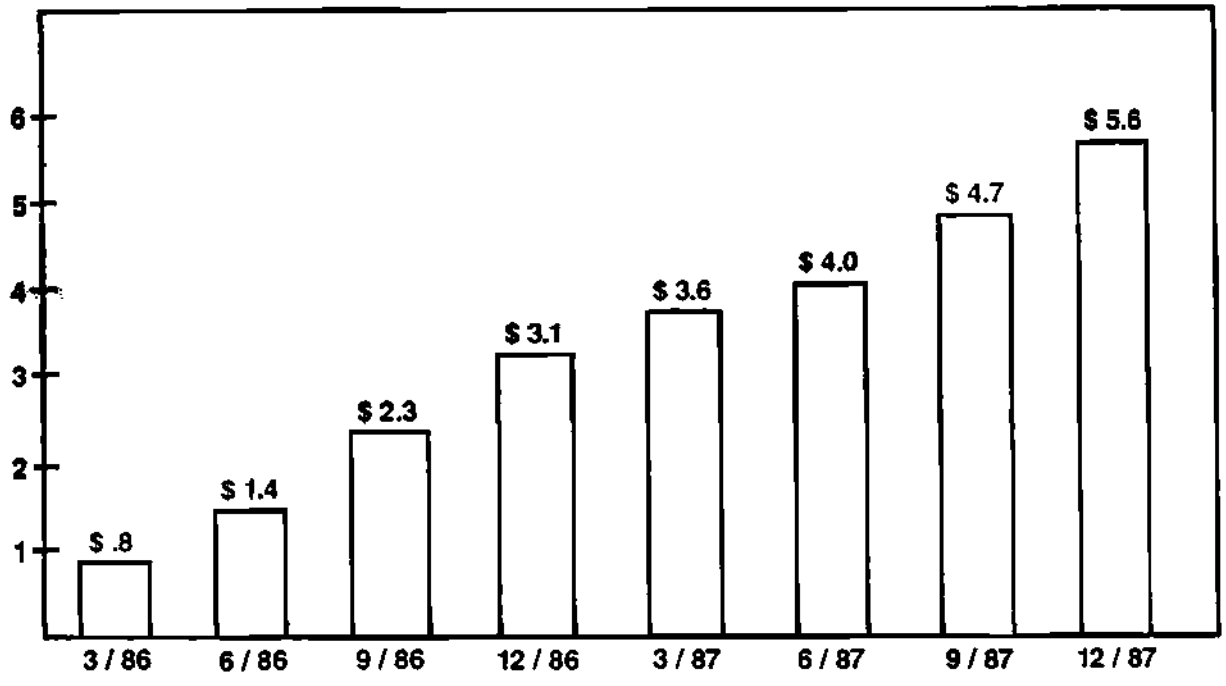
$ MILLIONS



CHIPS

NET INCOME

$ MILLIONS



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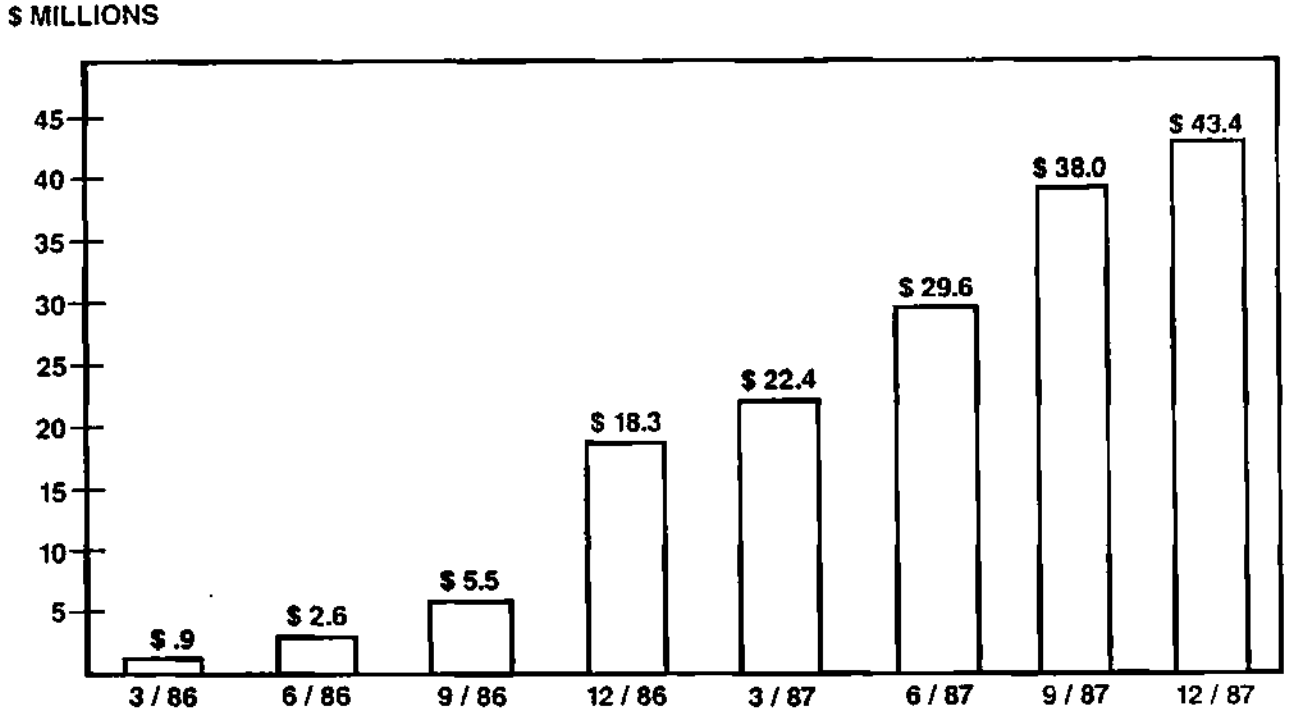
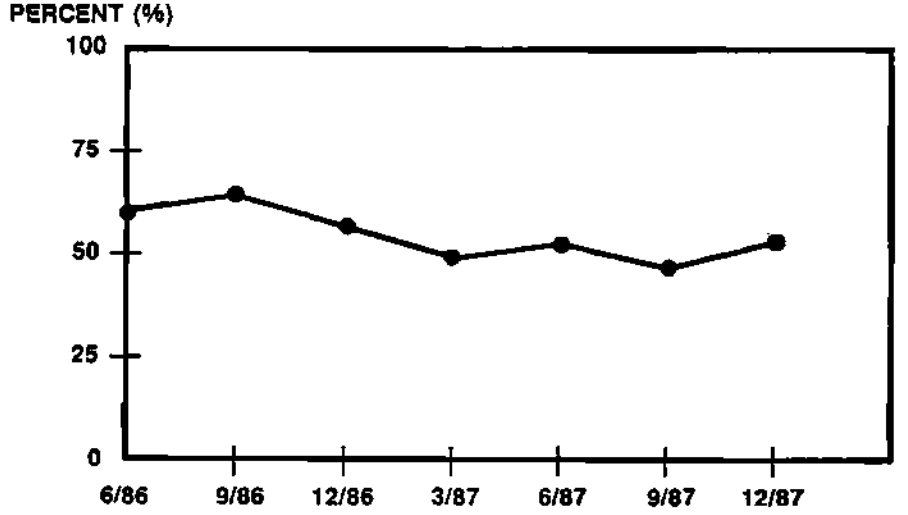
CASH GENERATION



CHIPS

GROSS MARGIN ANALYSIS



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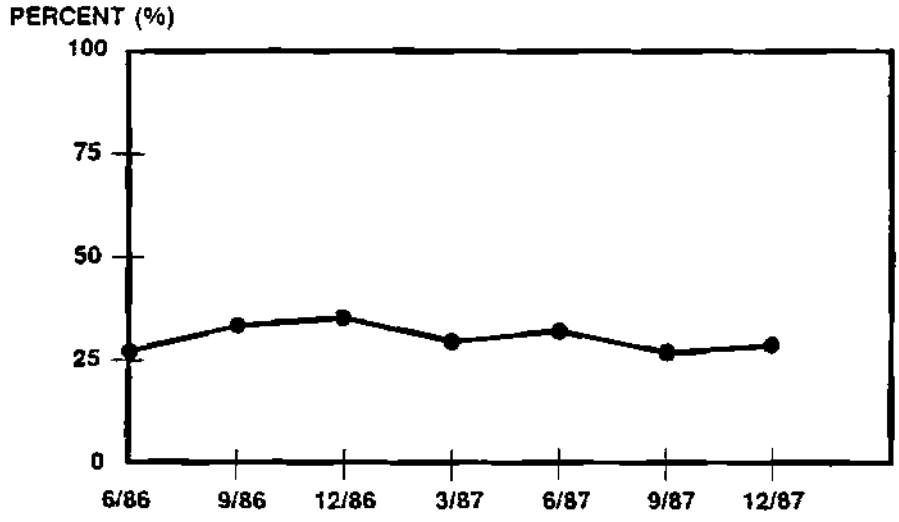
PRETAX MARGIN ANALYSIS



CHIPS

QUARTER ENDED DECEMBER 31, 1987

• CASH	$43.4 MILLION
• CASH PER SHARE	$3.05
• CURRENT RATIO	4.5 TO 1
• LONG TERM DEBT	$2.9 MILLION
• DEBT TO EQUITY	.92 TO 1
• INVENTORY TURNS	11.6x
• RETURN ON EQUITY	48% ANNUALLY
• CASH FLOW PER SHARE	$.42 PER QUARTER

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THE CHANGING ROLE OF ASIC TECHNOLOGIES

GORDON A. CAMPBELL
PRESIDENT AND CEO
CHIPS AND TECHNOLOGIES, INCORPORATED

CHIPS

MATCHING TECHNOLOGY FOR MARKET APPLICATION

- CMOS CANNOT DO IT ALL. SELECTIVE USE OF BICMOS AND BIPOLAR.
- THE HIGHEST INTEGRATION DOES NOT NECESSARILY PRODUCE THE HIGHEST PERFORMANCE, LOWEST COST SOLUTION:
  - LOGIC PARTITIONING FOR MAX PERFORMANCE
  - ESOTERIC VS STANDARD PACKAGES
  - FLEXIBILITY OF SYSTEM DESIGN

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MATCHING TECHNOLOGY FOR MARKET APPLICATION

- SOME APPLICATIONS DO NOT NEED MORE THAN MEDIUM DENSITY ASICS. VALUE ADDED IS IN SYSTEMS INTEGRATION KNOWLEDGE AND SOFTWARE.
- LIKE ANY OTHER TECHNOLOGY ASICS HAS A HIGH AND A LOW END. KNOWING WHEN TO APPLY A SPECIFIC SOLUTION WILL BE MORE IMPORTANT IN THE FUTURE THAN THE SOLUTION ITSELF.

CHIPS

PRODUCT DEVELOPMENT CYCLES USING LEADING ASIC TECHNOLOGIES

- SYSTEM SIMULATION INCORPORATING PROCESSOR MODEL AND OTHER SUPPORT LOGIC REQUIRES MIXED BEHAVIORAL, GATE LEVEL AND HARDWARE MODELING.
- ASIC DESIGN ISN'T COMPLETE UNTIL SYSTEM INTEGRATION HAS BEEN TESTED. TOTAL ELAPSED TIME $\approx$ 9 - 12 MONTHS.

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IMPACT OF LEADING ASIC TECHNOLOGIES ON PRODUCT DEVELOPMENT

- SEA OF GATES APPROACHES WILL DOMINATE HIGH END ASIC DESIGN AND WILL WIN MARKET SHARE FROM CELL BASED TECHNOLOGIES
  - FASTER TURNAROUND
  - ON-CHID MEMORY CAPABILITY
  - EASE OF IMPLEMENTATION OF COMPLEX CORE CELLS
  - BETTER CHARACTERIZATION; LESS RISK

CHIPS

IMPACT OF LEADING ASIC TECHNOLOGIES ON PRODUCT DEVELOPMENT

- FEASIBILITY OF NEW APPLICATIONS
  - CACHE CONTROLLERS AND MEMORY MANAGEMENT
  - HIGHER RESOLUTION BIT MAPPED GRAPHICS
  - SINGLE CHIP CUSTOM PROCESSORS
- CUSTOMIZATION OF SYSTEM LEVEL CONTENT AS OPPOSED TO CHIP LEVEL CONTENT
- FUTURE VALUE ADDED WILL BE IN SYSTEM LEVEL HARDWARE/SOFTWARE INTEGRATION

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WHAT ARE LEADING ASIC TECHNOLOGIES IN 1988?

- SUB 1.0μ SEA OF GATES AND STANDARD CELL.
  - 2-LAYER AND 3-LAYER METAL INTERCONNECT
  - HCMOS AND BICMOS
- EPLDS AND PROGRAMMABLE GATE ARRAYS OFFERING DENSITIES OF SEVERAL THOUSAND USEABLE GATES.
- EXTENSIVE AND WELL CHARACTERIZED CELL AND FUNCTION LIBRARIES.
- MULTI VENDOR SILICON SPECIFIC CAD CAPABILITY.
- SYSTEM DESIGN AND APPLICATION KNOWLEDGE.

CHIPS

PRODUCT DEVELOPMENT CYCLES USING LEADING ASIC TECHNOLOGIES

- REQUIREMENT FOR ARCHITECTURAL LEVEL DEFINITION AND SIMULATION.
- ACCELERATED GATE LEVEL SIMULATION. COMPLEX ASICS REQUIRE SEVERAL MAN MONTHS OF DETAILED LOGIC DESIGN WORK.
- BIOS DEVELOPMENT AND OTHER SYSTEM LEVEL SOFTWARE NEEDS TO BE DEVELOPED IN PARALLEL WITH HARDWARE.

