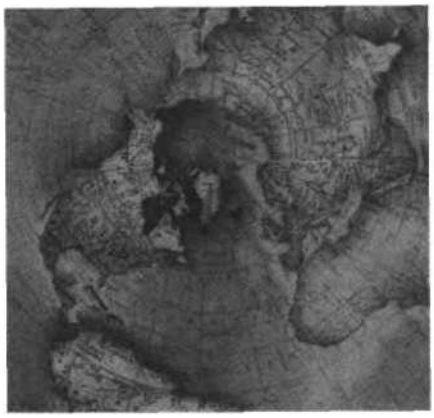
DRAM Supply and Demand Quarterly Statistics Worldwide—DSDR-WW

Check to Re-order	Document Code	Publication Date	Document Title
Tab: Market Statistics			
❑	DSDR-WW-MS-97Q1	April 28, 1997	DRAM Supply/Demand Quarterly Statistics: Second Quarter 1997 Outlook
❑	DSDR-WW-MS-97Q2	September 1, 1997	DRAM Supply/Demand Quarterly Statistics: Third Quarter 1997 Outlook
❑	DSDR-WW-MS-97Q3	October 20, 1997	DRAM Supply/Demand Quarterly Statistics: Fourth Quarter 1997 Outlook
❑	DSDR-WW-MS-97Q4	January 26, 1997	DRAM Supply/Demand Quarterly Statistics: Fourth Quarter 1998 Outlook



Dataquest

DRAM Supply/Demand Quarterly Statistics: First Quarter 1998 Outlook

Market Statistics

Program: DRAM Supply and Demand Quarterly Statistics Worldwide
Product Code: DSDR-WW-MS-97Q4
Publication Date: January 26, 1998
Filing: Market Statistics

DRAM Supply/Demand Quarterly Statistics: First Quarter 1998 Outlook

Market Statistics

Program: DRAM Supply and Demand Quarterly Statistics Worldwide
Product Code: DSDR-WW-MS-97Q4
Publication Date: January 26, 1998
Filing: Market Statistics

Table of Contents

List of Tables

List of Tables (Continued)

Chapter 1
Executive Summary

This report provides the first quarter 1998 outlook for the worldwide DRAM market based on the results of recent supplier surveys and related information. The report includes quarterly information through the fourth quarter of 1998 and yearly information for 1999.

Market Conditions

Dataquest's DRAM supply and demand outlook remains largely consistent with original expectations. DRAM production capacity clearly exceeds DRAM bit demand as of early 1998. The current oversupply means strong 1998 pricing competition among manufacturers of both 16Mb and 64Mb DRAM.

The market backdrop is a large 1997 oversupply. Dataquest believes that the DRAM market will move toward balance around the end of 1998; however, this balance depends heavily on restrained 1998 capital spending by DRAM manufacturers. Our basic expectation is that major Korean and Japanese manufacturers will reduce their 4Mb and 16Mb production and increase 64Mb production throughout this year. As noted, Dataquest bases the year-end 1998 scenario of more balanced DRAM demand and supply on this assumption of restrained capital spending by DRAM manufacturers in 1998. If DRAM manufacturers do not refrain from aggressive capital spending in 1998, the sharp oversupply is likely to continue into 1999.

Meanwhile, the Asia/Pacific turmoil commands market attention.

Asia/Pacific Crisis

The economic and financial crisis in Asia/Pacific is creating considerable market uncertainty, especially for DRAM suppliers. The immediate effect centers on additional downward pressure on DRAM pricing, as measured in dollars, because of weaker Asian currencies. Capital spending will also be affected.

The crisis increases the likelihood that DRAM capital spending will be restrained during 1998. For example, Korea-based suppliers were in the process of re-evaluating their spending plans in late December 1997 and January 1998. The capital spending plans of the worldwide network of DRAM suppliers will become clearer by the end of the first quarter. The impact will become understood in the marketplace later in the year.

Factors such as the Asia/Pacific crisis might cause some Korea-based suppliers to place less emphasis on 64Mb output than now expected. Korean manufacturers might decrease their investment for their next-generation fabs. That decision, in turn, could result in restricted 64Mb production capacity for Korean suppliers while still providing them with sufficient 16Mb capacity. Under this scenario, Korean suppliers might support 16Mb production strongly in 1998 and 1999—which is not Dataquest's current assumption.

By contrast, we expect a firm commitment from Taiwan-based suppliers to 16Mb production during 1998, despite the crisis. If Taiwanese suppliers become zealously committed to the 16Mb DRAM, the 16Mb oversupply could persist well into 1999.

64Mb Die Shrinks

Other factors could exacerbate the 16Mb and 64Mb supply/demand outlook. A key manufacturing issue has emerged that centers on the die size of 64Mb DRAM. Dataquest believes that some companies have been unable to reduce (that is, shrink) the 64Mb DRAM die as expected. Some companies might decide that 16Mb production is their most profitable strategy for 1998 and 1999—which is not the assumption of the forecasts shown in this report. If this proves to be a trend, the 16Mb DRAM supply could be much higher than shown in this report and the 64Mb supply much lower.

As indicated, Dataquest should have new 1998 capital spending data soon. Companies are formulating their 1998 capital spending plans right now. We will use that data to revise our estimate of DRAM capacity trends in the next DRAM supply and demand report.

SDRAM

The market shift from extended data out (EDO) DRAM to synchronous DRAM (SDRAM) started in the third quarter of 1997 and is proceeding rapidly. The mainstream SDRAM is 66-MHz version; however, the 100-MHz version should quickly win market acceptance following market introduction.

Intel's 440BX chipset serves as the key "gating factor" for 100-MHz SDRAM. DRAM manufacturers right now are focusing on development of a 100-MHz version of 64Mb SDRAM. To date, just several DRAM manufacturers have had their devices qualified by PC vendors.

We should note that timely 1998 release of the 440BX chipset might cause a shortage later this year of the 100-MHz version of 64Mb SDRAM.

Suppliers' Strategies

Dataquest believes that the main density remains the 16Mb device, but the shift to 64Mb SDRAM continues to accelerate. Micron Technology Inc. has a very good DRAM shrink technology—that is, the ability to reduce the size of the DRAM manufacturing die multiple times during each density's life cycle. If other DRAM manufacturers cannot compete successfully with Micron in terms of lowering 64Mb production cost, the result for them will be less profitable 64Mb businesses.

The following sections summarize Dataquest's view on DRAM supplier strategies at the 16Mb and 64Mb DRAM densities.

16Mb

U.S. and Taiwanese manufacturers are still increasing 16Mb production. Meanwhile, Korean and Japanese manufacturers are reducing 16Mb output. U.S. manufacturers will increase their 16Mb production but will switch to 64Mb as demand grows for this part.

Key "wild card" suppliers include Taiwan-based suppliers and U.S.-based Micron Technology. Taiwanese manufacturers encountered a production yield challenge in 1997, but this year Dataquest believes they have yield improvements under way.

Taiwanese companies plan to strongly increase their 16Mb production in 1998. Among Taiwanese companies, Nan Ya Technology Inc. has very strong expectations of 16Mb market demand in 1998. Taiwanese DRAM companies will make especially large increases in 16Mb production through 1998. They will provide some of the 16Mb output to their alliance partners (often on a contract manufacturing basis).

The 16Mb market might remain in oversupply during 1999 if Taiwanese manufacturers continue to increase their production of 16Mb during 1999. We should note that Taiwan-based suppliers remain on track with a new generation of DRAM fabs that could have strong 1999 market impact.

Micron's Strategy

Micron will try to remain at the 16Mb density—and boost output—until required by major customers to migrate to the 64Mb density.

Micron now ranks as the leading producer of 16Mb, based on unit shipments. The company will likely increase 16Mb production into 1999. As indicated, however, Micron can and will switch production from 16Mb to 64Mb in line with market demand.

Historically, Micron's strategy has been to make multiple DRAM die shrinks (its competitors make just several). The continuing series of die reductions enables Micron to increase market share during the middle and latter stages of a DRAM life cycle.

At the 64Mb density, Micron will have to be more responsive to the timing of demand for this newer-generation device by major PC manufacturers. PC OEMs represent a much larger portion of Micron's DRAM business today than in 1994 and 1995, when the market migrated to 16Mb DRAM. When the 16Mb density emerged, Micron was able—because it was more dependent on the spot market and less dependent on major PC companies—to delay its shift from 4Mb to 16Mb. During 1998 and 1999, however, major customers could require Micron to migrate more rapidly to the 64Mb density than currently expected.

64Mb

This market will remain in oversupply for most of 1998.

Korean and Japanese manufacturers started increasing production of 64Mb DRAM during the second half of 1997. They did this when the 64Mb market was oversupplied. They chose to do so because of an even greater oversupply of 16Mb devices.

The main application of 64Mb in the first half of 1997 was the workstation. Samsung Electronics Company Ltd. and NEC Corporation served as the main 1997 providers of 64Mb DRAM for this application. Workstation market demand was somewhat restricted, resulting in a small oversupply in the first half of 1997. During the second half of 1997, notebook PCs joined with workstations as 64Mb end applications. As noted, at that time, major DRAM manufacturers started increasing production, which exacerbated the oversupply.

Desktop PCs will start using 64Mb in 1998, which means increased 1998 demand for 64Mb. In spite of that, the market will remain in oversupply unless suppliers reduce 16Mb production more sharply than Dataquest expects.

Project Analyst: James Seay

Contributors: Masahiro Suzuki, Senior Industry Analyst (Japan), Ronald Bohn, Director, Worldwide Semiconductor Research Operations, Jim Handy, Director and Principal Analyst (Worldwide and Americas), James Seay, Research Analyst (Worldwide and Americas), , Sabrina Chiou, Research Analyst (Asia/Pacific and Taiwan), and Chang Soo Kim, Industry Analyst (Asia/Pacific and Korea)

Chapter 2
Production Statistics of 4Mb DRAM

This chapter provides estimates of 4Mb DRAM quarterly unit shipments by supplier. The tables show a summary for 4Mb (see Table 2-1) and total 4Mb shipments (see Table 2-2). Subsequent tables show shipments by organization (x1, x4, x8/9, and x16/18, in Tables 2-3 through 2-6) and by technology (fast page mode—FPM, extended data out, synchronous, next-generation, and display, in Tables 2-7 through 2-11). Dataquest collects data through quarterly supplier surveys. These tables represent 4Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 4Mb DRAM. Average selling prices (ASPs) for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5.

4Mb Market Condition

The major DRAM manufacturers have reduced 4Mb production, but pricing continues to decline. Even so, the market situation is clearly changing. So-called second-tier manufacturers are now the main players in the 4Mb market. The market may be moving toward balanced supply/demand in 1998, but the total supply capability will remain beyond 4Mb demand.

What Has Changed since the Previous Report

The 1998 supply/demand forecast of 4Mb DRAM remains consistent with the prior report.

Dataquest has revised the format of Table 2-1. The portion of Table 2-1 that formerly displayed configuration and technology detail in units now shows the same detail as percentages of total 4Mb DRAM unit shipments. Dataquest has also revised Tables 2-3 through 2-11 to display configuration and technology detail as a percentage of each company's overall 4Mb DRAM shipments. The "all companies" total at the bottom of these tables will show the weighted average of each detail subcategory as a percentage of overall "all companies" production of 4Mb DRAM. Dataquest believes this new arrangement will better show how each company allocates its production across the configuration and technology subcategories, as well as provide better analysis of market shifts.

Table 2-1
4Mb DRAM Supply and Demand Summary, Q1/97 to 1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Total Revenue (U.S.$M)	669.1	570.7	499.6	376.5	2,115.9	291.2	218.3	168.9	130.7	809.2	194.7
Total Units Shipped	258.3	222.9	202.2	175.3	858.7	151.1	128.5	104.8	87.3	471.6	173.2
Total Units Demanded	258.0	221.7	197.9	173.2	850.7	149.6	125.4	103.8	88.2	467.0	174.8
Sufficiency (%)	100.12	100.57	102.16	101.23	100.94	100.97	102.45	100.95	99.00	100.99	99.06
All Configurations (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
x1	7.7	7.3	7.1	7.0	7.3	5.6	6.2	6.2	6.4	6.0	5.2
x4	48.7	43.3	40.6	34.9	42.6	33.4	31.1	29.2	28.1	30.9	19.1
x8/9	6.4	7.1	6.6	6.5	6.7	5.7	5.7	5.8	5.8	5.7	7.0
x16/18	37.1	42.3	45.7	51.7	43.5	55.2	57.1	58.8	59.7	57.4	68.8
x32/36	-	-	-	-	-	-	-	-	-	-	-
All Interfaces (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Fast Page Mode	33.6	31.5	28.8	27.1	30.6	23.7	23.2	22.3	21.6	22.9	23.7
Extended Data Out	62.5	64.4	66.8	68.6	65.2	70.6	70.7	70.2	71.5	70.7	67.9
Synchronous	-	-	-	-	-	-	-	-	-	-	-
Next-Generation	-	-	-	-	-	-	-	-	-	-	-
Display	3.9	4.2	4.4	4.3	4.2	5.7	6.2	7.4	6.9	6.4	8.5

Source: Dataquest (January 1998)

Table 2-2
Quarterly Shipments of All Configurations of 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	5.3	6.9	8.6	8.7	29.5	8.3	7.5	6.2	5.0	27.0	3.4
Fujitsu	9.2	7.7	6.6	6.2	29.7	5.8	5.3	5.1	4.8	21.0	10.5
Hitachi	23.0	20.3	18.3	16.0	77.6	13.5	11.0	9.5	7.4	41.4	25.0
Hyundai	21.0	18.0	15.0	13.0	67.0	12.5	9.5	7.5	6.5	36.0	5.4
IBM Microelectronics	7.6	3.6	1.8	0.9	13.9	0.3	0.2	0.1	-	0.6	-
LG Semicon	15.0	14.0	13.0	11.0	53.0	9.1	7.6	6.5	5.6	28.8	5.0
Matsushita	7.5	5.9	5.0	4.5	22.9	4.2	3.6	3.3	3.0	14.1	11.3
Micron Technology	23.2	16.0	12.5	10.3	62.0	7.1	4.0	1.0	0.2	12.3	-
Mitsubishi	14.1	11.6	10.4	9.0	45.1	7.5	6.9	6.0	5.2	25.6	11.0
Mosel Vitelic	16.3	22.4	23.3	18.0	80.0	14.4	11.4	8.5	5.7	40.0	15.0
Motorola	0.7	0.5	0.6	-	1.8	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	22.0	19.8	18.1	16.3	76.3	14.5	11.8	9.0	7.0	42.3	15.0
Nippon Steel	14.0	13.1	12.8	12.4	52.3	12.4	12.4	12.3	12.3	49.4	36.4
Oki	4.0	7.0	8.0	8.0	27.0	6.0	6.0	4.0	4.0	20.0	10.0
Samsung	21.0	14.0	13.0	9.0	57.0	8.0	8.0	7.0	7.0	30.0	9.0
Sharp	1.0	0.8	0.9	0.8	3.5	0.8	0.7	0.7	0.7	2.9	2.5
Siemens	17.2	15.6	14.8	13.7	61.4	12.7	11.1	9.3	7.3	40.4	10.7
Texas Instruments	20.4	15.5	12.8	10.0	58.7	7.5	5.7	3.8	1.9	18.9	-
Toshiba	11.7	6.8	4.8	2.5	25.8	2.5	2.5	2.0	1.8	8.8	3.0
Vanguard	4.1	3.4	1.8	5.0	14.3	4.0	3.3	3.0	2.0	12.3	-
All Companies	**258.3**	**222.9**	**202.2**	**175.3**	**858.7**	**151.1**	**128.5**	**104.8**	**87.3**	**471.6**	**173.2**
Average Selling Price	2.59	2.56	2.47	2.15	2.46	1.93	1.70	1.61	1.50	1.72	1.12
Total Revenue (U.S.$M)	669.1	570.7	499.6	376.5	2,115.9	291.2	218.3	168.9	130.7	809.2	194.7
Total Demand	258.0	221.7	197.9	173.2	850.7	149.6	125.4	103.8	88.2	467.0	174.8
Sufficiency (%)	100.12	100.57	102.16	101.23	100.94	100.97	102.45	100.95	99.00	100.99	99.06

Table 2-3
Quarterly Shipments of x1 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	5.0	5.0	8.0	8.0	6.3	10.0	10.0	10.0	10.0	10.0	8.0
Hitachi	6.7	6.7	6.0	6.0	6.4	5.0	5.0	5.0	5.0	5.0	4.0
Hyundai	4.0	3.0	3.0	3.0	3.3	4.0	4.0	4.0	4.0	4.0	4.0
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Matsushita	6.7	6.7	5.9	5.9	6.4	5.0	5.0	5.0	5.0	5.0	3.0
Micron Technology	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	-
Mitsubishi	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	8.0
Mosel Vitelic	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	-
Motorola	19.0	18.0	16.0	-	17.7	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	9.0	9.0	8.0	8.0	8.5	4.0	4.0	4.0	4.0	4.0	3.0
Nippon Steel	-	-	-	-	-	5.0	6.0	6.0	6.0	5.7	5.0
Oki	8.0	8.0	8.0	8.0	8.0	6.0	6.0	6.0	6.0	6.0	5.0
Samsung	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Sharp	6.7	6.7	5.9	5.9	6.3	5.0	5.0	5.0	5.0	5.0	5.0
Siemens	18.0	16.0	15.0	15.0	16.1	10.0	15.0	15.0	15.0	13.4	15.0
Texas Instruments	14.0	14.0	14.0	15.0	14.2	-	-	-	-	-	-
Toshiba	3.0	2.0	2.0	2.0	2.5	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**7.7**	**7.3**	**7.1**	**7.0**	**7.3**	**5.6**	**6.2**	**6.2**	**6.4**	**6.0**	**5.2**
Average Selling Price	2.60	2.55	2.45	2.26	2.49	2.02	1.69	1.57	1.44	1.71	1.08
Total Revenue (U.S.$M)	51.6	41.4	35.3	27.6	155.8	17.0	13.4	10.2	8.0	48.6	9.7

Source: Dataquest (January 1998)

Table 2-4
Quarterly Shipments of x4 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	100.0	90.0	70.0	50.0	74.1	40.0	30.0	25.0	20.0	30.1	-
Fujitsu	50.0	35.0	30.0	30.0	37.5	20.0	20.0	20.0	20.0	20.0	15.0
Hitachi	43.0	40.0	33.0	33.0	37.8	25.0	25.0	20.0	20.0	23.0	20.0
Hyundai	42.0	40.0	37.0	37.0	39.4	34.0	34.0	34.0	34.0	34.0	34.0
IBM Microelectronics	64.9	50.0	35.0	25.0	54.6	15.0	5.0	-	-	9.2	-
LG Semicon	59.0	59.0	59.0	59.0	59.0	60.0	61.0	62.0	63.0	61.3	63.0
Matsushita	42.7	34.7	33.0	33.0	36.6	27.0	25.0	25.0	25.0	25.6	20.0
Micron Technology	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	70.0	-
Mitsubishi	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	35.0	30.0
Mosel Vitelic	60.0	45.0	40.0	5.0	37.6	5.0	5.0	5.0	5.0	5.0	-
Motorola	81.0	82.0	84.0	-	82.3	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	24.0	11.0	13.0	13.0	15.7	10.0	10.0	10.0	10.0	10.0	10.0
Nippon Steel	59.0	53.0	46.0	46.0	51.2	31.0	27.0	27.0	27.0	28.0	14.0
Oki	24.0	18.0	16.0	16.0	17.7	11.0	10.0	6.0	6.0	8.7	5.0
Samsung	34.0	34.0	38.0	38.0	35.5	37.8	37.5	37.3	37.0	37.4	37.0
Sharp	42.7	34.7	33.0	33.0	36.1	27.0	25.0	25.0	25.0	25.6	25.6
Siemens	56.0	56.0	54.0	50.0	54.2	50.0	45.0	45.0	45.0	46.6	45.0
Texas Instruments	61.0	58.0	56.0	55.0	58.1	100.0	100.0	100.0	100.0	100.0	-
Toshiba	40.0	20.0	10.0	10.0	26.2	-	-	-	-	-	-
Vanguard	-	-	-	-	-	10.0	10.0	10.0	10.0	10.0	-
All Companies	**48.7**	**43.3**	**40.6**	**34.9**	**42.6**	**33.4**	**31.1**	**29.2**	**28.1**	**30.9**	**19.1**
Average Selling Price	2.40	2.35	2.19	1.90	2.26	1.71	1.54	1.50	1.39	1.57	1.04
Total Revenue (U.S.$M)	302.1	227.0	180.0	116.1	825.2	86.5	61.6	46.0	34.1	228.2	34.3

Source: Dataquest (January 1998)

Table 2-5
Quarterly Shipments of x8/9 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	5.0	8.0	8.0	8.0	7.1	10.0	10.0	10.0	10.0	10.0	8.0
Hitachi	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0	11.0
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Matsushita	19.5	18.7	17.0	17.0	18.3	15.0	15.0	15.0	15.0	15.0	15.0
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	22.0	31.0	30.0	30.0	28.0	30.0	30.0	30.0	30.0	30.0	30.0
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	3.0	3.0	3.0	3.0	3.0	2.0	2.0	2.0	2.0	2.0	2.0
Samsung	6.0	6.0	2.0	2.0	4.5	2.3	2.5	2.8	3.0	2.6	3.0
Sharp	19.5	18.7	17.0	17.0	18.1	15.0	15.0	15.0	15.0	15.0	15.0
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	15.0	16.0	16.0	15.0	15.5	-	-	-	-	-	-
Toshiba	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**6.4**	**7.1**	**6.6**	**6.5**	**6.7**	**5.7**	**5.7**	**5.8**	**5.8**	**5.7**	**7.0**
Average Selling Price	2.82	2.66	2.56	2.15	2.58	1.90	1.54	1.39	1.25	1.57	1.12
Total Revenue (U.S.$M)	46.8	42.1	34.1	24.5	147.4	16.4	11.3	8.4	6.3	42.5	13.5

Source: Dataquest (January 1998)

Table 2-6
Quarterly Shipments of x16/18 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	10.0	30.0	50.0	25.9	60.0	70.0	75.0	80.0	69.9	100.0
Fujitsu	40.0	52.0	54.0	54.0	49.1	60.0	60.0	60.0	60.0	60.0	69.0
Hitachi	39.3	42.3	50.0	50.0	44.8	59.0	59.0	64.0	64.0	61.0	65.0
Hyundai	54.0	57.0	60.0	60.0	57.3	62.0	62.0	62.0	62.0	62.0	62.0
IBM Microelectronics	35.1	50.0	65.0	75.0	45.4	85.0	95.0	100.0	-	90.8	-
LG Semicon	31.0	31.0	31.0	31.0	31.0	30.0	29.0	28.0	27.0	28.7	27.0
Matsushita	31.1	40.0	44.1	44.1	38.8	53.0	55.0	55.0	55.0	54.4	62.0
Micron Technology	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	-
Mitsubishi	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	52.0
Mosel Vitelic	35.0	50.0	55.0	90.0	57.4	90.0	90.0	90.0	90.0	90.0	100.0
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	45.0	49.0	49.0	49.0	47.8	56.0	56.0	56.0	56.0	56.0	57.0
Nippon Steel	41.0	47.0	54.0	54.0	48.8	64.0	67.0	67.0	67.0	66.2	81.0
Oki	65.0	71.0	73.0	73.0	71.3	81.0	82.0	86.0	86.0	83.3	88.0
Samsung	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Sharp	31.1	40.0	44.1	44.1	39.5	53.0	55.0	55.0	55.0	54.4	54.5
Siemens	26.0	28.0	31.0	35.0	29.7	40.0	40.0	40.0	40.0	40.0	40.0
Texas Instruments	10.0	12.0	14.0	15.0	12.3	-	-	-	-	-	-
Toshiba	50.0	71.0	81.0	81.0	64.3	93.0	93.0	93.0	93.0	93.0	93.0
Vanguard	100.0	100.0	100.0	100.0	100.0	90.0	90.0	90.0	90.0	90.0	-
All Companies	**37.1**	**42.3**	**45.7**	**51.7**	**43.5**	**55.2**	**57.1**	**58.8**	**59.7**	**57.4**	**68.8**
Average Selling Price	2.80	2.76	2.71	2.30	2.65	2.05	1.80	1.69	1.58	1.81	1.15
Total Revenue (U.S.$M)	268.6	260.3	250.2	208.3	987.4	171.3	132.1	104.3	82.2	489.9	137.3

Source: Dataquest (January 1998)

Table 2-7
Quarterly Shipments of Fast Page Mode 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	100.0	90.0	60.0	40.0	68.3	30.0	25.0	20.0	10.0	22.6	-
Fujitsu	55.0	40.0	33.0	33.0	41.6	25.0	25.0	23.0	23.0	24.1	20.0
Hitachi	45.0	45.0	40.0	40.0	42.8	35.0	35.0	35.0	35.0	35.0	34.0
Hyundai	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
IBM Microelectronics	15.2	25.0	25.0	20.0	19.3	15.0	5.0	-	-	9.2	-
LG Semicon	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Matsushita	40.0	18.0	10.0	10.0	21.9	5.0	5.0	5.0	5.0	5.0	5.0
Micron Technology	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	-
Mitsubishi	60.0	50.0	40.0	40.0	48.8	30.0	30.0	30.0	30.0	30.0	30.0
Mosel Vitelic	20.0	15.0	15.0	10.0	14.9	10.0	10.0	10.0	10.0	10.0	-
Motorola	44.9	31.4	20.0	-	33.0	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	70.0	70.0	70.0	70.0	70.0	69.0	69.0	68.0	68.0	68.6	68.0
Nippon Steel	40.0	30.0	30.0	30.0	32.7	20.0	20.0	20.0	20.0	20.0	20.0
Oki	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Samsung	13.0	13.0	13.0	13.0	13.0	7.0	7.0	7.0	7.0	7.0	7.0
Sharp	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Siemens	60.0	45.0	30.0	20.0	40.0	15.0	10.0	10.0	10.0	11.6	10.0
Texas Instruments	32.0	33.0	30.0	30.0	31.5	30.0	30.0	30.0	25.0	29.5	-
Toshiba	15.0	10.0	10.0	10.0	12.3	10.0	10.0	10.0	10.0	10.0	10.0
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**33.6**	**31.5**	**28.8**	**27.1**	**30.6**	**23.7**	**23.2**	**22.3**	**21.6**	**22.9**	**23.7**

Source: Dataquest (January 1998)

Table 2-8
Quarterly Shipments of Extended Data Out 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	10.0	40.0	60.0	31.7	70.0	75.0	80.0	90.0	77.4	100.0
Fujitsu	40.0	50.0	55.0	55.0	49.1	60.0	60.0	60.0	60.0	60.0	60.0
Hitachi	49.0	47.0	49.0	49.0	48.5	44.0	44.0	39.0	39.0	42.0	36.0
Hyundai	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0
IBM Microelectronics	49.8	25.0	10.0	5.0	35.3	-	-	-	-	-	-
LG Semicon	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0	95.0
Matsushita	50.0	70.0	75.0	75.0	65.5	80.0	75.0	75.0	75.0	76.5	75.0
Micron Technology	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	90.0	-
Mitsubishi	40.0	50.0	60.0	60.0	51.2	70.0	70.0	70.0	70.0	70.0	70.0
Mosel Vitelic	80.0	85.0	85.0	90.0	85.1	90.0	90.0	90.0	90.0	90.0	100.0
Motorola	55.1	68.6	80.0	-	67.0	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	17.0
Nippon Steel	60.0	70.0	70.0	70.0	67.3	80.0	80.0	80.0	80.0	80.0	80.0
Oki	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Samsung	84.0	84.0	84.0	84.0	84.0	84.8	85.5	86.3	87.0	85.8	87.0
Sharp	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0
Siemens	40.0	55.0	70.0	80.0	60.0	85.0	90.0	90.0	90.0	88.4	90.0
Texas Instruments	60.0	55.0	55.0	53.0	56.4	47.0	35.0	15.0	-	32.2	-
Toshiba	82.0	88.0	88.0	88.0	85.3	89.0	89.0	89.0	89.0	89.0	89.0
Vanguard	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-
All Companies	**62.5**	**64.4**	**66.8**	**68.6**	**65.2**	**70.6**	**70.7**	**70.2**	**71.5**	**70.7**	**67.9**

Source: Dataquest (January 1998)

Table 2-9
Quarterly Shipments of Synchronous 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	-	-	-	-	-	-	-

Source: Dataquest (January 1998)

Table 2-10
Quarterly Shipments of Next-Generation 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	-	-	-	-	-	-	-

Source: Dataquest (January 1998)

Table 2-11
Quarterly Shipments of Display 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	5.0	10.0	12.0	12.0	9.3	15.0	15.0	17.0	17.0	15.9	20.0
Hitachi	6.0	8.0	11.0	11.0	8.7	21.0	21.0	26.0	26.0	23.0	30.0
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	35.0	50.0	65.0	75.0	45.4	85.0	95.0	100.0	-	90.8	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	10.0	12.0	15.0	15.0	12.6	15.0	20.0	20.0	20.0	18.5	20.0
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	10.0	10.0	10.0	10.0	10.0	11.0	11.0	12.0	12.0	11.4	15.0
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	3.0	3.0	3.0	3.0	3.0	8.3	7.5	6.8	6.0	7.2	6.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	8.0	12.0	15.0	17.0	12.1	23.0	35.0	55.0	75.0	38.3	-
Toshiba	3.0	2.0	2.0	2.0	2.5	1.0	1.0	1.0	1.0	1.0	1.0
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**3.9**	**4.2**	**4.4**	**4.3**	**4.2**	**5.7**	**6.2**	**7.4**	**6.9**	**6.4**	**8.5**

Source: Dataquest (January 1998)

Chapter 3
Production Statistics of 16Mb DRAM

This chapter provides estimates of 16Mb DRAM quarterly unit shipments by supplier. Tables show a summary for 16Mb (see Table 3-1) and total 16Mb shipments (see Table 3-2). Subsequent tables show shipments by organization (x1, x4, x8/9, x16/18, and 32/36, in Tables 3-3 through 3-7) and by technology (fast page mode, extended data out, synchronous, next-generation, and display, in Tables 3-8 through 3-12). Dataquest collects data through quarterly supplier surveys. These tables represent 16Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 16Mb DRAM. Average selling prices for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5.

What Has Changed since the Previous Report

Dataquest continues to expect a 16Mb DRAM oversupply for most of 1998. Supply and demand of 16Mb are likely to move into balance during 1999 because demand will switch by then from 16Mb to 64Mb.

The forecast for total 16Mb DRAM supply for 1998 remains consistent with prior expectations. For 1998, Dataquest expects the worldwide supply of 16Mb DRAM to reach nearly 2.2 billion units (quite similar to the prior forecast of 2.3 billion units). Dataquest expects that the quarterly production peak of 16Mb will be late 1998 or early 1999. For the full year 1999, production should total 1.96 billion units. We base this outlook, which is higher than the prior 1999 forecast of 1.84 billion units, on a continued move by Taiwanese suppliers to 16Mb DRAM.

Expectations for 16Mb DRAM demand in 1998 remain consistent with prior expectations. For 1998, Dataquest expects worldwide demand for 16Mb DRAM to reach 2.14 billion units (the prior forecast called for 2.18 billion units). For 1999, demand for 16Mb DRAM is expected to total 1.91 billion units, versus the prior expectation of 1.82 billion units.

Table Format

Dataquest has revised the format of Table 3-1. The portion of Table 3-1 that formerly displayed configuration and technology detail in units now shows the same detail as percentages of total 16Mb DRAM unit shipments. Dataquest has also revised Tables 3-3 through 3-12 to display configuration and technology detail as a percentage of each company's overall 16Mb DRAM shipments. The "all companies" total at the bottom of these tables will show the weighted average of each detail subcategory as a percentage of overall "all companies" production of 16Mb DRAM. Dataquest believes this new arrangement will better show how each company allocates its production across the configuration and technology subcategories, as well as provide better analysis of market shifts.

High and Low Ranges of the 16Mb DRAM Supply Forecast

Under current market conditions, there is a greater likelihood that 16Mb supply will exceed Dataquest's forecast (than that it will be lower than our forecast). As noted, the high-side factors include the following:

- Taiwan-based suppliers might aggressively increase 16Mb production during 1998 and 1999.
- Micron might also increase 16Mb supply during most of 1998 and 1999.
- The economic crisis might cause some Korean manufacturers to emphasize 16Mb production and 256Mb development during 1998 and 1999.
- Other suppliers that plan to migrate more quickly to 64Mb DRAM might not, because of 64Mb die shrink delays, forcing them to produce more 16Mb DRAM during 1998 and 1998 than currently projected.

The High Side

For 1998, supply might be 20 percent above the current forecast—meaning a 1998 high-side estimate of more than 2.6 billion units.

For 1999, if all of the factors noted above occurred, 16Mb production might exceed 3 billion units, which is more than 50 percent higher than our current forecast.

The Low Side

For 1998, 16Mb supply might be 10 percent lower than the current forecast, meaning a low-side estimate of just under 2 billion units.

For 1999, 16Mb production might be 15 percent lower than our forecast, which is a low-side estimate of 1.67 million units.

Table 3-1
16Mb DRAM Supply and Demand Summary, Q1/97 to 1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Total Revenue (U.S.$M)	3,756.4	4,289.2	3,867.9	2,648.5	14,562.0	1,932.2	1,747.4	1,589.7	1,470.4	6,739.6	4,011.1
Total Units Shipped	433.2	484.4	534.4	530.1	1,982.0	532.8	540.8	545.9	561.9	2,181.3	1,963.0
Total Units Demanded	397.9	435.5	484.1	508.8	1,826.3	500.2	523.5	534.5	578.7	2,136.9	1,911.3
Sufficiency (%)	108.88	111.22	110.37	104.19	108.53	106.51	103.30	102.12	97.10	102.08	102.71
All Configurations (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
x1	2.0	1.4	1.2	1.3	1.4	1.1	1.1	1.0	1.0	1.0	0.8
x4	52.6	55.5	55.5	55.8	55.0	55.7	55.3	55.5	55.2	55.4	56.7
x8/9	13.7	15.6	17.4	16.3	15.9	16.9	16.9	17.3	17.9	17.3	14.7
x16/18	31.5	27.2	25.7	26.4	27.5	25.7	26.0	25.5	25.1	25.6	26.7
x32/36	0.2	0.2	0.2	0.2	0.2	0.6	0.6	0.7	0.8	0.7	1.2
All Interfaces (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Fast Page Mode	11.4	8.8	7.0	7.6	8.6	5.5	5.4	4.9	4.6	5.1	3.2
Extended Data Out	68.9	67.0	58.1	48.8	60.1	40.3	35.5	29.2	25.1	32.4	18.0
Synchronous	18.1	22.2	33.0	42.2	29.6	52.9	57.8	64.3	68.8	61.1	77.1
Next-Generation	1.6	2.0	1.9	1.5	1.7	1.1	1.0	1.3	1.2	1.2	1.0
Display	-	-	-	-	-	0.1	0.2	0.3	0.4	0.2	0.6

Source: Dataquest (January 1998)

Table 3-2
Quarterly Shipments of All Configurations of 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	0.1	0.2	0.7	1.4	2.3	2.1	2.9	3.7	4.3	13.0	21.0
Fujitsu	21.0	23.0	26.5	21.0	91.5	18.0	15.0	12.0	12.0	57.0	30.0
Hitachi	40.0	40.0	45.0	37.0	162.0	28.0	26.0	25.0	25.0	104.0	70.0
Hyundai	41.0	47.0	53.5	46.5	188.0	41.7	40.0	37.3	35.1	154.1	117.0
IBM Microelectronics	17.5	20.2	21.7	23.7	83.1	24.5	25.1	24.0	23.9	97.5	58.0
LG Semicon	36.9	38.5	37.0	35.2	147.7	34.5	32.5	31.0	29.0	127.0	95.0
Matsushita	5.5	6.0	6.4	7.1	25.0	7.3	8.0	8.6	9.7	33.6	23.5
Micron Technology	40.0	53.0	61.5	69.0	223.5	84.0	97.0	110.0	125.0	416.0	661.0
Mitsubishi	28.0	27.0	25.0	19.0	99.0	17.0	17.0	15.0	15.0	64.0	44.8
Mosel Vitelic	0.1	0.4	3.3	3.5	7.3	4.3	4.9	5.9	7.5	22.5	33.0
Motorola	6.0	8.0	4.8	4.0	22.8	0.5	-	-	-	0.5	-
Nan Ya Technology	1.7	3.3	7.8	11.6	24.4	14.6	15.5	19.5	23.5	73.1	121.0
NEC	43.0	46.0	46.0	36.0	171.0	35.0	32.0	32.0	30.0	129.0	81.0
Nippon Steel	1.7	2.5	5.3	8.4	17.9	10.4	12.4	13.4	15.9	52.1	36.5
Oki	7.5	7.7	8.5	8.8	32.5	8.9	9.0	9.0	9.0	35.9	25.2
Samsung	58.0	63.0	63.0	60.0	244.0	55.0	47.0	43.0	39.0	184.0	130.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	15.9	18.9	21.8	29.0	85.6	35.0	41.5	44.5	49.0	170.0	120.0
Texas Instruments	40.0	46.0	56.0	63.0	205.0	67.0	69.0	70.0	72.0	278.0	213.0
Toshiba	23.3	22.6	22.6	21.0	89.5	18.0	16.0	14.0	12.0	60.0	20.0
Vanguard	6.0	11.1	18.0	24.9	60.0	27.0	30.0	28.0	25.0	110.0	63.0
All Companies	**433.2**	**484.4**	**534.4**	**530.1**	**1,982.0**	**532.8**	**540.8**	**545.9**	**561.9**	**2,181.3**	**1,963.0**
Average Selling Price	8.67	8.86	7.24	5.00	7.35	3.63	3.23	2.91	2.62	3.09	2.04
Total Revenue (U.S.$M)	3,756.4	4,289.2	3,867.9	2,648.5	14,562.0	1,932.2	1,747.4	1,589.7	1,470.4	6,739.6	4,011.1
Total Demand	397.9	435.5	484.1	508.8	1,826.3	500.2	523.5	534.5	578.7	2,136.9	1,911.3
Sufficiency (%)	108.88	111.22	110.37	104.19	108.53	106.51	103.30	102.12	97.10	102.08	102.71

Source: Dataquest (January 1998)

Table 3-3
Quarterly Shipments of x1 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	4.0	4.0	4.0	4.0	4.0	3.0	3.0	2.0	2.0	2.5	2.0
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	9.0	8.0	8.0	8.0	8.2	6.0	6.0	5.0	5.0	5.5	3.0
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	4.0	4.0	3.0	3.0	3.6	3.0	3.0	3.0	3.0	3.0	2.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	2.0	2.0	1.0	1.0	1.5	1.0	1.0	1.0	1.0	1.0	1.0
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	5.0	5.0	4.0	4.0	4.5	2.0	2.0	2.0	2.0	2.0	2.0
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	10.0	5.0	4.0	5.0	5.7	5.0	5.0	5.0	5.0	5.0	5.0
Toshiba	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**2.0**	**1.4**	**1.2**	**1.3**	**1.4**	**1.1**	**1.1**	**1.0**	**1.0**	**1.0**	**0.8**
Average Selling Price	9.12	9.22	7.70	5.75	8.05	4.18	3.49	3.00	2.68	3.35	2.13
Total Revenue (U.S.$M)	79.2	64.5	48.7	38.4	230.8	24.4	20.5	16.5	15.1	76.6	32.3

Source: Dataquest (January 1998)

Table 3-4
Quarterly Shipments of x4 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	50.0	50.0	40.0	40.0	44.8	42.0	42.0	42.0	42.0	42.0	40.0
Hitachi	58.0	58.0	55.0	55.0	56.5	42.0	39.0	39.0	39.0	39.8	35.0
Hyundai	55.0	65.0	70.0	70.0	65.5	70.0	70.0	70.0	70.0	70.0	70.0
IBM Microelectronics	51.7	48.7	41.9	40.0	45.1	40.0	40.0	40.0	40.0	40.0	30.0
LG Semicon	42.0	57.0	67.0	67.0	58.1	67.5	68.0	68.5	69.0	68.2	69.0
Matsushita	22.0	22.0	22.0	22.0	22.0	21.0	21.0	21.0	21.0	21.0	18.0
Micron Technology	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0	80.0
Mitsubishi	50.0	50.0	50.0	50.0	50.0	47.0	47.0	47.0	47.0	47.0	45.0
Mosel Vitelic	10.0	15.0	10.9	34.3	22.3	23.5	24.6	27.2	29.3	26.7	21.8
Motorola	96.5	95.7	91.7	91.7	94.3	100.0	-	-	-	100.0	-
Nan Ya Technology	100.0	100.0	100.0	100.0	100.0	80.0	60.0	50.0	30.0	51.7	50.0
NEC	38.0	32.0	27.0	27.0	31.1	29.0	29.0	27.0	27.0	28.0	27.0
Nippon Steel	-	-	2.0	2.0	1.5	62.0	60.0	60.0	60.0	60.4	60.0
Oki	76.0	77.0	80.0	80.0	78.4	86.0	88.0	90.0	90.0	88.5	90.0
Samsung	56.0	66.0	70.0	70.0	65.6	71.3	72.5	73.8	75.0	72.9	75.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	50.0	51.3	51.0	50.0	50.6	50.0	50.0	50.0	50.0	50.0	50.0
Texas Instruments	37.0	30.0	30.0	30.0	31.4	30.0	30.0	30.0	30.0	30.0	16.0
Toshiba	55.0	60.0	60.0	65.0	59.9	50.0	40.0	35.0	35.0	40.8	35.0
Vanguard	40.0	40.0	52.0	52.0	48.6	56.5	61.0	65.5	70.0	63.1	40.0
All Companies	**52.6**	**55.5**	**55.5**	**55.8**	**55.0**	**55.7**	**55.3**	**55.5**	**55.2**	**55.4**	**56.7**
Average Selling Price	8.42	8.50	6.88	4.83	7.05	3.55	3.18	2.87	2.59	3.04	2.00
Total Revenue (U.S.$M)	1,919.8	2,286.2	2,040.7	1,429.9	7,676.7	1,053.6	952.6	870.1	802.7	3,679.1	2,219.0

Source: Dataquest (January 1998)

Table 3-5
Quarterly Shipments of x8/9 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	35.0	35.0	50.0	50.0	42.8	50.0	50.0	50.0	50.0	50.0	45.0
Hitachi	14.0	14.0	15.0	15.0	14.5	18.0	20.0	23.0	23.0	20.9	28.0
Hyundai	3.0	5.0	10.0	10.0	7.2	13.0	13.0	13.0	13.0	13.0	15.0
IBM Microelectronics	32.8	35.1	41.2	40.0	37.6	40.0	40.0	40.0	40.0	40.0	45.0
LG Semicon	4.0	8.0	10.0	10.0	8.0	10.0	10.0	10.0	10.0	10.0	10.0
Matsushita	25.0	26.0	27.0	27.0	26.3	28.0	29.0	29.0	29.0	28.8	30.0
Micron Technology	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
Mitsubishi	14.0	14.0	13.0	13.0	13.6	13.0	13.0	13.0	13.0	13.0	12.0
Mosel Vitelic	-	-	-	-	-	5.9	6.2	6.8	7.3	6.7	2.7
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	20.0	40.0	50.0	70.0	48.3	50.0
NEC	34.0	42.0	52.0	52.0	44.8	50.0	50.0	54.0	54.0	51.9	54.0
Nippon Steel	-	-	3.0	3.0	2.3	15.0	15.0	15.0	15.0	15.0	15.0
Oki	4.0	4.0	4.0	4.0	4.0	2.0	1.0	1.0	1.0	1.2	1.0
Samsung	10.0	17.0	15.0	15.0	14.3	15.0	15.0	15.0	15.0	15.0	15.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	6.0	6.3	8.0	10.0	7.9	10.0	10.0	10.0	10.0	10.0	10.0
Texas Instruments	18.0	18.0	19.0	20.0	18.9	20.0	20.0	20.0	20.0	20.0	10.0
Toshiba	8.0	5.0	4.0	4.0	5.3	3.0	3.0	2.0	2.0	2.6	2.0
Vanguard	20.0	20.0	10.0	10.0	12.9	11.3	12.5	13.8	15.0	13.1	20.0
All Companies	**13.7**	**15.6**	**17.4**	**16.3**	**15.9**	**16.9**	**16.9**	**17.3**	**17.9**	**17.3**	**14.7**
Average Selling Price	10.15	10.34	8.66	5.21	8.40	3.69	3.26	2.96	2.66	3.13	2.09
Total Revenue (U.S.$M)	603.1	783.0	806.8	451.3	2,644.3	331.3	297.5	279.9	268.3	1,177.0	602.8

Source: Dataquest (January 1998)

Table 3-6
Quarterly Shipments of x16/18 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fujitsu	15.0	15.0	10.0	10.0	12.4	8.0	8.0	6.0	6.0	7.2	13.0
Hitachi	24.0	24.0	26.0	26.0	25.0	37.0	38.0	36.0	36.0	36.8	35.0
Hyundai	42.0	30.0	20.0	20.0	27.3	17.0	17.0	17.0	17.0	17.0	15.0
IBM Microelectronics	15.5	16.2	16.8	20.0	17.3	20.0	20.0	20.0	20.0	20.0	25.0
LG Semicon	54.0	35.0	23.0	23.0	33.9	22.5	22.0	21.5	21.0	21.8	21.0
Matsushita	44.0	44.0	43.0	43.0	43.5	45.0	44.0	45.0	45.0	44.8	49.0
Micron Technology	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
Mitsubishi	32.0	32.0	34.0	34.0	32.9	37.0	37.0	37.0	37.0	37.0	41.0
Mosel Vitelic	90.0	85.0	89.1	37.9	64.3	16.8	17.3	18.6	19.7	18.3	10.5
Motorola	3.5	4.4	8.3	8.3	5.7	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	26.0	24.0	20.0	20.0	22.6	20.0	20.0	18.0	18.0	19.0	18.0
Nippon Steel	100.0	100.0	95.0	95.0	96.2	23.0	25.0	25.0	25.0	24.6	25.0
Oki	15.0	14.0	12.0	12.0	13.2	10.0	9.0	7.0	7.0	8.2	7.0
Samsung	34.0	17.0	15.0	15.0	20.0	13.8	12.5	11.3	10.0	12.1	10.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	44.0	42.3	41.0	40.0	41.5	40.0	40.0	40.0	40.0	40.0	40.0
Texas Instruments	35.0	47.0	47.0	45.0	44.0	45.0	45.0	45.0	45.0	45.0	69.0
Toshiba	33.0	30.0	30.0	30.0	30.8	40.0	50.0	56.0	56.0	49.6	56.0
Vanguard	40.0	40.0	38.0	38.0	38.6	32.3	26.5	20.8	15.0	23.8	40.0
All Companies	**31.5**	**27.2**	**25.7**	**26.4**	**27.5**	**25.7**	**26.0**	**25.5**	**25.1**	**25.6**	**26.7**
Average Selling Price	8.42	8.71	7.03	5.18	7.31	3.73	3.31	2.96	2.65	3.16	2.12
Total Revenue (U.S.$M)	1,148.3	1,147.8	963.9	724.2	3,984.1	510.9	465.6	412.0	373.4	1,761.8	1,111.0

Source: Dataquest (January 1998)

Table 3-7
Quarterly Shipments of x32/36 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	2.0	2.0	0.8	2.0
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	27.9	13.4	53.8	51.9	47.3	43.7	48.3	65.0
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	3.0	4.0	5.0	-	3.1	6.0	6.0	6.0	6.0	6.0	6.0
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.6**	**0.6**	**0.7**	**0.8**	**0.7**	**1.2**
Average Selling Price	8.42	8.50	6.88	4.83	7.03	3.55	3.18	2.87	2.59	3.02	1.98
Total Revenue (U.S.$M)	5.9	7.7	7.8	4.7	26.1	12.0	11.1	11.1	11.0	45.1	45.9

Source: Dataquest (January 1998)

Table 3-8
Quarterly Shipments of Fast Page Mode 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	10.0	10.0	10.0	10.0	10.0	8.0	5.0	5.0	10.0	7.0	10.0
Hitachi	10.0	7.0	5.0	5.0	6.7	3.0	3.0	2.0	2.0	2.5	2.0
Hyundai	10.0	10.0	10.0	10.0	10.0	7.0	7.0	7.0	7.0	7.0	5.0
IBM Microelectronics	15.0	10.0	5.0	5.0	8.3	5.0	5.0	5.0	5.0	5.0	3.0
LG Semicon	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Matsushita	50.0	27.0	15.0	15.0	25.6	7.0	5.0	5.0	5.0	5.4	3.0
Micron Technology	13.0	10.0	6.0	5.0	7.9	5.0	5.0	3.0	1.0	3.3	1.0
Mitsubishi	15.0	10.0	5.0	5.0	9.2	5.0	8.0	7.0	7.0	6.7	6.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	30.0	15.0	10.0	100.0	32.8	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	40.0	30.0	30.0	30.0	30.9	20.0	10.0	9.0	9.0	11.4	-
Oki	50.0	30.0	10.0	10.0	24.0	5.0	5.0	5.0	5.0	5.0	3.0
Samsung	10.0	10.0	10.0	10.0	10.0	5.0	5.0	5.0	5.0	5.0	5.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	25.0	20.0	15.0	10.0	16.3	10.0	10.0	10.0	10.0	10.0	10.0
Texas Instruments	15.0	10.0	10.0	10.0	11.0	10.0	10.0	10.0	10.0	10.0	8.0
Toshiba	3.0	2.0	2.0	2.0	2.3	2.0	2.0	2.0	2.0	2.0	2.0
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**11.4**	**8.8**	**7.0**	**7.6**	**8.6**	**5.5**	**5.4**	**4.9**	**4.6**	**5.1**	**3.2**

Source: Dataquest (January 1998)

Table 3-9
Quarterly Shipments of Extended Data Out 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fujitsu	40.0	40.0	20.0	20.0	29.6	20.0	20.0	20.0	20.0	20.0	20.0
Hitachi	72.0	68.0	65.0	65.0	67.5	47.0	37.0	23.0	23.0	33.0	13.0
Hyundai	83.0	70.0	55.0	30.0	58.7	13.0	13.0	13.0	13.0	13.0	10.0
IBM Microelectronics	70.0	73.0	75.0	70.0	72.0	65.0	60.0	55.0	45.0	56.3	37.0
LG Semicon	84.0	84.0	73.0	73.0	78.6	58.5	44.0	29.5	15.0	37.8	15.0
Matsushita	50.0	70.0	80.0	80.0	71.0	70.0	70.0	65.0	65.0	67.3	52.0
Micron Technology	84.0	72.0	47.0	25.0	52.8	20.0	15.0	12.0	9.0	13.4	9.0
Mitsubishi	60.0	60.0	60.0	60.0	60.0	50.0	37.0	30.0	30.0	37.2	19.0
Mosel Vitelic	100.0	100.0	100.0	88.6	94.5	64.1	60.0	53.6	52.0	56.4	27.3
Motorola	60.0	70.0	70.0	-	55.1	100.0	-	-	-	100.0	-
Nan Ya Technology	100.0	100.0	100.0	100.0	100.0	80.0	60.0	50.0	30.0	51.7	30.0
NEC	35.0	40.0	35.0	30.0	35.3	15.0	15.0	10.0	10.0	12.6	10.0
Nippon Steel	60.0	70.0	70.0	70.0	69.1	79.0	73.0	34.0	34.0	52.3	20.0
Oki	46.0	63.0	79.0	79.0	67.6	69.0	66.0	63.0	63.0	65.2	47.0
Samsung	70.0	63.0	52.0	20.0	51.3	15.0	15.0	15.0	15.0	15.0	15.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	70.0	70.0	65.0	60.0	65.3	50.0	45.0	40.0	35.0	41.8	40.0
Texas Instruments	70.0	70.0	55.0	50.0	59.8	45.0	40.0	35.0	30.0	37.4	18.8
Toshiba	87.0	83.0	78.0	73.0	80.4	58.0	48.0	28.0	28.0	42.3	20.0
Vanguard	100.0	100.0	95.0	95.0	96.4	85.0	75.0	65.0	55.0	70.4	10.0
All Companies	**68.9**	**67.0**	**58.1**	**48.8**	**60.1**	**40.3**	**35.5**	**29.2**	**25.1**	**32.4**	**18.0**

Source: Dataquest (January 1998)

Table 3-10
Quarterly Shipments of Synchronous 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	50.0	50.0	70.0	70.0	60.4	72.0	75.0	75.0	70.0	73.0	70.0
Hitachi	18.0	25.0	30.0	30.0	25.8	50.0	60.0	75.0	75.0	64.5	85.0
Hyundai	7.0	20.0	35.0	60.0	31.3	80.0	80.0	80.0	80.0	80.0	85.0
IBM Microelectronics	15.0	17.0	20.0	25.0	19.6	30.0	35.0	40.0	50.0	38.7	60.0
LG Semicon	10.0	10.0	20.0	20.0	14.9	33.8	47.5	61.3	75.0	53.4	75.0
Matsushita	-	3.0	5.0	5.0	3.4	23.0	25.0	30.0	30.0	27.3	45.0
Micron Technology	3.0	18.0	47.0	70.0	39.3	75.0	80.0	85.0	90.0	83.3	90.0
Mitsubishi	25.0	30.0	35.0	35.0	30.8	45.0	55.0	63.0	63.0	56.1	75.0
Mosel Vitelic	-	-	-	11.4	5.5	23.5	24.6	27.2	29.3	26.7	40.9
Motorola	10.0	15.0	20.0	-	12.1	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	20.0	40.0	50.0	70.0	48.3	70.0
NEC	50.0	40.0	45.0	50.0	46.0	70.0	70.0	70.0	70.0	70.0	70.0
Nippon Steel	-	-	-	-	-	1.0	17.0	57.0	57.0	36.3	80.0
Oki	4.0	7.0	11.0	11.0	8.4	26.0	29.0	32.0	32.0	29.8	50.0
Samsung	20.0	27.0	38.0	70.0	38.8	80.0	80.0	80.0	80.0	80.0	80.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	5.0	10.0	20.0	30.0	18.4	40.0	45.0	50.0	55.0	48.2	50.0
Texas Instruments	15.0	20.0	35.0	40.0	29.3	45.0	50.0	55.0	60.0	52.6	73.1
Toshiba	10.0	15.0	20.0	25.0	17.3	40.0	50.0	70.0	70.0	55.7	78.0
Vanguard	-	-	5.0	5.0	3.6	15.0	25.0	35.0	45.0	29.6	90.0
All Companies	**18.1**	**22.2**	**33.0**	**42.2**	**29.6**	**52.9**	**57.8**	**64.3**	**68.8**	**61.1**	**77.1**

Source: Dataquest (January 1998)

Table 3-11
Quarterly Shipments of Next-Generation 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	1.0	1.0	2.0	2.0	1.5	2.3	2.5	2.8	3.0	2.6	3.0
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	15.0	20.0	20.0	20.0	18.7	15.0	15.0	20.0	20.0	17.4	20.0
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**1.6**	**2.0**	**1.9**	**1.5**	**1.7**	**1.1**	**1.0**	**1.3**	**1.2**	**1.2**	**1.0**

Source: Dataquest (January 1998)

Table 3-12
Quarterly Shipments of Display 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	0.5	1.0	1.5	2.0	1.2	2.0
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	12.4	15.4	19.2	18.7	16.9	31.8
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	-	**0.1**	**0.2**	**0.3**	**0.4**	**0.2**	**0.6**

Source: Dataquest (January 1998)

Chapter 4
Production Statistics of 64Mb DRAM

This chapter provides estimates of 64Mb DRAM quarterly unit shipments by supplier. Tables show a summary for 64Mb (see Table 4-1) and total 64Mb shipments (see Table 4-2). Subsequent tables show shipments by organization (x4, x8/9, x64/18, and 32/36, in Tables 4-3 through 4-6) and by technology (fast page mode, extended data out, synchronous, and next generation, in Tables 4-7 through 4-10). Dataquest collects data through quarterly supplier surveys. These tables represent 64Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 64Mb DRAM. Average selling prices for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5.

64Mb Market Conditions

The 64Mb market remains oversupplied. The 64Mb market expansion during 1998 depends largely on the bit-price crossover to 64Mb from the 16Mb density. Cost reduction of 64Mb now emerges as the foremost issue. As indicated, the ability of suppliers to shrink the 64Mb die size during 1998 and 1999 will have a major impact on cost reduction.

What Has Changed since the Previous Report

Dataquest's outlook continues to call for 64Mb oversupply through most of 1998. For 1998, desktop PCs should emerge as a mainstream application.

The 1998 forecast for 64Mb DRAM supply remains generally consistent with prior expectations. For 1998, Dataquest expects worldwide supply of 64Mb DRAM to total 382 million units (while the prior forecast called for 372 million units). For 1999, worldwide supply of 64Mb DRAM should total 895 million units (which is quite similar to the prior forecast).

The 1998 demand forecast for 64Mb DRAM also remains consistent with last quarter's expectations. For 1998, Dataquest expects worldwide demand for 64Mb DRAM to total 374 million units (while the prior forecast called for 358 million units). For 1999, worldwide demand for 64Mb DRAM should total 904 million units, which remains consistent with last quarter's expectation. Under current market conditions, 64Mb supply and demand will not move into balance until the end of 1998, at the earliest.

The supply and demand equation should tighten during the 100-MHz SDRAM production migration to the 0.25-micron process. The production rate of 100-MHz SDRAM will accelerate at that time, but so will demand, which should cause supply and demand for this device to tighten by the end of 1998.

Table Format

Dataquest has revised the format of Table 4-1. The portion of Table 4-1 that formerly displayed configuration and technology detail in units now shows the same detail as percentages of total 64Mb DRAM unit shipments. Dataquest has also revised Tables 4-3 through 4-10 to display configuration and technology detail as a percentage of each company's overall 64Mb DRAM shipments. The "all companies" total at the bottom of these tables will show the weighted average of each detail subcategory as a percentage of overall, "all companies" production of 64Mb DRAM. Dataquest believes this new arrangement will better show how each company allocates its production across the configuration and technology subcategories, as well as provide better analysis of market shifts.

High and Low Ranges of the 64Mb DRAM Supply Forecast

Under current market conditions, there is a greater likelihood that 64Mb supply will be lower than Dataquest's forecast (rather than higher than our forecast). As noted, key high-side factors include the following:

- Some suppliers planning to migrate quickly during 1998 and 1999 to 64Mb DRAM might not; a delay in making 64Mb die shrinks might force them to produce fewer 64Mb DRAM during 1998 and 1999 than currently projected.
- The economic crisis might cause some Korean manufacturers to de-emphasize 64Mb production during 1998 and 1999; they could instead emphasize 16Mb production and 256Mb development.

The High-Side Estimate

For 1998, 64Mb supply might be 15 percent higher than the current forecast, which means a 1998 high-side forecast of 440 million units. For 1999, 64Mb supply might exceed our forecast by 15 percent, which means a 1999 high-side forecast of 1.03 billion units.

The Low-Side Estimate

Concerns about the 64Mb transition suggest that, on the low side, the 1998 supply of 64Mb DRAM might be about 22 percent lower than the current forecast, which means a low-side estimate of just under 300 million units.

For 1999, current market conditions indicate that 64Mb supply might be one-third lower than now forecast. This means a 1999 low-side 64Mb DRAM supply estimate of just 600 million units.

Table 4-1
64Mb DRAM Supply and Demand Summary, Q1/97 to 1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Total Revenue (U.S.$M)	481.3	628.8	824.2	1,073.6	3,008.0	1,184.7	1,459.5	1,764.7	2,112.4	6,521.3	10,098.5
Total Units Shipped	8.5	15.5	25.5	44.4	93.8	59.2	79.4	106.1	136.9	381.5	894.8
Total Units Demanded	7.8	14.0	23.5	42.8	88.0	55.8	76.8	103.0	138.7	374.3	904.4
Sufficiency (%)	107.84	111.09	108.43	103.77	106.53	106.08	103.33	103.04	98.68	101.94	98.94
All Configurations (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
x1	-	-	-	-	-	-	-	-	-	-	-
x4	49.3	50.8	52.6	51.7	51.6	45.3	42.8	39.6	38.4	40.7	33.4
x8/9	31.8	32.5	31.4	30.3	31.1	31.1	30.5	30.1	30.3	30.4	31.6
x16/18	18.9	16.4	15.9	17.8	17.2	22.6	24.9	28.0	28.4	26.7	30.7
x32/36	-	0.2	0.1	0.1	0.1	1.0	1.8	2.3	2.9	2.2	4.3
All Interfaces (%)	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Fast Page Mode	0.6	0.2	0.1	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2
Extended Data Out	81.5	78.5	74.1	75.0	75.9	64.3	49.2	39.9	34.2	43.6	18.7
Synchronous	17.9	21.1	25.5	24.6	23.7	34.9	49.8	58.6	64.1	55.1	79.0
Next-Generation	-	0.1	0.4	0.3	0.2	0.6	0.7	1.3	1.5	1.1	2.1
Display	-	-	-	-	-	-	-	-	-	-	-

Source: Dataquest (January 1998)

Table 4-2
Quarterly Shipments of All Configurations of 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	1.0
Fujitsu	0.3	0.5	0.7	1.2	2.7	1.5	3.0	5.0	7.0	16.5	46.8
Hitachi	0.3	0.4	1.1	3.0	4.8	4.0	6.0	9.0	12.0	31.0	83.7
Hyundai	0.3	0.6	1.0	3.0	4.9	5.4	8.2	11.7	15.5	40.8	82.0
IBM Microelectronics	0.3	0.3	0.4	0.7	1.7	1.8	3.0	4.7	6.5	16.0	50.1
LG Semicon	0.6	0.9	1.5	2.0	5.0	3.5	4.5	6.0	8.0	22.0	55.0
Matsushita	-	-	-	-	-	0.0	0.1	0.3	0.6	1.0	5.0
Micron Technology	0.2	0.5	0.9	1.2	2.8	1.6	2.1	2.9	3.5	10.1	20.9
Mitsubishi	0.6	1.0	2.0	5.0	8.6	6.0	7.5	10.0	13.6	37.1	79.7
Mosel Vitelic	-	-	-	0.2	0.2	0.6	1.0	1.5	2.5	5.6	22.5
Motorola	-	-	-	0.1	0.1	0.3	0.6	0.4	0.3	1.6	-
Nan Ya Technology	-	-	-	-	-	-	0.1	0.3	0.4	0.8	4.5
NEC	1.9	3.2	5.6	10.0	20.7	11.0	13.6	17.5	21.1	63.2	114.7
Nippon Steel	-	-	-	-	-	-	-	0.5	0.8	1.3	13.3
Oki	-	-	-	0.2	0.2	0.6	1.0	1.3	1.3	4.2	6.3
Samsung	3.2	6.8	10.0	12.0	32.0	15.5	18.5	21.0	24.0	79.0	130.4
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	0.2	0.2	0.3	0.4	1.0	0.7	1.0	1.5	2.5	5.7	26.0
Texas Instruments	0.4	0.5	0.7	1.4	3.0	1.7	3.2	4.9	8.2	18.0	61.2
Toshiba	0.3	0.7	1.3	4.0	6.3	5.0	6.0	7.5	9.0	27.5	90.0
Vanguard	-	-	-	-	-	-	-	0.1	0.1	0.2	1.7
All Companies	**8.5**	**15.5**	**25.5**	**44.4**	**93.8**	**59.2**	**79.4**	**106.1**	**136.9**	**381.5**	**894.8**
Average Selling Price	56.96	40.57	32.39	24.18	32.07	20.02	18.38	16.63	15.44	17.09	11.29
Total Revenue (U.S.$M)	481.3	628.8	824.2	1,073.6	3,008.0	1,184.7	1,459.5	1,764.7	2,112.4	6,521.3	10,098.5
Total Demand	7.8	14.0	23.5	42.8	88.0	55.8	76.8	103.0	138.7	374.3	904.4
Sufficiency (%)	107.84	111.09	108.43	103.77	106.53	106.08	103.33	103.04	98.68	101.94	98.94

Source: Dataquest (January 1998)

Table 4-3
Quarterly Shipments of All Configurations of 64MB DRAM to the World, Q1/97 to 1999 (Millions of Dollars)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	20.0	10.0	10.0	10.0	11.1	5.0	5.0	5.0	5.0	5.0	3.0
Hitachi	80.0	70.0	65.0	65.0	66.3	40.0	35.0	35.0	35.0	35.6	25.0
Hyundai	70.0	70.0	70.0	70.0	70.0	66.5	66.5	66.5	66.5	66.5	64.0
IBM Microelectronics	40.0	40.0	39.0	40.0	39.8	40.0	40.0	40.0	40.0	40.0	45.0
LG Semicon	80.0	70.0	70.0	70.0	71.2	66.5	63.0	59.5	56.0	60.1	56.0
Matsushita	-	-	-	-	-	70.0	65.0	60.0	60.0	60.8	50.0
Micron Technology	100.0	100.0	100.0	80.0	91.3	75.0	70.0	65.0	60.0	65.9	60.0
Mitsubishi	74.0	70.0	65.0	65.0	66.2	55.0	50.0	45.0	45.0	47.6	30.0
Mosel Vitelic	-	-	-	100.0	100.0	60.0	35.0	20.0	15.0	24.7	10.0
Motorola	-	-	-	50.0	50.0	50.0	50.0	50.0	50.0	50.0	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	100.0
NEC	43.0	43.0	40.0	40.0	40.7	23.0	20.0	15.0	15.0	17.5	10.0
Nippon Steel	-	-	-	-	-	-	-	31.0	31.0	31.0	35.0
Oki	-	-	-	57.0	57.0	54.0	62.0	65.0	65.0	62.7	58.0
Samsung	40.0	50.0	55.0	55.0	52.4	53.8	52.5	51.3	50.0	51.7	50.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	75.0	70.0	64.0	60.0	65.0	55.0	50.0	45.0	40.0	44.9	30.0
Texas Instruments	20.0	25.0	30.0	35.0	30.3	40.0	40.0	35.0	30.0	34.1	30.0
Toshiba	60.0	30.0	30.0	30.0	31.4	25.0	25.0	20.0	20.0	22.0	15.0
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**49.3**	**50.8**	**52.6**	**51.7**	**51.6**	**45.3**	**42.8**	**39.6**	**0**	**0**	**0**
Average Selling Price	56.95	40.54	32.44	24.34	32.03	20.02	18.37	16.63	15.46	15.46	10.79
Total Revenue (U.S.$M)	237.1	319.5	434.4	558.7	1,549.7	537.0	624.8	698.1	0	1,859.9	0.0

Source: Dataquest (January 1998)

Table 4-4
Quarterly Shipments of x8/9 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	20.0	15.0	15.0	15.0	15.6	20.0	20.0	20.0	20.0	20.0	25.0
Hitachi	20.0	30.0	30.0	30.0	29.4	40.0	40.0	40.0	40.0	40.0	45.0
Hyundai	30.0	25.0	25.0	25.0	25.3	28.0	28.0	28.0	28.0	28.0	29.0
IBM Microelectronics	30.0	33.0	35.9	35.0	34.0	30.0	25.0	25.0	25.0	25.6	25.0
LG Semicon	20.0	20.0	20.0	20.0	20.0	24.0	28.0	32.0	36.0	31.4	36.0
Matsushita	-	-	-	-	-	30.0	35.0	35.0	35.0	34.8	40.0
Micron Technology	-	-	-	15.0	6.5	15.0	15.0	15.0	15.0	15.0	10.0
Mitsubishi	25.0	27.0	30.0	30.0	29.3	29.0	27.0	25.0	25.0	26.1	25.0
Mosel Vitelic	-	-	-	-	-	30.0	40.0	40.0	40.0	38.9	25.0
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	22.0	25.0	25.0	25.0	24.7	25.0	25.0	25.0	25.0	25.0	30.0
Nippon Steel	-	-	-	-	-	-	-	31.0	31.0	31.0	30.0
Oki	-	-	-	29.0	29.0	31.0	25.0	20.0	20.0	22.8	28.0
Samsung	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	25.0	27.0	31.0	30.0	29.0	30.0	30.0	30.0	30.0	30.0	30.0
Texas Instruments	75.0	65.0	55.0	45.0	54.3	35.0	30.0	30.0	30.0	30.5	25.0
Toshiba	40.0	40.0	30.0	30.0	31.6	30.0	30.0	30.0	30.0	30.0	35.0
Vanguard	-	-	-	-	-	-	-	7.5	10.0	8.8	30.0
All Companies	**31.8**	**32.5**	**31.4**	**30.3**	**31.1**	**31.1**	**30.5**	**30.1**	**30.3**	**30.4**	**31.6**
Average Selling Price	56.96	40.59	32.47	24.34	32.38	20.02	18.49	16.63	15.46	17.14	11.31
Total Revenue (U.S.$M)	153.1	204.8	259.2	327.7	944.7	368.0	447.2	531.9	641.2	1,988.2	3,195.8

Source: Dataquest (January 1998)

Table 4-5
Quarterly Shipments of x16/18 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	100.0
Fujitsu	60.0	70.0	70.0	70.0	68.9	55.0	55.0	55.0	55.0	55.0	52.0
Hitachi	-	-	5.0	5.0	4.3	20.0	25.0	25.0	25.0	24.4	30.0
Hyundai	-	5.0	5.0	5.0	4.7	5.0	5.0	5.0	5.0	5.0	5.0
IBM Microelectronics	30.0	27.0	25.1	25.0	26.3	30.0	35.0	35.0	35.0	34.4	30.0
LG Semicon	-	10.0	10.0	10.0	8.8	8.8	7.5	6.3	5.0	6.4	5.0
Matsushita	-	-	-	-	-	-	-	5.0	5.0	4.3	10.0
Micron Technology	-	-	-	5.0	2.2	10.0	15.0	20.0	25.0	19.1	30.0
Mitsubishi	1.0	3.0	5.0	5.0	4.5	15.0	20.0	25.0	25.0	22.4	35.0
Mosel Vitelic	-	-	-	-	-	10.0	25.0	40.0	45.0	36.3	40.0
Motorola	-	-	-	50.0	50.0	50.0	50.0	50.0	50.0	50.0	-
Nan Ya Technology	-	-	-	-	-	-	100.0	100.0	100.0	100.0	-
NEC	35.0	32.0	35.0	35.0	34.5	52.0	55.0	60.0	60.0	57.5	60.0
Nippon Steel	-	-	-	-	-	-	-	38.0	38.0	38.0	35.0
Oki	-	-	-	14.0	14.0	15.0	13.0	15.0	15.0	14.5	14.0
Samsung	20.0	10.0	5.0	5.0	7.6	5.0	5.0	5.0	5.0	5.0	5.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	3.0	5.0	10.0	6.0	15.0	20.0	25.0	30.0	25.1	40.0
Texas Instruments	5.0	10.0	15.0	20.0	15.3	25.0	30.0	35.0	35.0	33.2	35.0
Toshiba	-	30.0	40.0	40.0	37.0	45.0	45.0	50.0	50.0	48.0	50.0
Vanguard	-	-	-	-	-	-	-	92.5	90.0	91.3	70.0
All Companies	**18.9**	**16.4**	**15.9**	**17.8**	**17.2**	**22.6**	**24.9**	**28.0**	**28.4**	**26.7**	**30.7**
Average Selling Price	56.97	40.62	32.04	23.45	31.65	20.02	18.27	16.63	15.37	16.91	11.21
Total Revenue (U.S.$M)	91.1	103.6	129.5	185.8	510.0	267.5	361.9	493.4	597.0	1,719.9	3,081.3

Source: Dataquest (January 1998)

Table 4-6
Quarterly Shipments of x32/36 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	5.0	5.0	5.0	4.4	20.0	20.0	20.0	20.0	20.0	20.0
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	0.5	0.5	0.5	0.5	0.5	2.0
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	0.8	1.5	2.3	3.0	2.1	3.0
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	1.0	3.0	5.0	5.0	3.9	10.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	25.0
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	1.3	2.5	3.8	5.0	3.3	5.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	5.0	2.3	10.0
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**-**	**0.2**	**0.1**	**0.1**	**0.1**	**1.0**	**1.8**	**2.3**	**2.9**	**2.2**	**4.3**
Average Selling Price	-	40.54	32.44	24.34	30.08	20.02	18.37	16.63	15.46	16.61	11.31
Total Revenue (U.S.$M)	-	1.0	1.1	1.5	3.6	12.2	25.6	41.3	62.0	141.0	439.9

Source: Dataquest (January 1998)

Table 4-7
Quarterly Shipments of Fast Page Mode 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	5.0	4.0	3.0	3.0	3.5	3.0	3.0	1.0	1.0	1.6	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	5.0	5.0	5.0	5.0	5.0	5.0	5.0	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	9.0	3.5	2.0	3.0	3.6	3.0	3.0	3.0	3.0	3.0	3.0
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**0.6**	**0.2**	**0.1**	**0.2**	**0.2**	**0.2**	**0.3**	**0.2**	**0.2**	**0.2**	**0.2**

Source: Dataquest (January 1998)

Table 4-8
Quarterly Shipments of Extended Data Out 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	100.0	100.0	95.0	95.0	95.7	90.0	70.0	55.0	55.0	62.4	20.0
Hyundai	90.0	90.0	85.0	85.0	85.9	70.0	25.0	25.0	20.0	29.1	15.0
IBM Microelectronics	85.2	80.0	74.0	72.0	76.2	67.0	62.0	59.0	49.0	56.4	20.0
LG Semicon	90.0	83.0	74.0	74.0	77.5	57.9	41.8	25.7	9.6	28.2	9.6
Matsushita	-	-	-	-	-	95.0	90.0	80.0	80.0	81.5	50.0
Micron Technology	100.0	100.0	100.0	100.0	100.0	95.0	90.0	85.0	70.0	82.4	25.1
Mitsubishi	100.0	100.0	100.0	100.0	100.0	95.0	90.0	70.0	67.0	77.0	35.0
Mosel Vitelic	-	-	-	100.0	100.0	80.0	60.0	40.0	20.0	38.9	20.0
Motorola	-	-	-	80.0	80.0	80.0	80.0	80.0	80.0	80.0	-
Nan Ya Technology	-	-	-	-	-	-	10.0	10.0	10.0	10.0	-
NEC	70.0	55.0	55.0	55.0	56.4	30.0	20.0	20.0	18.0	21.1	10.0
Nippon Steel	-	-	-	-	-	-	-	23.0	23.0	23.0	20.0
Oki	-	-	-	100.0	100.0	92.0	87.0	75.0	75.0	80.3	60.0
Samsung	85.0	85.0	75.0	70.0	76.3	60.0	45.0	35.0	20.0	37.7	15.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	100.0	100.0	100.0	90.0	95.8	85.0	80.0	75.0	70.0	74.9	50.0
Texas Instruments	78.0	81.5	80.0	77.0	78.6	74.0	72.0	70.0	67.0	69.4	30.0
Toshiba	100.0	100.0	97.0	97.0	97.5	90.0	70.0	40.0	37.0	54.7	15.0
Vanguard	-	-	-	-	-	-	-	40.0	20.0	30.0	10.0
All Companies	**81.5**	**78.5**	**74.1**	**75.0**	**75.9**	**64.3**	**49.2**	**39.9**	**34.2**	**43.6**	**18.7**

Source: Dataquest (January 1998)

Table 4-9
Quarterly Shipments of Synchronous 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	100.0
Fujitsu	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Hitachi	-	-	5.0	5.0	4.3	10.0	30.0	45.0	45.0	37.6	80.0
Hyundai	10.0	10.0	15.0	15.0	14.1	30.0	75.0	75.0	80.0	70.9	85.0
IBM Microelectronics	9.8	16.0	23.0	25.0	20.3	30.0	35.0	40.0	50.0	42.0	80.0
LG Semicon	10.0	15.0	20.0	20.0	17.9	32.6	45.1	57.7	70.2	55.7	70.2
Matsushita	-	-	-	-	-	5.0	10.0	20.0	20.0	18.5	50.0
Micron Technology	-	-	-	-	-	5.0	10.0	15.0	30.0	17.6	74.9
Mitsubishi	-	-	-	-	-	5.0	10.0	30.0	33.0	23.0	65.0
Mosel Vitelic	-	-	-	-	-	20.0	40.0	60.0	80.0	61.1	80.0
Motorola	-	-	-	15.0	15.0	15.0	15.0	15.0	15.0	15.0	-
Nan Ya Technology	-	-	-	-	-	-	90.0	90.0	90.0	90.0	100.0
NEC	30.0	45.0	45.0	45.0	43.6	70.0	80.0	80.0	82.0	78.9	90.0
Nippon Steel	-	-	-	-	-	-	-	77.0	77.0	77.0	80.0
Oki	-	-	-	-	-	8.0	13.0	25.0	25.0	19.7	40.0
Samsung	15.0	15.0	25.0	30.0	23.8	40.0	55.0	65.0	80.0	62.3	85.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	10.0	4.2	15.0	20.0	25.0	30.0	25.1	50.0
Texas Instruments	13.0	15.0	18.0	20.0	17.8	23.0	25.0	27.0	30.0	27.6	62.0
Toshiba	-	-	3.0	3.0	2.5	10.0	30.0	55.0	58.0	42.3	80.0
Vanguard	-	-	-	-	-	-	-	60.0	80.0	70.0	90.0
All Companies	**17.9**	**21.1**	**25.5**	**24.6**	**23.7**	**34.9**	**49.8**	**58.6**	**64.1**	**55.1**	**79.0**

Source: Dataquest (January 1998)

Table 4-10
Quarterly Shipments of Next-Generation 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	2.0	6.0	6.0	4.6	9.6	13.1	16.7	20.2	16.1	20.2
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	5.0
Toshiba	-	-	-	-	-	-	-	5.0	5.0	3.0	5.0
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**-**	**0.1**	**0.4**	**0.3**	**0.2**	**0.6**	**0.7**	**1.3**	**1.5**	**1.1**	**2.1**

Source: Dataquest (January 1998)

Chapter 5
Consumption of DRAMs by Application

This chapter provides details of Dataquest's DRAM demand analysis. Quarterly DRAM demand figures are derived from Dataquest's electronic equipment forecast, generated by the Semiconductor Application Markets Worldwide program, as well as forecasts from Dataquest's Computer Systems and Peripherals group and Telecommunications group.

Table 5-1 shows the quarterly electronic equipment production forecast (the systems forecast). Table 5-2 provides Dataquest's estimate of DRAM megabyte consumption for each type of system. Dataquest calls this "megabytes per system." Table 5-3 shows the number of bits of memory required by the entire market (the system forecasts times DRAM usage) and the memory module market. Table 5-4 provides DRAM demand for each application by DRAM density, as well as total supply and demand by density and sufficiency in millions of 16Mb equivalent units.

What Has Changed since the Previous Report

Dataquest has revised the systems forecasts contained in Table 5-1. The key PC forecast shows undramatic changes for 1997 and 1998 (versus the forecast in last quarter's report). Dataquest has now included NT workstations in the "workstation" category and has made minor changes to the overall consumption forecast.

Table 5-1
High-Volume Electronic Equipment Unit Production Forecast, Q1/97 to 1999 (Thousands of Systems)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers	0.6	0.6	0.6	0.6	2.3	0.6	0.6	0.6	0.7	2.5	2.6
Mainframes	2.0	2.0	2.0	2.0	8.0	1.9	1.9	1.9	1.8	7.5	7.0
Midranges	203.2	211.8	220.5	229.1	864.5	229.9	239.7	249.5	259.3	978.3	1,097.1
Workstations	233.8	243.5	262.7	279.9	1,019.9	306.4	318.3	347.2	370.1	1,342.0	1,778.9
Personal Computers	18,746.4	19,351.2	21,072.7	25,108.0	84,278.3	21,824.4	22,323.8	24,463.9	29,764.4	98,376.6	113,596.1
Server PCs	337.3	366.9	384.7	517.5	1,606.4	427.9	446.9	479.3	641.4	1,995.5	2,483.1
486 and Below Server PCs	0.5	0.1	-	-	0.6	-	-	-	-	-	-
586 Server PCs	260.3	253.4	230.2	256.5	1,000.4	164.2	150.0	151.1	148.4	613.8	252.1
686 and Future Server PCs	69.8	105.3	145.5	249.9	570.5	252.7	287.5	317.9	480.8	1,338.9	2,184.9
Other Server PCs	6.7	8.0	9.1	11.2	35.0	10.9	9.4	10.3	12.1	42.8	46.1
Mobile PCs	3,177.7	3,328.6	3,718.6	4,166.5	14,391.4	3,763.9	3,886.5	4,473.0	5,059.5	17,182.9	20,364.2
486 and Below Mobile PCs	48.3	27.0	11.3	5.0	91.7	3.1	-	-	-	3.1	-
586 Mobile PCs	3,011.3	3,169.2	3,507.2	3,840.1	13,527.8	3,227.4	3,232.7	3,366.9	3,613.7	13,440.7	6,849.3
686 and Future Mobile PCs	0.4	2.9	41.5	140.8	185.6	307.6	469.9	855.2	1,154.5	2,787.1	12,402.4
Other Mobile PCs	117.7	129.4	158.6	180.6	586.3	225.8	183.9	250.9	291.3	952.0	1,112.5
Desk PCs	15,231.3	15,655.8	16,969.4	20,424.1	68,280.6	17,632.7	17,990.4	19,511.7	24,063.4	79,198.2	90,748.8
486 and Below Desk PCs	84.8	54.0	4.3	-	143.1	-	-	-	-	-	-
586 Desk PCs	12,902.1	12,529.6	12,033.2	12,091.5	49,556.4	8,846.2	7,606.2	6,541.7	6,550.4	29,544.6	10,974.5
686 and Future Desk PCs	1,402.0	2,125.5	3,850.8	7,192.8	14,571.1	7,778.8	9,249.8	11,763.5	16,247.8	45,039.8	74,920.9
Other Desk PCs	842.4	946.7	1,081.1	1,139.7	4,010.0	1,007.7	1,134.4	1,206.5	1,265.2	4,613.8	4,853.4
Additional Motherboards	2,954.4	2,745.7	2,662.8	2,581.2	10,944.1	2,678.4	2,792.4	2,906.4	3,020.4	11,397.6	13,171.8
Data Storage Devices	46,580.7	48,562.8	50,545.0	52,527.2	198,215.7	54,038.4	56,337.9	58,637.4	60,936.9	229,950.6	260,401.5
Printers	11,388.1	11,872.7	12,357.3	12,841.9	48,460.0	12,929.3	13,479.5	14,029.7	14,579.9	55,018.3	58,739.0
Facsimiles	2,633.7	2,613.9	2,666.0	2,659.4	10,572.9	2,663.4	2,681.9	2,691.9	2,739.8	10,777.0	11,321.0
Telephone Answering Machines	7,040.1	7,060.1	7,110.1	7,090.1	28,300.2	7,306.4	7,236.0	7,296.3	7,427.5	29,266.3	29,463.6
Routers/Internetworking	274.6	292.7	313.8	334.9	1,216.0	374.5	399.9	423.1	448.5	1,646.0	2,132.0
Industrial Applications	901.8	921.6	930.9	957.7	3,712.0	993.0	1,017.1	1,030.8	1,039.0	4,080.0	4,386.6
DVD Players	176.1	353.3	477.9	712.7	1,720.0	782.2	990.6	1,161.9	1,534.3	4,469.0	10,322.1
Set-Top Boxes	4,882.4	5,090.1	5,297.9	5,505.6	20,776.0	5,836.2	6,084.6	6,332.9	6,581.3	24,835.0	26,412.0
Video Games	4,414.8	4,602.6	4,790.5	4,978.4	18,786.2	5,410.7	5,664.5	5,687.2	5,207.7	21,970.0	18,573.6

Source: Dataquest (January 1998)

Table 5-2
High-Volume Electronic Equipment Unit Production Forecast, Q1/97 to 1999 (Megabytes per System)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers	4,284.0	4,300.8	4,321.3	4,403.2	4,328.0	4,567.0	4,976.6	5,529.6	5,898.2	5,256.8	6,467.6
Mainframes	3,099.4	3,153.9	3,215.4	3,317.8	3,195.4	3,604.5	3,850.2	4,034.6	4,177.9	3,912.3	4,744.3
Midranges	218.9	224.0	233.6	256.0	233.7	310.4	348.8	386.1	423.0	369.0	509.3
Workstations	100.8	108.8	118.4	126.4	114.3	134.4	145.6	156.8	168.0	152.1	220.6
Personal Computers	24.0	24.8	26.3	28.0	26.0	31.0	36.2	39.3	42.4	37.7	51.7
Server PCs	61.5	68.7	76.1	82.4	73.4	88.7	93.1	96.5	102.6	96.0	120.4
486 and Below Server PCs	42.0	47.0	-	-	42.8	-	-	-	-	-	-
586 Server PCs	58.8	65.4	72.0	77.0	68.2	82.7	88.2	92.8	95.8	89.7	102.2
686 and Future Server PCs	72.0	77.0	82.7	88.2	82.7	92.8	95.8	98.4	104.8	99.1	122.9
Other Server PCs	58.8	65.4	72.0	77.0	69.5	82.7	88.2	92.8	95.8	90.1	102.7
Mobile PCs	15.1	16.3	17.9	20.9	17.8	22.4	24.2	26.6	29.8	26.1	37.7
486 and Below Mobile PCs	13.1	13.1	14.2	15.5	13.4	17.0	-	-	-	17.0	-
586 Mobile PCs	15.1	16.3	17.8	20.8	17.7	22.1	23.5	25.5	28.6	25.1	33.3
686 and Future Mobile PCs	17.0	20.0	21.8	23.0	22.7	25.5	28.6	30.5	33.0	30.7	40.2
Other Mobile PCs	15.5	17.0	20.0	21.8	19.0	23.0	25.5	28.6	30.5	27.3	36.3
Desk PCs	25.0	25.6	27.0	28.1	26.6	31.5	37.4	40.8	43.5	38.8	53.0
486 and Below Desk PCs	21.6	25.0	26.4	-	23.0	-	-	-	-	-	-
586 Desk PCs	24.6	24.9	25.2	25.2	25.0	27.0	35.4	38.0	38.7	34.2	42.0
686 and Future Desk PCs	27.7	28.6	31.7	32.1	31.0	36.1	39.0	42.6	45.8	41.9	55.3
Other Desk PCs	28.2	28.9	31.0	33.4	30.6	35.2	37.0	38.3	39.3	37.6	42.1

Table 5-2 (Continued)
High-Volume Electronic Equipment Unit Production Forecast, Q1/97 to 1999 (Megabytes per System)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Additional Motherboards	25.0	28.2	28.9	30.2	28.0	33.5	37.4	38.8	39.5	37.4	49.0
Memory Modules	12.2	14.2	16.7	16.9	15.1	18.4	18.6	18.7	18.9	18.6	21.3
Data Storage Devices	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.5	0.7
Printers	3.9	3.9	3.9	4.0	3.9	4.2	4.4	4.6	4.8	4.5	5.4
Facsimiles	2.2	2.2	2.3	2.3	2.2	2.6	2.6	2.9	3.1	2.8	4.0
Telephone Answering Machines	2.2	2.2	2.3	2.3	2.3	2.4	2.5	2.6	2.7	2.6	3.0
Routers/Internetworking	6.1	6.2	6.3	6.5	6.3	6.7	7.0	7.5	7.9	7.3	9.1
Industrial Applications	9.7	9.9	10.5	11.2	10.4	12.9	14.0	14.6	15.5	14.3	15.5
DVD Players	2.0	2.1	2.2	2.3	2.2	2.4	2.6	2.7	2.7	2.6	3.2
Set-Top Boxes	2.0	2.2	2.2	2.3	2.2	2.5	2.7	2.8	3.0	2.8	3.8
Video Games	4.4	4.9	5.0	5.2	4.9	5.4	5.6	5.8	6.0	5.7	6.8
Other Applications	-	-	-	-	-	-	-	-	-	-	-
PCs + Aftermarket Module Megabytes per System	36.7	40.2	43.6	43.5	41.2	50.8	56.2	58.3	58.7	56.3	72.4

Source: Dataquest (January 1998)

Table 5-3
High-Volume Electronic Equipment Unit Production Forecast, Q1/97 to 1999 (Thousands of Megabytes)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers	2,441.9	2,451.5	2,506.3	2,597.9	9,997.6	2,785.9	3,035.8	3,538.9	3,833.9	13,194.4	16,880.4
Mainframes	6,322.9	6,370.9	6,398.6	6,502.8	25,595.2	6,920.6	7,354.0	7,463.9	7,603.8	29,342.3	33,209.8
Midranges	44,467.7	47,443.2	51,497.1	58,647.0	202,055.0	71,361.0	83,600.4	96,325.4	109,662.8	360,949.5	558,734.0
Workstations	23,567.5	26,497.9	31,100.7	35,375.4	116,541.6	41,179.0	46,348.6	54,437.4	62,169.6	204,134.4	392,472.1
Personal Computers	450,048.1	480,656.8	554,684.9	703,315.2	2,188,705.0	676,928.4	808,485.2	961,847.4	1,263,133.4	3,710,394.4	5,877,354.2
Server PCs	20,744.7	25,198.2	29,261.5	42,625.8	117,830.2	37,940.3	41,605.4	46,261.9	65,783.2	191,590.8	299,026.9
486 and Below Server PCs	20.6	4.5	-	-	25.1	-	-	-	-	-	-
586 Server PCs	15,306.5	16,564.8	16,572.0	19,737.5	68,180.7	13,582.4	13,225.3	14,025.5	14,226.8	55,060.0	25,758.4
686 and Future Server PCs	5,022.6	8,104.7	12,036.3	22,029.8	47,193.3	23,454.9	27,549.3	31,280.7	50,393.0	132,677.9	268,534.6
Other Server PCs	395.0	524.3	653.3	858.5	2,431.2	903.0	830.7	955.7	1,163.5	3,852.9	4,733.9
Mobile PCs	47,998.3	54,329.6	66,523.7	87,124.7	255,976.3	84,366.3	94,184.7	119,174.1	150,521.1	448,246.2	767,212.8
486 and Below Mobile PCs	634.2	354.4	161.4	77.6	1,227.7	53.4	-	-	-	53.4	-
586 Mobile PCs	45,530.9	51,721.5	62,287.9	79,874.0	239,414.3	71,260.7	76,033.2	85,923.4	103,495.6	336,712.8	227,821.0
686 and Future Mobile PCs	6.2	58.8	902.5	3,243.8	4,211.3	7,849.1	13,457.1	26,065.4	38,146.1	85,517.7	498,986.7
Other Mobile PCs	1,827.0	2,195.0	3,171.8	3,929.3	11,123.1	5,203.2	4,694.4	7,185.3	8,879.5	25,962.4	40,405.0
Desk PCs	381,305.1	401,129.0	458,899.7	573,564.7	1,814,898.5	554,621.8	672,695.2	796,411.4	1,046,829.0	3,070,557.4	4,811,114.5
486 and Below Desk PCs	1,832.4	1,346.9	114.1	-	3,293.4	-	-	-	-	-	-
586 Desk PCs	316,874.9	311,737.1	303,236.2	304,706.5	1,236,554.7	238,493.9	269,564.6	248,584.6	253,633.2	1,010,276.3	461,015.2
686 and Future Desk PCs	38,807.6	60,703.5	121,992.3	230,745.1	452,248.5	280,657.9	361,112.0	501,594.0	743,498.9	1,886,862.8	4,145,813.8
Other Desk PCs	23,790.2	27,341.4	33,557.1	38,113.2	122,801.9	35,470.0	42,018.6	46,232.8	49,696.9	173,418.3	204,285.5

Table 5-3 (Continued)
High-Volume Electronic Equipment Unit Production Forecast, Q1/97 to 1999 (Thousands of Megabytes)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Additional Motherboards	73,742.6	77,537.2	76,902.2	77,848.7	306,030.7	89,781.0	104,324.4	112,767.5	119,364.6	426,237.6	645,209.4
Memory Modules	273,402.0	330,636.0	403,495.1	422,982.2	1,430,515.3	478,103.8	499,442.4	521,077.2	543,008.2	2,041,631.6	2,659,864.0
Data Storage Devices	13,857.8	14,447.4	15,037.1	16,414.7	59,757.1	19,318.7	23,943.6	28,439.1	33,210.6	104,912.1	180,002.6
Printers	44,413.6	46,303.6	48,193.5	51,881.3	190,792.0	54,303.1	59,174.9	63,975.3	69,837.5	247,290.8	317,088.7
Facsimiles	5,701.9	5,802.8	6,065.2	6,196.4	23,766.2	6,858.2	7,066.9	7,860.3	8,411.3	30,196.7	45,096.1
Telephone Answering Machines	15,488.1	15,532.1	16,210.9	16,448.9	63,680.1	17,535.4	18,234.8	18,970.5	19,905.8	74,646.4	86,936.2
Routers/Internetworking	1,674.9	1,814.6	1,977.0	2,177.0	7,643.6	2,516.5	2,807.1	3,182.0	3,561.1	12,066.8	19,419.4
Industrial Applications	8,765.8	9,160.8	9,811.4	10,764.5	38,502.5	12,849.7	14,219.6	15,070.6	16,084.2	58,224.1	67,903.9
DVD Players	352.1	742.0	1,051.4	1,639.2	3,784.7	1,877.3	2,575.5	3,090.7	4,142.6	11,686.1	33,307.3
Set-Top Boxes	9,862.4	11,198.3	11,549.4	12,773.1	45,383.1	14,824.0	16,671.7	17,985.5	19,612.2	69,093.5	99,826.3
Video Games	19,424.9	22,644.9	23,952.5	26,086.6	92,108.8	29,217.7	31,607.8	32,985.6	31,454.3	125,265.4	126,144.1
Other Applications	-	-	-	-	-	-	-	-	-	-	-
All Applications	993,534.2	1,099,240.0	1,260,433.3	1,451,651.1	4,804,858.6	1,526,360.2	1,728,892.6	1,949,017.4	2,314,995.8	7,519,265.9	11,159,448.6

Source: Dataquest (January 1998)

Table 5-4
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-
64Mb	305.2	306.4	313.3	324.7	1,249.7	348.2	379.5	442.4	479.2	1,649.3	2,110.1
Mainframes											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	158.1	-	-	-	158.1	-	-	-	-	-	-
64Mb	750.8	796.4	799.8	812.9	3,159.9	865.1	919.2	933.0	950.5	3,667.8	4,151.2
Midranges											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	8,893.5	-	-	-	8,893.5	-	-	-	-	-	-
64Mb	3,335.1	5,930.4	6,437.1	7,330.9	23,033.5	8,920.1	10,450.0	12,040.7	13,707.8	45,118.7	69,841.8
Workstations											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	8,248.6	5,299.6	4,665.1	1,768.8	19,982.1	-	-	-	-	-	-
64Mb	883.8	1,987.3	2,721.3	3,979.7	9,572.2	5,147.4	5,793.6	6,804.7	7,771.2	25,516.8	49,059.0
Personal Computers											
1Mb	161.3	-	-	-	161.3	-	-	-	-	-	-
4Mb	28,336.1	21,906.6	16,831.5	8,347.1	75,421.3	4,218.3	2,825.5	2,383.5	1,505.2	10,932.6	7,672.1
16Mb	214,522.3	226,696.1	248,579.3	278,908.7	968,706.4	220,684.8	237,065.5	231,759.5	292,812.2	982,322.0	593,905.6
64Mb	851.9	2,038.9	6,138.8	17,665.5	26,695.2	29,181.2	41,617.7	62,142.1	84,594.6	217,535.5	585,713.4
Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	622.3	-	-	-	622.3	-	-	-	-	-	-
16Mb	7,779.3	8,008.9	8,436.1	11,099.7	35,323.9	7,863.8	7,997.8	7,655.4	8,502.1	32,019.2	13,393.3
64Mb	609.4	1,147.5	1,548.7	2,553.3	5,858.9	2,776.6	3,201.2	3,868.9	6,097.4	15,944.1	34,030.1

Table 5-4 (Continued)
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
486 and Below Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	0.6	-	-	-	0.6	-	-	-	-	-	-
16Mb	7.7	1.6	-	-	9.3	-	-	-	-	-	-
64Mb	0.6	0.2	-	-	0.8	-	-	-	-	-	-
586 Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	459.2	-	-	-	459.2	-	-	-	-	-	-
16Mb	5,739.9	5,797.7	5,800.2	6,414.7	23,752.5	4,074.7	3,637.0	3,506.4	3,201.0	14,419.1	4,182.5
64Mb	449.6	621.2	621.4	863.5	2,555.8	679.1	743.9	876.6	978.1	3,277.7	2,174.2
686 and Future Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	150.7	-	-	-	150.7	-	-	-	-	-	-
16Mb	1,883.5	2,026.2	2,407.3	4,406.0	10,722.8	3,518.2	4,132.4	3,910.1	5,039.3	16,600.0	8,465.8
64Mb	147.5	506.5	902.7	1,652.2	3,209.0	2,052.3	2,410.6	2,932.6	5,039.3	12,434.7	31,450.4
Other Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	11.9	-	-	-	11.9	-	-	-	-	-	-
16Mb	148.1	183.5	228.7	279.0	839.3	270.9	228.5	238.9	261.8	1,000.1	744.9
64Mb	11.6	19.7	24.5	37.6	93.3	45.1	46.7	59.7	80.0	231.6	405.5
Mobile PCs											
1Mb	14.7	-	-	-	14.7	-	-	-	-	-	-
4Mb	6,771.1	5,433.0	3,991.4	5,300.0	21,495.5	4,218.3	2,825.5	2,383.5	1,505.2	10,932.6	7,672.1
16Mb	22,305.5	25,276.3	29,973.8	36,935.9	114,491.6	31,130.1	28,575.5	30,333.2	31,192.0	121,230.7	90,367.5
64Mb	-	132.6	572.5	1,325.4	2,030.5	2,499.6	4,452.6	7,164.5	10,923.1	25,039.8	72,830.2
486 and Below Mobile PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	88.8	35.4	9.7	5.4	139.4	2.7	-	-	-	2.7	-
16Mb	294.9	166.6	76.7	34.3	572.5	22.3	-	-	-	22.3	-
64Mb	-	0.4	0.4	0.8	1.6	0.9	-	-	-	0.9	-

Table 5-4 (Continued)
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
586 Mobile PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	6,374.3	5,172.1	3,737.3	4,792.4	20,076.2	3,563.0	2,281.0	1,718.5	1,035.0	8,597.5	2,278.2
16Mb	21,171.9	24,050.5	28,029.6	33,946.5	107,198.4	26,188.3	22,429.8	21,266.0	20,699.1	90,583.2	26,739.3
64Mb	-	129.3	545.0	1,198.1	1,872.4	2,137.8	3,754.1	5,316.5	7,697.5	18,906.0	21,650.4
686 and Future Mobile PCs											
1Mb	0.1	-	-	-	0.1	-	-	-	-	-	-
4Mb	1.0	5.9	54.2	227.1	288.1	392.5	403.7	521.3	381.5	1,698.9	4,989.9
16Mb	2.9	27.6	361.0	1,216.4	1,607.9	2,747.2	4,373.6	6,516.4	7,629.2	21,266.3	50,597.7
64Mb	-	0.1	19.2	87.2	106.4	269.8	563.5	1,596.5	2,837.1	5,266.9	49,412.1
Other Mobile PCs											
1Mb	14.6	-	-	-	14.6	-	-	-	-	-	-
4Mb	306.9	219.5	190.3	275.1	991.8	260.2	140.8	143.7	88.8	633.5	404.1
16Mb	835.8	1,031.6	1,506.6	1,738.7	5,112.8	2,172.3	1,772.1	2,550.8	2,863.6	9,358.9	13,030.6
64Mb	-	2.7	7.9	39.3	50.0	91.1	135.0	251.5	388.5	866.0	1,767.7
Desk PCs											
1Mb	146.6	-	-	-	146.6	-	-	-	-	-	-
4Mb	20,942.7	16,473.7	12,840.0	3,047.1	53,303.5	-	-	-	-	-	-
16Mb	184,437.5	193,410.9	210,169.3	230,873.1	818,890.9	181,690.9	200,492.2	193,771.0	253,118.1	829,072.1	490,144.8
64Mb	242.5	758.8	4,017.6	13,786.9	18,805.8	23,905.0	33,963.9	51,108.7	67,574.1	176,551.6	478,853.1
486 and Below Desk PCs											
1Mb	146.6	-	-	-	146.6	-	-	-	-	-	-
4Mb	1,282.7	942.9	63.9	-	2,289.4	-	-	-	-	-	-
16Mb	586.4	437.8	41.1	-	1,065.2	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-
586DeskPCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	6,337.5	6,234.7	6,064.7	3,047.1	21,684.0	-	-	-	-	-	-
16Mb	156,853.1	154,309.9	147,069.6	129,500.3	587,732.8	89,435.2	102,434.5	93,219.2	88,771.6	373,860.6	87,883.8
64Mb	-	-	758.1	5,522.8	6,280.9	7,452.9	8,086.9	7,768.3	9,511.2	32,819.4	35,655.9

Table 5-4 (Continued)
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
686 and Future Desk PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	18,433.6	27,316.6	48,796.9	84,221.9	178,769.1	77,180.9	81,250.2	83,214.4	146,952.6	388,598.1	357,643.8
64Mb	242.5	758.8	3,049.8	7,787.6	11,838.8	15,787.0	24,826.4	41,895.6	56,199.2	138,708.3	428,815.8
Other Desk PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	13,322.5	9,296.1	6,711.4	-	29,330.0	-	-	-	-	-	-
16Mb	8,564.5	11,346.7	14,261.8	17,150.9	51,323.9	15,074.8	16,807.4	17,337.3	17,393.9	66,613.4	44,617.1
64Mb	-	-	209.7	476.4	686.1	665.1	1,050.5	1,444.8	1,863.6	5,023.9	14,381.4
Additional Motherboards											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	41,295.8	26,362.6	15,380.4	-	83,038.9	-	-	-	-	-	-
16Mb	26,547.3	32,177.9	32,683.5	35,031.9	126,440.6	38,156.9	41,729.8	42,287.8	41,777.6	163,952.1	167,059.8
64Mb	-	-	480.6	973.1	1,453.7	1,683.4	2,608.1	3,524.0	4,476.2	12,291.7	38,886.2
Memory Modules											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	98,424.7	87,618.5	80,699.0	80,366.6	347,108.9	57,372.5	34,961.0	10,421.5	3,258.0	106,013.0	21,366.5
16Mb	105,259.8	131,841.1	155,345.6	144,871.4	537,317.9	186,460.5	181,047.9	190,193.2	165,617.5	723,319.0	726,121.0
64Mb	1,708.8	2,893.1	6,556.8	11,632.0	22,790.6	9,562.1	14,983.3	16,935.0	26,268.0	67,748.4	149,617.4
Data Storage Devices											
1Mb	49,167.3	45,873.5	43,306.9	41,365.1	179,712.9	38,637.4	35,436.5	34,127.0	32,944.9	141,145.9	112,516.3
4Mb	14,037.9	15,981.8	17,743.8	20,846.7	68,610.2	27,046.2	36,633.7	45,502.6	45,697.8	154,880.3	75,201.7
16Mb	346.4	361.2	375.9	410.4	1,493.9	483.0	598.6	711.0	3,121.8	4,914.3	64,168.6
64Mb	-	-	-	-	-	-	-	-	-	-	-
Printers											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	17,765.5	14,817.1	15,421.9	15,564.4	63,568.9	15,204.9	11,835.0	12,795.1	9,777.2	49,612.1	19,025.3
16Mb	17,765.5	19,447.5	20,241.3	22,049.6	79,503.8	23,350.3	26,628.7	28,788.9	32,474.4	111,242.3	153,788.0
64Mb	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Facsimiles											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	7,412.4	6,963.4	6,671.7	6,196.4	27,243.9	6,172.3	5,653.5	5,502.2	5,046.8	22,374.9	11,725.0
16Mb	997.8	1,160.6	1,364.7	1,549.1	5,072.1	1,886.0	2,120.1	2,554.6	2,944.0	9,504.6	19,616.8
64Mb	-	-	-	-	-	-	-	-	-	-	-
Telephone Answering Machines											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	29,427.5	26,404.6	24,316.4	23,028.5	103,177.0	21,042.5	16,411.3	13,279.3	9,952.9	60,686.0	10,369.3
16Mb	387.2	1,164.9	2,026.4	2,467.3	6,045.8	3,507.1	5,014.6	6,165.4	7,464.7	22,151.7	40,875.8
64Mb	-	-	-	-	-	-	-	-	-	-	-
Routers/Internetworking											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	134.0	127.0	138.4	43.5	443.0	-	-	-	-	-	-
16Mb	804.0	875.6	953.9	1,077.6	3,711.1	1,258.3	1,403.6	1,591.0	1,780.5	6,033.4	9,709.7
64Mb	-	-	-	-	-	-	-	-	-	-	-
Industrial Applications											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	9,028.8	9,527.2	9,418.9	7,104.6	35,079.5	7,709.8	5,687.8	5,124.0	4,825.3	23,346.9	11,796.9
16Mb	2,125.7	2,198.6	2,452.8	3,337.0	10,114.1	4,176.1	5,332.4	5,651.5	5,870.7	21,030.7	21,180.0
64Mb	-	-	24.5	67.3	91.8	80.3	88.9	150.7	241.3	561.2	2,455.7
DVD Players											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	281.7	519.4	630.9	819.6	2,251.5	375.5	515.1	309.1	248.6	1,448.2	1,998.4
16Mb	105.6	241.1	368.0	614.7	1,329.5	844.8	1,159.0	1,468.1	2,009.2	5,481.0	16,154.1
64Mb	-	-	-	-	-	-	-	-	-	-	-
Set-Top Boxes											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	10,256.9	9,630.5	8,777.5	8,762.3	37,427.2	8,153.2	8,335.9	7,194.2	7,844.9	31,528.2	15,680.4
16Mb	2,367.0	3,191.5	3,580.3	4,196.0	13,334.7	5,373.7	6,251.9	7,194.2	7,844.9	26,664.7	45,993.0
64Mb	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Video Games											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	1,554.0	1,811.6	1,916.2	2,086.9	7,368.7	2,337.4	2,528.6	1,319.4	-	6,185.5	-
16Mb	9,324.0	10,869.5	11,497.2	12,521.5	44,212.2	14,024.5	15,171.7	16,162.9	14,940.8	60,300.0	52,714.6
64Mb	-	-	-	-	-	-	-	-	196.6	196.6	2,589.4
Other Applications											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-
All Applications											
1Mb	49,328.6	45,873.5	43,306.9	41,365.1	179,874.2	38,637.4	35,436.5	34,127.0	32,944.9	141,145.9	112,516.3
4Mb	257,955.2	221,670.4	197,946.6	173,166.7	850,739.0	149,632.6	125,387.4	103,831.0	88,156.7	467,007.6	174,835.6
16Mb	397,852.8	435,525.2	484,133.9	508,804.0	1,826,315.9	500,206.0	523,523.6	534,528.1	578,658.2	2,136,915.9	1,911,287.0
64Mb	7,835.6	13,952.5	23,472.4	42,786.1	88,046.6	55,787.8	76,840.3	102,972.5	138,685.4	374,285.9	904,424.0
All Companies											
1Mb	49,350.0	45,860.0	43,660.0	41,510.0	180,380.0	38,320.0	35,690.0	34,050.0	32,900.0	140,960.0	112,400.0
4Mb	258,255.0	222,930.0	202,230.0	175,290.0	858,705.0	151,085.0	128,460.0	104,815.0	87,273.3	471,633.3	173,200.0
16Mb	433,190.0	484,370.0	534,350.0	530,130.0	1,982,040.0	532,750.0	540,775.0	545,875.0	561,900.0	2,181,300.0	1,963,000.0
64Mb	8,450.0	15,500.0	25,450.0	44,400.0	93,800.0	59,180.0	79,400.0	106,100.0	136,850.0	381,530.0	894,800.0
Megabyte Demand	**993,534.2**	**1,099,240.0**	**1,260,433.3**	**1,451,651.1**	**4,804,858.6**	**1,526,360.2**	**1,728,892.6**	**1,949,017.4**	**2,314,995.8**	**7,519,265.9**	**11,159,448.6**
Megabyte Supply	**1,069,276.3**	**1,209,937.5**	**1,378,872.5**	**1,508,293.8**	**5,166,380.0**	**1,619,272.5**	**1,785,441.3**	**1,997,213.8**	**2,266,349.2**	**7,668,276.7**	**11,185,050.0**
Megabyte Sufficiency	**107.62**	**110.07**	**109.40**	**103.90**	**107.52**	**106.09**	**103.27**	**102.47**	**97.90**	**101.98**	**100.23**

Source: Dataquest (January 1998)

Chapter 6
Worldwide DRAM Wafer Fabrication Plant Production Capacity

Chapter 6 provides analysis of DRAM fab capacity. Dataquest uses the data in this chapter to test the information provided in the supplier surveys.

Table 6-1 provides the silicon capacity for each production facility in square millimeters of silicon per month.

Please note that Dataquest does not gather all the displayed production information from the manufacturers themselves. Dataquest performs an extensive fab survey in the third and fourth quarters of each year and updates this periodically through the year with articles from the general and trade press. Analyzing fab production could cause some confusion when accounting for contract production. Contract production (foundry) is production by one company under license from a second company for that second company to sell under its brand name. Table 6-1 credits capacity used for contract production under foundry, while the shipment information in the tables in Chapters 2 through 4 credits shipments by the purchaser of that foundry production. Nearly every semiconductor manufacturer performs some contract manufacturing. Thus, these analyses should not be used to determine any particular company's inventory or utilization.

What Has Changed since the Previous Report

Dataquest has made no changes to this section of the report.

Table 6-1
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Dominion Semiconductor	Module 1	Manassas VA	U.S.	64Mb DRAM	1997	28,000	200	0.25	-	-	-	-	879.6	879.6
Dominion Semiconductor Total						**28,000**			-	-	-	-	**879.6**	**879.6**
Fujitsu	Phase 1	Newton-Aycliffe	U.K.	4Mb 16Mb DRAM	1991	5,600	150	0.5	-	-	99.0	-	-	99.0
Fujitsu	Phase 2	Newton Aycliffe	U.K.	4Mb DRAM	1995	14,000	150	0.5	-	-	247.4	-	-	247.4
Fujitsu	No. 1	Gresham OR	U.S.	4Mb DRAM	1982	17,000	150	0.65	-	300.4	-	-	-	300.4
Fujitsu	No. 3	Isawa-Gun	Japan	4Mb DRAM SRAM ROM MPU	1987	50,000	150	0.8	-	-	-	-	-	-
Fujitsu	No. 4-1	Isawa-Gun	Japan	16Mb DRAM SGRAM	1990	20,000	150	0.42	-	-	-	353.4	-	353.4
Fujitsu	No. 4-2	Isawa-Gun	Japan	16Mb DRAM	1996	25,000	200	0.18	-	-	-	-	785.4	785.4
Fujitsu	No. 2	Kuwana-Gun	Japan	Log Arrays 4Mb DRAM	1987	10,000	150	0.8	-	-	-	-	-	-
Fujitsu	No. 3 Phase 1	Kuwana-Gun	Japan	4Mb 16Mb DRAM SRAM MPU	1992	15,000	150	0.5	-	-	265.1	-	-	265.1
Fujitsu	No. 3 Phase 2	Kuwana-Gun	Japan	16Mb 64Mb DRAM	1994	500	200	0.25	-	-	-	-	15.7	15.7
Fujitsu	No. 2	Gresham OR	U.S.	64Mb DRAM	1998	10,000	200	0.25	-	-	-	-	314.2	314.2
Fujitsu	Fab 2	Newton-Aycliffe	U.K.	16Mb 64Mb DRAM	1999	15,000	200	0.25	-	-	-	-	471.2	471.2
Fujitsu Total						**182,100**			-	**300.4**	**611.4**	**353.4**	**1,586.5**	**2,851.8**
Hitachi	E2	Landshut	Germany	16Mb DRAM	1993	16,000	200	0.35	-	-	-	502.7	-	502.7
Hitachi	U2	Irving TX	U.S.	1Mb 4Mb DRAM 256Kb SRAM MPU	1990	16,500	150	0.8	-	-	-	-	-	-
Hitachi	D1	Mobara-Shi	Japan	1Mb 4Mb DRAM LCD Driver	1982	25,000	125	1.3	306.8	-	-	-	-	306.8
Hitachi	D3	Mobara-Shi	Japan	4Mb DRAM	1990	15,000	150	0.8	-	-	-	-	-	-
Hitachi	Chitose 1-1F	Chitose-Shi	Japan	4M DRAM MCU	1988	15,000	150	0.8	-	-	-	-	-	-

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Hitachi	Chitose 1-2F	Chitose-Shi	Japan	4M DRAM MCU	1990	15,000	150	0.8	-	-	-	-	-	-
Hitachi	N2-1	Hitachinaka-Shi	Japan	16Mb DRAM	1994	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	R&D 2	Kodaira-Shi	Japan	MPU SRAM DRAM Arrays CBIC	1985	3,000	150	0.5	-	-	53.0	-	-	53.0
Hitachi	K2-1F	Nakakoma-Gun	Japan	4Mb DRAM SRAM MCU	1990	25,000	150	2	441.8	-	-	-	-	441.8
Hitachi	K4-3F	Nakakoma-Gun	Japan	4Mb DRAM 1Mb SRAM EPROM	1989	10,000	150	0.8	-	-	-	-	-	-
Hitachi	N1-1	Hitachinaka-Shi	Japan	1Mb 4Mb DRAM	1983	15,000	150	0.8	-	-	-	-	-	-
Hitachi	N2-2	Hitachinaka-Shi	Japan	16Mb 64Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	K2-2F	Nakakoma-Gun	Japan	16Mb DRAM	1995	10,000	200	0.5	-	-	314.2	-	-	314.2
Hitachi	Chitose 2	Chitose-Shi	Japan	64Mb DRAM	1998	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	N3/2F	Hitachinaka-Shi	Japan	64Mb DRAM	1998	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	N2/3F	Hitachinaka-Shi	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.35	-	-	-	471.2	-	471.2
Hitachi Total						**220,500**			**748.6**	-	**367.2**	**2,230.5**	-	**3,346.3**
Hitachi/Nippon Steel Semiconductor	Tampines	Singapore	Singapore	64Mb DRAM	1998	20,000	200	0.3	-	-	-	-	628.3	628.3
Hitachi/Nippon Steel Total						**20,000**			-	-	-	-	**628.3**	**628.3**
Hyundai	MOS Fab 1-A	Ichon	Korea	256K DRAM SRAM	1985	15,000	125	1	184.1	-	-	-	-	184.1
Hyundai	MOS Fab 2-A	Ichon	Korea	1Mb 4Mb DRAM	1986	15,000	150	0.65	-	265.1	-	-	-	265.1
Hyundai	MOS Fab 3	Ichon	Korea	4Mb DRAM Telecom ICs ASIC	1989	20,000	150	0.5	-	-	353.4	-	-	353.4

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Hyundai	MOS Fab 2-B	Ichon	Korea	4Mb DRAM	1992	20,000	150	0.5	-	-	353.4	-	-	353.4
Hyundai	MOS R&D	Ichon	Korea	DRAM	1989	3,000	150	0.25	-	-	-	-	53.0	53.0
Hyundai	Fab 4	Ichon	Korea	4Mb DRAM Telecom ICs ASIC	1993	10,000	200	0.35	-	-	-	314.2	-	314.2
Hyundai	Fab 5	Ichon	Korea	16Mb 64Mb DRAM	1994	25,000	200	0.35	-	-	-	785.4	-	785.4
Hyundai	Fab 6	Ichon	Korea	64Mb DRAM	1996	30,000	200	0.35	-	-	-	942.5	-	942.5
Hyundai	Oregon Fab	Eugene OR	U.S.	16Mb 64Mb DRAM	1998	30,000	200	0.25	-	-	-	-	942.5	942.5
Hyundai	Fab 7	Ichon	Korea	16Mb 64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
Hyundai	Phase 1	Dumfermline	U.K.	64Mb DRAM	1998	30,000	200	0.18	-	-	-	-	942.5	942.5
Hyundai	Phase 2	Dumfermline	U.K.	64Mb 256Mb DRAM			12	0.18	-	-	-	-	-	-
Hyundai Total						**228,000**			**184.1**	**265.1**	**706.9**	**2,984.5**	**1,938.0**	**6,078.5**
IBM Microelectronics		Corbeil-Essonnes	France	DRAM SRAM		25,000	125	1	306.8	-	-	-	-	306.8
IBM Microelectronics		Sindelfingen	Germany	DRAM SRAM DSP MPU Custom		25,000	125	1.5	306.8	-	-	-	-	306.8
IBM Microelectronics		Corbeil-Essonnes	France	1Mb DRAM	1989	7,000	200	0.8	-	-	-	-	-	-
IBM Microelectronics	Bldg. 963	Essex Junction VT	U.S.	4Mb DRAM MPU	1989	16,000	125	0.5	-	-	196.3	-	-	196.3
IBM Microelectronics	Bldg. 970	Essex Junction VT	U.S.	64Mb DRAM MPU Multimedia ICs	1988	24,000	200	0.35	-	-	-	754.0	-	754.0
IBM Microelectronics	Bldg. 973	Essex Junction VT	U.S.	16Mb DRAM	1989	20,000	200	0.5	-	-	628.3	-	-	628.3
IBM Microelectronics		Yasu-Gun	Japan	64Mb DRAM pDSP	1990	15,000	200	0.35	-	-	-	471.2	-	471.2
IBM Microelectronics	AMF	Corbeil-Essonnes	France	64Mb DRAM	1997	15,000	200	0.2	-	-	-	-	471.2	471.2
IBM Microelectronics Total						**147,000**			**613.6**	-	**824.7**	**1,225.2**	**471.2**	**3,134.7**

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
IBM/Philips		Boeblingen	Germany	4Mb DRAM	1989	20,000	200	0.8	-	-	-	-	-	-
IBM/Philips Total						**20,000**			-	-	-	-	-	-
IBM/Siemens	ACL	Corbeil-Essonnes	France	16Mb 64Mb DRAM	1991	30,000	200	0.35	-	-	-	942.5	-	942.5
IBM/Siemens Total						**30,000**			-	-	-	**942.5**	-	**942.5**
Jinan	No. 2	Jinan	China	1Kb SRAM 4Kb DRAM	1989	8,000	75	5	35.3	-	-	-	-	35.3
Jinan Total						**8,000**			**35.3**	-	-	-	-	**35.3**
KTI Semiconductor	Fab 1	Nishiwaki-Shi	Japan	16Mb DRAM ASIC	1992	25,000	150	0.5	-	-	441.8	-	-	441.8
KTI Semiconductor	Fab 2	Nishiwaki-Shi	Japan	16Mb 64Mb DRAM ASIC	1996	5,500	200	0.35	-	-	-	172.8	-	172.8
KTI Semiconductor Total						**30,500**			-	-	**441.8**	**172.8**	-	**614.6**
LG Semicon	C1 Phase 1	Chongju-City	Korea	1Mb 4Mb DRAM	1990	30,000	150	0.5	-	-	530.1	-	-	530.1
LG Semicon	C1 Phase 2	Chongju-City	Korea	4Mb DRAM	1991	30,000	150	0.5	-	-	530.1	-	-	530.1
LG Semicon	C2 Phase 1	Chongju-City	Korea	16Mb DRAM	1993	15,000	200	0.35	-	-	-	471.2	-	471.2
LG Semicon	C1 Phase 3	Chongju-City	Korea	16Mb 64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
LG Semicon	C2 Phase 2	Chongju-City	Korea	16Mb DRAM	1995	25,000	200	0.35	-	-	-	785.4	-	785.4
LG Semicon	G2	Gumi-City	Korea	64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
LG Semicon	Phase 1	Newport	U.K.	64Mb DRAM 256Mb DRAM	1999	30,000	200		-	-	-	-	942.5	942.5
LG Semicon Total						**190,000**			-	-	**1,060.3**	**3,141.6**	**942.5**	**5,144.4**
Matsushita	Fab C	Puyallup WA	U.S.	1Mb 4Mb DRAM 4-bit 8-bit MCU	1992	21,000	150	0.6	-	-	371.1	-	-	371.1
Matsushita	Kyoto R&D	Kyoto-Shi	Japan	DRAM	1991	500	200	0.25	-	-	-	-	15.7	15.7
Matsushita	S/C R6	Kadoma-Shi	Japan	16Mb 64Mb DRAM 64-bit MPU	1991	500	150	0.35	-	-	-	8.8	-	8.8
Matsushita	Fab B	Tonami-Shi	Japan	16Mb DRAM 16-bit MCU	1996	20,000	150	0.35	-	-	-	353.4	-	353.4

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Matsushita	Fab C	Tonami-Shi	Japan	16Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Matsushita	Fab D	Tonami-Shi	Japan	16Mb 64Mb DRAM	1997	10,000	200	0.35	-	-	-	314.2	-	314.2
Matsushita	Fab D	Puyallup WA	U.S.	32-bit MRCO DSP 64Mb DRAM	1998	10,000	200	0.25	-	-	-	-	314.2	314.2
Matsushita Total						**72,000**			-	-	**371.1**	**990.6**	**329.9**	**1,691.6**
Micron Technology	Fab 3	Boise ID	U.S.	1Mb 4Mb 16Mb DRAM	1991	25,000	200	0.35	-	-	-	785.4	-	785.4
Micron Technology	Fab 1	Boise ID	U.S.	4Mb 16Mb DRAM VRAM SRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
Micron Technology	Fab 2	Boise ID	U.S.	16Mb 64Mb DRAM	1996	20,000	200	0.25	-	-	-	-	628.3	628.3
Micron Technology	Lehi Fab	Lehi UT	U.S.	64Mb DRAM	1999		200	0.25	-	-	-	-	-	-
Micron Technology Total						**65,000**			-	-	-	**1,413.7**	**628.3**	**2,042.0**
Mitsubishi		North Durham NC	U.S.	1Mb 4Mb DRAM	1990	9,000	150	0.5	-	-	159.0	-	-	159.0
Mitsubishi		Alsdorf	Germany	4MB 16MB DRAM	1997	7,000	200	0.35	-	-	-	219.9	-	219.9
Mitsubishi	B	Saijo-Shi	Japan	DRAM MCU	1984	39,000	125	0.9	478.6	-	-	-	-	478.6
Mitsubishi	Sa2B	Saijo-Shi	Japan	64Mb DRAM EDRAM	1993	16,000	200	0.4	-	-	-	502.7	-	502.7
Mitsubishi	ULSI	Itami-Shi	Japan	16Mb 64Mb 256Mb DRAM ASIC Flash	1993	10,000	200	0.2	-	-	-	-	314.2	314.2
Mitsubishi	TA1	Kami-Gun	Japan	4Mb DRAM 1Mb SRAM ASSP	1990	30,000	150	0.7	-	530.1	-	-	-	530.1
Mitsubishi	D-1F	Kikuchi-Gun	Japan	16Mb 64Mb DRAM	1994	10,000	200	0.35	-	-	-	314.2	-	314.2

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Mitsubishi	D-1F-2	Kikuchi-Gun	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.35	-	-	-	471.2	-	471.2
Mitsubishi	SA1F	Saijo-Shi	Japan	64Mb DRAM EDRAM EFlash	1997	15,000	200	0.3	-	-	-	-	471.2	471.2
Mitsubishi		Science Park	Taiwan	16Mb DRAM	1996	12,000	200	0.35	-	-	-	377.0	-	377.0
Mitsubishi Total						**163,000**			**478.6**	**530.1**	**159.0**	**1,885.0**	**785.4**	**3,838.1**
Mosel Vitelic	Fab 1A	Science Park	Taiwan	DRAM VRAM	1995	15,000	150	0.45	-	-	-	265.1	-	265.1
Mosel Vitelic	Fab 1B	Science Park	Taiwan	DRAM VRAM	1995	15,000	150	0.34	-	-	-	-	265.1	265.1
Mosel Vitelic Total						**30,000**			-	-	-	**265.1**	**265.1**	**530.1**
Nan Ya Technology	Fab 1	Tao Yuan	Taiwan	16Mb 64Mb DRAM	1996	30,000	200	0.45	-	-	-	942.5	-	942.5
Nan Ya Technology Total						**30,000**			-	-	-	**942.5**	-	**942.5**
NEC	Phase 1	Livingston	U.K.	DRAM SRAM MPU	1987	25,000	150	0.5	-	-	441.8	-	-	441.8
NEC	K-Line	Roseville CA	U.S.	DRAM ASIC MCU	1984	25,000	125	1	306.8	-	-	-	-	306.8
NEC	M-Line	Roseville CA	U.S.	16Mb DRAM	1991	35,000	150	0.5	-	-	618.5	-	-	618.5
NEC	Dif-1	Higashi Hiroshima-Shi	Japan	4Mb DRAM SRAM MPU 4Mb ROM	1990	30,000	150	0.6	-	-	530.1	-	-	530.1
NEC	G-1	Sagamihara-Shi	Japan	16Mb DRAM ASIC MPU 4Mb ROM	1988	10,000	150	0.8	-	-	-	-	-	-
NEC	Dif-5	Kumamoto-Shi	Japan	Logic DRAM MCU	1978	20,000	125	1.2	245.4	-	-	-	-	245.4
NEC	Dif-6	Kumamoto-Shi	Japan	1Mb DRAM MPU MCU Arrays	1987	30,000	150	1	530.1	-	-	-	-	530.1
NEC	Dif-7	Kumamoto-Shi	Japan	MCU 4Mb DRAM ASIC	1988	30,000	150	0.8	-	-	-	-	-	-

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
NEC	Dif-8 -1	Kumamoto-Shi	Japan	16Mb DRAM 4Mb SRAM RISC ASIC	1994	60,000	200	0.35	-	-	-	1,885.0	-	1,885.0
NEC	Dif-3	Otsu-Shi	Japan	SRAM 4Mb DRAM Micro ASIC	1983	17,000	150	1	300.4	-	-	-	-	300.4
NEC	Dif-1	Asa-Gun	Japan	4Mb DRAM 1Mb SRAM MPU FLASH	1988	45,000	150	0.8	-	-	-	-	-	-
NEC	Dif-2 (Bldg. C)	Asa-Gun	Japan	4Mb 16Mb DRAM ASIC	1993	45,000	150	0.5	-	-	795.2	-	-	795.2
NEC	Phase 2	Livingston	U.K.	16Mb 64Mb DRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
NEC	Dif-2	Higashi Hiroshima-Shi	Japan	16Mb 64Mb DRAM ASIC RISC	1996	33,000	200	0.25	-	-	-	-	1,036.7	1,036.7
NEC		Beijing	China	MCU Logic 4Mb 16Mb DRAM ASIC	2000	5,000	150	0.4	-	-	-	88.4	-	88.4
NEC Total						**430,000**			**1,382.8**	**-**	**2,385.6**	**2,601.6**	**1,036.7**	**7,406.8**
Nippon Silicon				16Mb DRAM	1990			0.6	-	-	-	-	-	-
Nippon Silicon Total						-			-	-	-	-	-	-
Nippon Steel Corporation	Electronics Lab	Sagamihara-Shi	Japan	ASIC 16Mb 64Mb DRAM	1991	500	150	0.35	-	-	-	8.8	-	8.8
Nippon Steel Corporation Total						**500**			-	-	-	8.8	-	8.8
Nippon Steel Semiconductor	M2	Tateyama-Shi	Japan	1Mb 4Mb DRAM Flash Logic	1988	12,000	150	0.6	-	-	212.1	-	-	212.1
Nippon Steel Semiconductor	M3	Tateyama-Shi	Japan	4Mb 16Mb DRAM	1990	20,000	150	0.5	-	-	353.4	-	-	353.4
Nippon Steel Semiconductor	N1	Tateyama-Shi	Japan	16Mb 64Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Nippon Steel Total						**42,000**			-	-	**565.5**	**314.2**	-	**879.6**

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Oki	S2	Kurokawa-Gun	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.3	-	-	-	-	471.2	471.2
Oki	S1	Kurokawa-Gun	Japan	4Mb DRAM 1Mb SRAM 16Mb ROM	1981	30,000	150	0.5	-	-	530.1	-	-	530.1
Oki	M2	Miyazaki-Gun	Japan	1Mb DRAM 256K SRAM 4Mb ROM	1991	60,000	125	0.8	-	-	-	-	-	-
Oki	M3	Miyazaki-Gun	Japan	4Mb 16Mb DRAM	1967	30,000	150	0.4	-	-	-	530.1	-	530.1
Oki	V3	Hachioji-Shi	Japan	16Mb 64Mb DRAM Micro Gate Array	1989	2,000	150	0.5	-	-	35.3	-	-	35.3
Oki	U1	Hachioji-Shi	Japan	64Mb 256Mb DRAM Micro Logic	1992	1,000	150	0.3	-	-	-	-	17.7	17.7
Oki Total						**138,000**			-	-	**565.5**	**530.1**	**488.9**	**1,584.5**
Powerchip (Elitegroup)	Fab 1	Science Park	Taiwan	16Mb DRAM	1996	25,000	200	0.4	-	-	-	785.4	-	785.4
Powerchip (Elitegroup) Total						**25,000**			-	-	-	**785.4**	-	**785.4**
ProMOS Technologies	Fab 2	Science Park	Taiwan	16Mb 64Mb 256Mb DRAM SRAM	1998	20,000	200	0.25	-	-	-	-	628.3	628.3
ProMOS Technologies Total						**20,000**			-	-	-	-	**628.3**	**628.3**
Samsung	Fab 4	Kiheung-Up	Korea	Alpha 4Mb DRAM SRAM EDRAM	1990	35,000	150	0.5	-	-	618.5	-	-	618.5
Samsung	Fab 5	Kiheung-Up	Korea	Alpha 4Mb DRAM SRAM EDRAM	1993	25,000	200	0.5	-	-	785.4	-	-	785.4
Samsung	Fab 6	Kiheung-Up	Korea	16Mb 64Mb DRAM	1995	30,000	200	0.35	-	-	-	942.5	-	942.5

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Samsung	Fab 7	Kiheung-Up	Korea	16Mb 64Mb DRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
Samsung	Fab 8	Kiheung-Up	Korea	64Mb DRAM	1997	25,000	200	0.3	-	-	-	-	785.4	785.4
Samsung		Austin TX	U.S.	64Mb DRAM	1998	25,000	200	0.3	-	-	-	-	785.4	785.4
Samsung Total						**160,000**			-	-	1,403.9	1,570.8	1,570.8	4,545.5
Sanyo	A 1	Ojiya-Shi	Japan	1Mb 4Mb DRAM 4-bit 8-bit MCU DSP	1985	35,000	125	0.8	-	-	-	-	-	-
Sanyo	C 2	Ojiya-Shi	Japan	DRAM	1994	25,000	150	0.85	441.8	-	-	-	-	441.8
Sanyo Total						**60,000**			**441.8**	-	-	-	-	**441.8**
Sharp	Factory 2	Fukuyama-Shi	Japan	16Mb MROM DRAM SRAM	1989	40,000	150	0.6	-	-	706.9	-	-	706.9
Sharp	Factory 4	Fukuyama-Shi	Japan	Flash 64Mb DRAM	1998	16,000	200	0.25	-	-	-	-	502.7	502.7
Sharp Total						**56,000**			-	-	706.9	-	502.7	1,209.5
Siemens	H15, H16, H17	Regensburg	Germany	1Mb 4Mb DRAM EDRAM ASIC ASSP	1986	46,600	150	0.35	-	-	-	823.5	-	823.5
Siemens	SIMEC (Lines 1 & 2)	Dresden	Germany	16Mb 64Mb DRAM	1996	30,000	200	0.25	-	-	-	-	942.5	942.5
Siemens		North Tyneside	U.K.	DRAM ASIC	1997	25,000	200	0.25	-	-	-	-	785.4	785.4
Siemens Total						**101,600**			-	-	-	823.5	1,727.9	2,551.4
Sony	3C	Isahaya-Shi	Japan	1Mb SRAM 4Mb VRAM CCD Logic	1991	25,000	150	0.5	-	-	441.8	-	-	441.8
Sony Total						**25,000**			-	-	**441.8**	-	-	**441.8**
Sumitomo Metal Industries		Amagasaki-Shi	Japan	4Mb DRAM Arrays	1991	300	150	0.8	-	-	-	-	-	-
Sumitomo Metal Industries Total						**300**			-	-	-	-	-	-

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
TSMC	Fab 3	Science Park	Taiwan	DRAM SRAM ROM Log Custom	1995	30,000	200	0.35	-	-	-	942.5	-	942.5
TSMC Total						**30,000**			-	-	-	**942.5**	-	**942.5**
Tech Semiconductor	Fab 1	Singapore	Singapore	16Mb DRAM	1993	12,000	200	0.5	-	-	377.0	-	-	377.0
Tech Semiconductor	Fab 2	Singapore	Singapore	16Mb DRAM	1996	25,000	200	0.35	-	-	-	785.4	-	785.4
Tech Semiconductor Total						**37,000**			-	-	**377.0**	**785.4**	-	**1,162.4**
Texas Instruments	AMOS-1	Avezzano	Italy	4Mb 16Mb DRAM 4Mb Flash	1990	22,000	200	0.25	-	-	-	-	691.2	691.2
Texas Instruments	AMOS-2	Avezzano	Italy	16Mb DRAM	1996	20,000	200	0.25	-	-	-	-	628.3	628.3
Texas Instruments	DMOS 5 Phase 1	Dallas TX	U.S.	16Mb DRAM	1995	16,000	200	0.5	-	-	502.7	-	-	502.7
Texas Instruments	DMOS 5 Phase 2	Dallas TX	U.S.	64Mb 256Mb DRAM	1997	16,000	200	0.35	-	-	-	502.7	-	502.7
Texas Instruments	Miho 6	Inashiki-Gun	Japan	1Mb 4Mb DRAM ASSP MPU		15,000	150	0.8	-	-	-	-	-	-
Texas Instruments	AMOS-3	Avezzano	Italy	Flash 64Mb 256Mb DRAM EDRAM	1999	6,600	12	0.18	-	-	-	-	0.7	0.7
Texas Instruments Total						**95,600**			-	-	**502.7**	**502.7**	**1,320.2**	**2,325.5**
Texas Instruments/Acer	Fab 1A	Science Park	Taiwan	4Mb DRAM	1991	22,000	150	0.5	-	-	388.8	-	-	388.8
Texas Instruments/Acer	Fab 1B	Science Park	Taiwan	4Mb 16Mb DRAM	1995	25,000	200	0.35	-	-	-	785.4	-	785.4
Texas Instruments/Acer	Fab 2	Science Park	Taiwan	16Mb 64Mb DRAM	1999	50,000	200	0.25	-	-	-	-	1,570.8	1,570.8
Texas Instruments/Acer Total						**97,000**			-	-	**388.8**	**785.4**	**1,570.8**	**2,745.0**
Texas Instruments/Anam Electronics		Pupyong	Korea	DRAM DSPs	2002	25,000	200	0.25	-	-	-	-	785.4	785.4
Texas Instruments/Anam Total						**25,000**			-	-	-	-	**785.4**	**785.4**

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Tohoku Semiconductor	Step 1	Sendai-Shi	Japan	1Mb DRAM MCU MPU	1988	7,500	150	1	132.5	-	-	-	-	132.5
Tohoku Semiconductor	Step 2	Sendai-Shi	Japan	4Mb DRAM MPU MCU	1991	10,000	150	0.8	-	-	-	-	-	-
Tohoku Semiconductor	Step 3	Sendai-Shi	Japan	16Mb DRAM	1995	15,000	200	0.35	-	-	-	471.2	-	471.2
Tohoku Semiconductor Total						**32,500**			**132.5**	-	-	**471.2**	-	**603.8**
Toshiba	Bldg.108 D-2	Kawasaki-Shi	Japan	16Mb 64Mb DRAM Flash	1990	1,300	200	0.35	-	-	-	40.8	-	40.8
Toshiba	Y-Cubed, No. 1-Mod 1	Yokkaichi-Shi	Japan	4Mb 16Mb DRAM	1993	10,000	200	0.5	-	-	314.2	-	-	314.2
Toshiba	Y-Cubed, No. 1-Mod 2	Yokkaichi-Shi	Japan	4Mb 16Mb DRAM	1994	25,000	200	0.35	-	-	-	785.4	-	785.4
Toshiba	C-Cubed 3	Oita-Shi	Japan	MCU ASIC DRAM SRAM	1989	32,000	125	1	392.7	-	-	-	-	392.7
Toshiba	C-Cubed 4	Oita-Shi	Japan	4Mb 16Mb DRAM	1991	40,000	150	0.5	-	-	706.9	-	-	706.9
Toshiba	Y-Cubed, No. 2	Yokkaichi-Shi	Japan	16Mb 64Mb 256Mb DRAM	1996	28,000	200	0.35	-	-	-	879.6	-	879.6
Toshiba	Step 5	Kitakami-Shi	Japan	16Mb 64Mb DRAM Logic	1998	30,000	200	0.35	-	-	-	942.5	-	942.5
Toshiba	C-Cubed 5	Oita-Shi	Japan	256Mb DRAM	2000		200	0.18	-	-	-	-	-	-
Toshiba Total						**166,300**			**392.7**	-	**1,021.0**	**2,648.4**		**4,062.1**
TwinStar Semiconductor	TwinStar	Richardson TX	U.S.	16Mb 64Mb DRAM	1996	15,000	200	0.3	-	-	-	-	471.2	471.2
Twinstar Semiconductor Total						**15,000**			-	-	-	-	**471.2**	**471.2**
Vanguard International	Fab 1	Science Park	Taiwan	4Mb DRAM	1991	4,000	150	0.5	-	-	70.7	-	-	70.7
Vanguard International	Fab 1A	Science Park	Taiwan	4Mb 16Mb DRAM	1995	16,000	200	0.35	-	-	-	502.7	-	502.7
Vanguard International	Fab 1B	Science Park	Taiwan	16Mb DRAM	1999	16,000	200	0.35	-	-	-	502.7	-	502.7

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Vanguard International	Fab 2	Science Park	Taiwan	4Mb 16Mb DRAM 1Mb SRAM	1999	40,000	200	0.18	-	-	-	-	1,256.6	1,256.6
Vanguard International Total						**76,000**			**-**	**-**	**70.7**	**1,005.3**	**1,256.6**	**2,332.6**
White Oak Semiconductor	MOS 18	Richmond VA	U.S.	64Mb 256Mb DRAM	1998	25,000	200	0.18	-	-	-	-	785.4	785.4
White Oak Semiconductor Total						**25,000**			**-**	**-**	**-**	**-**	**785.4**	**785.4**
Winbond	Fab II	Science Park	Taiwan	DRAM	1992	35,000	150	0.5	-	-	618.5	-	-	618.5
Winbond	Fab IV	Science Park	Taiwan	16Mb 64Mb 256Mb DRAM	1999	15,000	200	0.35	-	-	-	471.2	-	471.2
Winbond Total						**50,000**			**-**	**-**	**618.5**	**471.2**	**-**	**1,089.7**
Total						**3,171,900**			**4,410.0**	**1,095.6**	**13,590.1**	**30,793.9**	**20,599.8**	70,489.4

Source: Dataquest (January 1998)

Chapter 7
Definitions

Additional motherboards: PC motherboards that do not ship into brand-name PCs and thus are not counted by Dataquest's Computer Systems and Peripherals group. These numbers are based in part on Dataquest MPU shipments and analyst estimates of upgrade activity.

Demand: The number of shipments of a product that Dataquest estimates to be sustainable in a market at the price forecast by Dataquest for that time. If the price were lower, demand would increase. If the price were higher, demand would decrease. Demand is used to determine whether the market is undersupplied or oversupplied.

Desk PC: A PC designed to remain beside or underneath a user's desk surface and not designed to be moved readily from place to place.

Facsimile: A machine that scans and encodes a document into electrical signals, transmits these electrical signals over a telephone or data line, then reconstructs the signals to print an exact duplicate of the original document on paper at the receiving end (colloquially called a fax).

Industrial applications: All controller boards and equipment used in embedded industrial control and medical applications. These boards are not officially counted by Dataquest, and the numbers used in this survey are estimates based on processor shipment numbers, secondary sources, and primary inputs from industrial board producers.

Mobile PC: A PC that is completely self-contained and can be carried as a single unit, which includes a keyboard, a display, mass storage, and main system unit.

Mainframe computer: A general-purpose information system with a starting price range of $100,000 or more. CPU bit width ranges from 32 to 64 bits. The physical environment may or may not have special environmental controls and requires full-time support by professional computer systems support staff. The number of concurrent users is 100 or more. Dataquest views a mainframe system shipment as the CPU, the basic storage configuration (not including direct-access storage devices), the native operating system (the system must be bootable), and the operator's console. Dataquest does not routinely count upgrades unless the system footprint changes. Mainframes can use either DRAM or SRAM for cache storage.

Midrange computer: This includes all systems that fall between workstations and mainframes. These are multiuser systems that may or may not run proprietary operating systems. Midrange products have a wide price range, from as low as $10,000 to more than $1 million. Dataquest has included microcomputers, minicomputers, and superminicomputers in this product segment in the past. With the evolution of client/server computing and the systems that define this paradigm, traditional midrange product categories are becoming obsolete. Hewlett-Packard

Company's HP 9000 and HP 3000, Digital Equipment Corporation's VAX systems, and the IBM AS/400 line are joined by the dedicated server products from suppliers such as Auspex Systems Inc., NetFRAME Systems Inc., and Tricord Systems Inc. to make up the midrange product category. Office systems, which are proprietary turnkey computing solutions common in Japan, are also included in the midrange category, as are systems designed as servers from workstation suppliers.

Oversupply: An indication of an oversupplied market is low prices and growing inventories.

Router/internetworking: A shared media hub is a LAN device that connects multiple PCs through a single node on a network, allowing central control for optional functions such as wide area network (WAN) connectivity, multiple media support, multiple technology support, and network management. A router is a class of network controller that determines the best routing for data transmission between a transmitter (sender) and a receiver. Routers operate at layer 3 of the ISO-OSI model.

Set-top box: This is a cable converter box that sits on top of a TV and acts as converter device for cable television signals, telephone, or wireless networks to television sets. Set-top boxes contain a general-purpose microprocessor or a high-powered digital signal processor capable of digital transmission, reception, and decompression. Set-top boxes can be analog or digital, but only digital set-top boxes contain appreciable DRAM content.

Storage: Storage is a collective term for computer hard disk drives and CD-ROMs, where DRAM is often used as a cache memory. Since static RAM (SRAM) is sometimes used in place of DRAM, the DRAM consumption for this category appears unusually low to account for limited DRAM penetration into this equipment segment.

Supercomputer: This is a high-performance computer designed for numerically intensive applications. It is a system priced at more than $2 million and is used mainly for batch applications, scientific, engineering, and other computation-oriented problems, or other very numerically intensive applications. Supercomputers require special environmental controls and cooling techniques. Performance speeds range upward from 50 mflops. Supercomputers can use either DRAM or SRAM.

Telephone answering machine: This is a machine for individual telephone lines using either cassette tape or MOS memory technology for incoming and outgoing message storage. Only tapeless (digital) phone answering machines use MOS memory for storage. Tapeless answering machines can use either DRAM or flash memory.

Undersupply: An indication of an undersupplied market is long lead times, high prices, and product allocation.

Video game: Video game and CD-ROM players are microprocessor-based devices that are handheld or console-based and play video games housed on cartridges or CD-ROMs.

Workstation: Dataquest classifies workstations by a composite of features, including their hardware and software. Workstations are typically based on reduced-instruction-set computing (RISC) processor architecture with a high-performance bus structure, graphics, and operating system. In general, a workstation must come standard with integrated floating-point processing, integrated networking, and a 32-bit multitasking operating system and offer a configuration that has high-resolution graphics capabilities (typically 1-megapixel display). Dataquest does not determine a workstation architecture by its usage (that is, single-user, server, or multiuser). Instead, computers are classified by the primary market for which they are designed.

For More Information...

Ron Bohn, Director ..... (408) 468-8265
Internet address ..... ron.bohn@dataquest.com
Via fax ..... (408) 954-1780
Dataquest Interactive ..... http://www.dataquest.com

Dataquest
A Gartner Group Company

DATAQUEST WORLDWIDE OFFICES

NORTH AMERICA

Worldwide Headquarters
251 River Oaks Parkway
San Jose, California 95134-1913
United States
Phone: 1-408-468-8000
Facsimile: 1-408-954-1780

East Coast Research Center
Nine Technology Drive
P.O. Box 5093
Westborough, Massachusetts 01581-5093
United States
Phone: 1-508-871-5555
Facsimile: 1-508-871-6262

Dataquest Global Events
3990 Westerly Place, Suite 100
Newport Beach, California 92660
United States
Phone: 1-714-476-9117
Facsimile: 1-714-476-9969

EUROPE

European Headquarters
Tamesis, The Glanty
Egham, Surrey TW20 9AW
United Kingdom
Phone: +44 1784 431 611
Facsimile: +44 1784 488 980

Dataquest France
Immeuble Défense Bergères
345, avenue Georges Clémenceau
TSA 40002
92882 - Nanterre CTC Cedex 9
France
Phone: +33 1 41 35 13 00
Facsimile: +33 1 41 35 13 13

Dataquest Germany
Martin-Kollar-Strasse 15
D-81829 München
Germany
Phone: +49 89 42 70 4-0
Facsimile: +49 89 42 70 4-270

JAPAN

Japan Headquarters
Aobadai Hills 4-7-7
Aobadai
Meguro-ku, Tokyo 153
Japan
Phone: 81-3-3481-3670
Facsimile: 81-3-3481-3644

ASIA/PACIFIC

Asia/Pacific Headquarters
Suite 5904-7, Central Plaza
18 Harbour Road, Wanchai
Hong Kong
Phone: 852-2824-6168
Facsimile: 852-2824-6138

Dataquest Korea
Suite 2407, Trade Tower
159 Samsung-dong, Kangnam-gu
Seoul 135-729
Korea
Phone: 822-551-1331
Facsimile: 822-551-1330

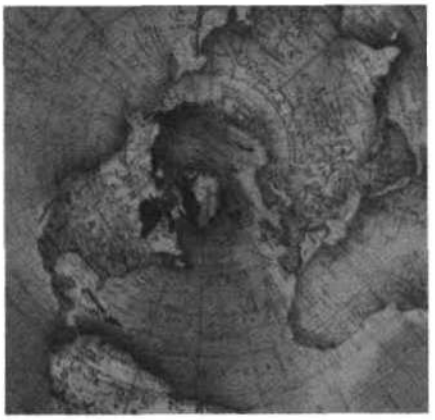
Dataquest Taiwan
11F-2, No. 188, Section 5
Nan King East Road
Taipei
Taiwan, R.O.C.
Phone: 8862-756-0389
Facsimile: 8862-756-2663

Dataquest Singapore
105 Cecil Street
#06-01/02 The Octagon
Singapore 069534
Phone: 65-227-1213
Facsimile: 65-227-4607

Dataquest Thailand
12/F, Vanissa Building
29 Soi Chidlom
Ploenchit Road
Patumwan, Bangkok 10330
Thailand
Phone: 662-655-0577
Facsimile: 662-655-0576

Dataquest Australia
80 Alfred Street
Milsons Point NSW 2061
Australia
Phone: 61-2-9941-4860
Facsimile: 61-2-9941-4868

Dataquest
A Gartner Group Company



Dataquest

DRAM Supply and Demand Quarterly Statistics: Fourth Quarter 1997 Outlook

Market Statistics

Program: DRAM Supply and Demand Quarterly Statistics Worldwide
Product Code: DSDR-WW-MS-97Q3
Publication Date: October 20, 1997
Filing: Market Statistics

DRAM Supply and Demand Quarterly Statistics: Fourth Quarter 1997 Outlook

Market Statistics

Program: DRAM Supply and Demand Quarterly Statistics Worldwide
Product Code: DSDR-WW-MS-97Q3
Publication Date: October 20, 1997
Filing: Market Statistics

Table of Contents

List of Tables

List of Tables (Continued)

Chapter 1
Executive Summary

This report provides a fourth quarter 1997 outlook of the worldwide DRAM market based on the results of recent supplier surveys and related information. The report includes quarterly information through fourth quarter 1998 and yearly information for 1999.

Another Change in Market Conditions

Dataquest's DRAM supply and demand outlook remains consistent with original 1997 and oversupply expectations. DRAM production capacity currently clearly exceeds DRAM bit demand.

The current oversupply will continue until late 1998. Dataquest bases the year-end 1998 scenario of tighter DRAM demand and supply on the assumption of restrained capital spending by DRAM manufacturers in 1998. If DRAM manufacturers do not refrain from aggressive capital spending in 1998, the oversupply is likely to continue into 1999. The current large oversupply means concomitant downward price pressure and constrained profit for most suppliers. Strong fourth quarter 1997 demand might restore a short-term supply and demand balance, but there will be a large oversupply during the first half of 1998.

Suppliers' 1998 Strategies

In last quarter's report, Dataquest predicted a threatening second half 1997 outlook for most DRAM suppliers. The threat has materialized. Last quarter, suppliers had set a $6-plus contract price for 16Mb DRAM as their year-end 1997 objective. Recently, the contract price declined below $6, while the spot price approached $5 in some world regions—with additional downward price pressure expected.

Dataquest believes that the main density remains the 16Mb device, but the shift to 64Mb will accelerate by early second half 1998. Micron Technology Inc. has a very good DRAM shrink technology—that is, the ability to reduce the size of the DRAM manufacturing die multiple times during each density's life cycle.

If other DRAM manufacturers cannot compete successfully with Micron in terms of low 64Mb production cost, the ultimate result for them will be less profitable 64Mb businesses, especially in 1999. For the medium term, Japanese major manufacturers will increase their OEM purchases of 16Mb from alliance partners on a contract manufacturing basis. The Japanese "majors" will focus on the next-generation 64Mb DRAM. This strategy is useful to reduce their investment risk. But it is also essential that they reduce their production costs for future-generation devices in order to survive in the DRAM market.

The following summarizes Dataquest's view on three different DRAM supplier strategies.

Major Korean and Japanese Manufacturers

Most of the Korean and Japanese suppliers will accelerate the shift from 16Mb DRAM production to 64Mb output as soon as possible. For them, the low 16Mb selling price means no 16Mb profitability. Their strategy is to move into the 64Mb market and capture the high profits associated with the early stage of a new DRAM life cycle. At the same time, these companies will research shrink technologies and apply them to 64Mb DRAM next year. The Korean and Japanese companies view this as fundamental for competing in the 64Mb market.

Micron Technology

As noted in Dataquest's prior DRAM supply and demand report, Micron Technology has emerged as the key company in today's 16Mb DRAM market. Although major Asian-based DRAM suppliers plan to decrease 16Mb shipments starting in the fourth quarter of 1997, Micron Technology will lead other vendors planning a continuous increase of 16Mb shipments. This signals competitive 1998 pricing for 16Mb DRAM. Despite 64Mb price declines, a downward trend in 16Mb pricing would delay the 4:1 price crossover well into 1998.

Dataquest expects Micron to retain its leadership position in 16Mb unit shipments. Korean and Japanese DRAM suppliers are willing to cede the 16Mb market but do not want Micron to migrate early to 64Mb DRAM. Micron historically has focused on constantly lowering the production cost of each DRAM density through a series of DRAM die shrinks. Micron typically ramps up a DRAM density somewhat later than many competitors—but accompanies the ramp with a very low cost of production.

This strategy enables Micron to use the less expensive current generation of semiconductor manufacturing equipment. By contrast, competitors in Japan and Korea gearing today for a 64Mb ramp next year must use more expensive next-generation equipment.

The timing of Micron's 64Mb DRAM ramp—whether it occurs in 1998 or 1999—will command considerable market attention.

Other DRAM Suppliers' Strategies

Other suppliers based in the Americas, Europe, Japan, and Taiwan are likely to continue to increase production of 16Mb throughout 1998. This is in part because these companies started or will start 64Mb production at later dates than major Korean and Japanese suppliers.

Taiwan DRAM companies will make especially strong increases in 16Mb production through 1998. They will provide some of the 16Mb output to their alliance partners (often on a contract manufacturing basis).

SDRAM

The production percentage of synchronous DRAM (SDRAM) has increased, especially in the American market. Note that the 66-MHz version of 16Mb SDRAM and 16Mb extended data out (EDO) DRAM offer the same performance and price.

The move to SDRAM stems from supply base logistics. In the United States, PC vendors have shortened the DRAM procurement cycle. Accelerated price declines for both of DRAM and MPUs reward buyers with shorter purchase cycles. Inventory control for PC vendors becomes less costly if they purchase one DRAM product technology than if they buy both SDRAM and EDO—and SDRAM emerges as the choice.

Japanese DRAM manufacturers increased the production ratio, or manufacturing percentage, of SDRAM during the first half of 1997. They had excess SDRAM inventory for a while this year. Eventually, they reduced the production ratio, and the 16Mb SDRAM inventory level is now at the right level for them.

Japanese suppliers will increase the SDRAM output ratio gradually during the rest of 1997. They will increase the ratio much more in 1998, in large part because Intel's 440BX chipset remains on schedule for early 1998 release. This means that the 100-MHz version of SDRAM with 440BX compatibility will be used for high-end PCs. The 66-MHz SDRAM will be used for low-end PCs in 1998.

Some DRAM suppliers will release the 100-MHz version of SDRAM in the 16Mb density. Also, some suppliers will release the 100-MHz version of the 64Mb density during the first half of 1998. When suppliers start mass production using the 0.25-micron process, 100-MHz SDRAM production will switch from the 16Mb density to the 64Mb density.

Project Analyst: James Seay

Contributors: Masahiro Suzuki, Senior Industry Analyst (Japan), Ronald Bohn, Principal Analyst (Worldwide and Americas), Jim Handy, Director and Principal Analyst (Worldwide and Americas), James Seay, Research Analyst (Worldwide and Americas), In-Hyung Baik, Research Analyst (Asia/Pacific and Korea), Sabrina Chiou, Research Analyst (Asia/Pacific and Taiwan), and Chang Soo Kim, Industry Analyst (Asia/Pacific and Korea).

Chapter 2
Production Statistics of 4Mb DRAM

This chapter provides estimates of 4Mb DRAM quarterly unit shipments by supplier. The tables show a summary for 4Mb (see Table 2-1) and total 4Mb shipments (see Table 2-2). Subsequent tables show shipments by organization (x1, x4, x8/9, and x16/18, in Tables 2-3 through 2-6) and by technology (fast page mode, extended data out, synchronous, next generation, and display, in Tables 2-7 through 2-11). Dataquest collects data through quarterly supplier surveys. These tables represent 4Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 4Mb DRAM. Average selling prices (ASPs) for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5.

4Mb Market Condition

The 4Mb market has moved into slight oversupply. Major suppliers planned a sharp 1997 reduction of 4Mb shipments. Instead, they increased 4Mb production capacity of 4Mb (from 16Mb) because the 16Mb business was not profitable. As a result, the 4Mb market moved into oversupply, and 4Mb prices have sunk to a very low level.

Dataquest believes the market will start to move toward a balance in 1998 because major suppliers will accelerate their reduction of 4Mb production. Second-tier suppliers, however, will increase production in order to satisfy demand. Suppliers will continue to confront low 4Mb pricing.

What Has Changed since the Previous Report

As noted, this report now shows a slight 4Mb DRAM oversupply for 1997 and 1998. Some 4Mb demand has shifted to 16Mb parts.

The 1997 and 1997 supply forecast of 4Mb DRAM remains consistent with the prior report. As indicated, the 1997, 1998, and 1999 demand forecast has been lowered somewhat.

Table 2-1
4Mb DRAM Supply and Demand Summary, Q1/97 to 1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Total Revenue (U.S.$M)	901.1	724.6	638.9	541.5	2,806.2	453.0	358.5	293.9	218.8	1,324.2	436.3
Total Units Shipped	291.2	237.8	209.5	182.3	920.8	154.7	128.4	106.2	83.9	473.1	173.6
Total Units Demanded	287.8	232.9	202.2	182.1	905.1	153.0	127.3	105.1	83.6	469.0	172.1
Sufficiency (%)	101.15	102.09	103.60	100.14	101.74	101.11	100.86	101.04	100.26	100.88	100.83
All Configurations	**291.2**	**237.8**	**209.5**	**182.3**	**920.8**	**154.7**	**128.4**	**106.2**	**83.9**	**473.1**	**173.6**
x1	21.0	16.4	14.1	12.2	63.7	8.4	7.7	6.5	5.3	27.9	9.8
x4	139.5	108.1	84.0	70.5	402.1	67.5	51.2	38.8	27.8	185.3	36.3
x8/9	17.0	16.0	13.3	11.5	57.8	8.8	7.4	6.1	5.0	27.3	13.1
x16/18	113.7	97.2	98.1	88.1	397.1	70.0	62.1	54.7	45.7	232.5	114.4
x32/36	-	-	-	-	-	-	-	-	-	-	-
All Interfaces	**291.2**	**237.8**	**209.5**	**182.3**	**920.8**	**154.7**	**128.4**	**106.2**	**83.9**	**473.1**	**173.6**
Fast Page Mode	89.1	68.7	55.5	46.2	259.5	45.9	36.1	28.3	20.3	130.7	44.3
Extended Data Out	191.9	159.7	145.0	128.5	625.1	98.7	82.2	67.7	55.7	304.3	112.2
Synchronous	-	-	-	-	-	1.3	2.1	2.3	1.9	7.7	-
Next-Generation	-	-	-	-	-	-	-	-	-	-	-
Display	10.1	9.4	9.0	7.6	36.1	8.8	8.0	7.8	5.9	30.4	17.1

Source: Dataquest (October 1997)

Table 2-2
Quarterly Shipments of All Configurations of 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	5.3	6.9	8.6	8.7	29.5	8.3	7.5	6.2	5.0	27.0	3.4
Fujitsu	9.2	7.7	6.6	6.2	29.7	5.8	5.3	5.1	4.8	21.0	10.5
Hitachi	23.0	20.3	18.3	16.0	77.6	13.5	11.0	9.5	7.4	41.4	33.0
Hyundai	21.0	17.7	14.9	12.5	66.1	9.5	7.5	6.5	4.8	28.3	5.4
IBM Microelectronics	7.6	3.6	1.8	0.9	13.9	0.3	0.2	0.1	-	0.6	-
LG Semicon	23.0	18.2	16.5	15.0	72.7	13.2	11.0	10.0	8.5	42.6	5.0
Matsushita	7.5	5.9	5.0	4.5	22.9	4.2	3.6	3.3	3.0	14.1	11.3
Micron Technology	23.2	16.0	12.5	10.3	62.0	7.1	4.0	1.0	0.2	12.3	-
Mitsubishi	14.1	11.6	10.4	9.0	45.1	7.5	6.9	6.0	5.2	25.6	13.0
Mosel Vitelic	24.2	19.8	17.0	13.8	74.8	10.8	8.3	6.3	3.8	29.1	-
Motorola	0.7	0.5	0.6	-	1.8	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	22.0	19.8	18.1	16.3	76.3	14.5	11.8	9.0	7.0	42.3	15.0
Nippon Steel	14.0	13.1	12.8	12.4	52.3	12.4	12.4	12.3	12.3	49.4	45.4
Oki	4.0	3.8	3.7	3.6	15.1	2.7	2.3	2.2	2.0	9.2	6.4
Samsung	23.2	17.0	14.1	11.9	66.2	9.9	8.3	7.0	5.5	30.7	9.0
Sharp	1.0	0.8	0.9	0.8	3.5	0.8	0.7	0.7	0.7	2.9	2.5
Siemens	17.2	15.6	14.8	13.7	61.4	12.7	11.1	9.3	7.3	40.4	10.7
Texas Instruments	20.4	15.5	12.8	10.0	58.7	7.5	5.7	3.8	1.9	18.9	-
Toshiba	11.7	6.8	4.8	3.5	26.8	2.5	2.5	2.0	1.8	8.8	3.0
Vanguard	19.0	17.2	15.1	13.3	64.6	11.6	8.4	5.9	2.8	28.6	-
All Companies	**291.2**	**237.8**	**209.5**	**182.3**	**920.8**	**154.7**	**128.4**	**106.2**	**83.9**	**473.1**	**173.6**
Average Selling Price ($)	**3.10**	**3.05**	**3.05**	**2.97**	**3.05**	**2.93**	**2.79**	**2.77**	**2.61**	**2.80**	**2.51**
Total Revenue (U.S.$M)	**901.1**	**724.6**	**638.9**	**541.5**	**2,806.2**	**453.0**	**358.5**	**293.9**	**218.8**	**1,324.2**	**436.3**
Total Demand	**287.8**	**232.9**	**202.2**	**182.1**	**905.1**	**153.0**	**127.3**	**105.1**	**83.6**	**469.0**	**172.1**
Sufficiency (%)	**101.15**	**102.09**	**103.60**	**100.14**	**101.74**	**101.11**	**100.86**	**101.04**	**100.26**	**100.88**	**100.83**

Source: Dataquest (October 1997)

Table 2-3
Quarterly Shipments of x1 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.5	0.4	0.5	0.5	1.9	0.6	0.5	0.5	0.5	2.1	0.8
Hitachi	1.5	1.4	1.1	1.0	5.0	0.7	0.6	0.5	0.4	2.1	1.3
Hyundai	0.8	0.5	0.4	0.4	2.2	0.4	0.3	0.3	0.2	1.1	0.2
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	1.6	1.3	1.2	1.1	5.1	0.9	0.8	0.7	0.6	3.0	0.4
Matsushita	0.5	0.4	0.3	0.3	1.5	0.2	0.2	0.2	0.2	0.7	0.3
Micron Technology	2.3	1.6	1.3	1.0	6.2	0.7	0.4	0.1	-	1.2	-
Mitsubishi	1.4	1.2	1.0	0.9	4.5	0.8	0.7	0.6	0.5	2.6	1.0
Mosel Vitelic	1.2	1.0	0.9	0.7	3.7	0.5	0.4	0.3	0.2	1.5	-
Motorola	0.1	0.1	0.1	-	0.3	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	2.0	1.8	1.5	1.3	6.5	0.6	0.5	0.4	0.3	1.7	0.5
Nippon Steel	-	-	-	-	-	0.6	0.7	0.7	0.7	2.8	2.3
Oki	0.3	0.3	0.3	0.3	1.2	0.2	0.1	0.1	0.1	0.6	0.3
Samsung	2.3	1.7	1.4	1.2	6.6	1.0	0.8	0.7	0.6	3.1	0.9
Sharp	0.1	0.1	0.1	-	0.2	-	-	-	-	0.1	0.1
Siemens	3.1	2.5	2.2	2.1	9.9	1.3	1.7	1.4	1.1	5.4	1.6
Texas Instruments	2.8	2.2	1.8	1.5	8.3	-	-	-	-	-	-
Toshiba	0.4	0.1	0.1	0.1	0.7	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**21.0**	**16.4**	**14.1**	**12.2**	**63.7**	**8.4**	**7.7**	**6.5**	**5.3**	**27.9**	**9.8**
Average Selling Price ($)	**2.60**	**2.55**	**2.45**	**2.44**	**2.52**	**2.25**	**2.03**	**1.86**	**1.70**	**1.99**	**1.39**
Total Revenue (U.S.$M)	**54.6**	**41.9**	**34.5**	**29.8**	**160.8**	**18.9**	**15.7**	**12.1**	**9.1**	**55.7**	**13.6**

Source: Dataquest (October 1997)

Table 2-4
Quarterly Shipments of x4 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	5.3	6.2	6.0	4.4	21.8	3.3	2.3	1.5	1.0	8.1	-
Fujitsu	4.6	2.7	2.0	1.9	11.1	1.2	1.1	1.0	1.0	4.2	1.6
Hitachi	9.9	8.1	6.0	5.3	29.3	3.4	2.8	1.9	1.5	9.5	6.6
Hyundai	8.8	7.1	5.5	4.6	26.0	3.2	2.6	2.2	1.6	9.6	1.8
IBM Microelectronics	4.9	1.8	0.6	0.2	7.6	-	-	-	-	0.1	-
LG Semicon	13.6	10.7	9.7	8.9	42.9	7.9	6.7	6.2	5.3	26.1	3.2
Matsushita	3.2	2.0	1.7	1.5	8.4	1.1	0.9	0.8	0.8	3.6	2.3
Micron Technology	16.2	11.2	8.8	7.2	43.4	5.0	2.8	0.7	0.1	8.6	-
Mitsubishi	4.9	4.1	3.6	3.2	15.8	2.6	2.4	2.1	1.8	9.0	3.9
Mosel Vitelic	8.5	18.8	9.4	7.6	44.2	4.7	2.7	1.3	0.4	9.1	-
Motorola	0.6	0.4	0.5	-	1.5	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	5.3	2.2	2.4	2.1	11.9	1.5	1.2	0.9	0.7	4.2	1.5
Nippon Steel	8.3	6.9	5.9	5.7	26.8	3.8	3.3	3.3	3.3	13.8	6.4
Oki	1.0	0.7	0.6	0.6	2.8	0.3	0.2	0.1	0.1	0.8	0.3
Samsung	7.9	5.8	5.4	4.5	23.5	3.7	3.1	2.6	2.0	11.5	3.3
Sharp	0.4	0.3	0.3	0.3	1.3	0.2	0.2	0.2	0.2	0.7	0.6
Siemens	9.6	8.7	8.0	6.9	33.2	6.3	5.0	4.2	3.3	18.8	4.8
Texas Instruments	12.4	9.0	7.2	5.5	34.1	7.5	5.7	3.8	1.9	18.9	-
Toshiba	4.7	1.4	0.5	0.3	6.9	-	-	-	-	-	-
Vanguard	9.5	-	-	-	9.5	11.6	8.4	5.9	2.8	28.6	-
All Companies	**139.5**	**108.1**	**84.0**	**70.5**	**402.1**	**67.5**	**51.2**	**38.8**	**27.8**	**185.3**	**36.3**
Average Selling Price ($)	**2.40**	**2.35**	**2.19**	**2.16**	**2.30**	**2.10**	**1.93**	**1.77**	**1.62**	**1.91**	**1.30**
Total Revenue (U.S.$M)	**334.8**	**254.1**	**184.0**	**152.3**	**925.1**	**141.7**	**98.8**	**68.7**	**45.0**	**354.3**	**47.3**

Source: Dataquest (October 1997)

Table 2-5
Quarterly Shipments of x8/9 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.5	0.6	0.5	0.5	2.1	0.6	0.5	0.5	0.5	2.1	0.8
Hitachi	2.5	2.2	2.0	1.8	8.5	1.5	1.2	1.0	0.8	4.6	3.6
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	0.7	0.5	0.5	0.5	2.2	0.4	0.3	0.3	0.3	1.3	0.2
Matsushita	1.5	1.1	0.9	0.8	4.2	0.6	0.5	0.5	0.5	2.1	1.7
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	1.4	1.2	1.0	0.9	4.5	0.8	0.7	0.6	0.5	2.6	1.3
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	4.8	6.1	5.4	4.9	21.3	4.4	3.5	2.7	2.1	12.7	4.5
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	0.1	0.1	0.1	0.1	0.5	0.1	-	-	-	0.2	0.1
Samsung	1.4	1.0	0.3	0.2	2.9	0.2	0.2	0.2	0.2	0.8	0.3
Sharp	0.2	0.1	0.2	0.1	0.6	0.1	0.1	0.1	0.1	0.4	0.4
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	3.1	2.5	2.1	1.5	9.1	-	-	-	-	-	-
Toshiba	0.8	0.5	0.3	0.2	1.9	0.2	0.2	0.1	0.1	0.6	0.2
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**17.0**	**16.0**	**13.3**	**11.5**	**57.8**	**8.8**	**7.4**	**6.1**	**5.0**	**27.3**	**13.1**
Average Selling Price ($)	**2.82**	**2.66**	**2.56**	**2.52**	**2.66**	**2.27**	**2.03**	**1.83**	**1.68**	**2.00**	**1.32**
Total Revenue (U.S.$M)	**47.9**	**42.7**	**34.1**	**29.0**	**153.5**	**19.9**	**14.9**	**11.2**	**8.5**	**54.5**	**17.3**

Source: Dataquest (October 1997)

Table 2-6
Quarterly Shipments of x16/18 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	0.7	2.6	4.4	7.6	5.0	5.3	4.6	4.0	18.9	3.4
Fujitsu	3.7	4.0	3.6	3.3	14.6	3.5	3.2	3.1	2.9	12.6	7.2
Hitachi	9.0	8.6	9.2	8.0	34.8	7.9	6.5	6.1	4.7	25.3	21.5
Hyundai	11.3	10.1	8.9	7.5	37.9	5.9	4.7	4.0	3.0	17.6	3.3
IBM Microelectronics	2.7	1.8	1.2	0.7	6.3	0.3	0.2	0.1	-	0.6	-
LG Semicon	7.1	5.6	5.1	4.7	22.5	3.9	3.2	2.8	2.3	12.2	1.4
Matsushita	2.3	2.4	2.2	2.0	8.9	2.2	2.0	1.8	1.7	7.7	7.0
Micron Technology	4.6	3.2	2.5	2.1	12.4	1.4	0.8	0.2	-	2.5	-
Mitsubishi	6.4	5.2	4.7	4.1	20.3	3.4	3.1	2.7	2.3	11.5	6.8
Mosel Vitelic	14.5	-	6.8	5.5	26.8	5.5	5.2	4.6	3.2	18.5	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	9.9	9.7	8.9	8.0	36.5	8.1	6.6	5.0	3.9	23.7	8.6
Nippon Steel	5.7	6.2	6.9	6.7	25.5	7.9	8.3	8.2	8.2	32.7	36.8
Oki	2.6	2.7	2.7	2.6	10.6	2.2	1.9	1.9	1.7	7.7	5.6
Samsung	11.6	8.5	7.1	5.9	33.1	4.9	4.1	3.5	2.8	15.3	4.5
Sharp	0.3	0.3	0.4	0.4	1.4	0.4	0.4	0.4	0.4	1.6	1.4
Siemens	4.5	4.4	4.6	4.8	18.2	5.1	4.4	3.7	2.9	16.1	4.3
Texas Instruments	2.0	1.9	1.8	1.5	7.2	-	-	-	-	-	-
Toshiba	5.9	4.8	3.9	2.8	17.4	2.3	2.3	1.9	1.7	8.2	2.8
Vanguard	9.5	17.2	15.1	13.3	55.1	-	-	-	-	-	-
All Companies	**113.7**	**97.2**	**98.1**	**88.1**	**397.1**	**70.0**	**62.1**	**54.7**	**45.7**	**232.5**	**114.4**
Average Selling Price ($)	**4.08**	**3.97**	**3.94**	**3.75**	**3.95**	**3.89**	**3.69**	**3.69**	**3.42**	**3.70**	**3.13**
Total Revenue (U.S.$M)	**463.8**	**386.0**	**386.4**	**330.5**	**1,566.7**	**272.4**	**229.1**	**201.9**	**156.2**	**859.7**	**358.2**

Source: Dataquest (October 1997)

Table 2-7
Quarterly Shipments of Fast Page Mode 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	5.3	6.2	5.2	3.5	20.1	2.5	1.9	1.2	0.5	6.1	-
Fujitsu	5.1	3.1	2.2	2.0	12.4	1.4	1.3	1.2	1.1	5.0	2.1
Hitachi	10.4	9.1	7.3	6.4	33.2	4.7	3.9	3.3	2.6	14.5	11.2
Hyundai	2.1	1.8	1.5	1.3	6.6	1.0	0.8	0.7	0.5	2.8	0.5
IBM Microelectronics	1.2	0.9	0.5	0.2	2.7	-	-	-	-	0.1	-
LG Semicon	1.2	0.9	0.8	0.8	3.6	0.7	0.6	0.5	0.4	2.1	0.3
Matsushita	3.0	1.1	0.5	0.5	5.0	0.2	0.2	0.2	0.2	0.7	0.6
Micron Technology	2.3	1.6	1.3	1.0	6.2	0.7	0.4	0.1	-	1.2	-
Mitsubishi	8.5	5.8	4.2	3.6	22.0	2.3	2.1	1.8	1.6	7.7	3.9
Mosel Vitelic	4.8	3.0	2.6	2.1	12.4	1.5	1.0	0.7	0.4	3.6	-
Motorola	0.3	0.2	0.1	-	0.6	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	15.4	13.9	12.7	11.4	53.4	10.0	8.1	6.1	4.8	29.0	10.2
Nippon Steel	5.6	3.9	3.8	3.7	17.1	2.5	2.5	2.5	2.5	9.9	9.1
Oki	2.0	1.9	1.9	1.8	7.6	1.4	1.2	1.1	1.0	4.6	3.2
Samsung	3.0	2.2	1.8	1.5	8.6	0.7	0.6	0.5	0.4	2.1	0.6
Sharp	0.5	0.4	0.5	0.4	1.8	0.4	0.4	0.4	0.4	1.5	1.3
Siemens	10.3	7.0	4.4	2.7	24.5	1.9	1.1	0.9	0.7	4.7	1.1
Texas Instruments	6.5	5.1	3.8	3.0	18.5	2.3	1.7	1.1	0.5	5.6	-
Toshiba	1.8	0.7	0.5	0.3	3.3	0.3	0.3	0.2	0.2	0.9	0.3
Vanguard	-	-	-	-	-	11.6	8.4	5.9	2.8	28.6	-
All Companies	**89.1**	**68.7**	**55.5**	**46.2**	**259.5**	**45.9**	**36.1**	**28.3**	**20.3**	**130.7**	**44.3**

Source: Dataquest (October 1997)

Table 2-8
Quarterly Shipments of Extended Data Out 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	0.7	3.4	5.2	9.4	5.8	5.6	4.9	4.5	20.9	3.4
Fujitsu	3.7	3.9	3.7	3.4	14.6	3.5	3.2	3.1	2.9	12.6	6.3
Hitachi	11.3	9.5	9.0	7.8	37.6	5.9	4.8	3.7	2.9	17.4	11.9
Hyundai	18.9	15.9	13.4	11.3	59.5	8.6	6.8	5.9	4.4	25.5	4.9
IBM Microelectronics	3.8	0.9	0.2	-	4.9	-	-	-	-	-	-
LG Semicon	21.9	17.3	15.7	14.3	69.1	12.5	10.5	9.5	8.0	40.5	4.8
Matsushita	3.8	4.1	3.8	3.4	15.0	3.4	2.7	2.5	2.3	10.8	8.5
Micron Technology	20.9	14.4	11.3	9.2	55.8	6.4	3.6	0.9	0.2	11.1	-
Mitsubishi	5.7	5.8	6.2	5.4	23.1	5.3	4.8	4.2	3.6	17.9	9.1
Mosel Vitelic	19.3	16.8	14.5	11.8	62.4	8.0	5.2	3.2	1.5	17.8	-
Motorola	0.4	0.3	0.5	-	1.2	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	4.4	4.0	3.6	3.3	15.3	2.9	2.4	1.8	1.4	8.5	2.6
Nippon Steel	8.4	9.2	9.0	8.7	35.2	9.9	9.9	9.8	9.8	39.5	36.3
Oki	2.0	1.9	1.9	1.8	7.6	1.4	1.2	1.1	1.0	4.6	3.2
Samsung	19.5	14.3	11.9	10.0	55.6	8.4	7.1	6.0	4.8	26.3	7.8
Sharp	0.5	0.4	0.5	0.4	1.8	0.4	0.4	0.4	0.4	1.5	1.3
Siemens	6.9	8.6	10.4	11.0	36.8	10.8	10.0	8.4	6.6	35.7	9.6
Texas Instruments	12.2	8.5	7.1	5.3	33.1	3.5	2.0	0.6	-	6.1	-
Toshiba	9.6	6.0	4.3	3.0	22.9	2.2	2.2	1.8	1.6	7.8	2.7
Vanguard	19.0	17.2	15.1	13.3	64.6	-	-	-	-	-	-
All Companies	**191.9**	**159.7**	**145.0**	**128.5**	**625.1**	**98.7**	**82.2**	**67.7**	**55.7**	**304.3**	**112.2**

Source: Dataquest (October 1997)

Table 2-9
Quarterly Shipments of Synchronous 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	1.3	2.1	2.3	1.9	7.7	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	-	1.3	2.1	2.3	1.9	7.7	-

Source: Dataquest (October 1997)

Table 2-10
Quarterly Shipments of Next-Generation 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	-	-	-	-	-	-	-

Note: Previous editions of this book have shown data for this segment. This now-empty table reflects the companies' changed plans.
Source: Dataquest (October 1997)

Table 2-11
Quarterly Shipments of Display 4Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.5	0.8	0.8	0.7	2.8	0.9	0.8	0.9	0.8	3.3	2.1
Hitachi	1.4	1.6	2.0	1.8	6.8	2.8	2.3	2.5	1.9	9.5	9.9
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	2.7	1.8	1.2	0.7	6.3	0.3	0.2	0.1	-	0.6	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	0.8	0.7	0.8	0.7	2.9	0.6	0.7	0.7	0.6	2.6	2.3
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	2.2	2.0	1.8	1.6	7.6	1.6	1.3	1.1	0.8	4.8	2.3
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	0.7	0.5	0.4	0.4	2.0	0.8	0.6	0.5	0.3	2.2	0.5
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	1.6	1.9	1.9	1.7	7.1	1.7	2.0	2.1	1.4	7.2	-
Toshiba	0.4	0.1	0.1	0.1	0.7	-	-	-	-	0.1	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**10.1**	**9.4**	**9.0**	**7.6**	**36.1**	**8.8**	**8.0**	**7.8**	**5.9**	**30.4**	**17.1**

Source: Dataquest (October 1997)

Chapter 3
Production Statistics of 16Mb DRAM

This chapter provides estimates of 16Mb DRAM quarterly unit shipments by supplier. Tables show a summary for 16Mb (see Table 3-1) and total 16Mb shipments (see Table 3-2). Subsequent tables show shipments by organization (x1, x4, x8/9, x16/18, and 32/36, in Tables 3-3 through 3-7) and by technology (fast page mode, extended data out, synchronous, next generation, and display, in Tables 3-8 through 3-12). Dataquest collects data through quarterly supplier surveys. These tables represent 16Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 16Mb DRAM. Average selling prices for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5.

What Has Changed since the Previous Report

As noted, Dataquest expects a DRAM oversupply for most of 1997 and 1998. The 16Mb market will move into supply and demand balance in 1999 because demand will switch by then from 16Mb to 64Mb. The forecast for total 16Mb DRAM supply for 1997 and 1998 remains consistent with prior expectations. For the full year 1997, the worldwide supply forecast of 16Mb devices calls for 1.95 billion units. For fourth quarter 1997, the 16Mb supply forecast remains at 530 million units. For 1998, Dataquest expects the worldwide supply of 16Mb DRAM to reach nearly 2.3 billion units (quite similar to the prior forecast of 2.26 billion units).

Dataquest expects that the production peak of 16Mb will be 1999 (which is slightly later than last quarter's expectation of late 1998).

Expectations for 16Mb DRAM demand in 1997 and 1998 remain consistent with prior expectations. For the full year 1997, the worldwide demand forecast of 16Mb devices calls for 1.81 billion units (versus 1.84 billion units in the prior forecast). For fourth quarter 1997, the 16Mb demand forecast remains at just over 520 million units. For 1998, Dataquest expects worldwide demand for 16Mb DRAM to reach 2.18 billion units (while the prior forecast called for 2.21 billion units).

Average selling prices for 16Mb DRAM now show a faster rate of decline than in the prior forecast because of changed market conditions. Higher-priced synchronous DRAM (SDRAM) represents a higher proportion of the 16Mb market, but even these parts face pricing pressure.

High and Low Ranges of the 16Mb DRAM Supply Forecast

The High Side

On the high side, 1997 supply of 16Mb DRAM might be about 7 percent higher than the current forecast. This means a high-side 1997 forecast of just under 2.1 billion units. For 1998, supply might be 17 percent above the current forecast—meaning a 1998 high-side estimate of 2.7 billion units.

The Low Side

For 1997, 16Mb DRAM supply could be about 7 percent lower than forecast—which translates to just over 1.8 billion units. This would occur if key suppliers adhered to an aggressive 1997 program of 16Mb supply reduction, which is not likely. For 1998, assuming continuation of that unlikely trend, 16Mb supply might be 25 percent lower than the current forecast—meaning a low-side estimate of just over 1.7 billion units.

Table 3-1
16Mb DRAM Supply and Demand Summary, Q1/97 to 1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Total Revenue (U.S.$M)	3,776.4	4,239.6	3,659.2	3,758.7	15,433.9	3,764.9	3,939.5	3,940.6	4,235.1	15,880.0	9,916.8
Total Units Shipped	435.2	478.2	504.2	531.8	1,949.3	537.3	565.8	569.0	613.6	2,285.7	1,837.3
Total Units Demanded	384.2	426.8	475.3	521.0	1,807.3	511.5	528.5	536.8	602.2	2,179.1	1,817.6
Sufficiency (%)	113.27	112.03	106.06	102.08	107.86	105.04	107.05	105.99	101.89	104.89	101.08
All Configurations	**435.2**	**478.2**	**504.2**	**531.8**	**1,949.3**	**537.3**	**565.8**	**569.0**	**613.6**	**2,285.7**	**1,837.3**
x1	8.8	7.0	6.2	6.7	28.6	5.9	6.1	5.7	6.1	23.9	7.4
x4	226.4	261.4	277.9	294.9	1,060.6	298.8	314.7	319.6	348.2	1,281.3	1,046.4
x8/9	59.8	75.6	91.4	93.2	319.9	93.5	97.1	97.6	104.6	392.8	259.2
x16/18	139.5	133.3	127.5	136.8	537.1	136.9	145.6	143.6	151.9	578.0	513.7
x32/36	0.7	0.9	1.2	0.2	3.1	2.2	2.3	2.5	2.8	9.7	10.6
All Interfaces	**435.2**	**478.2**	**504.2**	**531.8**	**1,949.3**	**537.3**	**565.8**	**569.0**	**613.6**	**2,285.7**	**1,837.3**
Fast Page Mode	49.7	42.2	35.7	40.2	167.7	32.4	32.3	30.5	30.2	125.4	138.5
Extended Data Out	300.3	328.8	310.2	310.4	1,249.8	263.9	233.4	184.9	165.1	847.4	316.7
Synchronous	78.4	97.6	147.7	170.8	494.4	233.3	292.5	344.3	408.8	1,278.9	1,354.1
Next-Generation	6.8	9.6	10.5	10.4	37.4	7.5	7.3	8.8	8.9	32.4	26.1
Display	-	-	-	-	-	0.2	0.3	0.4	0.6	1.5	1.7

Source: Dataquest (October 1997)

Table 3-2
Quarterly Shipments of All Configurations of 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	0.1	0.2	0.7	1.4	2.3	2.1	2.9	3.7	4.3	13.0	21.0
Fujitsu	21.0	23.0	26.5	27.0	97.5	25.0	24.0	21.0	21.0	91.0	63.4
Hitachi	40.0	40.0	45.0	40.0	165.0	32.0	30.0	29.0	29.0	120.0	84.0
Hyundai	41.0	47.0	46.5	44.4	178.9	41.7	40.0	35.0	35.0	151.7	106.0
IBM Microelectronics	17.5	20.2	21.7	23.7	83.1	24.5	25.1	24.0	23.9	97.5	58.0
LG Semicon	36.9	38.5	37.0	35.2	147.6	34.0	32.5	29.0	29.0	124.5	87.2
Matsushita	5.5	6.0	6.4	7.1	25.0	7.3	8.0	8.6	9.7	33.6	23.5
Micron Technology	40.0	45.0	53.0	74.0	212.0	89.0	107.0	129.0	150.0	475.0	525.0
Mitsubishi	28.0	27.0	25.0	19.0	99.0	17.0	17.0	15.0	15.0	64.0	44.8
Mosel Vitelic	0.1	0.3	0.9	2.0	3.3	2.5	3.0	3.9	5.5	14.9	18.0
Motorola	6.0	8.0	4.8	4.0	22.8	0.5	-	-	-	0.5	-
Nan Ya Technology	2.2	4.8	10.0	14.0	31.0	15.0	16.0	17.0	20.5	68.5	75.4
NEC	43.0	46.0	49.0	48.7	186.7	45.0	43.0	40.0	40.0	168.0	117.6
Nippon Steel	1.7	2.5	5.3	8.4	17.9	10.4	12.4	13.4	15.9	52.1	36.5
Oki	7.5	7.7	8.0	8.8	32.0	8.9	9.0	9.0	9.0	35.9	25.2
Samsung	58.0	66.0	55.0	51.0	230.0	49.0	49.0	42.0	42.0	182.0	127.4
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	15.9	18.9	21.8	29.0	85.6	35.0	41.5	44.5	49.0	170.0	120.0
Texas Instruments	41.0	45.5	52.0	58.0	196.5	63.0	68.0	71.0	78.0	280.0	196.0
Toshiba	23.3	22.6	22.6	21.6	90.1	20.0	20.0	15.0	14.0	69.0	48.3
Vanguard	6.5	9.0	13.0	14.5	43.0	15.4	17.4	18.9	22.8	74.5	60.0
All Companies	**435.2**	**478.2**	**504.2**	**531.8**	**1,949.3**	**537.3**	**565.8**	**569.0**	**613.6**	**2,285.7**	**1,837.3**
Average Selling Price ($)	**8.68**	**8.87**	**7.26**	**7.07**	**7.92**	**7.01**	**6.96**	**6.93**	**6.90**	**6.95**	**5.40**
Total Revenue (U.S.$M)	**3,776.4**	**4,239.6**	**3,659.2**	**3,758.7**	**15,433.9**	**3,764.9**	**3,939.5**	**3,940.6**	**4,235.1**	**15,880.0**	**9,916.8**
Total Demand	**384.2**	**426.8**	**475.3**	**521.0**	**1,807.3**	**511.5**	**528.5**	**536.8**	**602.2**	**2,179.1**	**1,817.6**
Sufficiency (%)	**113.27**	**112.03**	**106.06**	**102.08**	**107.86**	**105.04**	**107.05**	**105.99**	**101.89**	**104.89**	**101.08**

Source: Dataquest (October 1997)

Table 3-3
Quarterly Shipments of x1 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	1.6	1.6	1.8	1.6	6.6	1.0	0.9	0.6	0.6	3.0	1.7
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	0.5	0.5	0.5	0.6	2.1	0.4	0.5	0.4	0.5	1.8	0.7
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	1.1	1.1	0.8	0.6	3.5	0.5	0.5	0.5	0.5	1.9	0.9
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	0.9	0.9	0.5	0.5	2.8	0.5	0.4	0.4	0.4	1.7	1.2
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	0.4	0.4	0.3	0.4	1.4	0.2	0.2	0.2	0.2	0.7	0.5
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	4.1	2.3	2.1	2.9	11.3	3.2	3.4	3.6	3.9	14.0	2.0
Toshiba	0.2	0.2	0.2	0.2	0.9	0.2	0.2	0.2	0.1	0.7	0.5
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**8.8**	**7.0**	**6.2**	**6.7**	**28.6**	**5.9**	**6.1**	**5.7**	**6.1**	**23.9**	**7.4**
Average Selling Price ($)	**8.98**	**8.86**	**7.26**	**7.21**	**8.17**	**7.12**	**7.06**	**7.04**	**7.01**	**7.06**	**5.33**
Total Revenue (U.S.$M)	**78.8**	**61.7**	**44.9**	**48.3**	**233.6**	**41.9**	**43.1**	**40.4**	**43.0**	**168.4**	**39.5**

Source: Dataquest (October 1997)

Table 3-4
Quarterly Shipments of x4 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	10.5	11.5	10.6	10.8	43.4	10.5	10.1	8.8	8.8	38.2	25.4
Hitachi	23.2	23.2	24.8	22.0	93.2	13.4	11.7	11.3	11.3	47.8	29.4
Hyundai	22.6	30.6	32.6	31.1	116.7	29.2	28.0	24.5	24.5	106.2	74.2
IBM Microelectronics	9.1	9.8	9.1	9.5	37.5	9.8	10.0	9.6	9.6	39.0	17.4
LG Semicon	15.5	21.9	24.8	23.6	85.8	23.0	22.1	19.9	20.0	84.9	60.1
Matsushita	1.2	1.3	1.4	1.6	5.5	1.5	1.7	1.8	2.0	7.1	4.2
Micron Technology	32.0	36.0	42.4	59.2	169.6	71.2	85.6	103.2	120.0	380.0	420.0
Mitsubishi	14.0	13.5	12.5	9.5	49.5	8.0	8.0	7.1	7.1	30.1	20.2
Mosel Vitelic	-	-	0.1	0.5	0.6	0.9	1.2	1.8	2.9	6.8	8.1
Motorola	5.8	7.7	4.4	3.7	21.5	0.5	-	-	-	0.5	-
Nan Ya Technology	2.2	4.8	10.0	14.0	31.0	13.7	13.2	12.5	13.3	52.8	75.4
NEC	16.3	14.7	13.2	13.1	57.4	13.1	12.5	10.8	10.8	47.1	31.8
Nippon Steel	-	-	0.1	0.2	0.3	6.4	7.4	8.0	9.5	31.5	21.9
Oki	5.7	5.9	6.4	7.0	25.1	7.7	7.9	8.1	8.1	31.8	22.7
Samsung	32.5	43.6	38.5	35.7	150.2	34.9	35.5	31.0	31.5	132.9	95.6
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	8.0	9.7	11.1	14.5	43.2	17.5	20.8	22.3	24.5	85.0	60.0
Texas Instruments	15.1	13.7	15.6	17.4	61.8	18.9	20.4	21.3	23.4	84.0	39.2
Toshiba	12.8	13.6	13.6	14.0	54.0	10.0	8.0	5.3	4.9	28.2	16.9
Vanguard	-	-	6.8	7.5	14.3	8.7	10.6	12.4	16.0	47.7	24.0
All Companies	**226.4**	**261.4**	**277.9**	**294.9**	**1,060.6**	**298.8**	**314.7**	**319.6**	**348.2**	**1,281.3**	**1,046.4**
Average Selling Price ($)	**8.42**	**8.50**	**6.88**	**6.71**	**7.56**	**6.67**	**6.65**	**6.62**	**6.62**	**6.64**	**5.25**
Total Revenue (U.S.$M)	**1,906.6**	**2,222.2**	**1,911.8**	**1,978.7**	**8,019.3**	**1,993.1**	**2,092.7**	**2,115.7**	**2,305.2**	**8,506.7**	**5,491.1**

Source: Dataquest (October 1997)

Table 3-5
Quarterly Shipments of x8/9 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	7.4	8.1	13.3	13.5	42.2	12.5	12.0	10.5	10.5	45.5	28.5
Hitachi	5.6	5.6	6.8	6.0	24.0	5.8	6.0	6.7	6.7	25.1	23.5
Hyundai	1.2	2.4	4.7	4.4	12.7	4.7	5.0	4.8	5.3	19.8	15.9
IBM Microelectronics	5.7	7.1	8.9	9.5	31.3	9.8	10.0	9.6	9.6	39.0	26.1
LG Semicon	1.5	3.1	3.7	3.5	11.8	3.4	3.3	2.9	2.9	12.5	8.7
Matsushita	1.4	1.6	1.7	1.9	6.6	2.0	2.3	2.5	2.8	9.7	7.1
Micron Technology	0.8	0.9	1.1	1.5	4.2	1.8	2.1	2.6	3.0	9.5	10.5
Mitsubishi	3.9	3.8	3.3	2.5	13.4	2.2	2.2	2.0	2.0	8.3	5.4
Mosel Vitelic	-	-	-	-	-	-	-	0.1	0.2	0.3	0.6
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	1.3	2.8	4.5	7.2	15.8	-
NEC	14.6	19.3	25.5	25.3	84.7	22.5	21.5	21.6	21.6	87.2	63.5
Nippon Steel	-	-	0.2	0.3	0.4	1.6	1.9	2.0	2.4	7.8	5.5
Oki	0.3	0.3	0.3	0.4	1.3	0.2	0.1	0.1	0.1	0.4	0.3
Samsung	5.8	11.2	8.3	7.7	32.9	7.4	7.4	6.3	6.3	27.3	19.1
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	1.0	1.2	1.7	2.9	6.8	3.5	4.2	4.5	4.9	17.0	12.0
Texas Instruments	7.4	8.2	9.9	11.6	37.1	12.6	13.6	14.2	15.6	56.0	19.6
Toshiba	1.9	1.1	0.9	0.9	4.8	0.6	0.6	0.3	0.3	1.8	1.0
Vanguard	1.3	1.8	1.3	1.5	5.9	1.7	2.2	2.6	3.4	9.9	12.0
All Companies	**59.8**	**75.6**	**91.4**	**93.2**	**319.9**	**93.5**	**97.1**	**97.6**	**104.6**	**392.8**	**259.2**
Average Selling Price ($)	**10.15**	**10.34**	**8.66**	**8.41**	**9.26**	**7.98**	**7.81**	**7.71**	**7.61**	**7.77**	**5.83**
Total Revenue (U.S.$M)	**606.5**	**781.4**	**791.3**	**783.8**	**2,963.0**	**746.4**	**758.6**	**752.6**	**795.8**	**3,053.3**	**1,511.6**

Source: Dataquest (October 1997)

Table 3-6
Quarterly Shipments of x16/18 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	0.1	0.2	0.7	1.4	2.3	2.1	2.9	3.7	4.3	13.0	21.0
Fujitsu	3.2	3.5	2.7	2.7	12.0	2.0	1.9	1.3	1.3	6.4	8.2
Hitachi	9.6	9.6	11.7	10.4	41.3	11.8	11.4	10.4	10.4	44.1	29.4
Hyundai	17.2	14.1	9.3	8.9	49.5	7.8	7.0	5.7	5.3	25.8	15.9
IBM Microelectronics	2.7	3.3	3.7	4.7	14.4	4.9	5.0	4.8	4.8	19.5	14.5
LG Semicon	19.9	13.5	8.5	8.1	50.0	7.7	7.2	6.2	6.1	27.1	18.3
Matsushita	2.4	2.6	2.8	3.1	10.9	3.3	3.5	3.9	4.4	15.0	11.5
Micron Technology	7.2	8.1	9.5	13.3	38.2	16.0	19.3	23.2	27.0	85.5	94.5
Mitsubishi	9.0	8.6	8.5	6.5	32.6	6.3	6.3	5.6	5.6	23.7	18.4
Mosel Vitelic	0.1	0.3	0.7	1.3	2.3	0.7	0.7	0.8	0.9	3.1	2.9
Motorola	0.2	0.3	0.4	0.3	1.3	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	11.2	11.0	9.8	9.7	41.8	9.0	8.6	7.2	7.2	32.0	21.2
Nippon Steel	1.7	2.5	5.0	8.0	17.2	2.4	3.1	3.4	4.0	12.8	9.1
Oki	1.1	1.1	1.0	1.1	4.2	0.9	0.8	0.6	0.6	3.0	1.8
Samsung	19.7	11.2	8.3	7.7	46.8	6.7	6.1	4.7	4.2	21.8	12.7
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	7.0	8.0	8.9	11.6	35.5	14.0	16.6	17.8	19.6	68.0	48.0
Texas Instruments	14.3	21.4	24.4	26.1	86.3	28.4	30.6	32.0	35.1	126.0	135.2
Toshiba	7.7	6.8	6.8	6.5	27.7	8.0	10.0	8.4	7.8	34.2	27.0
Vanguard	5.2	7.2	4.9	5.5	22.9	5.0	4.6	3.9	3.4	16.9	24.0
All Companies	**139.5**	**133.3**	**127.5**	**136.8**	**537.1**	**136.9**	**145.6**	**143.6**	**151.9**	**578.0**	**513.7**
Average Selling Price ($)	**8.42**	**8.71**	**7.03**	**6.91**	**7.78**	**7.01**	**7.01**	**7.01**	**7.00**	**7.01**	**5.40**
Total Revenue (U.S.$M)	**1,174.5**	**1,161.2**	**896.2**	**945.1**	**4,177.0**	**959.7**	**1,020.8**	**1,006.4**	**1,063.3**	**4,050.1**	**2,774.0**

Source: Dataquest (October 1997)

Table 3-7
Quarterly Shipments of x32/36 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	0.4	0.4	0.8	1.3
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	0.1	0.2	0.3	1.0	1.1	1.2	1.5	4.7	6.4
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	0.7	0.9	1.1	-	2.7	1.2	1.2	0.9	0.8	4.1	2.9
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**0.7**	**0.9**	**1.2**	**0.2**	**3.1**	**2.2**	**2.3**	**2.5**	**2.8**	**9.7**	**10.6**
Average Selling Price ($)	**14.35**	**14.48**	**12.12**	**11.77**	**13.29**	**11.00**	**10.75**	**10.25**	**10.00**	**10.46**	**9.50**
Total Revenue (U.S.$M)	**10.0**	**13.1**	**15.0**	**2.8**	**40.9**	**23.7**	**24.4**	**25.5**	**27.8**	**101.4**	**100.6**

Source: Dataquest (October 1997)

Table 3-8
Quarterly Shipments of Fast Page Mode 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	2.1	2.3	2.7	2.7	9.8	2.0	1.2	1.1	2.1	6.4	6.3
Hitachi	4.0	2.8	2.3	2.0	11.1	1.0	0.9	0.6	0.6	3.0	1.7
Hyundai	4.1	4.7	4.7	4.4	17.9	3.6	3.0	2.2	1.8	10.6	5.3
IBM Microelectronics	2.6	2.0	1.1	1.2	6.9	1.2	1.3	1.2	1.2	4.9	1.7
LG Semicon	1.8	1.9	1.9	1.8	7.4	1.7	1.6	1.5	1.5	6.2	4.4
Matsushita	2.8	1.6	1.0	1.1	6.4	0.5	0.4	0.4	0.5	1.8	0.7
Micron Technology	5.2	4.5	3.7	4.4	17.9	4.5	5.9	6.5	4.7	21.4	5.3
Mitsubishi	4.2	2.7	1.3	1.0	9.1	0.9	1.4	1.1	1.1	4.3	2.7
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	1.8	1.2	0.5	4.0	7.5	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	75.4
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	0.7	0.8	1.6	2.5	5.5	2.1	1.2	1.2	1.4	6.0	-
Oki	3.8	2.3	0.8	0.9	7.7	0.4	0.5	0.5	0.5	1.8	0.8
Samsung	5.8	6.6	5.5	5.1	23.0	4.3	3.7	2.6	2.1	12.7	6.4
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	4.0	3.8	3.3	2.9	13.9	3.5	4.2	4.5	4.9	17.0	12.0
Texas Instruments	6.2	4.6	5.2	5.8	21.7	6.3	6.8	7.1	7.8	28.0	15.0
Toshiba	0.7	0.5	0.5	0.4	2.0	0.4	0.4	0.3	0.3	1.4	1.0
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**49.7**	**42.2**	**35.7**	**40.2**	**167.7**	**32.4**	**32.3**	**30.5**	**30.2**	**125.4**	**138.5**

Source: Dataquest (October 1997)

Table 3-9
Quarterly Shipments of Extended Data Out 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	0.1	0.2	0.7	1.4	2.3	2.1	2.9	3.7	4.3	13.0	21.0
Fujitsu	8.4	9.2	5.3	5.4	28.3	5.0	4.8	4.2	4.2	18.2	12.7
Hitachi	28.8	27.2	29.3	26.0	111.3	15.0	11.1	6.7	6.7	39.5	10.9
Hyundai	34.0	37.6	32.6	31.1	135.3	23.5	17.0	10.1	5.3	55.8	15.9
IBM Microelectronics	12.3	14.7	16.3	16.6	59.9	15.9	15.1	13.2	10.8	54.9	21.5
LG Semicon	31.0	32.3	27.0	25.7	116.0	19.9	14.3	8.6	4.4	47.1	13.1
Matsushita	2.8	4.2	5.1	5.7	17.8	5.1	5.6	5.6	6.3	22.6	12.2
Micron Technology	33.6	32.4	28.1	34.8	128.9	34.7	31.0	28.4	24.0	118.1	47.3
Mitsubishi	16.8	16.2	15.0	11.4	59.4	8.5	6.3	4.5	4.5	23.8	8.5
Mosel Vitelic	0.1	0.3	0.9	1.8	3.1	2.0	2.3	2.7	3.5	10.5	6.1
Motorola	3.6	5.6	3.4	-	12.6	0.5	-	-	-	0.5	-
Nan Ya Technology	2.2	4.8	10.0	14.0	31.0	13.7	13.2	12.5	13.3	52.8	-
NEC	15.1	18.4	17.2	14.6	65.2	6.8	6.5	4.0	4.0	21.2	11.8
Nippon Steel	1.0	1.8	3.7	5.9	12.4	8.2	9.1	4.6	5.4	27.2	7.3
Oki	3.5	4.9	6.3	7.0	21.6	6.1	5.9	5.7	5.7	23.4	11.8
Samsung	40.6	46.2	36.9	33.2	156.8	26.3	19.8	11.4	5.9	63.5	17.8
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	11.1	13.2	14.2	17.4	55.9	17.5	18.7	17.8	17.2	71.1	48.0
Texas Instruments	28.7	31.9	28.6	29.0	118.2	28.4	27.2	24.9	23.4	103.8	35.2
Toshiba	20.3	18.8	17.6	15.8	72.4	11.6	9.6	4.2	3.9	29.3	9.7
Vanguard	6.5	9.0	12.4	13.8	41.6	13.1	13.1	12.3	12.5	51.0	6.0
All Companies	**300.3**	**328.8**	**310.2**	**310.4**	**1,249.8**	**263.9**	**233.4**	**184.9**	**165.1**	**847.4**	**316.7**

Source: Dataquest (October 1997)

Table 3-10
Quarterly Shipments of Synchronous 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	10.5	11.5	18.6	18.9	59.5	18.0	18.0	15.8	14.7	66.5	44.4
Hitachi	7.2	10.0	13.5	12.0	42.7	16.0	18.0	21.8	21.8	77.5	71.4
Hyundai	2.9	4.7	9.3	8.9	25.8	14.6	20.0	22.8	28.0	85.3	84.8
IBM Microelectronics	2.6	3.4	4.3	5.9	16.3	7.4	8.8	9.6	12.0	37.7	34.8
LG Semicon	3.7	3.9	7.4	7.0	22.0	11.5	15.4	17.8	21.8	66.4	65.4
Matsushita	-	0.2	0.3	0.4	0.9	1.7	2.0	2.6	2.9	9.2	10.6
Micron Technology	1.2	8.1	21.2	34.8	65.3	49.8	70.1	94.2	121.4	335.4	472.5
Mitsubishi	7.0	8.1	8.8	6.7	30.5	7.7	9.4	9.5	9.5	35.9	33.6
Mosel Vitelic	-	-	-	0.2	0.2	0.5	0.7	1.2	2.0	4.4	11.9
Motorola	0.6	1.2	1.0	-	2.8	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	1.3	2.8	4.5	7.2	15.8	-
NEC	21.5	18.4	22.1	24.4	86.3	31.5	30.1	28.0	28.0	117.6	82.3
Nippon Steel	-	-	-	-	-	0.1	2.1	7.6	9.1	18.9	29.2
Oki	0.3	0.5	0.9	1.0	2.7	2.3	2.6	2.9	2.9	10.7	12.6
Samsung	11.6	13.2	12.7	12.8	50.2	18.4	25.5	27.9	34.0	105.8	103.2
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	0.8	1.9	4.4	8.7	15.7	14.0	18.7	22.3	27.0	81.9	60.0
Texas Instruments	6.2	9.1	18.2	23.2	56.7	28.4	34.0	39.1	46.8	148.2	145.8
Toshiba	2.3	3.4	4.5	5.4	15.6	8.0	10.0	10.5	9.8	38.3	37.7
Vanguard	-	-	0.7	0.7	1.4	2.3	4.4	6.6	10.3	23.5	54.0
All Companies	**78.4**	**97.6**	**147.7**	**170.8**	**494.4**	**233.3**	**292.5**	**344.3**	**408.8**	**1,278.9**	**1,354.1**

Source: Dataquest (October 1997)

Table 3-11
Quarterly Shipments of Next-Generation 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	0.4	0.4	0.7	0.7	2.2	0.8	0.8	0.8	0.9	3.2	2.6
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	6.5	9.2	9.8	9.7	35.2	6.8	6.5	8.0	8.0	29.2	23.5
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**6.8**	**9.6**	**10.5**	**10.4**	**37.4**	**7.5**	**7.3**	**8.8**	**8.9**	**32.4**	**26.1**

Source: Dataquest (October 1997)

Table 3-12
Quarterly Shipments of Display 16Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	0.2	0.3	0.4	0.6	1.5	1.7
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	-	**0.2**	**0.3**	**0.4**	**0.6**	**1.5**	**1.7**

Source: Dataquest (October 1997)

Chapter 4
Production Statistics of 64Mb DRAM

This chapter provides estimates of 64Mb DRAM quarterly unit shipments by supplier. Tables show a summary for 64Mb (see Table 4-1) and total 64Mb shipments (see Table 4-2). Subsequent tables show shipments by organization (x4, x8/9, x64/18, and 32/36, in Tables 4-3 through 4-6) and by technology (fast page mode, extended data out, synchronous, and next generation, in Tables 4-7 through 4-10). Dataquest collects data through quarterly supplier surveys. These tables represent 64Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 64Mb DRAM. Average selling prices for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5.

64Mb Market Conditions

The 64Mb market remains oversupplied. Workstations and notebook PCs are the main 1997 applications for the 64Mb device. Major suppliers started 64Mb mass production during third quarter 1997. These two applications, however, will not absorb 64Mb supply.

The 64Mb market expansion depends largely on the bit-price crossover to 64Mb from the 16Mb density. In 1997, excess supply caused an accelerated rate of 64Mb price decline. Cost reduction of the 64Mb device now emerges as the foremost issue, especially given Micron's success in reducing 16Mb pricing. If the shift from 16Mb to 64Mb is delayed during 1998, the prospect for the 64Mb EDO market will also become worse. As a result, the development both of the 66-MHz and 100-MHz versions of 64Mb SDRAM also emerges as a key issue.

What Has Changed since the Previous Report

Dataquest's outlook calls for 64Mb oversupply through the third quarter of 1998 (which is consistent with last quarter's expectation). For 1997, the key applications will be workstations and notebook PCs; in 1998, desktop PCs should emerge as a mainstream application.

The 1997 and 1998 forecast for 64Mb DRAM supply remains generally consistent with prior expectations. For the full year 1997, the worldwide supply forecast of 64Mb parts calls for 88 million units (versus the prior forecast of 92 million units). For 1998, Dataquest expects worldwide supply of 64Mb DRAM to total 37 million units (while the prior forecast called for 36 million units).

The 1997 and 1998 demand forecast for 64Mb DRAM also remains consistent with last quarter's expectations. For 1997, the worldwide demand forecast of 64Mb devices calls for 84 million units (versus 86 million units in the prior forecast). The fourth quarter 1997 demand outlook for 64Mb parts remains consistent with prior expectations of just under 40 million units. For 1998, Dataquest expects worldwide demand for 64Mb DRAM to total 36 million units (while the prior forecast called for 35 million units).

Under current market conditions, the 64Mb market will not move into supply and demand balance until the end of 1998. The supply and demand equation should tighten during the 100-MHz SDRAM production migration to the 0.25-micron process. The production rate of 100-MHz SDRAM will accelerate at that time, but so will demand, causing the supply and demand balance to tighten by the end of 1998.

High and Low Ranges of the 64Mb DRAM Supply Forecast

The High Side Estimate

For 1997, 64Mb supply could be about 7 percent higher than Dataquest's current forecast, which means a 1997 high-side forecast of just less than 95 million units. The 64Mb upside potential this year is somewhat constrained because suppliers face the challenge of rapidly improving 64Mb yields, which are far lower than 16Mb yields.

By contrast, the 64Mb DRAM upside potential for 1998 is higher, should suppliers significantly improve 64Mb yields by early 1998. For 1998, 64Mb supply might be 20 percent higher than the current forecast, which means a 1998 high-side forecast of nearly 450 million units.

The Low Side Estimate

The 1997 downside potential to 64Mb DRAM supply is somewhat steeper than the upside potential because 64Mb yields might prove quite low this year. For 1997, 64Mb supply might be about 10 percent lower than the current forecast, which means a 1997 low-side forecast of 80 million units.

The 64Mb yields should improve considerably in 1998. Concerns remain, however, about the 64Mb transition. On the low side, the 1998 supply of 64Mb DRAM might be about 15 percent lower than the current forecast, which means a low-side estimate of just under 320 million units.

Table 4-1
64Mb DRAM Supply and Demand Summary, Q1/97 to 1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Total Revenue (U.S.$M)	633.8	883.2	1,012.9	1,436.5	3,966.4	1,847.5	2,397.1	2,977.2	3,617.1	10,838.8	19,054.2
Total Units Shipped	8.5	15.5	25.0	38.9	87.8	54.5	77.1	103.9	136.5	372.1	900.2
Total Units Demanded	8.0	14.2	24.2	37.9	84.4	50.6	73.1	99.2	135.3	358.2	903.0
Sufficiency (%)	105.15	108.97	102.96	102.68	104.06	107.70	105.48	104.68	100.94	103.86	99.69
All Configurations	**8.5**	**15.5**	**25.0**	**38.9**	**87.8**	**54.5**	**77.1**	**103.9**	**136.5**	**372.1**	**900.2**
x1	-	-	-	-	-	-	-	-	-	-	-
x4	4.2	7.9	13.0	20.4	45.5	25.2	33.4	41.6	52.4	152.6	316.0
x8/9	2.7	5.0	7.9	11.9	27.5	17.0	23.4	31.5	41.5	113.5	281.1
x16/18	1.6	2.5	4.0	6.5	14.6	11.8	18.9	28.3	38.5	97.5	267.2
x32/36	-	-	-	-	0.1	0.6	1.4	2.5	4.1	8.5	35.9
All Interfaces	**8.5**	**15.5**	**25.0**	**38.9**	**87.8**	**54.5**	**77.1**	**103.9**	**136.5**	**372.1**	**900.2**
Fast Page Mode	-	-	-	0.1	0.2	0.1	0.2	0.2	0.3	0.9	6.3
Extended Data Out	6.9	12.2	18.4	29.1	66.6	34.6	40.1	42.1	46.3	163.1	178.2
Synchronous	1.5	3.3	6.4	9.6	20.9	19.5	36.2	60.2	87.9	203.8	696.5
Next-Generation	-	-	0.1	0.1	0.2	0.3	0.6	1.3	2.1	4.3	19.1
Display	-	-	-	-	-	-	-	-	-	-	-

Source: Dataquest (October 1997)

Table 4-2
Quarterly Shipments of All Configurations of 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	1.0
Fujitsu	0.3	0.5	0.7	0.9	2.4	1.5	2.7	4.3	6.1	14.6	46.8
Hitachi	0.3	0.4	1.1	2.8	4.6	4.0	6.0	9.0	12.0	31.0	83.7
Hyundai	0.3	0.6	1.0	3.0	4.9	5.4	8.2	11.7	15.5	40.8	88.3
IBM Microelectronics	0.3	0.3	0.4	0.7	1.7	1.8	3.0	4.7	6.5	16.0	50.1
LG Semicon	0.6	0.9	1.1	1.9	4.5	3.3	4.5	6.0	8.1	21.8	64.4
Matsushita	-	-	-	-	-	-	0.1	0.3	0.6	1.0	5.0
Micron Technology	0.2	0.5	0.9	1.2	2.8	1.6	2.4	3.3	4.5	11.8	37.6
Mitsubishi	0.6	1.0	1.9	3.1	6.6	5.0	7.5	10.0	13.6	36.1	79.7
Mosel Vitelic	-	-	-	0.2	0.2	0.6	1.0	1.9	2.8	6.3	22.4
Motorola	-	-	-	0.1	0.1	0.3	0.6	0.4	0.3	1.6	-
Nan Ya Technology	-	-	-	-	-	-	0.1	0.3	0.5	0.8	4.5
NEC	1.9	3.2	5.6	9.0	19.7	9.9	13.6	17.5	21.1	62.0	114.7
Nippon Steel	-	-	-	-	-	-	-	0.1	0.8	0.9	13.3
Oki	-	-	-	-	-	0.1	0.3	0.5	0.7	1.5	6.3
Samsung	3.2	6.8	10.0	12.0	32.0	15.4	18.5	21.3	23.9	79.0	130.4
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	0.2	0.2	0.3	0.4	1.0	0.7	1.0	1.5	2.5	5.7	26.0
Texas Instruments	0.4	0.5	0.7	1.4	3.0	1.7	3.2	4.9	8.2	18.0	61.2
Toshiba	0.3	0.7	1.3	2.2	4.5	3.3	4.5	6.3	9.0	23.1	63.2
Vanguard	-	-	-	-	-	-	-	-	0.1	0.1	1.6
All Companies	**8.5**	**15.5**	**25.0**	**38.9**	**87.8**	**54.5**	**77.1**	**103.9**	**136.5**	**372.1**	**900.2**
Average Selling Price ($)	**75.00**	**56.98**	**40.60**	**36.93**	**45.18**	**33.87**	**31.09**	**28.67**	**26.49**	**29.13**	**21.17**
Total Revenue (U.S.$M)	**633.8**	**883.2**	**1,012.9**	**1,436.5**	**3,966.4**	**1,847.5**	**2,397.1**	**2,977.2**	**3,617.1**	**10,838.8**	**19,054.2**
Total Demand	**8.0**	**14.2**	**24.2**	**37.9**	**84.4**	**50.6**	**73.1**	**99.2**	**135.3**	**358.2**	**903.0**
Sufficiency (%)	**105.15**	**108.97**	**102.96**	**102.68**	**104.06**	**107.70**	**105.48**	**104.68**	**100.94**	**103.86**	**99.69**

Source: Dataquest (October 1997)

Table 4-3
Quarterly Shipments of x4 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.2	0.3	0.7	1.4
Hitachi	0.2	0.2	0.7	1.8	3.0	1.6	2.1	3.2	4.2	11.1	20.9
Hyundai	0.2	0.4	0.7	2.1	3.4	3.7	5.5	7.7	9.9	26.8	56.5
IBM Microelectronics	0.1	0.1	0.2	0.3	0.7	0.7	1.2	1.9	2.6	6.4	22.5
LG Semicon	0.5	0.6	0.8	1.3	3.2	2.2	2.8	3.6	4.5	13.1	36.1
Matsushita	-	-	-	-	-	-	0.1	0.2	0.3	0.6	2.5
Micron Technology	0.2	0.5	0.9	1.0	2.5	1.2	1.7	2.1	2.7	7.7	22.6
Mitsubishi	0.4	0.7	1.2	2.0	4.4	2.8	3.8	4.5	6.1	17.1	23.9
Mosel Vitelic	-	-	-	0.2	0.2	0.3	0.4	0.6	0.6	1.8	4.5
Motorola	-	-	-	0.1	0.1	0.2	0.3	0.2	0.2	0.8	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	4.5
NEC	0.8	1.4	2.2	3.6	8.0	2.3	2.7	2.6	3.2	10.8	11.5
Nippon Steel	-	-	-	-	-	-	-	-	0.2	0.3	4.7
Oki	-	-	-	-	-	0.1	0.2	0.3	0.4	1.0	3.7
Samsung	1.3	3.4	5.5	6.6	16.8	8.3	9.7	10.9	11.9	40.8	65.2
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	0.1	0.1	0.2	0.2	0.6	0.4	0.5	0.7	1.0	2.6	7.8
Texas Instruments	0.1	0.1	0.2	0.5	0.9	0.7	1.3	1.7	2.5	6.1	18.4
Toshiba	0.2	0.2	0.4	0.7	1.4	0.8	1.1	1.3	1.8	5.0	9.5
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**4.2**	**7.9**	**13.0**	**20.4**	**45.5**	**25.2**	**33.4**	**41.6**	**52.4**	**152.6**	**316.0**
Average Selling Price ($)	**75.00**	**56.95**	**40.54**	**36.88**	**44.89**	**33.66**	**30.71**	**28.15**	**25.98**	**28.87**	**20.40**
Total Revenue (U.S.$M)	**312.3**	**448.8**	**528.9**	**753.6**	**2,043.6**	**846.7**	**1,026.5**	**1,170.4**	**1,362.3**	**4,406.0**	**6,445.4**

Source: Dataquest (October 1997)

Table 4-4
Quarterly Shipments of x8/9 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.1	0.1	0.1	0.1	0.4	0.3	0.5	0.9	1.2	2.9	11.7
Hitachi	0.1	0.1	0.3	0.8	1.3	1.6	2.4	3.6	4.8	12.4	37.7
Hyundai	0.1	0.2	0.3	0.8	1.2	1.4	2.2	3.3	4.5	11.4	25.6
IBM Microelectronics	0.1	0.1	0.1	0.2	0.6	0.5	0.8	1.2	1.6	4.1	12.5
LG Semicon	0.1	0.2	0.2	0.4	0.9	0.8	1.2	1.9	2.9	6.9	23.2
Matsushita	-	-	-	-	-	-	-	0.1	0.2	0.3	2.0
Micron Technology	-	-	-	0.2	0.2	0.2	0.4	0.5	0.7	1.8	3.8
Mitsubishi	0.2	0.3	0.6	0.9	1.9	1.5	2.0	2.5	3.4	9.4	19.9
Mosel Vitelic	-	-	-	-	-	0.2	0.4	0.8	1.1	2.5	6.7
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	0.4	0.8	1.4	2.3	4.9	2.5	3.4	4.4	5.3	15.5	34.4
Nippon Steel	-	-	-	-	-	-	-	-	0.2	0.3	4.0
Oki	-	-	-	-	-	-	0.1	0.1	0.1	0.3	1.8
Samsung	1.3	2.7	4.0	4.8	12.8	6.2	7.4	8.5	9.5	31.6	52.2
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	0.1	0.1	0.3	0.2	0.3	0.5	0.8	1.7	7.8
Texas Instruments	0.3	0.3	0.4	0.6	1.6	0.6	1.0	1.5	2.5	5.5	15.3
Toshiba	0.1	0.3	0.4	0.7	1.5	1.0	1.4	1.9	2.7	6.9	22.1
Vanguard	-	-	-	-	-	-	-	-	-	-	0.5
All Companies	**2.7**	**5.0**	**7.9**	**11.9**	**27.5**	**17.0**	**23.4**	**31.5**	**41.5**	**113.5**	**281.1**
Average Selling Price ($)	**75.00**	**56.96**	**40.59**	**36.93**	**45.37**	**33.72**	**30.81**	**28.36**	**26.24**	**28.89**	**20.74**
Total Revenue (U.S.$M)	**201.6**	**287.3**	**319.5**	**440.2**	**1,248.6**	**573.5**	**722.3**	**893.3**	**1,090.0**	**3,279.1**	**5,829.3**

Source: Dataquest (October 1997)

Table 4-5
Quarterly Shipments of x16/18 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	1.0
Fujitsu	0.2	0.4	0.5	0.6	1.7	0.8	1.5	2.4	3.4	8.0	24.3
Hitachi	-	-	0.1	0.1	0.2	0.8	1.5	2.3	3.0	7.6	25.1
Hyundai	-	-	0.1	0.2	0.2	0.3	0.4	0.6	0.8	2.0	4.4
IBM Microelectronics	0.1	0.1	0.1	0.2	0.4	0.5	1.1	1.6	2.3	5.5	15.0
LG Semicon	-	0.1	0.1	0.2	0.4	0.3	0.3	0.4	0.4	1.4	3.2
Matsushita	-	-	-	-	-	-	-	-	-	-	0.5
Micron Technology	-	-	-	0.1	0.1	0.2	0.4	0.7	1.1	2.3	11.3
Mitsubishi	-	-	0.1	0.2	0.3	0.8	1.5	2.5	3.4	8.2	27.9
Mosel Vitelic	-	-	-	-	-	0.1	0.2	0.6	1.1	2.0	9.0
Motorola	-	-	-	0.1	0.1	0.2	0.3	0.2	0.2	0.8	-
Nan Ya Technology	-	-	-	-	-	-	0.1	0.3	0.5	0.8	-
NEC	0.7	1.0	2.0	3.2	6.8	5.1	7.5	10.5	12.6	35.7	68.8
Nippon Steel	-	-	-	-	-	-	-	-	0.3	0.3	4.7
Oki	-	-	-	-	-	-	-	0.1	0.1	0.2	0.9
Samsung	0.6	0.7	0.5	0.6	2.4	0.8	0.9	1.1	1.2	4.0	6.5
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	0.1	0.1	0.2	0.4	0.8	1.4	10.4
Texas Instruments	-	0.1	0.1	0.3	0.5	0.4	1.0	1.7	2.9	6.0	21.4
Toshiba	-	0.2	0.5	0.9	1.6	1.5	2.0	3.2	4.5	11.2	31.6
Vanguard	-	-	-	-	-	-	-	-	0.1	0.1	1.1
All Companies	**1.6**	**2.5**	**4.0**	**6.5**	**14.6**	**11.8**	**18.9**	**28.3**	**38.5**	**97.5**	**267.2**
Average Selling Price ($)	**75.00**	**56.97**	**40.62**	**36.95**	**45.59**	**33.76**	**30.86**	**28.44**	**26.25**	**28.69**	**20.79**
Total Revenue (U.S.$M)	**119.9**	**145.3**	**162.4**	**240.2**	**667.7**	**397.9**	**582.1**	**805.3**	**1,010.8**	**2,796.1**	**5,552.9**

Source: Dataquest (October 1997)

Table 4-6
Quarterly Shipments of x32/36 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	0.1	0.3	0.5	0.9	1.2	2.9	9.4
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	0.1	0.2	0.3	0.6	1.8
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	0.1	0.1	0.2	0.5	1.9
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	0.1	0.2	0.5	0.7	1.5	8.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	2.2
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	0.2	0.5	0.8	1.2	2.6	6.5
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	0.4	0.4	6.1
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	**0.1**	**0.6**	**1.4**	**2.5**	**4.1**	**8.5**	**35.9**
Average Selling Price ($)	-	**72.11**	**61.83**	**56.04**	**61.80**	**49.56**	**48.07**	**43.84**	**37.95**	**42.11**	**34.16**
Total Revenue (U.S.$M)	-	**1.8**	**2.2**	**2.5**	**6.5**	**29.4**	**66.2**	**108.2**	**153.9**	**357.7**	**1,226.6**

Source: Dataquest (October 1997)

Table 4-7
Quarterly Shipments of Fast Page Mode 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	0.1	0.1	0.1	-	0.1	0.3	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	0.1	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	4.5
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	0.1	-	0.1	0.1	0.2	0.5	1.8
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**-**	**-**	**-**	**0.1**	**0.2**	**0.1**	**0.2**	**0.2**	**0.3**	**0.9**	**6.3**

Source: Dataquest (October 1997)

Table 4-8
Quarterly Shipments of Extended Data Out 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	0.3	0.4	1.0	2.7	4.4	3.6	4.2	5.0	6.6	19.4	16.7
Hyundai	0.3	0.5	0.9	2.6	4.2	3.7	4.3	4.2	3.1	15.4	17.7
IBM Microelectronics	0.3	0.2	0.3	0.5	1.3	1.2	1.9	2.8	3.2	9.0	10.0
LG Semicon	0.5	0.7	0.8	1.4	3.5	1.9	1.9	1.5	0.8	6.1	6.4
Matsushita	-	-	-	-	-	-	0.1	0.2	0.4	0.8	2.5
Micron Technology	0.2	0.5	0.9	1.1	2.6	1.4	1.8	1.7	1.4	6.2	7.5
Mitsubishi	0.6	1.0	1.9	3.1	6.6	4.8	6.8	7.0	9.1	27.6	27.9
Mosel Vitelic	-	-	-	0.2	0.2	0.5	0.8	1.2	1.4	3.9	4.5
Motorola	-	-	-	0.1	0.1	0.2	0.5	0.3	0.2	1.3	-
Nan Ya Technology	-	-	-	-	-	-	-	0.1	0.2	0.3	-
NEC	1.3	1.8	3.1	5.0	11.1	3.0	2.7	3.5	3.8	13.0	11.5
Nippon Steel	-	-	-	-	-	-	-	-	0.2	0.2	2.7
Oki	-	-	-	-	-	0.1	0.2	0.4	0.5	1.2	3.8
Samsung	2.7	5.8	7.5	9.0	25.0	9.4	8.8	7.2	4.8	30.2	26.1
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	0.2	0.2	0.3	0.4	0.9	0.6	0.8	1.1	1.8	4.3	13.0
Texas Instruments	0.3	0.4	0.6	1.1	2.3	1.2	2.3	3.4	5.5	12.4	18.4
Toshiba	0.3	0.7	1.3	2.1	4.4	3.0	3.2	2.5	3.3	12.0	9.5
Vanguard	-	-	-	-	-	-	-	-	-	-	0.2
All Companies	**6.9**	**12.2**	**18.4**	**29.1**	**66.6**	**34.6**	**40.1**	**42.1**	**46.3**	**163.1**	**178.2**

Source: Dataquest (October 1997)

Table 4-9
Quarterly Shipments of Synchronous 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	1.0
Fujitsu	0.3	0.5	0.7	0.9	2.4	1.5	2.7	4.3	6.1	14.6	46.8
Hitachi	-	-	0.1	0.1	0.2	0.4	1.8	4.1	5.4	11.7	67.0
Hyundai	-	0.1	0.2	0.5	0.7	1.7	3.9	7.5	12.4	25.4	70.6
IBM Microelectronics	-	-	0.1	0.2	0.3	0.5	1.1	1.9	3.3	6.7	40.1
LG Semicon	0.1	0.1	0.2	0.4	0.8	1.1	2.0	3.5	5.7	12.2	45.1
Matsushita	-	-	-	-	-	-	-	0.1	0.1	0.2	2.5
Micron Technology	-	-	-	0.1	0.2	0.2	0.6	1.7	3.2	5.6	30.1
Mitsubishi	-	-	-	-	-	0.3	0.8	3.0	4.5	8.5	51.8
Mosel Vitelic	-	-	-	-	-	0.1	0.3	0.7	1.4	2.4	17.9
Motorola	-	-	-	-	-	-	0.1	0.1	-	0.2	-
Nan Ya Technology	-	-	-	-	-	-	0.1	0.1	0.3	0.5	-
NEC	0.6	1.4	2.5	4.1	8.6	6.9	10.9	14.0	17.3	49.0	103.2
Nippon Steel	-	-	-	-	-	-	-	0.1	0.6	0.7	10.6
Oki	-	-	-	-	-	-	-	0.1	0.2	0.3	2.5
Samsung	0.5	1.0	2.5	3.0	7.0	6.0	9.7	14.1	19.1	48.8	104.3
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	0.1	0.2	0.4	0.8	1.4	13.0
Texas Instruments	-	0.1	0.1	0.3	0.5	0.4	0.8	1.3	2.5	5.0	37.9
Toshiba	-	-	-	0.1	0.1	0.3	1.4	3.5	5.2	10.4	50.6
Vanguard	-	-	-	-	-	-	-	-	0.1	0.1	1.4
All Companies	**1.5**	**3.3**	**6.4**	**9.6**	**20.9**	**19.5**	**36.2**	**60.2**	**87.9**	**203.8**	**696.5**

Source: Dataquest (October 1997)

Table 4-10
Quarterly Shipments of Next-Generation 64Mb DRAM to the World, Q1/97 to 1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	0.1	0.1	0.2	0.3	0.6	1.0	1.6	3.5	12.9
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	3.1
Toshiba	-	-	-	-	-	-	-	0.3	0.5	0.8	3.2
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**-**	**-**	**0.1**	**0.1**	**0.2**	**0.3**	**0.6**	**1.3**	**2.1**	**4.3**	**19.1**

Source: Dataquest (October 1997)

Chapter 5
Consumption of DRAMs by Application

This chapter provides details of Dataquest's DRAM demand analysis. Quarterly DRAM demand figures are derived from Dataquest's electronic equipment forecast generated by the Semiconductor Application Markets Worldwide program, as well as forecasts from Dataquest's Computer Systems and Peripherals group and Telecommunications group.

Table 5-1 shows the quarterly electronic equipment production forecast (the systems forecast). Table 5-2 provides Dataquest's estimate of DRAM megabyte consumption for each type of system. Dataquest calls this "megabytes per system." Table 5-3 shows the number of bits of memory required by the entire market (the system forecasts times DRAM usage) and the memory module market. Table 5-4 provides DRAM demand for each application by DRAM density, as well as total supply and demand by density and sufficiency in millions of 16Mb equivalent units.

What Has Changed since the Previous Report

Dataquest has revised the systems forecasts contained in Table 5-1. The key PC forecast shows undramatic changes for 1997 and 1998 (versus the forecast in last quarter's report).

Dataquest has revised downward the estimated number of DRAM megabytes contained in PCs as shipped from the PC factory and as upgraded following shipment from the PC factory.

Table 5-1
High-Volume Electronic Equipment Unit Production Forecast, Q1/97 to 1999 (Thousands of Systems)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers	0.6	0.6	0.6	0.6	2.3	0.6	0.6	0.6	0.7	2.5	2.6
Mainframes	2.0	2.0	2.0	2.0	8.0	1.9	1.9	1.9	1.8	7.5	7.0
Midrange	203.2	211.8	220.5	229.1	864.5	229.9	239.7	249.5	259.3	978.3	1,097.1
Workstations	182.1	189.7	189.7	197.3	758.8	181.1	188.6	188.6	196.2	754.5	750.9
Personal Computers	**18,746.4**	**19,351.2**	**21,072.7**	**25,108.0**	**84,278.3**	**21,824.4**	**22,323.8**	**24,463.9**	**29,764.4**	**98,376.6**	**113,596.1**
Server PCs	**337.3**	**366.9**	**384.7**	**517.5**	**1,606.4**	**427.9**	**446.9**	**479.3**	**641.4**	**1,995.5**	**2,483.1**
486 and Below Server PCs	0.5	0.1	-	-	0.6	-	-	-	-	-	-
586 Server PCs	260.3	253.4	230.2	256.5	1,000.4	164.2	150.0	151.1	148.4	613.8	252.1
686 and Future Server PCs	69.8	105.3	145.5	249.9	570.5	252.7	287.5	317.9	480.8	1,338.9	2,184.9
Other Server PCs	6.7	8.0	9.1	11.2	35.0	10.9	9.4	10.3	12.1	42.8	46.1
Mobile PCs	**3,177.7**	**3,328.6**	**3,718.6**	**4,166.5**	**14,391.4**	**3,763.9**	**3,886.5**	**4,473.0**	**5,059.5**	**17,182.9**	**20,364.2**
486 and Below Mobile PCs	48.3	27.0	11.3	5.0	91.7	3.1	-	-	-	3.1	-
586 Mobile PCs	3,011.3	3,169.2	3,507.2	3,840.1	13,527.8	3,227.4	3,232.7	3,366.9	3,613.7	13,440.7	6,849.3
686 and Future Mobile PCs	0.4	2.9	41.5	140.8	185.6	307.6	469.9	855.2	1,154.5	2,787.1	12,402.4
Other Mobile PCs	117.7	129.4	158.6	180.6	586.3	225.8	183.9	250.9	291.3	952.0	1,112.5
Desk PCs	**15,231.3**	**15,655.8**	**16,969.4**	**20,424.1**	**68,280.6**	**17,632.7**	**17,990.4**	**19,511.7**	**24,063.4**	**79,198.2**	**90,748.8**
486 and Below Desk PCs	84.8	54.0	4.3	-	143.1	-	-	-	-	-	-
586 Desk PCs	12,902.1	12,529.6	12,033.2	12,091.5	49,556.4	8,846.2	7,606.2	6,541.7	6,550.4	29,544.6	10,974.5
686 and Future Desk PCs	1,402.0	2,125.5	3,850.8	7,192.8	14,571.1	7,778.8	9,249.8	11,763.5	16,247.8	45,039.8	74,920.9
Other Desk PCs	842.4	946.7	1,081.1	1,139.7	4,010.0	1,007.7	1,134.4	1,206.5	1,265.2	4,613.8	4,853.4
Additional Motherboards	2,954.4	2,745.7	2,662.8	2,581.2	10,944.1	2,678.4	2,792.4	2,906.4	3,020.4	11,397.6	13,171.8
Data Storage Devices	46,580.7	48,562.8	50,545.0	52,527.2	198,215.7	54,038.4	56,337.9	58,637.4	60,936.9	229,950.6	260,401.5
Printers	11,388.1	11,872.7	12,357.3	12,841.9	48,460.0	12,929.3	13,479.5	14,029.7	14,579.9	55,018.3	58,739.0
Facsimiles	2,633.7	2,613.9	2,666.0	2,659.4	10,572.9	2,663.4	2,681.9	2,691.9	2,739.8	10,777.0	11,321.0
Telephone Answering Machines	7,040.1	7,060.1	7,110.1	7,090.1	28,300.2	7,306.4	7,236.0	7,296.3	7,427.5	29,266.3	29,463.6
Routers/Internetworking	274.6	292.7	313.8	334.9	1,216.0	374.5	399.9	423.1	448.5	1,646.0	2,132.0

Table 5-1 (Continued)
High-Volume Electronic Equipment Unit Production Forecast, Q1/97 to 1999 (Thousands of Systems)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Industrial Applications	901.8	921.6	930.9	957.7	3,712.0	993.0	1,017.1	1,030.8	1,039.0	4,080.0	4,386.6
DVD Players	176.1	353.3	477.9	712.7	1,720.0	782.2	990.6	1,161.9	1,534.3	4,469.0	10,322.1
Set-Top Boxes	4,882.4	5,090.1	5,297.9	5,505.6	20,776.0	5,836.2	6,084.6	6,332.9	6,581.3	24,835.0	26,412.0
Video Games	4,414.8	4,602.6	4,790.5	4,978.4	18,786.2	5,410.7	5,664.5	5,687.2	5,207.7	21,970.0	18,573.6
Other Applications	-	-	-	-	-	-	-	-	-	-	-

Source: Dataquest (October 1997)

Table 5-2
High-Volume Electronic Equipment Unit Production Forecast, Q1/97 to 1999 (Megabytes per System)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers	4,284.0	4,300.8	4,321.3	4,403.2	4,328.0	4,567.0	4,976.6	5,529.6	5,898.2	5,256.8	6,467.6
Mainframes	3,099.4	3,153.9	3,215.4	3,317.8	3,195.4	3,604.5	3,850.2	4,034.6	4,177.9	3,912.3	4,744.3
Midrange	218.9	224.0	233.6	256.0	233.7	310.4	348.8	386.1	423.0	369.0	509.3
Workstations	100.8	104.0	118.4	126.4	112.7	134.4	145.6	156.8	168.0	151.5	220.1
Personal Computers	**24.0**	**24.8**	**26.3**	**28.0**	**26.0**	**31.0**	**36.2**	**39.3**	**43.7**	**38.1**	**51.7**
Server PCs	**61.5**	**68.7**	**76.1**	**82.4**	**73.4**	**88.7**	**93.1**	**96.5**	**102.6**	**96.0**	**120.4**
486 and Below Server PCs	42.0	47.0	-	-	42.8	-	-	-	-	-	-
586 Server PCs	58.8	65.4	72.0	77.0	68.2	82.7	88.2	92.8	95.8	89.7	102.2
686 and Future Server PCs	72.0	77.0	82.7	88.2	82.7	92.8	95.8	98.4	104.8	99.1	122.9
Other Server PCs	58.8	65.4	72.0	77.0	69.5	82.7	88.2	92.8	95.8	90.1	102.7
Mobile PCs	**15.1**	**16.3**	**17.9**	**20.9**	**17.8**	**22.4**	**24.2**	**26.6**	**29.8**	**26.1**	**37.7**
486 and Below Mobile PCs	13.1	13.1	14.2	15.5	13.4	17.0	-	-	-	17.0	-
586 Mobile PCs	15.1	16.3	17.8	20.8	17.7	22.1	23.5	25.5	28.6	25.1	33.3
686 and Future Mobile PCs	17.0	20.0	21.8	23.0	22.7	25.5	28.6	30.5	33.0	30.7	40.2
Other Mobile PCs	15.5	17.0	20.0	21.8	19.0	23.0	25.5	28.6	30.5	27.3	36.3
Desk PCs	**25.0**	**25.6**	**27.0**	**28.1**	**26.6**	**31.5**	**37.4**	**40.8**	**45.0**	**39.2**	**53.0**
486 and Below Desk PCs	21.6	25.0	26.4	-	23.0	-	-	-	-	-	-
586 Desk PCs	24.6	24.9	25.2	25.2	25.0	27.0	35.4	38.0	38.7	34.2	42.0
686 and Future Desk PCs	27.7	28.6	31.7	32.1	31.0	36.1	39.0	42.6	48.0	42.7	55.3
Other Desk PCs	28.2	28.9	31.0	33.4	30.6	35.2	37.0	38.3	39.3	37.6	42.1
Additional Motherboards	25.0	28.2	28.9	30.2	28.0	33.5	37.4	38.8	39.5	37.4	49.0
Memory Modules	12.2	14.2	16.7	16.9	15.1	18.4	18.6	18.7	18.9	18.6	21.3
Data Storage Devices	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.7	0.5	0.8
Printers	3.9	3.9	3.9	4.0	3.9	4.2	4.4	4.6	4.8	4.5	5.4
Facsimiles	2.2	2.2	2.3	2.3	2.2	2.6	2.6	2.9	3.1	2.8	4.0
Telephone Answering Machines	2.2	2.2	2.3	2.3	2.3	2.4	2.5	2.6	2.7	2.6	3.0

Table 5-2 (Continued)
High-Volume Electronic Equipment Unit Production Forecast, Q1/97 to 1999 (Megabytes per System)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Routers/Internetworking	6.1	6.2	6.3	6.5	6.3	6.7	7.0	7.5	7.9	7.3	9.1
Industrial Applications	9.7	9.9	10.5	11.2	10.4	12.9	14.0	14.6	15.5	14.3	15.5
DVD Players	2.0	2.1	2.2	2.3	2.2	2.4	2.6	2.7	2.7	2.6	3.2
Set-Top Boxes	2.0	2.2	2.2	2.3	2.2	2.5	2.7	2.8	3.0	2.8	3.8
Video Games	4.4	4.9	5.0	5.2	4.9	5.4	5.6	5.8	6.0	5.7	6.8
Other Applications	-	-	-	-	-	-	-	-	-	-	-
All Applications	8.0	8.6	9.4	10.2	9.1	10.7	11.7	12.6	14.4	12.4	16.2
PC + Aftermarket Module Megabytes per System	36.7	40.2	43.6	43.5	41.2	50.8	56.2	58.3	59.8	56.6	72.4

Source: Dataquest (October 1997)

Table 5-3 DRAM CONSUMPTION BY APPLICATION

~~High-Volume Electronic Equipment Unit Production~~ Forecast, Q1/97 to 1999 (Thousands of Megabytes)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers	2,441.9	2,451.5	2,506.3	2,597.9	9,997.6	2,785.9	3,035.8	3,538.9	3,833.9	13,194.4	16,880.4
Mainframes	6,322.9	6,370.9	6,398.6	6,502.8	25,595.2	6,920.6	7,354.0	7,463.9	7,603.8	29,342.3	33,209.8
Midrange	44,467.7	47,443.2	51,497.1	58,647.0	202,055.0	71,361.0	83,600.4	96,325.4	109,662.8	360,949.5	558,734.0
Workstations	18,356.8	19,728.7	22,460.4	24,937.1	85,482.9	24,336.5	27,463.1	29,575.6	32,955.6	114,330.7	165,236.2
Personal Computers	**450,048.1**	**480,656.8**	**554,684.9**	**703,315.2**	**2,188,705.0**	**676,928.4**	**808,485.2**	**961,847.4**	**1,299,528.4**	**3,746,789.5**	**5,877,354.2**
Server PCs	**20,744.7**	**25,198.2**	**29,261.5**	**42,625.8**	**117,830.2**	**37,940.3**	**41,605.4**	**46,261.9**	**65,783.2**	**191,590.8**	**299,026.9**
486 and Below Server PCs	20.6	4.5	-	-	25.1	-	-	-	-	-	-
586 Server PCs	15,306.5	16,564.8	16,572.0	19,737.5	68,180.7	13,582.4	13,225.3	14,025.5	14,226.8	55,060.0	25,758.4
686 and Future Server PCs	5,022.6	8,104.7	12,036.3	22,029.8	47,193.3	23,454.9	27,549.3	31,280.7	50,393.0	132,677.9	268,534.6
Other Server PCs	395.0	524.3	653.3	858.5	2,431.2	903.0	830.7	955.7	1,163.5	3,852.9	4,733.9
Mobile PCs	**47,998.3**	**54,329.6**	**66,523.7**	**87,124.7**	**255,976.3**	**84,366.3**	**94,184.7**	**119,174.1**	**150,521.1**	**448,246.2**	**767,212.8**
486 and Below Mobile PCs	634.2	354.4	161.4	77.6	1,227.7	53.4	-	-	-	53.4	-
586 Mobile PCs	45,530.9	51,721.5	62,287.9	79,874.0	239,414.3	71,260.7	76,033.2	85,923.4	103,495.6	336,712.8	227,821.0
686 and Future Mobile PCs	6.2	58.8	902.5	3,243.8	4,211.3	7,849.1	13,457.1	26,065.4	38,146.1	85,517.7	498,986.7
Other Mobile PCs	1,827.0	2,195.0	3,171.8	3,929.3	11,123.1	5,203.2	4,694.4	7,185.3	8,879.5	25,962.4	40,405.0
Desk PCs	**381,305.1**	**401,129.0**	**458,899.7**	**573,564.7**	**1,814,898.5**	**554,621.8**	**672,695.2**	**796,411.4**	**1,083,224.1**	**3,106,952.4**	**4,811,114.5**
486 and Below Desk PCs	1,832.4	1,346.9	114.1	-	3,293.4	-	-	-	-	-	-
586 Desk PCs	316,874.9	311,737.1	303,236.2	304,706.5	1,236,554.7	238,493.9	269,564.6	248,584.6	253,633.2	1,010,276.3	461,015.2
686 and Future Desk PCs	38,807.6	60,703.5	121,992.3	230,745.1	452,248.5	280,657.9	361,112.0	501,594.0	779,894.0	1,923,257.8	4,145,813.8
Other Desk PCs	23,790.2	27,341.4	33,557.1	38,113.2	122,801.9	35,470.0	42,018.6	46,232.8	49,696.9	173,418.3	204,285.5
Additional Motherboards	73,742.6	77,537.2	76,902.2	77,848.7	306,030.7	89,781.0	104,324.4	112,767.5	119,364.6	426,237.6	645,209.4
Memory Modules	273,402.0	330,636.0	403,495.1	422,982.2	1,430,515.3	478,103.8	499,442.4	521,077.2	543,008.2	2,041,631.6	2,659,864.0
Data Storage Devices	13,857.8	14,447.4	15,037.1	16,414.7	59,757.1	19,318.7	23,943.6	28,439.1	43,569.9	115,271.3	207,142.9
Printers	44,413.6	46,303.6	48,193.5	51,881.3	190,792.0	54,303.1	59,174.9	63,975.3	69,837.5	247,290.8	317,088.7
Facsimiles	5,701.9	5,802.8	6,065.2	6,196.4	23,766.2	6,858.2	7,066.9	7,860.3	8,411.3	30,196.7	45,096.1
Telephone Answering Machines	15,488.1	15,532.1	16,210.9	16,448.9	63,680.1	17,535.4	18,234.8	18,970.5	19,905.8	74,646.4	86,936.2
Routers/Internetworking	1,674.9	1,814.6	1,977.0	2,177.0	7,643.6	2,516.5	2,807.1	3,182.0	3,561.1	12,066.8	19,419.4
Industrial Applications	8,765.8	9,160.8	9,811.4	10,764.5	38,502.5	12,849.7	14,219.6	15,070.6	16,084.2	58,224.1	67,903.9
DVD Players	352.1	742.0	1,051.4	1,639.2	3,784.7	1,877.3	2,575.5	3,090.7	4,142.6	11,686.1	33,307.3
Set-Top Boxes	9,862.4	11,198.3	11,549.4	12,773.1	45,383.1	14,824.0	16,671.7	17,985.5	19,612.2	69,093.5	99,826.3
Video Games	19,424.9	22,644.9	23,952.5	26,086.6	92,108.8	29,217.7	31,607.8	32,985.6	31,454.3	125,265.4	126,144.1
Other Applications	-	-	-	-	-	-	-	-	-	-	-
All Applications	988,323.5	1,092,470.7	1,251,792.9	1,441,212.7	4,773,799.9	1,509,517.7	1,710,007.2	1,924,155.6	2,332,536.1	7,476,216.5	10,959,353.0

Source: Dataquest (October 1997)

Table 5-4
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-
64Mb	305.2	306.4	313.3	324.7	1,249.7	348.2	379.5	442.4	479.2	1,649.3	2,110.1
Mainframes											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	158.1	-	-	-	158.1	-	-	-	-	-	-
64Mb	750.8	796.4	799.8	812.9	3,159.9	865.1	919.2	933.0	950.5	3,667.8	4,151.2
Midrange											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	8,893.5	-	-	-	8,893.5	-	-	-	-	-	-
64Mb	3,335.1	5,930.4	6,437.1	7,330.9	23,033.5	8,920.1	10,450.0	12,040.7	13,707.8	45,118.7	69,841.8
Workstations											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	6,424.9	3,945.7	3,369.1	1,246.9	14,986.5	-	-	-	-	-	-
64Mb	688.4	1,479.7	1,965.3	2,805.4	6,938.7	3,042.1	3,432.9	3,697.0	4,119.4	14,291.3	20,654.5
Personal Computers											
1Mb	161.3	-	-	-	161.3	-	-	-	-	-	-
4Mb	46,237.6	32,341.3	21,076.8	11,394.1	111,049.8	10,419.2	9,295.1	3,626.4	1,505.2	24,845.9	7,672.1
16Mb	208,462.5	220,970.1	241,453.2	293,056.8	963,942.6	231,309.5	240,937.0	231,448.8	300,005.6	1,003,701.0	593,905.6
64Mb	1,248.0	2,818.3	7,655.0	13,938.1	25,659.4	26,137.5	40,245.5	62,142.1	87,345.6	215,870.6	585,713.4
Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	622.3	-	-	-	622.3	-	-	-	-	-	-
16Mb	7,779.3	8,008.9	8,436.1	11,099.7	35,323.9	7,863.8	7,997.8	7,655.4	8,502.1	32,019.2	13,393.3
64Mb	609.4	1,147.5	1,548.7	2,553.3	5,858.9	2,776.6	3,201.2	3,868.9	6,097.4	15,944.1	34,030.1

Table 5-4 (Continued)
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
486 and Below Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	0.6	-	-	-	0.6	-	-	-	-	-	-
16Mb	7.7	1.6	-	-	9.3	-	-	-	-	-	-
64Mb	0.6	0.2	-	-	0.8	-	-	-	-	-	-
586 Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	459.2	-	-	-	459.2	-	-	-	-	-	-
16Mb	5,739.9	5,797.7	5,800.2	6,414.7	23,752.5	4,074.7	3,637.0	3,506.4	3,201.0	14,419.1	4,182.5
64Mb	449.6	621.2	621.4	863.5	2,555.8	679.1	743.9	876.6	978.1	3,277.7	2,174.2
686 and Future Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	150.7	-	-	-	150.7	-	-	-	-	-	-
16Mb	1,883.5	2,026.2	2,407.3	4,406.0	10,722.8	3,518.2	4,132.4	3,910.1	5,039.3	16,600.0	8,465.8
64Mb	147.5	506.5	902.7	1,652.2	3,209.0	2,052.3	2,410.6	2,932.6	5,039.3	12,434.7	31,450.4
Other Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	11.9	-	-	-	11.9	-	-	-	-	-	-
16Mb	148.1	183.5	228.7	279.0	839.3	270.9	228.5	238.9	261.8	1,000.1	744.9
64Mb	11.6	19.7	24.5	37.6	93.3	45.1	46.7	59.7	80.0	231.6	405.5
Mobile PCs											
1Mb	14.7	-	-	-	14.7	-	-	-	-	-	-
4Mb	6,771.1	5,433.0	3,991.4	5,300.0	21,495.5	4,218.3	2,825.5	2,383.5	1,505.2	10,932.6	7,672.1
16Mb	22,305.5	25,276.3	29,973.8	36,935.9	114,491.6	31,130.1	28,575.5	30,333.2	31,192.0	121,230.7	90,367.5
64Mb	-	132.6	572.5	1,325.4	2,030.5	2,499.6	4,452.6	7,164.5	10,923.1	25,039.8	72,830.2
486 and Below Mobile PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	88.8	35.4	9.7	5.4	139.4	2.7	-	-	-	2.7	-
16Mb	294.9	166.6	76.7	34.3	572.5	22.3	-	-	-	22.3	-
64Mb	-	0.4	0.4	0.8	1.6	0.9	-	-	-	0.9	-

Table 5-4 (Continued)
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
586 Mobile PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	6,374.3	5,172.1	3,737.3	4,792.4	20,076.2	3,563.0	2,281.0	1,718.5	1,035.0	8,597.5	2,278.2
16Mb	21,171.9	24,050.5	28,029.6	33,946.5	107,198.4	26,188.3	22,429.8	21,266.0	20,699.1	90,583.2	26,739.3
64Mb	-	129.3	545.0	1,198.1	1,872.4	2,137.8	3,754.1	5,316.5	7,697.5	18,906.0	21,650.4
686 and Future Mobile PCs											
1Mb	0.1	-	-	-	0.1	-	-	-	-	-	-
4Mb	1.0	5.9	54.2	227.1	288.1	392.5	403.7	521.3	381.5	1,698.9	4,989.9
16Mb	2.9	27.6	361.0	1,216.4	1,607.9	2,747.2	4,373.6	6,516.4	7,629.2	21,266.3	50,597.7
64Mb	-	0.1	19.2	87.2	106.4	269.8	563.5	1,596.5	2,837.1	5,266.9	49,412.1
Other Mobile PCs											
1Mb	14.6	-	-	-	14.6	-	-	-	-	-	-
4Mb	306.9	219.5	190.3	275.1	991.8	260.2	140.8	143.7	88.8	633.5	404.1
16Mb	835.8	1,031.6	1,506.6	1,738.7	5,112.8	2,172.3	1,772.1	2,550.8	2,863.6	9,358.9	13,030.6
64Mb	-	2.7	7.9	39.3	50.0	91.1	135.0	251.5	388.5	866.0	1,767.7
Desk PCs											
1Mb	146.6	-	-	-	146.6	-	-	-	-	-	-
4Mb	38,844.2	26,908.4	17,085.3	6,094.1	88,932.0	6,200.8	6,469.6	1,242.9	-	13,913.3	-
16Mb	178,377.8	187,684.8	203,043.3	245,021.2	814,127.1	192,315.6	204,363.7	193,460.2	260,311.6	850,451.1	490,144.8
64Mb	638.6	1,538.1	5,533.8	10,059.4	17,770.0	20,861.3	32,591.6	51,108.7	70,325.1	174,886.7	478,853.1
486 and Below Desk PCs											
1Mb	146.6	-	-	-	146.6	-	-	-	-	-	-
4Mb	1,282.7	942.9	63.9	-	2,289.4	-	-	-	-	-	-
16Mb	586.4	437.8	41.1	-	1,065.2	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-
586 Desk PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	16,477.5	10,599.1	10,310.0	6,094.1	43,480.7	6,200.8	6,469.6	1,242.9	-	13,913.3	-
16Mb	152,733.7	150,101.4	139,943.5	137,879.7	580,658.3	95,695.7	100,817.2	92,908.5	88,771.6	378,193.0	87,883.8
64Mb	396.1	779.3	2,274.3	3,237.5	6,687.2	5,500.3	8,086.9	7,768.3	9,511.2	30,866.7	35,655.9

Table 5-4 (Continued)
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
686 and Future Desk PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	7,761.5	6,070.4	-	-	13,831.9	-	-	-	-	-	-
16Mb	16,493.2	25,799.0	48,796.9	89,990.6	181,079.7	81,545.2	86,739.1	83,214.4	154,146.0	405,644.7	357,643.8
64Mb	242.5	758.8	3,049.8	6,345.5	10,396.6	14,696.0	23,454.2	41,895.6	58,950.2	138,996.0	428,815.8
Other Desk PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	13,322.5	9,296.1	6,711.4	-	29,330.0	-	-	-	-	-	-
16Mb	8,564.5	11,346.7	14,261.8	17,150.9	51,323.9	15,074.8	16,807.4	17,337.3	17,393.9	66,613.4	44,617.1
64Mb	-	-	209.7	476.4	686.1	665.1	1,050.5	1,444.8	1,863.6	5,023.9	14,381.4
Additional Motherboards											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	41,295.8	26,362.6	15,380.4	-	83,038.9	-	-	-	-	-	-
16Mb	26,547.3	32,177.9	32,683.5	35,031.9	126,440.6	38,156.9	41,729.8	42,287.8	41,777.6	163,952.1	167,059.8
64Mb	-	-	480.6	973.1	1,453.7	1,683.4	2,608.1	3,524.0	4,476.2	12,291.7	38,886.2
Memory Modules											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	120,296.9	92,578.1	80,699.0	84,596.4	378,170.4	52,591.4	27,968.8	10,421.5	-	90,981.7	-
16Mb	99,791.7	130,601.2	155,345.6	143,814.0	529,552.5	187,655.7	182,795.9	192,798.6	176,477.7	739,727.9	623,474.2
64Mb	1,708.8	2,893.1	6,556.8	11,632.0	22,790.6	9,562.1	14,983.3	16,283.7	23,756.6	64,585.6	176,614.5
Data Storage Devices											
1Mb	94,232.7	68,191.9	49,321.8	41,365.1	253,111.6	38,637.4	35,436.5	34,127.0	33,113.1	141,314.1	111,611.0
4Mb	4,157.3	11,846.9	17,743.8	22,488.2	56,236.2	28,978.1	39,028.1	45,502.6	44,441.3	157,950.1	93,870.7
16Mb	-	-	-	-	-	-	-	711.0	8,605.1	9,316.0	73,128.1
64Mb	-	-	-	-	-	-	-	-	-	-	-
Printers											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	17,765.5	14,817.1	15,421.9	15,564.4	63,568.9	15,204.9	11,835.0	12,795.1	9,777.2	49,612.1	19,025.3
16Mb	17,765.5	19,447.5	20,241.3	22,049.6	79,503.8	23,350.3	26,628.7	28,788.9	32,474.4	111,242.3	153,788.0
64Mb	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Facsimiles											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	7,412.4	6,963.4	6,671.7	6,196.4	27,243.9	6,172.3	5,653.5	5,502.2	5,046.8	22,374.9	11,725.0
16Mb	997.8	1,160.6	1,364.7	1,549.1	5,072.1	1,886.0	2,120.1	2,554.6	2,944.0	9,504.6	19,616.8
64Mb	-	-	-	-	-	-	-	-	-	-	-
Telephone Answering Machines											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	29,427.5	26,404.6	24,316.4	23,028.5	103,177.0	21,042.5	16,411.3	13,279.3	9,952.9	60,686.0	10,369.3
16Mb	387.2	1,164.9	2,026.4	2,467.3	6,045.8	3,507.1	5,014.6	6,165.4	7,464.7	22,151.7	40,875.8
64Mb	-	-	-	-	-	-	-	-	-	-	-
Routers/Internetworking											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	134.0	127.0	138.4	43.5	443.0	-	-	-	-	-	-
16Mb	804.0	875.6	953.9	1,077.6	3,711.1	1,258.3	1,403.6	1,591.0	1,780.5	6,033.4	9,709.7
64Mb	-	-	-	-	-	-	-	-	-	-	-
Industrial Applications											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	9,028.8	9,527.2	9,418.9	7,104.6	35,079.5	7,709.8	5,687.8	5,124.0	4,825.3	23,346.9	11,796.9
16Mb	2,125.7	2,198.6	2,452.8	3,337.0	10,114.1	4,176.1	5,332.4	5,651.5	5,870.7	21,030.7	21,180.0
64Mb	-	-	24.5	67.3	91.8	80.3	88.9	150.7	241.3	561.2	2,455.7
DVD Players											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	281.7	519.4	630.9	819.6	2,251.5	375.5	515.1	309.1	248.6	1,448.2	1,998.4
16Mb	105.6	241.1	368.0	614.7	1,329.5	844.8	1,159.0	1,468.1	2,009.2	5,481.0	16,154.1
64Mb	-	-	-	-	-	-	-	-	-	-	-
Set-Top Boxes											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	10,256.9	9,630.5	8,777.5	8,762.3	37,427.2	8,153.2	6,335.9	7,194.2	7,844.9	31,528.2	15,680.4
16Mb	2,367.0	3,191.5	3,580.3	4,196.0	13,334.7	5,373.7	6,251.9	7,194.2	7,844.9	26,664.7	45,993.0
64Mb	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
Consumption by Density by Application, Q1/97 to 1999 (Thousands of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Video Games											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	1,554.0	1,811.6	1,916.2	2,086.9	7,368.7	2,337.4	2,528.6	1,319.4	-	6,185.5	-
16Mb	9,324.0	10,869.5	11,497.2	12,521.5	44,212.2	14,024.5	15,171.7	16,162.9	14,940.8	60,300.0	52,714.6
64Mb	-	-	-	-	-	-	-	-	196.6	196.6	2,589.4
Other Applications											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-
All Applications											
1Mb	94,394.0	68,191.9	49,321.8	41,365.1	253,272.8	38,637.4	35,436.5	34,127.0	33,113.1	141,314.1	111,611.0
4Mb	287,848.3	232,929.8	202,191.9	182,085.1	905,055.1	152,984.2	127,259.2	105,073.9	83,642.1	468,959.4	172,138.1
16Mb	384,154.8	426,844.3	475,335.8	520,962.3	1,807,297.2	511,543.0	528,544.6	536,822.8	602,195.1	2,179,105.4	1,817,599.6
64Mb	8,036.3	14,224.2	24,232.5	37,884.4	84,377.3	50,638.7	73,107.4	99,213.4	135,273.2	358,232.7	903,016.7
All Companies											
1Mb	49,350.0	45,860.0	43,660.0	41,510.0	180,380.0	38,320.0	35,690.0	34,050.0	32,900.0	140,960.0	112,400.0
4Mb	291,165.0	237,800.0	209,470.0	182,340.0	920,775.0	154,685.0	128,350.0	106,165.0	83,863.3	473,063.3	173,572.0
16Mb	435,150.0	478,190.0	504,150.0	531,800.0	1,949,290.0	537,300.0	565,800.0	569,000.0	613,600.0	2,285,700.0	1,837,250.0
64Mb	8,450.0	15,500.0	24,950.0	38,900.0	87,800.0	54,540.0	77,110.0	103,860.0	136,540.0	372,050.0	900,200.0
Megabyte Demand	**988,323.5**	**1,092,470.7**	**1,251,792.9**	**1,441,212.7**	**4,773,799.9**	**1,509,517.7**	**1,710,007.2**	**1,924,155.6**	**2,332,536.1**	**7,476,216.5**	**10,959,353.0**
Megabyte Supply	**1,089,651.3**	**1,205,012.5**	**1,318,092.5**	**1,471,158.8**	**5,083,915.0**	**1,593,052.5**	**1,817,116.3**	**2,026,218.8**	**2,365,564.2**	**7,801,951.7**	**10,976,936.0**
Megabyte Sufficiency (%)	**110.25**	**110.30**	**105.30**	**102.08**	**106.50**	**105.53**	**106.26**	**105.30**	**101.42**	**104.36**	**100.16**

Source: Dataquest (October 1997)

Chapter 6
Worldwide DRAM Wafer Fabrication Plant Production Capacity

Chapter 6 provides analysis of DRAM fab capacity. Dataquest uses the data in this chapter to test the information provided in the supplier surveys.

Table 6-1 provides the silicon capacity for each production facility in square millimeters of silicon per month.

Please note that Dataquest does not gather all the displayed production information from the manufacturers themselves. Dataquest performs an extensive fab survey in the third and fourth quarters of each year and updates this periodically through the year with articles from the general and trade press. Analyzing fab production could cause some confusion when accounting for contract production. Contract production (foundry) is production by one company under license from a second company for that second company to sell under its brand name. Table 6-1 credits capacity used for contract production under foundry, while the shipment information in the tables in Chapters 2 through 4 credit shipments by the purchaser of that foundry production. Nearly every semiconductor manufacturer performs some contract manufacturing. Thus, these analyses should not be used to determine any particular company's inventory or utilization.

What Has Changed since the Previous Report

Dataquest has made no changes to this section of the report.

Table 6-1
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Dominion Semiconductor	Module 1	Manassas VA	U.S.	64Mb DRAM	1997	28,000	200	0.25	-	-	-	-	879.6	879.6
Dominion Semiconductor Total						**28,000**			-	-	-	-	879.6	**879.6**
Fujitsu	Phase 1	Newton-Aycliffe	U.K.	4Mb 16Mb DRAM	1991	5,600	150	0.5	-	-	99.0	-	-	99.0
Fujitsu	Phase 2	Newton Aycliffe	U.K.	4Mb DRAM	1995	14,000	150	0.5	-	-	247.4	-	-	247.4
Fujitsu	No. 1	Gresham OR	U.S.	4Mb DRAM	1982	17,000	150	0.65	-	300.4	-	-	-	300.4
Fujitsu	No. 3	Isawa-Gun	Japan	4Mb DRAM SRAM ROM MPU	1987	50,000	150	0.8	-	-	-	-	-	-
Fujitsu	No. 4-1	Isawa-Gun	Japan	16Mb DRAM SGRAM	1990	20,000	150	0.42	-	-	-	353.4	-	353.4
Fujitsu	No. 4-2	Isawa-Gun	Japan	16Mb DRAM	1996	25,000	200	0.18	-	-	-	-	785.4	785.4
Fujitsu	No. 2	Kuwana-Gun	Japan	Log Arrays 4Mb DRAM	1987	10,000	150	0.8	-	-	-	-	-	-
Fujitsu	No. 3 Phase 1	Kuwana-Gun	Japan	4Mb 16Mb DRAM SRAM MPU	1992	15,000	150	0.5	-	-	265.1	-	-	265.1
Fujitsu	No. 3 Phase 2	Kuwana-Gun	Japan	16Mb 64Mb DRAM	1994	500	200	0.25	-	-	-	-	15.7	15.7
Fujitsu	No. 2	Gresham OR	U.S.	64Mb DRAM	1998	10,000	200	0.25	-	-	-	-	314.2	314.2
Fujitsu	Fab 2	Newton-Aycliffe	U.K.	16Mb 64Mb DRAM	1999	15,000	200	0.25	-	-	-	-	471.2	471.2
Fujitsu Total						**182,100**			-	**300.4**	**611.4**	**353.4**	**1,586.5**	**2,851.8**
Hitachi	E2	Landshut	Germany	16Mb DRAM	1993	16,000	200	0.35	-	-	-	502.7	-	502.7
Hitachi	U2	Irving TX	U.S.	1Mb 4Mb DRAM 256Kb SRAM MPU	1990	16,500	150	0.8	-	-	-	-	-	-
Hitachi	D1	Mobara-Shi	Japan	1Mb 4Mb DRAM LCD Driver	1982	25,000	125	1.3	306.8	-	-	-	-	306.8
Hitachi	D3	Mobara-Shi	Japan	4Mb DRAM	1990	15,000	150	0.8	-	-	-	-	-	-

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Hitachi	Chitose 1-1F	Chitose-Shi	Japan	4M DRAM MCU	1988	15,000	150	0.8	-	-	-	-	-	-
Hitachi	Chitose 1-2F	Chitose-Shi	Japan	4M DRAM MCU	1990	15,000	150	0.8	-	-	-	-	-	-
Hitachi	N2-1	Hitachinaka-Shi	Japan	16Mb DRAM	1994	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	R&D 2	Kodaira-Shi	Japan	MPU SRAM DRAM Arrays CBIC	1985	3,000	150	0.5	-	-	53.0	-	-	53.0
Hitachi	K2-1F	Nakakoma-Gun	Japan	4Mb DRAM SRAM MCU	1990	25,000	150	2	441.8	-	-	-	-	441.8
Hitachi	K4-3F	Nakakoma-Gun	Japan	4Mb DRAM 1Mb SRAM EPROM	1989	10,000	150	0.8	-	-	-	-	-	-
Hitachi	N1-1	Hitachinaka-Shi	Japan	1Mb 4Mb DRAM	1983	15,000	150	0.8	-	-	-	-	-	-
Hitachi	N2-2	Hitachinaka-Shi	Japan	16Mb 64Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	K2-2F	Nakakoma-Gun	Japan	16Mb DRAM	1995	10,000	200	0.5	-	-	314.2	-	-	314.2
Hitachi	Chitose 2	Chitose-Shi	Japan	64Mb DRAM	1998	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	N3/2F	Hitachinaka-Shi	Japan	64Mb DRAM	1998	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	N2/3F	Hitachinaka-Shi	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.35	-	-	-	471.2	-	471.2
Hitachi Total						**220,500**			**748.6**	-	**367.2**	**2,230.5**	-	**3,346.3**
Hitachi/Nippon Steel Semiconductor	Tampines	Singapore	Singapore	64Mb DRAM	1998	20,000	200	0.3	-	-	-	-	628.3	628.3
Hitachi/Nippon Steel Total						**20,000**			-	-	-	-	**628.3**	**628.3**
Hyundai	MOS Fab 1-A	Ichon	Korea	256K DRAM SRAM	1985	15,000	125	1	184.1	-	-	-	-	184.1
Hyundai	MOS Fab 2-A	Ichon	Korea	1Mb 4Mb DRAM	1986	15,000	150	0.65	-	265.1	-	-	-	265.1

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Hyundai	MOS Fab 3	Ichon	Korea	4Mb DRAM Telecom ICs ASIC	1989	20,000	150	0.5	-	-	353.4	-	-	353.4
Hyundai	MOS Fab 2-B	Ichon	Korea	4Mb DRAM	1992	20,000	150	0.5	-	-	353.4	-	-	353.4
Hyundai	MOS R&D	Ichon	Korea	DRAM	1989	3,000	150	0.25	-	-	-	-	53.0	53.0
Hyundai	Fab 4	Ichon	Korea	4Mb DRAM Telecom ICs ASIC	1993	10,000	200	0.35	-	-	-	314.2	-	314.2
Hyundai	Fab 5	Ichon	Korea	16Mb 64Mb DRAM	1994	25,000	200	0.35	-	-	-	785.4	-	785.4
Hyundai	Fab 6	Ichon	Korea	64Mb DRAM	1996	30,000	200	0.35	-	-	-	942.5	-	942.5
Hyundai	Oregon Fab	Eugene OR	U.S.	16Mb 64Mb DRAM	1998	30,000	200	0.25	-	-	-	-	942.5	942.5
Hyundai	Fab 7	Ichon	Korea	16Mb 64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
Hyundai	Phase 1	Dumfermline	U.K.	64Mb DRAM	1998	30,000	200	0.18	-	-	-	-	942.5	942.5
Hyundai	Phase 2	Dumfermline	U.K.	64Mb 256Mb DRAM			12	0.18	-	-	-	-	-	-
Hyundai Total						**228,000**			**184.1**	**265.1**	**706.9**	**2,984.5**	**1,938.0**	**6,078.5**
IBM Microelectronics		Corbeil-Essonnes	France	DRAM SRAM		25,000	125	1	306.8	-	-	-	-	306.8
IBM Microelectronics		Sindelfingen	Germany	DRAM SRAM DSP MPU Custom		25,000	125	1.5	306.8	-	-	-	-	306.8
IBM Microelectronics		Corbeil-Essonnes	France	1Mb DRAM	1989	7,000	200	0.8	-	-	-	-	-	-
IBM Microelectronics	Bldg. 963	Essex Junction VT	U.S.	4Mb DRAM MPU	1989	16,000	125	0.5	-	-	196.3	-	-	196.3
IBM Microelectronics	Bldg. 970	Essex Junction VT	U.S.	64Mb DRAM MPU Multimedia ICs	1988	24,000	200	0.35	-	-	-	754.0	-	754.0
IBM Microelectronics	Bldg. 973	Essex Junction VT	U.S.	16Mb DRAM	1989	20,000	200	0.5	-	-	628.3	-	-	628.3
IBM Microelectronics		Yasu-Gun	Japan	64Mb DRAM pDSP	1990	15,000	200	0.35	-	-	-	471.2	-	471.2

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
IBM Microelectronics	AMF	Corbeil-Essonnes	France	64Mb DRAM	1997	15,000	200	0.2	-	-	-	-	471.2	471.2
IBM Microelectronics Total						**147,000**			**613.6**	**-**	**824.7**	**1,225.2**	**471.2**	**3,134.7**
IBM/Philips		Boeblingen	Germany	4Mb DRAM	1989	20,000	200	0.8	-	-	-	-	-	-
IBM/Philips Total						**20,000**			**-**	**-**	**-**	**-**	**-**	**-**
IBM/Siemens	ACL	Corbeil-Essonnes	France	16Mb 64Mb DRAM	1991	30,000	200	0.35	-	-	-	942.5	-	942.5
IBM/Siemens Total						**30,000**			**-**	**-**	**-**	**942.5**	**-**	**942.5**
Jinan	No. 2	Jinan	China	1Kb SRAM 4Kb DRAM	1989	8,000	75	5	35.3	-	-	-	-	35.3
Jinan Total						**8,000**			**35.3**	**-**	**-**	**-**	**-**	**35.3**
KTI Semiconductor	Fab 1	Nishiwaki-Shi	Japan	16Mb DRAM ASIC	1992	25,000	150	0.5	-	-	441.8	-	-	441.8
KTI Semiconductor	Fab 2	Nishiwaki-Shi	Japan	16Mb 64Mb DRAM ASIC	1996	5,500	200	0.35	-	-	-	172.8	-	172.8
KTI Semiconductor Total						**30,500**			**-**	**-**	**441.8**	**172.8**	**-**	**614.6**
LG Semicon	C1 Phase 1	Chongju-City	Korea	1Mb 4Mb DRAM	1990	30,000	150	0.5	-	-	530.1	-	-	530.1
LG Semicon	C1 Phase 2	Chongju-City	Korea	4Mb DRAM	1991	30,000	150	0.5	-	-	530.1	-	-	530.1
LG Semicon	C2 Phase 1	Chongju-City	Korea	16Mb DRAM	1993	15,000	200	0.35	-	-	-	471.2	-	471.2
LG Semicon	C1 Phase 3	Chongju-City	Korea	16Mb 64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
LG Semicon	C2 Phase 2	Chongju-City	Korea	16Mb DRAM	1995	25,000	200	0.35	-	-	-	785.4	-	785.4
LG Semicon	C2	Gumi-City	Korea	64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
LG Semicon	Phase 1	Newport	U.K.	64Mb DRAM 256Mb DRAM	1999	30,000	200		-	-	-	-	942.5	942.5
LG Semicon Total						**190,000**			**-**	**-**	**1,060.3**	**3,141.6**	**942.5**	**5,144.4**
Matsushita	Fab C	Puyallup WA	U.S.	1Mb 4Mb DRAM 4-bit 8-bit MCU	1992	21,000	150	0.6	-	-	371.1	-	-	371.1
Matsushita	Kyoto R&D	Kyoto-Shi	Japan	DRAM	1991	500	200	0.25	-	-	-	-	15.7	15.7

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Matsushita	S/C R6	Kadoma-Shi	Japan	16Mb 64Mb DRAM 64-bit MPU	1991	500	150	0.35	-	-	-	8.8	-	8.8
Matsushita	Fab B	Tonami-Shi	Japan	16Mb DRAM 16-bit MCU	1996	20,000	150	0.35	-	-	-	353.4	-	353.4
Matsushita	Fab C	Tonami-Shi	Japan	16Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Matsushita	Fab D	Tonami-Shi	Japan	16Mb 64Mb DRAM	1997	10,000	200	0.35	-	-	-	314.2	-	314.2
Matsushita	Fab D	Puyallup WA	U.S.	32-bit MRCO DSP 64Mb DRAM	1998	10,000	200	0.25	-	-	-	-	314.2	314.2
Matsushita Total						**72,000**			-	-	**371.1**	**990.6**	**329.9**	**1,691.6**
Micron Technology	Fab 3	Boise ID	U.S.	1Mb 4Mb 16Mb DRAM	1991	25,000	200	0.35	-	-	-	785.4	-	785.4
Micron Technology	Fab 1	Boise ID	U.S.	4Mb 16Mb DRAM VRAM SRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
Micron Technology	Fab 2	Boise ID	U.S.	16Mb 64Mb DRAM	1996	20,000	200	0.25	-	-	-	-	628.3	628.3
Micron Technology	Lehi Fab	Lehi UT	U.S.	64Mb DRAM	1999		200	0.25	-	-	-	-	-	-
Micron Technology Total						**65,000**			-	-	-	**1,413.7**	**628.3**	**2,042.0**
Mitsubishi		North Durham NC	U.S.	1Mb 4Mb DRAM	1990	9,000	150	0.5	-	-	159.0	-	-	159.0
Mitsubishi		Alsdorf	Germany	4MB 16MB DRAM	1997	7,000	200	0.35	-	-	-	219.9	-	219.9
Mitsubishi	B	Saijo-Shi	Japan	DRAM MCU	1984	39,000	125	0.9	478.6	-	-	-	-	478.6
Mitsubishi	Sa2B	Saijo-Shi	Japan	64Mb DRAM EDRAM	1993	16,000	200	0.4	-	-	-	502.7	-	502.7
Mitsubishi	ULSI	Itami-Shi	Japan	16Mb 64Mb 256Mb DRAM ASIC Flash	1993	10,000	200	0.2	-	-	-	-	314.2	314.2

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Mitsubishi	TA1	Kami-Gun	Japan	4Mb DRAM 1Mb SRAM ASSP	1990	30,000	150	0.7	-	530.1	-	-	-	530.1
Mitsubishi	D-1F	Kikuchi-Gun	Japan	16Mb 64Mb DRAM	1994	10,000	200	0.35	-	-	-	314.2	-	314.2
Mitsubishi	D-1F-2	Kikuchi-Gun	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.35	-	-	-	471.2	-	471.2
Mitsubishi	SA1F	Saijo-Shi	Japan	64Mb DRAM EDRAM EFlash	1997	15,000	200	0.3	-	-	-	-	471.2	471.2
Mitsubishi		Science Park	Taiwan	16Mb DRAM	1996	12,000	200	0.35	-	-	-	377.0	-	377.0
Mitsubishi Total						163,000			478.6	530.1	159.0	1,885.0	785.4	3,838.1
Mosel Vitelic	Fab 1A	Science Park	Taiwan	DRAM VRAM	1995	15,000	150	0.45	-	-	-	265.1	-	265.1
Mosel Vitelic	Fab 1B	Science Park	Taiwan	DRAM VRAM	1995	15,000	150	0.34	-	-	-	-	265.1	265.1
Mosel Vitelic Total						30,000			-	-	-	265.1	265.1	530.1
Nan Ya Technology	Fab 1	Tao Yuan	Taiwan	16Mb 64Mb DRAM	1996	30,000	200	0.45	-	-	-	942.5	-	942.5
Nan Ya Technology Total						30,000			-	-	-	942.5		942.5
NEC	Phase 1	Livingston	U.K.	DRAM SRAM MPU	1987	25,000	150	0.5	-	-	441.8	-	-	441.8
NEC	K-Line	Roseville CA	U.S.	DRAM ASIC MCU	1984	25,000	125	1	306.8	-	-	-	-	306.8
NEC	M-Line	Roseville CA	U.S.	16Mb DRAM	1991	35,000	150	0.5	-	-	618.5	-	-	618.5
NEC	Dif-1	Higashi Hiroshima-Shi	Japan	4Mb DRAM SRAM MPU 4Mb ROM	1990	30,000	150	0.6	-	-	530.1	-	-	530.1
NEC	G-1	Sagamihara-Shi	Japan	16Mb DRAM ASIC MPU 4Mb ROM	1988	10,000	150	0.8	-	-	-	-	-	-
NEC	Dif-5	Kumamoto-Shi	Japan	Logic DRAM MCU	1978	20,000	125	1.2	245.4	-	-	-	-	245.4

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
NEC	Dif-6	Kumamoto-Shi	Japan	1Mb DRAM MPU MCU Arrays	1987	30,000	150	1	530.1	-	-	-	-	530.1
NEC	Dif-7	Kumamoto-Shi	Japan	MCU 4Mb DRAM ASIC	1988	30,000	150	0.8	-	-	-	-	-	-
NEC	Dif-8 -1	Kumamoto-Shi	Japan	16Mb DRAM 4Mb SRAM RISC ASIC	1994	60,000	200	0.35	-	-	-	1,885.0	-	1,885.0
NEC	Dif-3	Otsu-Shi	Japan	SRAM 4Mb DRAM Micro ASIC	1983	17,000	150	1	300.4	-	-	-	-	300.4
NEC	Dif-1	Asa-Gun	Japan	4Mb DRAM 1Mb SRAM MPU FLASH	1988	45,000	150	0.8	-	-	-	-	-	-
NEC	Dif-2 (Bldg. C)	Asa-Gun	Japan	4Mb 16Mb DRAM ASIC	1993	45,000	150	0.5	-	-	795.2	-	-	795.2
NEC	Phase 2	Livingston	U.K.	16Mb 64Mb DRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
NEC	Dif-2	Higashi Hiroshima-Shi	Japan	16Mb 64Mb DRAM ASIC RISC	1996	33,000	200	0.25	-	-	-	-	1,036.7	1,036.7
NEC		Beijing	China	MCU Logic 4Mb 16Mb DRAM ASIC	2000	5,000	150	0.4	-	-	-	88.4	-	88.4
NEC Total						**430,000**			**1,382.8**	**-**	**2,385.6**	**2,601.6**	**1,036.7**	**7,406.8**
Nippon Silicon				16Mb DRAM	1990			0.6	-	-	-	-	-	-
Nippon Silicon Total						-			-	-	-	-	-	-
Nippon Steel Corporation	Electronics Lab	Sagamihara-Shi	Japan	ASIC 16Mb 64Mb DRAM	1991	500	150	0.35	-	-	-	8.8	-	8.8
Nippon Steel Corporation Total						**500**			**-**	**-**	**-**	**8.8**	**-**	**8.8**

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Nippon Steel Semiconductor	M2	Tateyama-Shi	Japan	1Mb 4Mb DRAM Flash Logic	1988	12,000	150	0.6	-	-	212.1	-	-	212.1
Nippon Steel Semiconductor	M3	Tateyama-Shi	Japan	4Mb 16Mb DRAM	1990	20,000	150	0.5	-	-	353.4	-	-	353.4
Nippon Steel Semiconductor	N1	Tateyama-Shi	Japan	16Mb 64Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Nippon Steel Total						**42,000**			-	-	565.5	314.2	-	879.6
Oki	S2	Kurokawa-Gun	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.3	-	-	-	-	471.2	471.2
Oki	S1	Kurokawa-Gun	Japan	4Mb DRAM 1Mb SRAM 16Mb ROM	1981	30,000	150	0.5	-	-	530.1	-	-	530.1
Oki	M2	Miyazaki-Gun	Japan	1Mb DRAM 256K SRAM 4Mb ROM	1991	60,000	125	0.8	-	-	-	-	-	-
Oki	M3	Miyazaki-Gun	Japan	4Mb 16Mb DRAM	1967	30,000	150	0.4	-	-	-	530.1	-	530.1
Oki	V3	Hachioji-Shi	Japan	16Mb 64Mb DRAM Micro Gate Array	1989	2,000	150	0.5	-	-	35.3	-	-	35.3
Oki	U1	Hachioji-Shi	Japan	64Mb 256Mb DRAM Micro Logic	1992	1,000	150	0.3	-	-	-	-	17.7	17.7
Oki Total						**138,000**			-	-	565.5	530.1	488.9	1,584.5
Powerchip (Elitegroup)	Fab 1	Science Park	Taiwan	16Mb DRAM	1996	25,000	200	0.4	-	-	-	785.4	-	785.4
Powerchip (Elitegroup) Total						**25,000**			-	-	-	785.4	-	785.4
ProMOS Technologies	Fab 2	Science Park	Taiwan	16Mb 64Mb 256Mb DRAM SRAM	1998	20,000	200	0.25	-	-	-	-	628.3	628.3
ProMOS Technologies Total						**20,000**			-	-	-	-	628.3	628.3

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Samsung	Fab 4	Kiheung-Up	Korea	Alpha 4Mb DRAM SRAM EDRAM	1990	35,000	150	0.5	-	-	618.5	-	-	618.5
Samsung	Fab 5	Kiheung-Up	Korea	Alpha 4Mb DRAM SRAM EDRAM	1993	25,000	200	0.5	-	-	785.4	-	-	785.4
Samsung	Fab 6	Kiheung-Up	Korea	16Mb 64Mb DRAM	1995	30,000	200	0.35	-	-	-	942.5	-	942.5
Samsung	Fab 7	Kiheung-Up	Korea	16Mb 64Mb DRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
Samsung	Fab 8	Kiheung-Up	Korea	64Mb DRAM	1997	25,000	200	0.3	-	-	-	-	785.4	785.4
Samsung		Austin TX	U.S.	64Mb DRAM	1998	25,000	200	0.3	-	-	-	-	785.4	785.4
Samsung Total						**160,000**			-	-	**1,403.9**	**1,570.8**	**1,570.8**	**4,545.5**
Sanyo	A 1	Ojiya-Shi	Japan	1Mb 4Mb DRAM 4-bit 8-bit MCU DSP	1985	35,000	125	0.8	-	-	-	-	-	-
Sanyo	C 2	Ojiya-Shi	Japan	DRAM	1994	25,000	150	0.85	441.8	-	-	-	-	441.8
Sanyo Total						**60,000**			**441.8**	-	-	-	-	**441.8**
Sharp	Factory 2	Fukuyama-Shi	Japan	16Mb MROM DRAM SRAM	1989	40,000	150	0.6	-	-	706.9	-	-	706.9
Sharp	Factory 4	Fukuyama-Shi	Japan	Flash 64Mb DRAM	1998	16,000	200	0.25	-	-	-	-	502.7	502.7
Sharp Total						**56,000**			-	-	**706.9**	-	**502.7**	**1,209.5**
Siemens	H15, H16, H17	Regensburg	Germany	1Mb 4Mb DRAM EDRAM ASIC ASSP	1986	46,600	150	0.35	-	-	-	823.5	-	823.5
Siemens	SIMEC (Lines 1 & 2)	Dresden	Germany	16Mb 64Mb DRAM	1996	30,000	200	0.25	-	-	-	-	942.5	942.5
Siemens		North Tyneside	U.K.	DRAM ASIC	1997	25,000	200	0.25	-	-	-	-	785.4	785.4
Siemens Total						**101,600**			-	-	-	**823.5**	**1,727.9**	**2,551.4**

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Sony	3G	Isahaya-Shi	Japan	1Mb SRAM 4Mb VRAM CCD Logic	1991	25,000	150	0.5	-	-	441.8	-	-	441.8
Sony Total						**25,000**			-	-	441.8	-	-	441.8
Sumitomo Metal Industries		Amagasaki-Shi	Japan	4Mb DRAM Arrays	1991	300	150	0.8	-	-	-	-	-	-
Sumitomo Metal Industries Total						**300**			-	-	-	-	-	-
TSMC	Fab 3	Science Park	Taiwan	DRAM SRAM ROM Log Custom	1995	30,000	200	0.35	-	-	-	942.5	-	942.5
TSMC Total						**30,000**			-	-	-	942.5	-	942.5
Tech Semiconductor	Fab 1	Singapore	Singapore	16Mb DRAM	1993	12,000	200	0.5	-	-	377.0	-	-	377.0
Tech Semiconductor	Fab 2	Singapore	Singapore	16Mb DRAM	1996	25,000	200	0.35	-	-	-	785.4	-	785.4
Tech Semiconductor Total						**37,000**			-	-	377.0	785.4	-	1,162.4
Texas Instruments	AMOS-1	Avezzano	Italy	4Mb 16Mb DRAM 4Mb Flash	1990	22,000	200	0.25	-	-	-	-	691.2	691.2
Texas Instruments	AMOS-2	Avezzano	Italy	16Mb DRAM	1996	20,000	200	0.25	-	-	-	-	628.3	628.3
Texas Instruments	DMOS 5 Phase 1	Dallas TX	U.S.	16Mb DRAM	1995	16,000	200	0.5	-	-	502.7	-	-	502.7
Texas Instruments	DMOS 5 Phase 2	Dallas TX	U.S.	64Mb 256Mb DRAM	1997	16,000	200	0.35	-	-	-	502.7	-	502.7
Texas Instruments	Miho 6	Inashiki-Gun	Japan	1Mb 4Mb DRAM ASSP MPU		15,000	150	0.8	-	-	-	-	-	-
Texas Instruments	AMOS-3	Avezzano	Italy	Flash 64Mb 256Mb DRAM EDRAM	1999	6,600	12	0.18	-	-	-	-	0.7	0.7
Texas Instruments Total						**95,600**			-	-	502.7	502.7	1,320.2	2,325.5
Texas Instruments/Acer	Fab 1A	Science Park	Taiwan	4Mb DRAM	1991	22,000	150	0.5	-	-	388.8	-	-	388.8

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Texas Instruments/Acer	Fab 1B	Science Park	Taiwan	4Mb 16Mb DRAM	1995	25,000	200	0.35	-	-	-	785.4	-	785.4
Texas Instruments/Acer	Fab 2	Science Park	Taiwan	16Mb 64Mb DRAM	1999	50,000	200	0.25	-	-	-	-	1,570.8	1,570.8
Texas Instruments/Acer Total						**97,000**			-	-	388.8	785.4	1,570.8	2,745.0
Texas Instruments/Anam Electronics		Pupyong	Korea	DRAM DSPs	2002	25,000	200	0.25	-	-	-	-	785.4	785.4
Texas Instruments/Anam Total						**25,000**			-	-	-	-	785.4	785.4
Tohoku Semiconductor	Step 1	Sendai-Shi	Japan	1Mb DRAM MCU MPU	1988	7,500	150	1	132.5	-	-	-	-	132.5
Tohoku Semiconductor	Step 2	Sendai-Shi	Japan	4Mb DRAM MPU MCU	1991	10,000	150	0.8	-	-	-	-	-	-
Tohoku Semiconductor	Step 3	Sendai-Shi	Japan	16Mb DRAM	1995	15,000	200	0.35	-	-	-	471.2	-	471.2
Tohoku Semiconductor Total						**32,500**			132.5	-	-	471.2	-	603.8
Toshiba	Bldg.108 D-2	Kawasaki-Shi	Japan	16Mb 64Mb DRAM Flash	1990	1,300	200	0.35	-	-	-	40.8	-	40.8
Toshiba	Y-Cubed, No. 1-Mod 1	Yokkaichi-Shi	Japan	4Mb 16Mb DRAM	1993	10,000	200	0.5	-	-	314.2	-	-	314.2
Toshiba	Y-Cubed, No. 1-Mod 2	Yokkaichi-Shi	Japan	4Mb 16Mb DRAM	1994	25,000	200	0.35	-	-	-	785.4	-	785.4
Toshiba	C-Cubed 3	Oita-Shi	Japan	MCU ASIC DRAM SRAM	1989	32,000	125	1	392.7	-	-	-	-	392.7
Toshiba	C-Cubed 4	Oita-Shi	Japan	4Mb 16Mb DRAM	1991	40,000	150	0.5	-	-	706.9	-	-	706.9
Toshiba	Y-Cubed, No. 2	Yokkaichi-Shi	Japan	16Mb 64Mb 256Mb DRAM	1996	28,000	200	0.35	-	-	-	879.6	-	879.6
Toshiba	Step 5	Kitakami-Shi	Japan	16Mb 64Mb DRAM Logic	1998	30,000	200	0.35	-	-	-	942.5	-	942.5
Toshiba	C-Cubed 5	Oita-Shi	Japan	256Mb DRAM	2000		200	0.18	-	-	-	-	-	-
Toshiba Total						**166,300**			**392.7**	-	**1,021.0**	**2,648.4**	-	**4,062.1**

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

									Maximum Silicon Area Capacity (Millions of Sq. mm)					
Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
TwinStar Semiconductor	TwinStar	Richardson TX	U.S.	16Mb 64Mb DRAM	1996	15,000	200	0.3	-	-	-	-	471.2	471.2
Twinstar Semiconductor Total						**15,000**			-	-	-	-	**471.2**	**471.2**
Vanguard International	Fab 1	Science Park	Taiwan	4Mb DRAM	1991	4,000	150	0.5	-	-	70.7	-	-	70.7
Vanguard International	Fab 1A	Science Park	Taiwan	4Mb 16Mb DRAM	1995	16,000	200	0.35	-	-	-	502.7	-	502.7
Vanguard International	Fab 1B	Science Park	Taiwan	16Mb DRAM	1999	16,000	200	0.35	-	-	-	502.7	-	502.7
Vanguard International	Fab 2	Science Park	Taiwan	4Mb 16Mb DRAM 1Mb SRAM	1999	40,000	200	0.18	-	-	-	-	1,256.6	1,256.6
Vanguard International Total						**76,000**			-	-	**70.7**	**1,005.3**	**1,256.6**	**2,332.6**
White Oak Semiconductor	MOS 18	Richmond VA	U.S.	64Mb 256Mb DRAM	1998	25,000	200	0.18	-	-	-	-	785.4	785.4
White Oak Semiconductor Total						**25,000**			-	-	-	-	**785.4**	**785.4**
Winbond	Fab II	Science Park	Taiwan	DRAM	1992	35,000	150	0.5	-	-	618.5	-	-	618.5
Winbond	Fab IV	Science Park	Taiwan	16Mb 64Mb 256Mb DRAM	1999	15,000	200	0.35	-	-	-	471.2	-	471.2
Winbond Total						**50,000**			-	-	**618.5**	**471.2**	-	**1,089.7**
Total						**3,171,900**			**4,410.0**	**1,095.6**	**13,590.1**	**30,793.9**	**20,599.8**	**70,489.4**

Source: Dataquest (July 1997)

Chapter 7
Definitions

Additional motherboards: PC motherboards that do not ship into brand-name PCs and thus are not counted by Dataquest's Computer Systems and Peripherals group. These numbers are based in part on Dataquest MPU shipments and analyst estimates of upgrade activity.

Demand: The number of shipments of a product that Dataquest estimates to be sustainable in a market at the price forecast by Dataquest for that time. If the price were lower, demand would increase. If the price were higher, demand would decrease. Demand is used to determine whether the market is undersupplied or oversupplied.

Desk PC: PCs designed to remain beside or underneath a user's desk surface and not designed to be moved readily from place to place.

Facsimile: A machine that scans and encodes a document into electrical signals, transmits these electrical signals over a telephone or data line, then reconstructs the signals to print an exact duplicate of the original document on paper at the receiving end (colloquially called a fax).

Industrial applications: All controller boards and equipment used in embedded industrial control and medical applications. These boards are not officially counted by Dataquest, and the numbers used in this survey are estimates based on processor shipment numbers, secondary sources, and primary inputs from industrial board producers.

Mobile PC: PCs that are completely self-contained and can be carried as a single unit, which includes a keyboard, a display, mass storage, and main system unit.

Mainframe computer: A general-purpose information system with a starting price range of $100,000 or more. CPU bit width ranges from 32 to 64 bits. The physical environment can be either with or without special environmental controls and requires full-time support by professional computer systems support staff. The number of concurrent users is 100 or more. Dataquest views a mainframe system shipment as the CPU, the basic storage configuration (not including direct-access storage devices), the native operating system (the system must be bootable), and the operator's console. Dataquest does not routinely count upgrades unless the system footprint changes. Mainframes can use either DRAM or SRAM for cache storage.

Midrange computer: Includes all systems that fall between workstations and mainframes. These are multiuser systems that may or may not run proprietary operating systems. Midrange products have a wide price range, from as low as $10,000 to more than $1 million. Dataquest has included microcomputers, minicomputers, and superminicomputers in this product segment in the past. With the evolution of client/server computing and the systems that define this paradigm, traditional midrange product categories are becoming obsolete. Hewlett-Packard Company's HP 9000 and HP 3000, Digital Equipment Corporation's VAX systems, and

the IBM AS/400 line are joined by the dedicated server products from suppliers such as Auspex Systems Inc., NetFRAME Systems Inc., and Tricord Systems Inc. to make up the midrange product category. Office systems, which are proprietary turnkey computing solutions common in Japan, are also included in the midrange category, as are systems designed as servers from workstation suppliers.

Oversupply: An indication of an oversupplied market is low prices and growing inventories.

Routers/internetworking: A shared media hub is a LAN device that connects multiple PCs through a single node on a network, allowing central control for optional functions such as wide area network (WAN) connectivity, multiple media support, multiple technology support, and network management. A router is a class of network controller that determines the best routing for data transmission between a transmitter (sender) and a receiver. Routers operate at layer 3 of the ISO-OSI model.

Set-top box: Cable converter boxes that sit on top of TVs and act as converter devices for cable television signals, telephone, or wireless networks to television sets. These boxes contain a general-purpose microprocessor or a high-powered digital signal processor capable of digital transmission, reception, and decompression. Set-top boxes can be analog or digital, but only digital set-top boxes contain appreciable DRAM content.

Storage: A collective term for computer hard disk drives and CD-ROMs, where DRAM is often used as a cache memory. Since static RAM (SRAM) is sometimes used in place of DRAM, the DRAM consumption for this category appears unusually low to account for limited DRAM penetration into this equipment segment.

Supercomputer: A high-performance computer designed for numerically intensive applications. It is a system priced at more than $2 million, mainly used for batch applications, scientific, engineering, and other computation-oriented problems, or other very numerically intensive applications. Supercomputers require special environmental controls and cooling techniques. Performance speeds range upward from 50 mflops. Supercomputers can use either DRAM or SRAM.

Telephone answering machine: Machines for individual telephone lines using either cassette tape or MOS memory technology for incoming and outgoing message storage. Only tapeless (digital) phone answering machines use MOS memory for storage. Tapeless answering machines can use either DRAM or flash memory.

Undersupply: An indication of an undersupplied market is long lead times, high prices, and product allocation.

Video game: Video game and CD-ROM players are microprocessor-based devices that are handheld or console-based and play video games housed on cartridges or CD-ROMs.

Workstation: Dataquest classifies workstations by a composite of features, including their hardware and software. Workstations are typically based on reduced-instruction-set computing (RISC) processor architecture with a high-performance bus structure, graphics, and operating system. In general, a workstation must come standard with integrated floating-point processing, integrated networking, and a 32-bit multitasking operating system and offer a configuration that has high-resolution graphics capabilities (typically 1-megapixel display). Dataquest does not determine a workstation architecture by its usage (that is, single-user, server, or multiuser). Instead, computers are classified by the primary market for which they are designed.

For More Information...

James Seay, Research Analyst ..... (408) 468-8259
Internet address .....james.seay@dataquest.com
Via fax ..... (408) 954-1780
Dataquest Interactive ..... http://www.dataquest.com

Dataquest
A Gartner Group Company

DATAQUEST WORLDWIDE OFFICES

NORTH AMERICA

Worldwide Headquarters
251 River Oaks Parkway
San Jose, California 95134-1913
United States
Phone: 1-408-468-8000
Facsimile: 1-408-954-1780

East Coast Research Center
Nine Technology Drive
P.O. Box 5093
Westborough, Massachusetts 01581-5093
United States
Phone: 1-508-871-5555
Facsimile: 1-508-871-6262

Dataquest Global Events
3990 Westerly Place, Suite 100
Newport Beach, California 92660
United States
Phone: 1-714-476-9117
Facsimile: 1-714-476-9969

EUROPE

European Headquarters
Tamesis, The Glanty
Egham, Surrey TW20 9AW
United Kingdom
Phone: +44 1784 431 611
Facsimile: +44 1784 488 980

Dataquest France
Immeuble Défense Bergères
345, avenue Georges Clémenceau
TSA 40002
92882 - Nanterre CTC Cedex 9
France
Phone: +33 1 41 35 13 00
Facsimile: +33 1 41 35 13 13

Dataquest Germany
Martin-Kollar-Strasse 15
D-81829 München
Germany
Phone: +49 89 42 70 4-0
Facsimile: +49 89 42 70 4-270

JAPAN

Japan Headquarters
Aobadai Hills 4-7-7
Aobadai
Meguro-ku, Tokyo 153
Japan
Phone: 81-3-3481-3670
Facsimile: 81-3-3481-3644

ASIA/PACIFIC

Asia/Pacific Headquarters
Suite 5904-7, Central Plaza
18 Harbour Road, Wanchai
Hong Kong
Phone: 852-2824-6168
Facsimile: 852-2824-6138

Dataquest Korea
Suite 2407, Trade Tower
159 Samsung-dong, Kangnam-gu
Seoul 135-729
Korea
Phone: 822-551-1331
Facsimile: 822-551-1330

Dataquest Taiwan
11F-2, No. 188, Section 5
Nan King East Road
Taipei
Taiwan, R.O.C.
Phone: 8862-756-0389
Facsimile: 8862-756-2663

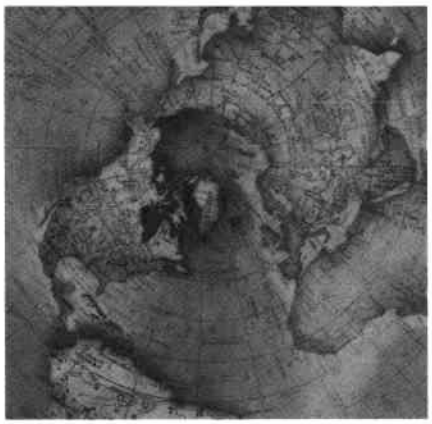
Dataquest Singapore
105 Cecil Street
#06-01/02 The Octagon
Singapore 069534
Phone: 65-227-1213
Facsimile: 65-227-4607

Dataquest Thailand
12/F, Vanissa Building
29 Soi Chidlom
Ploenchit Road
Patumwan, Bangkok 10330
Thailand
Phone: 662-655-0577
Facsimile: 662-655-0576

Dataquest Australia
80 Alfred Street
Milsons Point NSW 2061
Australia
Phone: 61-2-9941-4860
Facsimile: 61-2-9941-4868

Dataquest
A Gartner Group Company

'9/16



FILE COPY:
MARIA VALENZUELA

Dataquest

DRAM Supply/Demand Quarterly Statistics: Third Quarter 1997 Outlook

Market Statistics

Program: DRAM Supply and Demand Quarterly Statistics Worldwide
Product Code: DSDR-WW-MS-97Q2
Publication Date: September 1, 1997
Filing: Market Statistics

DRAM Supply/Demand Quarterly Statistics: Third Quarter 1997 Outlook

Market Statistics

Program: DRAM Supply and Demand Quarterly Statistics Worldwide
Product Code: DSDR-WW-MS-97Q2
Publication Date: September 1, 1997
Filing: Market Statistics

Table of Contents

List of Tables

List of Tables (Continued)

Chapter 1
Executive Summary

This report provides a third quarter 1997 outlook of the worldwide DRAM market based on the results of second quarter 1997 supplier surveys and related information. The report includes quarterly information through fourth quarter 1998 and yearly information for 1999.

Another Change in Market Conditions

Dataquest's DRAM supply/demand outlook has reverted to our original 1997 oversupply expectations. Last quarter, expectations shifted to a fragile supply/demand balance, in part because of reduced 16Mb shipments during late first quarter and early second quarter of this year. This fragile balance unraveled by midyear 1997. DRAM suppliers—in the face of excess capacity—tried unsuccessfully to control 16Mb shipments. During the late May through July, DRAM users and suppliers shipped 16Mb DRAM inventory into the market, which restored the market oversupply.

The current large oversupply means concomitant downward price pressure and constrained profit for most suppliers. Strong fourth quarter 1997 demand should restore a short-term supply/demand balance, but there will be a large oversupply during first half 1998.

Suppliers' 1997 Optimism Fades

In last quarter's report, Dataquest indicated that if current market conditions held—and suppliers succeeded in their goal of $10-plus contract pricing for 16Mb DRAM—the 1997 DRAM profit outlook would be quite bright. Market conditions, however, did not hold, and the reversion to oversupply now means a threatening second half 1997 outlook for most DRAM suppliers. Suppliers now set a $6-plus contract price as their year-end 1997 objective.

Micron's Emergence

Micron Technology Inc. has emerged as the key company in today's 16Mb DRAM market. Major Asian-based DRAM suppliers plan to decrease 16Mb shipments starting in fourth quarter 1997. Led by Micron Technology, however, other vendors plan a continuous increase of 16Mb shipments. This signals competitive 1998 pricing for 16Mb DRAM. Despite 64Mb price declines, a downward trend in 16Mb pricing would delay the 4:1 price crossover well into 1998.

SDRAM

Major DRAM suppliers planned to increase supply of 16Mb synchronous DRAM (SDRAM) toward the end of 1997. The current 66-MHz version of SDRAM, however, does not sharply improve PC performance. This factor lowered 1997 SDRAM demand, so suppliers decreased the 1997 production rate of 16Mb SDRAM this year.

Dramatic improvements in PC performance require the 100-MHz version of SDRAM. There are indications that Intel Corporation will introduce a new chipset (the 440BX) in early 1998. The new chipset should support the 100-MHz clock frequency and enable use of 100-MHz SDRAM (16Mb or 64Mb). (Suppliers are also developing 100-MHz versions of 64Mb extended data out, or EDO, DRAM).

Even so, high-speed operation can cause problems, especially for board-mounted devices. Dual in-line memory modules (DIMMs) will be a likely requirement for 100-MHz PC operation. The SDRAM will have to operate at a speed greater than 100 MHz to achieve this PC performance. This means increased technical difficulty in the case of 64Mb, which has a larger chip size (than the 16Mb device) and more internal routing/capacitance, which in turn lower chip performance.

The specification for DIMMs was loosely defined by the Joint Electronic Device Engineering Council (JEDEC). With the current specifications, suppliers cannot easily maintain among themselves the compatibility of DIMM performance. Such compatibility becomes very important in the memory upgrade market. Suppliers want Intel to provide detailed guidelines (in addition to the JEDEC specifications). DRAM suppliers will likely start rigorous evaluation of DIMMs after they obtain guidelines from Intel.

128Mb

Dataquest does not cover the yet-to-be-introduced 128Mb DRAM in this supply and demand report. This device—scheduled for early 1998 introduction—would likely influence the 1998 supply/demand balance of 64Mb DRAM.

Some major DRAM manufacturers have indicated an inclination to produce the 128Mb density as the next generation after 64Mb. This would break the DRAM market's tradition of quadrupling (4x) densities each new generation.

Some PC manufacturers view the 128Mb density (16MB) as the most efficient way of configuring the 64MB main memory for PCs (also known as PC granularity). When a 64Mb bus width is used for the MPU, 128Mb is the most suitable for configuring the 64MB main memory. Two pieces of 128Mb DRAM (x16) will be used for 64MB. Although only two 256Mb DRAMs are required of the same memory, the x32 configuration may present a problem. The wide-bit products require additional interconnections, equivalent to the bit width, on an already crowded chip. Not only does this increase die size, but interfering signals also cause cross-talk noise that poses difficult manufacturing problems.

The first decision for DRAM companies before developing 128Mb is choosing between one-chip and two-chip (64Mbx2) configurations. The choice depends strongly on when the 64MB main memory will be in demand in bulk. Each company will have to make its decision by comparing the predicted timing and its internal schedule for development of the process technology.

The standard memory size for PC servers and high-end systems will become 64MB or greater in 1997. However, commodity desktops might not adopt this memory size until the year 2000. For PC server and high-end applications, the two-chip configuration can be viable by using relatively costly stacking technology, but the single-chip configuration offers the cost advantage when volume production for low-end PCs is targeted.

Development of a one-chip solution for 128Mb DRAM requires the use of 0.25-micron or 0.20-micron design rules. Some DRAM makers are working vigorously and plan to ship samples in the first half of 1998.

A two-chip approach to 128Mb DRAM requires stacking technology. For use of stacking technology, the tape carrier package (TCP) has been developed, replacing the plastic encapsulated package. Nevertheless, the stacking approach will likely face various problems related to signal timing and noise because synchronous DRAMs with clock frequencies of 100 MHz or over will become the mainstay in 1999 or later.

Dataquest will continue to monitor the potential impact of 128Mb DRAM on the 1998 and 1999 DRAM supply/demand balance.

Contributors: Masahiro Suzuki, Senior Industry Analyst (Japan), Ronald Bohn, Principal Analyst (Worldwide and Americas), Jim Handy, Director and Principal Analyst (Worldwide and Americas), James Seay, Research Analyst (Worldwide and Americas), In-Hyung Baik, Research Analyst (Asia/Pacific and Korea), Sabrina Chiou, Research Analyst (Taiwan), and Chang Soo Kim, Senior Industry Analyst (Korea).

Chapter 2
Production Statistics of 4Mb DRAM

This chapter provides estimates of 4Mb DRAM quarterly unit shipments by supplier. The tables show a summary for 4Mb (see Table 2-1) and total 4Mb shipments (see Table 2-2). Subsequent tables show shipments by organization (x1, x4, x8/9, and x16/18, in Tables 2-3 through 2-6) and by technology (fast page mode, extended data out, synchronous, next generation, and display, in Tables 2-7 through 2-11). Dataquest collects data through quarterly supplier surveys. These tables represent 4Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 4Mb DRAM. Average selling prices (ASPs) for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5.

What Has Changed since the Previous Report

This report continues to show a 4Mb DRAM supply/demand balance for 1997 and 1998. This stems in part from the nature of this mature business segment—Japan-based and Korea-based companies produce 4Mb devices only on contract. Taiwan-based suppliers might increase 4Mb supply if they cannot grow their 16Mb business. This might create a slight 4Mb market oversupply.

The 4Mb forecast shows sharp changes for 1997 and 1998 regarding both unit shipments and unit demand. Shipments for 1997 have increased by 200 million units and for 1998 by 60 million units.

Most major DRAM suppliers are accelerating their 4Mb DRAM cutbacks. This provides other suppliers (for example, Taiwanese companies) an opportunity increase 4Mb shipments and production. As a general trend, the number of 4Mb suppliers will decrease, and the level of supplier competition should also decrease. The scenario of reduced 4Mb market competition should mean balanced supply and demand or, at worst, a slight oversupply.

Dataquest has revised the tables for this chapter. Table 2-1 is now a summary for 4Mb DRAM (formerly Table 2-7). Table 2-2 contains data by vendor for total 4Mb (the former Table 2-1). Dataquest has also included detail by vendor for common DRAM architectures—segmented into fast page mode, extended data out, synchronous, next-generation (including Rambus), and display architectures. This report no longer contains the "wide-bit ratio" tables.

Table 2-1
4Mb DRAM Supply/Demand Summary, Q1/97-1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Total Revenue (U.S.$M)	769.2	612.5	536.7	465.0	2,383.5	396.7	332.6	280.0	220.0	1,231.3	487.6
Total Units Shipped	291.2	237.8	209.5	182.3	920.8	154.7	128.4	106.2	83.9	473.1	173.6
Total Units Demanded	290.6	238.8	208.4	182.8	920.6	154.7	128.0	106.1	83.9	472.6	174.1
Sufficiency (%)	100.21	99.58	100.51	99.75	100.02	100.02	100.27	100.07	99.97	100.09	99.68
All Configurations	291.2	237.8	209.5	182.3	920.8	154.7	128.4	106.2	83.9	473.1	173.6
x1	21.0	16.4	14.1	12.2	63.7	8.4	7.7	6.5	5.3	27.9	9.8
x4	139.5	108.1	84.0	70.5	402.1	67.5	51.2	38.8	27.8	185.3	36.3
x8/9	17.0	16.0	13.3	11.5	57.8	8.8	7.4	6.1	5.0	27.3	13.1
x16/18	113.7	97.2	98.1	88.1	397.1	70.0	62.1	54.7	45.7	232.5	114.4
x32/36	-	-	-	-	-	-	-	-	-	-	-
All Interfaces	291.2	237.8	209.5	182.3	920.8	154.7	128.4	106.2	83.9	473.1	173.6
Fast Page Mode	89.1	68.7	55.5	46.2	259.5	45.9	36.1	28.3	20.3	130.7	44.3
Extended Data Out	191.9	159.7	145.0	128.5	625.1	98.7	82.2	67.7	55.7	304.3	112.2
Synchronous	-	-	-	-	-	1.3	2.1	2.3	1.9	7.7	-
Next-Generation	-	-	-	-	-	-	-	-	-	-	-
Display	10.1	9.4	9.0	7.6	36.1	8.8	8.0	7.8	5.9	30.4	17.1

Source: Dataquest (August 1997)

Table 2-2
Quarterly Shipments of All Configurations of 4Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	5.3	6.9	8.6	8.7	29.5	8.3	7.5	6.2	5.0	27.0	3.4
Fujitsu	9.2	7.7	6.6	6.2	29.7	5.8	5.3	5.1	4.8	21.0	10.5
Hitachi	23.0	20.3	18.3	16.0	77.6	13.5	11.0	9.5	7.4	41.4	33.0
Hyundai	21.0	17.7	14.9	12.5	66.1	9.5	7.5	6.5	4.8	28.3	5.4
IBM Microelectronics	7.6	3.6	1.8	0.9	13.9	0.3	0.2	0.1	-	0.6	-
LG Semicon	23.0	18.2	16.5	15.0	72.7	13.2	11.0	10.0	8.5	42.6	5.0
Matsushita	7.5	5.9	5.0	4.5	22.9	4.2	3.6	3.3	3.0	14.1	11.3
Micron Technology	23.2	16.0	12.5	10.3	62.0	7.1	4.0	1.0	0.2	12.3	-
Mitsubishi	14.1	11.6	10.4	9.0	45.1	7.5	6.9	6.0	5.2	25.6	13.0
Mosel Vitelic	24.2	19.8	17.0	13.8	74.8	10.8	8.3	6.3	3.8	29.1	-
Motorola	0.7	0.5	0.6	-	1.8	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	22.0	19.8	18.1	16.3	76.3	14.5	11.8	9.0	7.0	42.3	15.0
Nippon Steel	14.0	13.1	12.8	12.4	52.3	12.4	12.4	12.3	12.3	49.4	45.4
Oki	4.0	3.8	3.7	3.6	15.1	2.7	2.3	2.2	2.0	9.2	6.4
Samsung	23.2	17.0	14.1	11.9	66.2	9.9	8.3	7.0	5.5	30.7	9.0
Sharp	1.0	0.8	0.9	0.8	3.5	0.8	0.7	0.7	0.7	2.9	2.5
Siemens	17.2	15.6	14.8	13.7	61.4	12.7	11.1	9.3	7.3	40.4	10.7
Texas Instruments	20.4	15.5	12.8	10.0	58.7	7.5	5.7	3.8	1.9	18.9	-
Toshiba	11.7	6.8	4.8	3.5	26.8	2.5	2.5	2.0	1.8	8.8	3.0
Vanguard	19.0	17.2	15.1	13.3	64.6	11.6	8.4	5.9	2.8	28.6	-
All Companies	**291.2**	**237.8**	**209.5**	**182.3**	**920.8**	**154.7**	**128.4**	**106.2**	**83.9**	**473.1**	**173.6**
Average Selling Price (U.S.$)	2.64	2.58	2.56	2.55	2.59	2.56	2.59	2.64	2.65	2.60	2.81
Total Revenue (U.S.$M)	769.2	612.5	536.7	465.0	2,383.5	396.7	332.6	280.0	220.0	1,231.3	487.6
Total Demand	290.6	238.8	208.4	182.8	920.6	154.7	128.0	106.1	83.9	472.6	174.1
Sufficiency (%)	100.21	99.58	100.51	99.75	100.02	100.02	100.27	100.07	99.97	100.09	99.68

Source: Dataquest (August 1997)

Table 2-3
Quarterly Shipments of x1 4Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.5	0.4	0.5	0.5	1.9	0.6	0.5	0.5	0.5	2.1	0.8
Hitachi	1.5	1.4	1.1	1.0	5.0	0.7	0.6	0.5	0.4	2.1	1.3
Hyundai	0.8	0.5	0.4	0.4	2.2	0.4	0.3	0.3	0.2	1.1	0.2
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	1.6	1.3	1.2	1.1	5.1	0.9	0.8	0.7	0.6	3.0	0.4
Matsushita	0.5	0.4	0.3	0.3	1.5	0.2	0.2	0.2	0.2	0.7	0.3
Micron Technology	2.3	1.6	1.3	1.0	6.2	0.7	0.4	0.1	-	1.2	-
Mitsubishi	1.4	1.2	1.0	0.9	4.5	0.8	0.7	0.6	0.5	2.6	1.0
Mosel Vitelic	1.2	1.0	0.9	0.7	3.7	0.5	0.4	0.3	0.2	1.5	-
Motorola	0.1	0.1	0.1	-	0.3	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	2.0	1.8	1.5	1.3	6.5	0.6	0.5	0.4	0.3	1.7	0.5
Nippon Steel	-	-	-	-	-	0.6	0.7	0.7	0.7	2.8	2.3
Oki	0.3	0.3	0.3	0.3	1.2	0.2	0.1	0.1	0.1	0.6	0.3
Samsung	2.3	1.7	1.4	1.2	6.6	1.0	0.8	0.7	0.6	3.1	0.9
Sharp	0.1	0.1	0.1	-	0.2	-	-	-	-	0.1	0.1
Siemens	3.1	2.5	2.2	2.1	9.9	1.3	1.7	1.4	1.1	5.4	1.6
Texas Instruments	2.8	2.2	1.8	1.5	8.3	-	-	-	-	-	-
Toshiba	0.4	0.1	0.1	0.1	0.7	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**21.0**	**16.4**	**14.1**	**12.2**	**63.7**	**8.4**	**7.7**	**6.5**	**5.3**	**27.9**	**9.8**
Average Selling Price (U.S.$)	2.60	2.55	2.50	2.50	2.55	2.45	2.45	2.45	2.45	2.45	2.45
Total Revenue (U.S.$M)	54.6	41.9	35.2	30.5	162.3	20.6	18.9	15.9	13.0	68.4	23.9

Source: Dataquest (August 1997)

Table 2-4
Quarterly Shipments of x4 4Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	5.3	6.2	6.0	4.4	21.8	3.3	2.3	1.5	1.0	8.1	-
Fujitsu	4.6	2.7	2.0	1.9	11.1	1.2	1.1	1.0	1.0	4.2	1.6
Hitachi	9.9	8.1	6.0	5.3	29.3	3.4	2.8	1.9	1.5	9.5	6.6
Hyundai	8.8	7.1	5.5	4.6	26.0	3.2	2.6	2.2	1.6	9.6	1.8
IBM Microelectronics	4.9	1.8	0.6	0.2	7.6	-	-	-	-	0.1	-
LG Semicon	13.6	10.7	9.7	8.9	42.9	7.9	6.7	6.2	5.3	26.1	3.2
Matsushita	3.2	2.0	1.7	1.5	8.4	1.1	0.9	0.8	0.8	3.6	2.3
Micron Technology	16.2	11.2	8.8	7.2	43.4	5.0	2.8	0.7	0.1	8.6	-
Mitsubishi	4.9	4.1	3.6	3.2	15.8	2.6	2.4	2.1	1.8	9.0	3.9
Mosel Vitelic	8.5	18.8	9.4	7.6	44.2	4.7	2.7	1.3	0.4	9.1	-
Motorola	0.6	0.4	0.5	-	1.5	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	5.3	2.2	2.4	2.1	11.9	1.5	1.2	0.9	0.7	4.2	1.5
Nippon Steel	8.3	6.9	5.9	5.7	26.8	3.8	3.3	3.3	3.3	13.8	6.4
Oki	1.0	0.7	0.6	0.6	2.8	0.3	0.2	0.1	0.1	0.8	0.3
Samsung	7.9	5.8	5.4	4.5	23.5	3.7	3.1	2.6	2.0	11.5	3.3
Sharp	0.4	0.3	0.3	0.3	1.3	0.2	0.2	0.2	0.2	0.7	0.6
Siemens	9.6	8.7	8.0	6.9	33.2	6.3	5.0	4.2	3.3	18.8	4.8
Texas Instruments	12.4	9.0	7.2	5.5	34.1	7.5	5.7	3.8	1.9	18.9	-
Toshiba	4.7	1.4	0.5	0.3	6.9	-	-	-	-	-	-
Vanguard	9.5	-	-	-	9.5	11.6	8.4	5.9	2.8	28.6	-
All Companies	**139.5**	**108.1**	**84.0**	**70.5**	**402.1**	**67.5**	**51.2**	**38.8**	**27.8**	**185.3**	**36.3**
Average Selling Price (U.S.$)	2.40	2.35	2.31	2.33	2.36	2.34	2.34	2.34	2.35	2.34	2.38
Total Revenue (U.S.$M)	334.8	254.1	194.0	163.9	946.8	157.9	119.8	90.9	65.3	433.9	86.2

Source: Dataquest (August 1997)

Table 2-5
Quarterly Shipments of x8/9 4Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.5	0.6	0.5	0.5	2.1	0.6	0.5	0.5	0.5	2.1	0.8
Hitachi	2.5	2.2	2.0	1.8	8.5	1.5	1.2	1.0	0.8	4.6	3.6
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	0.7	0.5	0.5	0.5	2.2	0.4	0.3	0.3	0.3	1.3	0.2
Matsushita	1.5	1.1	0.9	0.8	4.2	0.6	0.5	0.5	0.5	2.1	1.7
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	1.4	1.2	1.0	0.9	4.5	0.8	0.7	0.6	0.5	2.6	1.3
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	4.8	6.1	5.4	4.9	21.3	4.4	3.5	2.7	2.1	12.7	4.5
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	0.1	0.1	0.1	0.1	0.5	0.1	-	-	-	0.2	0.1
Samsung	1.4	1.0	0.3	0.2	2.9	0.2	0.2	0.2	0.2	0.8	0.3
Sharp	0.2	0.1	0.2	0.1	0.6	0.1	0.1	0.1	0.1	0.4	0.4
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	3.1	2.5	2.1	1.5	9.1	-	-	-	-	-	-
Toshiba	0.8	0.5	0.3	0.2	1.9	0.2	0.2	0.1	0.1	0.6	0.2
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**17.0**	**16.0**	**13.3**	**11.5**	**57.8**	**8.8**	**7.4**	**6.1**	**5.0**	**27.3**	**13.1**
Average Selling Price (U.S.$)	2.82	2.66	2.60	2.55	2.67	2.49	2.47	2.44	2.44	2.46	2.44
Total Revenue (U.S.$M)	47.9	42.7	34.6	29.3	154.4	21.8	18.2	15.0	12.3	67.3	32.0

Source: Dataquest (August 1997)

Table 2-6
Quarterly Shipments of x16/18 4Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	0.7	2.6	4.4	7.6	5.0	5.3	4.6	4.0	18.9	3.4
Fujitsu	3.7	4.0	3.6	3.3	14.6	3.5	3.2	3.1	2.9	12.6	7.2
Hitachi	9.0	8.6	9.2	8.0	34.8	7.9	6.5	6.1	4.7	25.3	21.5
Hyundai	11.3	10.1	8.9	7.5	37.9	5.9	4.7	4.0	3.0	17.6	3.3
IBM Microelectronics	2.7	1.8	1.2	0.7	6.3	0.3	0.2	0.1	-	0.6	-
LG Semicon	7.1	5.6	5.1	4.7	22.5	3.9	3.2	2.8	2.3	12.2	1.4
Matsushita	2.3	2.4	2.2	2.0	8.9	2.2	2.0	1.8	1.7	7.7	7.0
Micron Technology	4.6	3.2	2.5	2.1	12.4	1.4	0.8	0.2	-	2.5	-
Mitsubishi	6.4	5.2	4.7	4.1	20.3	3.4	3.1	2.7	2.3	11.5	6.8
Mosel Vitelic	14.5	-	6.8	5.5	26.8	5.5	5.2	4.6	3.2	18.5	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	9.9	9.7	8.9	8.0	36.5	8.1	6.6	5.0	3.9	23.7	8.6
Nippon Steel	5.7	6.2	6.9	6.7	25.5	7.9	8.3	8.2	8.2	32.7	36.8
Oki	2.6	2.7	2.7	2.6	10.6	2.2	1.9	1.9	1.7	7.7	5.6
Samsung	11.6	8.5	7.1	5.9	33.1	4.9	4.1	3.5	2.8	15.3	4.5
Sharp	0.3	0.3	0.4	0.4	1.4	0.4	0.4	0.4	0.4	1.6	1.4
Siemens	4.5	4.4	4.6	4.8	18.2	5.1	4.4	3.7	2.9	16.1	4.3
Texas Instruments	2.0	1.9	1.8	1.5	7.2	-	-	-	-	-	-
Toshiba	5.9	4.8	3.9	2.8	17.4	2.3	2.3	1.9	1.7	8.2	2.8
Vanguard	9.5	17.2	15.1	13.3	55.1	-	-	-	-	-	-
All Companies	**113.7**	**97.2**	**98.1**	**88.1**	**397.1**	**70.0**	**62.1**	**54.7**	**45.7**	**232.5**	**114.4**
Average Selling Price (U.S.$)	2.92	2.82	2.78	2.74	2.82	2.80	2.83	2.89	2.87	2.85	3.02
Total Revenue (U.S.$M)	331.9	273.9	272.9	241.3	1,119.9	196.4	175.8	158.3	131.3	661.7	345.5

Source: Dataquest (August 1997)

Table 2-7
Quarterly Shipments of Fast Page Mode 4Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	5.3	6.2	5.2	3.5	20.1	2.5	1.9	1.2	0.5	6.1	-
Fujitsu	5.1	3.1	2.2	2.0	12.4	1.4	1.3	1.2	1.1	5.0	2.1
Hitachi	10.4	9.1	7.3	6.4	33.2	4.7	3.9	3.3	2.6	14.5	11.2
Hyundai	2.1	1.8	1.5	1.3	6.6	1.0	0.8	0.7	0.5	2.8	0.5
IBM Microelectronics	1.2	0.9	0.5	0.2	2.7	-	-	-	-	0.1	-
LG Semicon	1.2	0.9	0.8	0.8	3.6	0.7	0.6	0.5	0.4	2.1	0.3
Matsushita	3.0	1.1	0.5	0.5	5.0	0.2	0.2	0.2	0.2	0.7	0.6
Micron Technology	2.3	1.6	1.3	1.0	6.2	0.7	0.4	0.1	-	1.2	-
Mitsubishi	8.5	5.8	4.2	3.6	22.0	2.3	2.1	1.8	1.6	7.7	3.9
Mosel Vitelic	4.8	3.0	2.6	2.1	12.4	1.5	1.0	0.7	0.4	3.6	-
Motorola	0.3	0.2	0.1	-	0.6	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	15.4	13.9	12.7	11.4	53.4	10.0	8.1	6.1	4.8	29.0	10.2
Nippon Steel	5.6	3.9	3.8	3.7	17.1	2.5	2.5	2.5	2.5	9.9	9.1
Oki	2.0	1.9	1.9	1.8	7.6	1.4	1.2	1.1	1.0	4.6	3.2
Samsung	3.0	2.2	1.8	1.5	8.6	0.7	0.6	0.5	0.4	2.1	0.6
Sharp	0.5	0.4	0.5	0.4	1.8	0.4	0.4	0.4	0.4	1.5	1.3
Siemens	10.3	7.0	4.4	2.7	24.5	1.9	1.1	0.9	0.7	4.7	1.1
Texas Instruments	6.5	5.1	3.8	3.0	18.5	2.3	1.7	1.1	0.5	5.6	-
Toshiba	1.8	0.7	0.5	0.3	3.3	0.3	0.3	0.2	0.2	0.9	0.3
Vanguard	-	-	-	-	-	11.6	8.4	5.9	2.8	28.6	-
All Companies	89.1	68.7	55.5	46.2	259.5	45.9	36.1	28.3	20.3	130.7	44.3

Source: Dataquest (August 1997)

Table 2-8
Quarterly Shipments of Extended Data Out 4Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	0.7	3.4	5.2	9.4	5.8	5.6	4.9	4.5	20.9	3.4
Fujitsu	3.7	3.9	3.7	3.4	14.6	3.5	3.2	3.1	2.9	12.6	6.3
Hitachi	11.3	9.5	9.0	7.8	37.6	5.9	4.8	3.7	2.9	17.4	11.9
Hyundai	18.9	15.9	13.4	11.3	59.5	8.6	6.8	5.9	4.4	25.5	4.9
IBM Microelectronics	3.8	0.9	0.2	-	4.9	-	-	-	-	-	-
LG Semicon	21.9	17.3	15.7	14.3	69.1	12.5	10.5	9.5	8.0	40.5	4.8
Matsushita	3.8	4.1	3.8	3.4	15.0	3.4	2.7	2.5	2.3	10.8	8.5
Micron Technology	20.9	14.4	11.3	9.2	55.8	6.4	3.6	0.9	0.2	11.1	-
Mitsubishi	5.7	5.8	6.2	5.4	23.1	5.3	4.8	4.2	3.6	17.9	9.1
Mosel Vitelic	19.3	16.8	14.5	11.8	62.4	8.0	5.2	3.2	1.5	17.8	-
Motorola	0.4	0.3	0.5	-	1.2	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	4.4	4.0	3.6	3.3	15.3	2.9	2.4	1.8	1.4	8.5	2.6
Nippon Steel	8.4	9.2	9.0	8.7	35.2	9.9	9.9	9.8	9.8	39.5	36.3
Oki	2.0	1.9	1.9	1.8	7.6	1.4	1.2	1.1	1.0	4.6	3.2
Samsung	19.5	14.3	11.9	10.0	55.6	8.4	7.1	6.0	4.8	26.3	7.8
Sharp	0.5	0.4	0.5	0.4	1.8	0.4	0.4	0.4	0.4	1.5	1.3
Siemens	6.9	8.6	10.4	11.0	36.8	10.8	10.0	8.4	6.6	35.7	9.6
Texas Instruments	12.2	8.5	7.1	5.3	33.1	3.5	2.0	0.6	-	6.1	-
Toshiba	9.6	6.0	4.3	3.0	22.9	2.2	2.2	1.8	1.6	7.8	2.7
Vanguard	19.0	17.2	15.1	13.3	64.6	-	-	-	-	-	-
All Companies	**191.9**	**159.7**	**145.0**	**128.5**	**625.1**	**98.7**	**82.2**	**67.7**	**55.7**	**304.3**	**112.2**

Source: Dataquest (August 1997)

Table 2-9
Quarterly Shipments of Synchronous 4Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	1.3	2.1	2.3	1.9	7.7	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	-	1.3	2.1	2.3	1.9	7.7	-

Source: Dataquest (August 1997)

Table 2-10
Quarterly Shipments of Next-Generation 4Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	-	-	-	-	-	-	-

Source: Dataquest (August 1997)

Table 2-11
Quarterly Shipments of Display DRAM 4Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.5	0.8	0.8	0.7	2.8	0.9	0.8	0.9	0.8	3.3	2.1
Hitachi	1.4	1.6	2.0	1.8	6.8	2.8	2.3	2.5	1.9	9.5	9.9
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	2.7	1.8	1.2	0.7	6.3	0.3	0.2	0.1	-	0.6	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	0.8	0.7	0.8	0.7	2.9	0.6	0.7	0.7	0.6	2.6	2.3
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	2.2	2.0	1.8	1.6	7.6	1.6	1.3	1.1	0.8	4.8	2.3
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	0.7	0.5	0.4	0.4	2.0	0.8	0.6	0.5	0.3	2.2	0.5
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	1.6	1.9	1.9	1.7	7.1	1.7	2.0	2.1	1.4	7.2	-
Toshiba	0.4	0.1	0.1	0.1	0.7	-	-	-	-	0.1	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**10.1**	**9.4**	**9.0**	**7.6**	**36.1**	**8.8**	**8.0**	**7.8**	**5.9**	**30.4**	**17.1**

Source: Dataquest (August 1997)

Chapter 3
Production Statistics of 16Mb DRAM

This chapter provides estimates of 16Mb DRAM quarterly unit shipments by supplier. Tables show a summary for 16Mb (see Table 3-1) and total 16Mb shipments (see Table 3-2). Subsequent tables show shipments by organization (x1, x4, x8/9, x16/18, and 32/36, in Tables 3-3 through 3-7) and by technology (fast page mode, extended data out, synchronous, next generation, and display, in Tables 3-8 through 3-12). Dataquest collects data through quarterly supplier surveys. These tables represent 16Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 16Mb DRAM. Average selling prices for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5.

What Has Changed since the Previous Report

As noted, Dataquest's outlook has reverted to the original oversupply expectation for most of 1997 and 1998.

Dataquest has increased the forecast for total 16Mb DRAM supply for 1997, while the 1998 supply forecast remains consistent with prior expectations. For the full year 1997, the worldwide supply forecast of 16Mb devices now calls for 1.95 billion units (versus 1.80 billion in the prior forecast). For third quarter 1997, the 16Mb supply forecast has increased by 35 million units. For fourth quarter 1997, supply has been increased by 20 million units. For 1998, