



Worldwide Semiconductor Growth: Watch Out for Asia/Pacific

Daniel A. Heyler

Manager/Senior Industry Analyst
Asia/Pacific Semiconductor Group (ASG)

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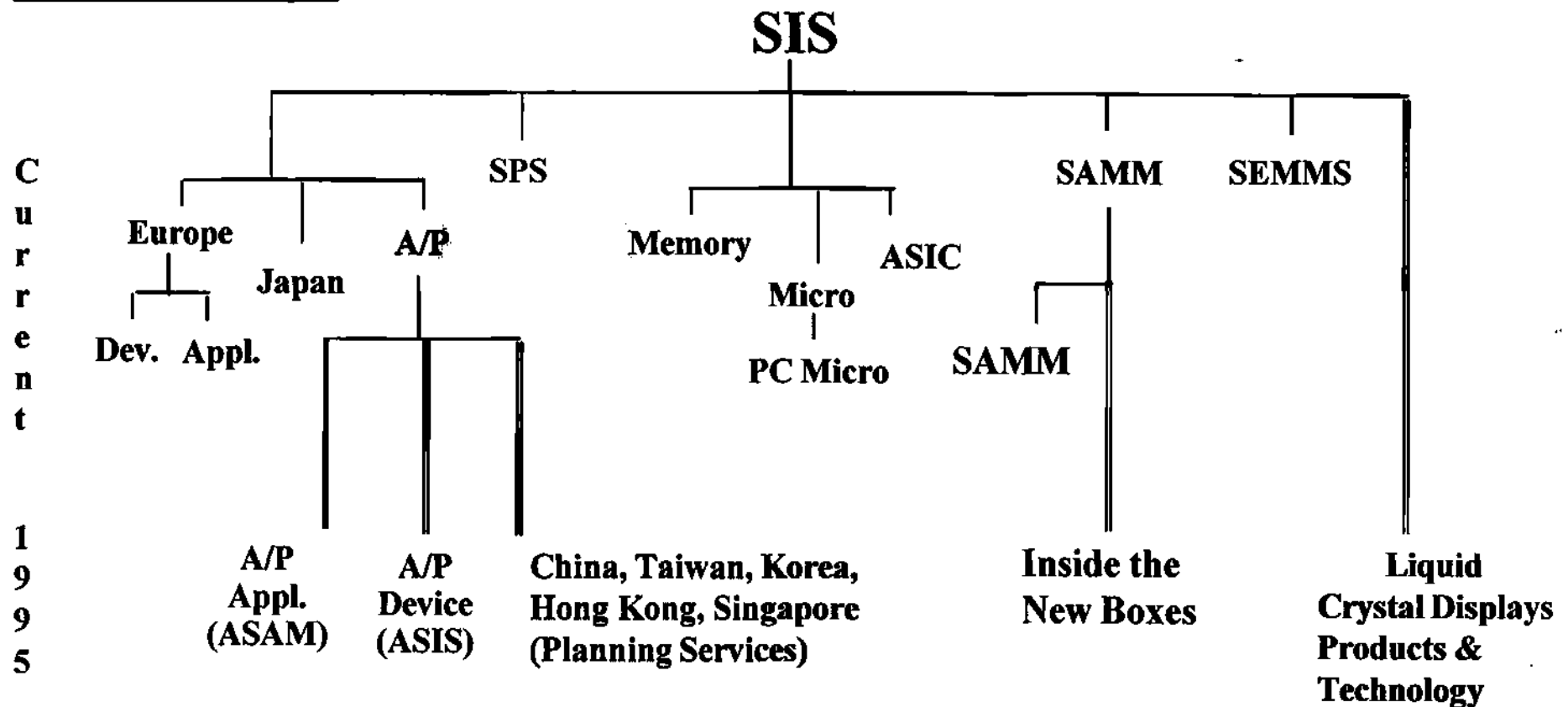
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Agenda

- Semiconductor Group Update
- Market Share
- Electronic Equipment Trends
- Semiconductor Markets Forecast
- Semiconductor Production Report
- Conclusion

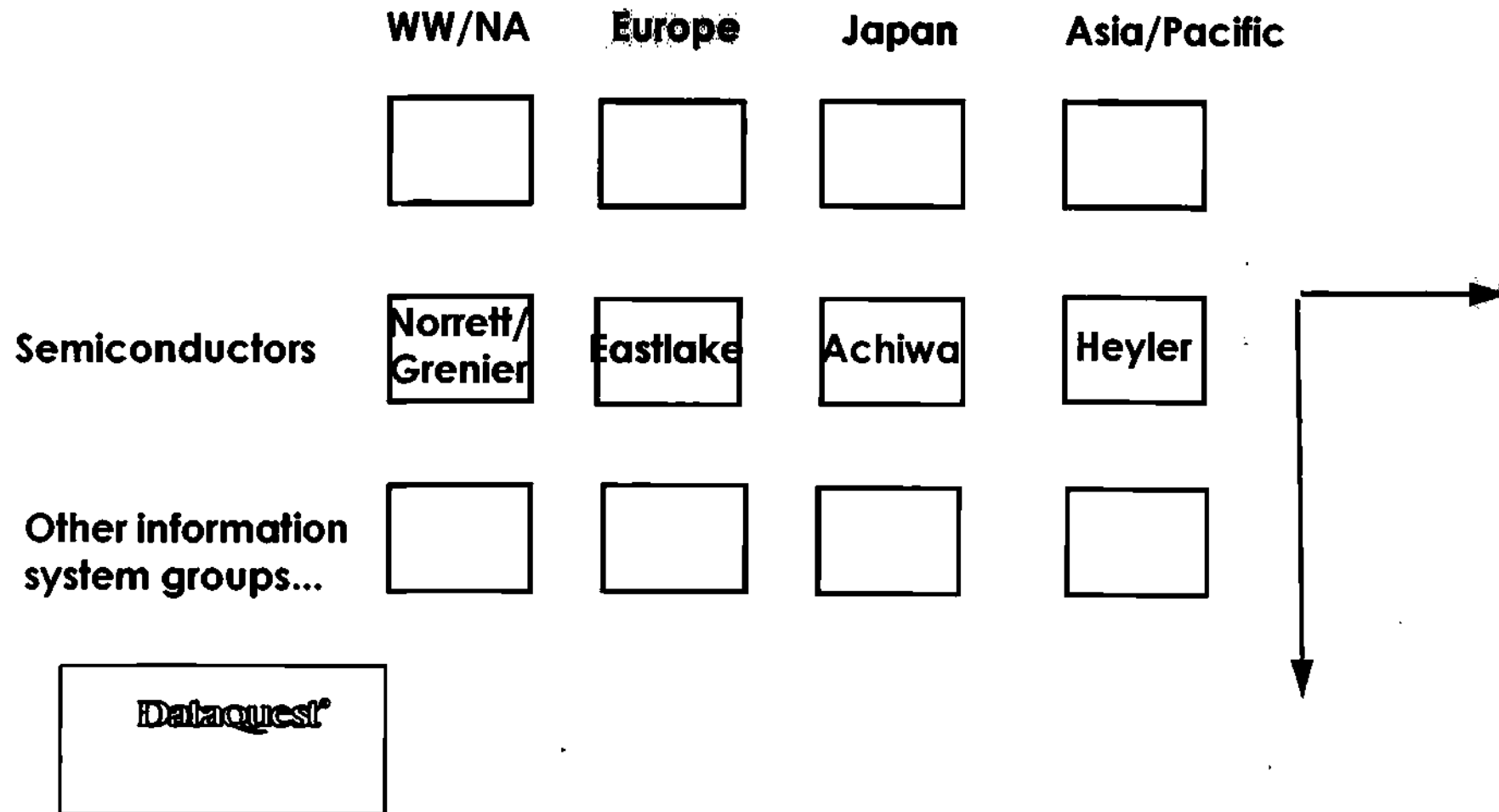
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Worldwide Semiconductor Group Genealogy



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Dataquest's Asia/Pacific Plans Semiconductors to Systems !



Asia/Pacific Semiconductor Group (ASG)
(Support Centers and Research Responsibilities)

Korea-J.H. Son (Korean Research)

Dan Heyler
Res. Mgr.

Taiwan- New Analyst by Q4, (Taiwan Research)

Singapore-Eddy Tan (Singapore and S-E Asia)

Hong Kong-New Analyst, Q2/95 (Hong Kong, China)

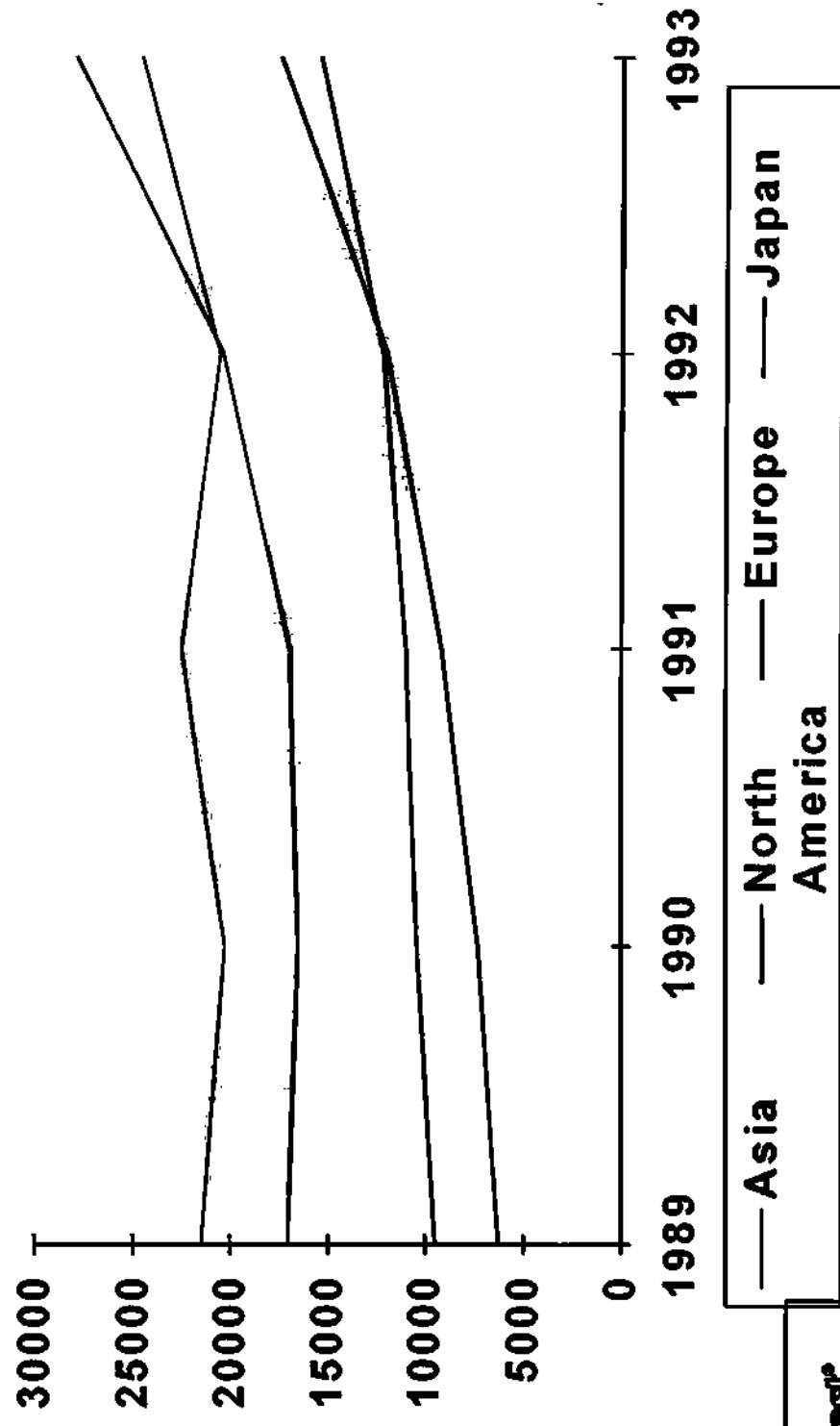
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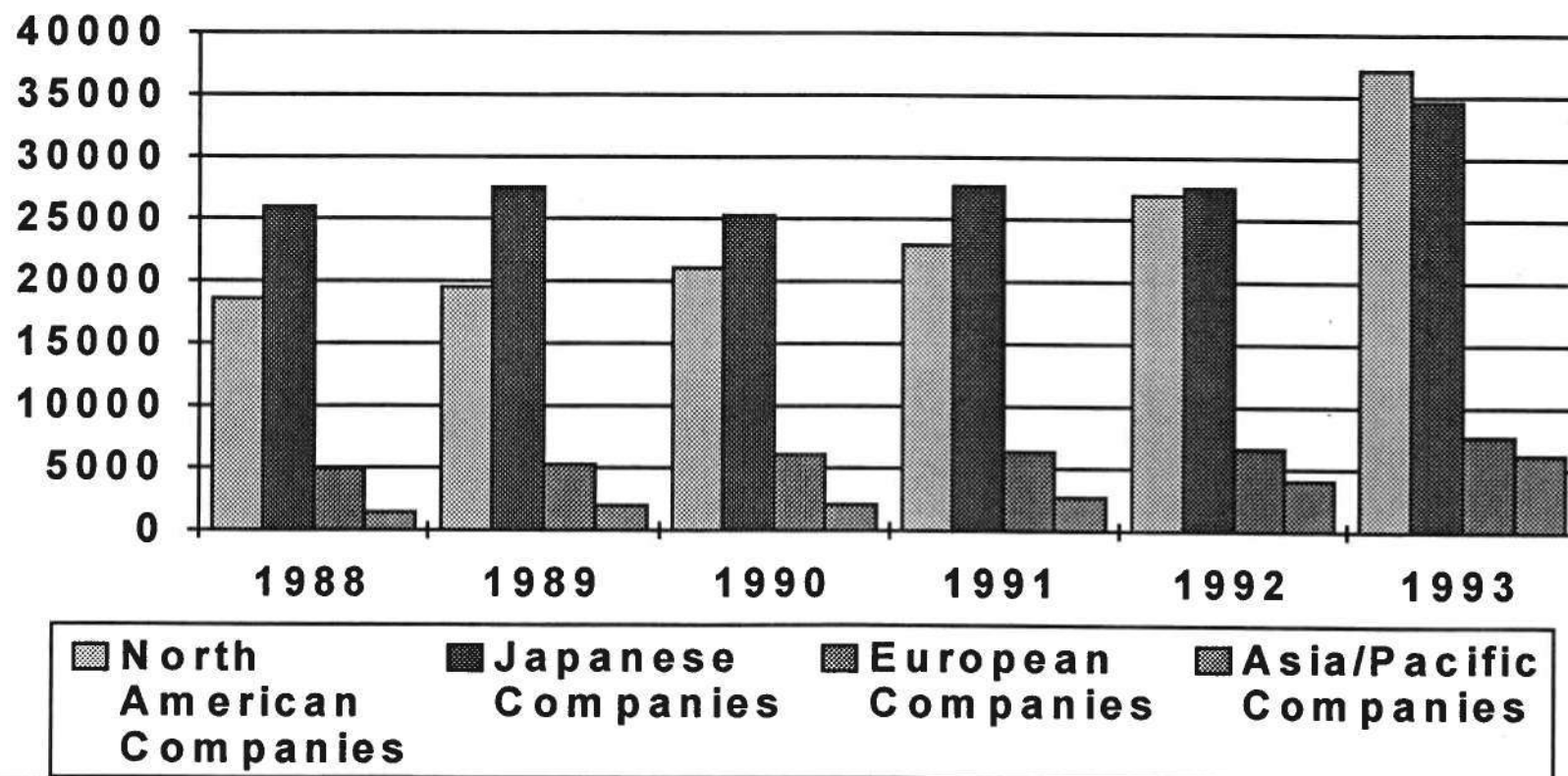
Worldwide Semiconductor Consumption: The Rise of Asia/Pacific



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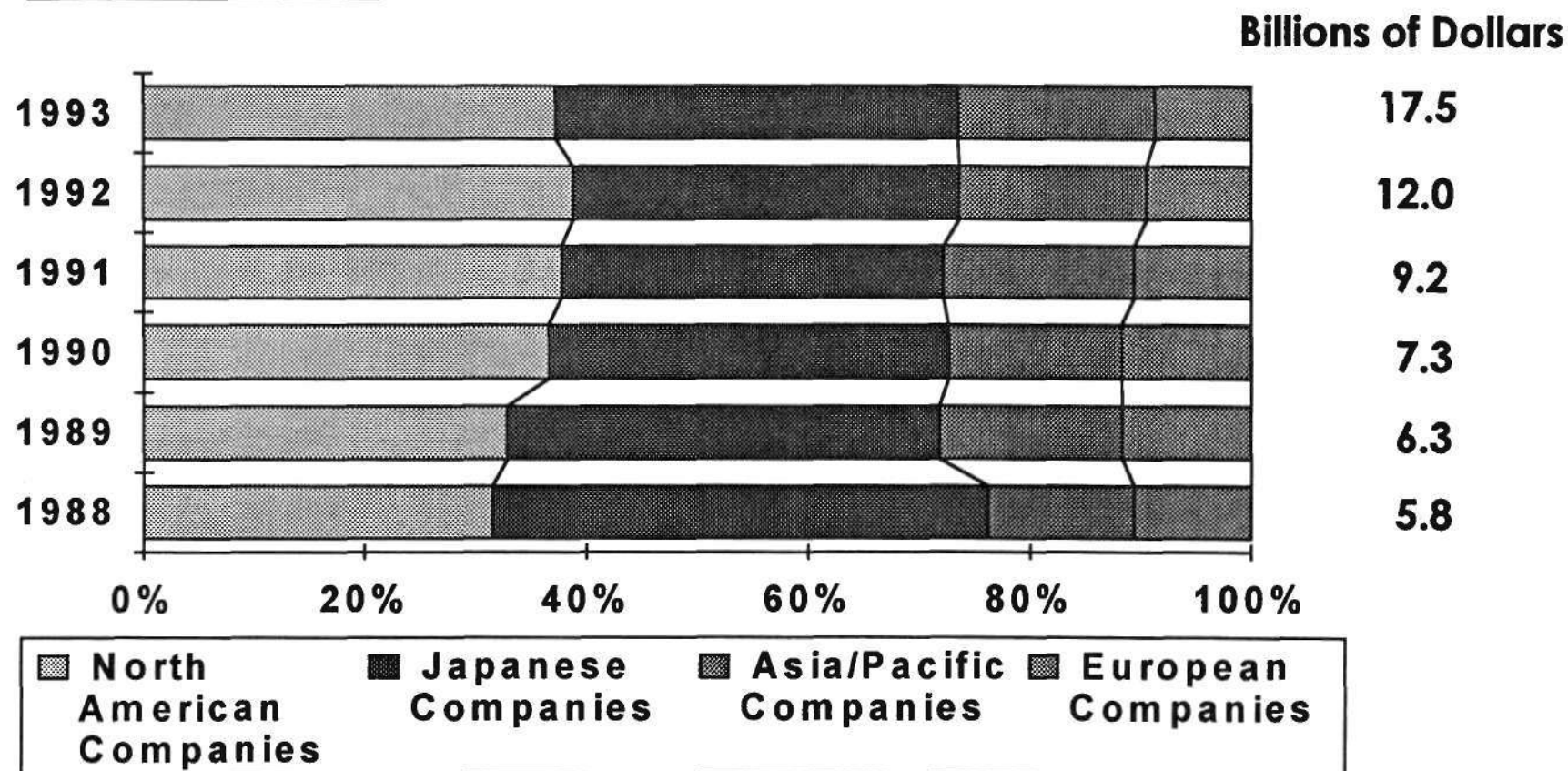
Worldwide Semiconductor Shipments

Millions of Dollars



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Asia/Pacific Market Share by Origin of Supplier, 1989 to 1993



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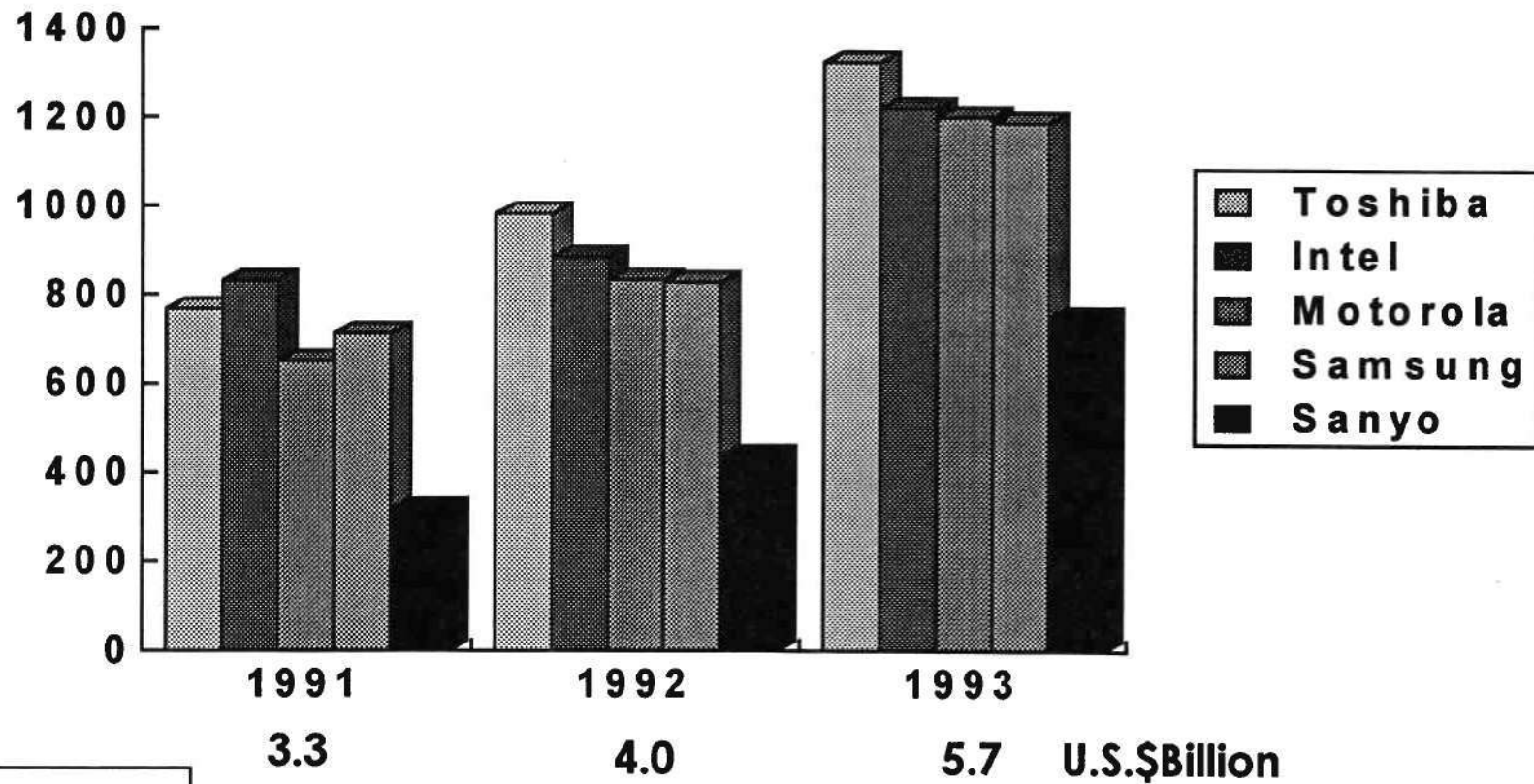
Top 10 Asia/Pacific Suppliers' Ranking and Worldwide Market Share

<i>Ranking</i>			<i>Market Share</i>	
World	Asia/Pacific		World	Asia/Pacific
4	1	Toshiba	6.7%	7.6%
1	2	Intel	9.3%	7.0%
3	3	Motorola	7.0%	6.9%
7	4	Samsung	3.6%	6.8%
15	5	Sanyo	2.2%	4.3%
5	6	Hitachi	5.9%	4.3%
6	7	Texas Instruments	4.8%	4.1%
2	8	NEC	7.2%	4.1%
22	9	Goldstar	1.1%	3.4%
12	10	Philips	2.7%	3.1%
Accumulative Share			50.5%	51.4%

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Top Five Suppliers in Asia/Pacific

U.S.\$Million



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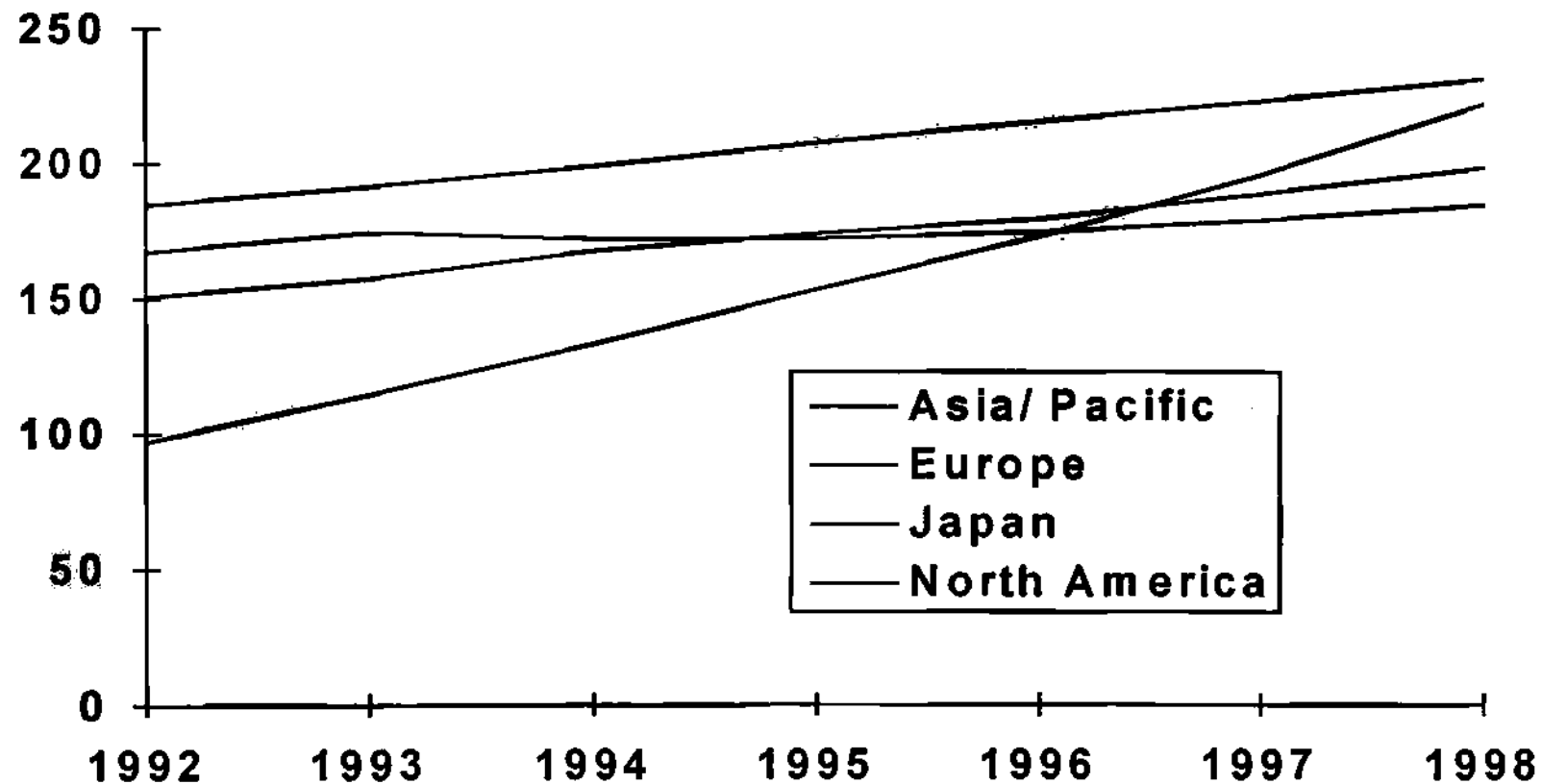
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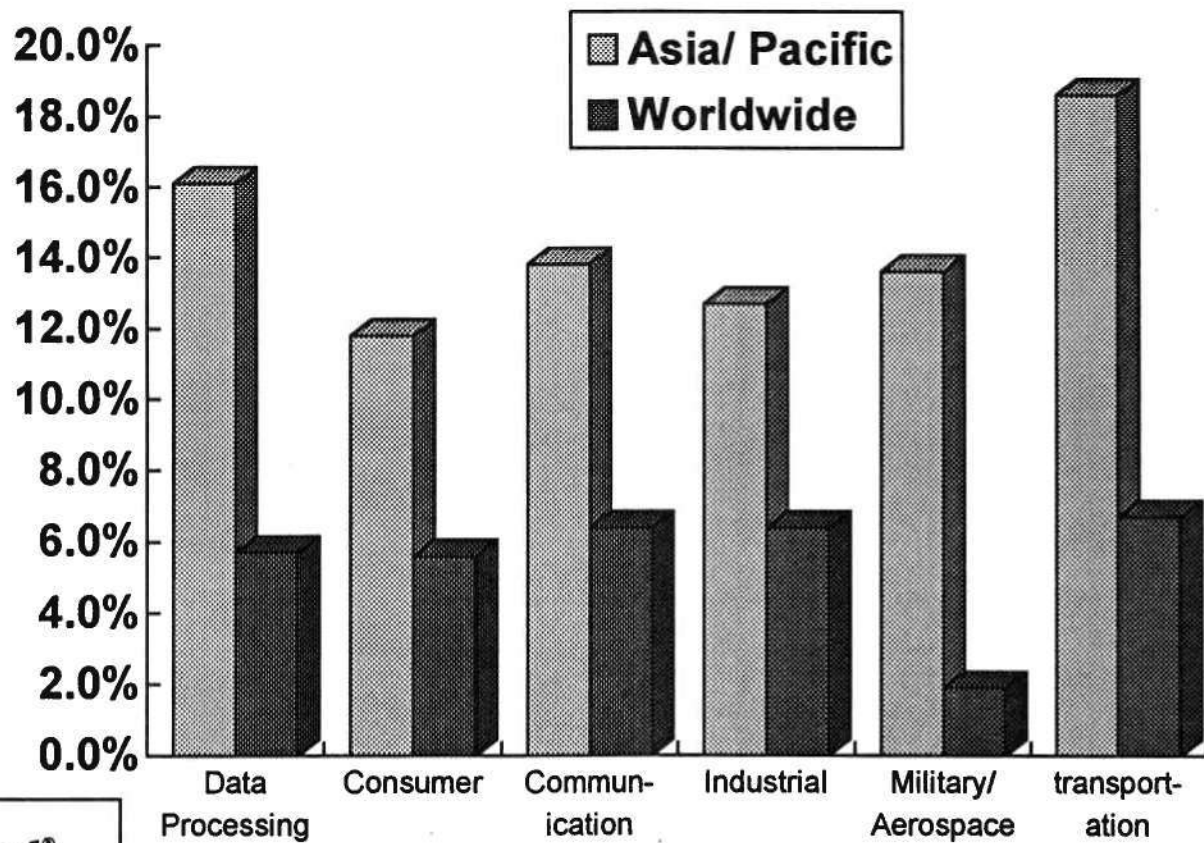
Worldwide Electronic Equipment Production Forecast by Region

Billions of Dollars



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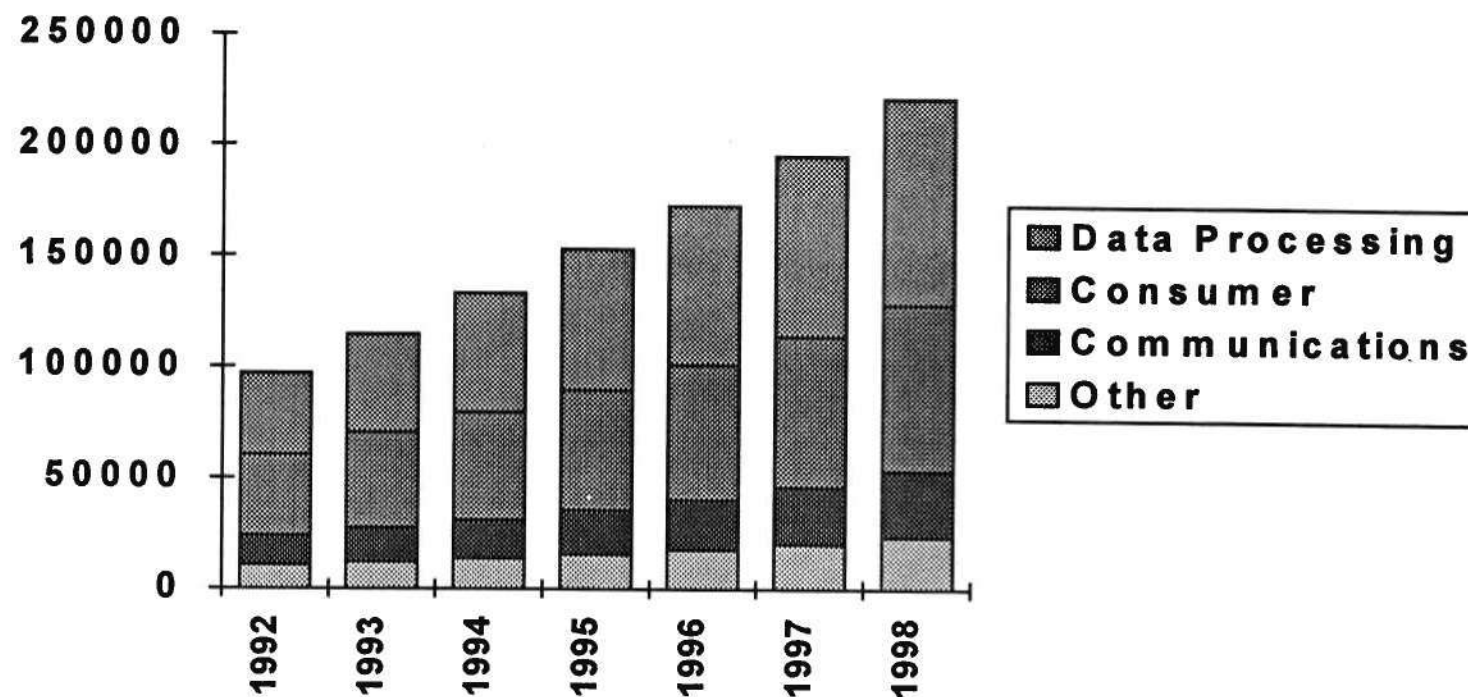
1993 to 1998 Worldwide and Asia/Pacific Electronic Equipment CAGR



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Asia/Pacific Electronic Equipment Production Forecast by Sector

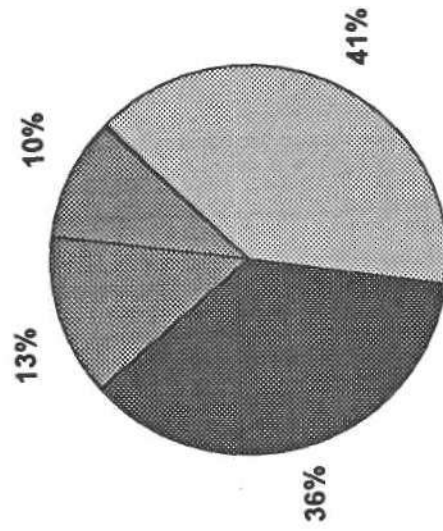
Millions of Dollars



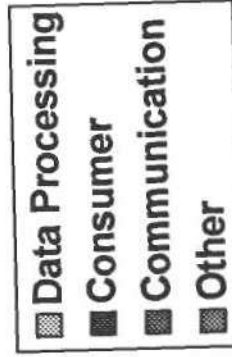
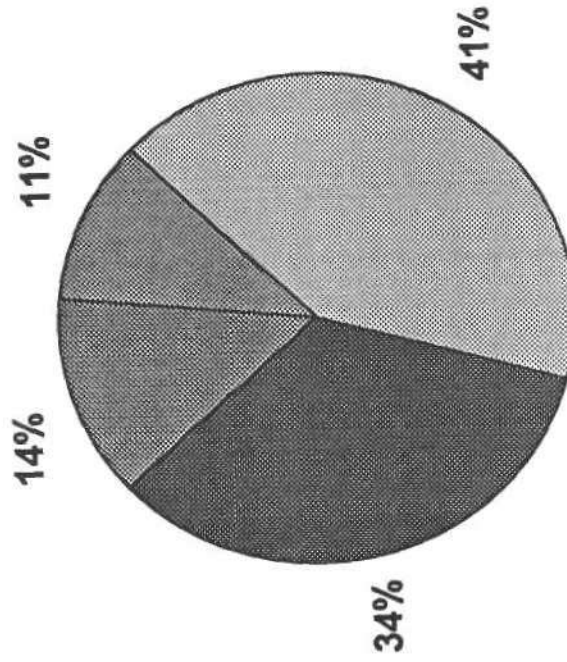
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Asia/Pacific Electronic Equipment Production Forecast by Application

1994



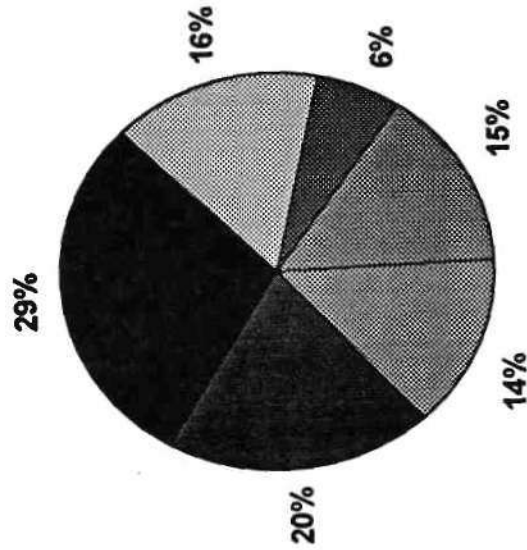
1998



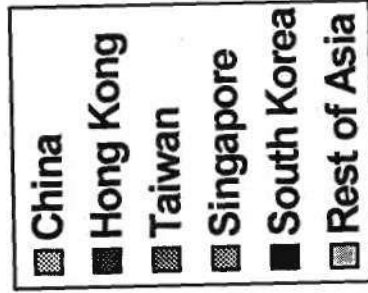
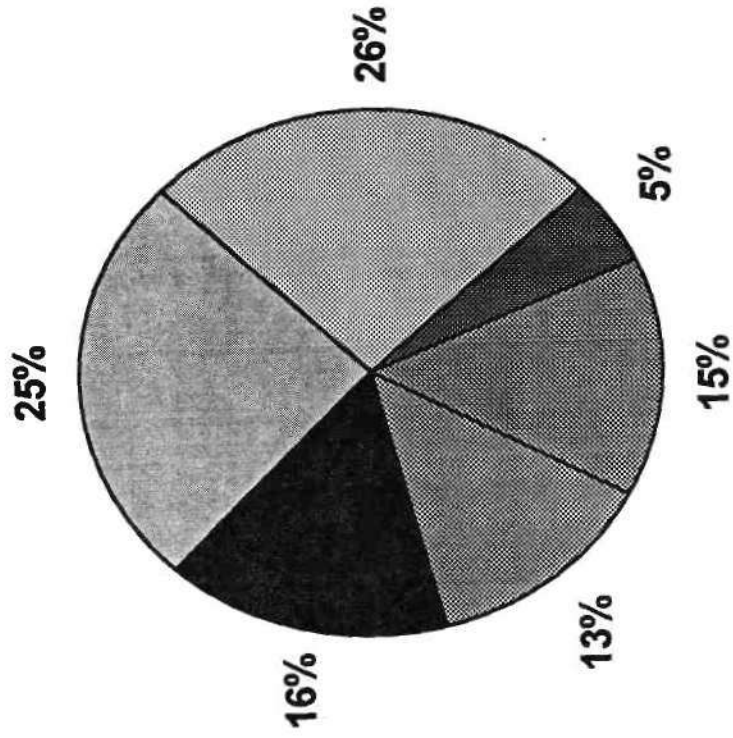
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Asia/Pacific Electronic Equipment Production Forecast by Region

1994



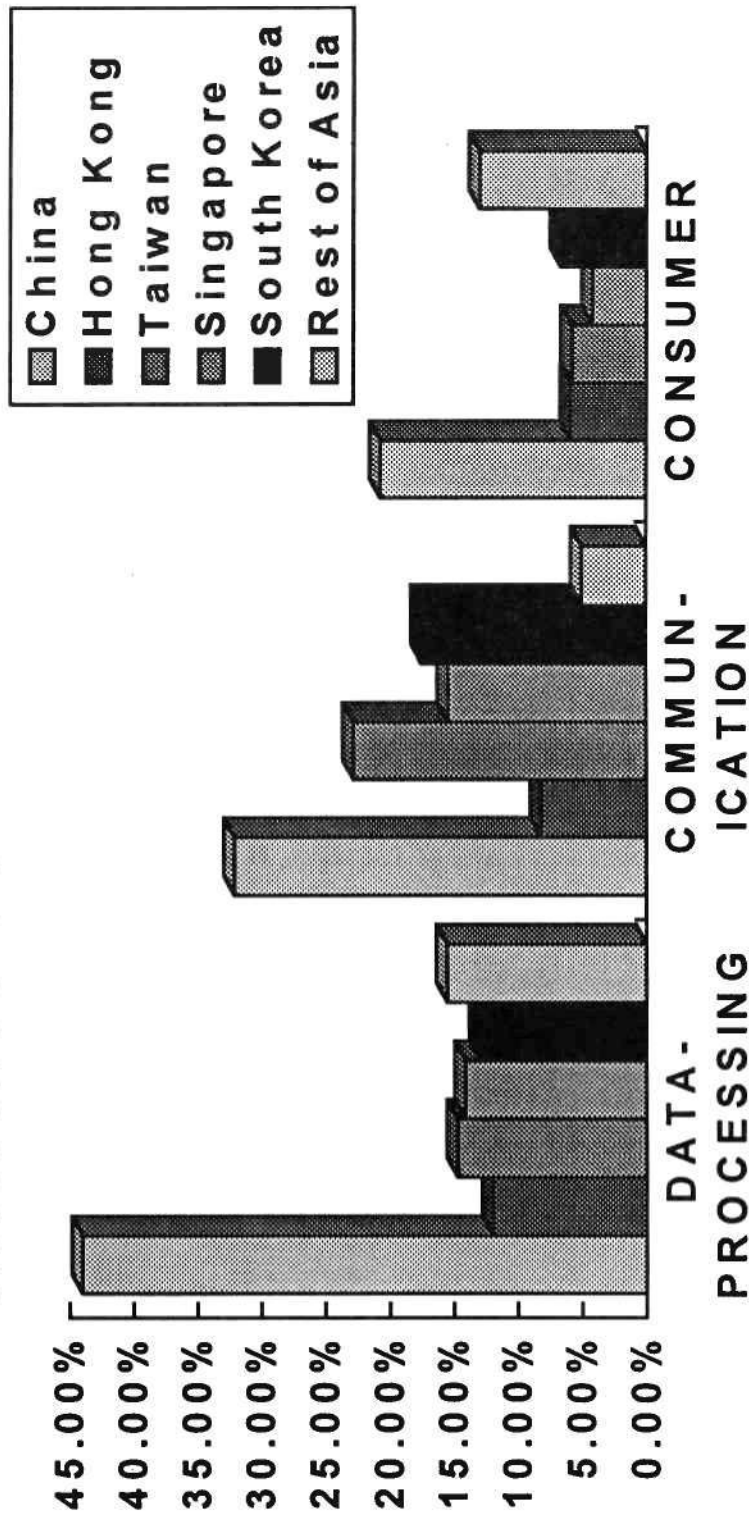
1998



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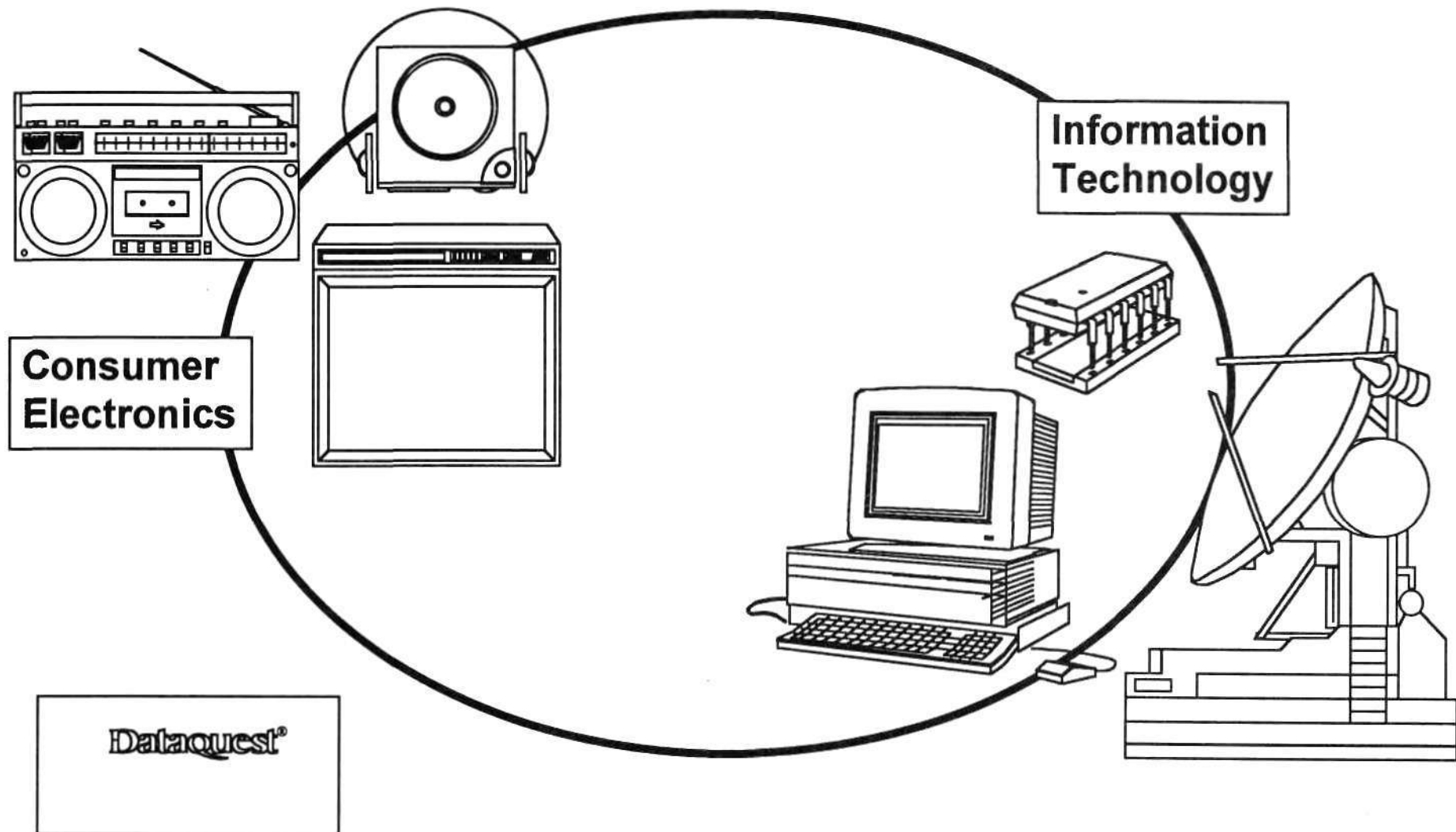
Asia/Pacific Electronic Equipment Production Forecast by Application and Region

1993 TO 1998 CAGRs

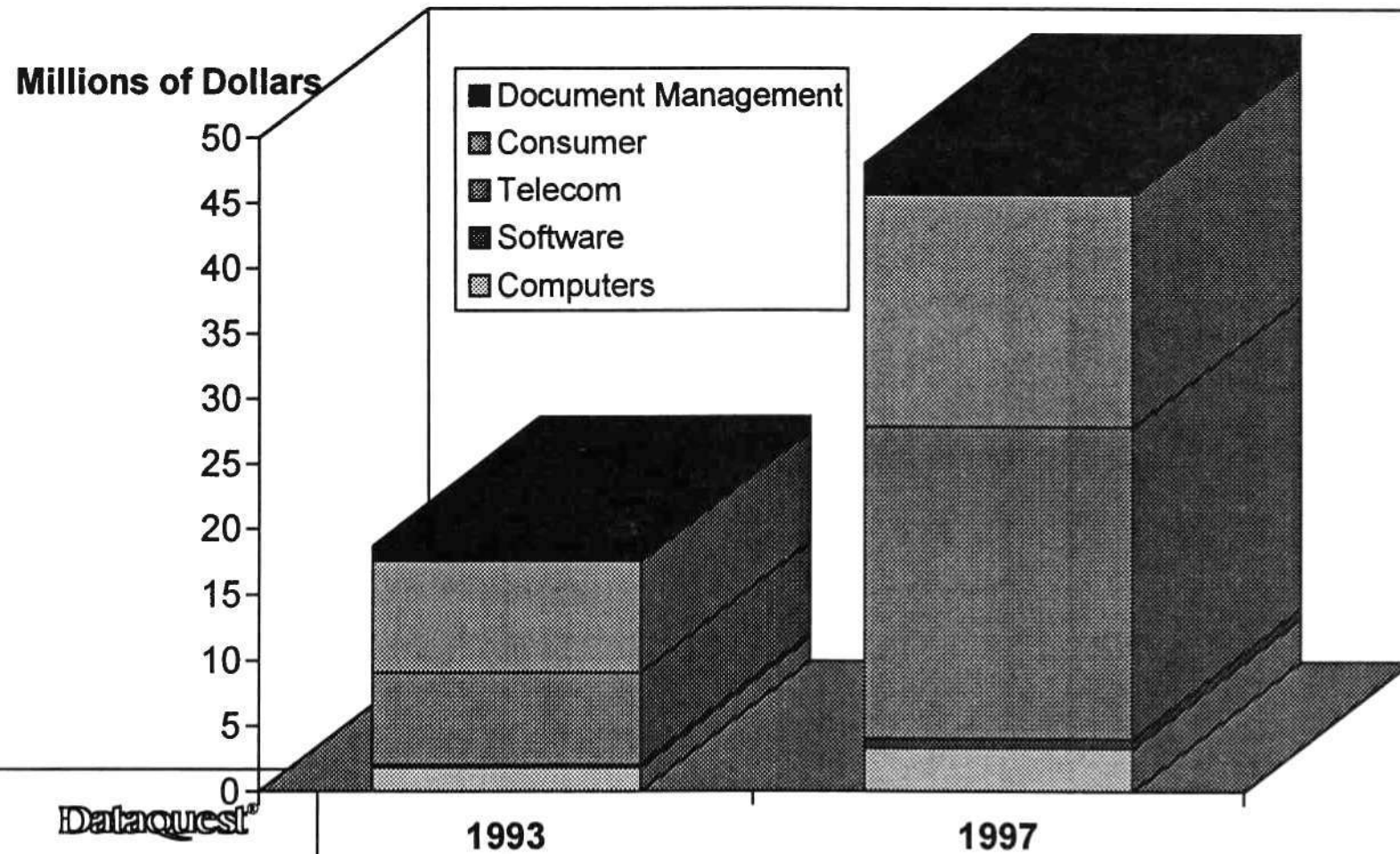


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China IT Market Overview

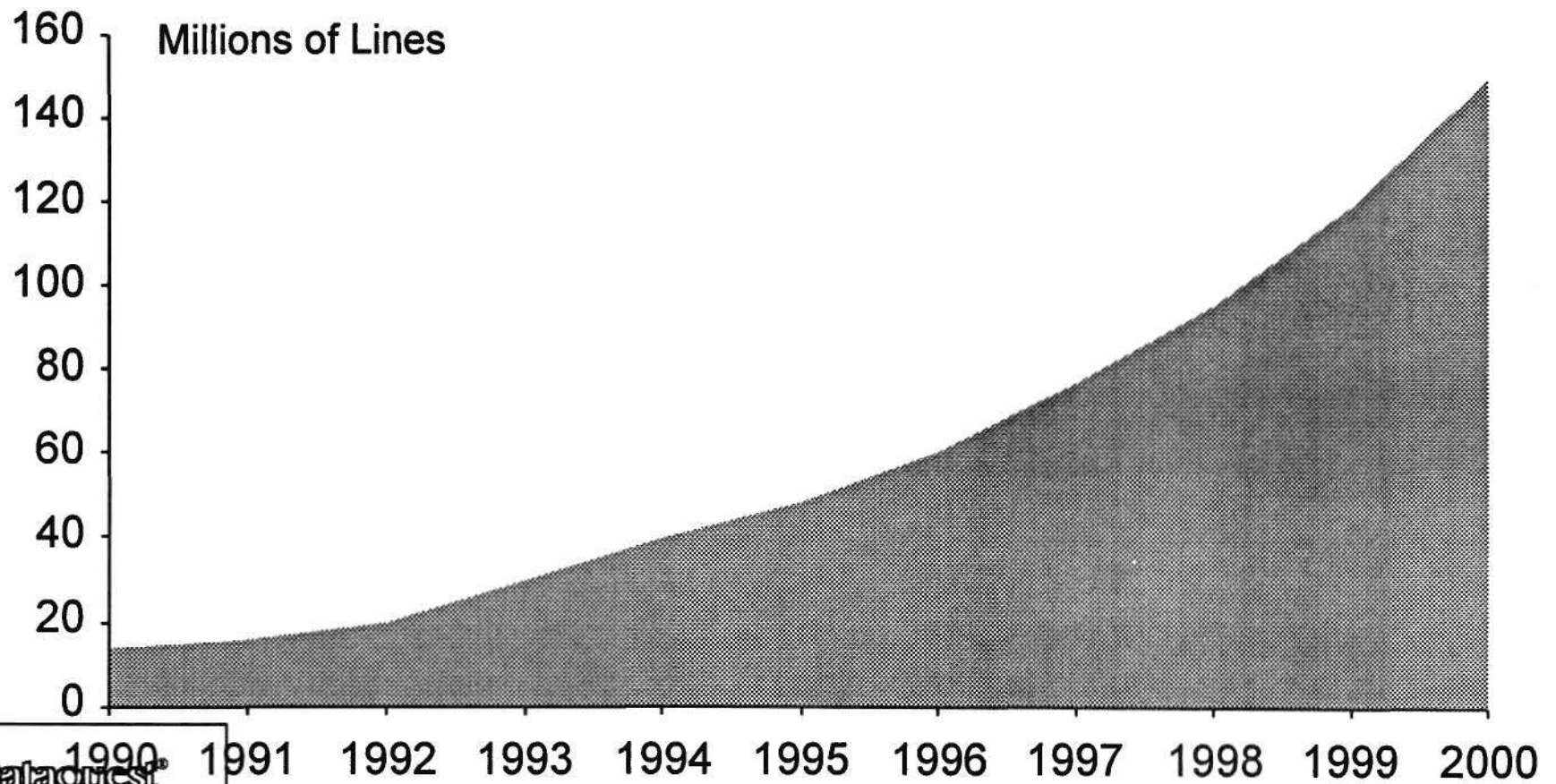


IT Market Growth Rate by Segment



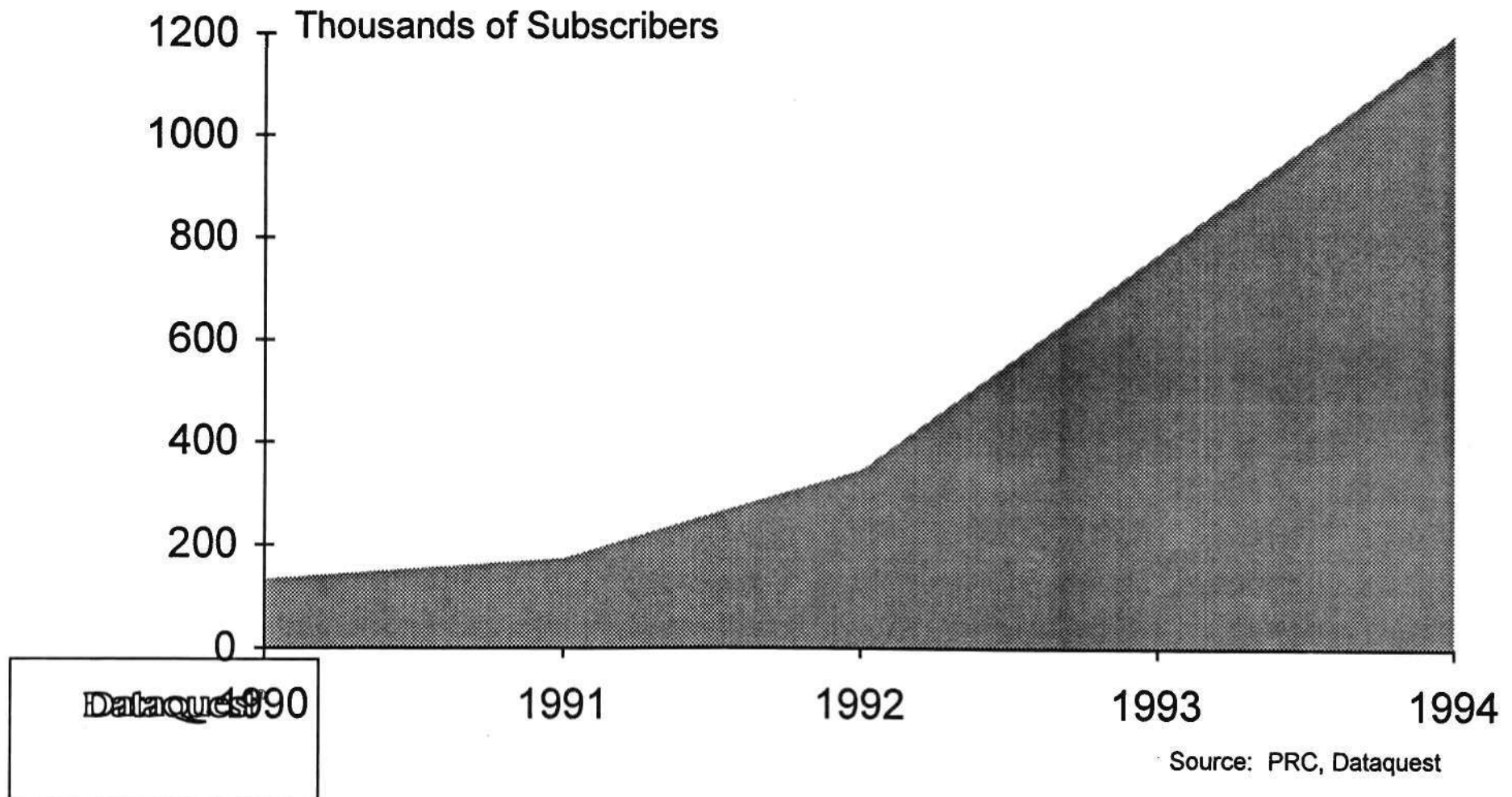
Source: Dataquest

Hot Market — Capacity of China's National Telephone Exchange 1990 to 2000



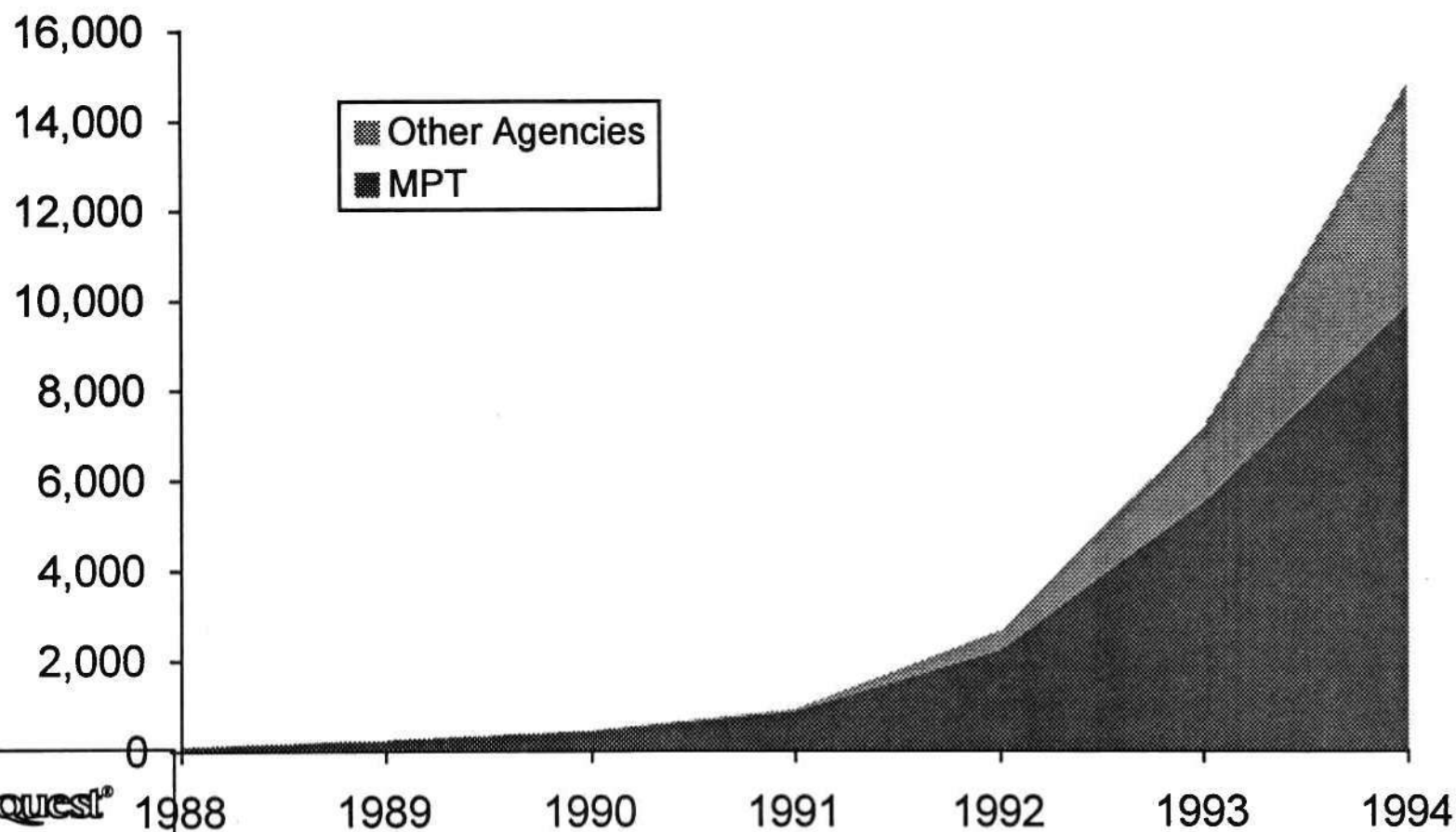
Source: PRC, Dataquest

Hot Market—Number of Cellular Phone Subscribers in China 1990 to 1994



Hot Market — Number of Paging Subscribers in China 1990 to 1994

Thousands of Subscribers



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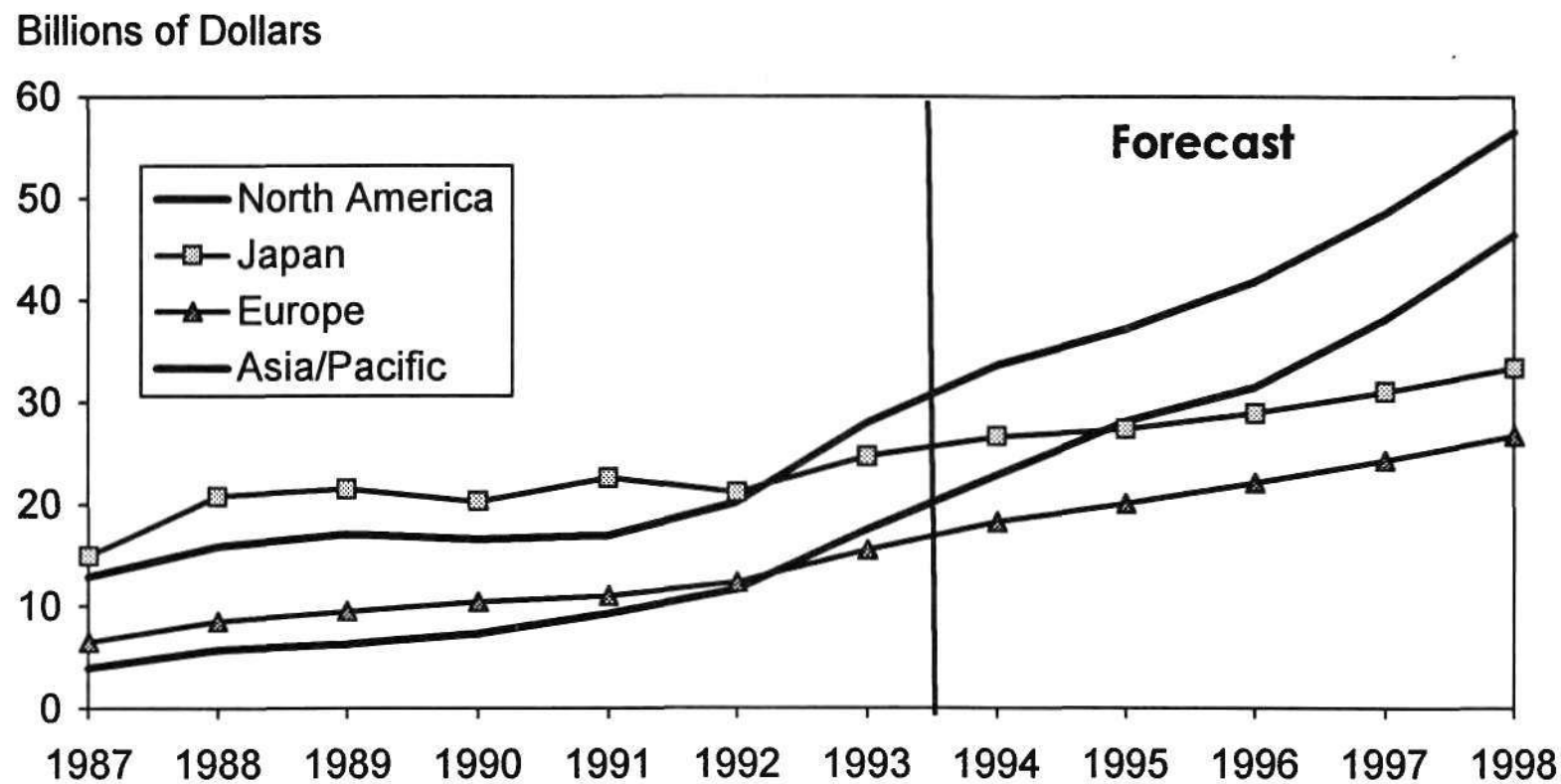
Source: PRC, Dataquest

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- Semiconductor Group Update
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Worldwide Semiconductor History and Forecast by Region

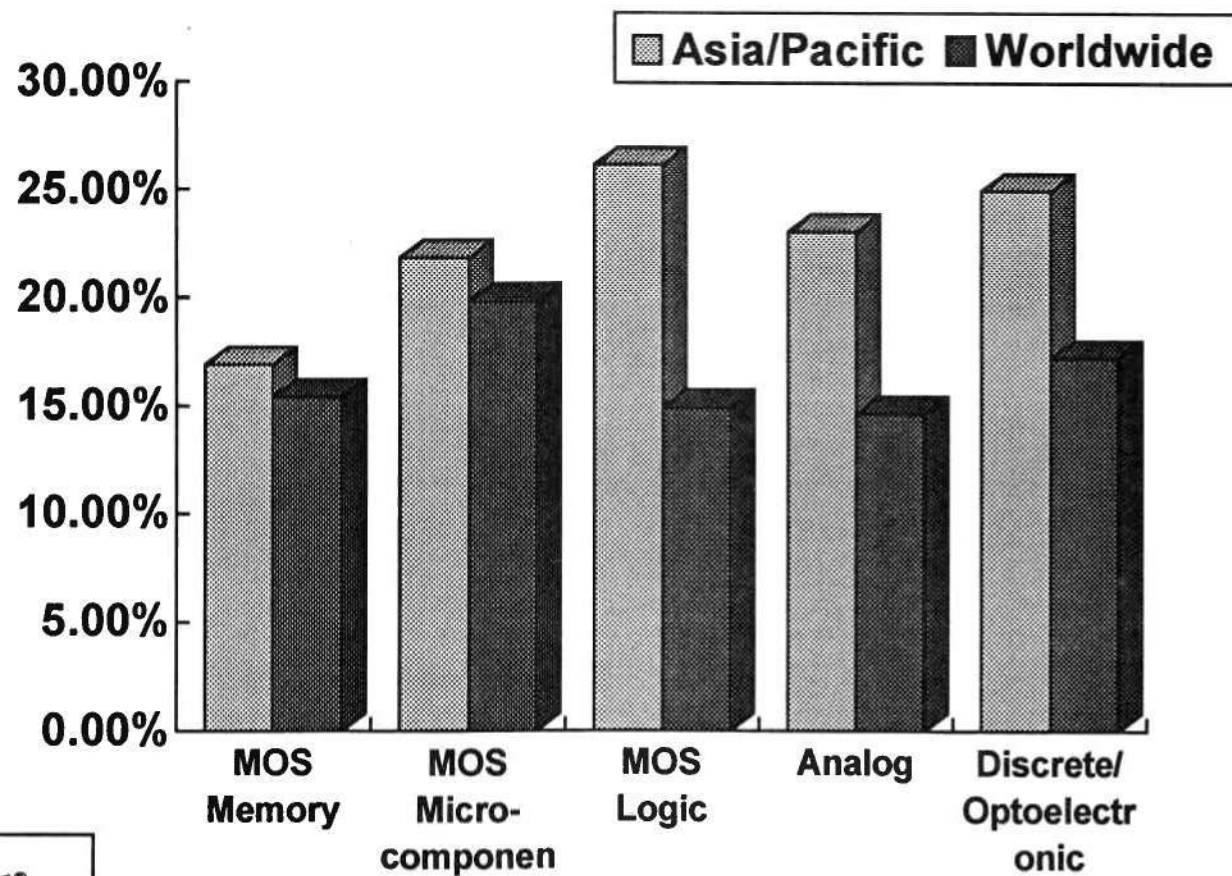


Source: Dataquest

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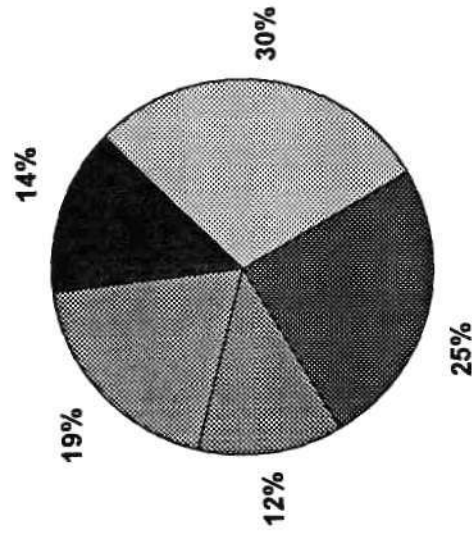
1993 to 1998 Worldwide and Asia/Pacific Market Forecasts by Device Type, CAGR



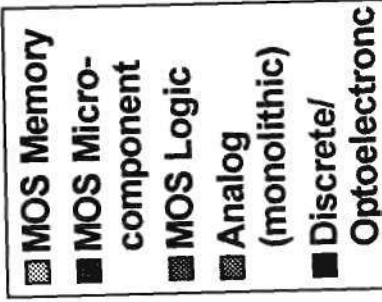
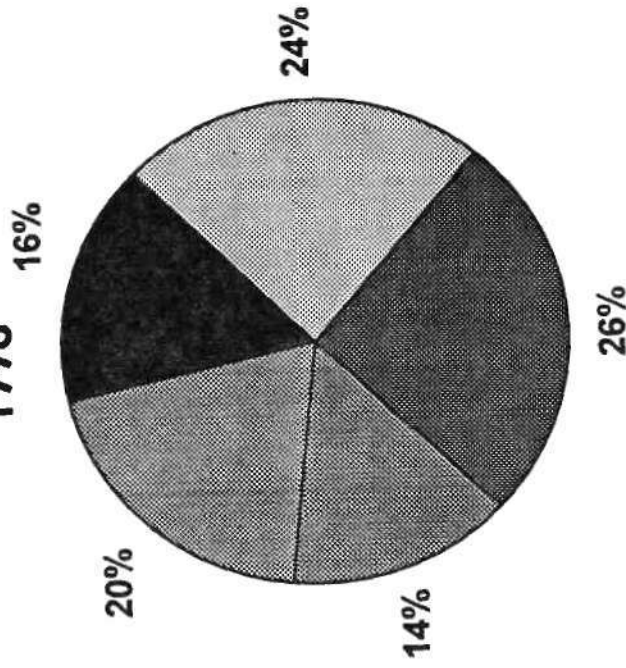
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Asia/Pacific Semiconductor Market Forecast by Device Type, Percent Share

1994



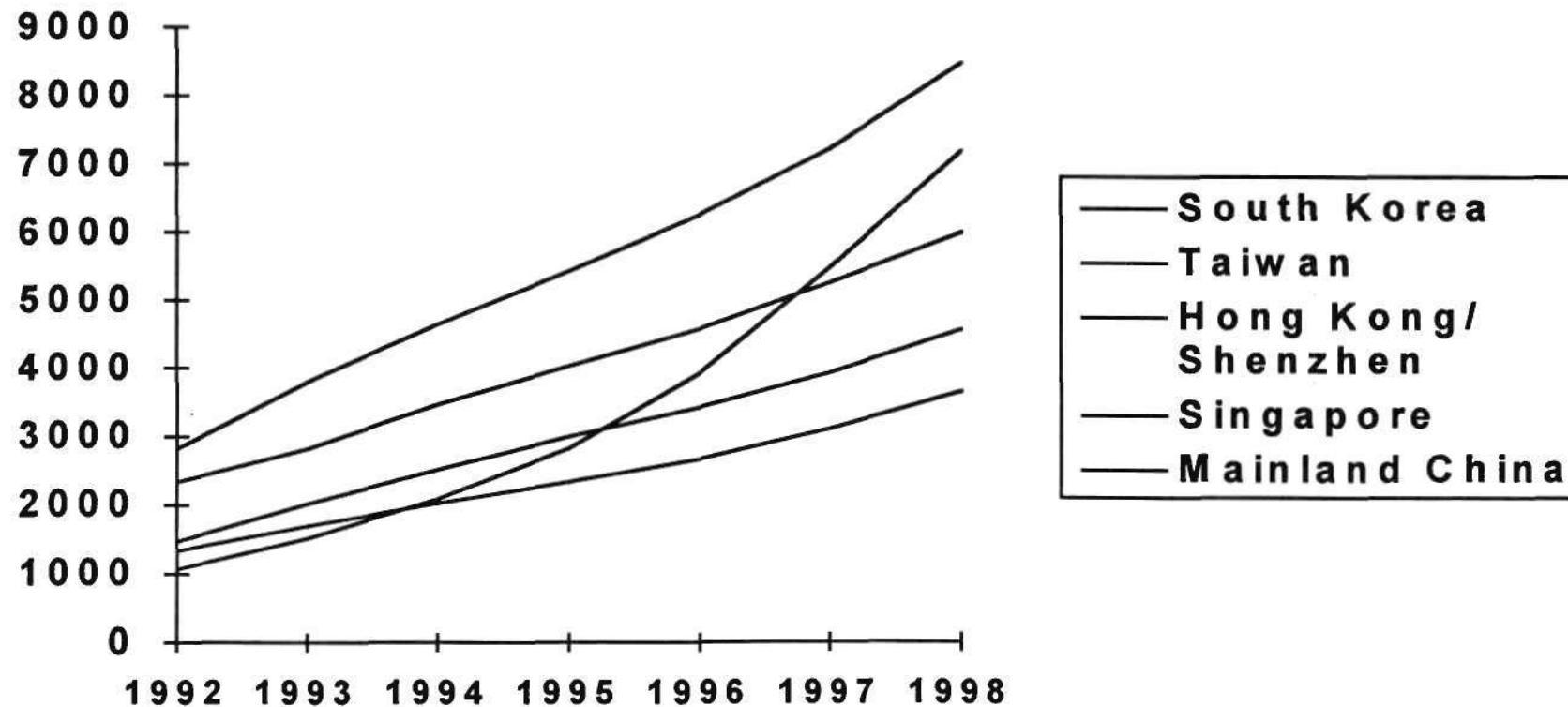
1998



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Asia/Pacific Semiconductor Consumption Forecast by Country

Millions of Dollars



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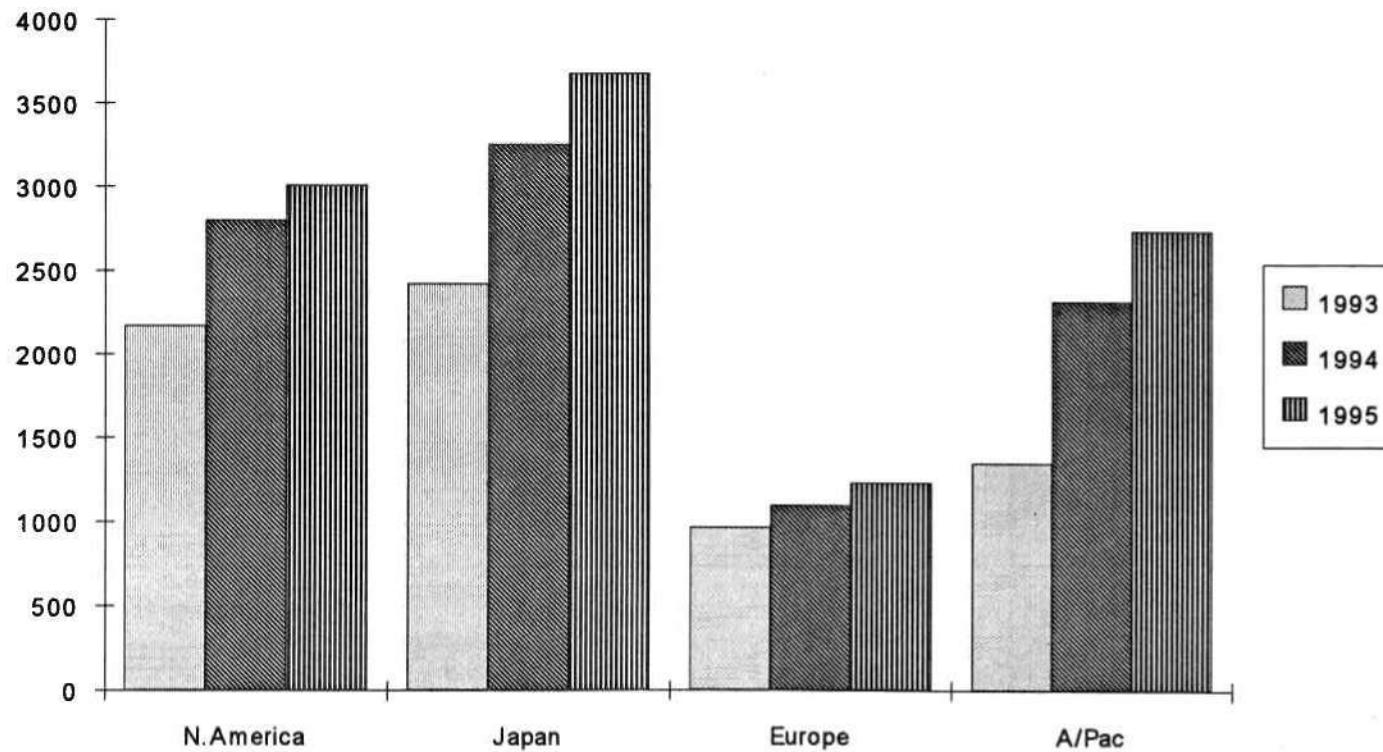
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Semiconductor Manufacturing Capital Spending by Region

U.S.\$Million



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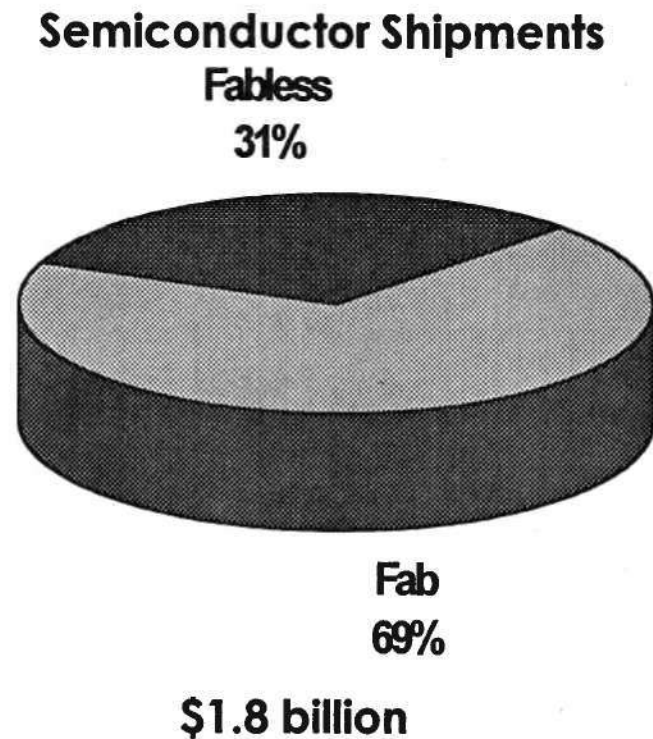
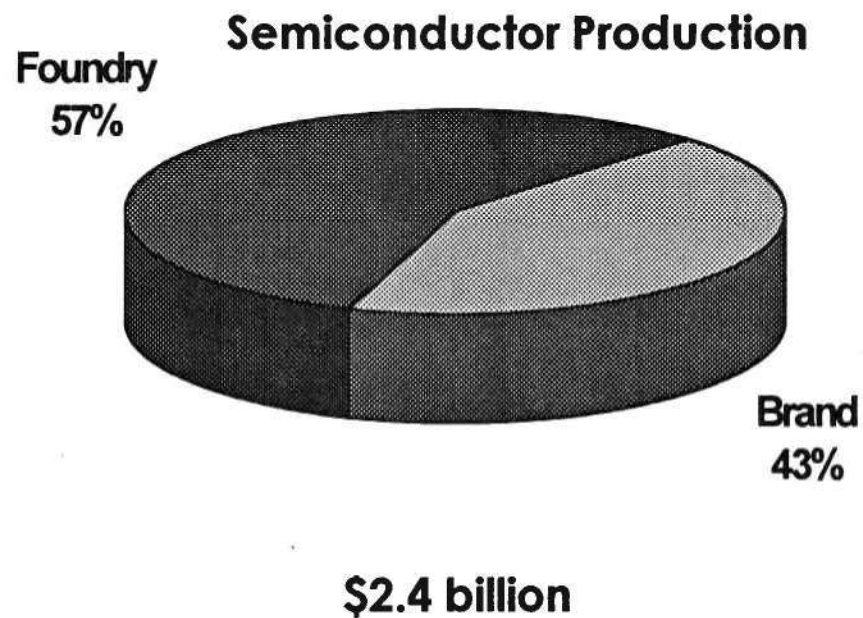
Semiconductor Production Revenue Ranking

	1993	1994*
North America	1	1
Japan	2	2
Korea	3	3
Germany	4	4
United Kingdom	5	5
Taiwan	7	6

* = Forecast

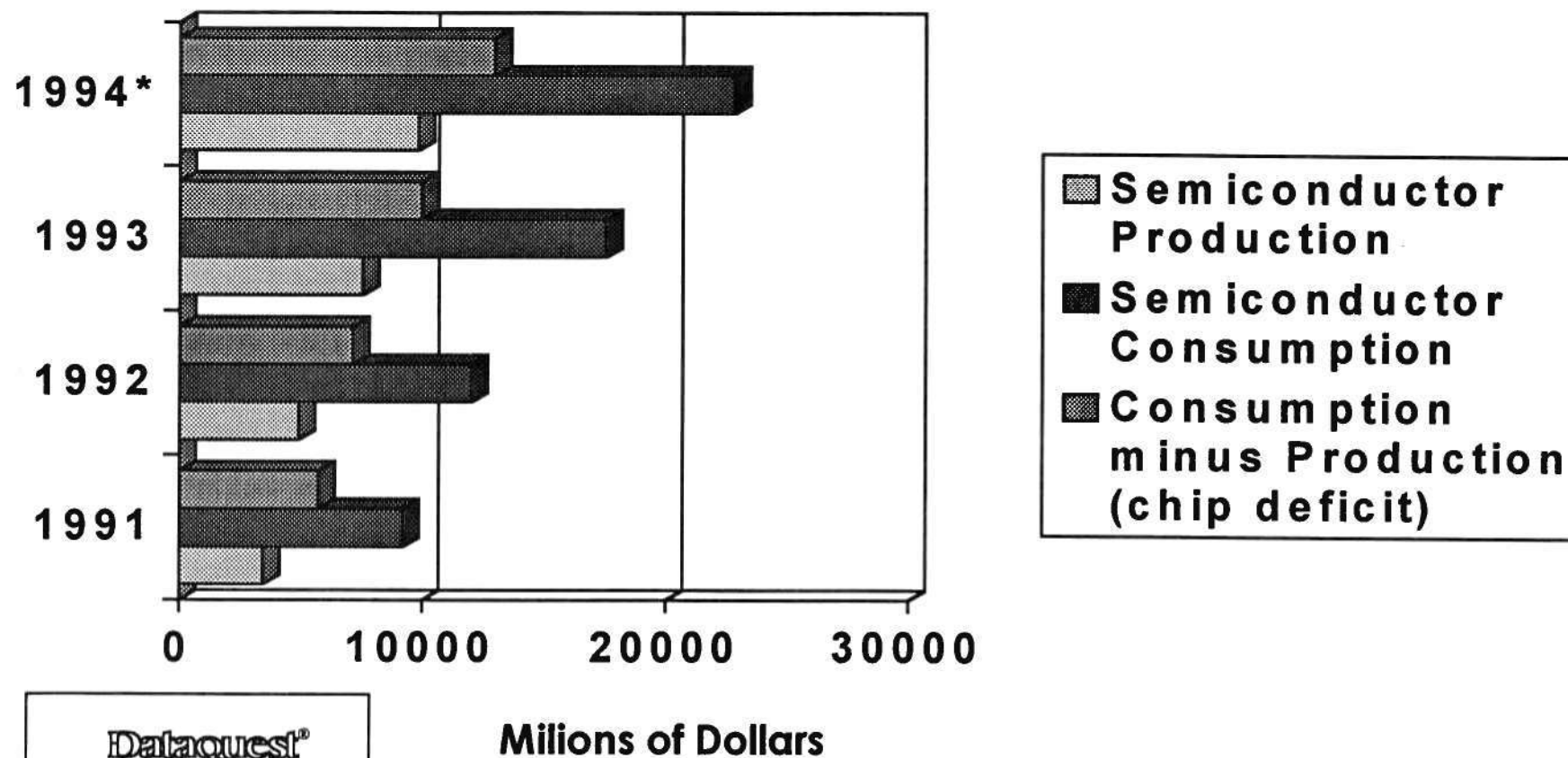
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Taiwan's Semiconductor Production vs. Shipment Revenues, 1994 (forecast)



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Asia/Pacific Semiconductor Production, Consumption, and Deficit



*** = Forecast**

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Conclusions

- Worldwide semiconductor applications are proliferating
- Japanese and U.S. companies target Asia/Pacific, but procurement patterns changing, local companies thrive
- Electronic equipment production accelerates due to investments, emerging economies, high-growth end-markets, and competitive design and manufacturing
- Asia/Pacific to surpass Japan as the second-largest semiconductor market, China and S-E Asia lead growth
- Asia/Pacific semiconductor Chip deficit will soar despite rapid production expansion in Taiwan, Singapore, and South Korea during the next two years

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R.O.C. IC Industry Outlook

Lien Wen-Chieh

ERSO/ITRI

Sept. 22, 1994



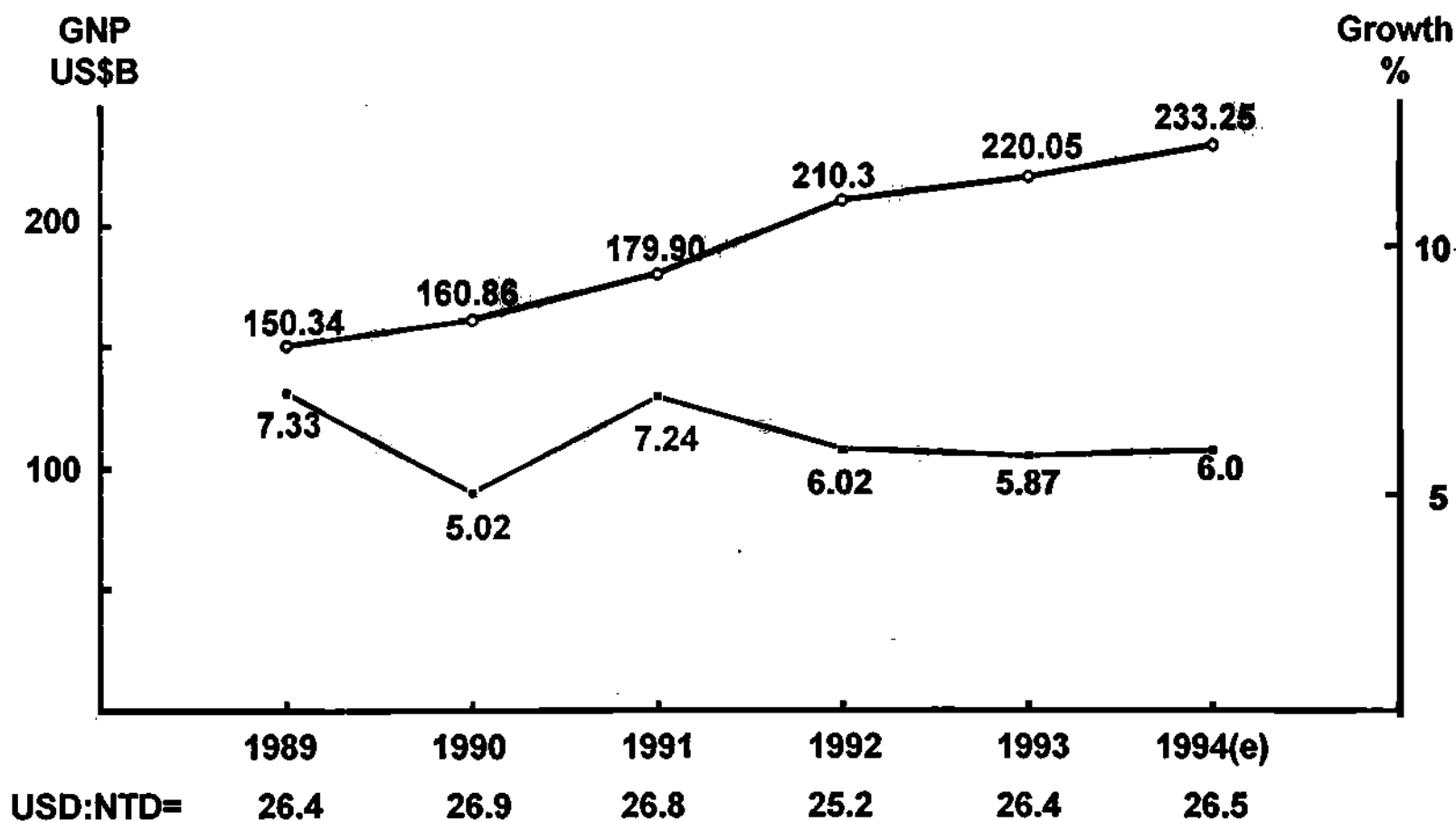
財團法人

工業技術研究院
電子工業研究所

Agenda

- **General Briefing**
- **R.O.C. IC Market & Application**
- **Import vs. Export**
- **R.O.C. IC Industry Update**
- **Conclusion**

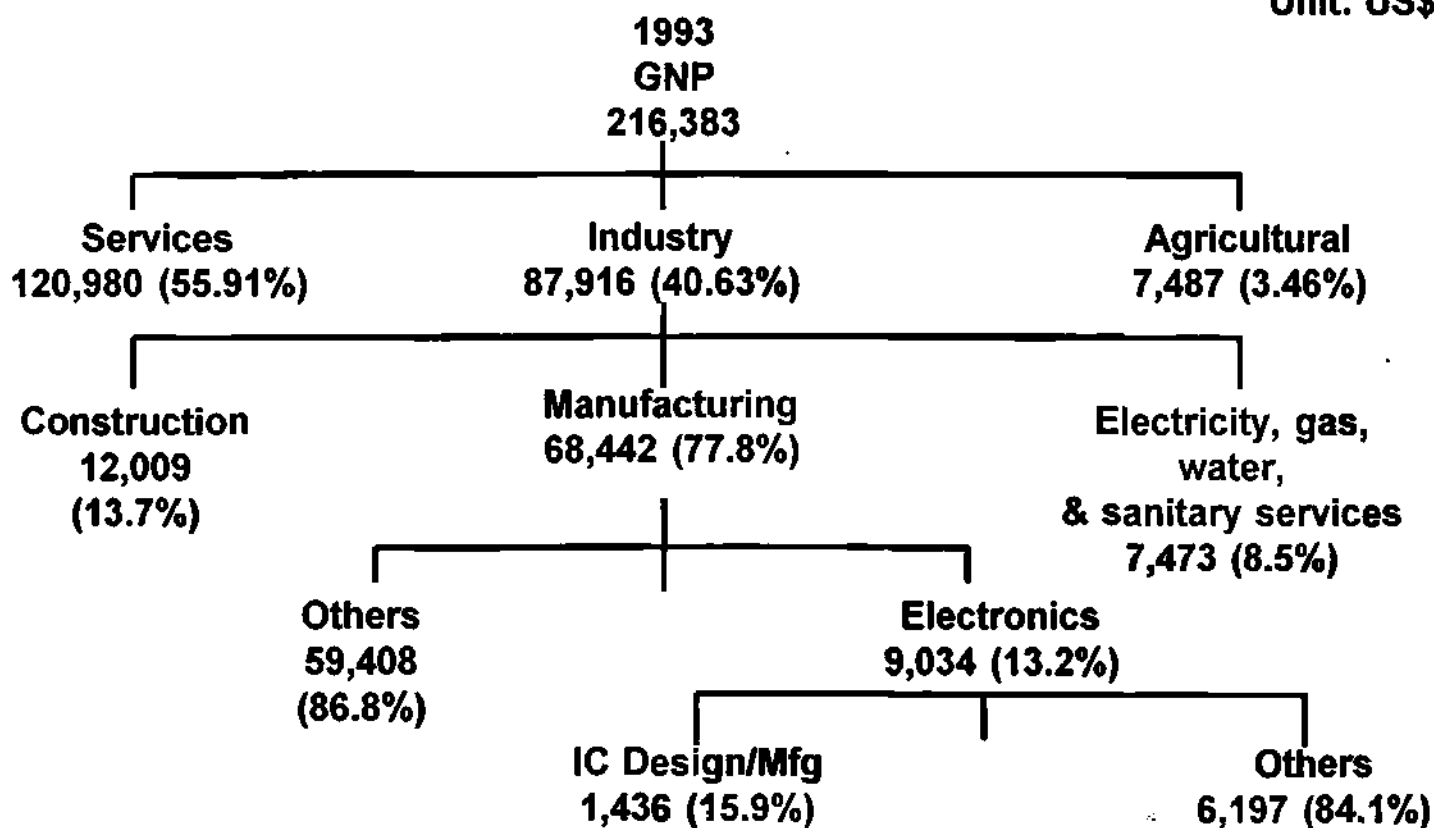
R.O.C. Economy Performance



Source: CEPD, ERSO/ITRI ITIS Project

The Economic Contribution of R.O.C. IC Industry

Unit: US\$M



Source: ERSO/ITRI ITIS Project

The R.O.C. IC Market Compared to Worldwide Consumption

Unit: US\$B

IC Consumption	1989	1990	1991	1992	1993
Worldwide	46	47.4	52.2	57.5	73.5
North America	15.0(33%)	14.7(31%)	15.7(30%)	18.4(32%)	24.8(33.8%)
Japan	17.3(38%)	17.1(36%)	19.3(37%)	17.8(31%)	21.2(28.8%)
Europe	8.0(17%)	9.6(19%)	9.4(18%)	10.9(19%)	13.6(18.5%)
Rest of World	5.7(12%)	6.6(14%)	7.8(15%)	10.2(18%)	13.9(18.9%)
Korea	1.7	1.75	1.78	1.79	1.92
Taiwan	2.1	2.4	2.7	3.2	4.3
Others	1.9	2.45	7.32	5.21	7.68

Source: ICE, Dataquest, ERSO/ITRI ITIS Project



The R.O.C. IC Production Compared to Worldwide Supply

Unit: US\$B

IC Supply	1989	1990	1991	1992	1993
Worldwide	46.0	47.4	52.2	57.5	73.5
North America	16.5(37%)	17.6(37%)	18.8(36%)	22.8(39.7%)	27.1(36.9%)
Japan	23.2(50%)	22.8(48%)	25.6(49%)	25.7(44.7%)	34.8(47.3%)
Europe	4.0(8%)	4.3(9%)	4.7(9%)	3.97(6.9%)	5.66(7.7%)
Rest of World	2.3(5%)	2.7(6%)	3.13(6%)	5.0(8.7%)	6.0(8.2%)
Korea	1.74	1.80	1.98	3.46	4.77
Taiwan	0.38	0.45	0.76	0.94	1.44
Otherssss	0.18	0.45	0.39	0.6	0.18

Source: ICE, Dataquest, ERSO/ITRI ITIS Project

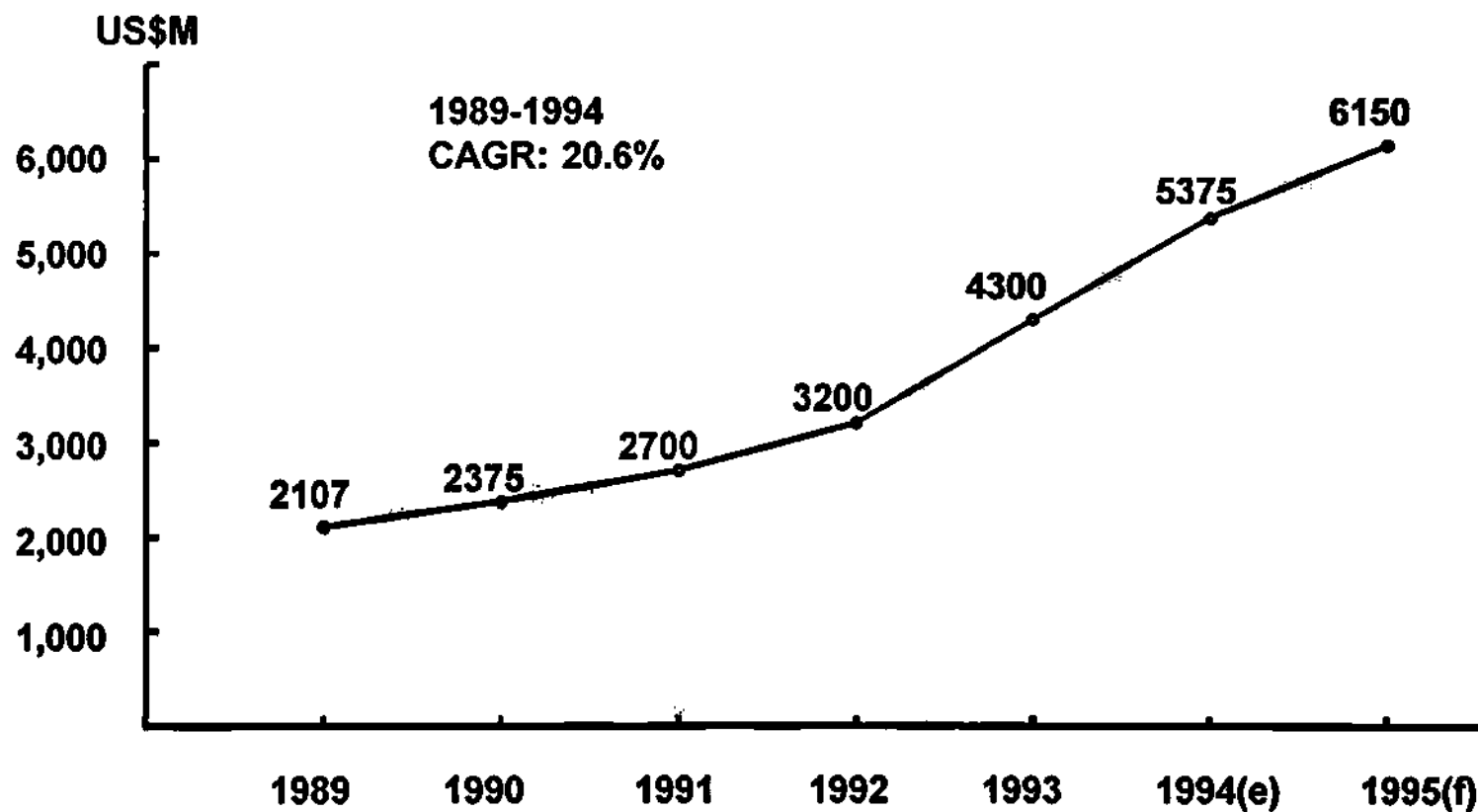
The R.O.C. IC Market & Applications

- **Market Characteristics**
- **Market Structure**
- **IC Application Analysis**

The R.O.C. IC Market Characteristics

- **Most growth is due to the prosperity of computer industry**
- **New niche market is emerging**
- **Still the most active areas for worldwide IC vendors**

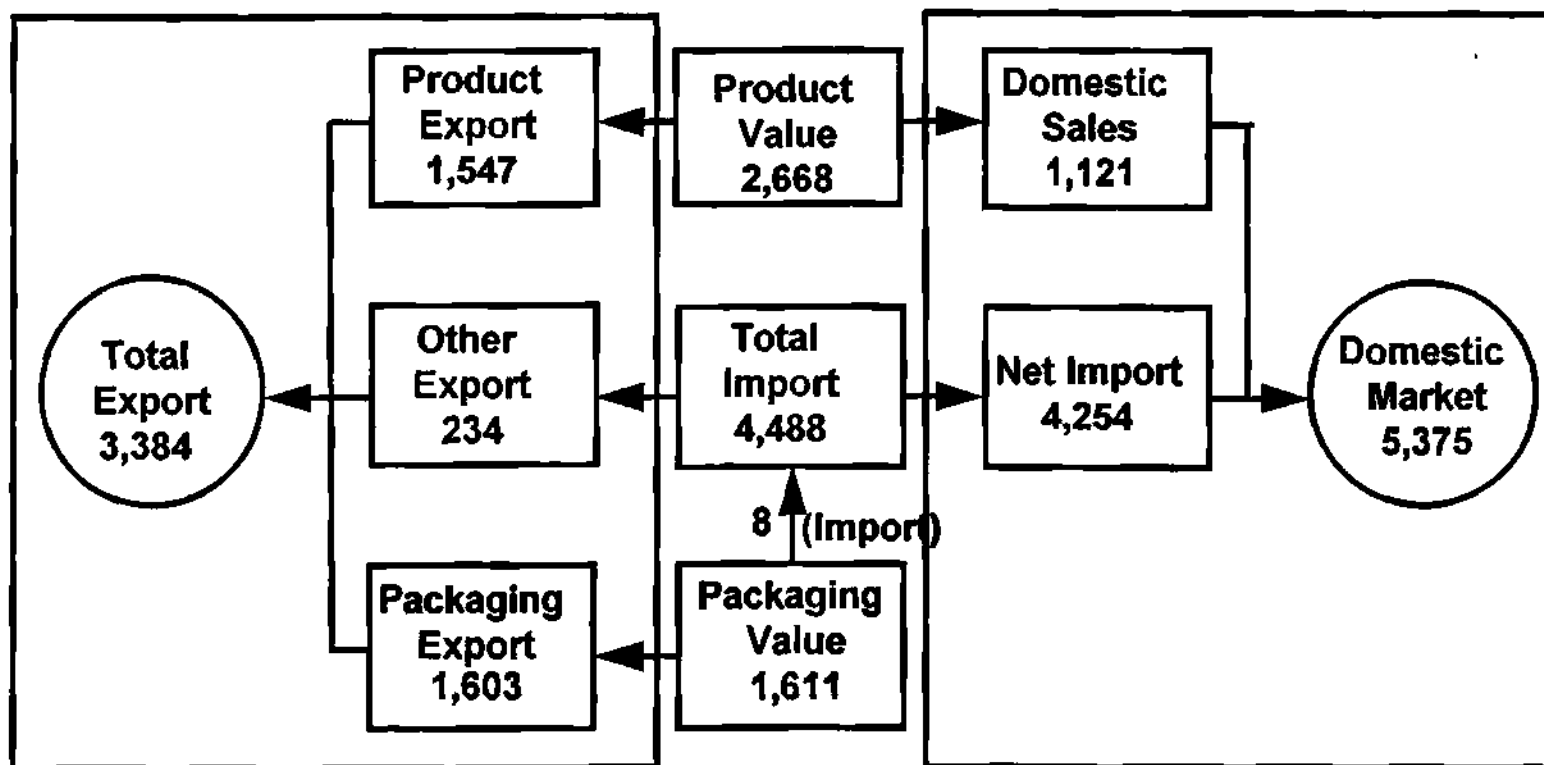
The Booming R.O.C. IC Market



Source: ERSO/ITRI ITIS Project

R.O.C. IC Market Structure

Unit: US\$M

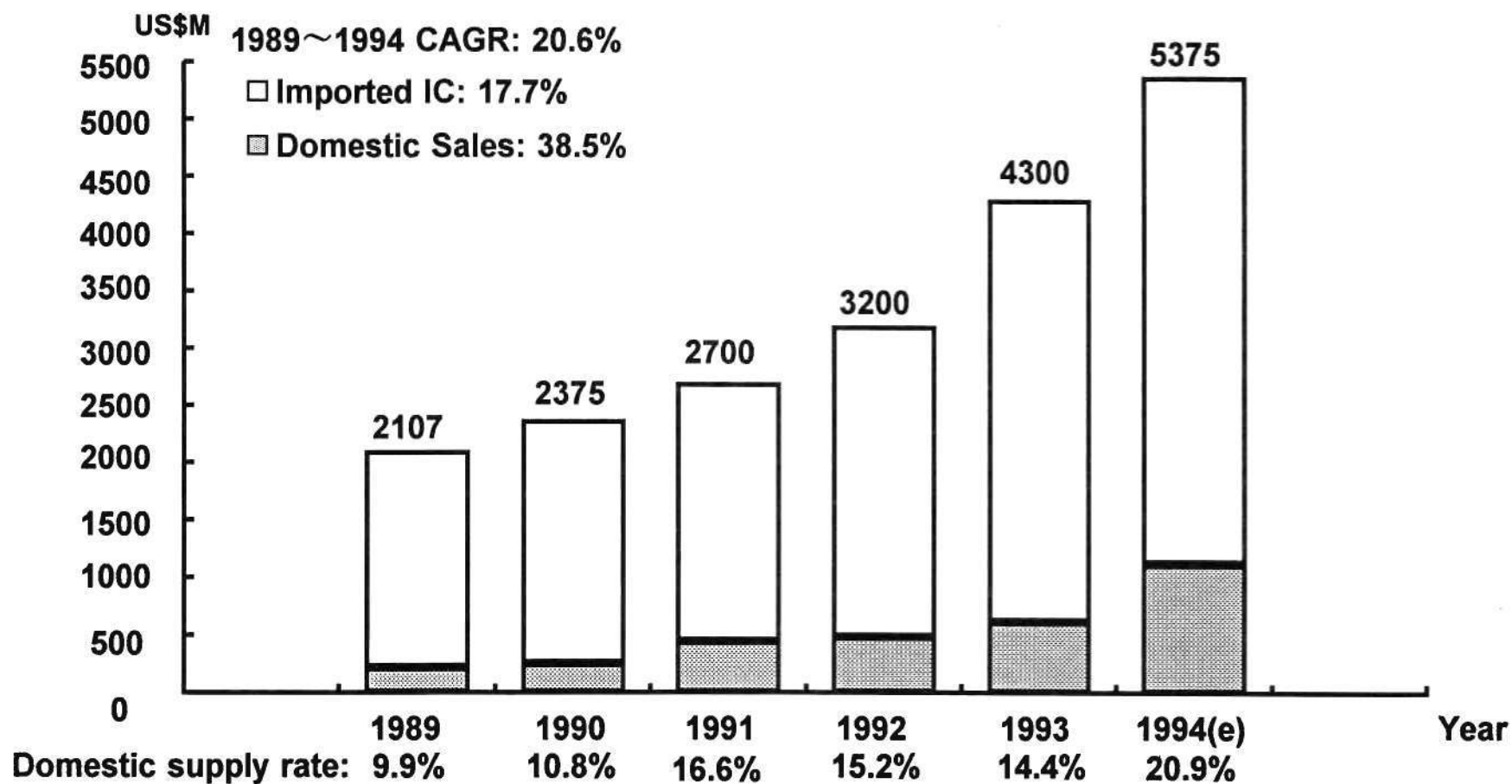


USD : NTD = 1 : 26.5

Source: ERSO/ITRI ITIS Project

1994(e)

The Domestic Supply of the IC Market

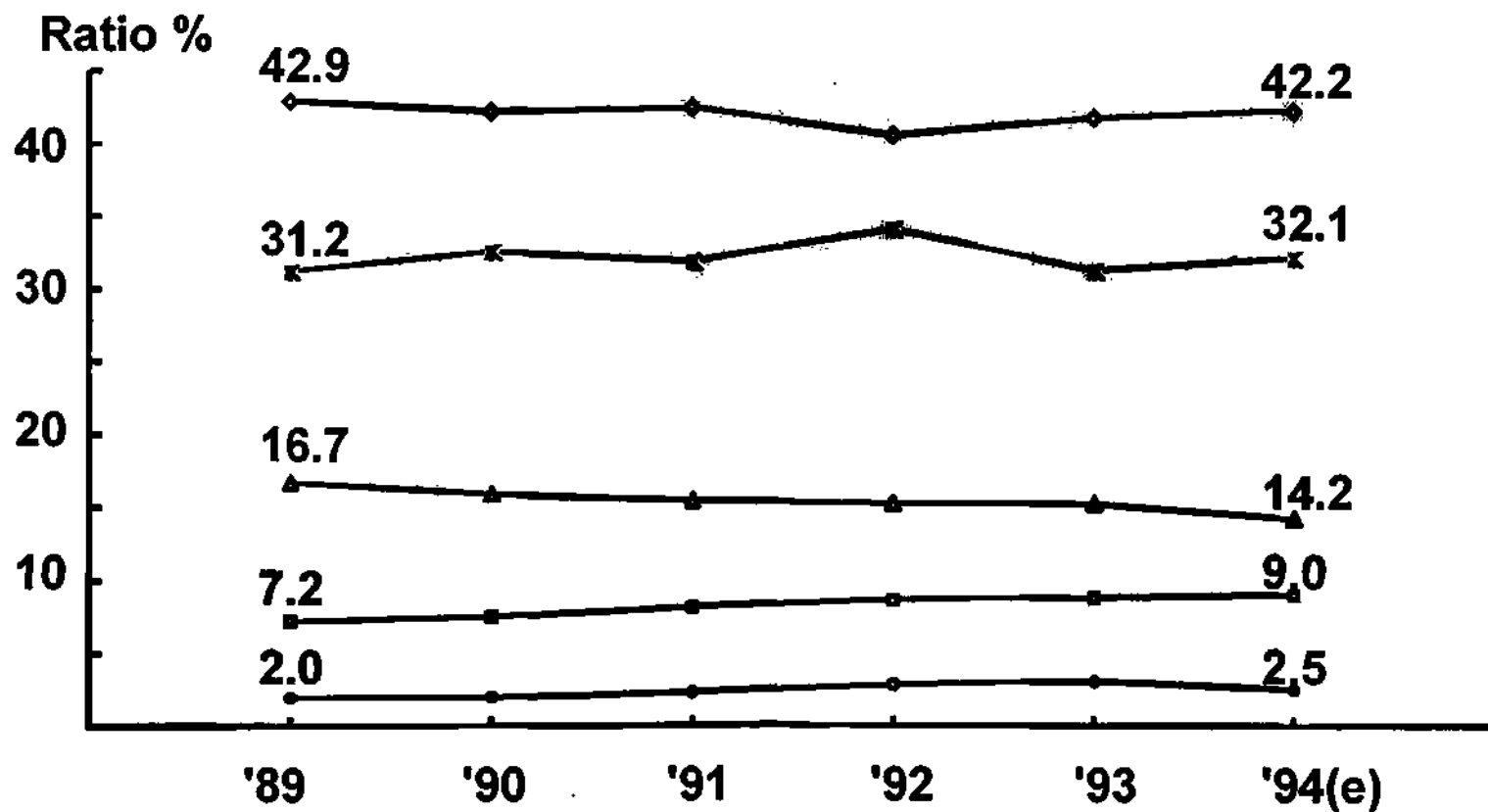


Source: ERSO/ITRI ITIS Project

The IC Application in R.O.C. Market

'89-'94 CAGR:

◇ Computer: 20.0% * Memory: 21.3% △ Consumer: 16.8%
 □ Communication: 26.1% ○ Others: 26.1%

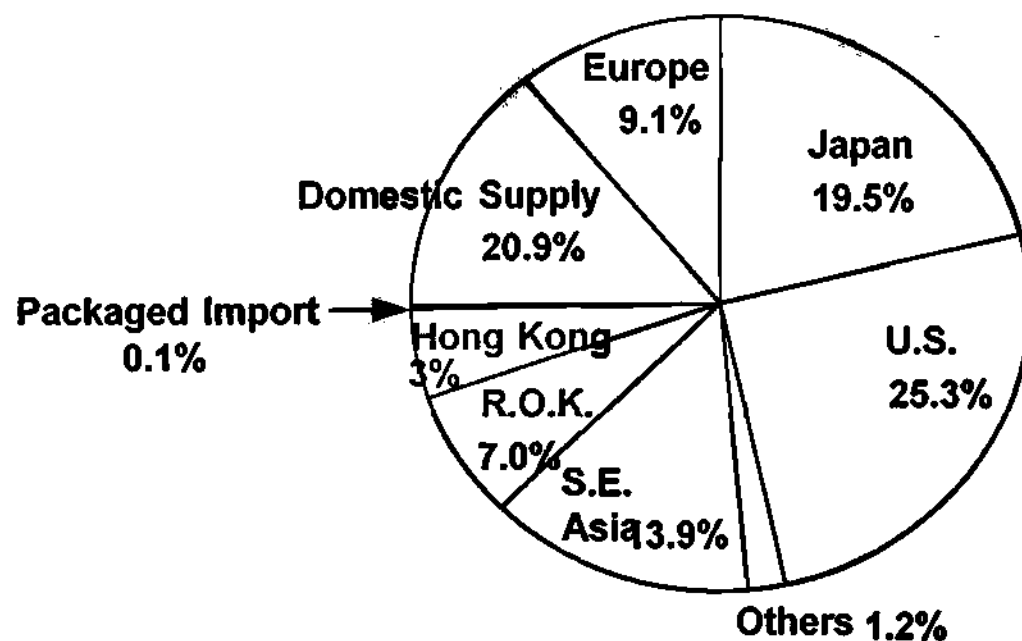


Source: ERSO/ITRI ITIS Project

Import VS. Export

- IC Supply Sources
- Import Analysis
- Export Analysis

Where Did the IC Come from (1994/1H)?



Source: ERSO/ITRI ITIS Project

The Areas R.O.C. Imported IC

Area \ Year	1989	1990	1991	1992	1993	1994(e)
Japan	39.6%	30.2%	26.4%	22.9%	24.8%	24.7%
U.S.A.	30.0%	34.6%	35.0%	33.5%	30.0%	32.0%
S.E.Area	10.4%	15.5%	18.9%	17.9%	16.0%	17.6%
R.O.K.	8.2%	6.6%	8.2%	8.0%	8.5%	8.9%
Hong Kong	5.6%	6.4%	5.6%	5.2%	6.0%	3.8%
Europe	2.8%	3.6%	3.1%	8.4%	12.4%	11.5%
Others	3.4%	3.1%	2.9%	2.3%	2.3%	1.5%
Total (US\$ M)	1853	2098	2305	2851	3856	4488

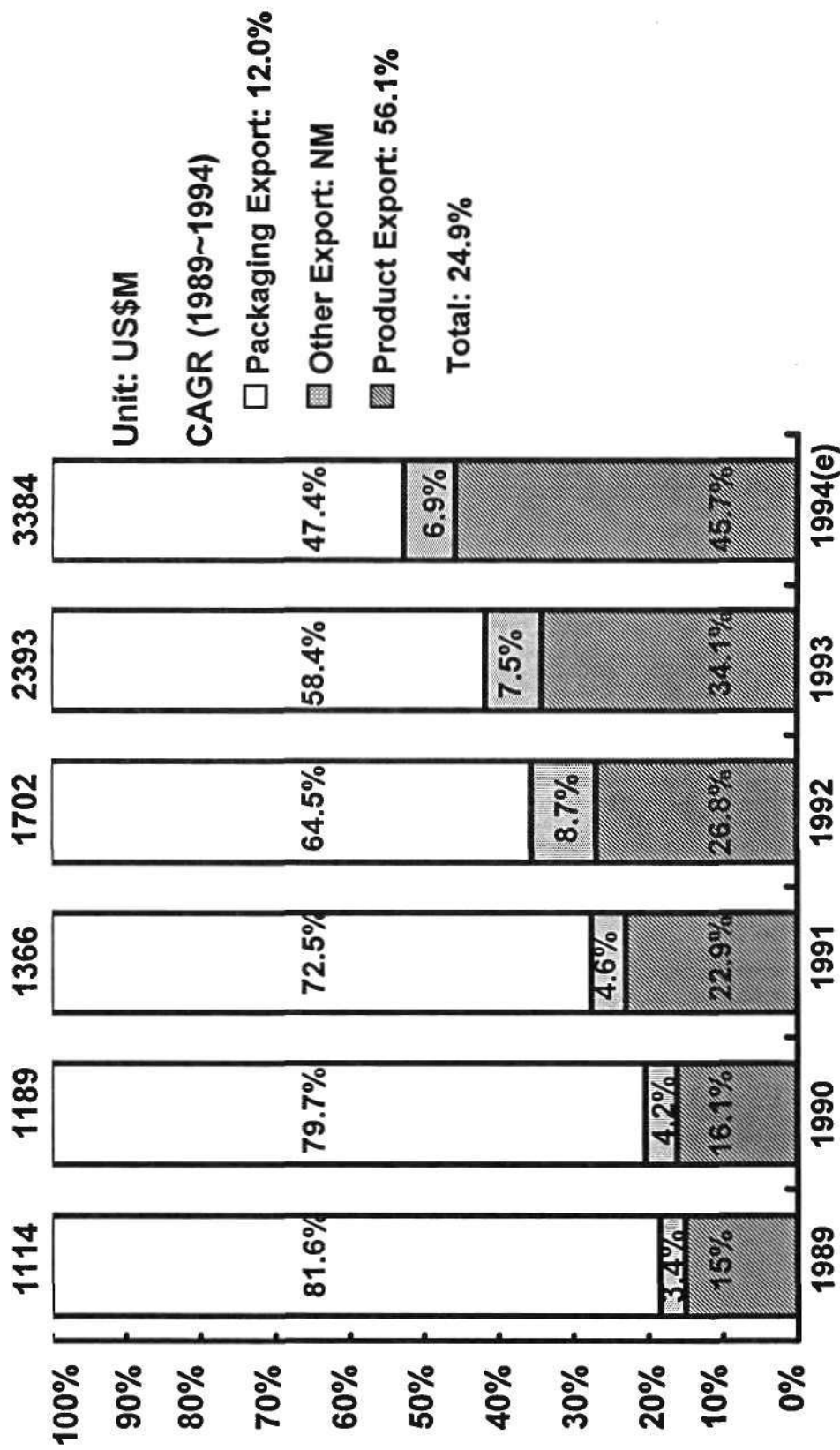
Source: ERSO/ITRI ITIS Project

The Top Ten IC Importers (1994/1H)

Rank	1994/1H	1993	1992	1991
1	Philips	Philips	Philips	Acer Computer
2	Acer Computer	Acer Computer	Toshiba	Toshiba
3	TI	Toshiba	Tatung	Tatung
4	Motorola	Motorola	FIC	Elite group
5	Toshiba	TI	Digital	Philips
6	Digital	NEC	NEC	Mitac
7	GVC	Mosel Vitelic	Efa	DTK
8	NEC	OSE	Dataexpert	NEC
9	Mosel Vitelic	GVC	Elite group	FIC
10	FIC	Tatung	Melco	Copam

Source: Customs, ERSO/ITRI ITIS Project

The IC Export Mix



Source: ERSO/ITRI ITIS Project

The Areas R.O.C. IC Exported

Area \ Year	1989	1990	1991	1992	1993	1994(e)
Japan	8.5%	11.6%	9.8%	7.2%	6.6%	5.8%
U.S.A.	34.0%	31.8%	24.9%	28.2%	34.9%	34.1%
S.E. Asia	9.1%	8.7%	4.7%	10.3%	12.6%	18.0%
R.O.K.	0.2%	8.7%	8.2%	3.5%	4.4%	4.2%
Hong Kong	13.7%	12.1%	15.9%	23.3%	21.3%	19.9%
Europe	20.8%	18.0%	15.8%	12.5%	17.1%	6.3%
Holland	12.7%	12.6%	19.6%	13.8%	12.0%	8.9%
Others	1.0%	1.1%	1.1%	1.1%	1.2%	2.8%
Total(US\$ M)	1114	1189	1366	1702	2393	3384

Source: ERSO/ITRI ITIS Project

The Top Ten IC Exporters (1994/1H)

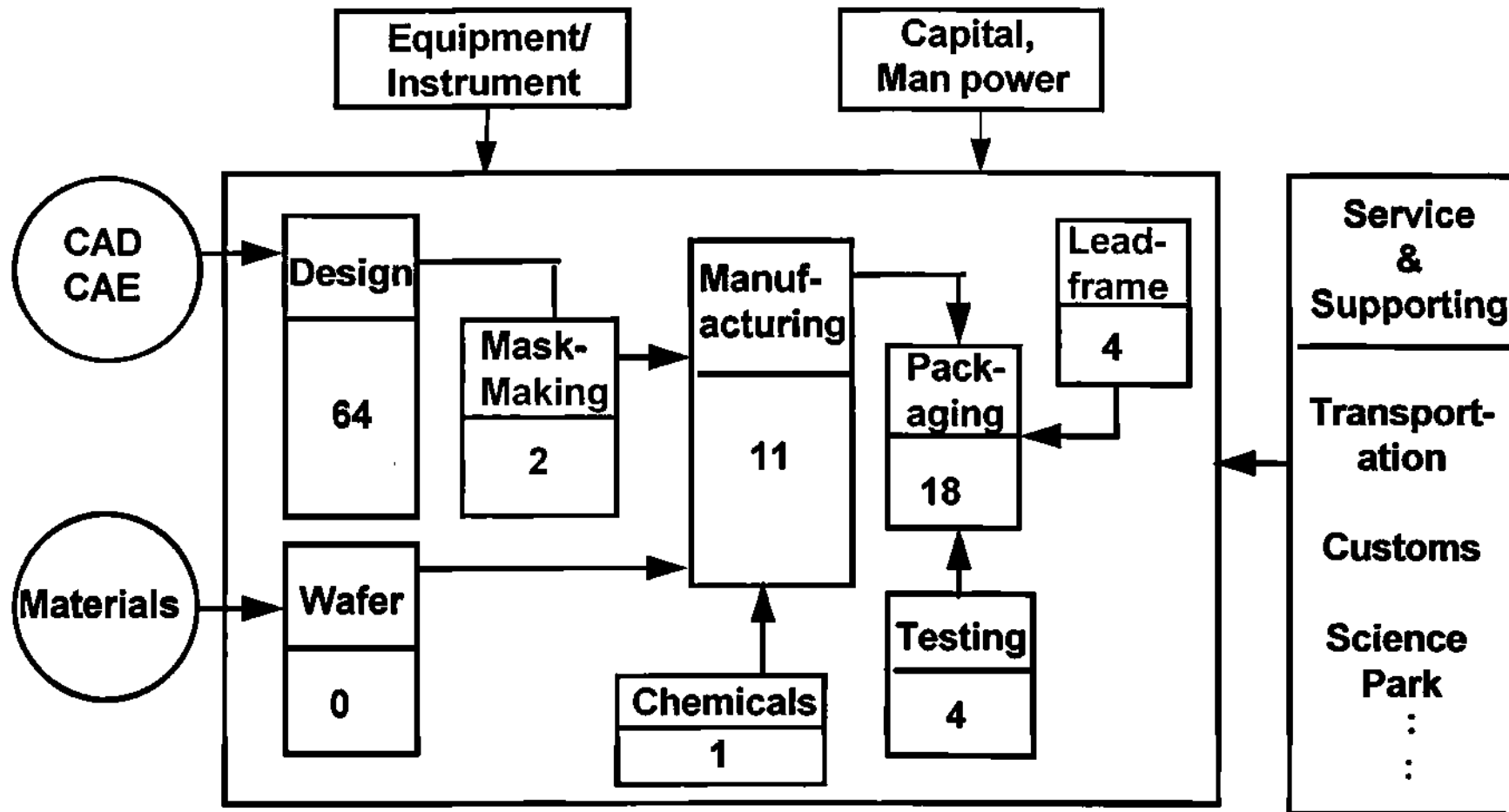
Rank	1994/1H	1993	1992	1991
1	Philips	Philips	Philips	Philips
2	TI	TI	TI	TI
3	TSMC	TSMC	Motorola	UMC
4	Motorola	Motorola	Microchip	Vitellic
5	Mosel Vitelic	Mosel Vitelic	UMC	Motorola
6	TI-Acer	UMC	TSMC	Microchip
7	UMC	Microchip	ASE	ASE
8	Winbond	Winbond	Mosel Vitelic	OSE
9	Microchip	ASE	Acer Computer	Sanyo
10	ASE	Acer Computer	OSE	Winbond

Source: ERSO/ITRI ITIS Project

R.O.C. IC Industry Update

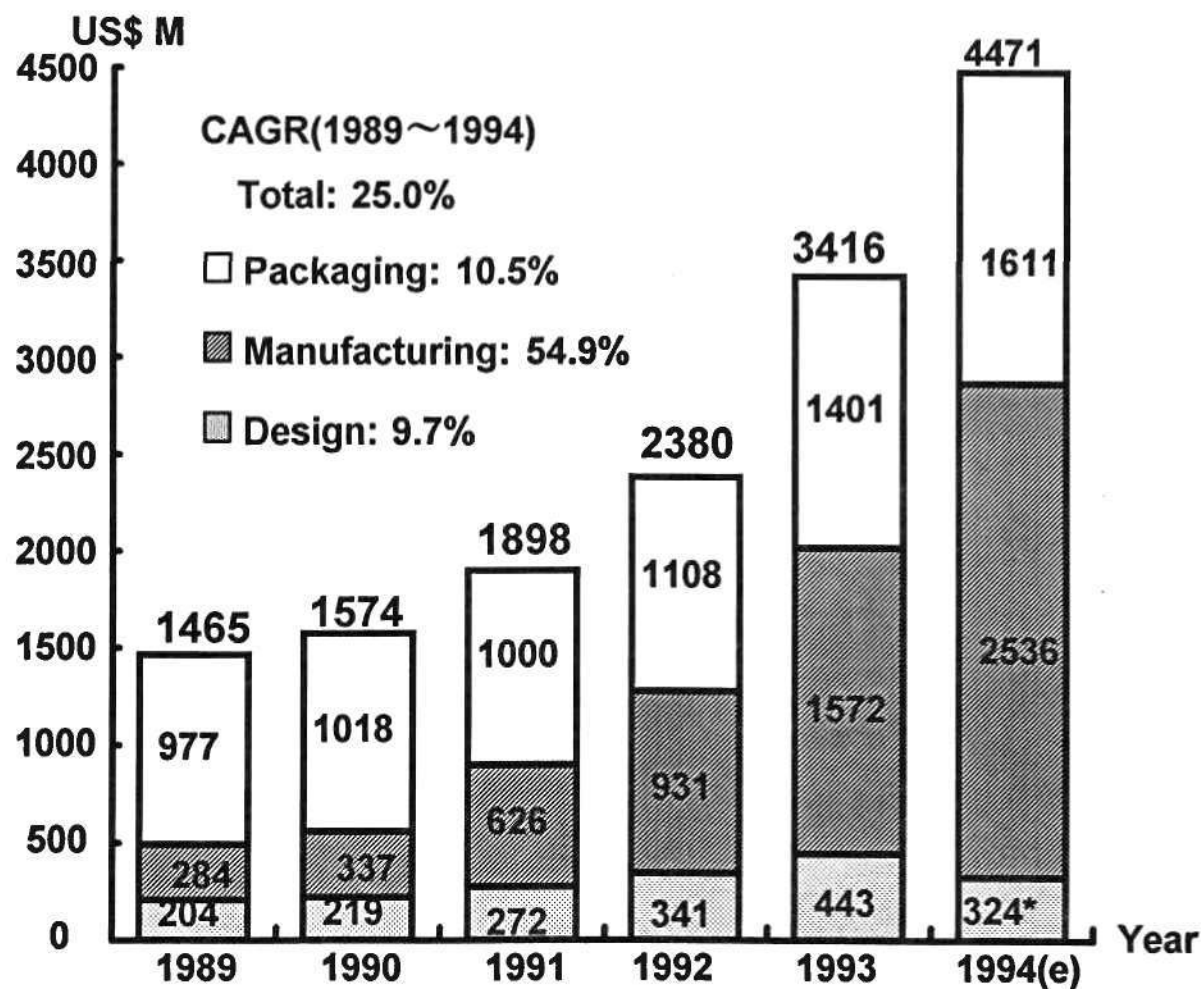
- **Structure & Production**
- **IC Design Industry**
- **IC Manufacturing Industry**
- **IC Packaging Industry**
- **IC Peripheral & Supporting Industry**

The IC Industry Structure



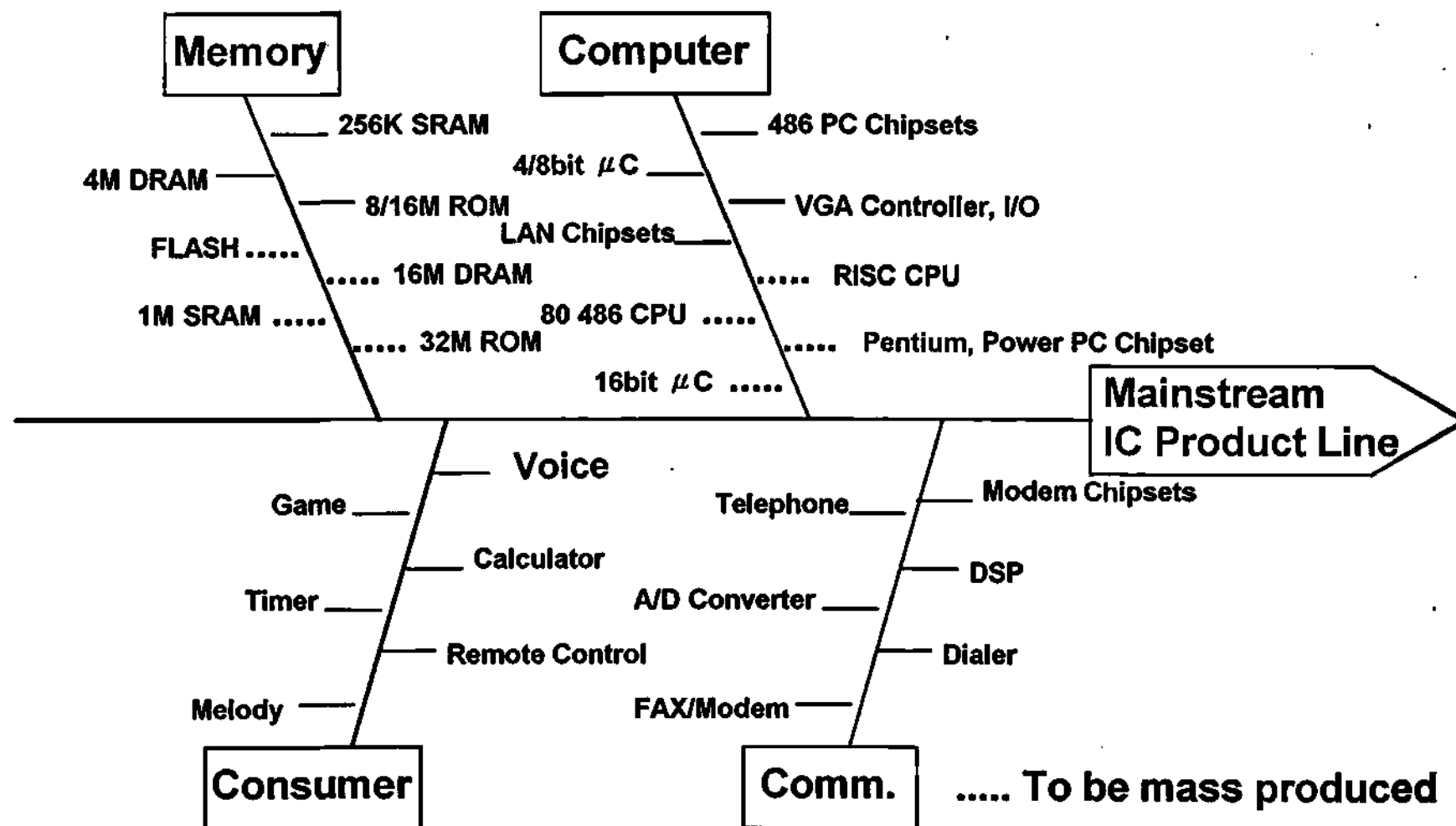
Source: ERSO/ITRI ITIS Project

The Revenue of IC Industries



Source: ERSO/ITRI ITIS Project * Not including Mosel/Vitellic

The Mainstream Product of R.O.C. IC Industry



Source: ERSO/ITRI ITIS Project

The R.O.C. IC Design Industry

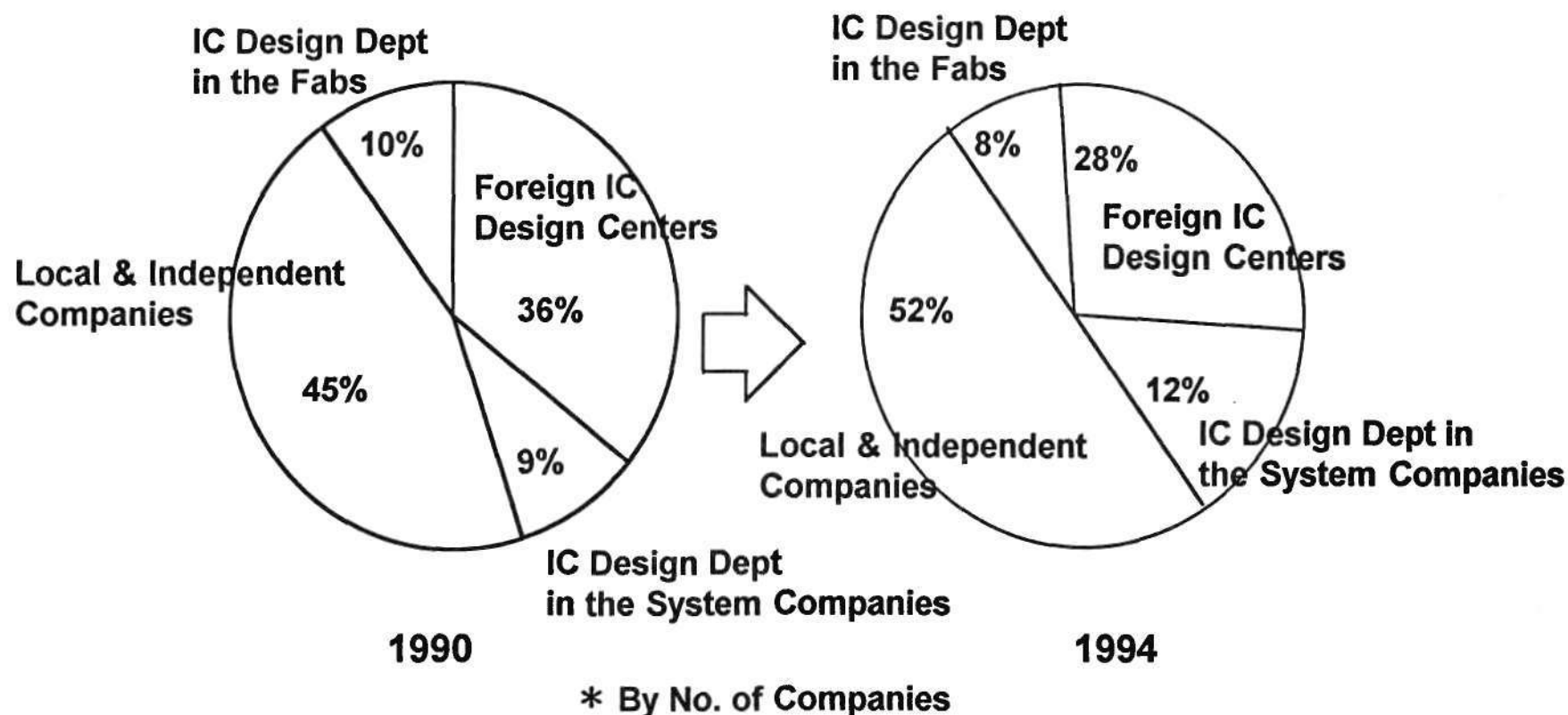
- **Mosel Vitelic join the IC manufacturing industry**
- **Taiwanese IC design houses becomes the major PC chipset supplier worldwide**
- **Leading foreign companies (Motorola, TI, NS, Sharp....) decide to establish operation/R&D centers in Taiwan**

The Key Indicators of IC Design Industry

Item \ Year		1989	1990	1991	1992	1993	1994(e)
No. of Companies		55	56	57	59	64	64
Revenue(US\$M)		204	219	272	341	443	324
Growth(%)		166	6.8	24	25.4	30	-26.9
Design Capability	K Gates	20	30	30	30	60	60

Source: ERSO/ITRI ITIS Project

The Classification of IC Design Companies



Source: ERSO/ITRI ITIS Project

The Top 10 IC Design Companies

Rank	1989	1990	1991	1992	1993
1	Vitellic ②	Vitellic ②	Mosel Vitelic	Mosel Vitelic	Mosel Vitelic①
2	SiS	SiS	SiS	SiS	SiS
3	Syntek	Syntek	Acer Lab	Acer Lab	Acer Lab
4	Holtek ①	Holtek ①	Syntek	Syntek	Realtek
5	Tamarack	Acer Lab	Realtek	Realtek	Syntek
6	Acer Lab	Realtek	Tontek	Tontek	Sunplus
7	UTIC ③	Mosel	Tidalwave②	Sunplus	Weltrend
8	Realtek	Macronix①	Weltrend	Weltrend	Myson
9	Proton③	Tontek	Chip Design	Chip Design	Mos Design
10	Mosel	Tamarack	Ginjet	Ginjet	Chip Design
Total Revenue (US\$M)	183.7	206.3	247.8	317.9	422.7

Source: ERSO/ITRI ITIS Project

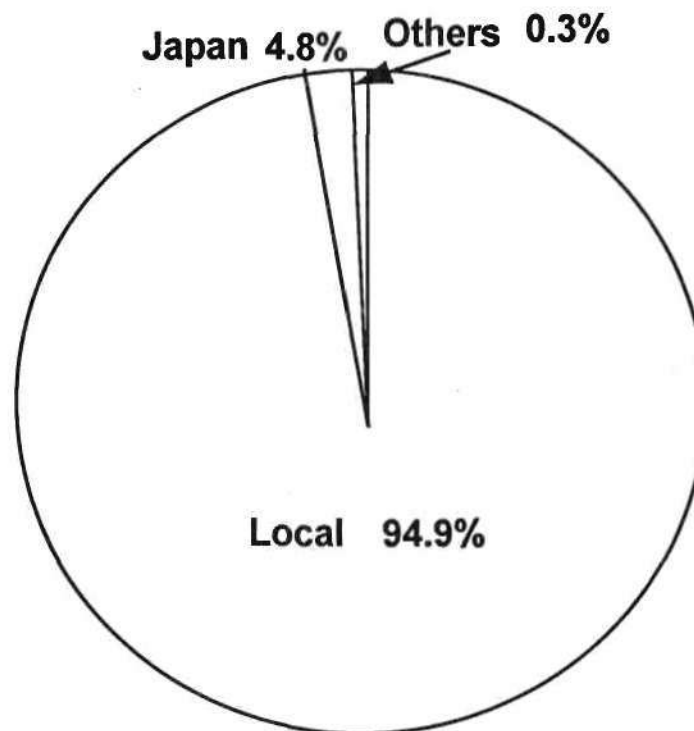
① Became IC manufacturing company ② Merged by other company ③ Closed

The Product Mix of R.O.C. IC Design Industry

Category \ Year	1990	1991	1992	1993	1994(e)
Computer	19%	25.30%	25.00%	30.70%	58.50%
Communication	—	0.10%	1.00%	3.40%	3.50%
Consumer	24%	28.30%	19.80%	17.00%	28.50%
Memories	56%	45.40%	53.30%	48.10%	8.50%
Others	1.00%	0.90%	0.90%	0.80%	1.00%

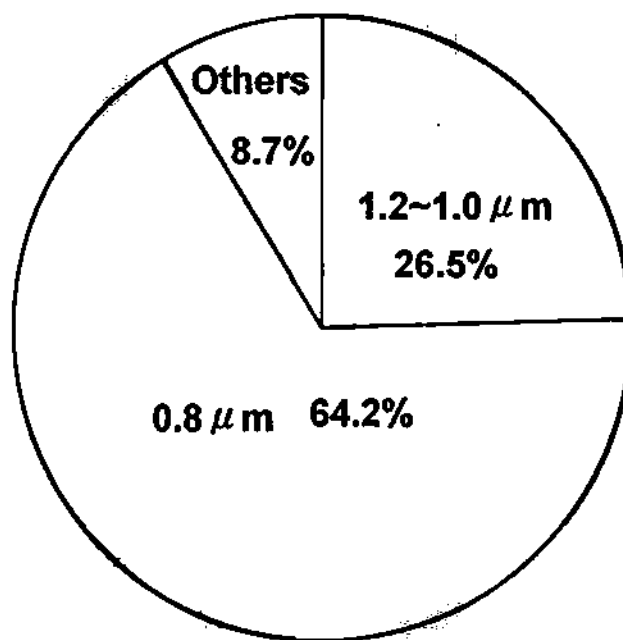
Source: ERSO/ITRI ITIS Project

The Foundry Service to R.O.C. IC Design Industry (1994/1H)



Source: ERSO/ITRI ITIS Project

The Process Requirement for Foundry Service (1994/1H)



Source: ERSO/ITRI ITIS Project

The R.O.C. IC Manufacturing Industry

- **Starting to build up 8-inch wafer production line**
- **Nanya determine to set up a DRAM fab**
- **R.O.C. brand cpu's show up in the market**
- **Foreign companies study the feasibility to invest in new fabs here**

The Key Indicators of R.O.C. IC Manufacturing Industry

Item \ Year	1989	1990	1991	1992	1993	1994(e)
No. of Companies	6	8	10	10	10	11
Revenue(US\$M)	284	337	626	931	1572	2535.6
Growth Rate(%)	87	17.4	85.4	48.7	68.8	61.3
Domestic : Export	45:55	59:41	64:36	54:46	47:53	42:58

Source: ERSO/ITRI ITIS Project

The Rank of R.O.C. IC Manufacturing Companies

Rank	1989	1990	1991	1992	1993
1	UMC	UMC	UMC	TSMC	TSMC
2	TSMC	TSMC	TSMC	UMC	UMC
3	Winbond	Winbond	Winbond	Winbond	TI-Acer
4	HMC	HMC	HMC	HMC	Winbond
5	ADT	ADT	Macronix & Holtek	TI-Acer & Macronix	Macronix
6	AMPi	AMPi			HMC
7	—	—	Episil	Holtek	Holtek
8	—	—	ADT	Episil	Episil
9	—	—	AMPi	ADT	ADT
10	—	—	—	AMPi	AMPi
Total Revenue (US\$M)	284	340	625	931	1572

Source: ERSO/ITRI ITIS Project

The Revenue of IC Manufacturing Companies

Company	94 Revenue(e)	93-94 Growth	93 Revenue	92-93 Growth	92 Revenue
TSMC	704.5	51.20%	465.9	77.90%	261.9
UMC	530.3	37.00%	378.8	49.10%	254
Winbond	303	63.30%	185.6	56.00%	119
Mosel Vitelic*	287.9	33.30%	215.9*	32.70%	162.7*
TI-Acer	284.1	22.90%	231.1	242.40%	67.5
Macronix	227.3	57.90%	143.9	113.20%	67.5
HMC	102.3	18.90%	86	-5.80%	91.3
Holtek	68.2	20.00%	56.8	19.40%	47.6
Episil	17	15.20%	14.8	24.40%	11.9
ADT	7	32.10%	5.3	-15.80%	6.3
AMPi	4	5.30%	3.8	-5.00%	4
Total	2535.6	61.30%	1572*	68.80%	931*

* Mosel/Vitelic's Fab is Setup in 1994
Source: ERSO/ITRI ITIS Project

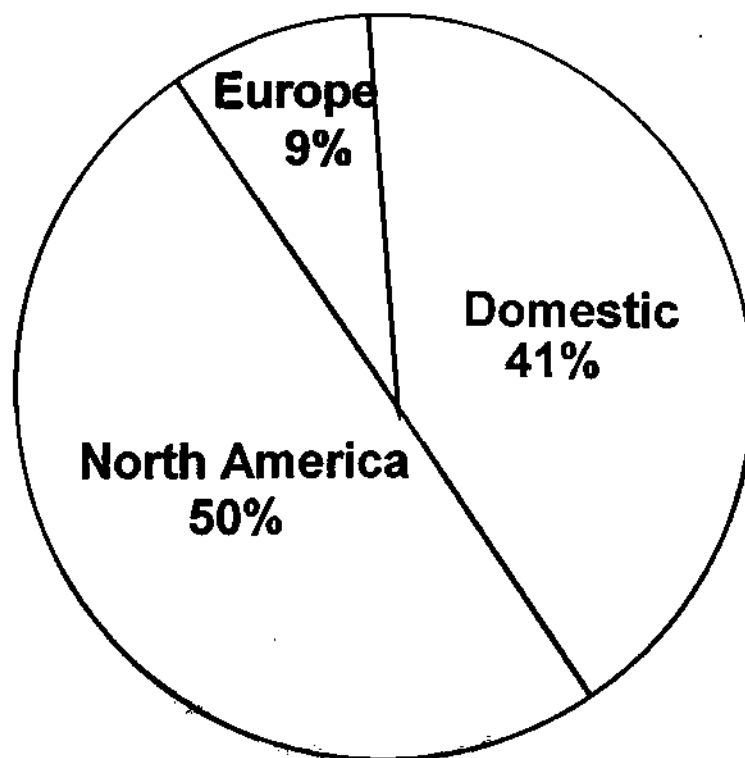
The Revenue Analysis of R.O.C. IC Manufacturing Industry

Year Category	1989	1990	1991	1992	1993	1994(e)
Computer	17%	18.5%	15.9%	15.4%	14.2%	12.2%
Communication	16%	9.1%	7%	6.3%	8.5%	6.8%
Consumer	23%	36.9%	26.8%	19.2%	10.9%	10.8%
Memories	28%	29.2%	32.7%	40.2%	51.2%	52.7%
ASIC	2%	—	9.6%	5.3%	5.0%	4.1%
Foundry*	14%	6.4%	8%	11.0%	10.2%	12%
Others	—	—	—	2.6%	—	1.4%
Total	100%	100%	100%	100%	100%	100%

* Not Including the foundry service from TSMC and Episl

Source: ERSO/ITRI ITIS Project

The Revenue Analysis of Foundry Service (1994/1H)



Source: ERSO/ITRI ITIS Project

Process & Capacity Development

Process						
			BiCMOS 1.0 μm	0.8 μm	0.8 μm	0.8 μm
	Bipolar		3.0 μm	3.0 μm	3.0 μm	3.0 μm
	NMOS 2.0 μm	2.0 μm	2.0 μm	2.0 μm	2.0 μm	2.0 μm
	CMOS 1.2 μm	1.2 μm	0.8 μm	0.8 μm	0.6 μm	0.5 μm
1989 1990 1991 1992 1993 1994						
Monthly Capacity	4": 60K	63k	67K	69K	69K	69K
	5": 50K	50k	70K	71K	78K	80K
	6": 23K	37k	79K	85K	105K	115K
						8": 2K

Source: ERSO/ITRI ITIS Project

Development Plan for 8-inch Fabs

Company	Investment Amount (US\$M)	Investments	Monthly Capacity	Process Technology	Main Products	Planned Open Date
TI-Acer	417	Purchasing Equipments	9,000	CMOS 0.35 μ m	16M DRAM	1994/4Q~1995/1Q
TSMC	758	Fab III	25,000	CMOS 0.5~0.35 μ m	Foundry	1995/4Q
UMC	947	Fab III	25,000	CMOS 0.5~0.35 μ m	SRAM, ROM	1996/1Q
HMC	417	Building a New Fab	15,000	CMOS 0.5~0.35 μ m	Memories, ASIC	1996/4Q
Sub- μ m Spin-off	NA	Purchasing Equipments	15,000	CMOS 0.5~0.35 μ m	16M DRAM	1994/4Q~1995/1Q
Nanya	758	Building a New Fab	15,000	CMOS 0.4 μ m	64M DRAM	1996/2Q~1996/3Q

Source: Companies' Annourcement, ERSO/ITRI ITIS Project

The R.O.C. IC Packaging Industry

- **Local companies strengthen the integration with the fabs and system manufacturers**
- **Foreign companies expand the assembly capability, and enhance branch's purchasing authorization**

The Key Indicators of R.O.C. IC Packaging Industry

Item \ Year	1989	1990	1991	1992	1993	1994(e)
No. of Companies	18	19	20	20	18	18
Revenue (US\$M)	977	1,018	1,000	1,108	1,401	1,611
Growth Rate(%)	13.5	4.2	-1.8	10.8	26.4	15.0
Domestic : Export	7:93	7:93	7:93	9:91	12:88	14:86

Source: ERSO/ITRI ITIS Project

The Technology Roadmap of R.O.C. IC Packaging Industry

					VSOP:48	48
	SOIC:28	28	28	40	44	44
QFP:100	100	160	208	256	304	304
LCC:84	84	84	84	84	84	84
1988	1989	1990	1991	1992	1993	1994
DIP:40	40	40	40	48	48	48
SDIP:28	28	28	28	28	28	32
			ZIP:28	28	48	48
				PGA:172	172	172

Source: ERSO/ITRI ITIS Project

The Market Analysis of R.O.C. IC Packaging Industry

Unit: %

Area Year	Domestic	Hong Kong	Japan	North America	Europe
1989	35.1	1.8	3.6	40.0	19.5
1990	38.7	0.3	4.5	37.0	19.5
1991	47.5	0.0	7.3	28.9	16.3
1992	57.5	0.2	1.5	32.1	12.7
1993	61.3	0.4	0.7	28.3	9.3
1994(e)	63.0	0.4	0.7	26.9	9.0

Source: ERSO/ITRI ITIS Project

The Packaging Type of R.O.C. IC Packaging Industry

Unit: %

Packaging Type Year	Plastic					Ceramic DIP	Others
	PTH		SMT				
	DIP	SDIP	SOP	QFP	LCC		
1989	75.8	1.7	5.1	2.7	4.1	0.0	10.6
1990	61.0	1.2	11.7	1.5	19.0	0.0	5.6
1991	54.8	2.1	3.4	8.6	21.2	3.9	6.0
1992	41.1	6.1	9.7	23.8	14.9	2.3	2.1
1993	34.3	8.8	12.0	30.0	10.2	1.3	3.4
1994(e)	28.0	14.0	8.0	38.0	9.0	1.0	2.0

Source: ERSO/ITRI ITIS Project

The R.O.C. IC Supporting & Peripheral Industry

- **China Steel join venture with MEMC in wafer plant project**
- **IC equipment suppliers start assembly line locally**
- **Leadframe/chemical suppliers and testing companies expand the capacities**

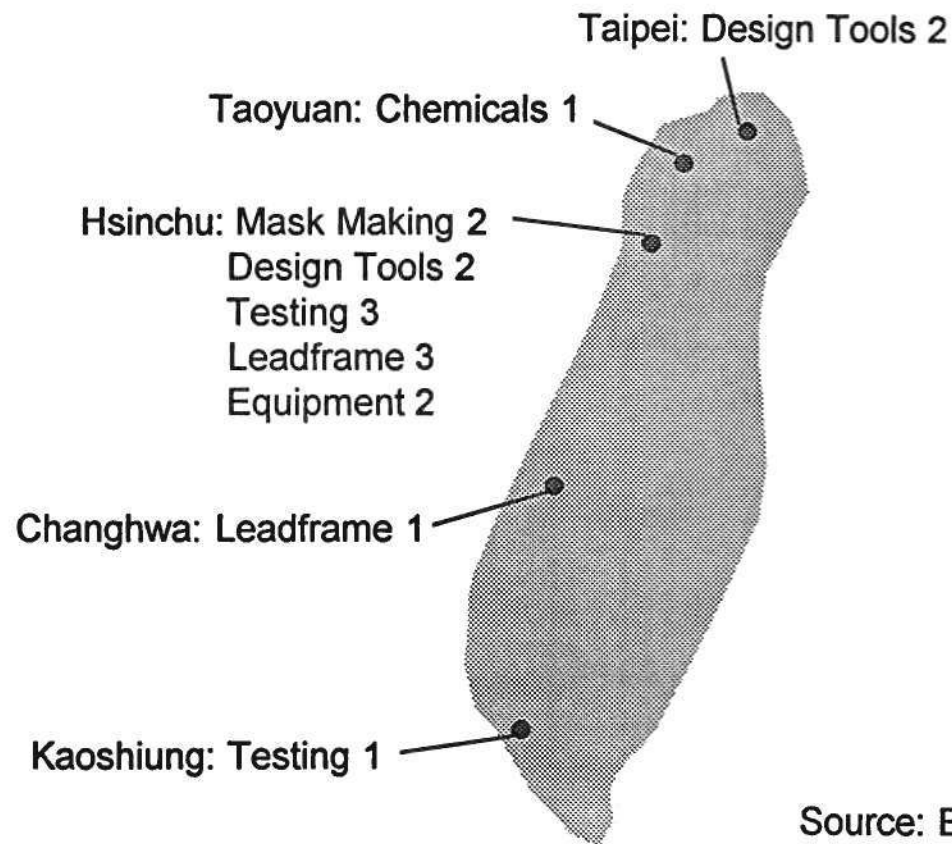


The Fledging R.O.C. Peripheral & Supporting Industry

<u>Chemicals</u>	<u>Design-Tools</u>	<u>Mask-Making</u>	<u>Testing</u>	<u>Leadframe</u>	<u>Equipment</u>
Merck-Kanto	Cadence	TMC	Vate	Getmore	Advantest
	Mentor	Innova	Siliconware	Hi-Tech	Applied Materials
	Campass		ASE Test	SDI	
	E-Team		FIC	Sitron	

Source: ERSO/ITRI ITIS Project

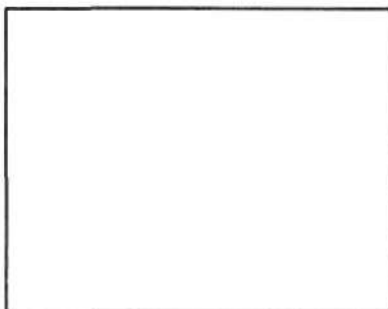
The Localities of Peripheral & Supporting Industry



Source: ERSO/ITRI ITIS Project

Conclusion

- The computer-related application will keep on driving the R.O.C. IC market, which is one of the most upring markets on earth.
- The IC industry is playing a more and more important role in the economy.
- The technology status of R.O.C. IC industry is still upgrading, nearing that of the worldwide leading companies.
- The synergy of R.O.C. IC industry structure is becoming more efficient and competitive.



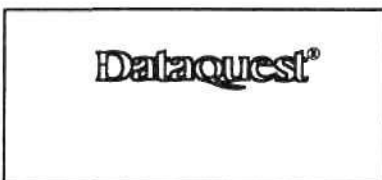
Capital Spending and Production, Trends and Forecast

Näder Pakdaman

Senior Industry Analyst

Semiconductor Equipment, Manufacturing, and Materials Service

Dataquest Incorporated



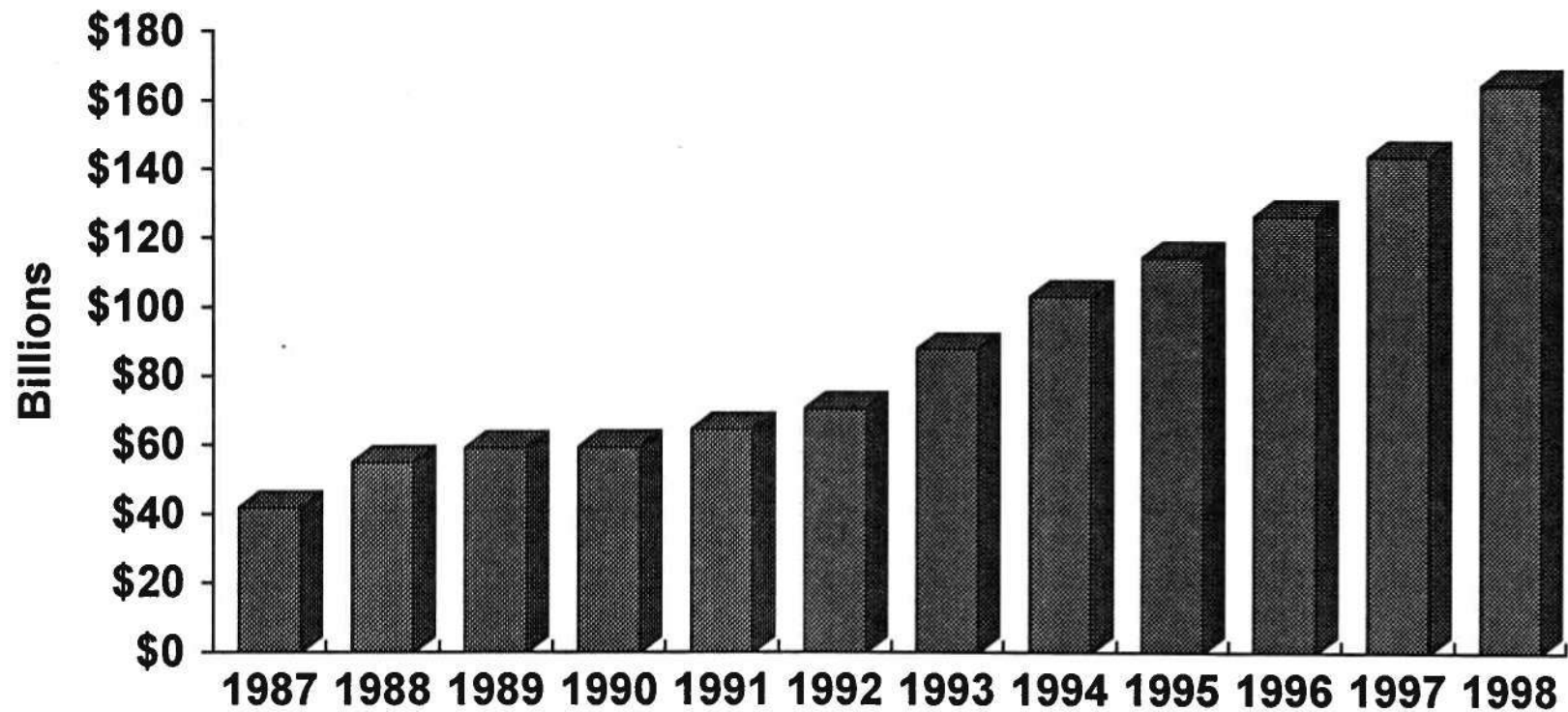
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Agenda

- Semiconductor Production
 - Worldwide and Regional
- Capital Spending
 - 1993 and 1994
 - Trends and Drivers
 - Wafer Fab Equipment
- Fabs and Silicon Consumption
 - 6-inch and 8-inch Fabs
 - Silicon Consumption
- Summary

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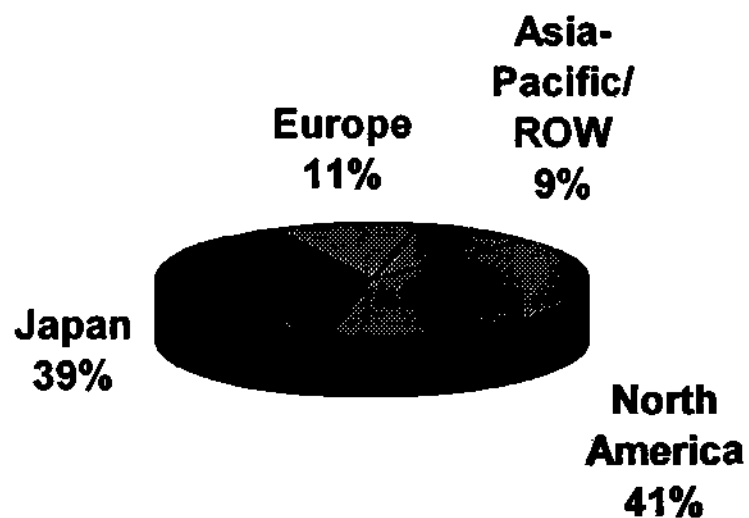
Estimated Semiconductor Production Worldwide



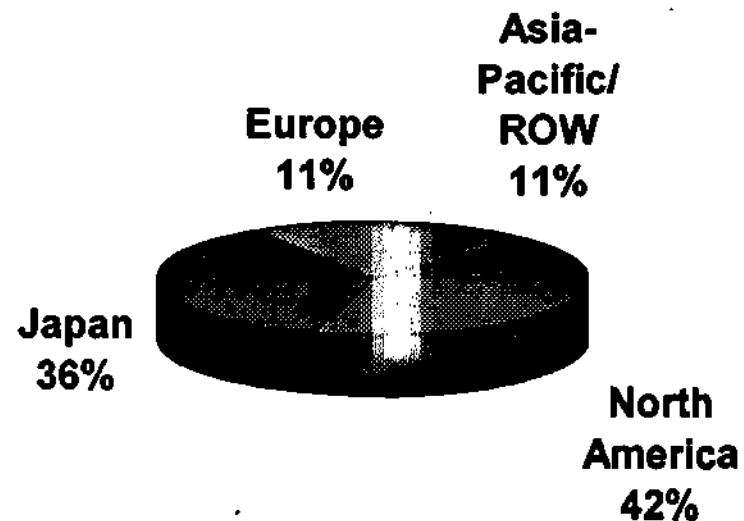
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Regional Semiconductor Production Trend

1993 Production: \$87.7 B



1998 Production: \$164.7 B



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1994 Capital Spending Overview

- Worldwide growth of 36.6 percent, from 1993 to 1994
 - \$14 to \$19.1 US Billion
- Asia-Pacific and Japan leading the way
- Japanese companies
 - Investing heavily despite the domestic economy
 - Filling the empty buildings with equipment
- North American investment sustained
- Second-tier companies participating in **every** region

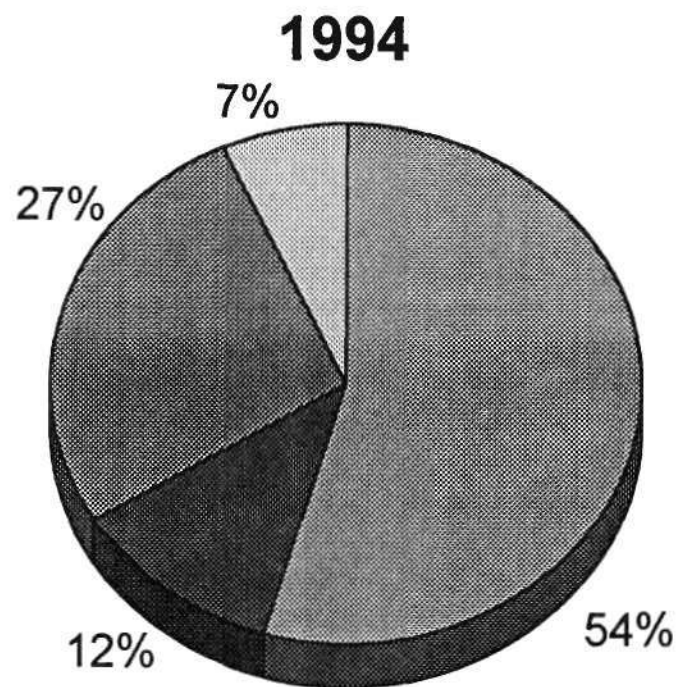
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Top Ten Capital Spenders in 1994

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

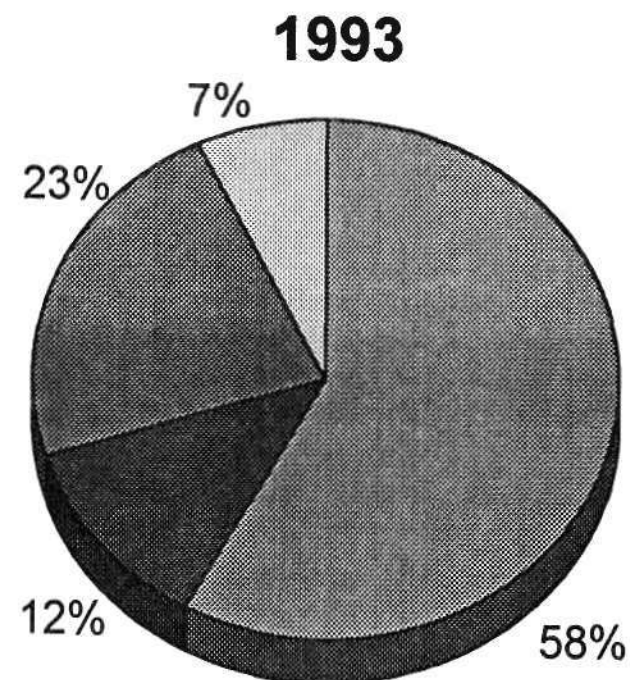
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Capital: What Did the Top 10 Spenders Do?



U.S.\$10.7 Billion

- ☐ Wafer Fab
- ☐ Test and Assembly
- ☐ Property and Plant
- ☐ Computer Equipment



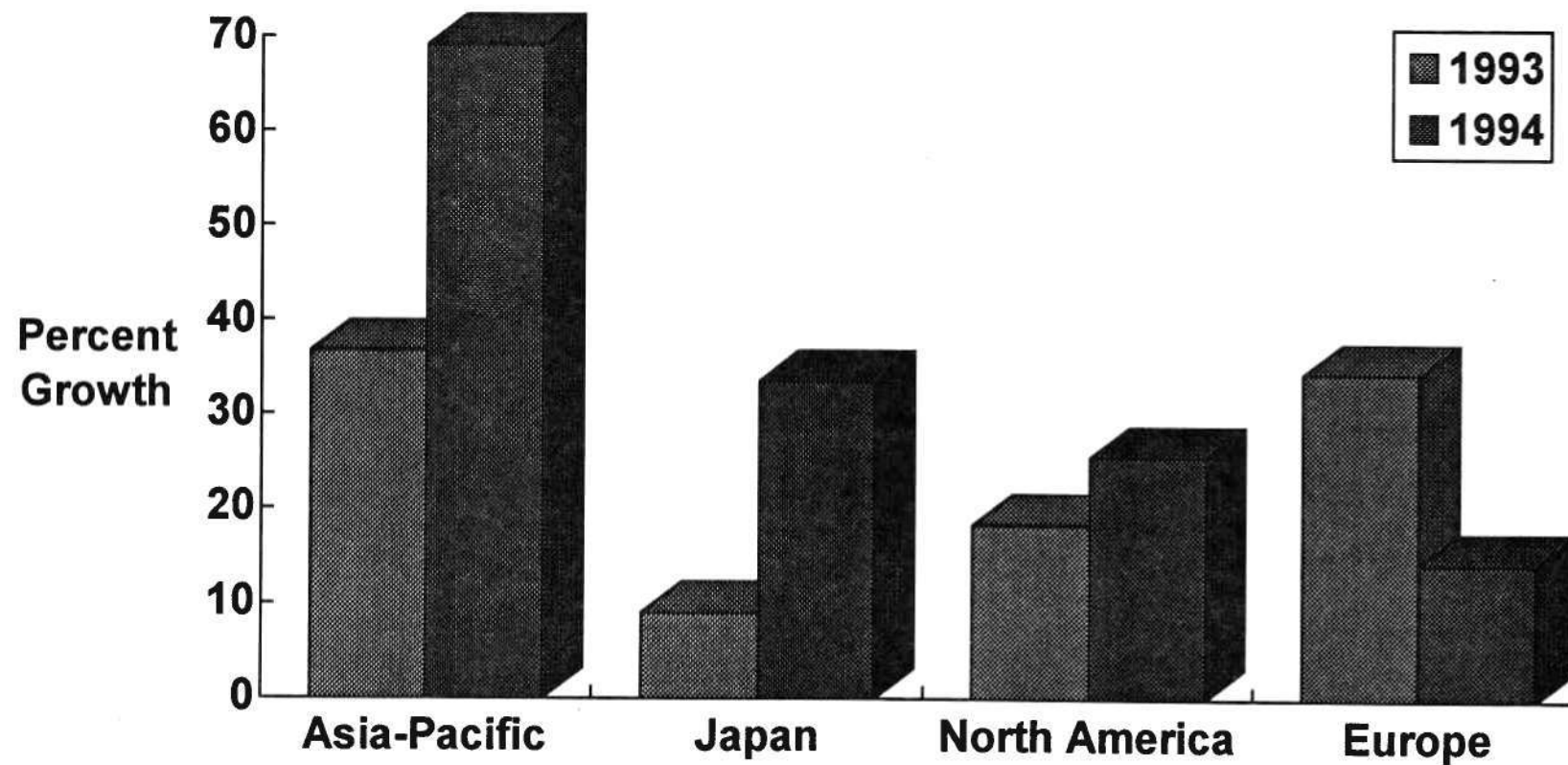
U.S.\$7.8 Billion

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Source: Dataquest

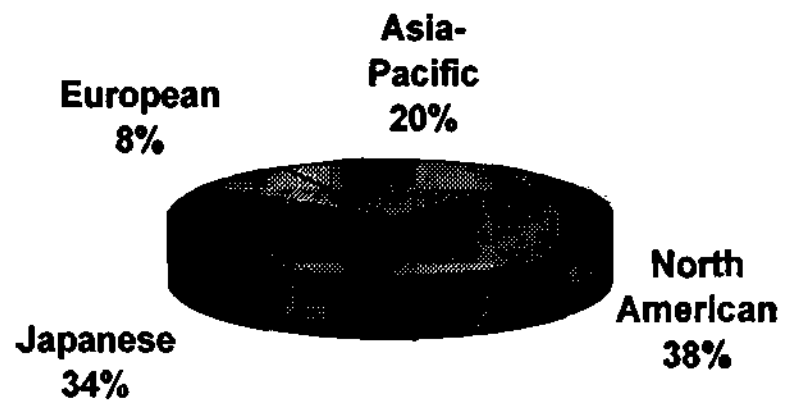
1993 and 1994 Regional Capital Spending



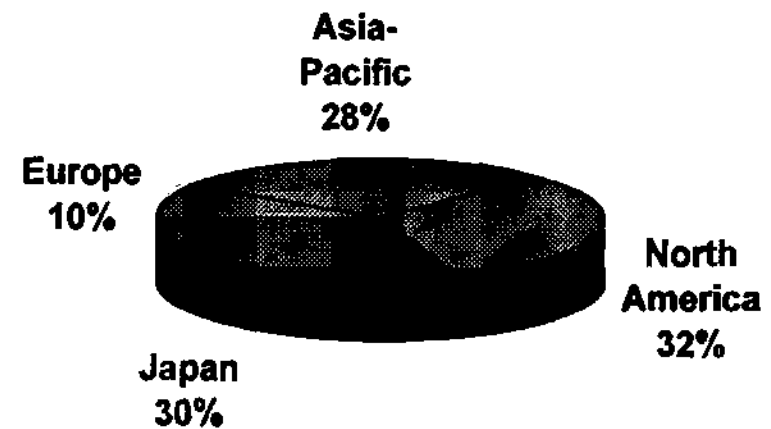
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1994 Capital Spending

By Base of Company



By Region of Spending



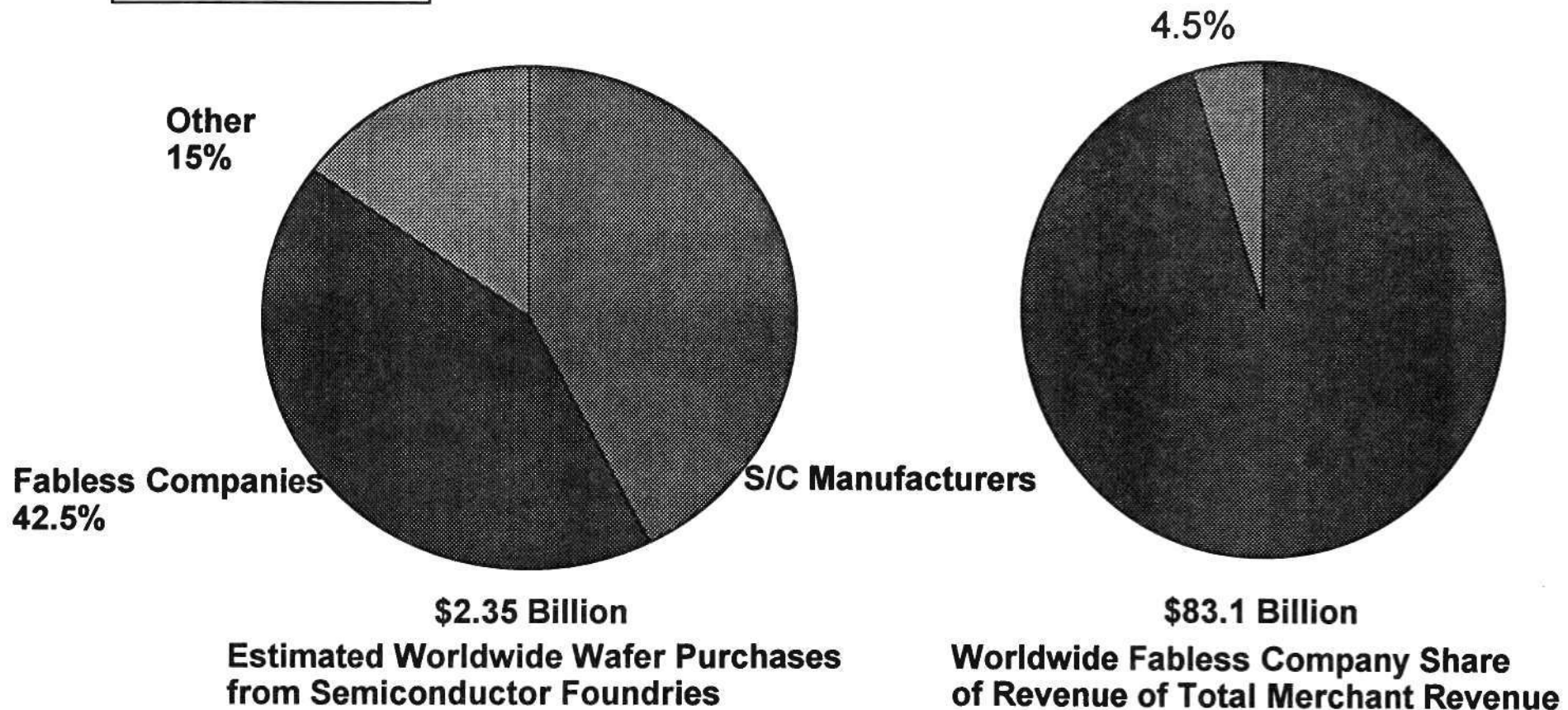
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Capital Spending Drivers

- DRAMs, DRAMs, and DRAMs
 - Korean spending up 75 percent
 - Incremental Japanese spending concentrated on 16 Mbit DRAM
- Logic/ASIC demand spurring North American strength
- Second-tier company profitability
- Foundries
 - Taiwan and Singapore spending triples to \$1.2 B

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1993 Fabless/Foundry Picture



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Source: Dataquest

Foundry: Definition?

- Evolution of contract manufacturing
 - Dedicated
 - Joint manufacturing
 - Seasonal opportunities
- Technology variation
 - Leading edge
 - One step behind
 - Leverage of previous technology

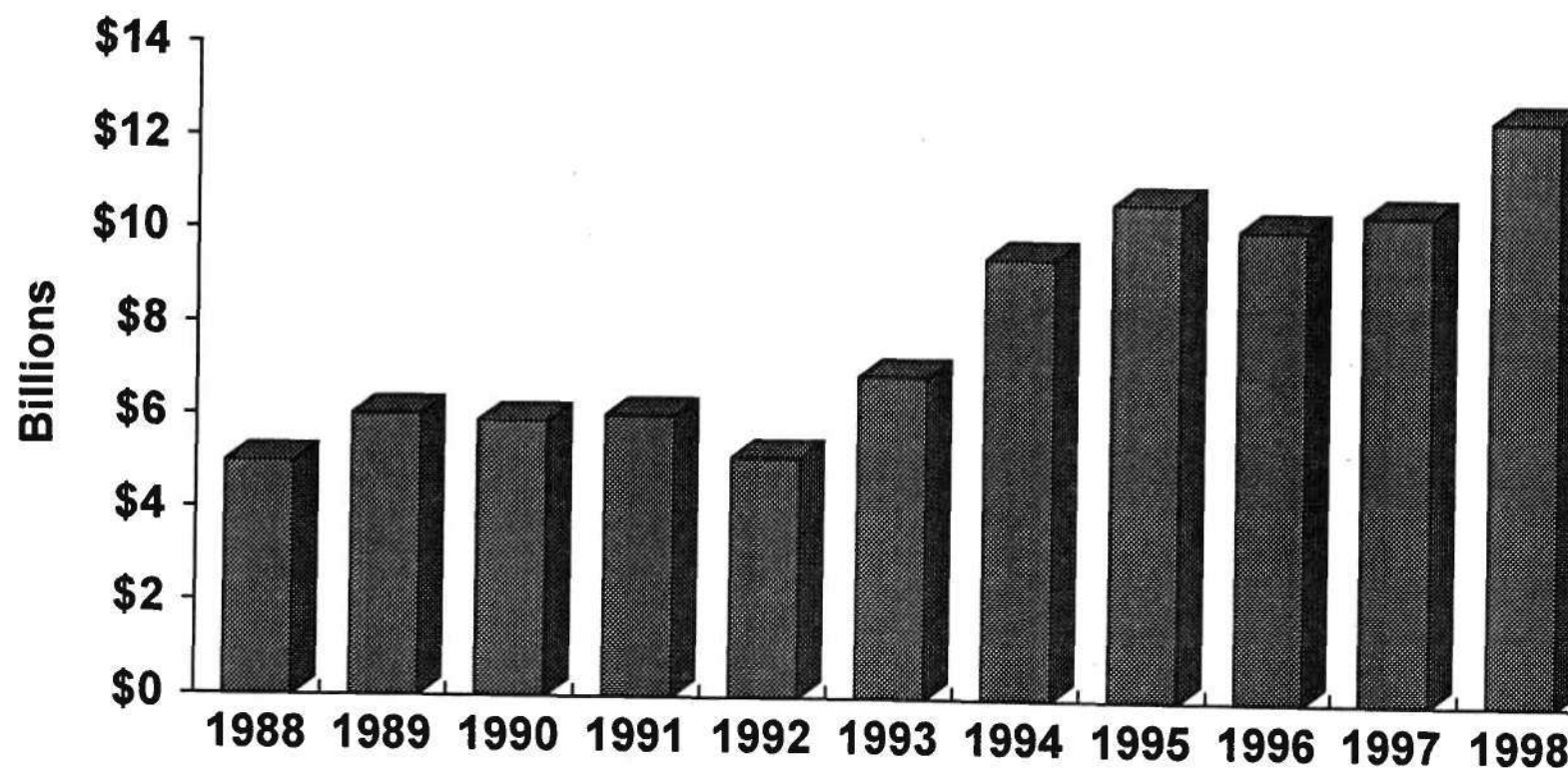
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Evolving Trends

- Long-term partnerships from start to
- Asia/Pacific will leverage capacity and technology for stronger partnerships
- Many fabless companies will not be so much fabless anymore
- Competition from other regions and semiconductor manufacturers
- Technology will increasingly become a key factor

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Worldwide Wafer Fab Equipment Forecast



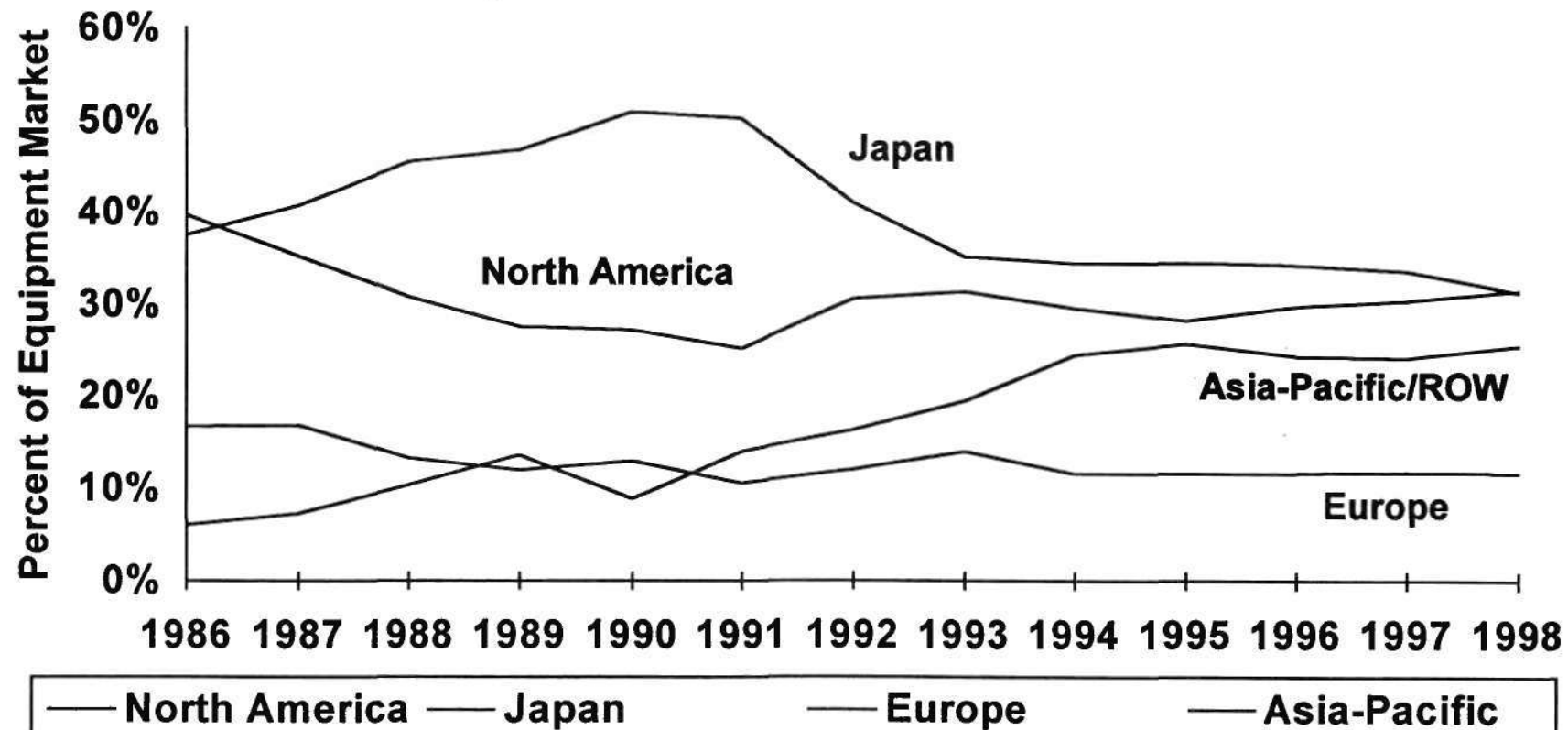
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Wafer Fab Equipment Forecast:

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

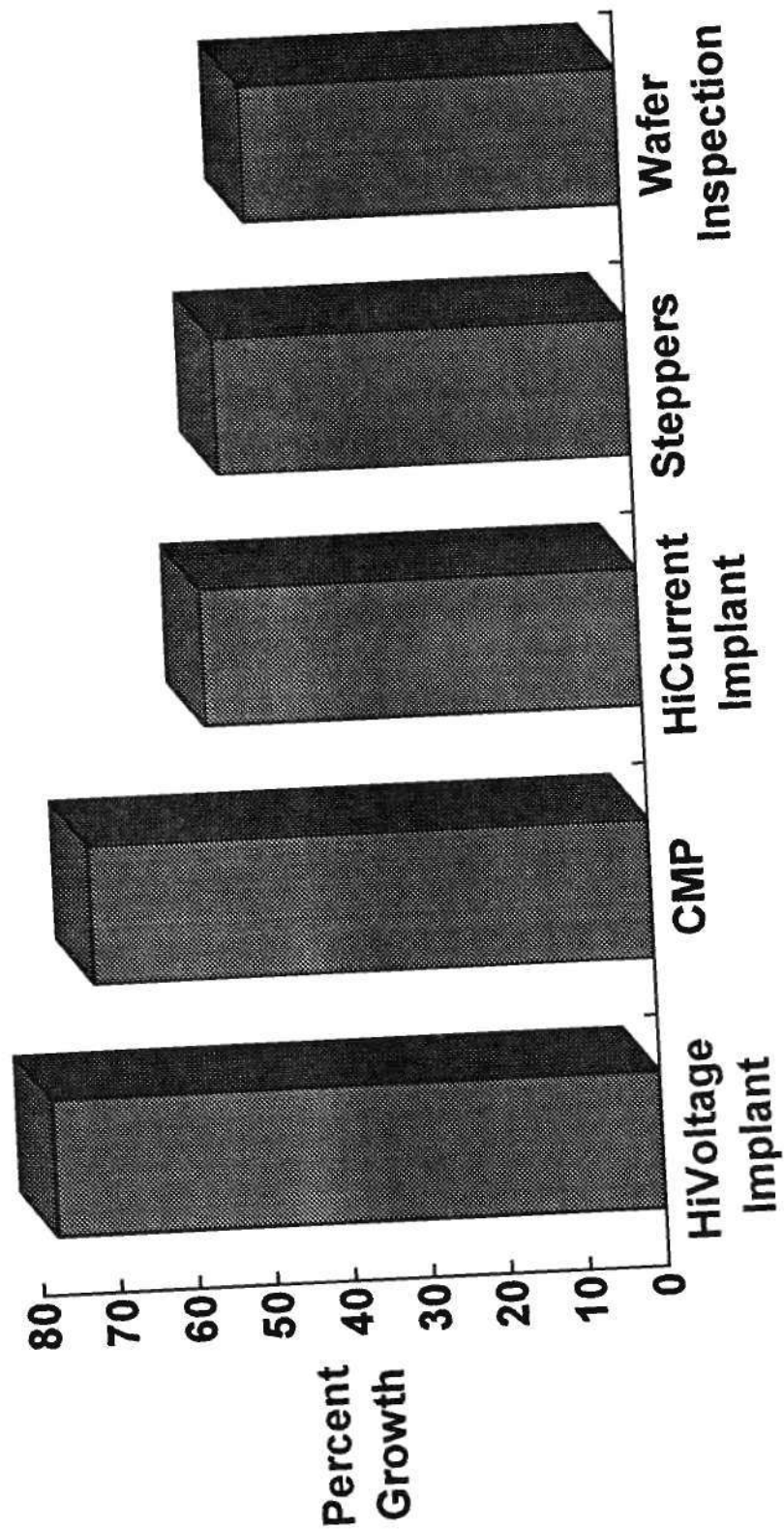
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Wafer Fab Equipment Market by Region



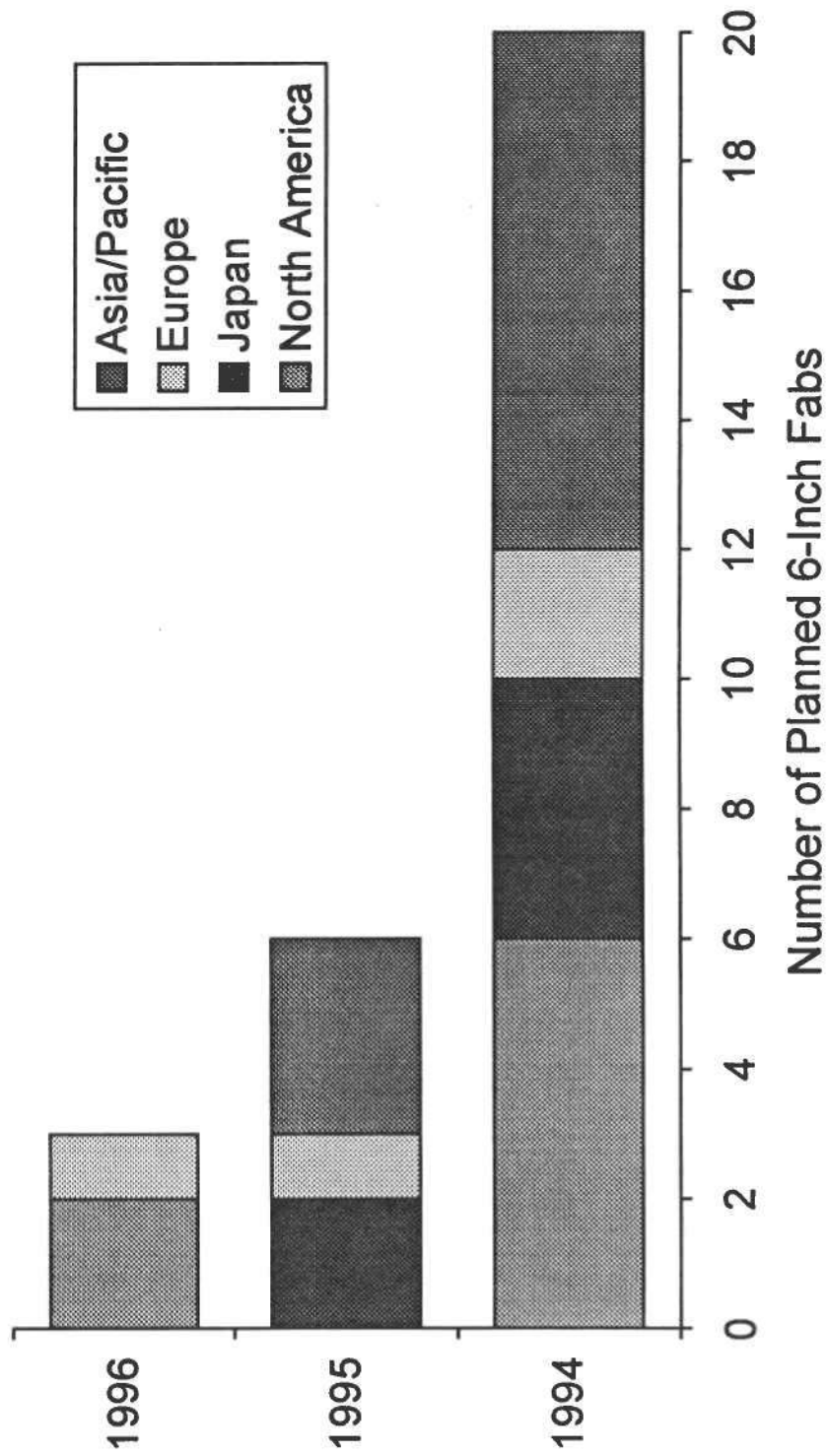
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Fastest Growing Equipment Segments in 1994



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6-Inch Planned Fabs

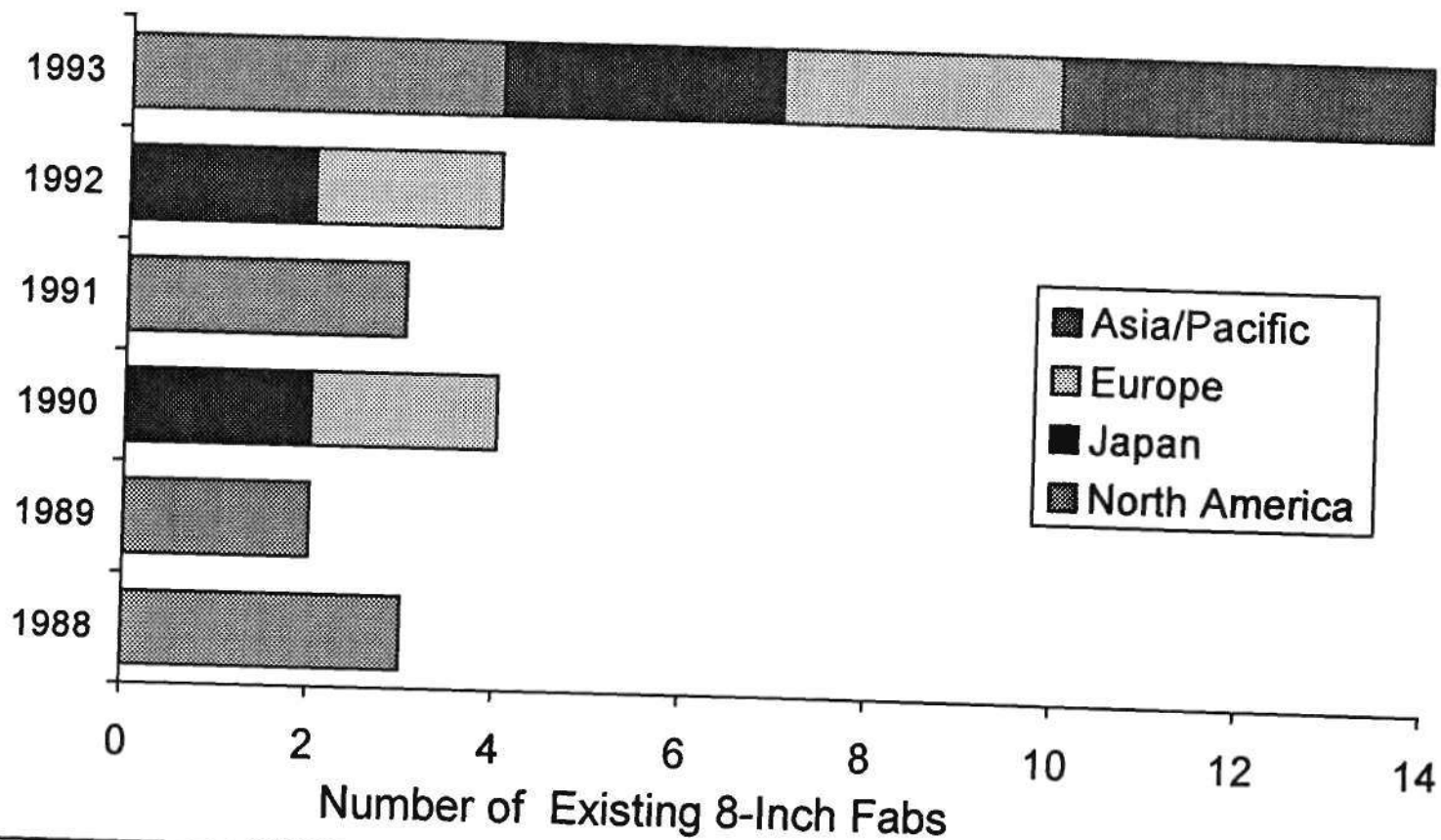


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Source: Dataquest

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8-Inch Existing Fabs (1988 to 1993)

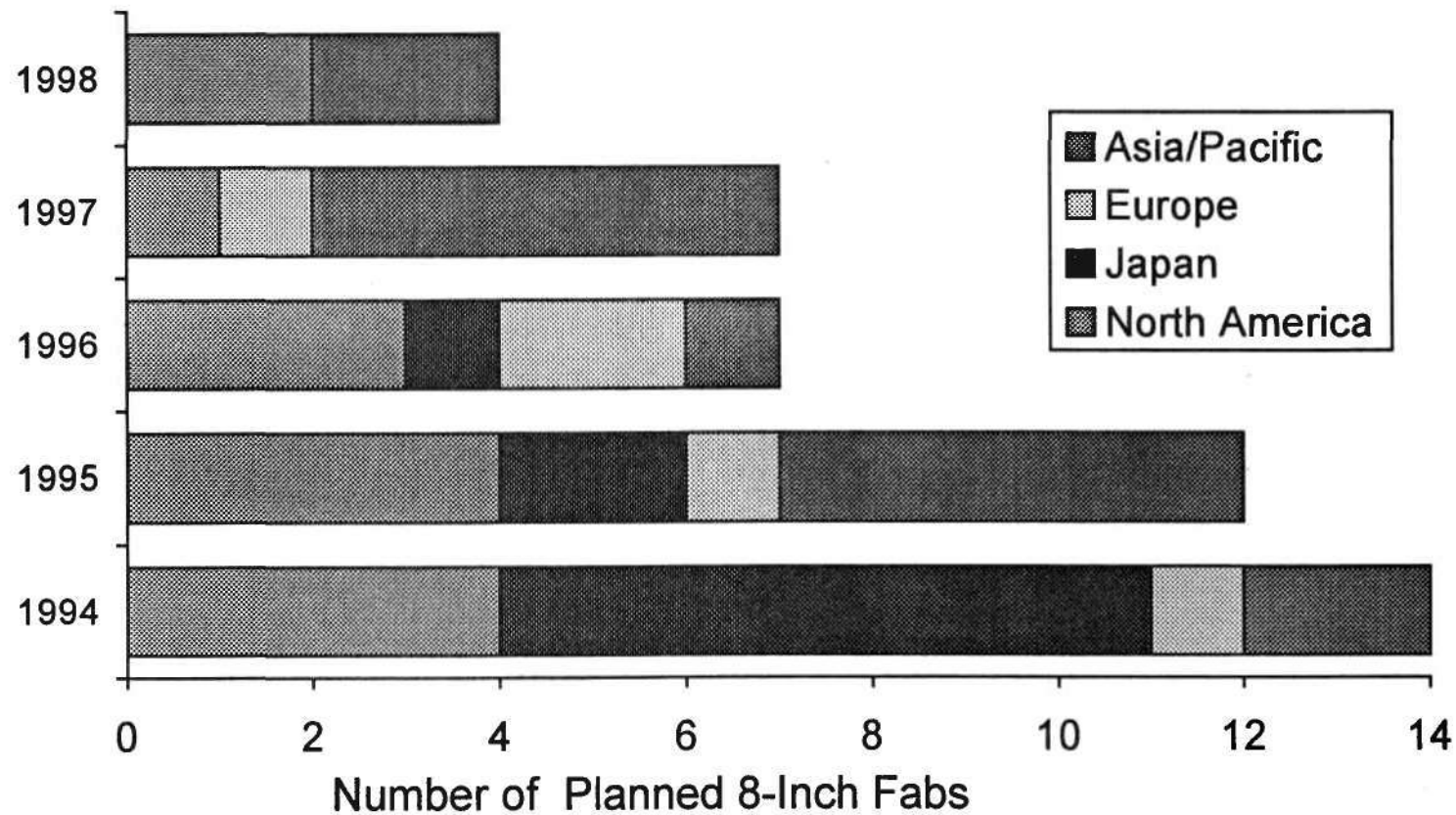


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Source: Dataquest

8-Inch Planned Fabs (1994 to 1998)



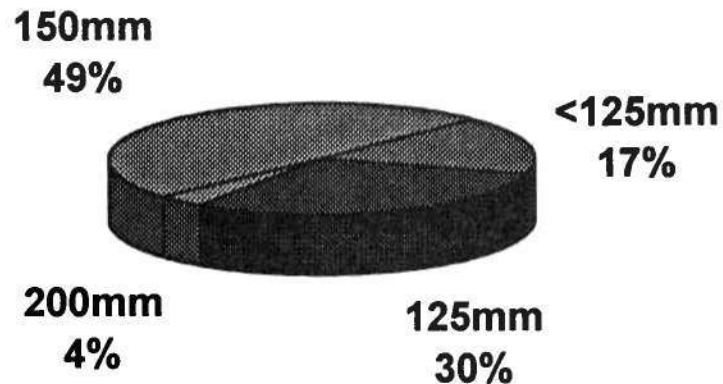
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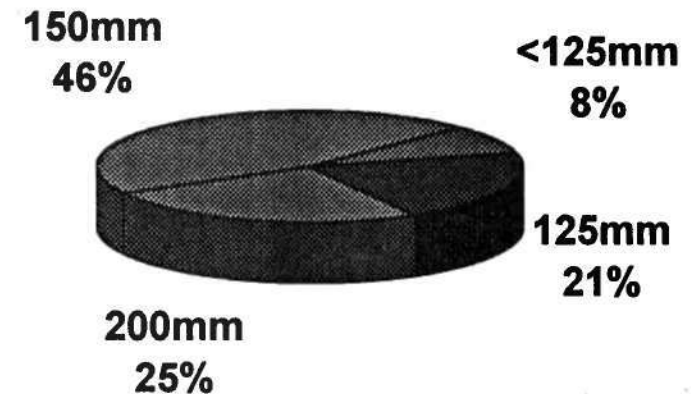
Source: Dataquest

Wafer Size Distribution Forecast: 200mm Ramp Becomes Reality

1993 Wafer Area



1998 Wafer Area

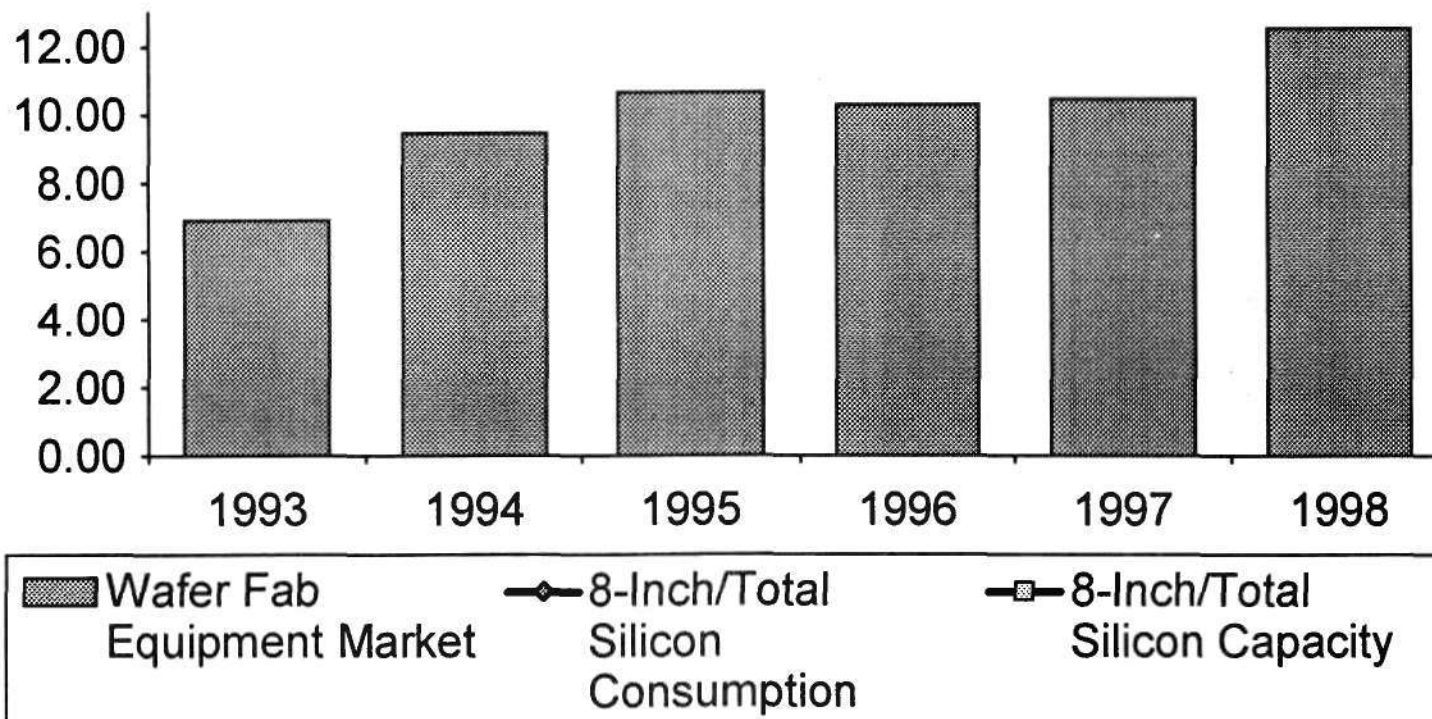


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Three in One... Pattern Recognition

A) Wafer Fab Equipment

Billions of U.S. Dollars



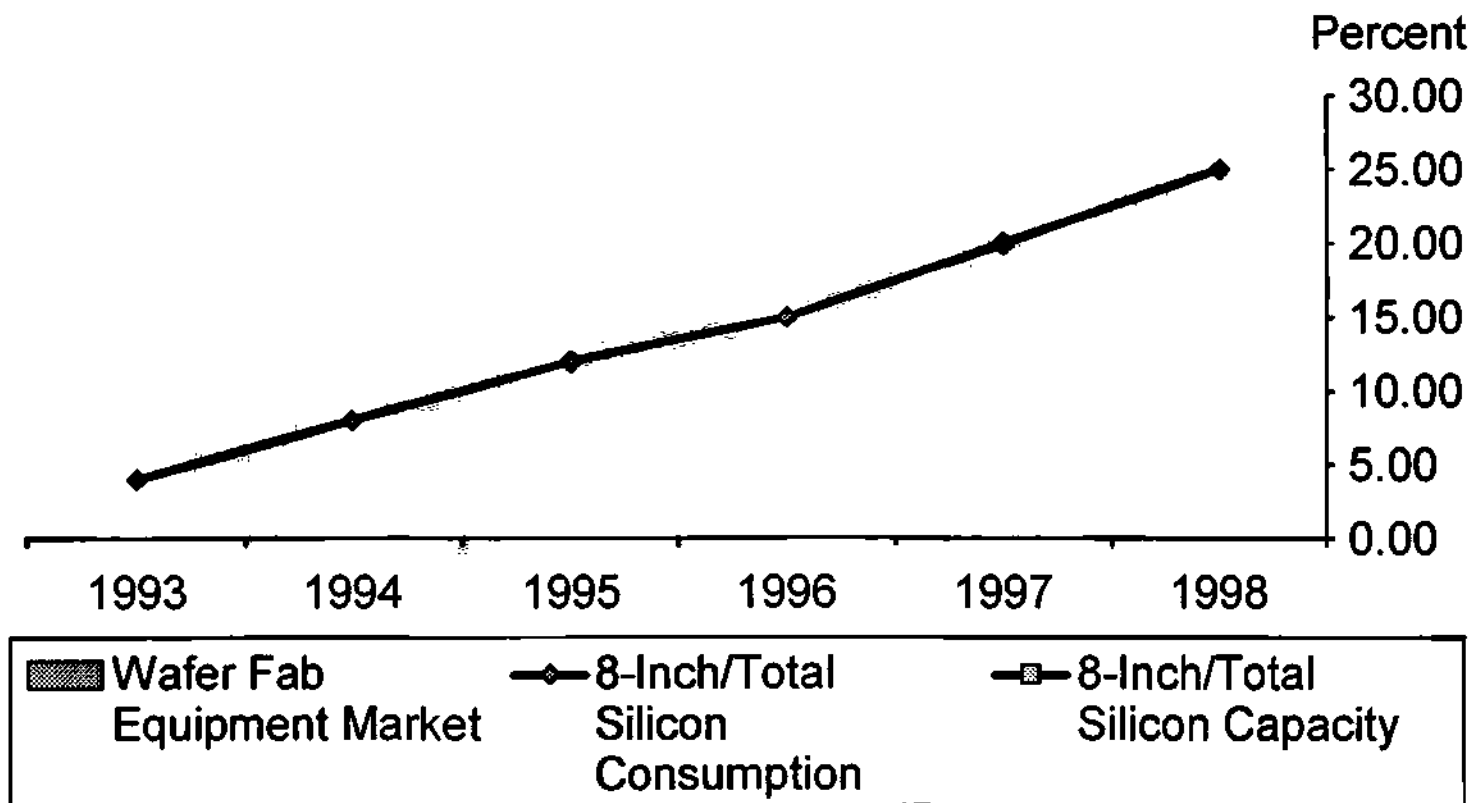
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Source: Dataquest

Three in One... Pattern Recognition

B) 8-inch Si Consumption



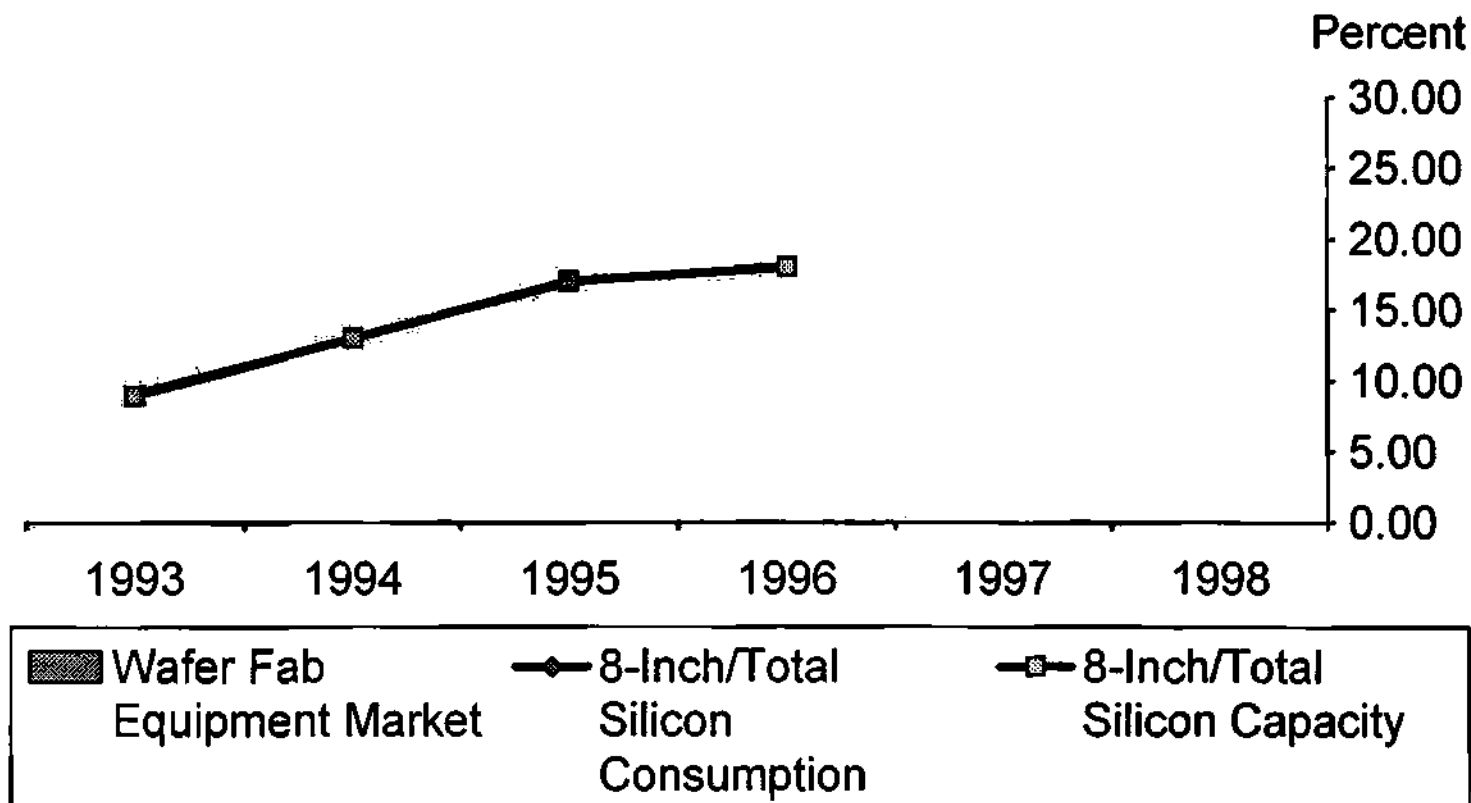
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Source: Dataquest

Three in One... Pattern Recognition

C) 8-inch Si Capacity

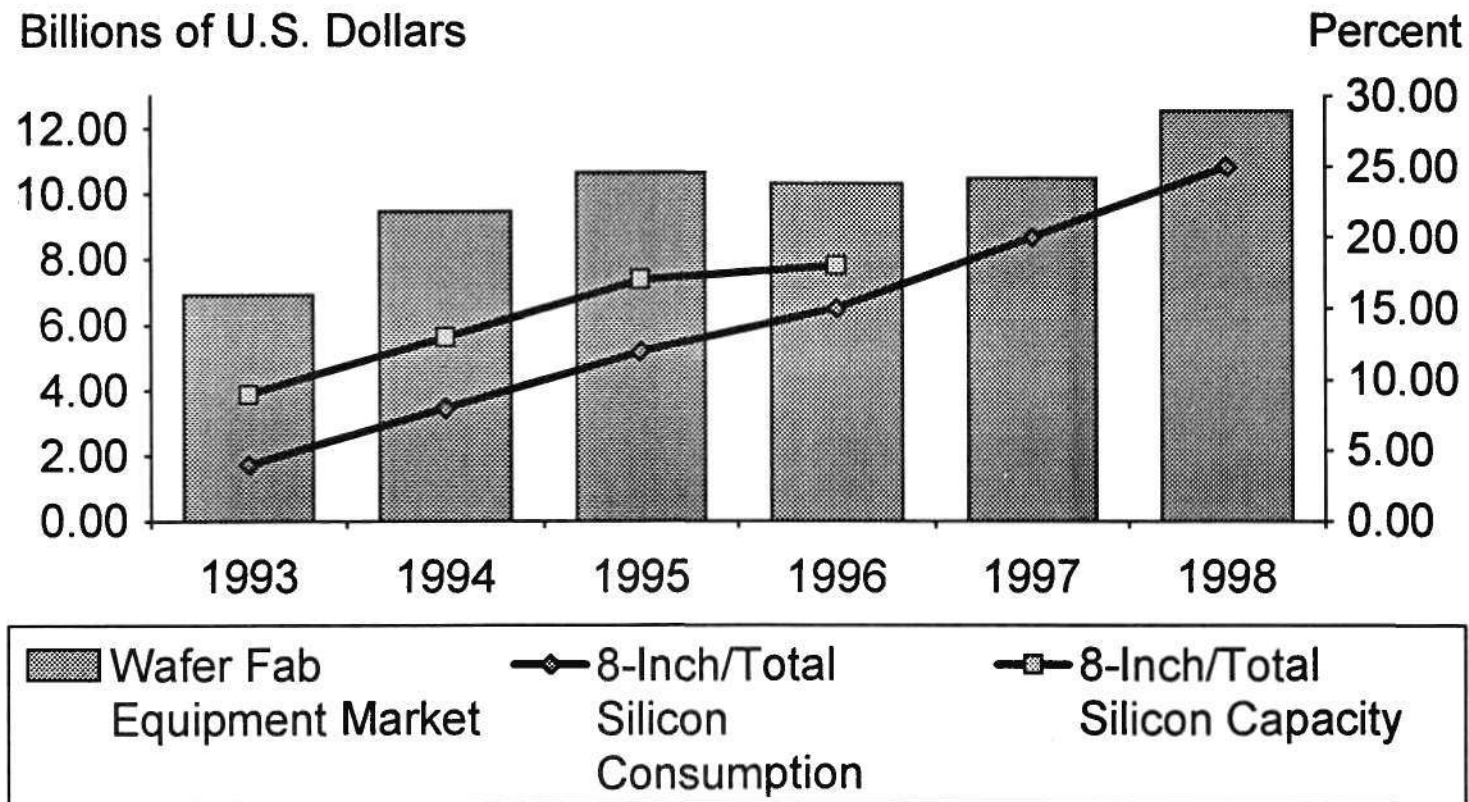


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Source: Dataquest

Summary: Three in One... Pattern Recognition



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Source: Dataquest

Acknowledgments

- Kunio Achiwa
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- Yoshihiro Shimada
- J. H. Son

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DRAM PUZZLE

---A Lesson from Micron Tech.

Speaker: John Kuo
ERSO/ITRI
Sept. 22 1994



Outline

- **DRAM Puzzle?**
- **Why Micron Tech.?**
- **Company Profile**
- **Strategy Analysis**
- **Findings**
- **Questions to Answer**

DRAM Puzzle?

- Money-making Machine?
- Black Hole?
- Big is Beauty?
- When Will Market Go Down?
- Most Risk but Less Profit ?
- Can We Make It?
- 6-in Fab. Still Can Survive?

A Legend of Micron ---From Dinosaur To Dynamo

Micron should not exist today

-- SoundView Financial Co.

Even Intel will take its hat to Micron

-- Kidder, Peabody & Co.

***Micron has been making 4M DRAM cheap,
around \$3 to \$4, and then selling them for \$14***

-- ICE

***Micron's ROE has exceeded 40%, higher than
Intel's 30%***

--SoundView Financial Co.

Why Micron Tech.?

- Small Enterprise
- Focus on DRAM/SRAM
- DRAM Experience for 15 Years
- Top 10 Vendor in DRAM
- Dramatic History
- Well-established
- Make Profit since 1988

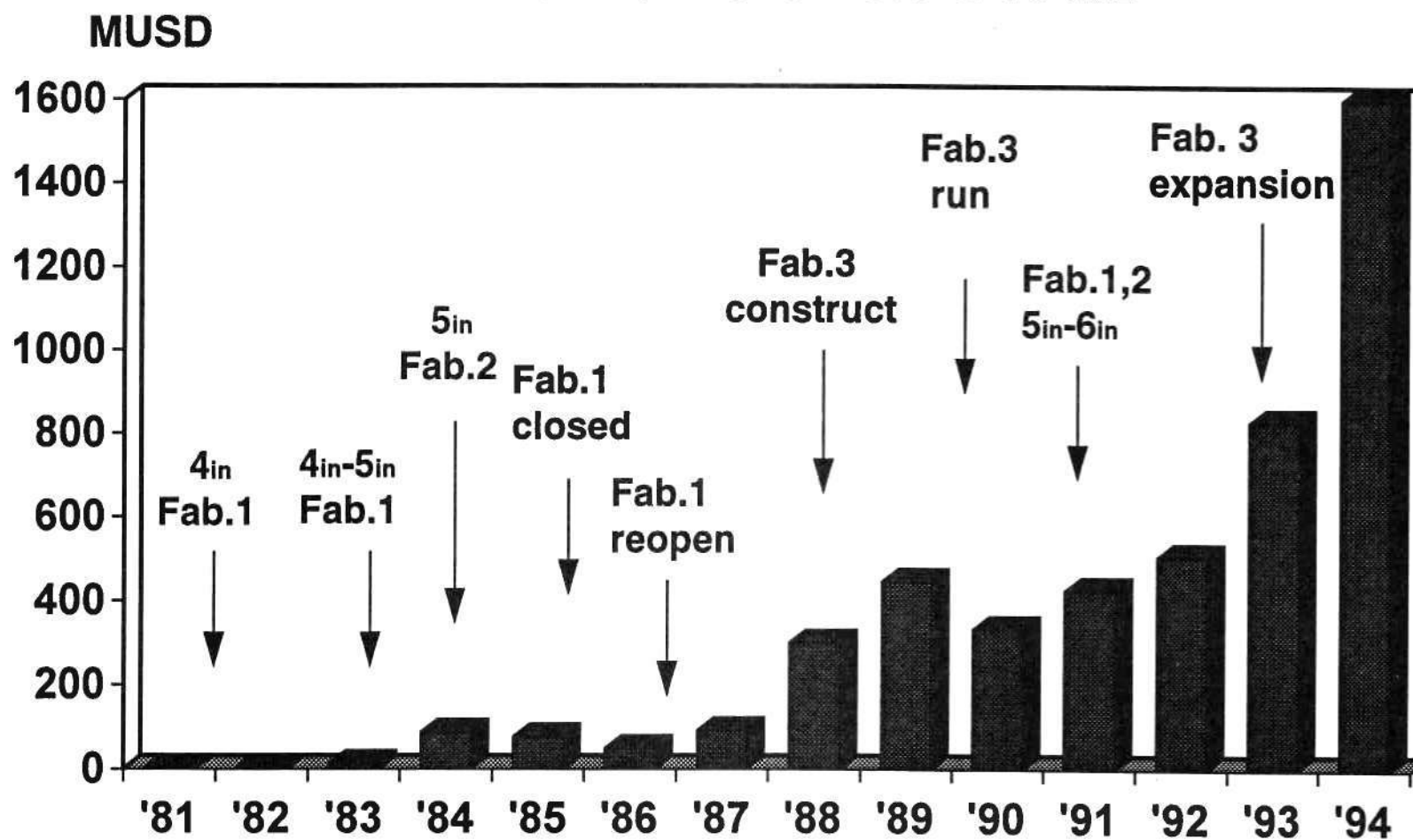
Company Profile

- **Location: Boise, Idaho**
- **FY1993 Sales amount : \$828 M USD**
Net Income : \$104 M USD
- **Employee : 4600**
- **Product : DRAM, VRAM, SRAM, Others**
- **Fab. : 3 fabs. , 70,000 wafers/m (6-in)**
- **Worldwide Ranking :**
 - **9th Memory vendor**
 - **8th DRAM vendor**
 - **11th SRAM vendor**

Historical Review

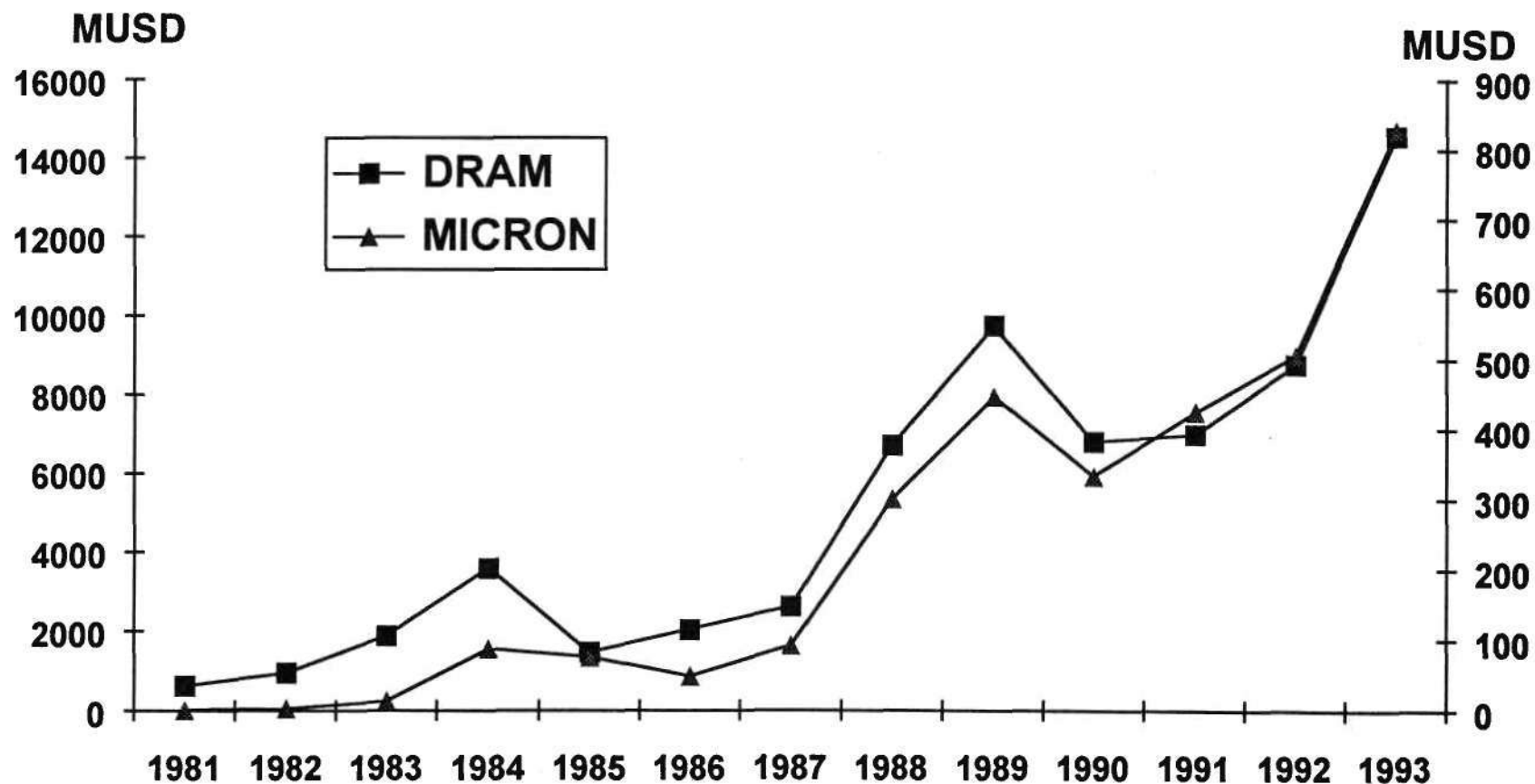
- **Company**
 - 1978 Design House
 - 1981 Fab. 1
 - 1984 Assembly/Testing, Fab. 2
 - 1989 Fab. 3
- **Product**
 - 1984 64K DRAM
 - 1986 256K DRAM
 - 1987 1M DRAM, Memory Board
 - 1988 16-256K SRAM
 - 1990 4M DRAM
 - 1993 16M DRAM

Revenue Growth



Source: Micron Tech., ERSO/ITRI ITIS project

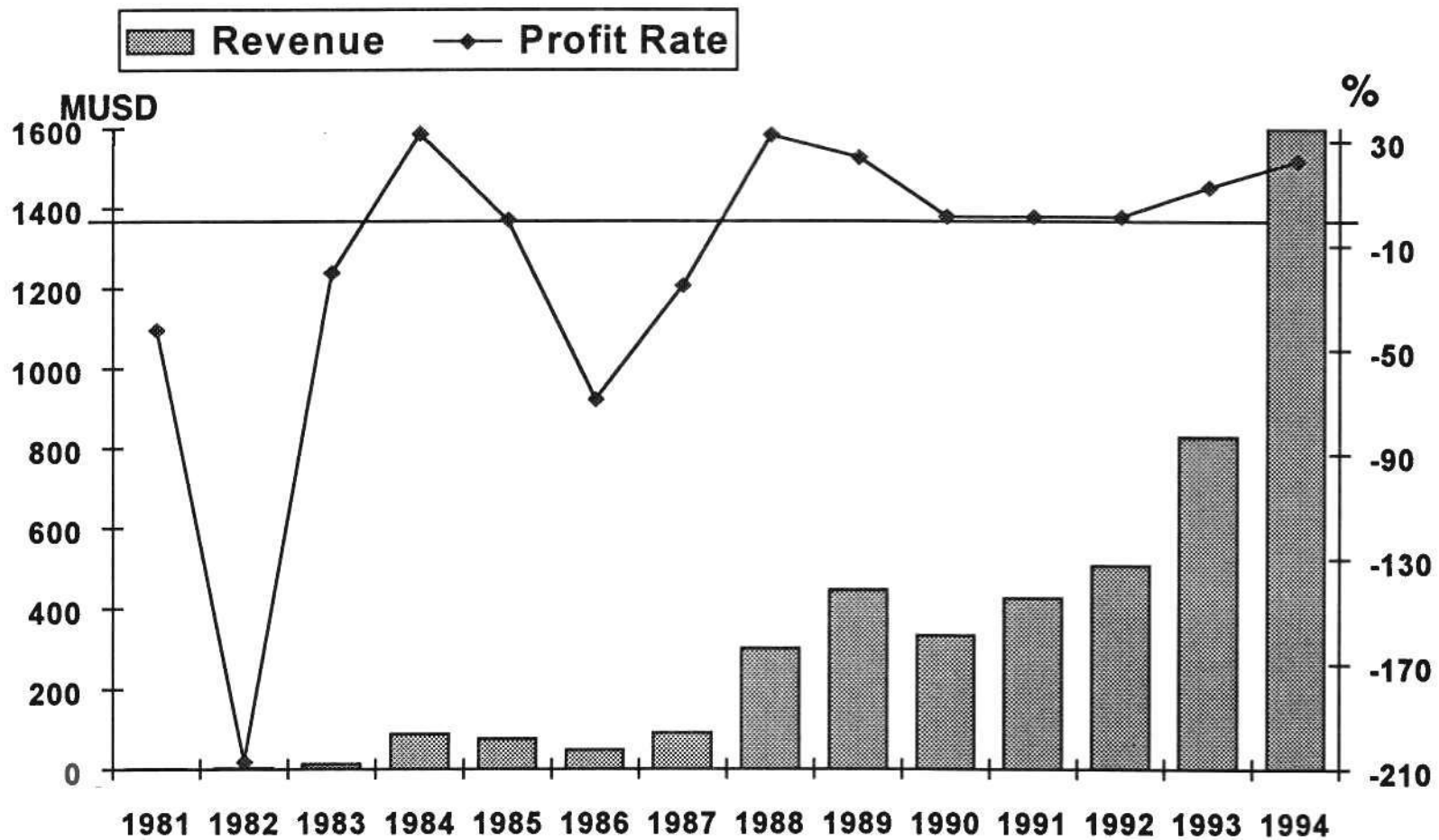
Growing with DRAM



Source: ERSO/ITRI ITIS Project



Profit v.s. Revenue



Source: ERSO/ITRI ITIS project

Strategy Analysis

*Don't Struggle to be First to Market,
Be First to Make Money*

- Product
- Production
- R&D
- Finance

Product

- **Product Line**



- **Price**
- **Brand+ OEM + Foundry**
- **Channel**
- **Promotion by Anti-dumping Accusation**

Production

- **Fab. Location**
- **Front-end to Back-end**
- **Common Process**
- **Familiar with Equipment**
- **Unique Testing System**
- **Short Cycle Time**
- **Continuous Improvement**
- **7-Eleven**
- **Improve Quality Gradually**
- **Strong at Design, Processing**

Chip Size & Mask Number Comparison

Item		General	Micron Tech.
Chip Size (mm ²)	256k	40	40(1st. gen.) 19.1(shrink 2)
	1M	50	56.8(1st gen.) 17.64(hypershrink)
	4M	90	100.1(1st gen.) 61.29(ministack)
	16M	130	140(prototype) 129(sample)
Mask Number	64k	9	7
	256k	11	9(1st gen.) 7(shrink 2)
	1M	14	13(1st gen.) 10(hypershrink)
	4M	16-18	13(1st gen.) 12(ministack)
	16M	20	16(prototype) 13(sample)

Source:Dataquest,ERSO/ITRI ITIS project

R&D

- **Technical Follower**
- **R&D/Sales**
- **64M DRAM Independently Developed**
- **DAPRA Support**
- **Sematech--Withdraw**
- **Get Technique through J.V. and Equity Investment**
- **Patent Issue**

Technical Cooperations

Year	Events
1985	Bought BRI equity to acquire CMOS ASIC tech.
1988	Joint Sematech
1989	IBM cross licence, to acquire 4M DRAM process and design tech.
1990	Established ETEC with IBM, Du Pont, Perkin-Elmer to E-Beam tech.
	Invested Ceram Inc. to develop Ferroelectric DRAM
1992	Developed Flat Panel Display with Coloray Display
1994	DRAM second source agreement with Samsung

Source: Dataquest, ERSO/ITRI ITIS project

Micron Patent Events

Year	Company	Events
1983	AT&T ITT Samsung	Cross Licence (1986, 1989) Paid Micron Patent fee Paid Micron Patent fee
1984,1985	Shell	Micron paid Patent fee
1986	Samsung Motorola	Accused infringement by Micron Licenced Micron
1988	Intel Standard Micro SYS.	Cross Licence, Micron paid \$50M USD MOS Patents, Micron paid \$9.3M USD
1989	TI Hitachi	Micron paid \$38.2M USD Cross Licence, Micron paid fee+unit fee
1991	Wang Labs.	SIMMs licence, Micron paid by unit fee

Source:Dataquest,ERSO/ITRI ITIS project

Micron Patent Events

Year	Company	Events
1992	TI Goldstar Hyundai	Patent argument Patent Infringement
1993	Goldstar	Goldstar agreed to pay fee to Micron
1994	TI	Signed agreement with Micron till 1998

Source:ERSO/ITRI ITIS project

Number of Micron's Patents

Year	Number of Patents
Before 1988	1
1989	12
1990	44
1991	106
1992	192
1993.1-6	230

Source:ERSO/ITRI ITIS project

Financial Analysis

- Investment Decision
- Finacing
 - Long Term Company Debt
 - Bank Loan
 - Issue Common Stock
 - Customer Investment
 - Sale TECH.
 - Company Earning
- Dividends
- Gross Margins:11%~23%~65%
- Net Income:-69%~1.5%~30%

Findings

- **Silicon cycle can't be ignored**
- **Investment decision timing is important**
- **DRAM is really risky for small enterprise**
- **Appropriate product lines should be developed**
- **More risk does not mean more profit**
- **You don't have to be first in high density DRAM development, but you do need to be good at process or design**
- **OEM or foundry strategy should be flexible**
- **You don't have to be in Silicon Valley to be success**

Findings

- **Patent issue should always be kept in mind**
- **To penetrate foreign market through right agency**
- **You don't have to be big to be famous**
- **Financial support can't be over-estimated, especially in recession**
- **Listing in security market is a key to Micron's success**

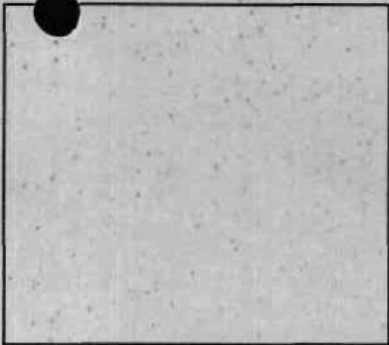


Questions to Answer ---Vendor Side

- **An exclusively DRAM maker or RAM supplier?**
- **Profit orientation, Market orientation or Technical orientation?**
- **Try to be a Technical Leader or just a Laggard in memory field?**
- **Own Brand or OEM?**
- **Is anti-dumping a good promotion method?**
- **Have any IPR problem?**
- **Where to get money during recession?**

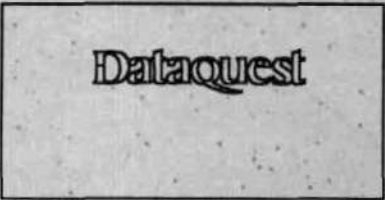
Questions to Answer ---Venture Side

- Do you believe DRAM a high profit product ?
- Do you believe the risks are the same between DRAM and other products?
- Withdraw or put your money in during recession?



Microcomponents: Setting the Pace in the Semiconductor Market

**Jerry J. Banks
Director/Principal Analyst**



Dataquest

Agenda

Definitions

Applications Drivers

Sizing the Market

Events Shaping the Market

The PC Connection

Five Year Forecast

Dataquest

Microcomponents

Microprocessors

Microcontrollers

Microperipherals

Programmable DSP

Dataquest

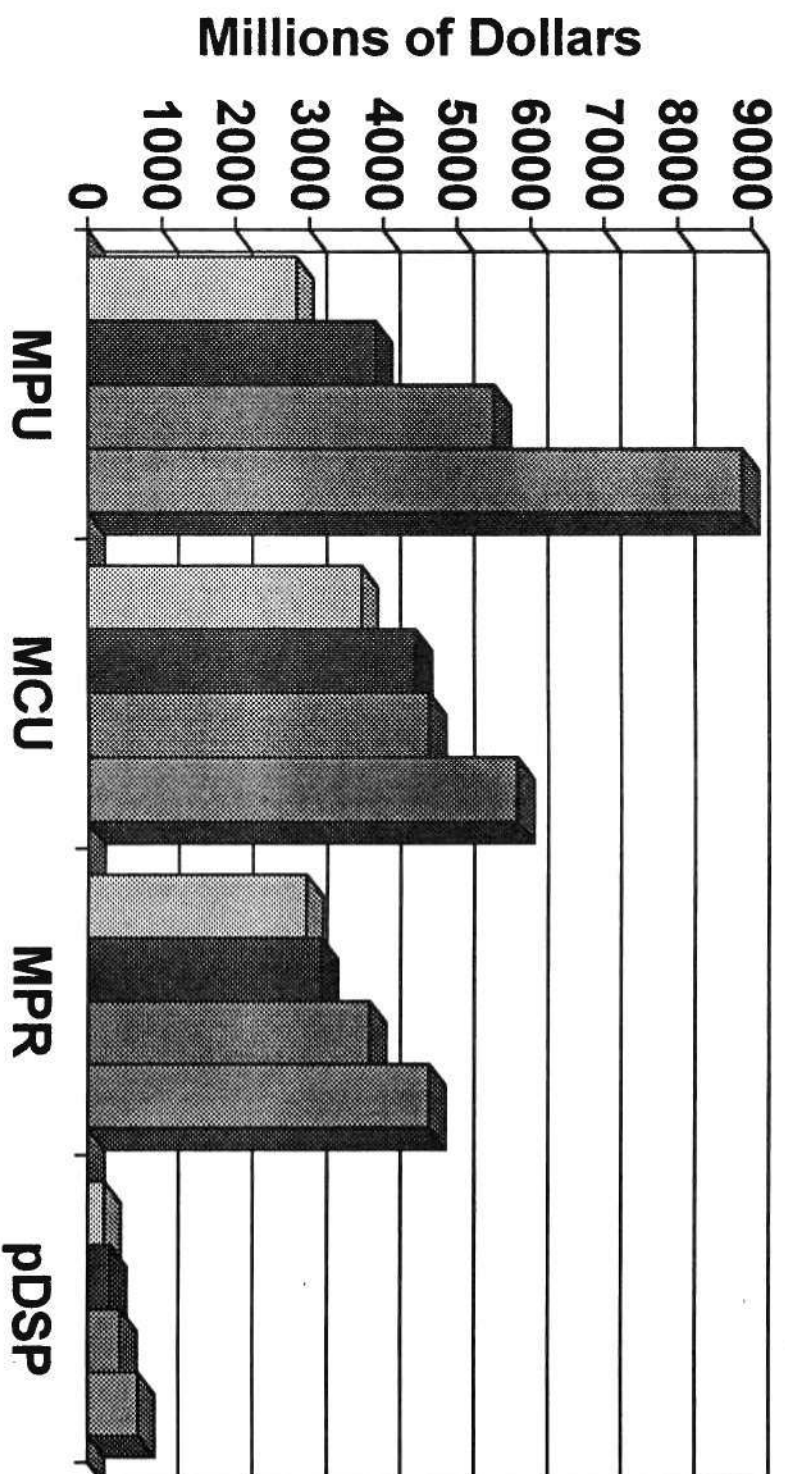
Application Drivers

- ♦ Computers
 - ♦ Microprocessors
 - ♦ Microperipherals
 - ♦ Microcontrollers
- ♦ Communications
 - ♦ Microcontrollers
 - ♦ Programmable DSP
- ♦ Consumer
 - ♦ Microcontrollers

Application Drivers

- ♦ Computers
 - ♦ Desktop
 - ♦ Notebook/sub-notebook
- ♦ Communications
 - ♦ Telephone handsets
 - ♦ Networking
- ♦ Consumer
 - ♦ Games
 - ♦ Entertainment

Revenue Growth



Dataquest

What Happened in 1993?

- PC unit shipments grew 20%
- Microprocessor revenue grew 61%
- Microcontrollers penetrate everything electric (26%)
- Microperipheral ASP's stabilized due to integration
- Shifting of regional manufacturing trends
- Three regions exceeded 40% growth
- IBM in merchant market (\$377M)

What's Happening in 1994?

- ♦ PC unit shipments growing ~ 20%
- ♦ Microprocessor revenue growing ~ 30% (ASP)
- ♦ Pentium positioned for explosive growth
- ♦ Microperipheral growth matching PC's
- ♦ Microcontrollers growing ~ 25%
- ♦ Three regions growing ~ 30%

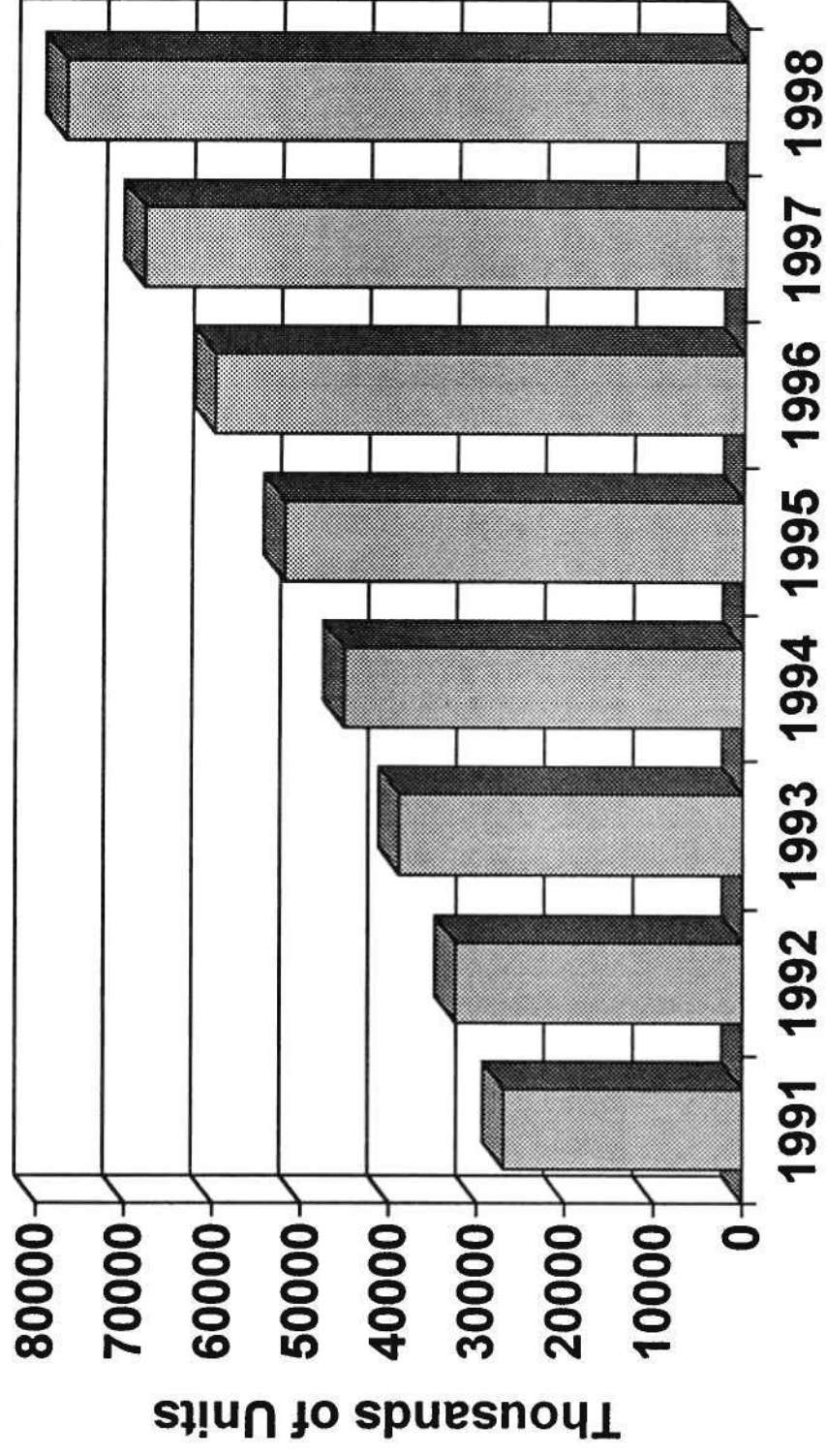
What Will Happen in 1995?

- ♦ PC's still The Driver for semiconductors ~ 15%
- ♦ Pentium shipping in volume ~ 22Mu
- ♦ P6 introduction ~ 500Ku
- ♦ Windows 4.0 released
- ♦ Microcontrollers still capacity constrained
- ♦ Digital cellular ramp will accelerate

Microprocessors Continue to Capture the Profit

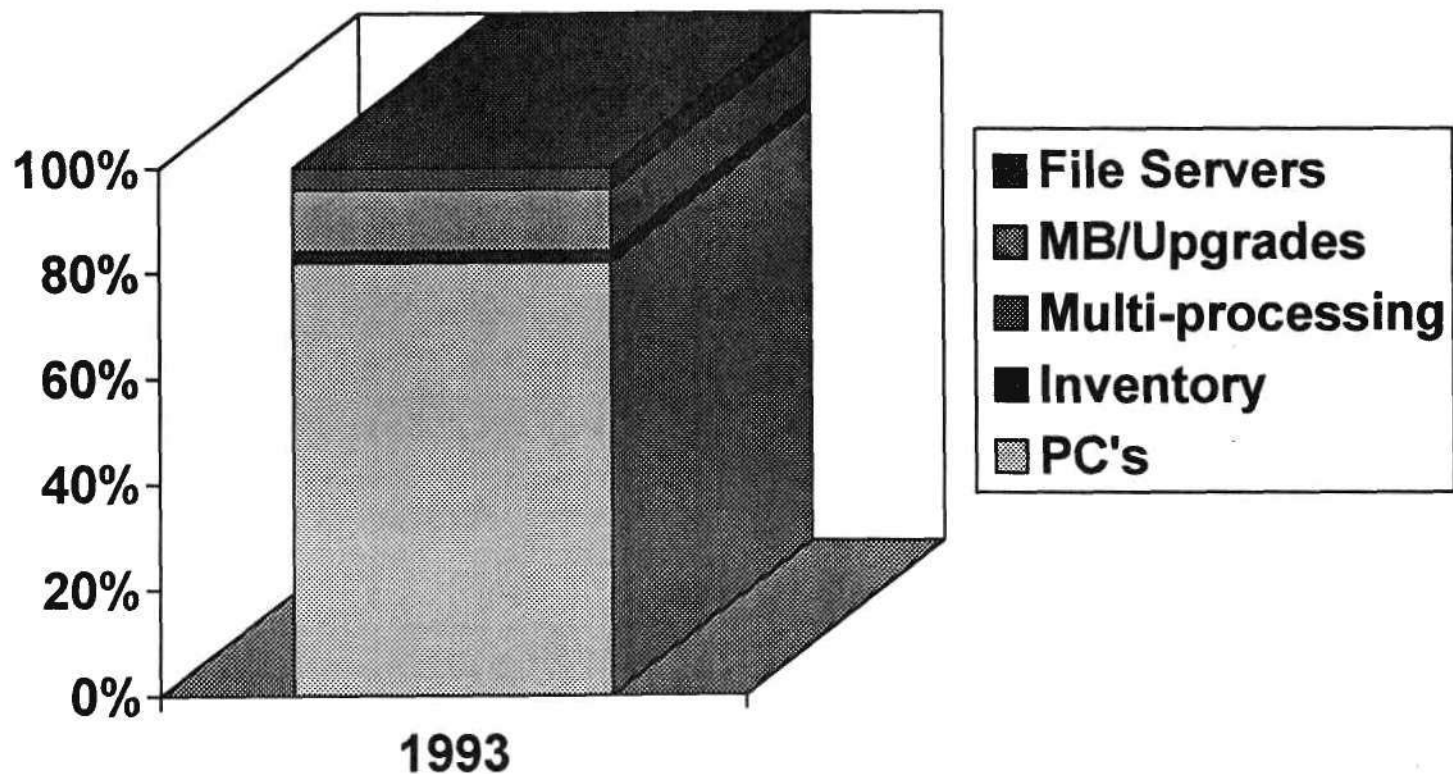
- ♦ PC's remain the principal market force
- ♦ Multi-media demands higher performance
- ♦ PCI becoming the bus of choice

PC Unit Forecast



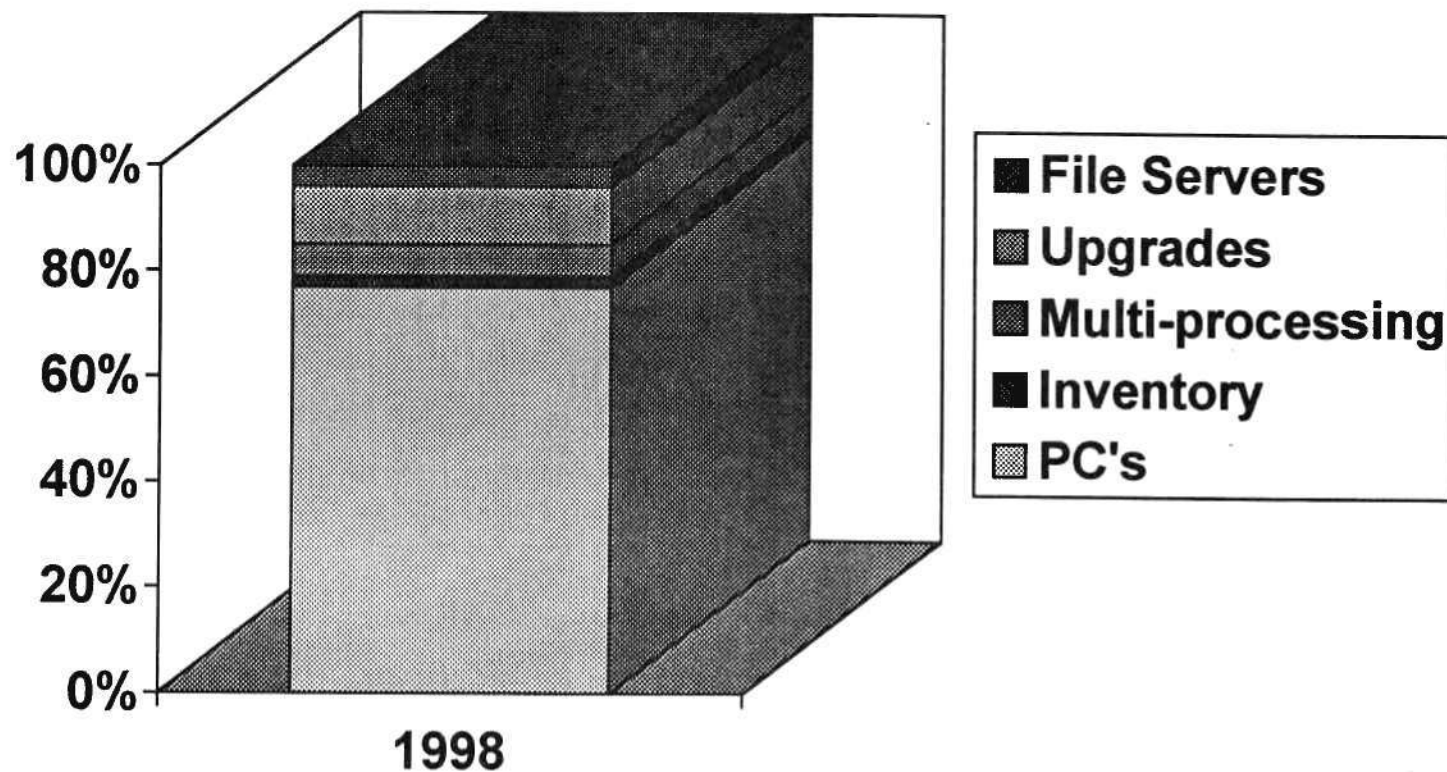
Dataquest

47 Million Microprocessors for Computers



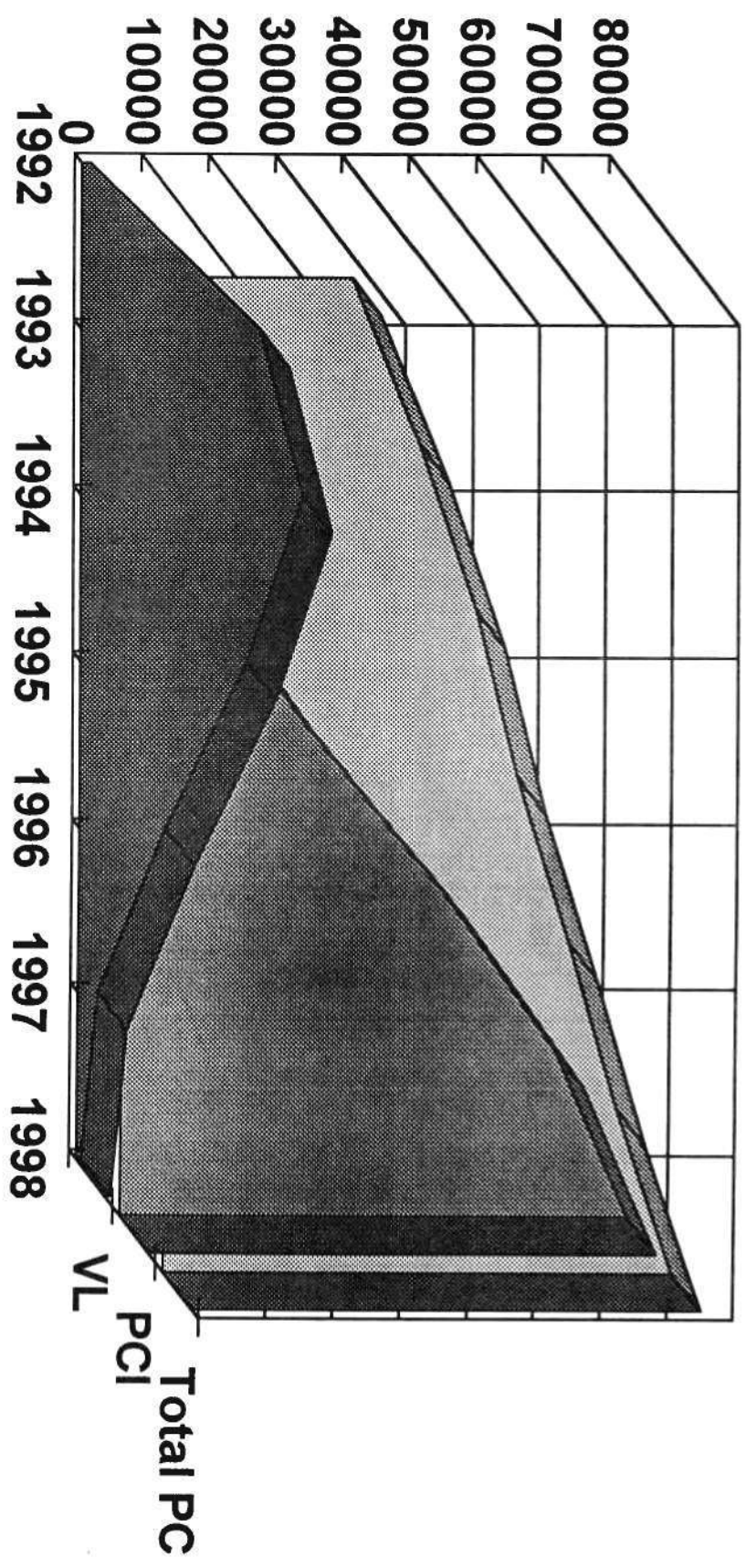
Dataquest

100 Million Microprocessors for Computers



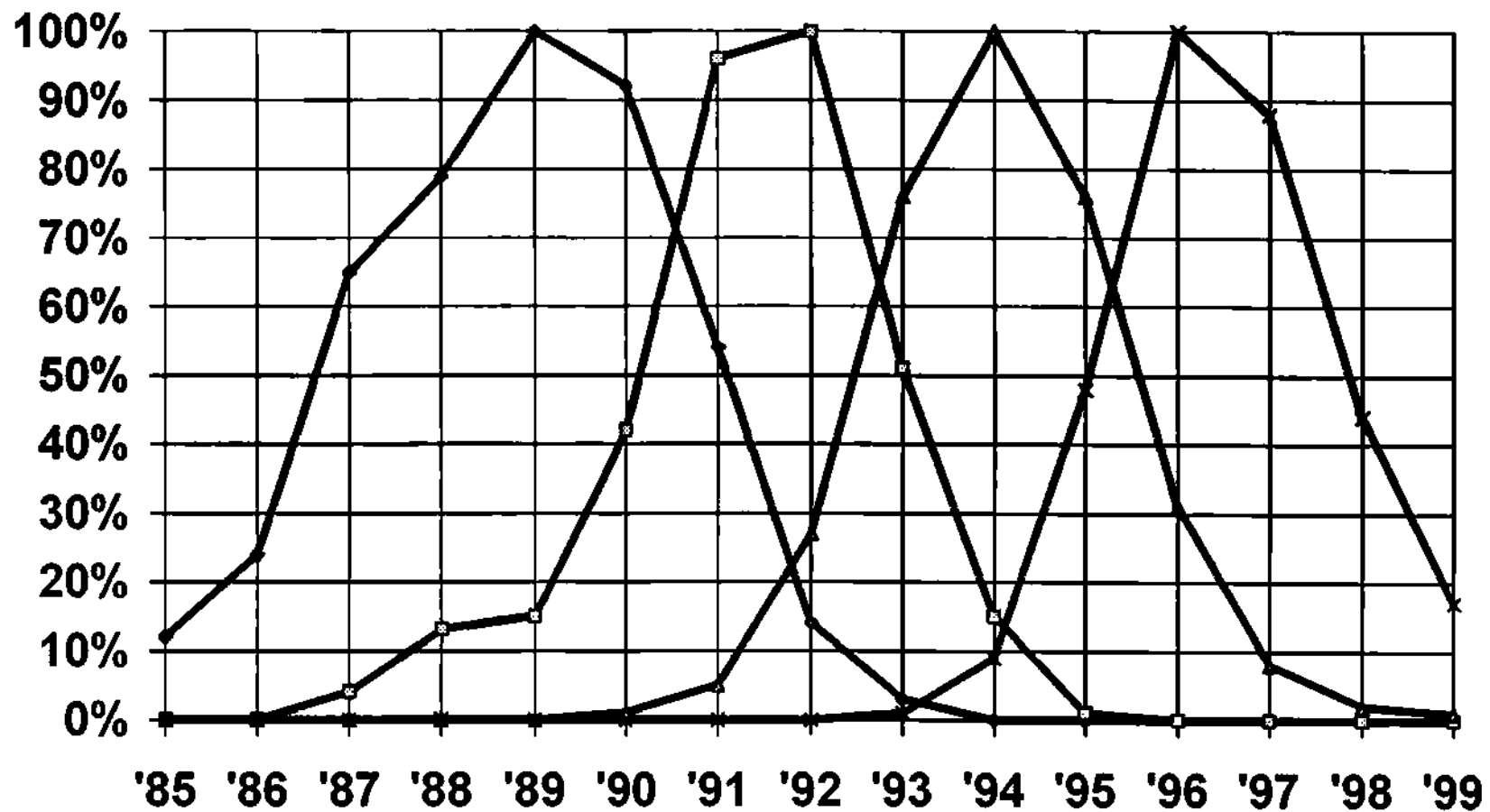
Dataquest

Local Bus Forecast



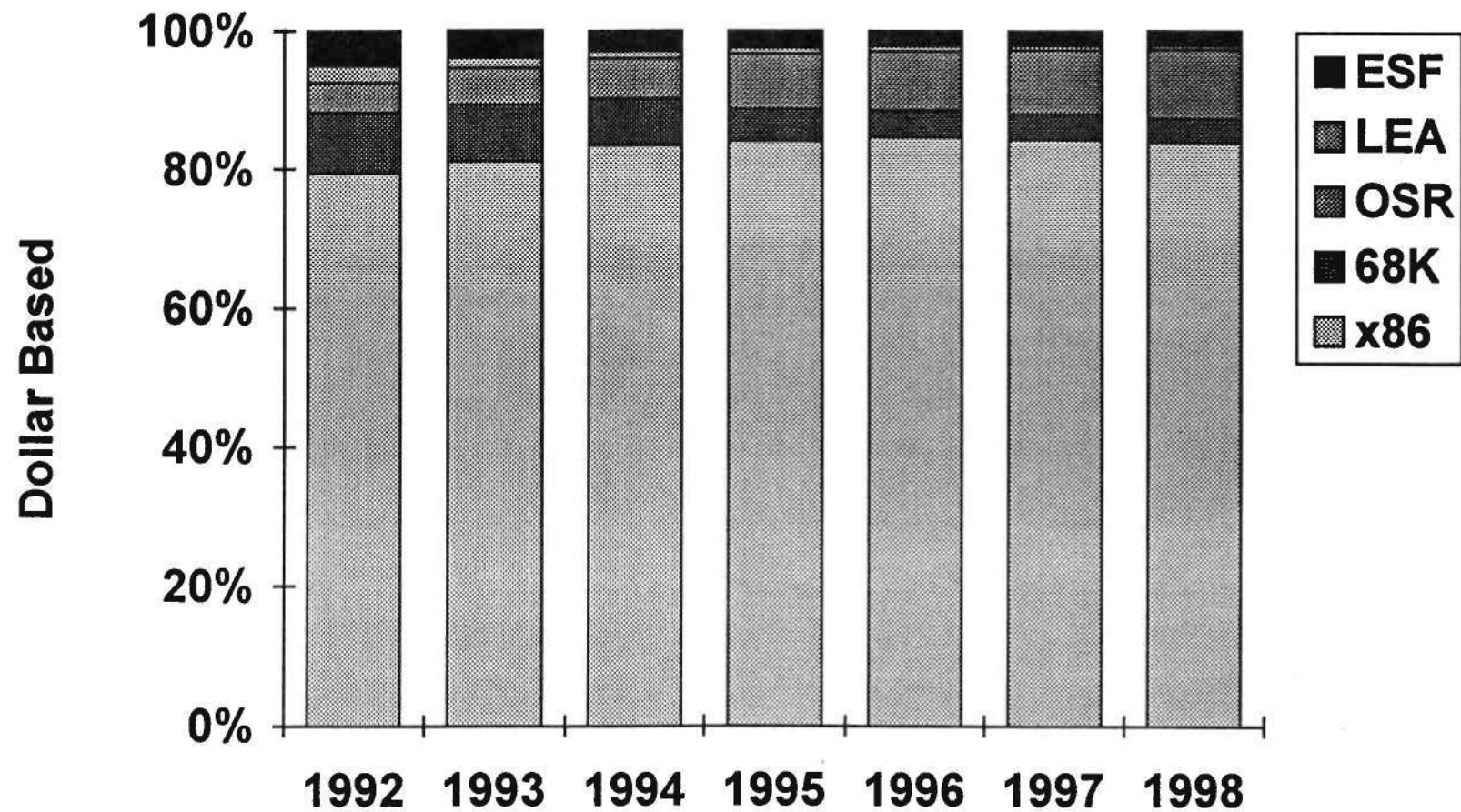
Dataquest

X86 Lifecycle



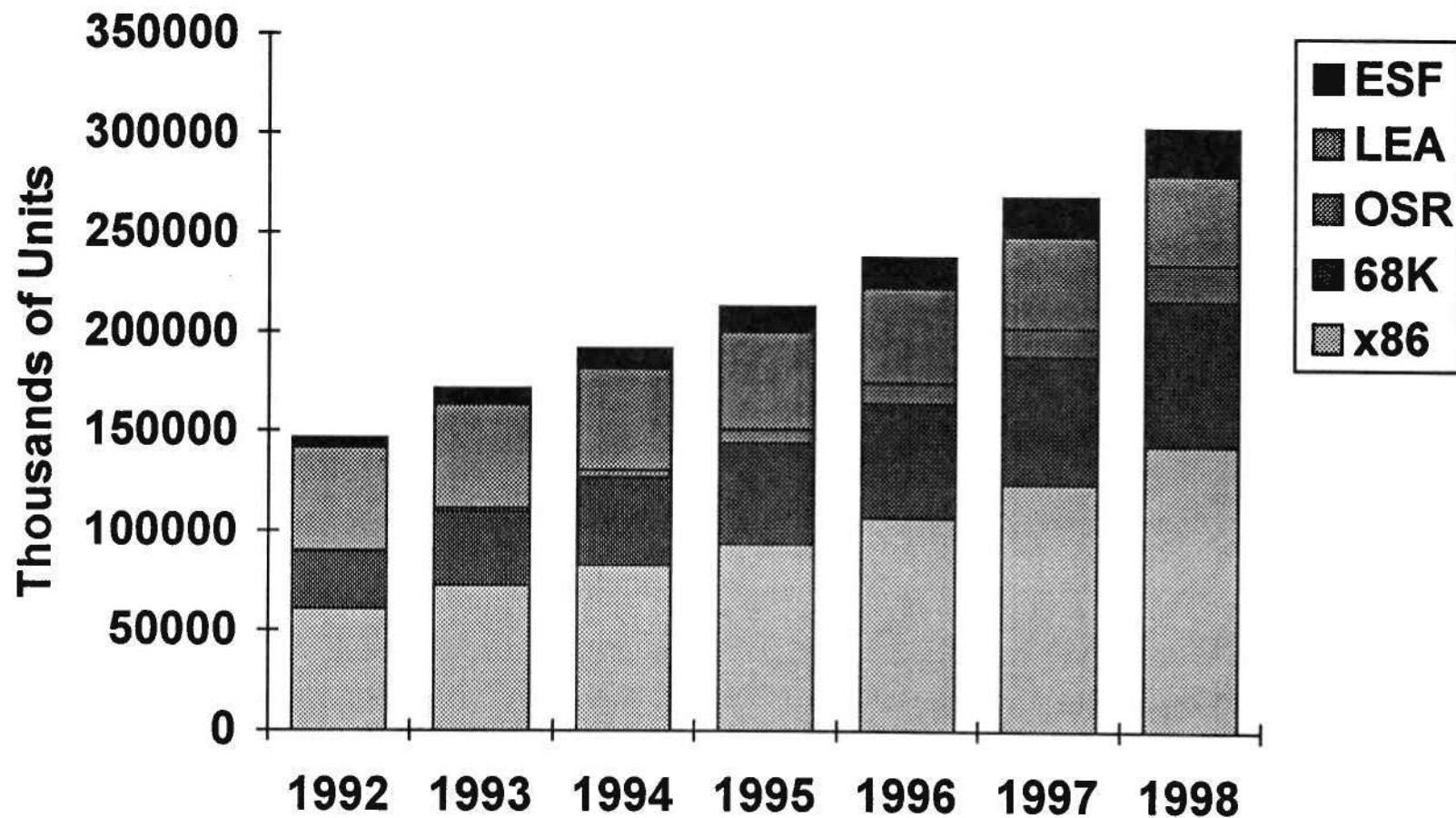
Dataquest

MPU Product Forecast



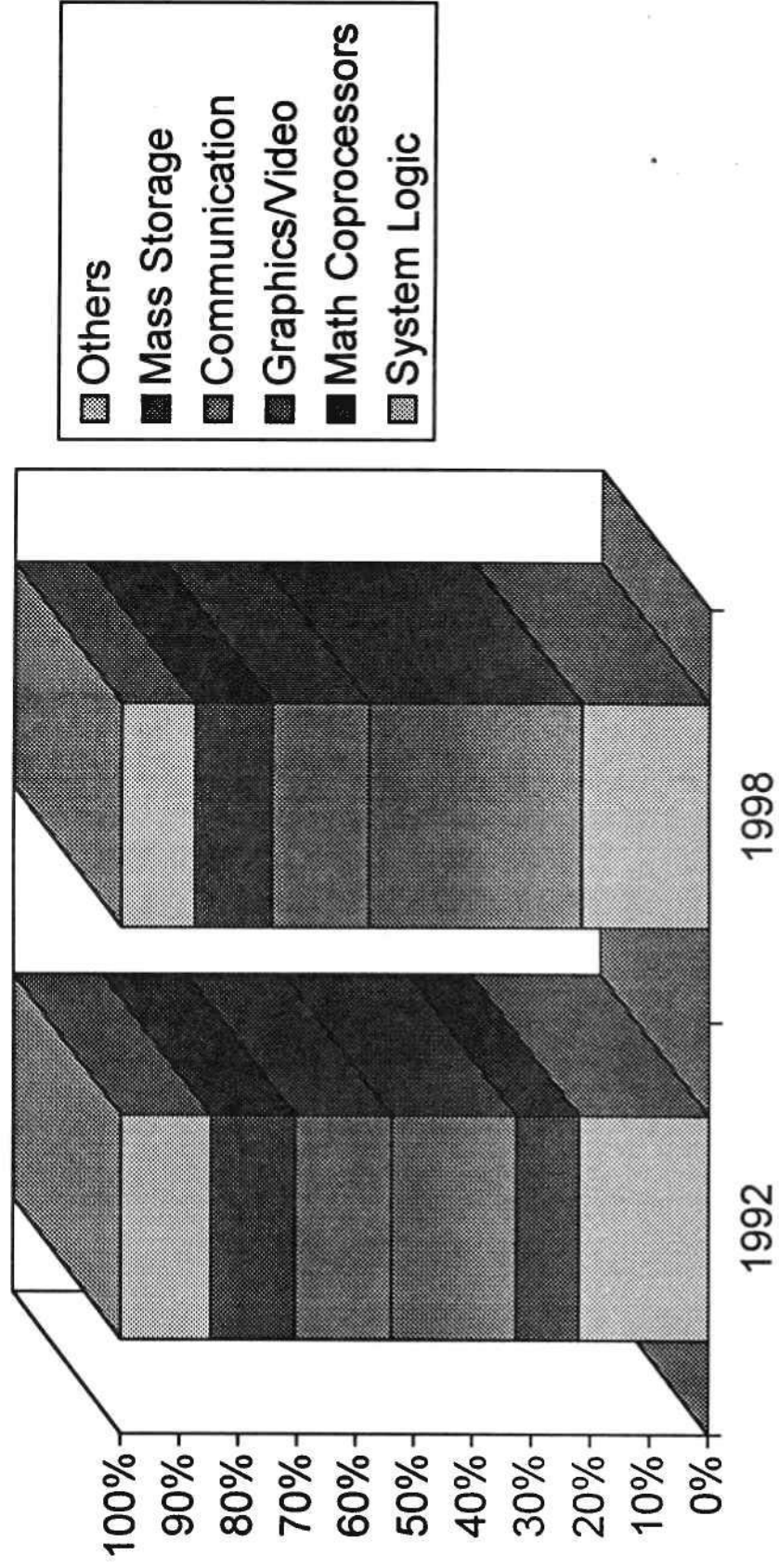
Dataquest

MPU Product Forecast



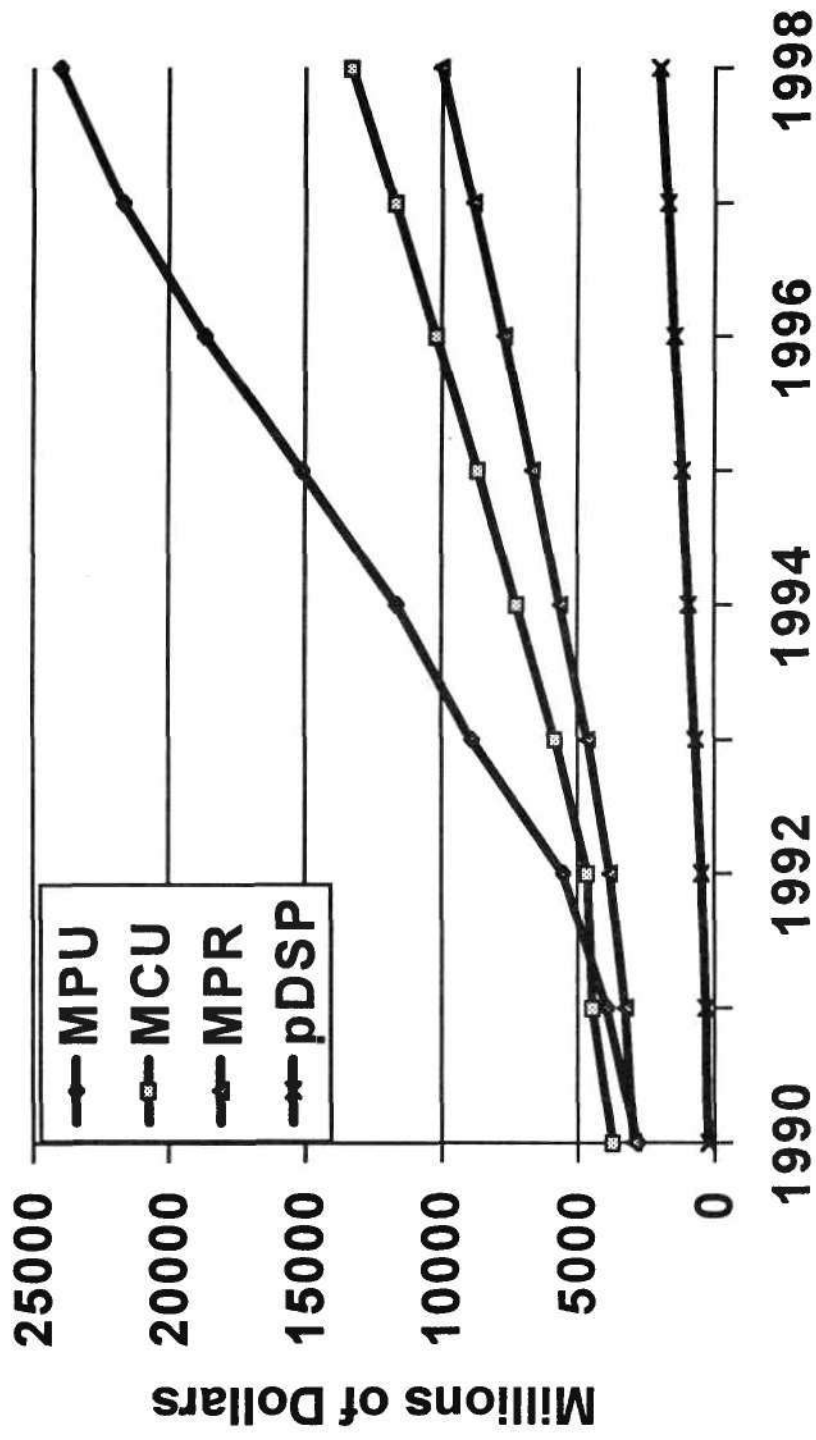
Dataquest

Microperipheral Product Forecast



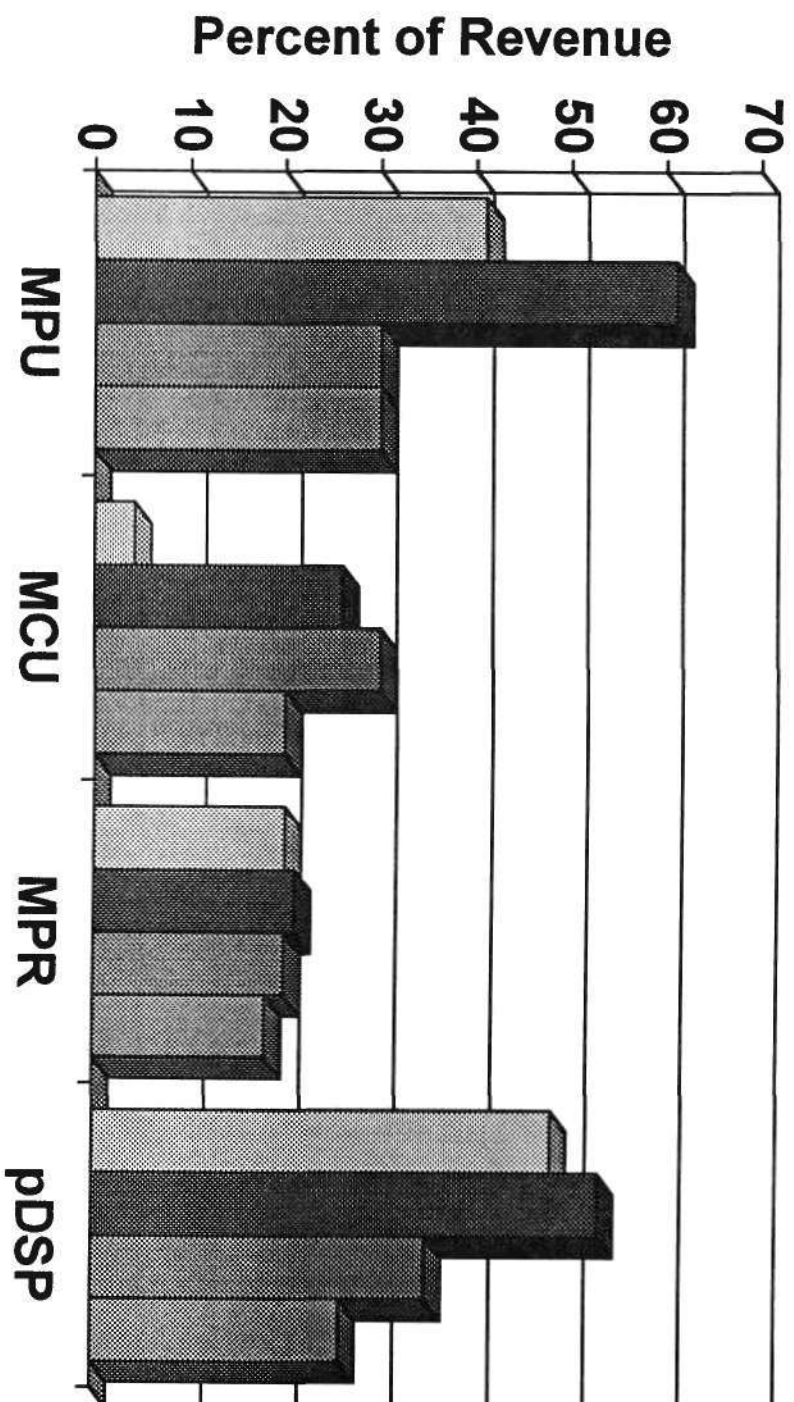
Dataquest

Microcomponent 5 Year Forecast



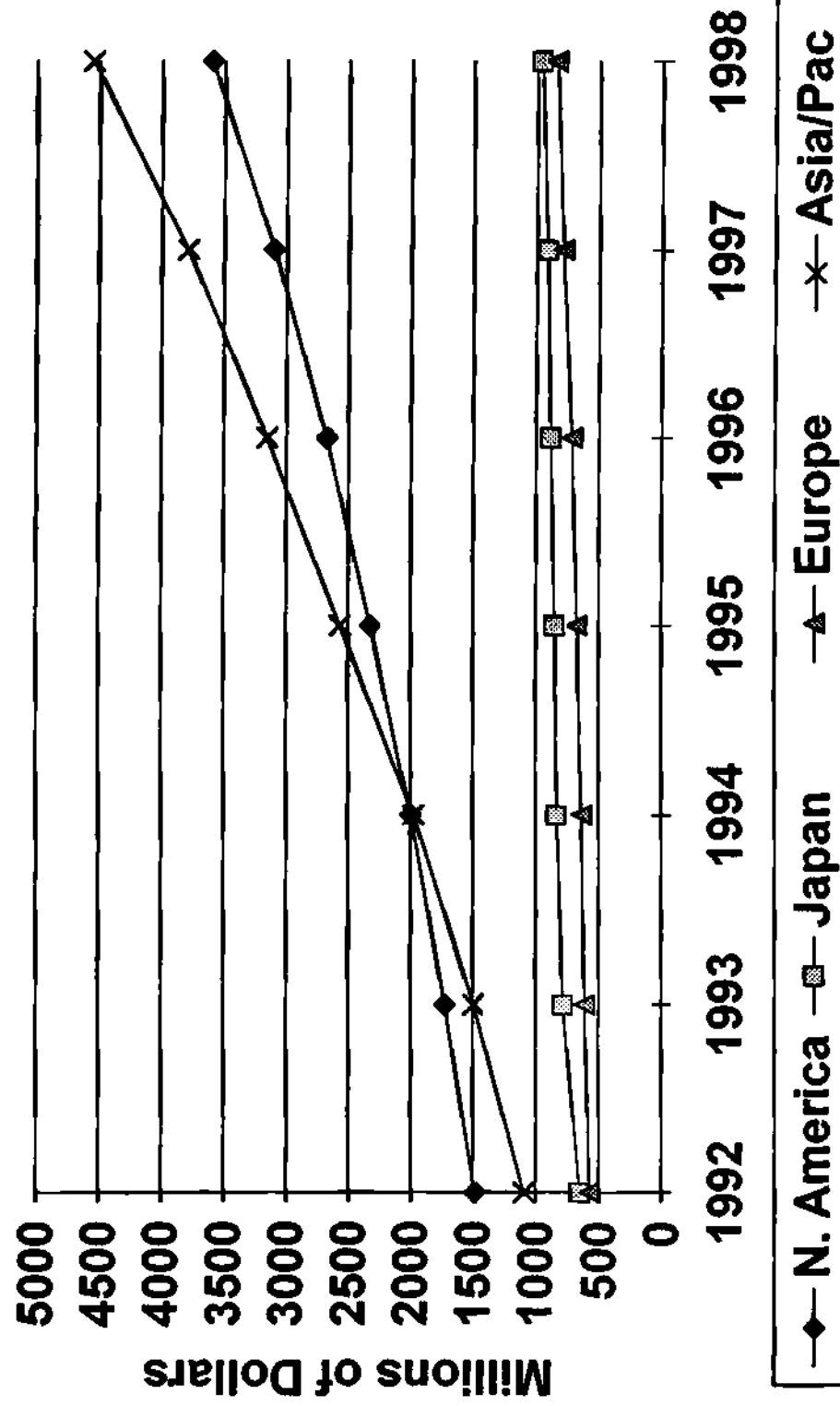
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Microcomponent Growth



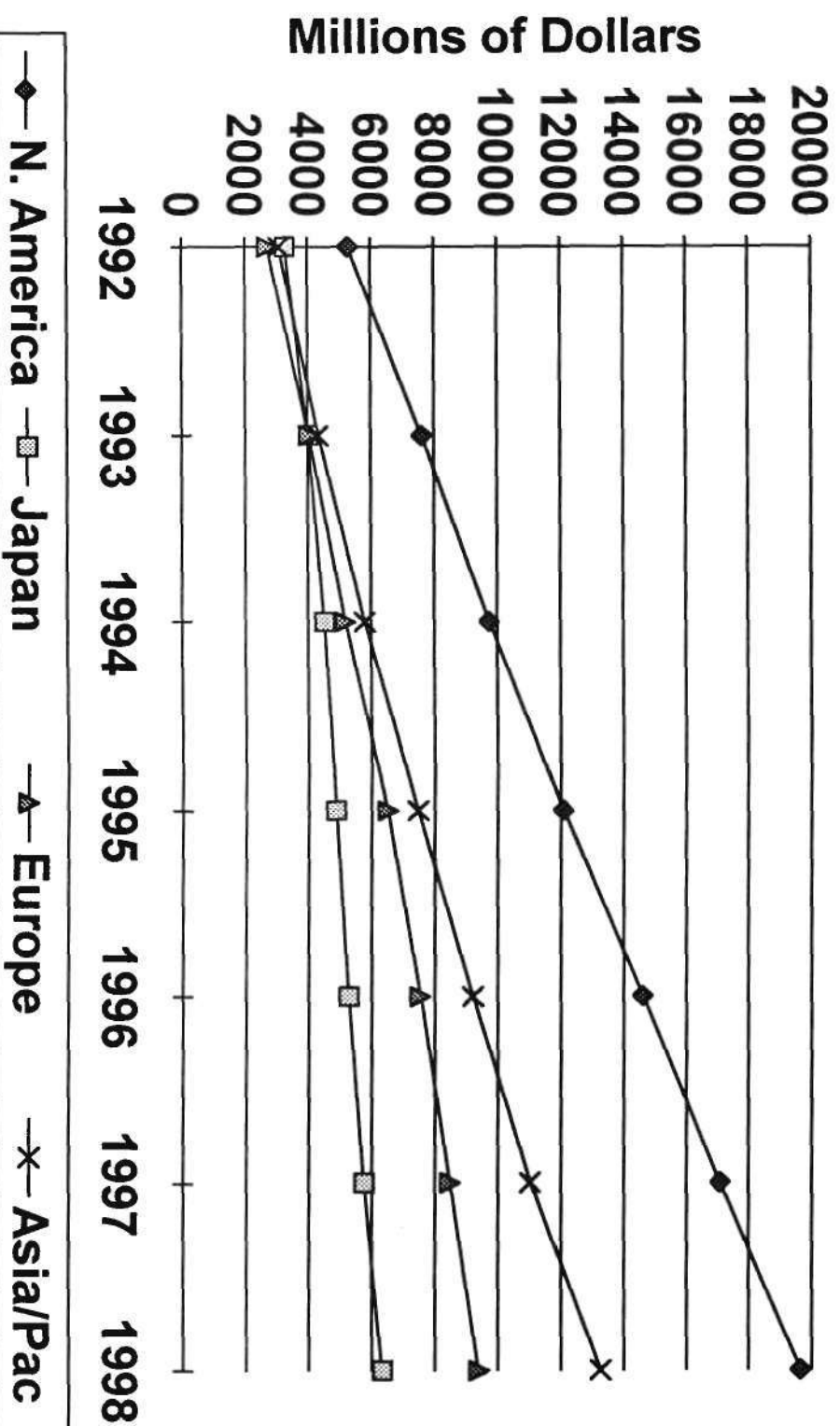
Dataquest

Microperipheral Forecast by Region



Dataquest

Microcomponent Forecast by Region



Dataquest

Summary

- ♦ PC's continue to be The Driver
- ♦ Microprocessors continue on performance curve
- ♦ Pentium poised for tremendous growth
- ♦ Windows 4.0 to become dominant OS
- ♦ X86 dominance continues through 1998
- ♦ PCI becoming bus of choice
- ♦ Chipsets consumed in region of m/b manufacture
- ♦ Microprocessors consumed in region of PC consumption

DSP World — The Decade of Converge Market

Albert Ying

ERSO/ITRI

Sept. 22, 1994



財團法人

工業技術研究院

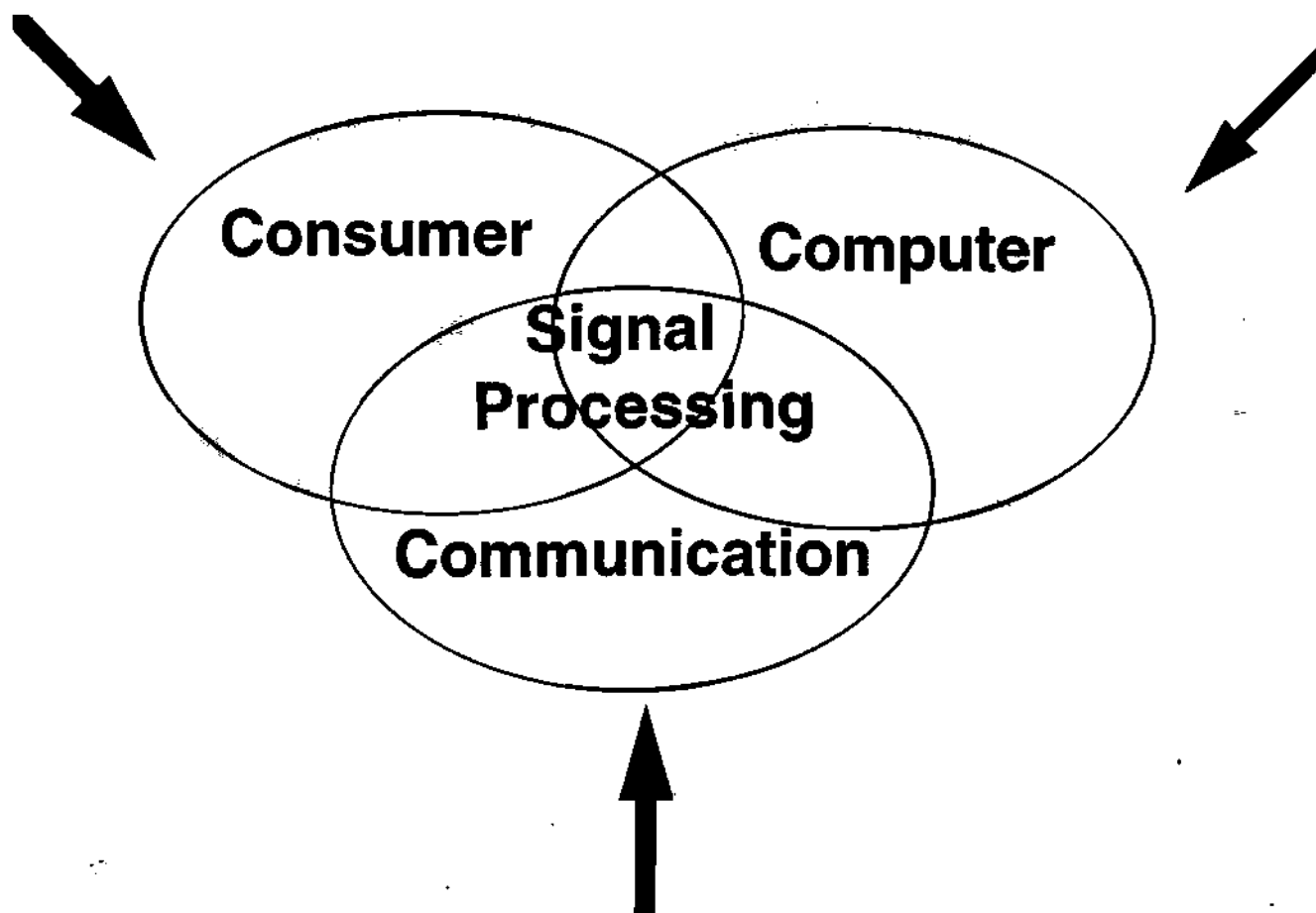
電子工業研究所

Outline

- **Introduction**
- **From Niche to Mainstream**
 - Suppliers said
 - Application trends
- **Welcome the New Era**
- **Summary**

Introduction

The Driving Technology for Converging Market



Historical Highlights

- 1838 Morse code telegraphy
(Digital communication begins)
- 1876 Age of signal begins
(Bell`s Undulatory currents)
- 1906 Alalog modulation of radio
- 1922 Electronic phonograph recording
- 1925 TV experiments
- 1951 First Univac sold
(Digital processing for unnmbers)
- 1977 `Digital audio processor` IC - Rockwell
- 1978 TI offers `speak and spell` product
- 1982 TI offers first programmable DSP
- 1984 Compact disk audio arrives

Source: Dataquest

Why DSP?

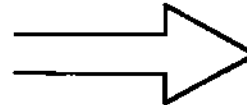
- **Cost effectiveness**
- **Reliability**
- **Stability**
- **Controllability**
- **Flexibility**
- **Multi-functionability**



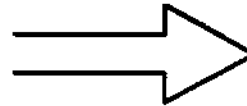
Application Characteristics of DSP

Application Requirement

Real Time Processing



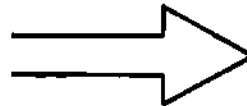
Large array of data



Algorithm



System
flexibility



Processor Attributes

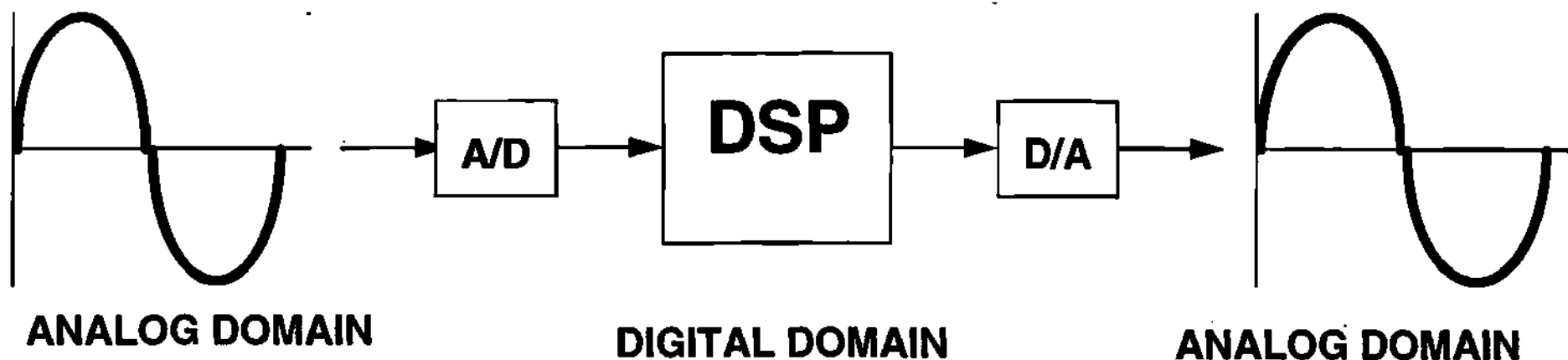
High speed,
high throughput

Instruction to move
and process large
data array

Fast mathematical
computations

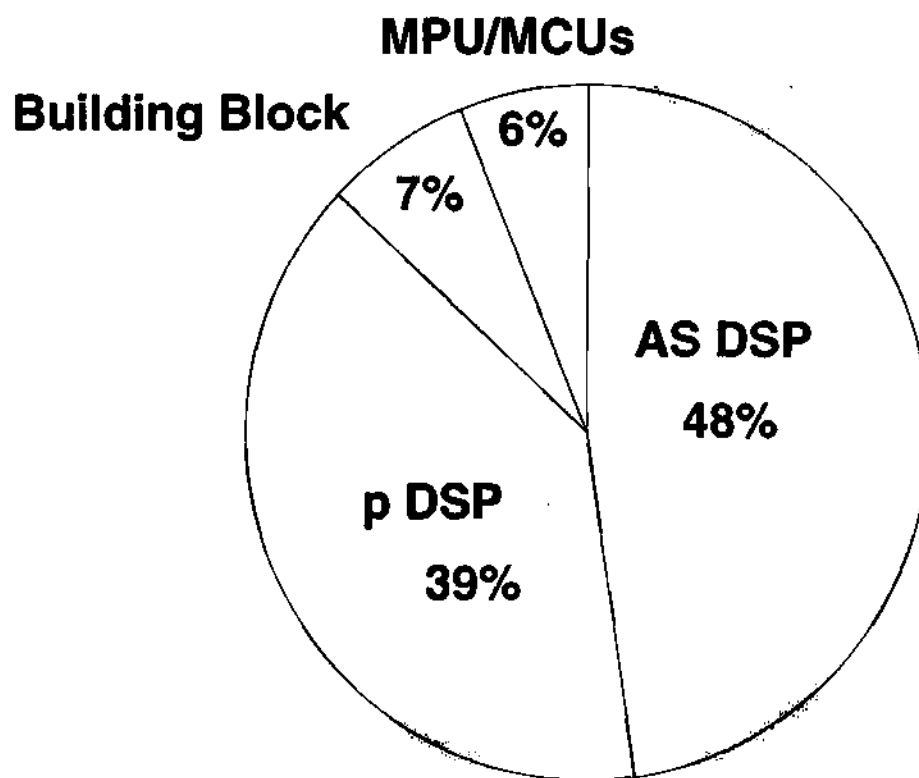
General purpose
programmability
EPROM, MC/MP
mode

What Is DSP ?



- Digital signal processing is concerned with the representation of signals by sequences of numbers, and the transformation or processing of such signal representations by numerical computation procedures.

Revenue Distribution of DSP

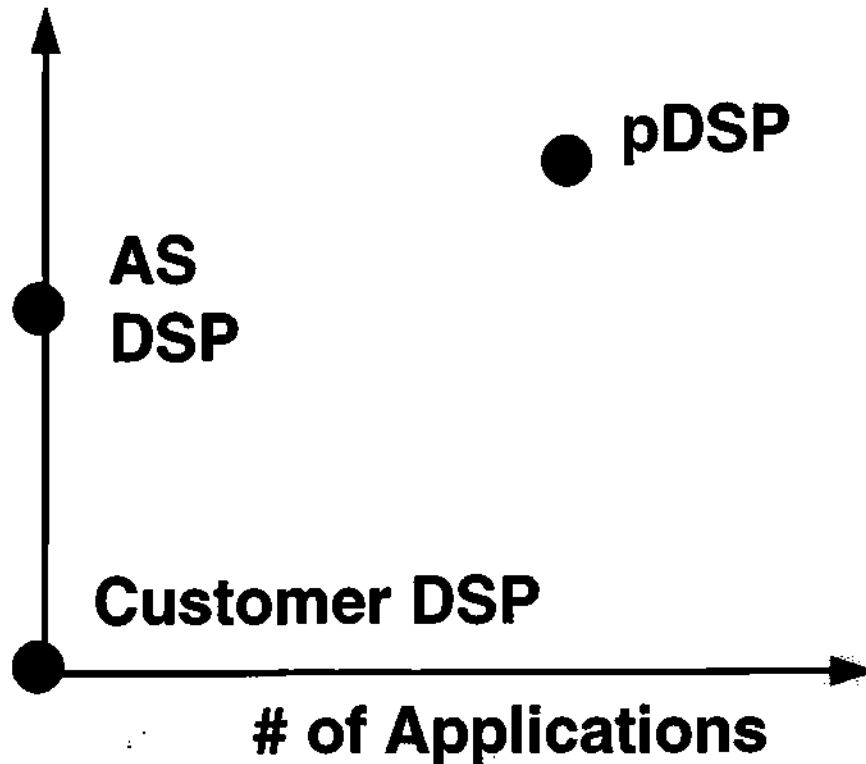


Source : Semiconductor Industry & Business Survey,
ERSO/TRI ITIS Project



Programmable V.S. Fixed

of
Customers



Programmable

- Flexible
- Upgradable

Fixed

- Lower Cost
- Higher Performance

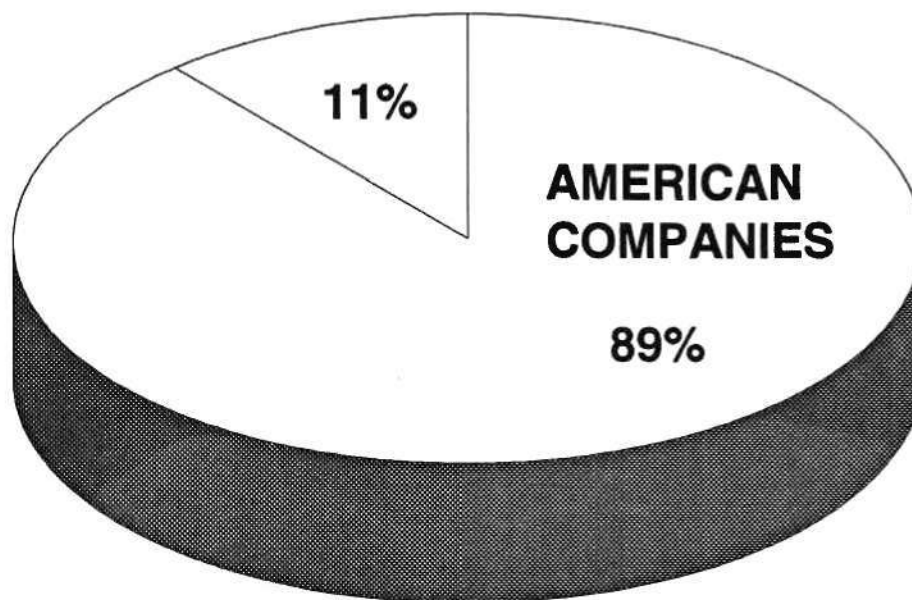
From Niche to Mainstream

- Suppliers said

Who are the Major Players ?

NEC
Fujitsu
Toshiba
Hitachi
Sanyo
Matsushita

Japanese Companies

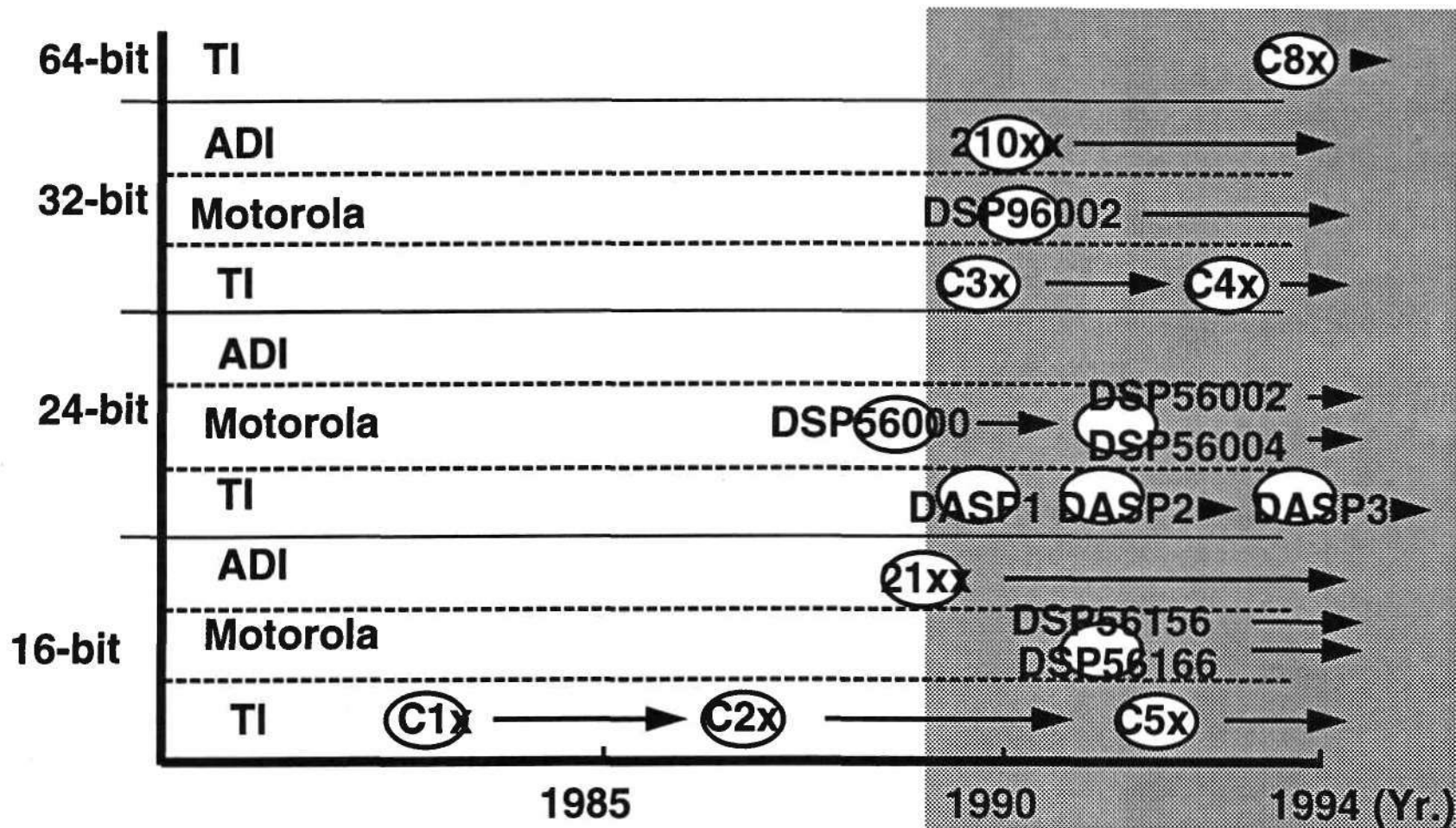


TI
AT&T
Motorola
Analog Devices
Microchip

Source : Dataquest, ERSO/ITRI ITIS Project

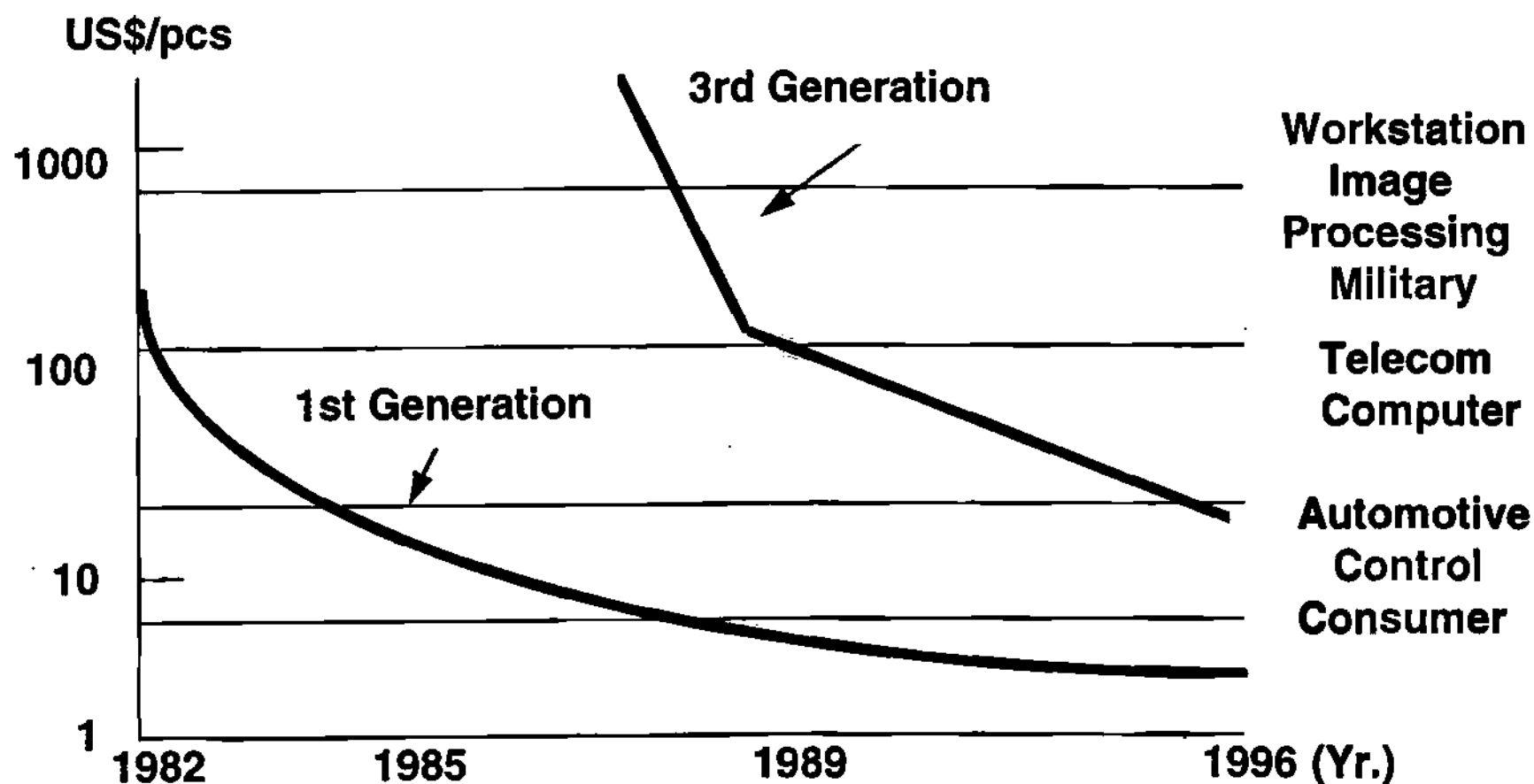


Road Map of Major Vendors



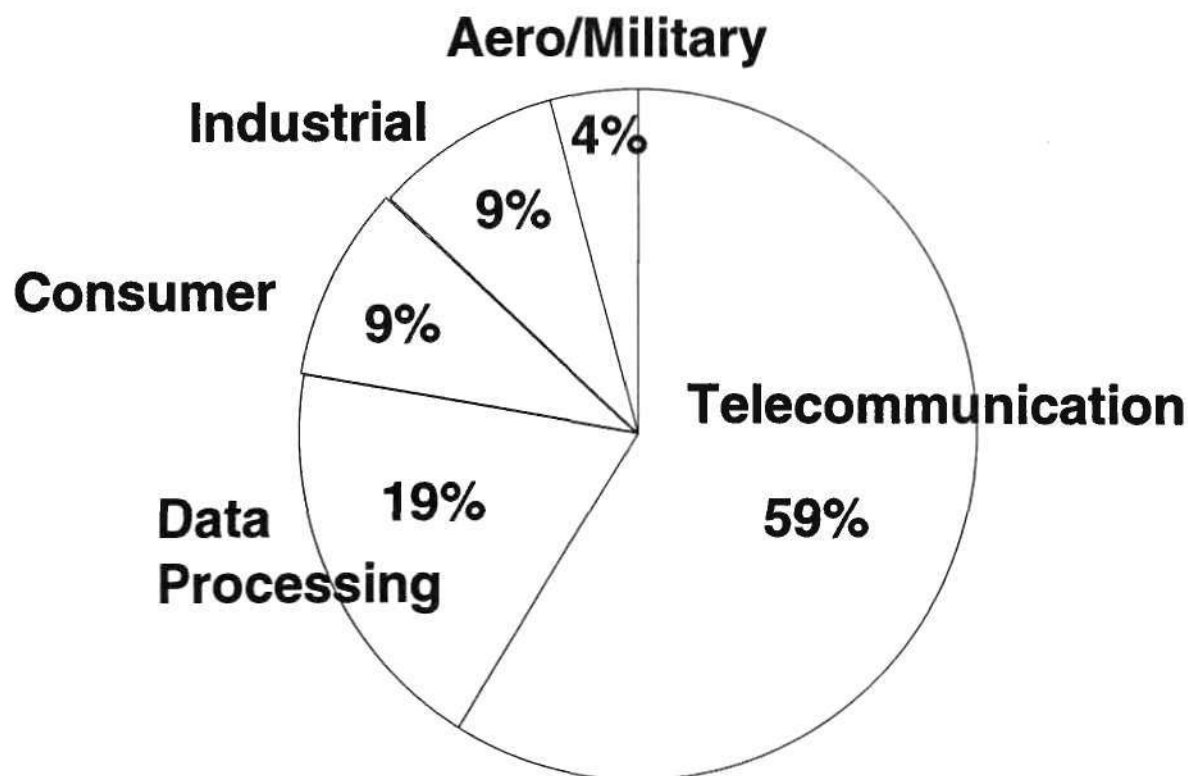
Source: ERSO/ITRI ITIS Project

Application Thresholds of DSP



Source: TI

Where Was pDSP Heading at in 1993

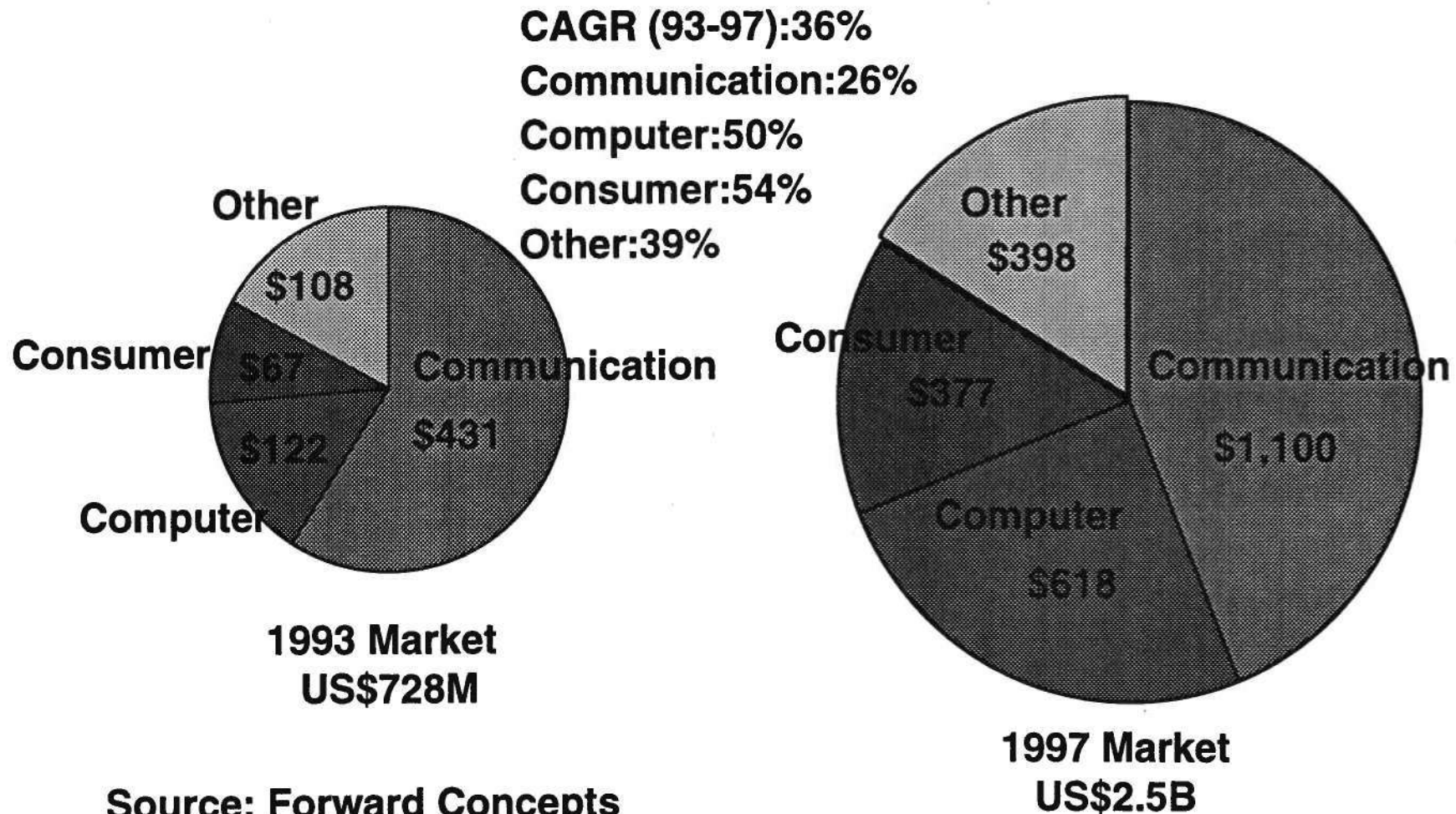


Source : Forward Concepts , ERSO/ITRI ITIS Project

From Niche to Mainstream

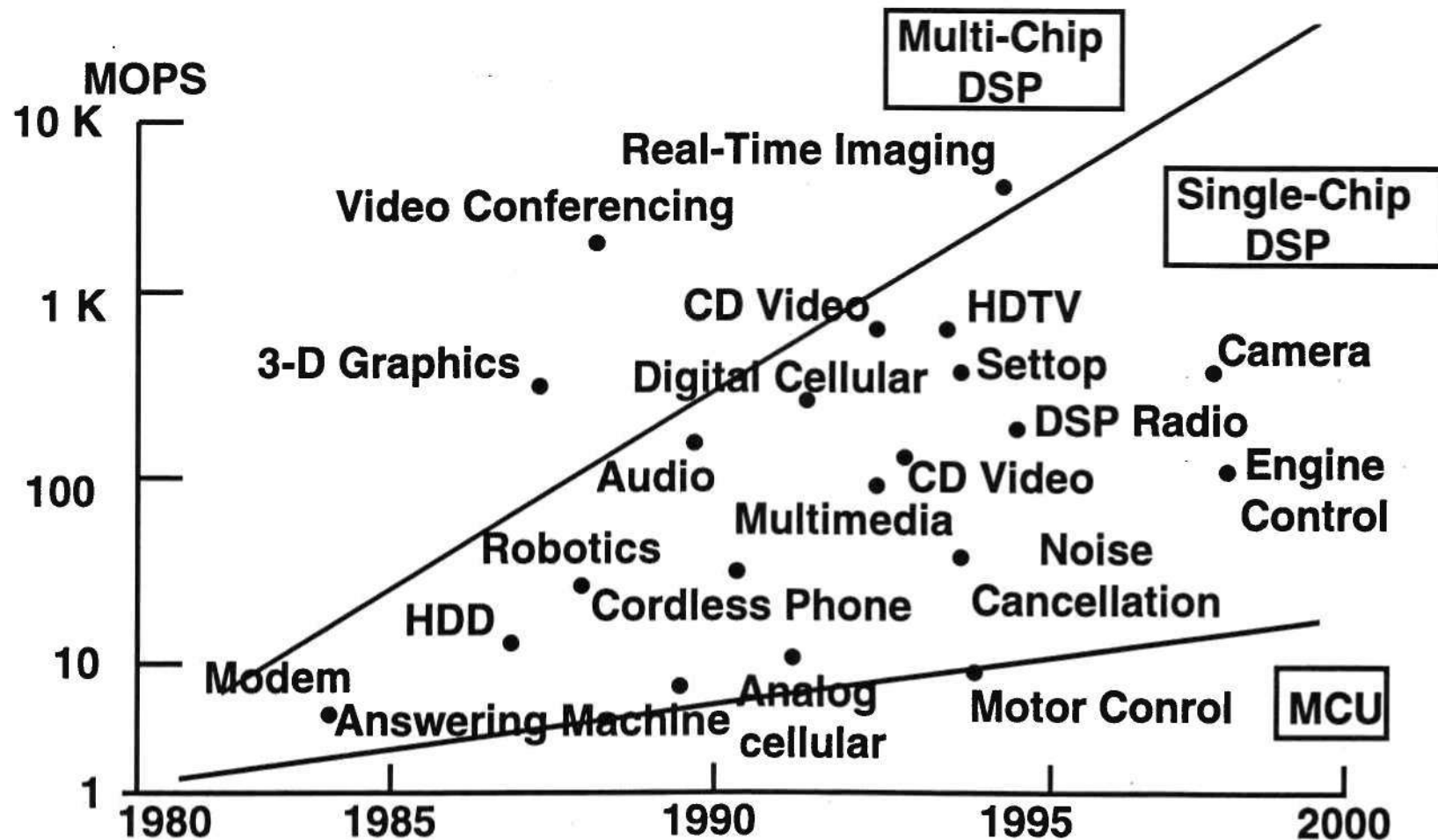
- Application trends

Market Race Begins



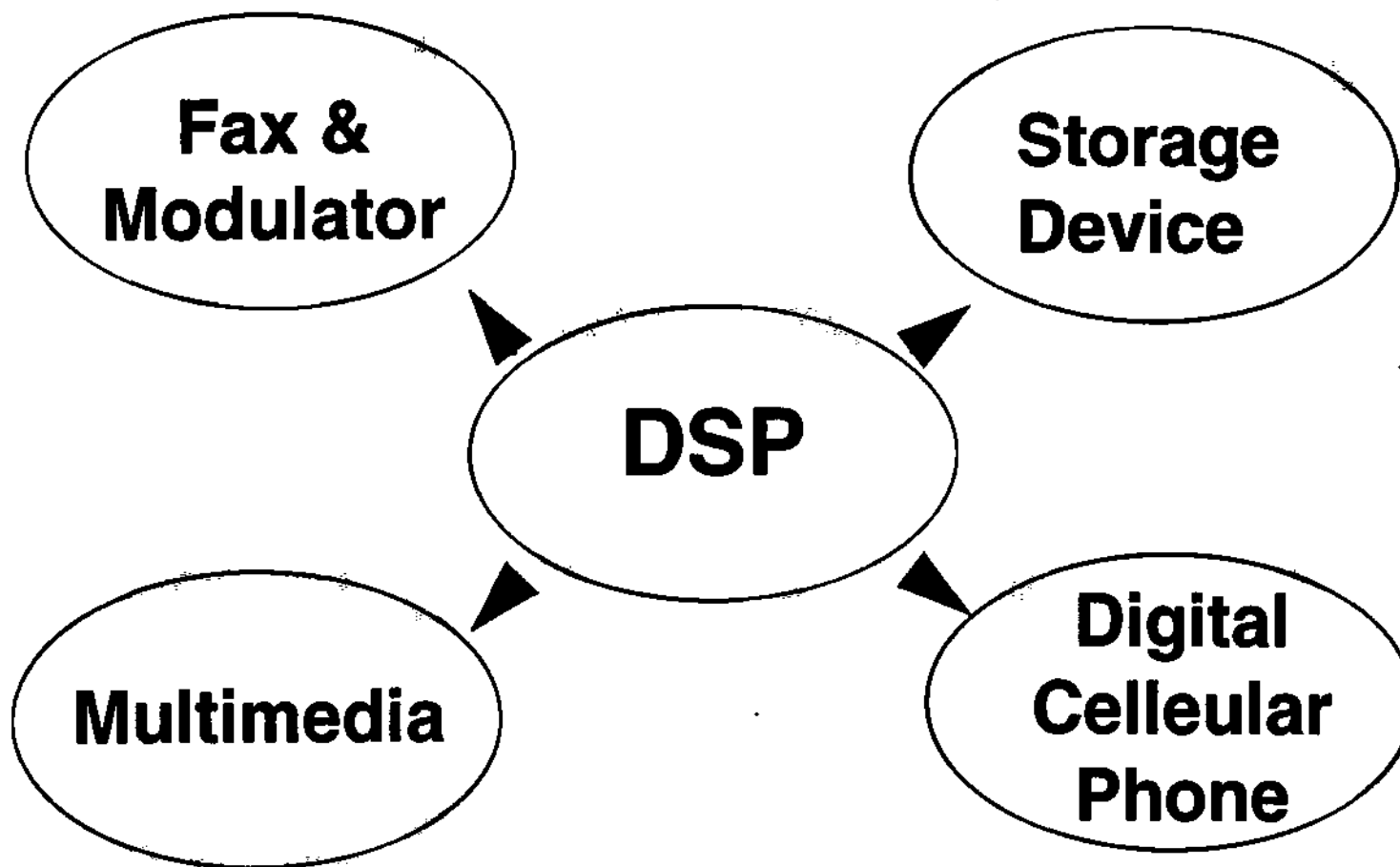


DSP-Enabled Applications



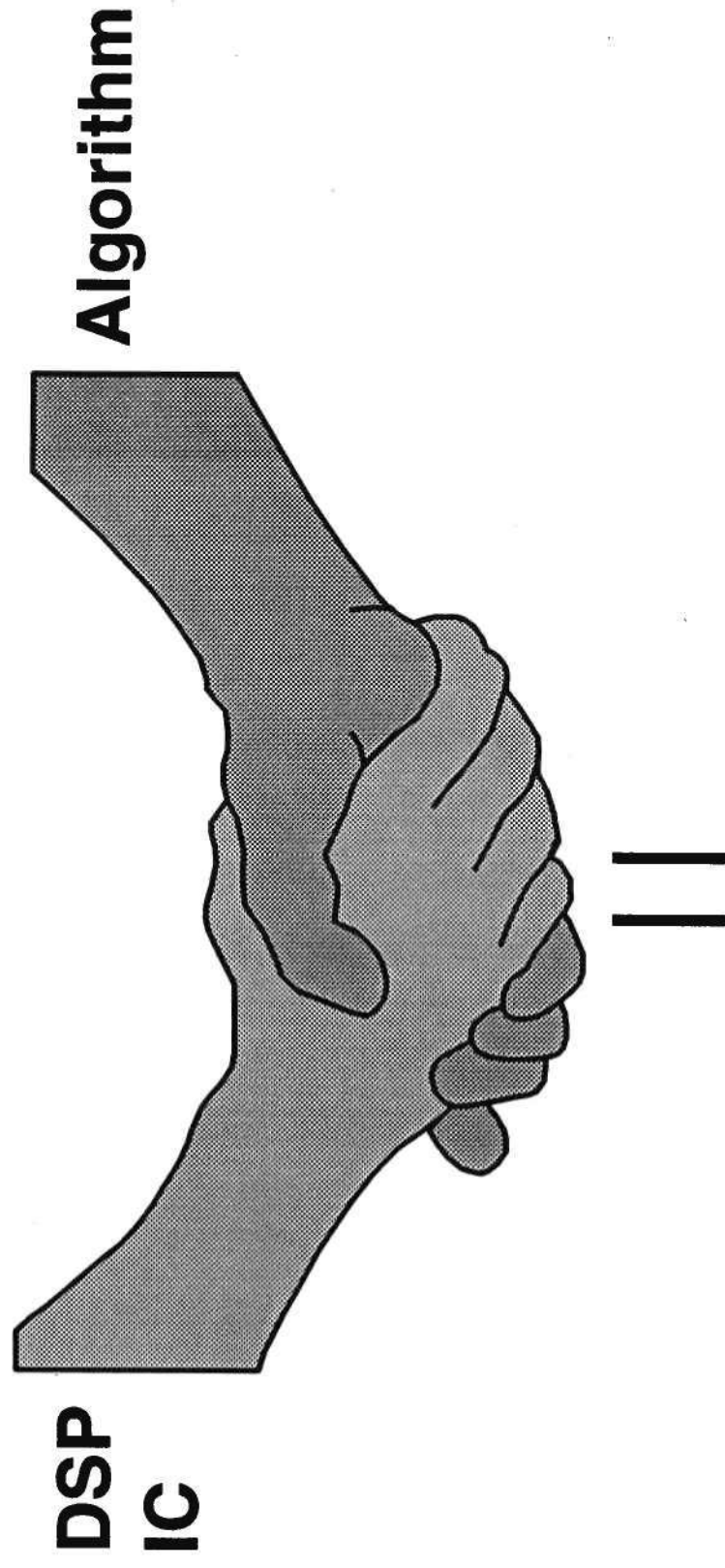
Source: TI

Most Potential Applications



Welcome the New Era

Most Attractiveness of DSP

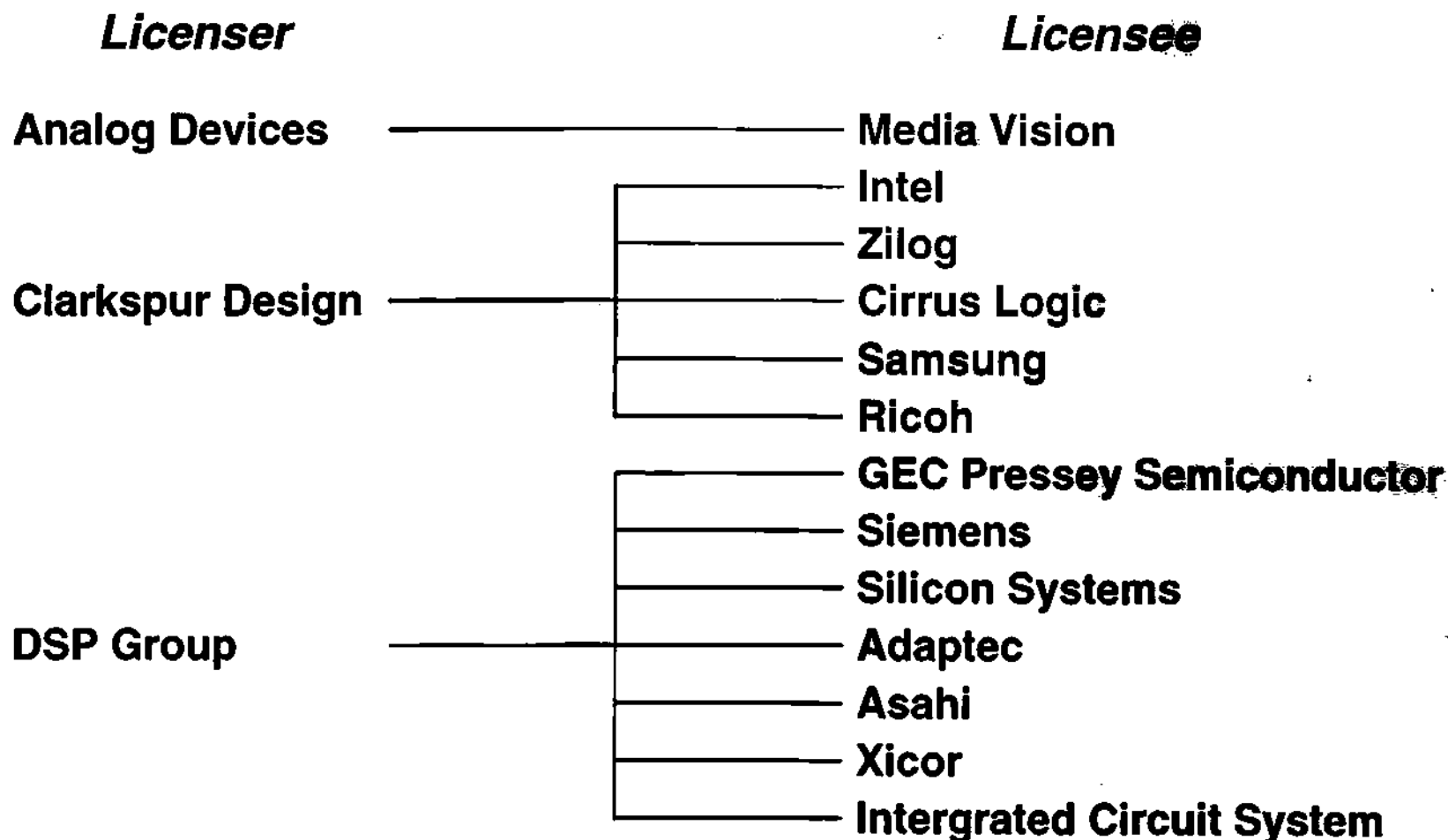


DSP Technology

Successful Factors of DSP

- **Commitment**
- **Knowledge**
- **Price**
- **Performance**

The Upside of Licensing

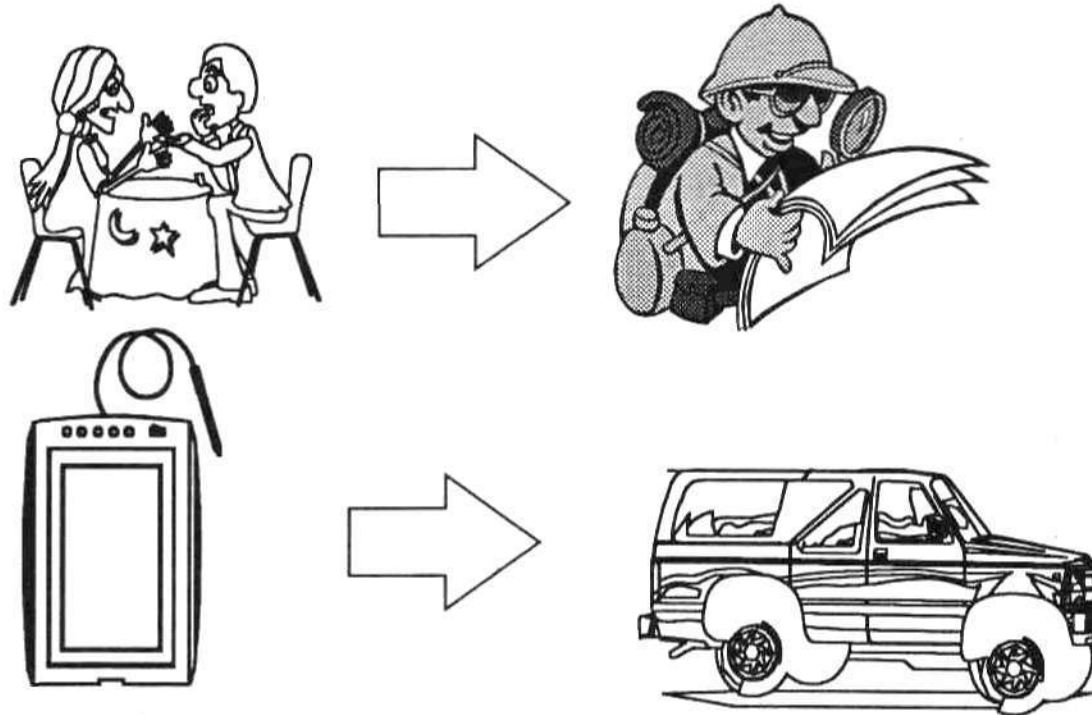


Source : EE Times, ERSO/ITRI ITIS Project

Summary

- **The converge market is maturing, so**
- **DSP gains the opportunity from niche to mainstream**
- **Is DSP not a product, but a kind of technology**
- **Application demand is the major driving force for DSP market, and**
- **Its CAGR will exceed 36% in the next few years**

Palmtops to Pathfinders—Predicting the Electronic Future



**ERSO/ITRI-Dataquest Semiconductor Seminar
September 22, 1994**

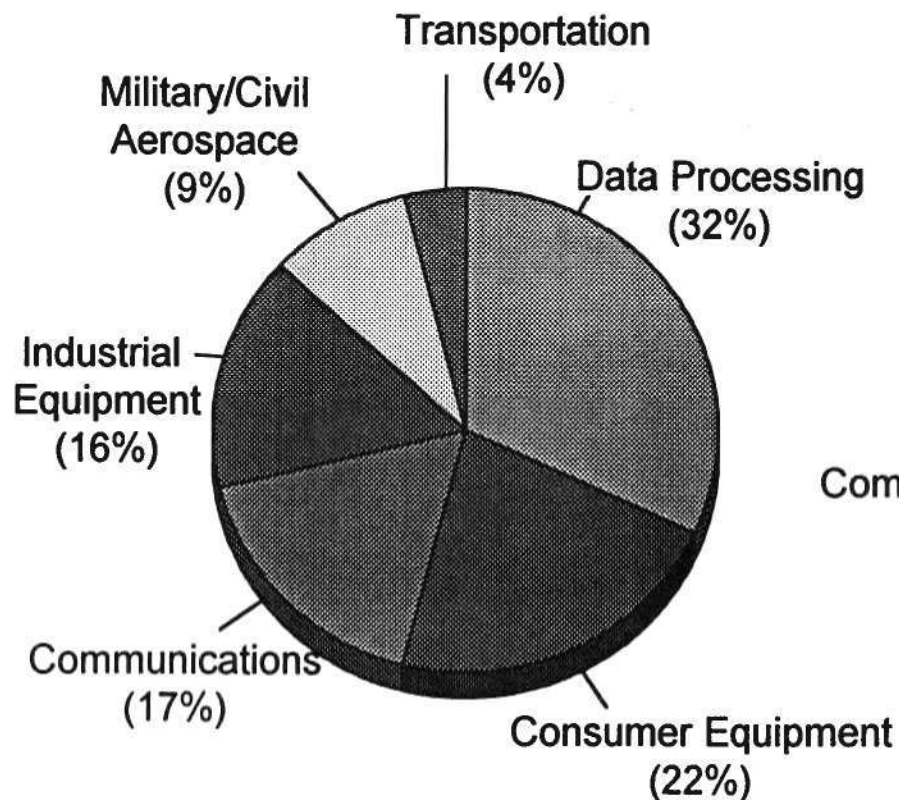
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AGENDA

- Worldwide Electronics Industry Overview
- Computers
 - Personal Computers & Multimedia
- Computer Storage Systems
- Computer Peripherals
- Telecommunications
 - Communications Terminals
- Consumer Electronics (Interactive Products)
- Automotive Electronics
- Summary

Worldwide Electronic Equipment Market, 1994

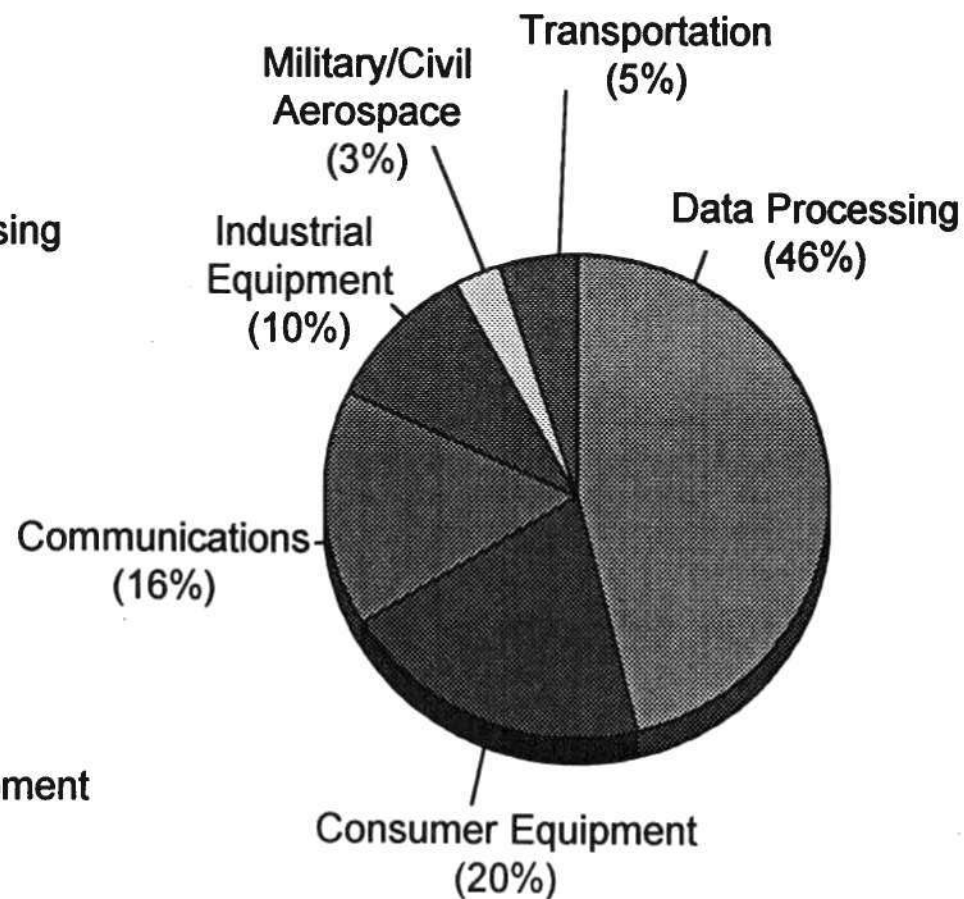


Total Market = \$671.2 Billion

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Worldwide Semiconductor Market, 1994

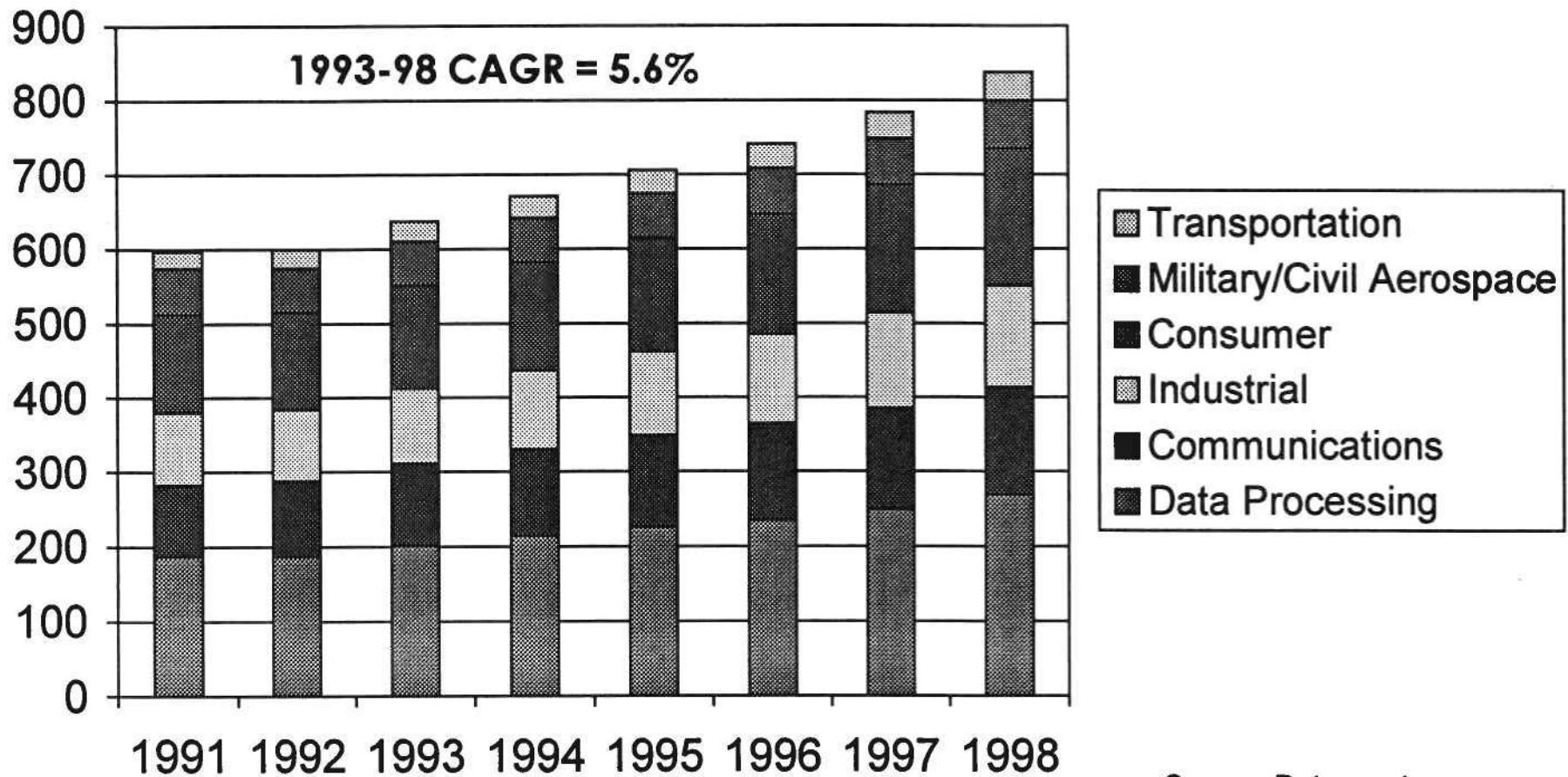


Total Market = \$101.3 Billion

Source: Dataquest

Worldwide Electronic Equipment Production Revenue Will Grow to \$838 Billion by 1998

Billions of U.S. Dollars



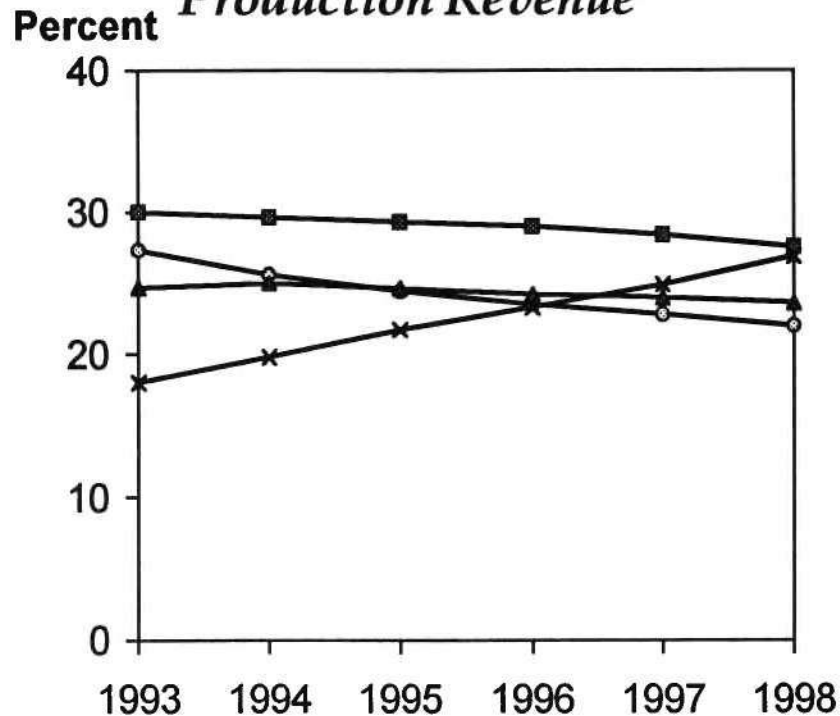
Source: Dataquest

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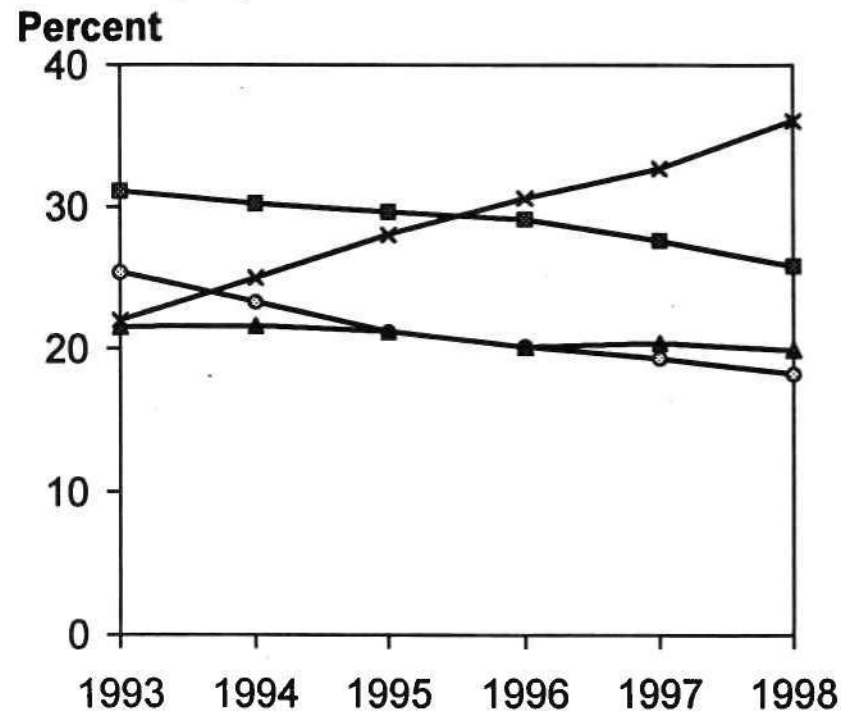
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Dramatic Production Shift to the Asia/Pacific Region

Regional Share of Worldwide Electronic Equipment Production Revenue



Regional Share of Data Processing Equipment Production



■ North America ◇ Japan
 ▲ Europe × Asia/Pacific

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Source: Dataquest

Opportunity Drivers

- Corporate downsizing
- Work-at-home/telecommuting
- Computer-based education and training
- “Green” initiatives
- User friendliness

New Technologies

- DSP and Compression
 - Telephony and multimedia
 - Digital video, audio, modem/fax
 - Video compression (MPEG, Indeo, H.261...)
 - Audio (ADPCM, Truespeech, MPEG)
- Battery (NiMH, Zinc air, ...)

New Technologies

- Displays

CRT size, resolution, refresh, power

LCD size, resolution, power, addressing

Alternatives: field emission, micro-mirror

- Input

Handwriting recognition

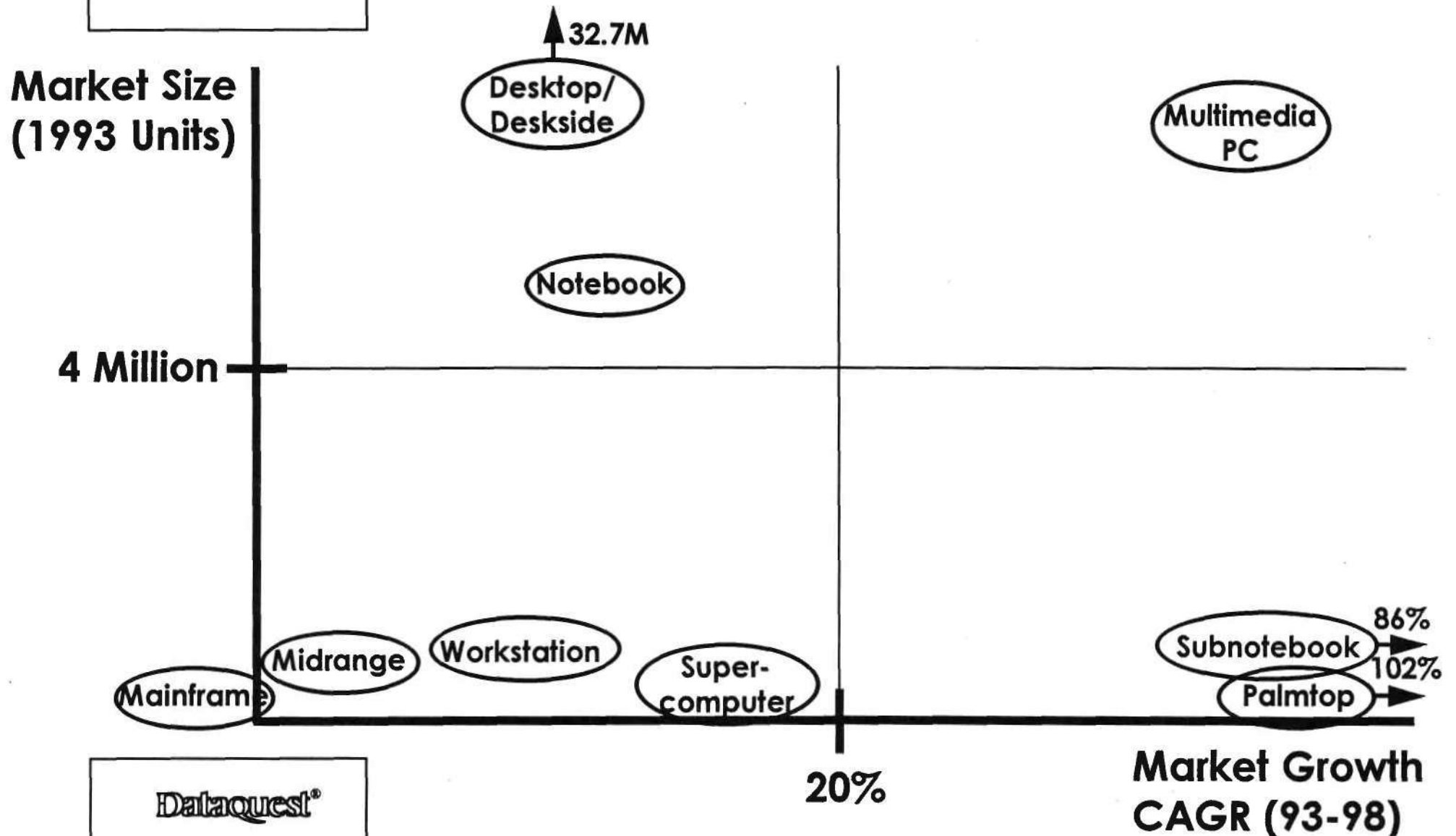
Touch screens/pads

Speech recognition

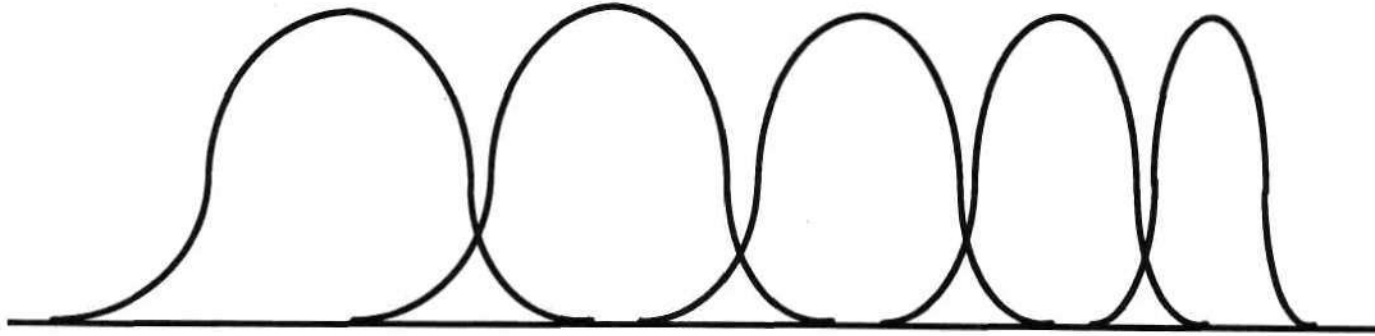
Standards Tracking

- Operating systems (Microsoft)
- MPU (Intel, x86...)
- Graphics (VESA, Microsoft, Open GL)
- Multimedia (VESA, MPC, IMA, Microsoft)
- Bus (Intel/PCI, VESA)
- Local interconnect (IEEE, EIA)
- LAN (IEEE)
- WAN (ITU)

By 1998 the Computer Market Will Reach 86 Million Units and \$182 Billion



Vicious PC Market Windows: PC Design Windows Open and Close Quickly



- MPUs (Pentium, P6, P7...)
- Buses (VL, PCI, PCMCIA)
- Graphics/Video (SVGA, Acc. Windows, Acc. Video)
- Inserting Sound
- DSP and Telephony
- 3 volt, "Green" redesigns

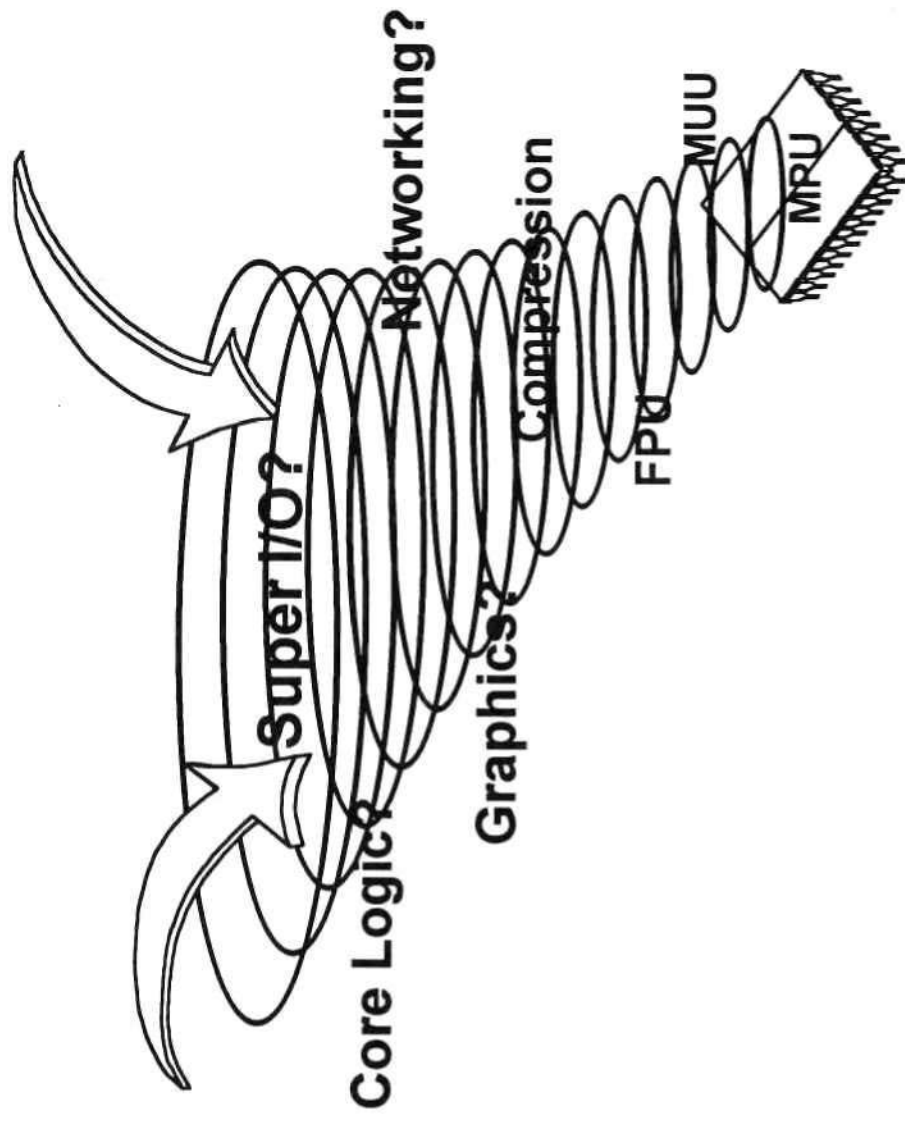
Vicious PC Market Windows

- MPUs (Pentium, P6, P7, ...)
- Buses (VL, PCI, PCMCIA)
- Graphics/Video (SVGA, Acc. Windows, Acc. Video)
- Inserting sound
- DSP and telephony
- 3 volt, "Green" redesigns

Semiconductor Subsystems

- CPU
- Cache
- Main Memory
- Core Logic
- Graphics, digital video, buffer
- Multimedia (video, audio)
- Serial/Parallel I/O
- Storage Control
- LAN and WAN (DSP-modem)

The MPU—Black Hole of the PC

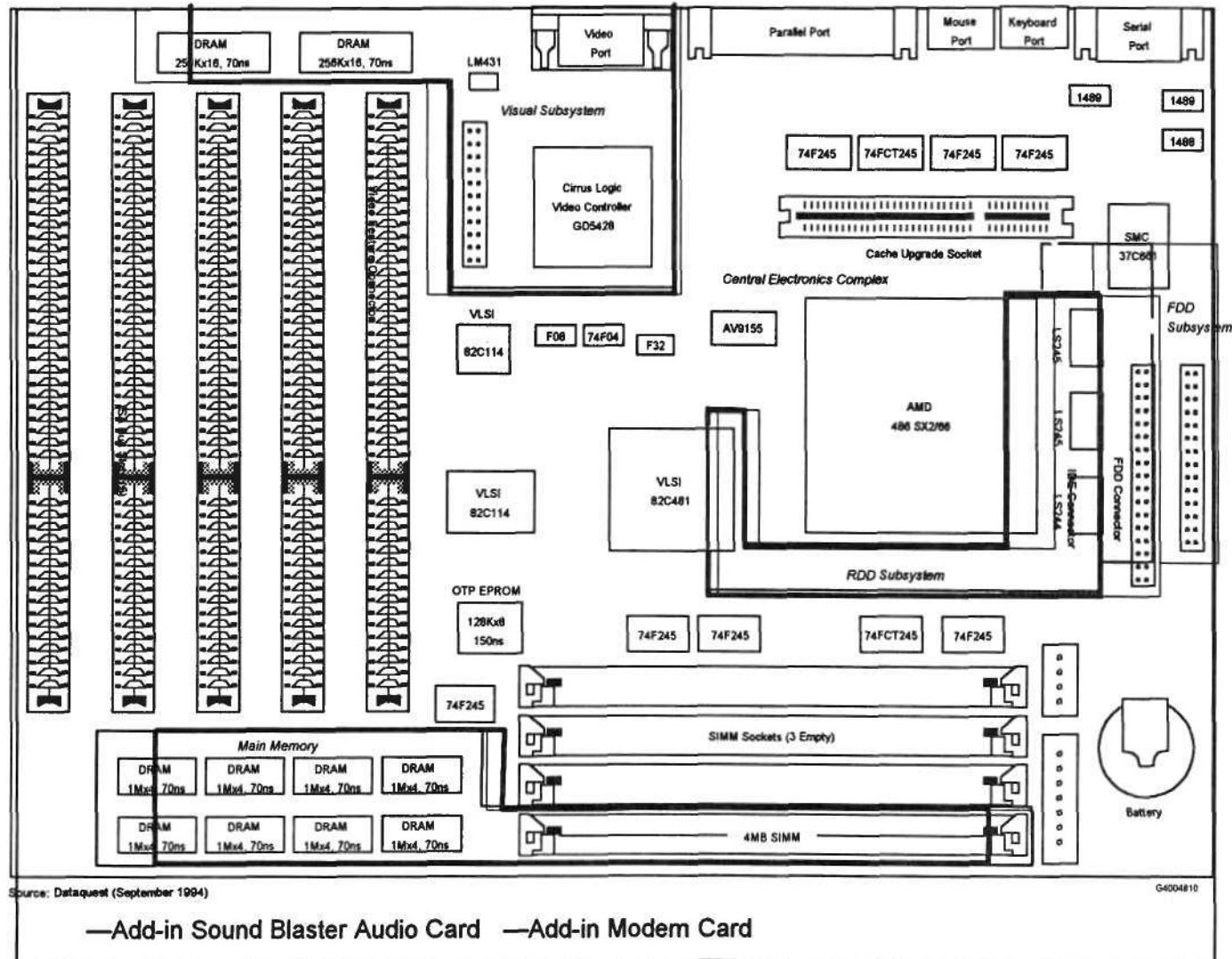


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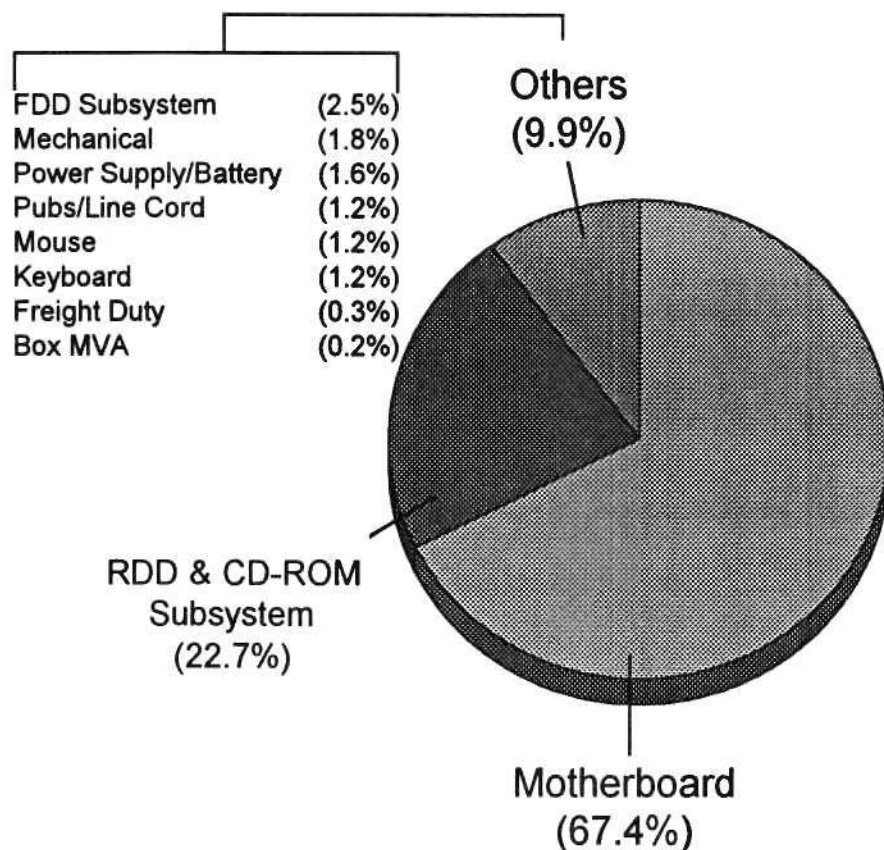
Market Opportunities in Multimedia PCs

Compaq Presario CDS 860 Motherboard



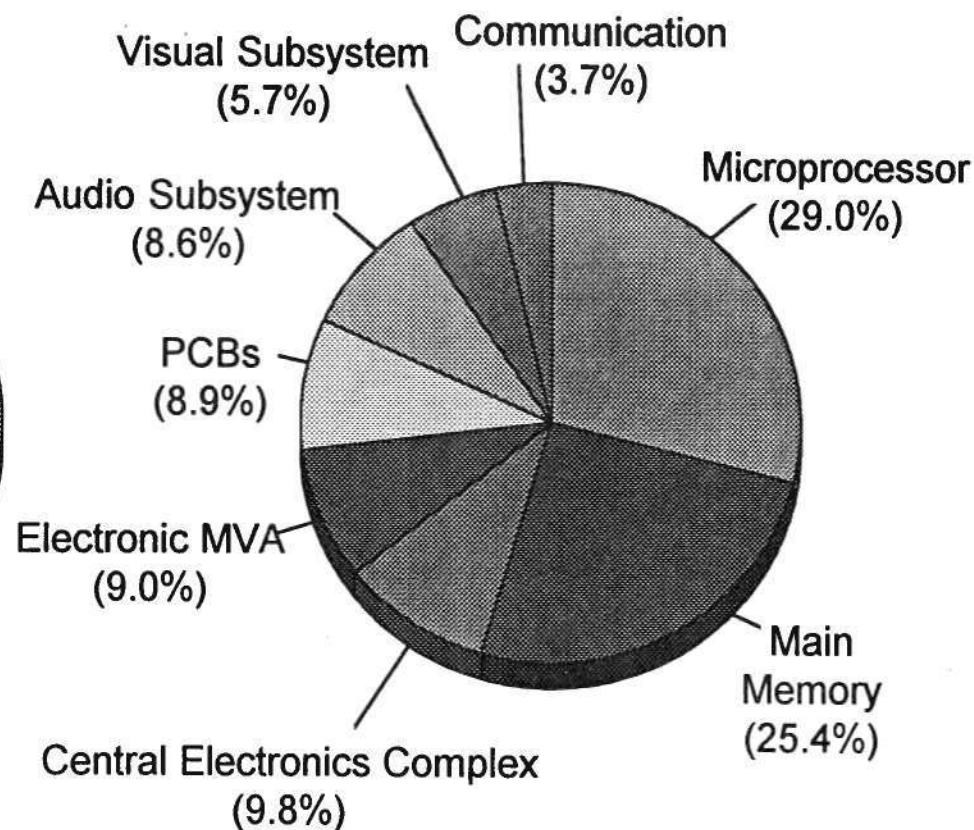
Market Opportunities in Multimedia PCs

Compaq Presario CDS 860 Costs



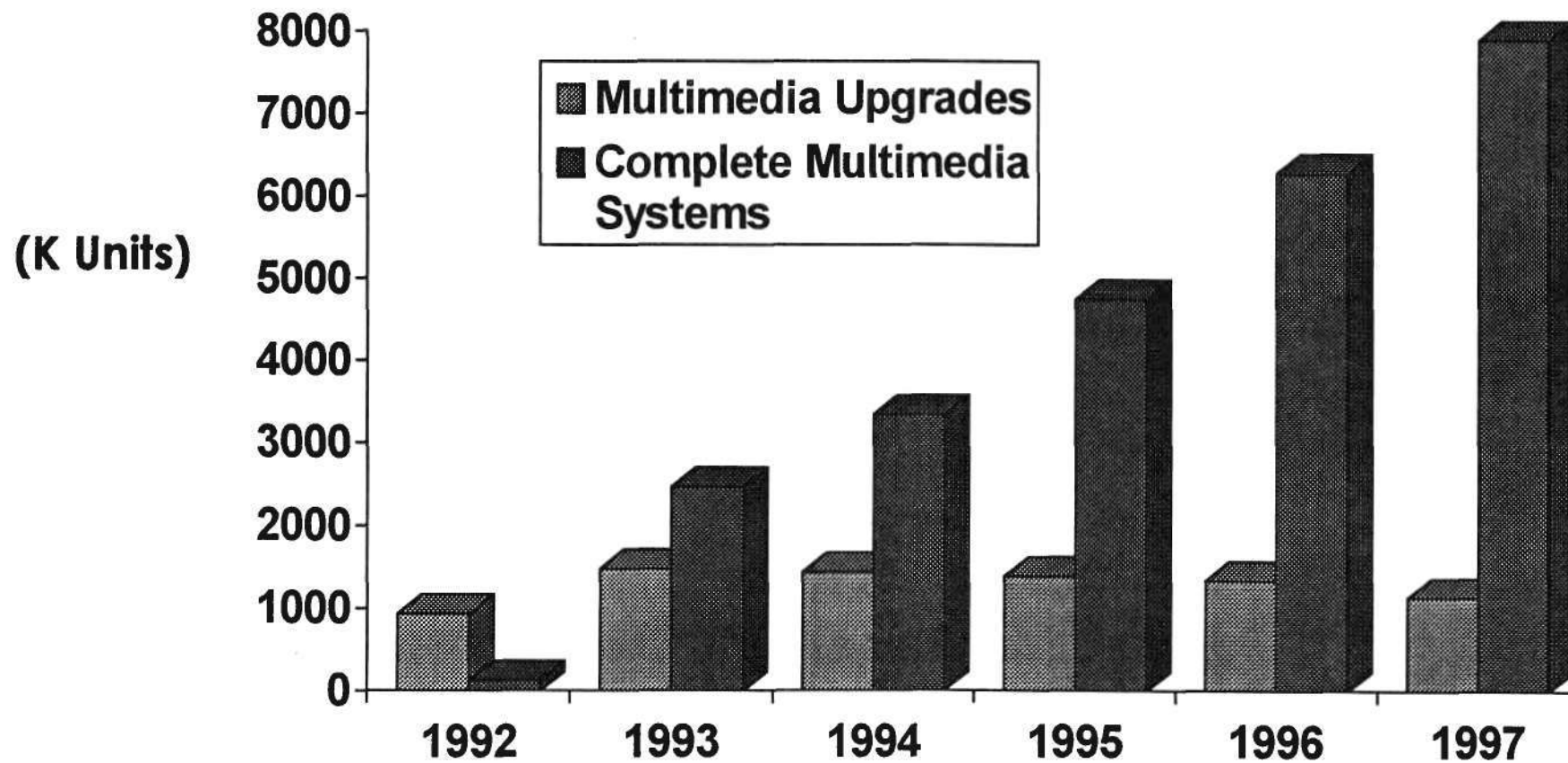
Total Cost = \$1,218.84

Compaq Presario CDS 860 Motherboard and Daughterboard Costs



Total Cost = \$803.34

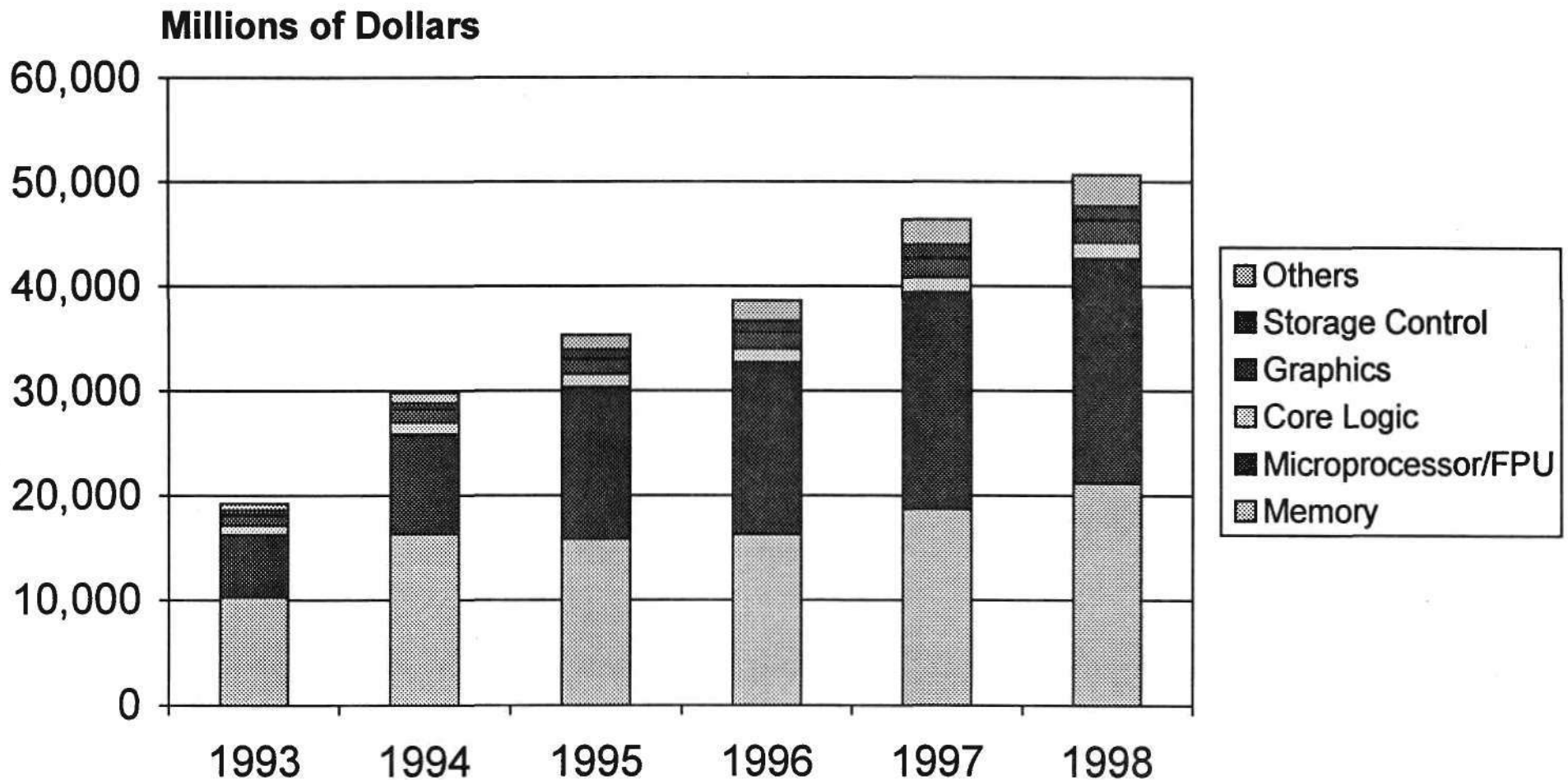
Multimedia PCs Proliferate



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Source: Dataquest

Worldwide PC Semiconductor Revenue Forecast by Device Type

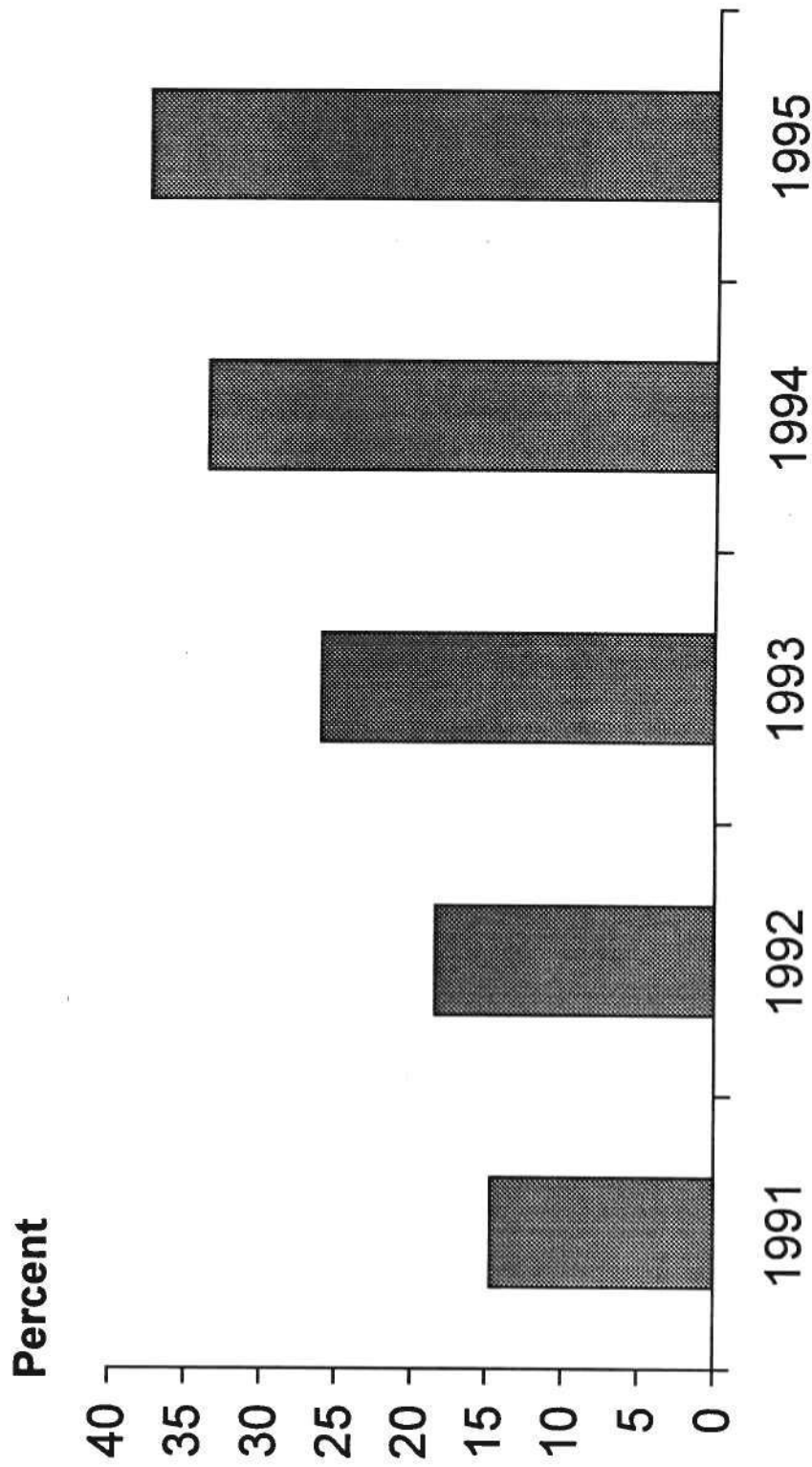


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Source: Dataquest

Semiconductor Costs as a Percentage of Total PC Revenue



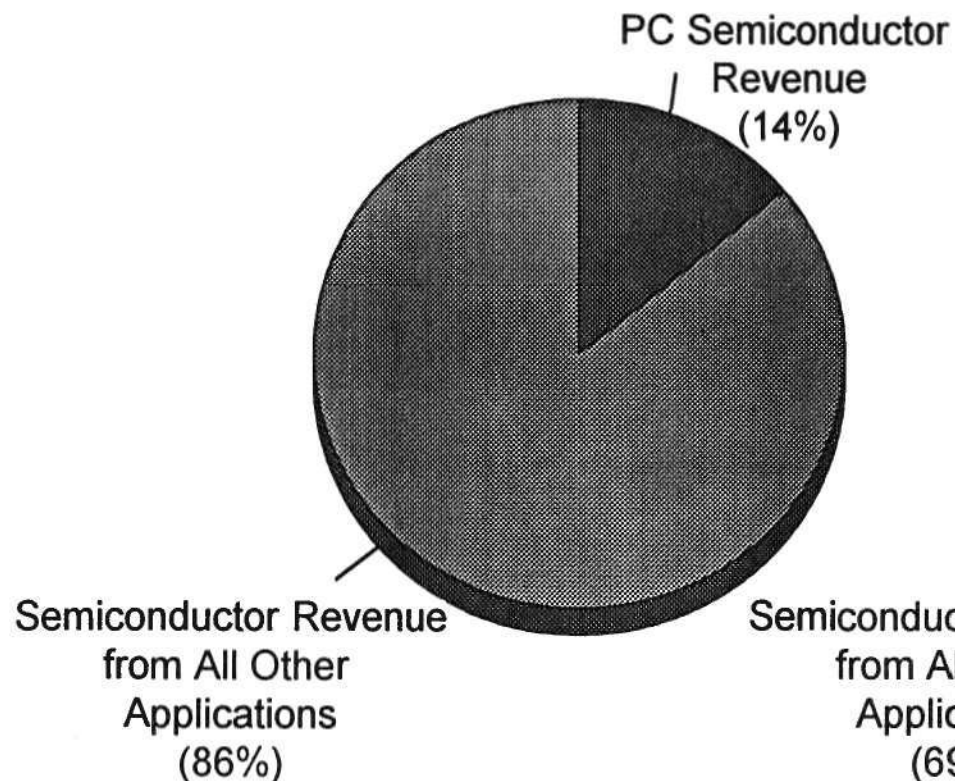
Source: Dataquest

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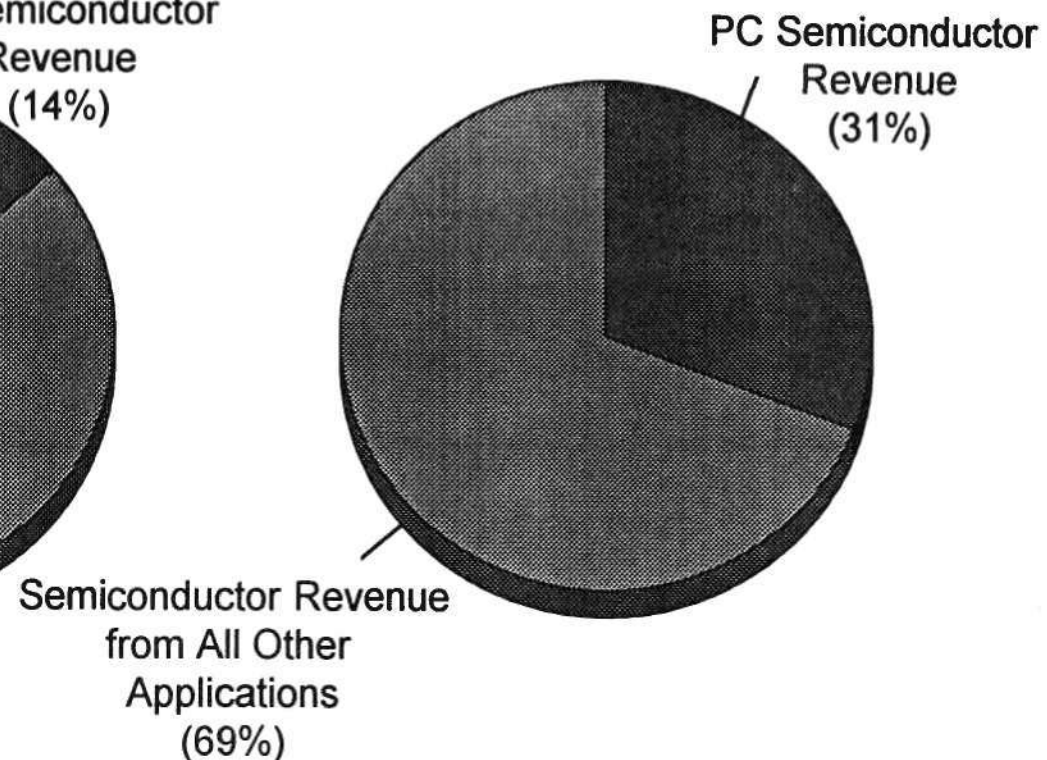
PC Semiconductor Revenue as a Percentage of Total Semiconductor Market

1991



**Total Value = \$59.7
Billion**

1995



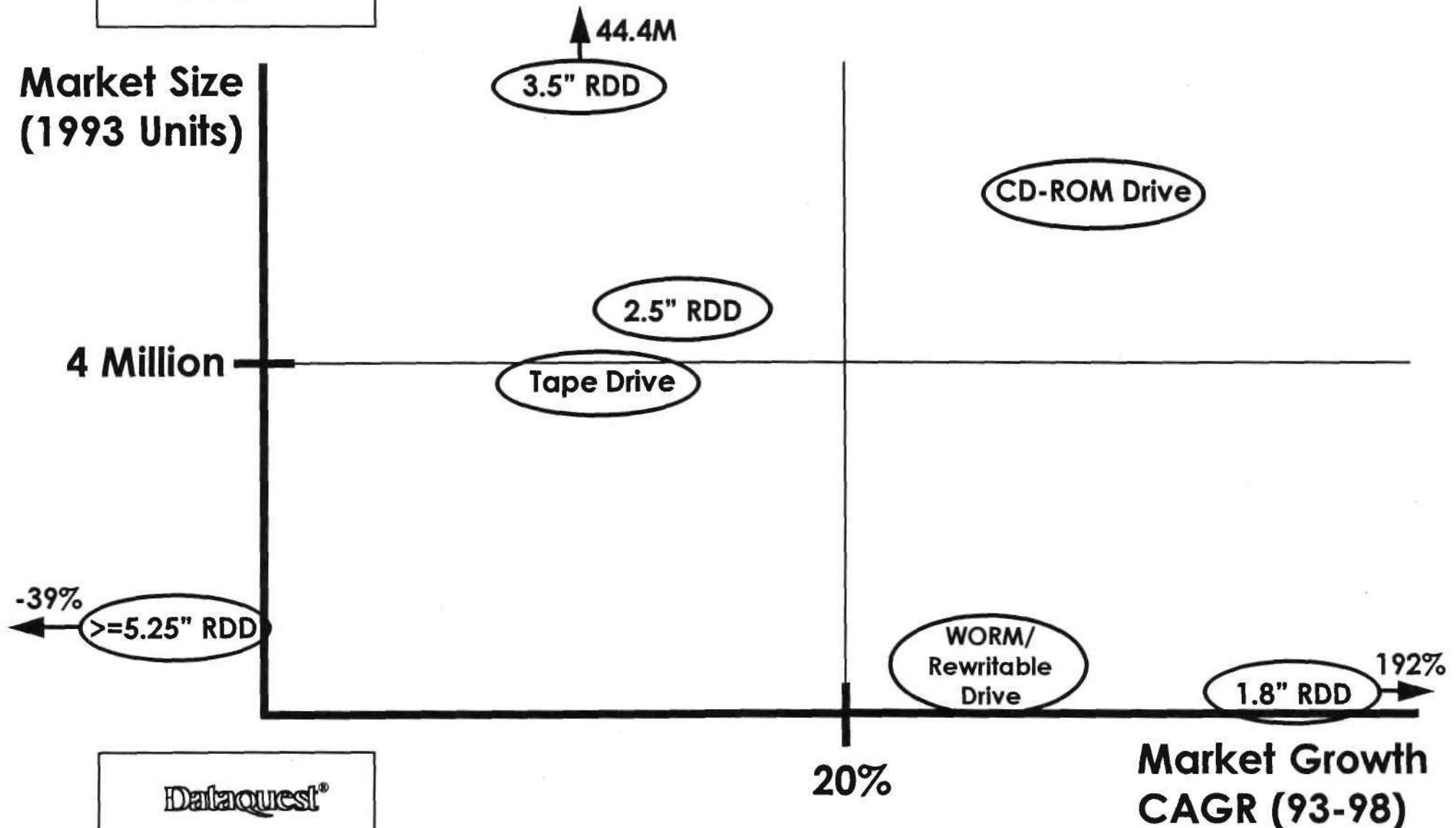
**Total Value = \$112.6
Billion**

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Source: Dataquest

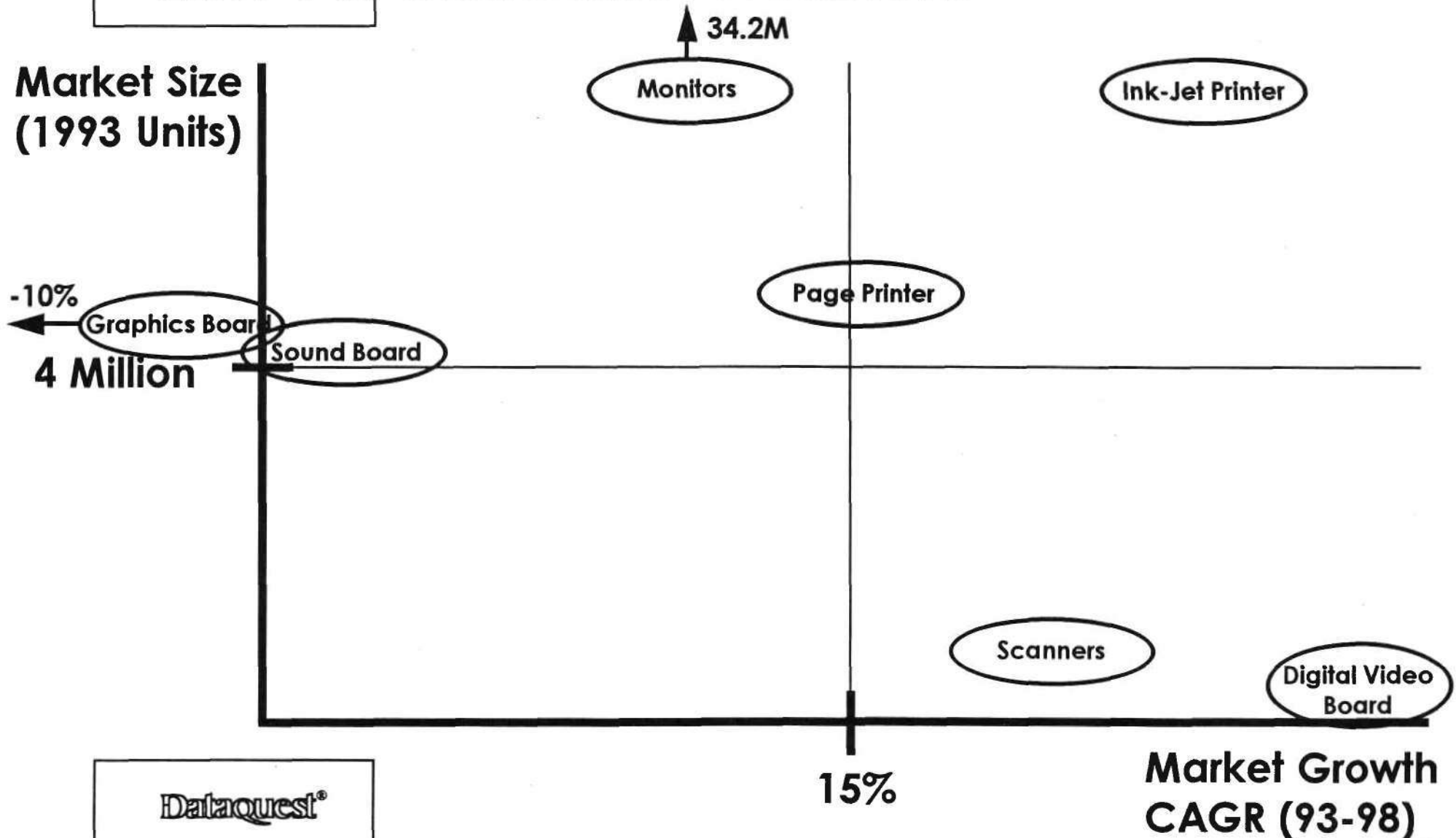
3.5" Rigid Disk Drives Dominate Mass Storage While Multimedia Market Drives CD-ROM Demand



Storage Systems: More Competitive Than DRAMs

- Precipitous price declines for RDD
- Average density 170 -> 250 -> 340 -> 500 MB
- CD-ROM explodes for home multimedia
- PCMCIA cards, slow start faster finish
- ICs: read-channel, servo, controllers, Flash

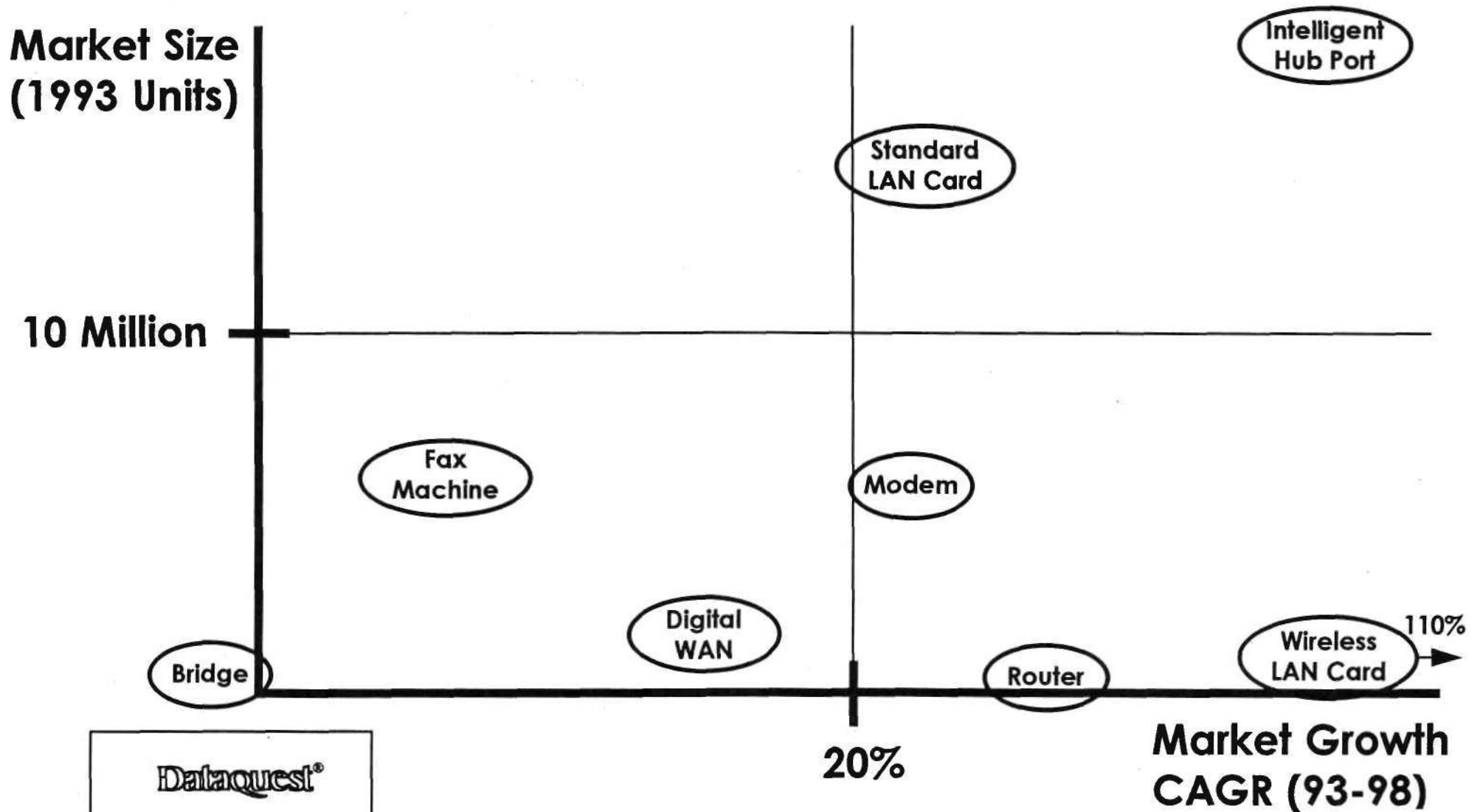
The Small Office / Home Office Drives Low-End Printer Market for Economical Ink-Jet and Laser Printers



Document Management Goes Digital

- Page printers to lead a split existence
- 600 -> 1200 DPI
- Ink jet becomes volume leader
- Scanners proliferate
- Digital documents on the horizon
- ASIC/ASSP, CCD, motor controls, DRAM

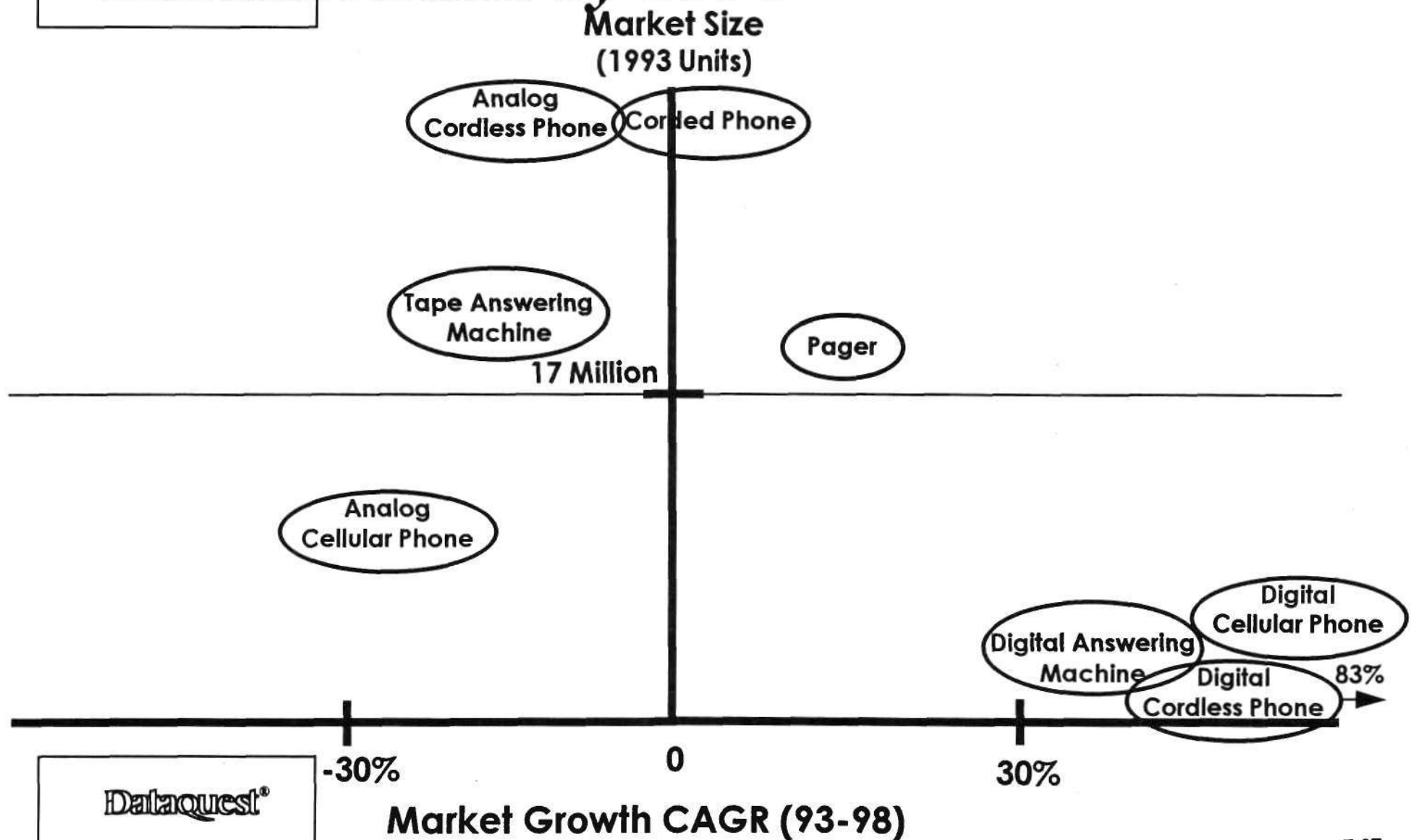
Telecommunications: Connecting the World



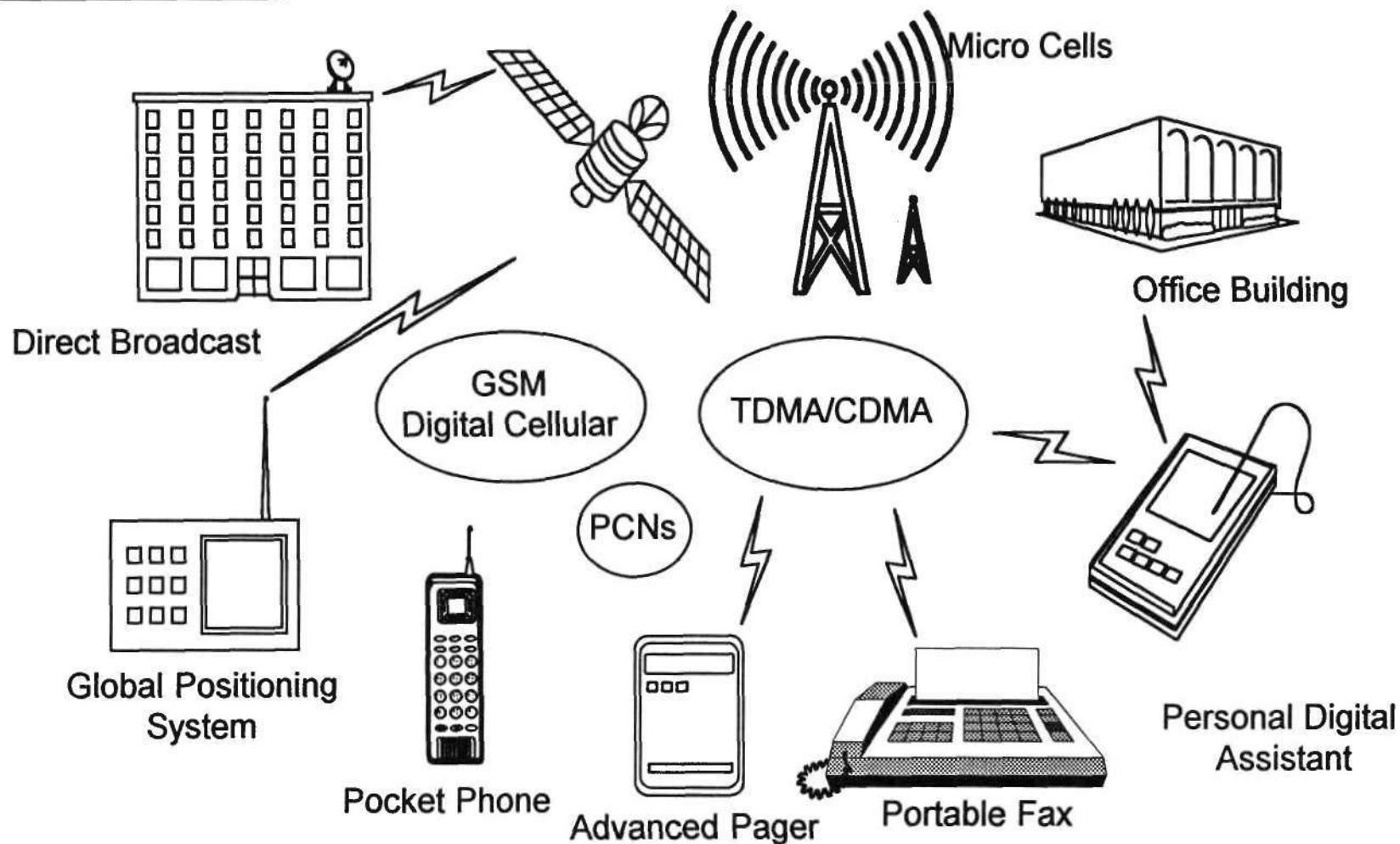
LAN and WAN Business Isn't Standing Still

- Ethernet stretches to 20 and 100 Mb/s
- FDDI legitimizes
- ATM in the backbone, full deployment to come
- Hubs and routers remain explosive
- New life for T/E carrier and ISDN
- Modems on the information super highway
- ASSPs, transceivers, ASICs, Flash

Digital Cordless and Cellular Handsets Will Capture the Majority of Mobile Handset Sales by 1998



Going Wireless (and Digital)



Source: Dataquest

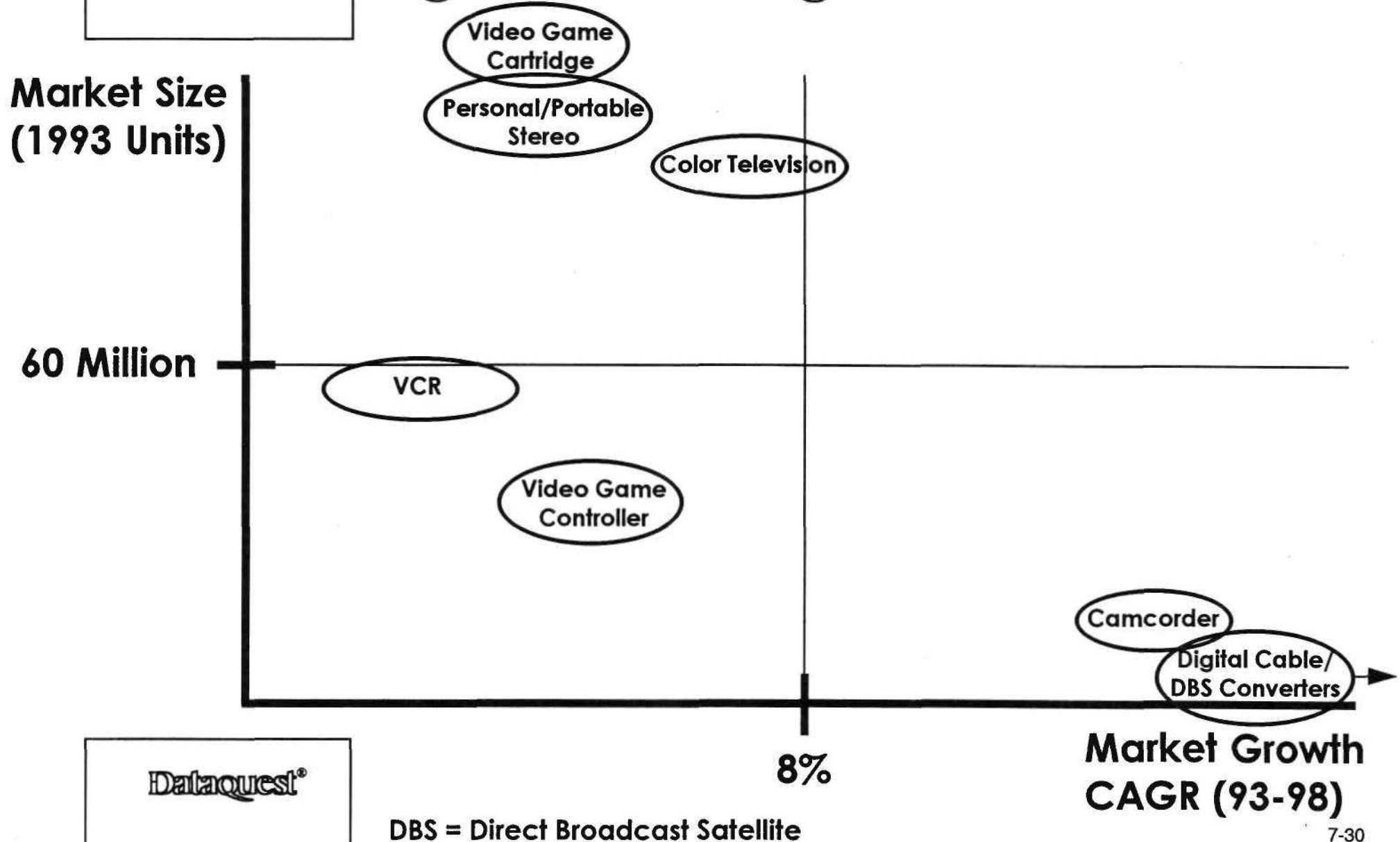
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Communication Terminals Proliferate

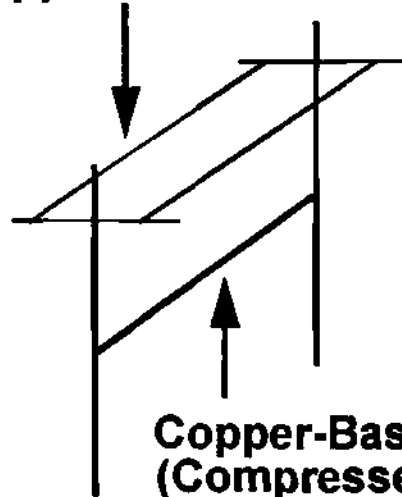
- Digital cellular/cordless emerges (GSM, IS-54/95...)
- PCS communicators (narrow band/ broad band)
- Wireless data (CDPD, Mobitex, Ardis...)
- Smart phones gaining interest
- Video conferencing slow to take off
- Base band chips, RF/IF I/Cs

A Wave of Interactive, Digital Technologies is Rolling Into the Home

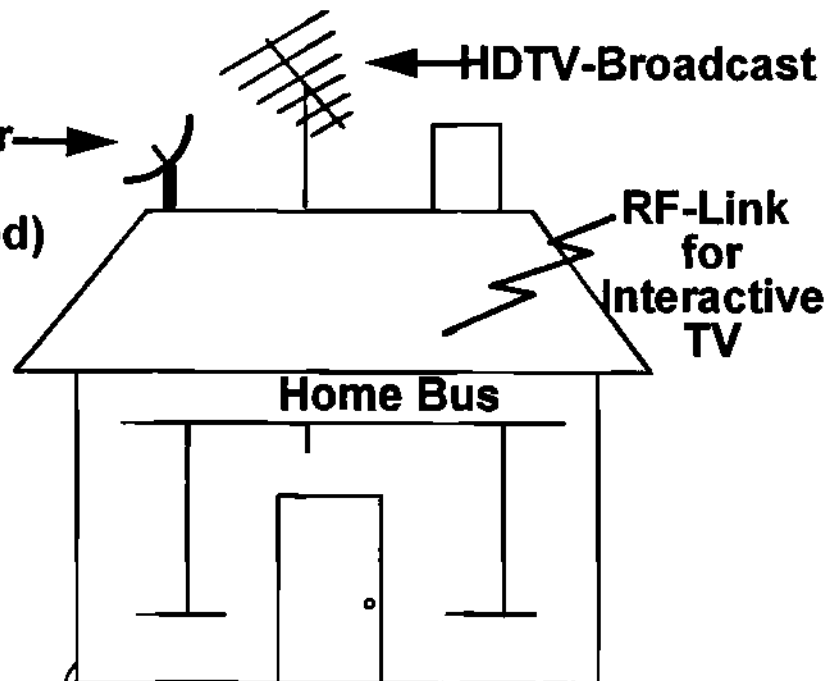


Evolution of Electronic Home Communication

Copper-Based N-ISDN



High-Power Satellite (Compressed)



Fiber Optics

B-ISDN

Services:

Home shopping/banking/classrooms
Video-on-demand/pay-per-view
500-channel-plus satellite/cable
Video telephones

Interactive TV (game shows, sports)
Music-on-demand/pay-per-title
HDTV: broadcast/cable

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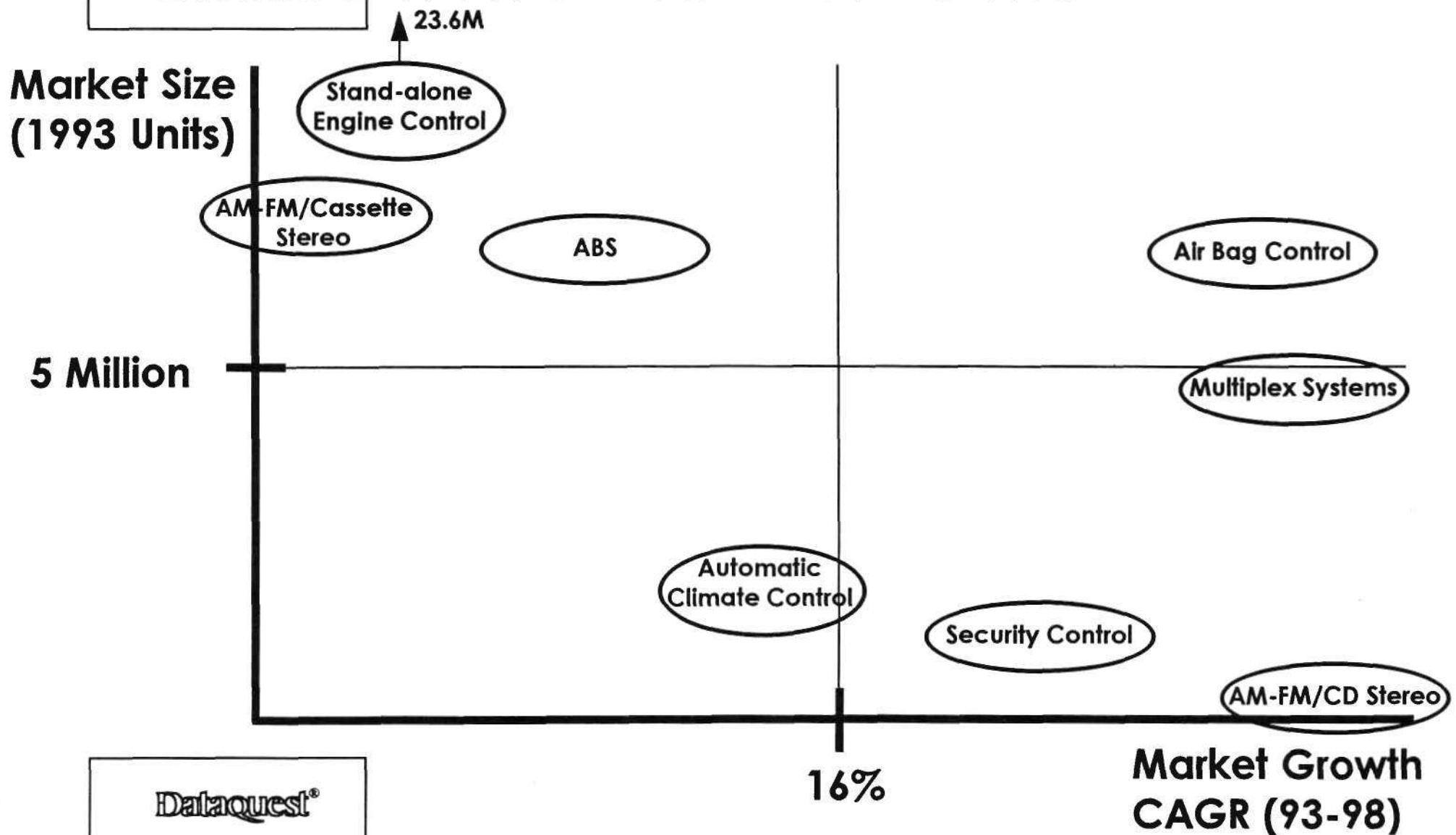
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Digital and Interactive Consumer: Is it a Computer or TV?

- Digitization: transition first
- Set-top boxes: great potential many hurdles to get there
- CD-Video vs. Laser Disc vs. Digital VCR
- Video games: computing power of workstation
- New digital audio: slow start
- Compression, integrated video and audio, demodulation

100 New or Redesigned Vehicles are Introduced Each Year. Sixty Percent of These Involve New Electronics



Summary

- Major Shift of Electronics Production to Asia/Pacific
- Personal Computers and Semiconductors Highly Interdependent
- Multimedia and Interactive Products Penetrating Homes and Businesses
- Digitization Revolutionizing Communications & Consumer Industries
- High Growth Markets Abound with Stimulating Challenges and Exciting Opportunities