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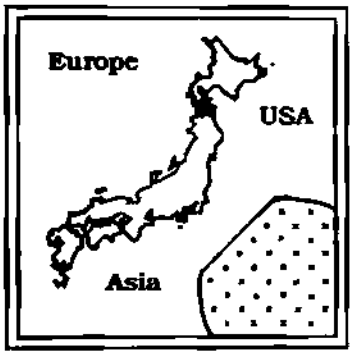
EMERGING TECHNOLOGIES

Sheridan M. Tatsuno
Senior Industry Analyst
Japanese Semiconductor Industry Service
Dataquest Incorporated

Mr. Tatsuno is a Senior Industry Analyst for Dataquest's Japanese Semiconductor Industry Service. He is reponsible for analyzing trends in Japanese government policies, procurement, financial markets, industrial financing, subsidized R&D, overall economics, and industrial plant siting. Prior to joining Dataquest, he had seven years of experience in market research, planning, and international finance with Bechtel Corporation and Woodward-Clyde Consultants. Mr. Tatsuno received a B.A. degree in Political Science from Yale University and an M.A. degree in Planning and Policy Analysis from Harvard University's Kennedy School for Government. In addition to these credentials, Mr. Tatsuno is fluent in Japanese, French, and Spanish, and has authored a book called The Technololis Strategy: Japan High Technology and the Control of the 21st Century.

Dataquest Incorporated
JAPANESE SEMICONDUCTOR INDUSTRY CONFERENCE
April 11-12, 1988
Tokyo, Japan



Japan's New International Role: Competition and Cooperation

EMERGING TECHNOLOGIES IN THE 1990s

SHERIDAN TATSUNO

Senior Industry Analyst
Japanese Semiconductor Industry Service
Dataquest Incorporated

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OVERVIEW - A DAY IN THE LIFE OF A. JOE AMERICA

- 6 a.m. - Home automation (HA)
- 7 a.m. - Car electronics
- 8 a.m. - Office automation (OA)
- 5 p.m. - Electronic shopping
- 7 p.m. - Home entertainment

Where there is a daily inconvenience, there is a market need.

INVENT THE FUTURE!

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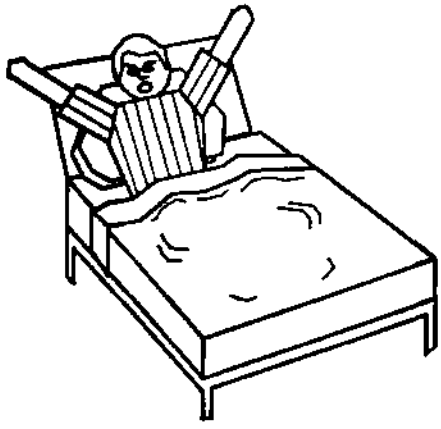
6 a.m. - Home Automation



- Wake up
- Shower
- Shave/apply makeup
- Breakfast
- Morning TV
- Home security and controls

HOME AUTOMATION IN THE 1990s

Problems	Needs	Devices Required
Get Kids Up	Stereo wake-up	MCU, DRAM, S/C lasers
Shower Too Hot/Cold	Preset temperature	Sensor, 4-bit MCU
Breakfast Rushed	Preset cooking	4-bit MCU, DRAM
Traffic Jams	Interactive TV/ traffic advisory	16-bit MCU
Forget Lights, Oven, Alarm and Other Items	House control panel at door	Voice-synthesis chips, audio RAM, 8-/16-bit MCUs, sensors

Source: Dataquest

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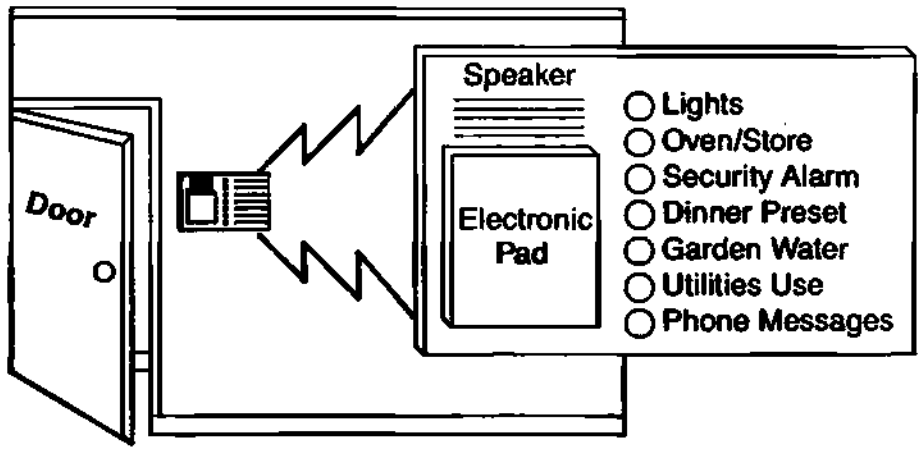
HOME CONTROL SYSTEM OF THE 1990s



Source: Dataquest

7 a.m. - Car Electronics

Problems	Needs	Devices Required
Traffic Jams	Navigation system	Modem ICs, sensors, 16-/32-bit RISC graphics chips, 4Mb/16Mb RAM and ROM
Business Calls	Built-in phone/ fax system	Modem ICs, 16-bit MPUs, 4Mb/16Mb memories

Source: Dataquest

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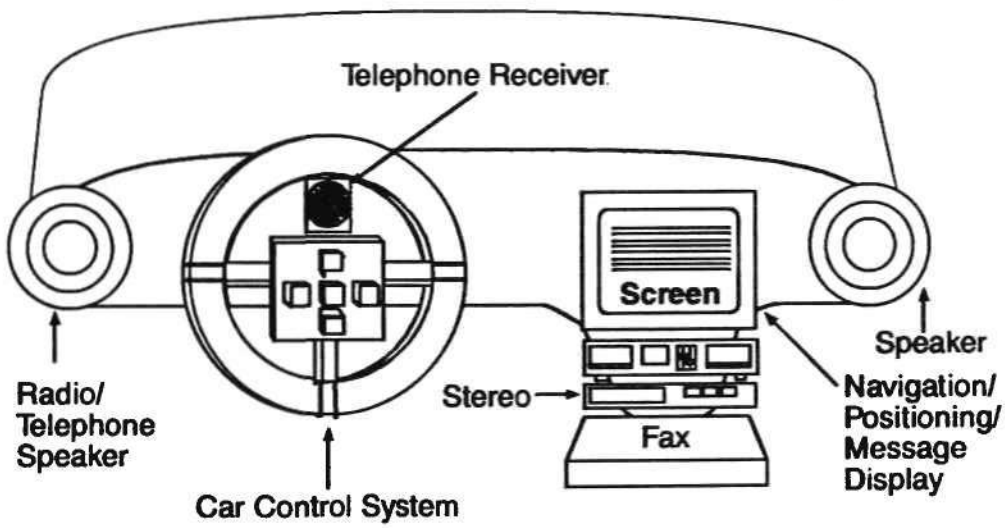
7 a.m. - Car Electronics

Problems	Needs	Devices Required
Reach for Dials	Built-in steering wheel control system	Voice recognition chips, 16-/32-bit MPUs
Maintenance (Tires, Repairs, Oil)	Maintenance advisory system	4Mb/16Mb ROMs and RAMs 4-bit MCUs
Locked Out	Voice door key	Voice recognition chips

Source: Dataquest

THE AUTOMOTIVE OFFICE OF THE 1990s



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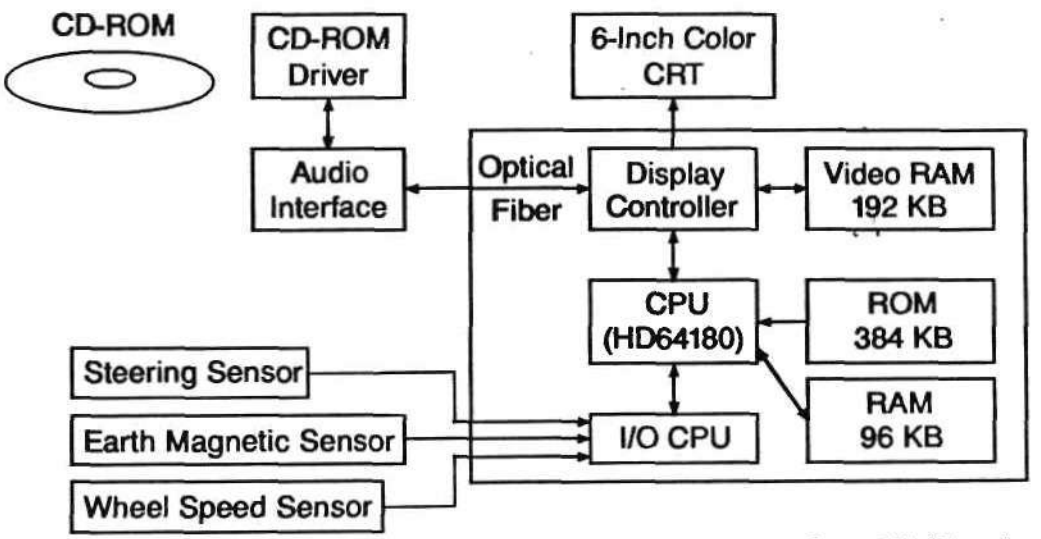
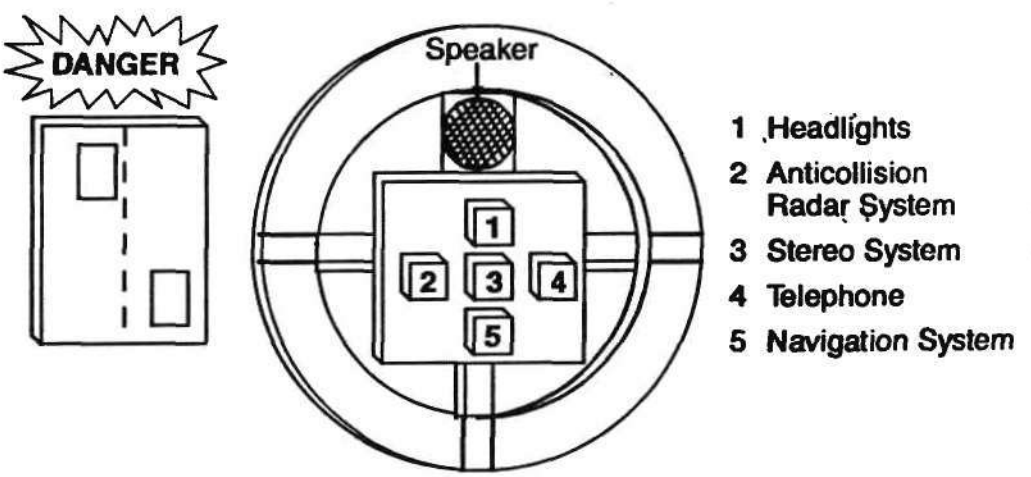
TOYOTA'S CD-ROM NAVIGATION SYSTEM



Source: Nikkei Electronics

STEERING WHEEL CONTROL SYSTEM



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8 a.m. - OFFICE AUTOMATION

Problems	Needs	Devices Required
Phone Tag	Office wrist phone	Modem ICs, DRAMs, MCUs
Copier and Fax Backed Up	Personal, plain paper fax/copier/printer	32-bit MPUs, DRAMs, ROMs, semiconductor lasers
Where Is Person?	Office locator system	Sensors, voice-synthesis ICs
Long Phone Calls	Phone stopwatch and cost calculator	4-bit MCUs, DRAMs
Fax or Phone Cheaper?	Fax/phone alternative cost calculator	MCUs, DRAMs, ROMs

Source: Dataquest

11 a.m. - OFFICE CHAOS

Possible Solutions:

- Memo-to-text/-graphics electronic tablet
- Transparency machine

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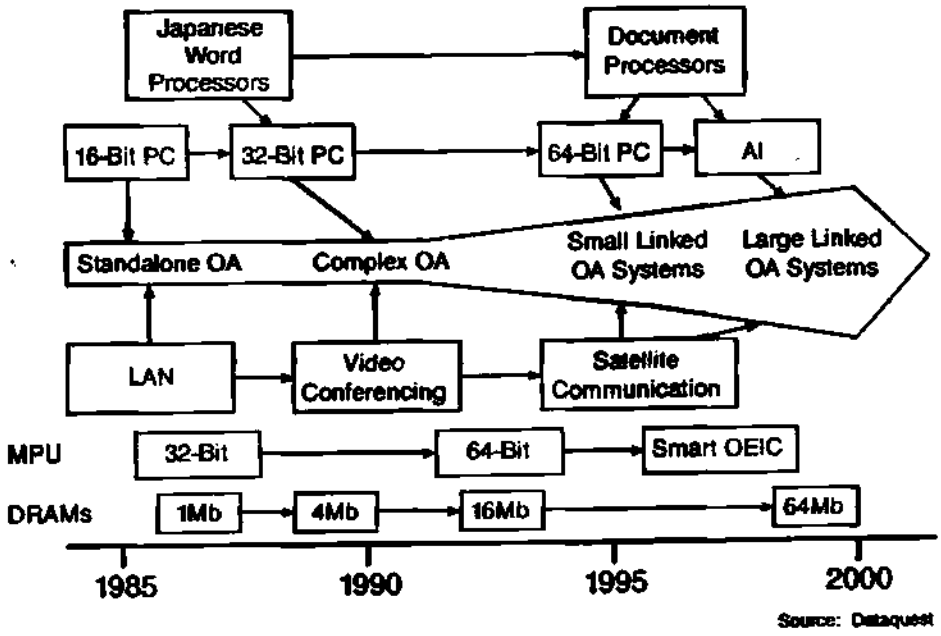
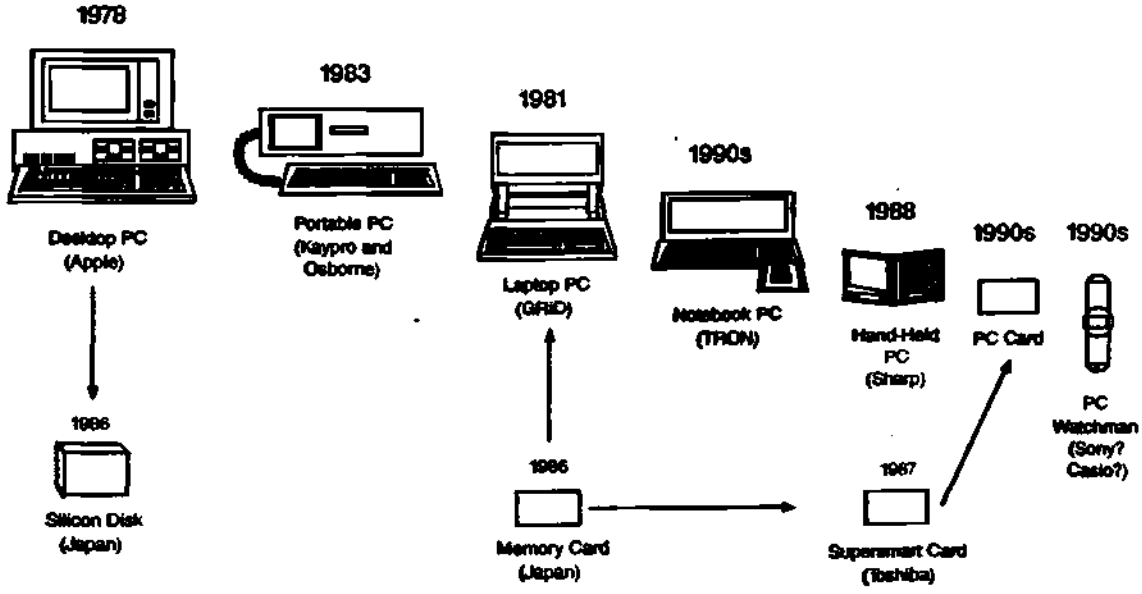
OFFICE SYSTEM TRENDS



Source: Dataquest

THE SHRINKING PERSONAL COMPUTER



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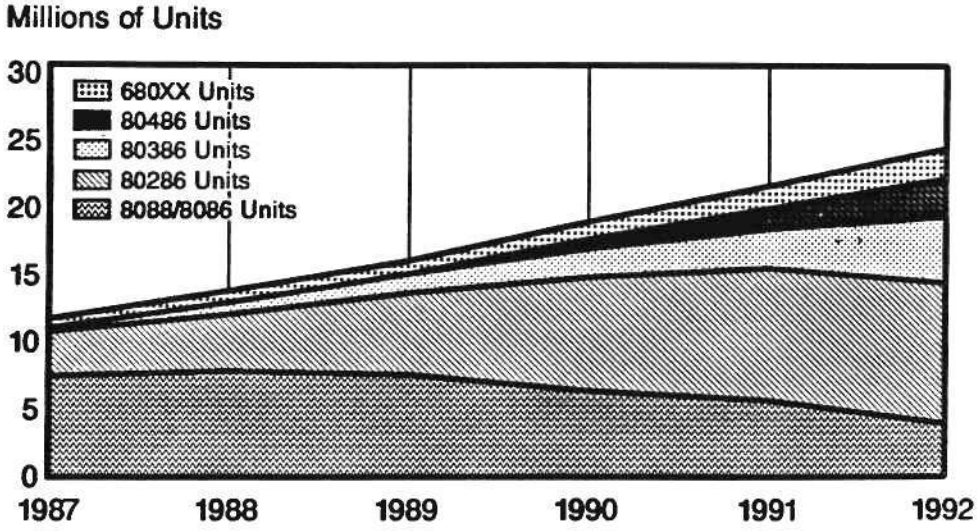
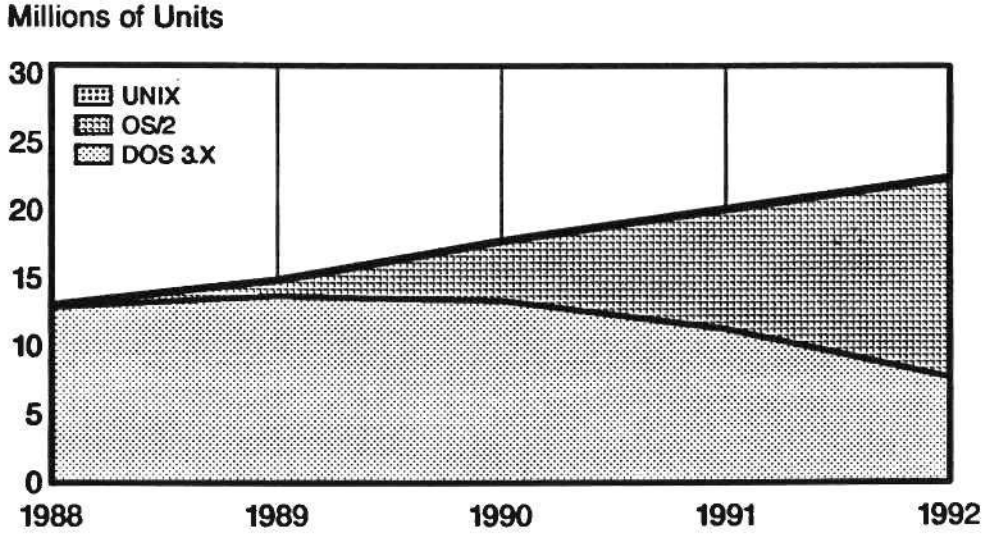
ESTIMATED PC SHIPMENTS

by Microprocessor Type



Source: Dataquest

ESTIMATED PERSONAL COMPUTER OPERATING SYSTEM SHIPMENTS



Source: Dataquest

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VIDEOPHONE PC OF THE 1990s

- 4-8 mips
- 4-8MB RAM
- Megapixel color displays - 8-10 inches
- 3.5-inch storage
- Built-in LAN
- Coprocessing
- 80MB hard disk

HOT NEW SEMICONDUCTORS FOR THE OFFICE

Emerging Systems	Semiconductors Needed
Laptop PC	Sea-of-gates ASICs, megabit memories (IC cards), specialized 32-bit MPUs, voice recognition chips.
Videophone PC	CCD sensors, voice recognition chips, IC card readers
Personal fax/copier	Advanced telecom ICs, printer font ROM cartridges, megabit memory storage

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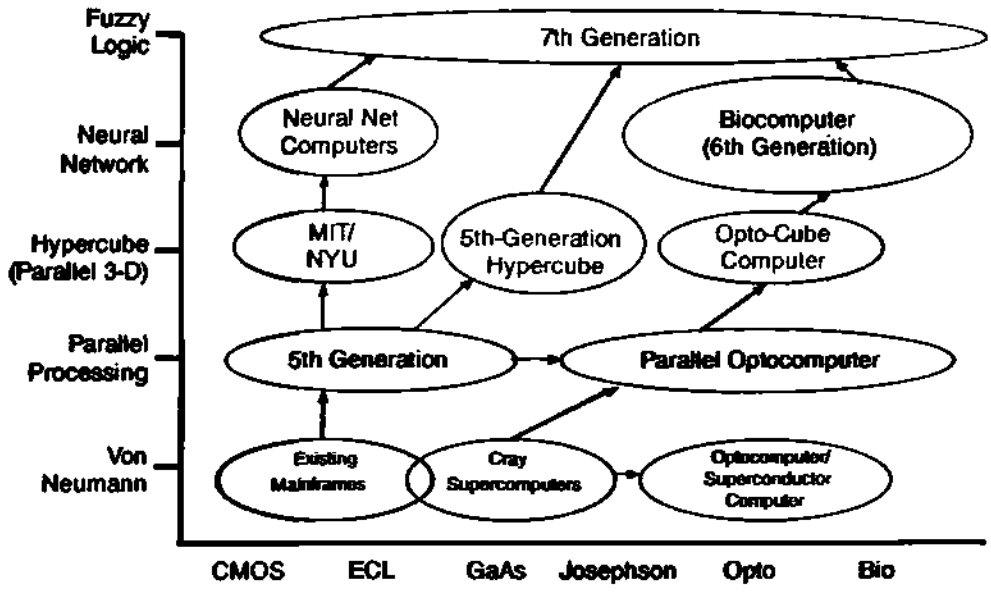
FUTURE COMPUTING TRENDS



Source: Dataquest

5 p.m. - ELECTRONIC COMPARISON SHOPPING

Item	Lucky's	Safeway	Alpha-Beta
Whole Wheat Bread	$1.39	$1.49	$1.25
1/2-Gallon Skim Milk	2.00	1.80	1.95
Boned Chicken	3.75	4.50	4.25
Raisin Bran Cereal	2.75	3.20	3.10
6-Pack Budweiser	3.50	4.20	3.99
Total	$13.39	$15.19	$14.54
Send Order	↑		

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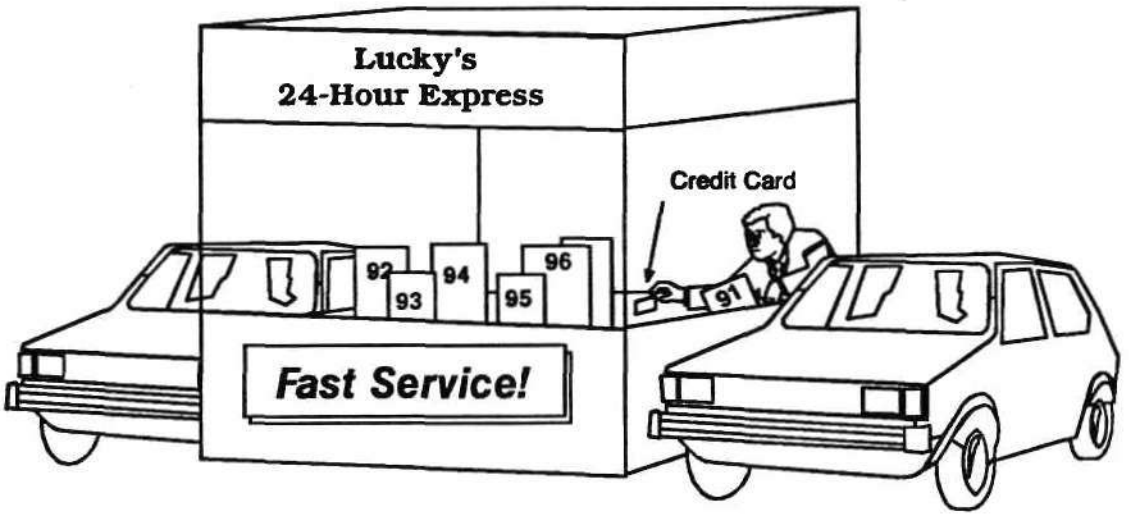
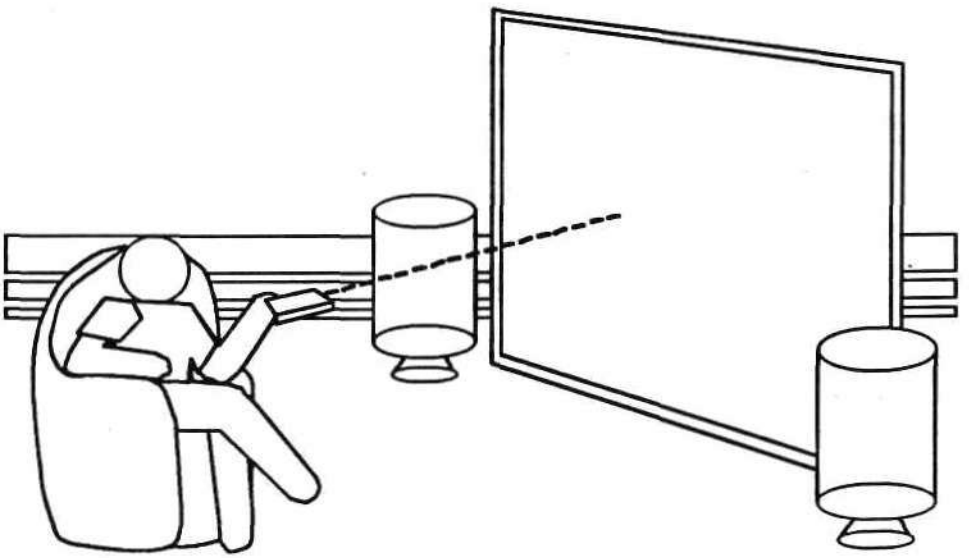
6 p.m. - SHOPPING PICKUP



7 p.m. - HOME ENTERTAINMENT



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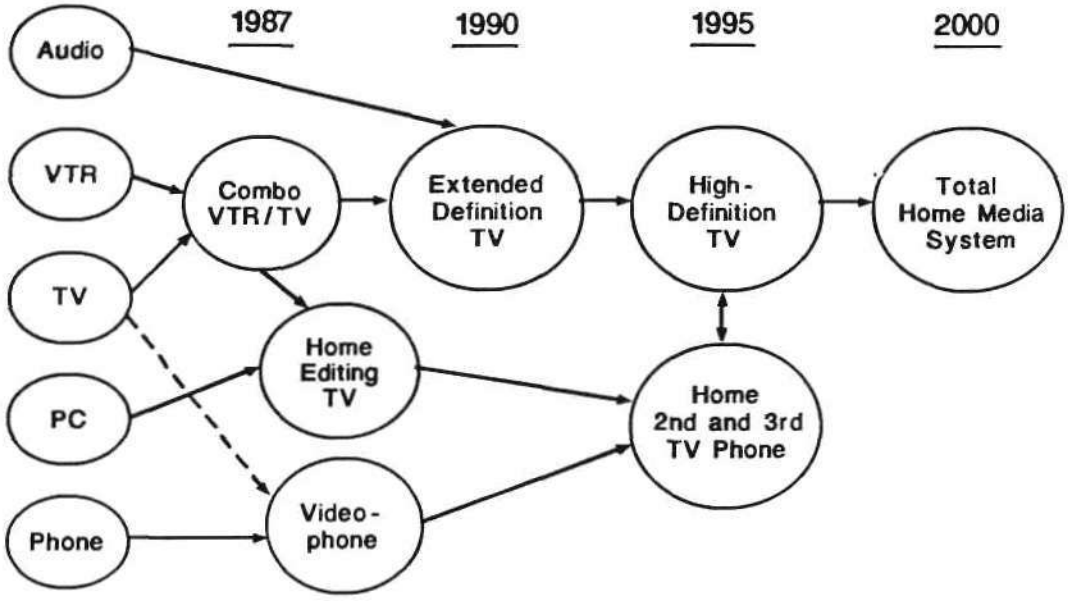
EMERGING HOME ELECTRONICS



HOT NEW HOME ELECTRONIC SEMICONDUCTORS

Emerging Systems	Semiconductors Needed
Large-Screen Combo VTR/TV	Video RAMs (4Mb/16Mb/64Mb) 32-bit video processors Sea-of-gates ASICs
Remote Control Handsets	Semiconductor lasers Voice recognition chips 32-bit controllers
Videophone Sets (Second or Third TVs)	Voice recognition chips Video RAMs CCD sensors Specialized 32-bit video processors

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FUTURE KEY TECHNOLOGIES

Devices	Applications
Megabit Memories (2-D and 3-D)	Video and voice storage PC data cards Icon generators
Specialized 32-bit MPUs	Video and voice processing Parallel processing Complex system controllers (handsets, PCs)
Optoelectronic ICs (OECs)	Semiconductor laser controllers Optical computing Video transmission processing Sensors
Superconductors	Ultrasupercomputing

MEETING THE COMING TECHNOLOGY EXPLOSION

- Service:
  - Closer vendor-user ties
  - Linkage of marketing and after-sales servicing
- Design:
  - 3-D CAD tools
  - Stronger applications engineering
- Manufacturing:
  - Flexible modular fabs
  - Increased status of manufacturing "researchers"
  - Rotation between production and R&D
  - Development of proprietary fab equipment

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SILICON AND EPITAXIAL WAFERS: STATUS AND FUTURE

Taro Sugawara
Executive Vice President
Shin-etsu Handotai Co., Ltd.

Mr. Sugawara is Executive Vice President of Shin-etsu Handotai Co., Ltd. He is also Senior Managing Director/General Manager of the Semiconductor Material Division of Shin-etsu Chemical Co., Ltd. Before attaining his current postions, Mr. Sugawara held a variety of executive positions at Shin-etsu Chemical Co., Ltd. He joined the company in 1952. Mr. Sugawara graduated from Hokkaido University (Faculty of Science).

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April 11-12, 1988
Tokyo, Japan

PRESENT AND FUTURE PROSPECT OF SILICON/EPITAXIAL WAFER MARKET

APRIL 12 1988

SHIN-ETSU HANDOTAI CO.,LTD.

EXECUTIVE VICE PRESIDENT

TARO SUGAWARA

SEH

1. SILICON MARKET TRENDS

2. WAFERS FOR VLSI TECHNOLOGY

3. EPI TRENDS

4. SEH GLOBAL ORGANIZATION

SEH

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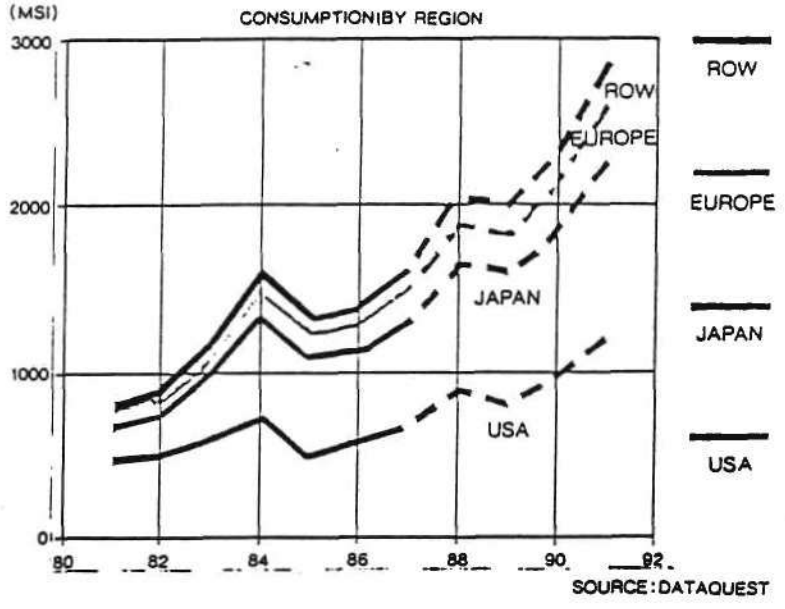
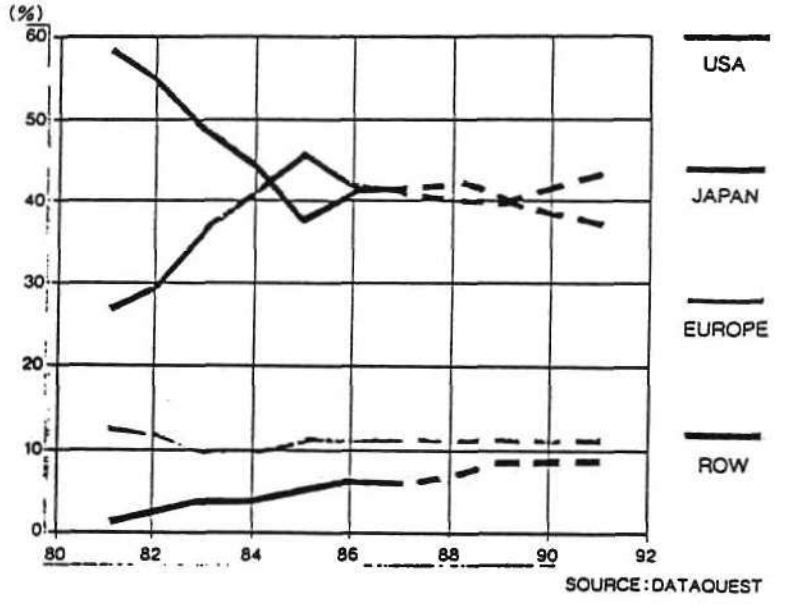
POLISHED AND EPITAXIAL WAFER



REGIONAL SILICON MARKET SHARE



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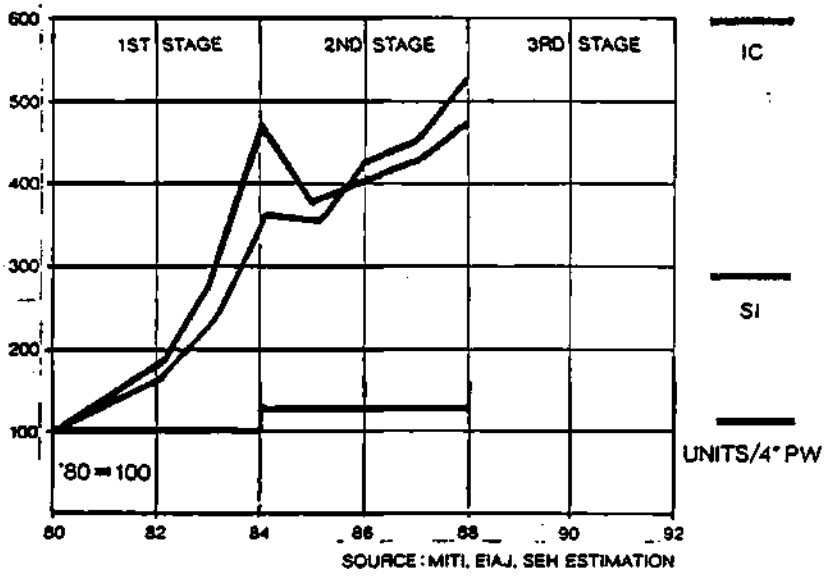
IC PRODUCTION vs SI CONSUMPTION IN JAPAN

PRODUCTION UNITS AND PW USED



LESS SILICON CONSUMPTION DURING '85-'87

YIELD SUBSTANTIALLY IMPROVED

CHIP SIZE SHRUNK

LESS WAFERS CONSUMED FOR MONITOR

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CRYSTAL TECHNOLOGY

1. IMPURITY CONTROL
2. CRYSTALLOGRAPHIC DEFECTS CONTROL
3. THERMAL HISTORY
4. OXYGEN CONTROL

WAFERING

1. SURFACE INTEGRITY
2. FLATNESS FROM GLOBAL TO SITE

SEH

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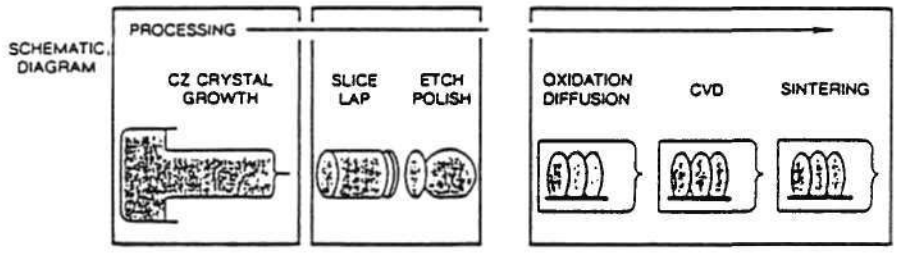
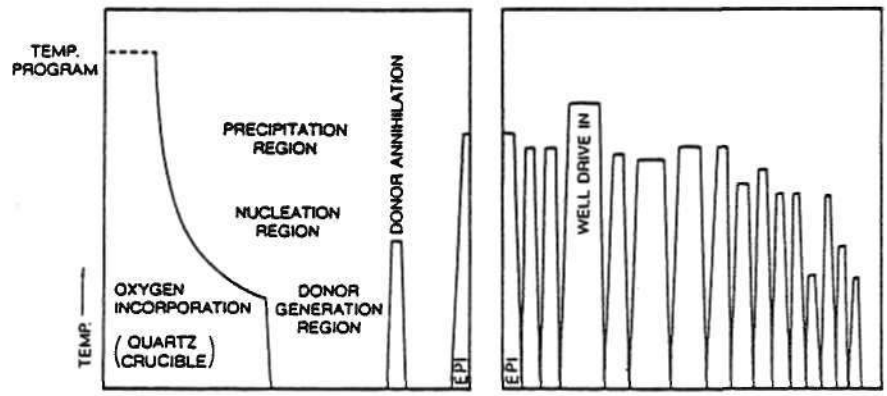
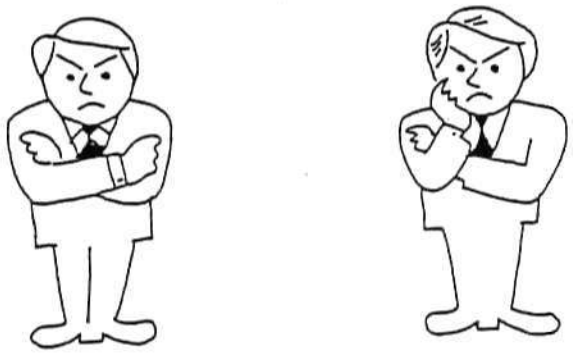
CRYSTAL WORLD DEVICE WORLD







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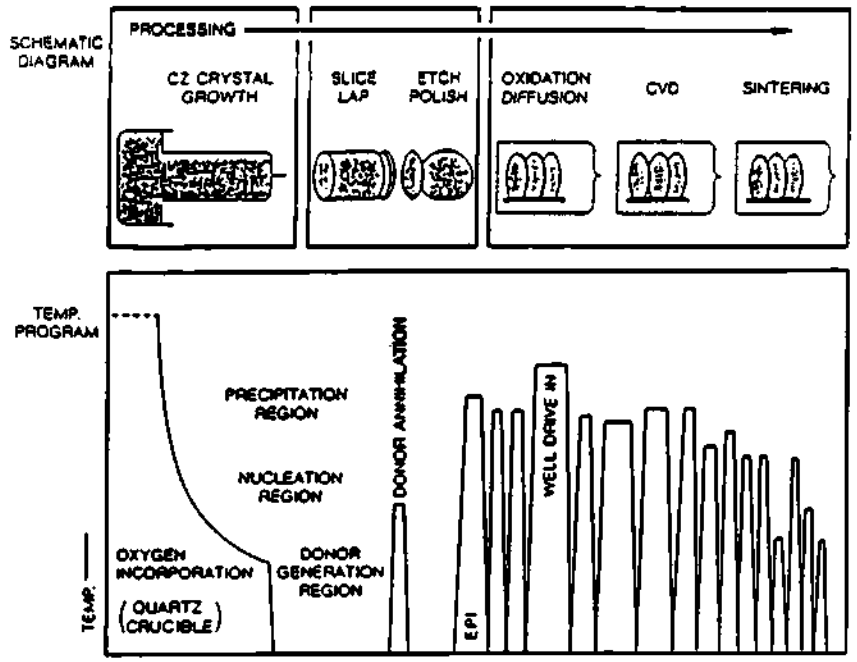
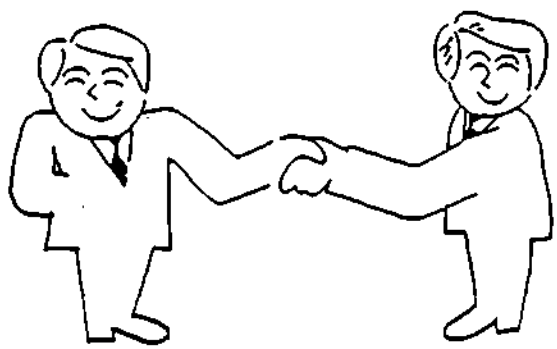
CRYSTAL WORLD DEVICE WORLD





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CRYSTAL TECHNOLOGY

1. IMPURITY CONTROL
2. CRYSTALLOGRAPHIC DEFECTS CONTROL
3. THERMAL HISTORY
4. OXYGEN CONTROL

WAFERING

1. SURFACE INTEGRITY
2. FLATNESS FROM GLOBAL TO SITE

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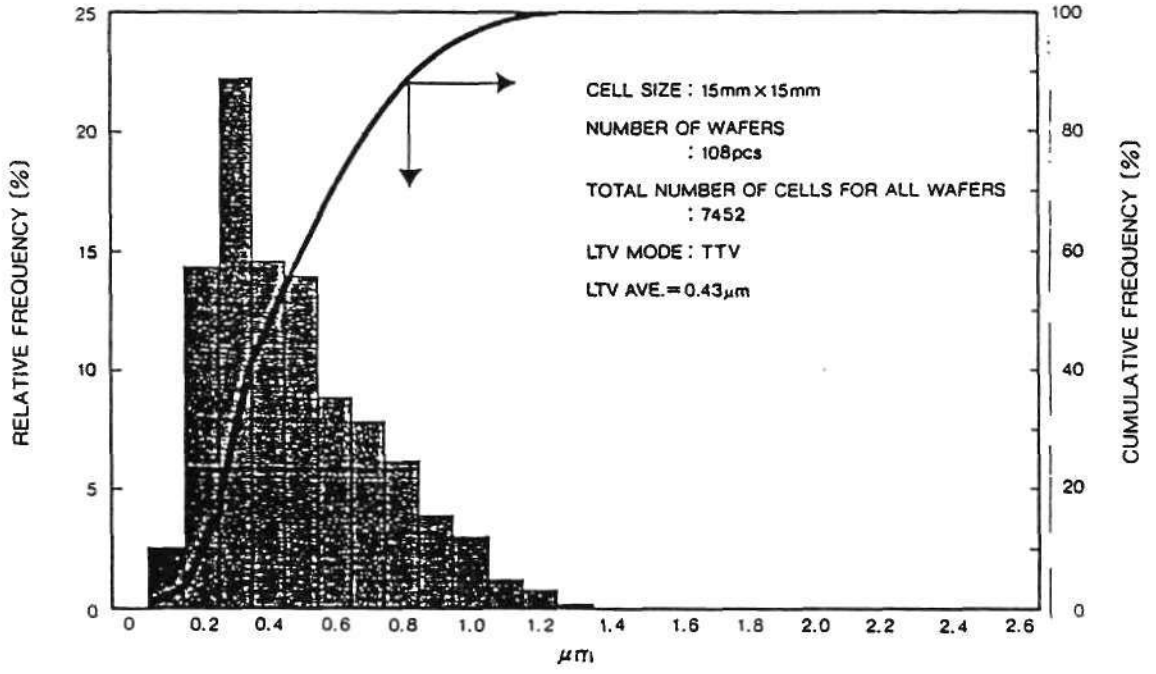
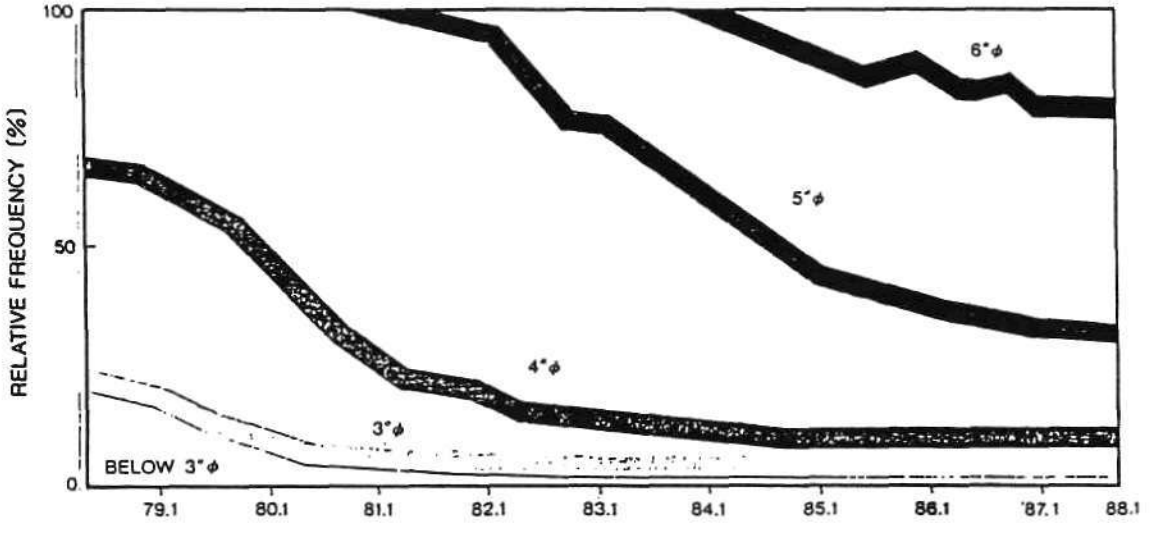
DISTRIBUTION OF LTV
(CELL BY CELL)



DIAMETER TREND OF CZ WAFERS
(SHIPPING BASE IN JAPAN)



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CAN 8" ERA BE AROUND CORNER?

STATUS QUO:

PILOT PRODUCTION

NEEDS FOR LARGER WAFER:

MASS PRODUCTION

TRADITIONAL YIELD IMPROVEMENT

GROWING CHIP SIZE

AREAS OF IMPROVEMENT REQUIRED:

HIGH COST

MACHINE, INSPECTION GEAR

CONSISTENT QUALITY

PROSPECTS:

1) LIMITED USE

MEMORY

CPU

2) MASS PRODUCTION FROM 1990 ONWARD

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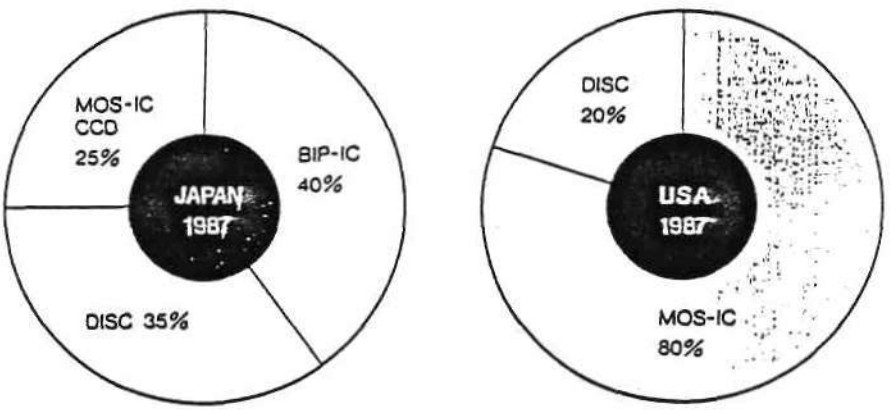
EPI TRENDS

EPW MERCHANT MARKET



SOURCE: SEH ESTIMATION

CHARACTERISTICS OF USA AND JAPANESE MARKET

	JAPAN			USA		
MERCHANT PRODUCTS	BIP	DISC	MOS	BIP	DISC	MOS
	40%	35%	25%	0%	20%	80%
GROWING MARKET	CCD	BI-CMOS		C-MOS	BI-CMOS	
	C-MOS LOGIC			POWER MOS FET		
	POWER MOS FET					

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IMPROVEMENTS REQUIRED IN EPI AREA

1. EPI PROCESS COST TO BE LOWERED
2. MACHINERY TO BE IMPROVED
   LOW COST, HIGH PRODUCTIVITY
   LARGE DIAMETER
3. QUALITY TO BE IMPROVED
   FLATNESS,
   LPD, PROFILE ETC
4. STRATEGY FOR VALUE ADDED PRODUCTS
   BURIED LAYER, EPI
5. OTHER TECHNOLOGICAL RIVALRY

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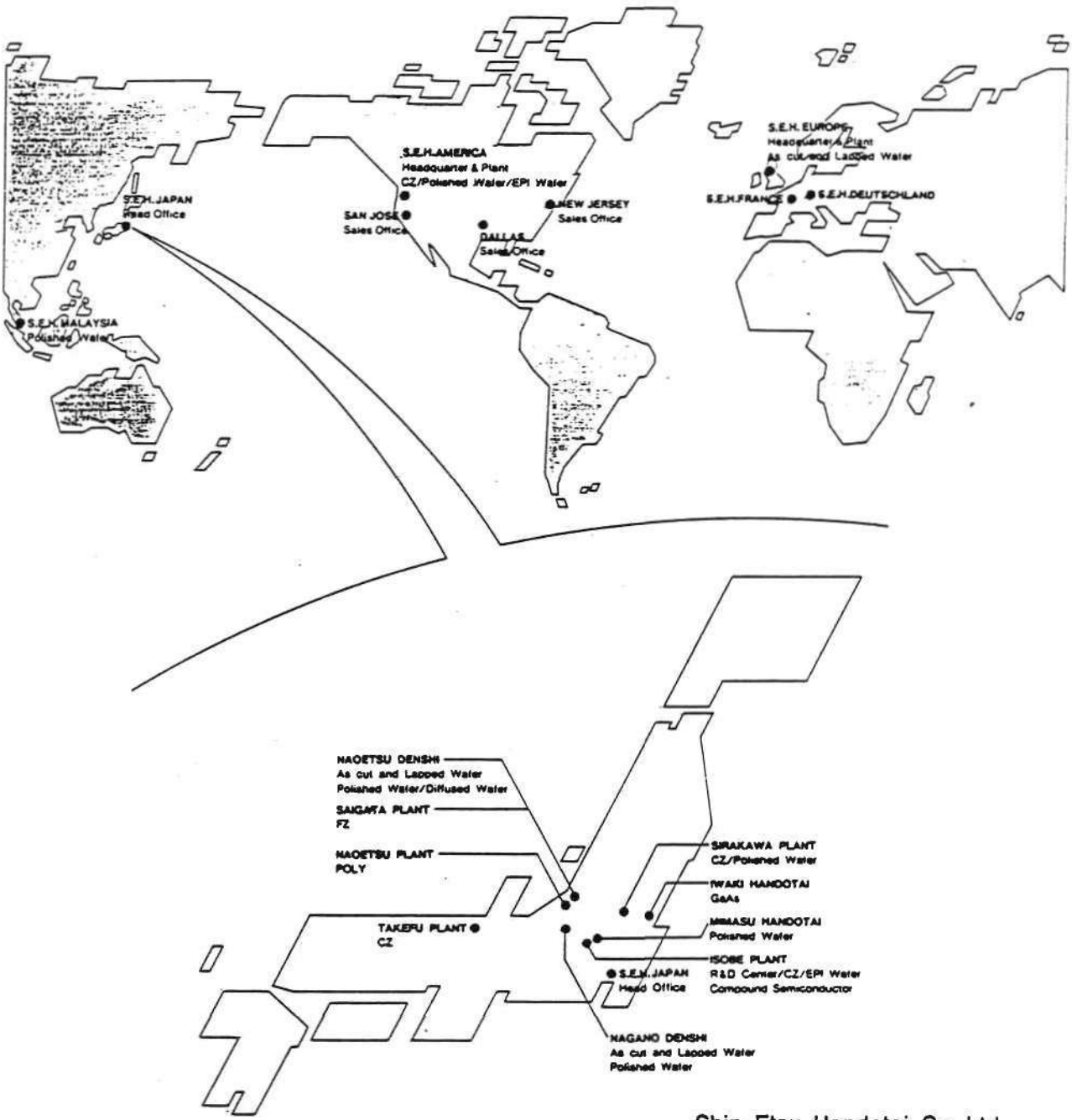
S.E.H.'S WORLD WIDE LOCATIONS



Shin-Etsu Handotai Co., Ltd.

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FUTURE TRENDS OF THE WORLD MEMORY MARKET

Victor de Dios
Senior Industry Analyst
Semiconductor Industry Service
Dataquest Incorporated

Mr. de Dios is a Senior Industry Analyst for Dataquest's Semiconductor Industry Service, focusing on analysis of the memory IC market. He has responsibility for tracking and evaluating market movements, forecasting market size, and tracking technology trends. Prior to joining Dataquest, Mr. de Dios held positions in product marketing management for a variety of leading MOS memory device companies. He was responsible for introducing several new memory products into the U.S. market and developing major account penetration strategies. Mr. de Dios received a B.S.E.E. degree from the University of the Philippines and an M.B.A. degree from Wharton School, University of Pennsylvania.

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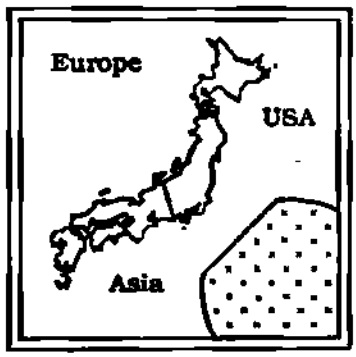
April 11-12, 1988
Tokyo, Japan



Japan's New International Role: Competition and Cooperation

FUTURE TRENDS OF THE WORLD MEMORY MARKET

VICTOR DE DIOS
Senior Industry Analyst
Semiconductor Industry Service
Dataquest Incorporated

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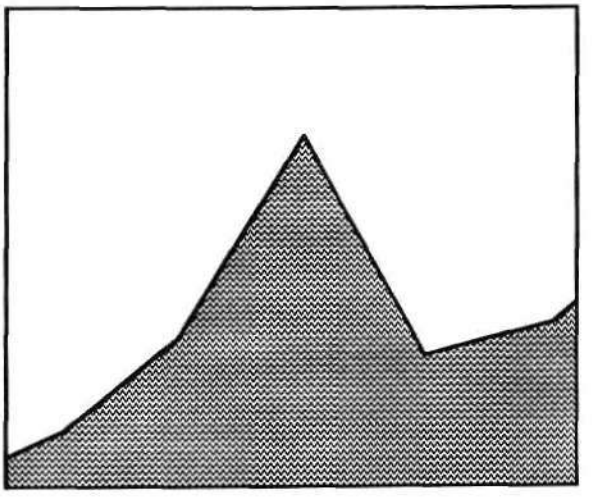
AGENDA

- Market forecast
- Near-term outlook
- Long-term outlook

THE HIGHER THE MOUNTAIN, THE DEEPER THE VALLEY



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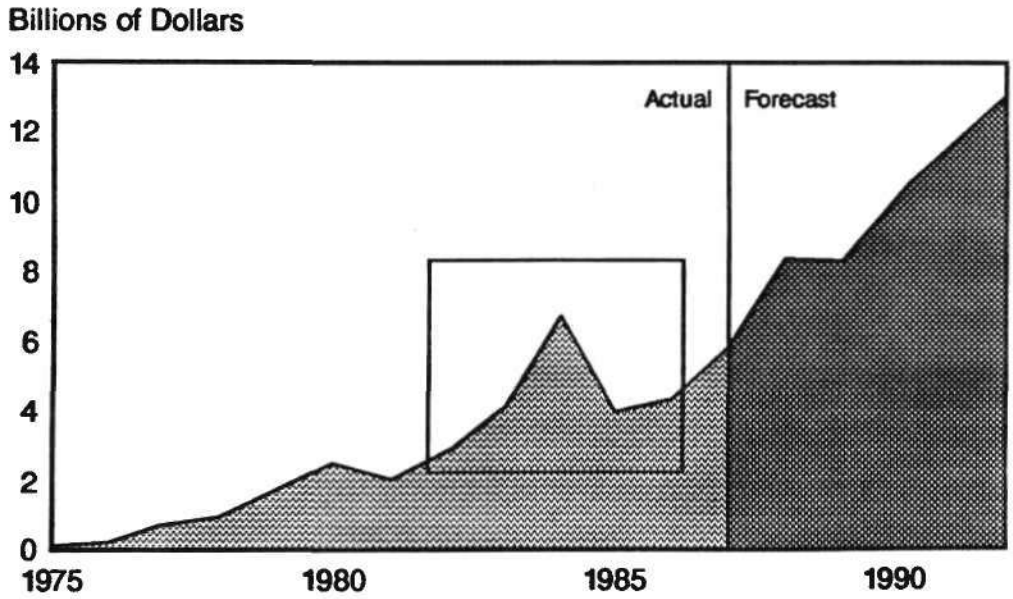
MOS MEMORY REVENUE



Source: Dataquest

AGENDA

- Market forecast

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MEMORY MARKET INFLUENCES

- Slower electronic equipment growth
- Increased pervasiveness
- Another recession?
- Submicron processes: higher capital, costs
- Political intervention: FMV, MITI
- Devaluing dollar, stronger yen

MOS MEMORY FORECAST

(Millions of Dollars)

	1987	1988	1992	1987-1992 CAGR
MOS Memory	5,846	8,388	13,107	17.5%
DRAM	2,761	4,605	7,017	20.5%
SRAM (>70ns)	718	1,016	1,530	16.3%
SRAM (<70ns)	369	450	645	11.8%
EPROM	1,259	1,399	2,625	15.8%
ROM	485	496	454	(1.3%)
EEPROM	189	309	576	25.0%
Others	65	113	260	32.0%

Source: Dataquest

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AGENDA

- Market forecast
- Near-term outlook

NEAR-TERM OUTLOOK

- Sufficient capacity in 1988
- Yield improvement may ease shortage by late Q3 1988
- Threat of slowing demand
- Effect of reentry of political influences

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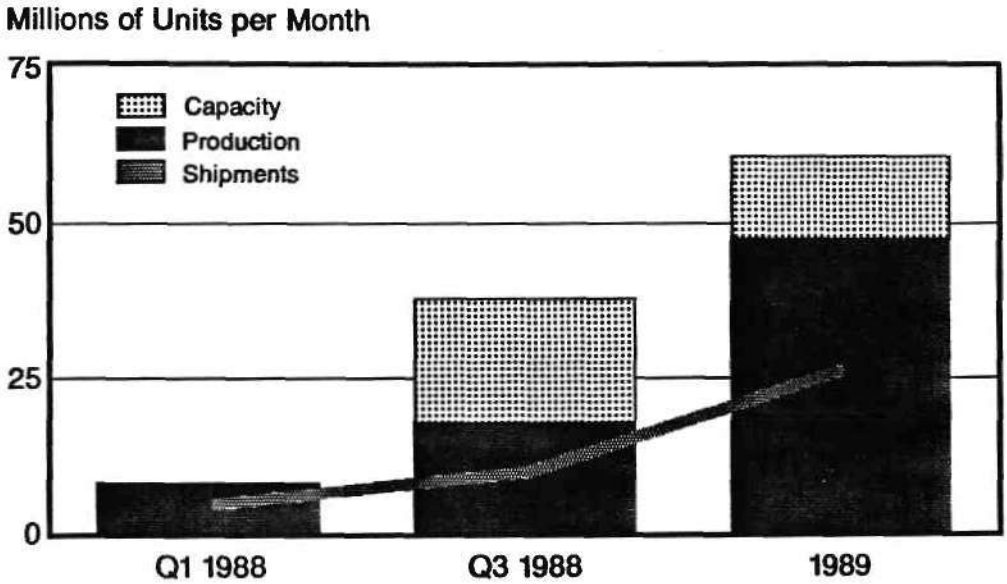
ESTIMATED 1Mb DRAM PRODUCTION RATES



Source: Dataquest

MEMORY DEMAND
POSSIBLE EARLY WARNING SIGNALS

- New product manufacturing rates versus sales rates
- Demand double-counting
- Conversion to new products
- New operating systems need larger memories: immediate demand?

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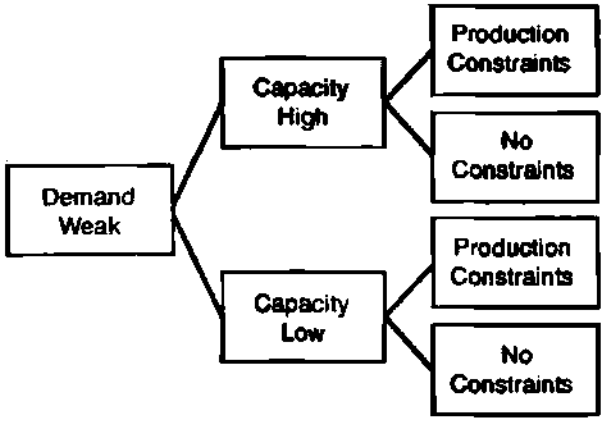
MEMORY DEMAND
POSSIBLE EARLY WARNING SIGNALS

- More memory per system: upward and downward accelerator
- Uncertainty over U.S. economy
- Shortage causes revised demand projections
- 256K versus 1Mb product mix

POTENTIAL EFFECT OF POLITICAL INFLUENCES ON DRAM MARKET



	FMV	Market Price	Japanese Share	U.S. Share
Capacity High / Production Constraints	Up	Normal Trend	Down	Up
Capacity High / No Constraints	Normal Trend	Down	Normal Trend	Normal Trend
Capacity Low / Production Constraints	Up	Normal Trend	Down	Up
Capacity Low / No Constraints	Normal Trend	Normal Trend	Normal Trend	Normal Trend

Source: Dataquest

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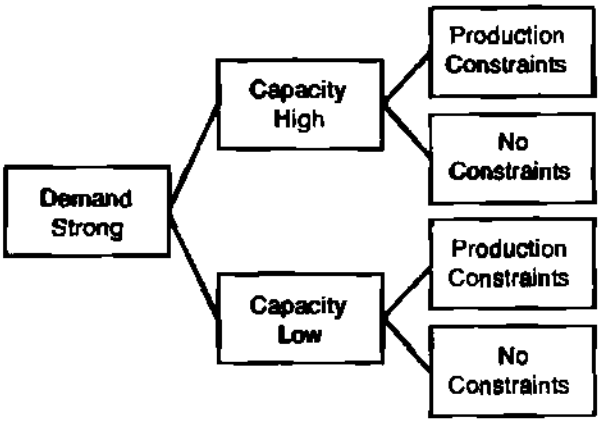
POTENTIAL EFFECT OF POLITICAL INFLUENCES ON DRAM MARKET



	FMV	Market Price	Japanese Share	U.S. Share
Capacity High / Production Constraints	Up	Up	Down	Up
Capacity High / No Constraints	Normal Trend	Normal Trend	Normal Trend	Normal Trend
Capacity Low / Production Constraints	Up	Up	Down	Up
Capacity Low / No Constraints	Normal Trend	Up	Normal Trend	Normal Trend

Source: Dataquest

AGENDA

- Market forecast
- Near-term outlook
- Long-term outlook

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LONG-TERM OUTLOOK

- Slower bit growth until 1991
  - Slower electronic equipment growth
- Beyond 1992: new applications
- New technologies emerging
- Specialty memories more significant
- Rising cost of technology and production

BIT GROWTH CONTRIBUTORS

- New applications
- Memory bits/system
- System shipments
- Conversion from other memory technologies

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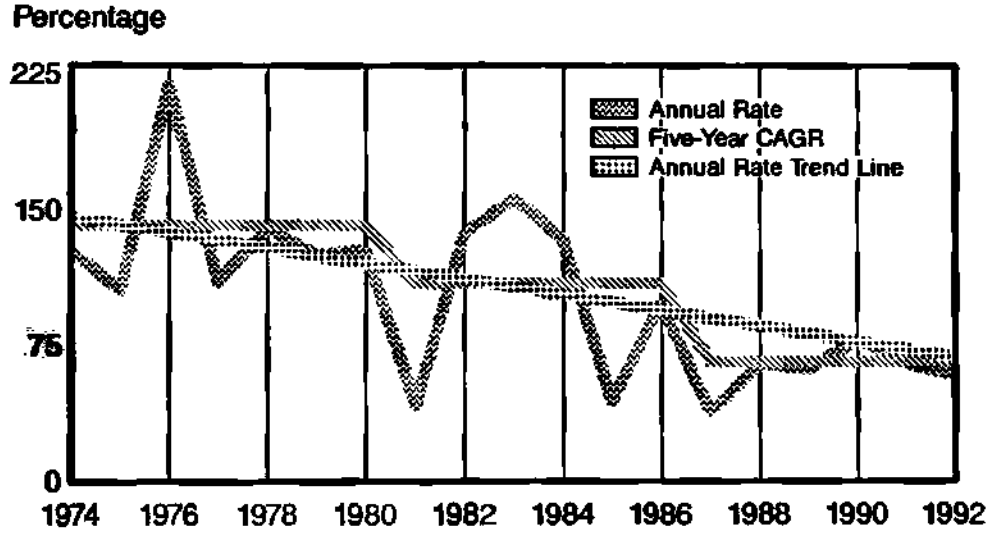
ESTIMATED ANNUAL DRAM BIT GROWTH RATES



Source: Dataquest

WORLDWIDE ELECTRONIC EQUIPMENT UNIT GROWTH FORECAST

	1982-1986 CAGR	1987-1991 CAGR
Personal Computers	34%	10%
Computer Storage	46%	12%
Business Computers	23%	10%

Source: Dataquest

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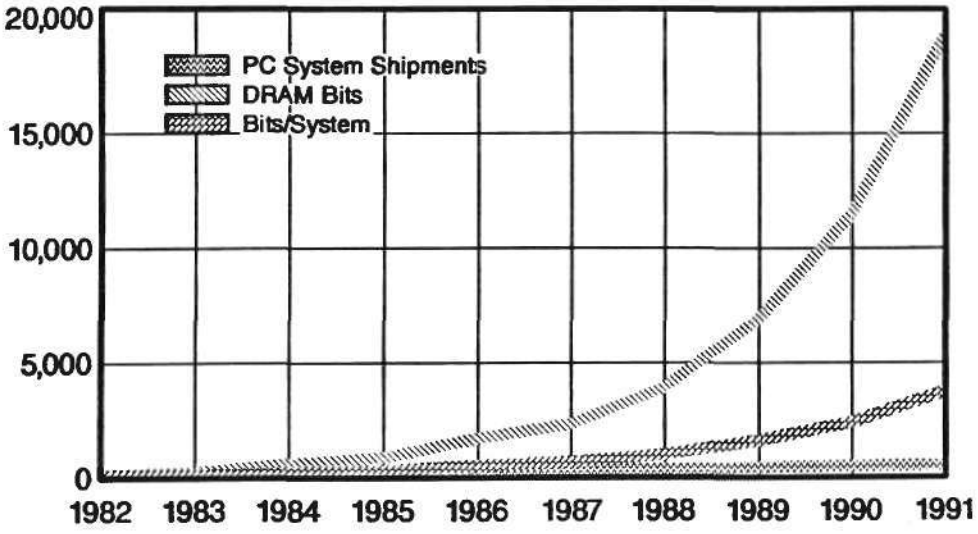
PERSONAL COMPUTER DRAM FORECAST

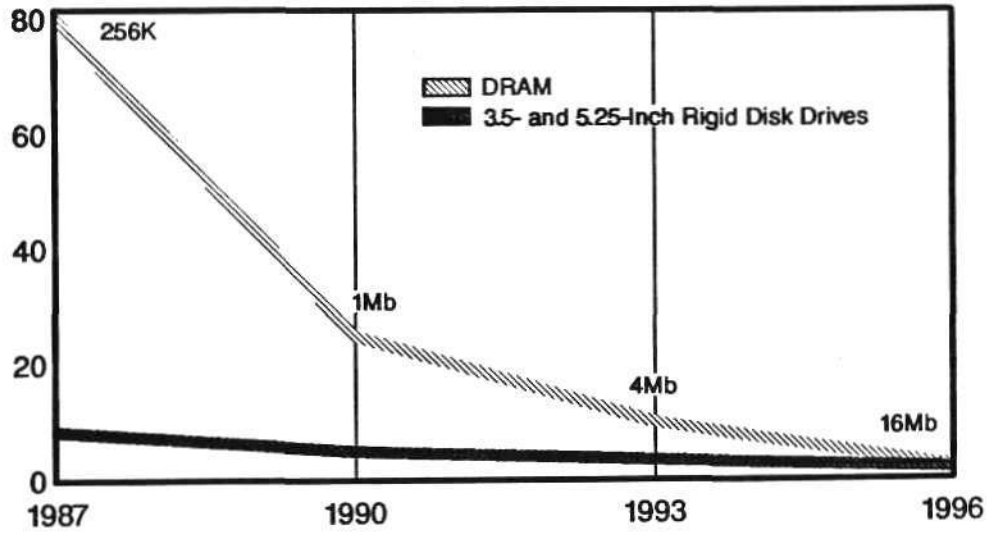
Index Base 1982 = 100



Source: Dataquest

ESTIMATED DRAM COST/BYTE TREND

Dollars per Megabyte



Source: Dataquest

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HIGH-PERFORMANCE COMPUTER APPLICATIONS

Application	Requirements	Devices
Primary Memory	Speed, density	BICMOS DRAMs, cache tags, cache data RAMs
Secondary Memory	Nonvolatility, density	Low-power DRAM, flash memory
Graphics Memory	Speed, density interface	Video RAM, video DAC (SRAM), color palette memory, fast SRAMs/FIFOs, high-density ROMs
Control Storage	Speed, diagnostics, organization	Smart fast SRAM/EPROM/ EEPROM

HIGH-PERFORMANCE COMPUTER APPLICATIONS

Application	Requirements	Devices
Program Storage	Density, speed	Faster, larger EPROMs, flash memory, faster, larger EEPROMs
Processor-to-Processor Communication	Density, speed, buffering features	Smart fast FIFOs, smart fast dual-port ROMs
Processor-to-Peripheral Communication	Density, buffering features	Smart slow FIFOs
Peripheral Memory	Density, buffering features	Frame DRAM, pseudo-SRAM, EPROMs

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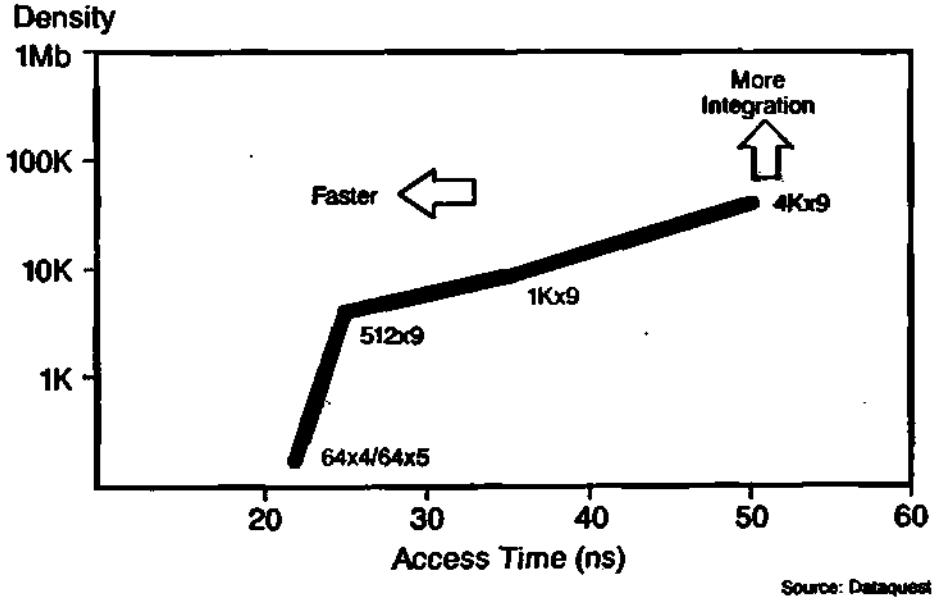
EMERGING APPLICATIONS

- Graphics/imaging memory
- Digital TV: IDTV, HDTV
- Fixed-drive replacements
- Memory IC cards
- Color laser printers
- Neural network systems
- Speech recognition

SRAM-BASED FIFO SPEED/DENSITY TRENDS



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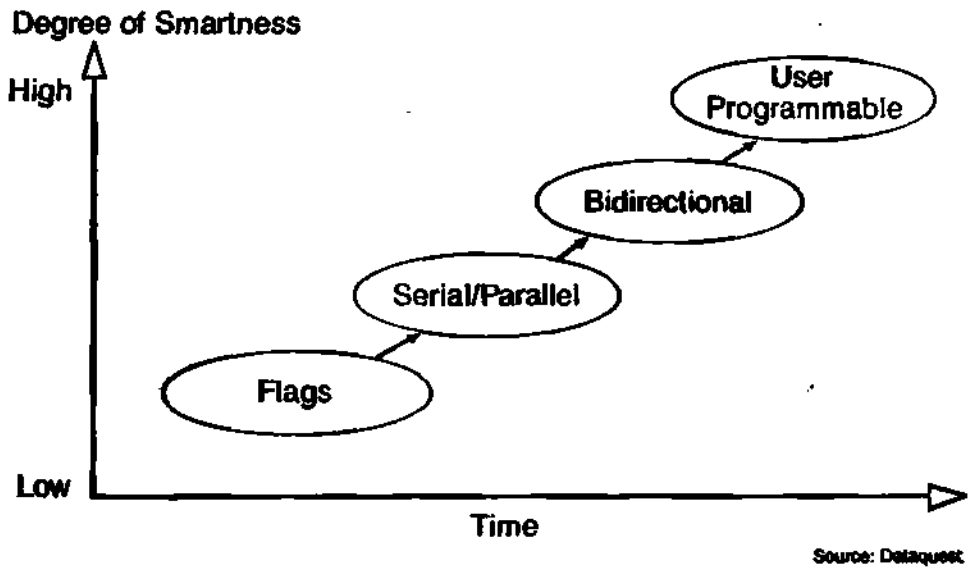
THE FOURTH DIMENSION: SMARTNESS SRAM-BASED FIFOs



MAJOR TECHNOLOGICAL ISSUES

- Return of ECL interface levels?
- DRAM 3-D cell issues
- Packaging: surface mount to TAB
- Rising cost of technology

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SUBMICRON PROCESS CHALLENGES

- Higher capital requirements
- Higher production costs
- Smaller surface-mount packages
- Increased performance
- Yield problems of 3-D cells

SUMMARY

- Good memory market prospects
- Changing markets
- Manage cyclical nature

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JAPANESE SEMICONDUCTOR EQUIPMENT INDUSTRY: STATUS AND FUTURE

Kazunori Hayashi
Industry Analyst
Japanese Semiconductor Industry Service
Dataquest Japan Limited

Mr. Hayashi is an Industry Analyst for Dataquest's Japanese Semiconductor Industry Service (JSIS) and is based in Tokyo. He covers the semiconductor equipment and materials area. Among his responsibilities are researching and compiling the JSIS capacity analysis data base and updating the semiconductor equipment and materials data base. Prior to joining Dataquest, Mr. Hayashi was a founder of Innov Japan and Techno System Research Corporation. He has had 12 years experience in the industry. During this time, he has authored publications and performed research and consulting on the Japanese semiconductor equipment industry. Mr. Hayashi is a Commercial Sciences graduate of Meiji University.

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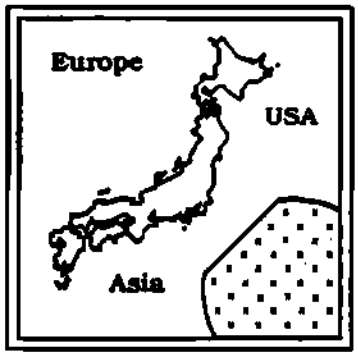

Japan's New International Role: Competition and Cooperation

JAPANESE SEMICONDUCTOR EQUIPMENT INDUSTRY: STATUS AND FUTURE

KAZUNORI HAYASHI

Japanese Semiconductor Industry Service
Dataquest Japan Limited

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AGENDA

- Capital spending
- Wafer fab equipment forecast
- Wafer fab equipment data base by region

ESTIMATED WORLDWIDE SEMICONDUCTOR PRODUCTION AND CAPITAL SPENDING

(Millions of Dollars)

	1983	1984	1985	1986	1987	CAGR 1983-1987
Semiconductor Production	23,242	33,464	29,698	36,431	44,508	18%
Capital Spending	4,238	8,738	7,238	5,303	5,924	9%
Wafer Fabrication Equipment	2,127	3,530	3,341	2,598	2,725	6%

Source: Dataquest

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ESTIMATED WORLDWIDE SEMICONDUCTOR PRODUCTION AND CAPITAL SPENDING

(Millions of Dollars)

	1988	1989	1990	1991	1992	CAGR 1988-1992
Semiconductor Production	54,723	55,332	62,865	73,488	87,778	13%
Capital Spending	7,660	7,889	9,897	12,564	16,122	20%
Wafer Fabrication Equipment	3,419	3,591	4,459	5,622	7,120	20%

Source: Dataquest

CAPITAL SPENDING BY REGION (PRELIMINARY ESTIMATES)

(Millions of Dollars)

	1987	1988	CAGR 1987-1988
United States	1,908	2,539	33%
Japan	1,683	2,300	37%
Europe	823	906	10%
ROW	406	606	49%
Captive	1,104	1,309	18%
Total	5,924	7,660	29%

Source: Dataquest

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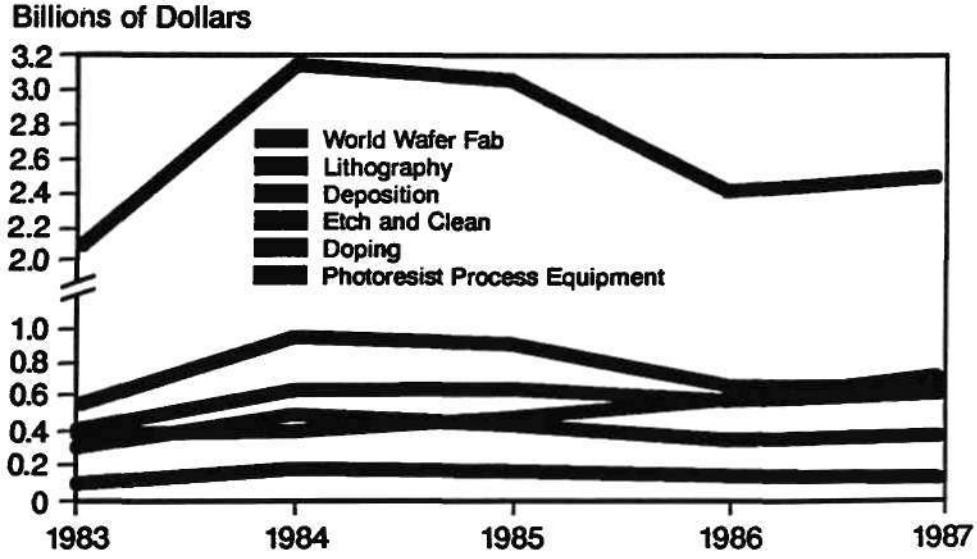
WORLDWIDE WAFER FAB EQUIPMENT HISTORY

(Millions of Dollars)

	1983	1984	1985	1986	1987	CAGR 1983-1987
Lithography	567	954	909	661	667	4%
Photoresist Process Equipment	100	185	166	144	133	7%
Etch and Clean	320	499	446	358	384	5%
Deposition	414	637	650	584	641	12%
Doping	300	495	532	311	323	2%

Source: Dataquest

WORLDWIDE WAFER FAB EQUIPMENT HISTORY



Source: Dataquest

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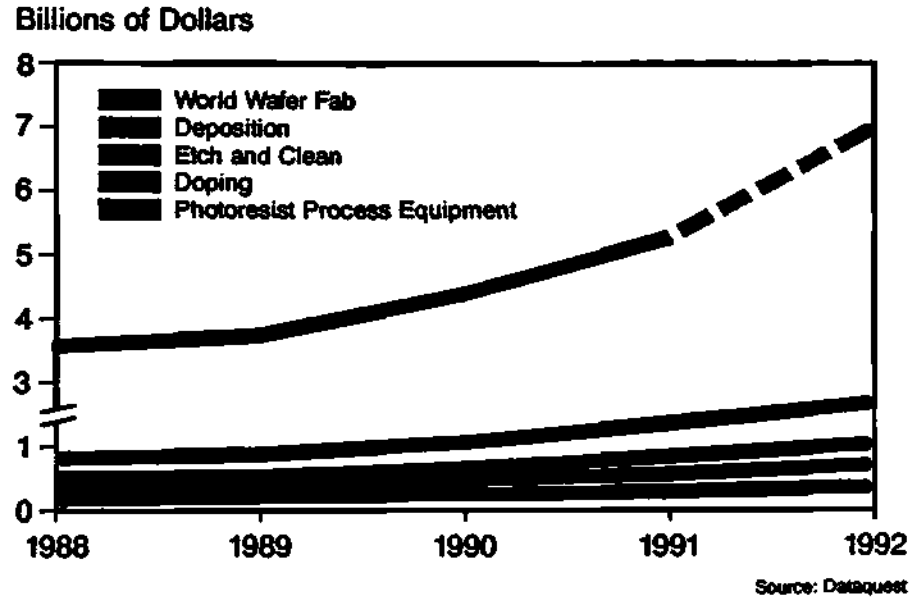
WORLDWIDE WAFER FAB EQUIPMENT FORECAST

(Millions of Dollars)

	1988	1989	1990	1991	1992	CAGR 1988-1992
Lithography	811	877	1,086	1,375	1,749	21%
Photoresist Process Equipment	162	175	217	275	350	21%
Etch and Clean	496	514	650	828	1,057	21%
Deposition	829	866	1,078	1,360	1,715	20%
Doping	386	395	478	584	720	17%

Source: Dataquest

WORLDWIDE WAFER FAB EQUIPMENT FORECAST



Source: Dataquest

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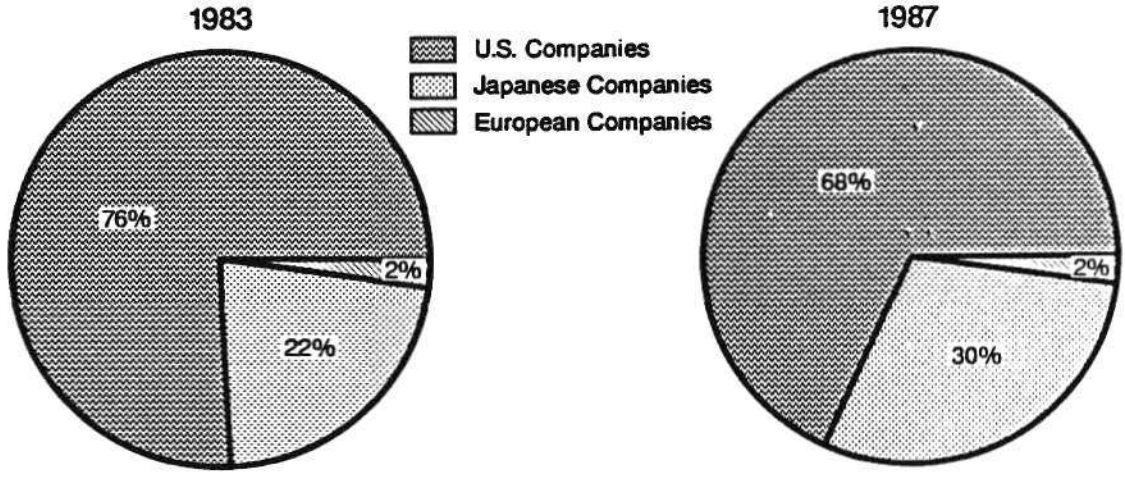
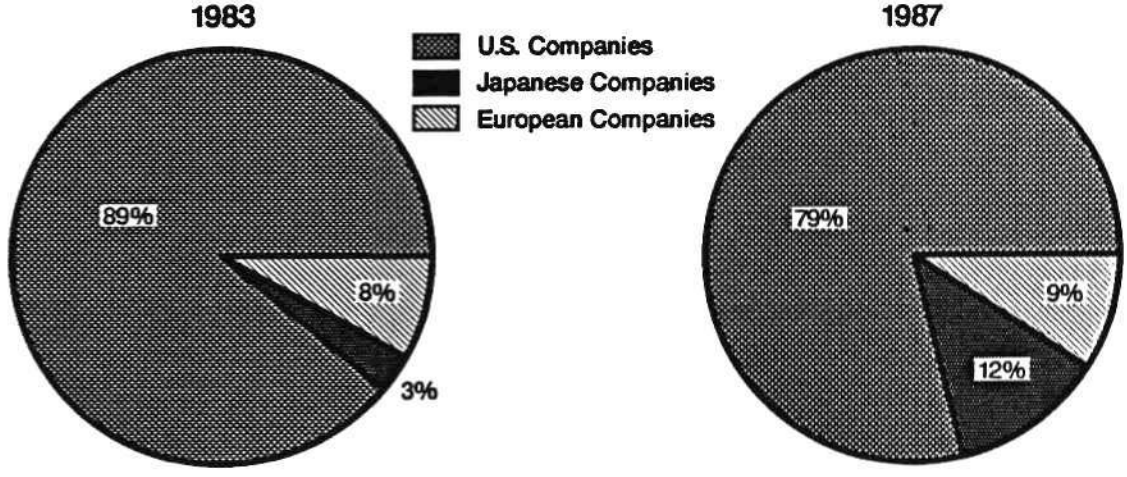
ESTIMATED WORLDWIDE WAFER FAB EQUIPMENT MARKET SHARE BY REGION



Source: Dataquest

ESTIMATED U.S. WAFER FAB EQUIPMENT MARKET SHARE BY REGION



Source: Dataquest

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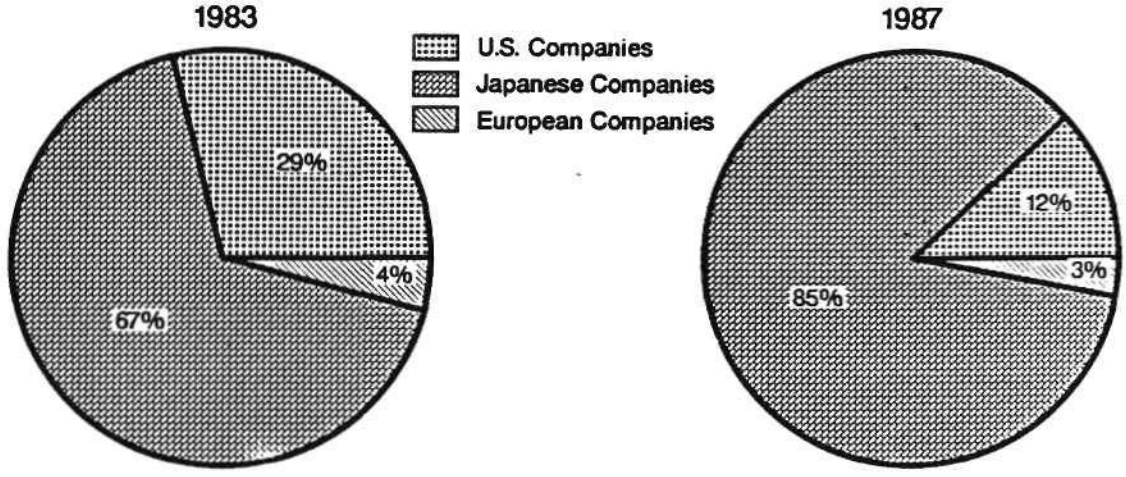
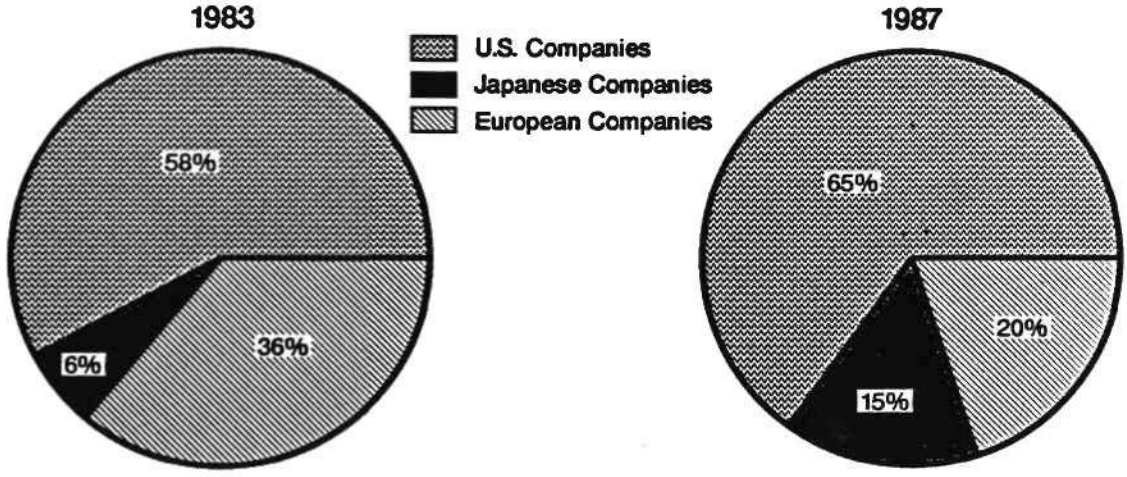
ESTIMATED JAPANESE WAFER FAB EQUIPMENT MARKET SHARE BY REGION



Source: Dataquest

ESTIMATED EUROPEAN WAFER FAB EQUIPMENT MARKET SHARE BY REGION



Source: Dataquest

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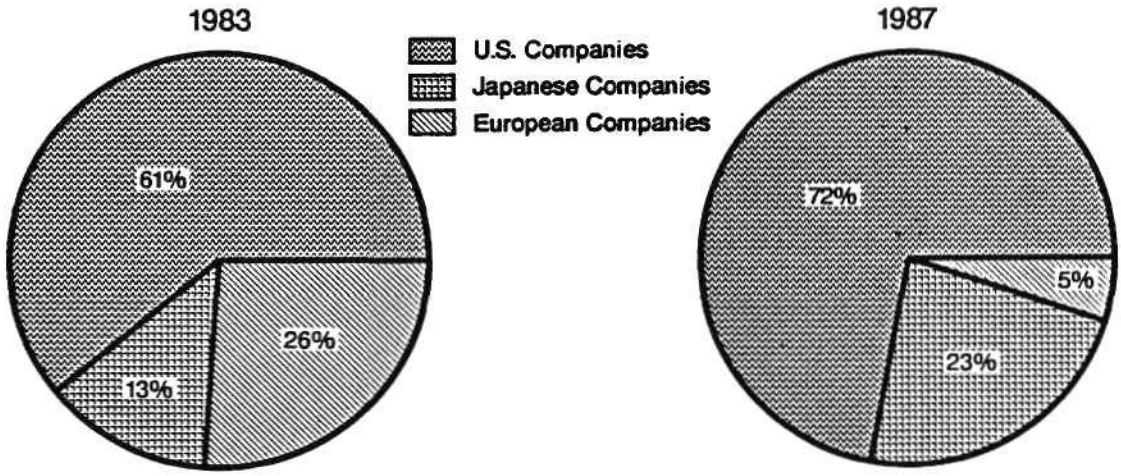
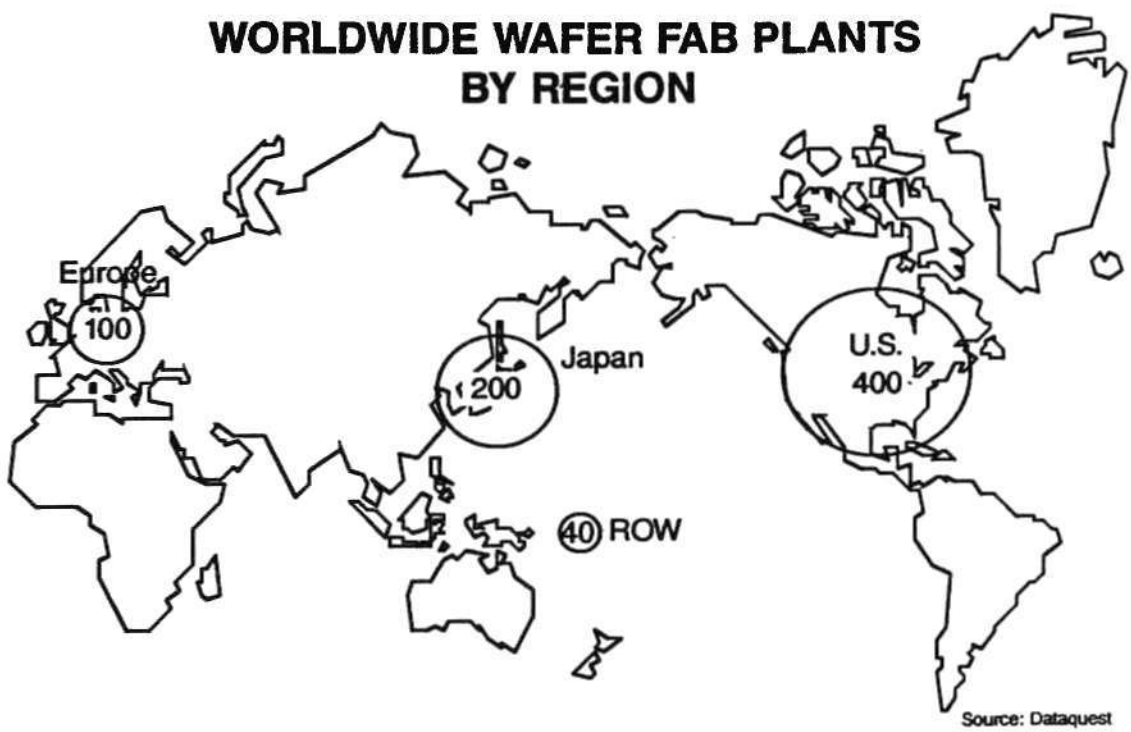
ESTIMATED ROW WAFER FAB EQUIPMENT MARKET SHARE BY REGION



Source: Dataquest

WORLDWIDE WAFER FAB PLANTS BY REGION



Source: Dataquest

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JAPANESE SEMICONDUCTOR EQUIPMENT ALLIANCES

Process	Company A	Company B	Product	Type of Alliance
Litho	Citizen Watch	Perkin Elmer	Stepper	Joint development
	Dai Nippon Screen	MRS Technology	Stepper for LCD	Sales agent
	JEOL	NTT	E-B	Joint development
	Mitsubishi	Sortech	SOR	Joint development
	Nikon	Matsushita	I-line stepper and excimer	Joint development
Etch	Anelva	Branson IPC	Stripper	Sales agent
	Sumitomo Metal	Lam Research	Plasma etcher	Sales agent
Implant	Innotech	General Ionex	High current	Sales agent

Source: Dataquest

JAPANESE SEMICONDUCTOR EQUIPMENT ALLIANCES

Process	Company A	Company B	Product	Type of Alliance
Diffusion	Sumisho Ele	Silicon Valley Group	Vertical thermal reactor	Sales agent
CVD	Nippon Sanso	Spire	MOCVD	Sales agent
	Marubemi Hitec	Watkins-Johnson	APCVD	Sales agent
	Seki Company	Novelus	LPCVD	Sales agent
	Sumisho Ele	SVG	LPCVD	Sales agent
Testers	Kobe Steel	Megatest	IC tester	Joint development
Assembly	Ikegami Tsushinki	Pacific Semiconductor Equipment	Bonder	Joint development with Kamematsu

Source: Dataquest

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CONCLUSION

	CAGR 1988-1992
Semiconductor Production	13%
Capital Spending	20%
Wafer Fab Equipment	20%
Stepper	26%
Dry Etch	29%
CVD	23%
R.T.P.	35%
Ion Implantation	24%

Source: Dataquest

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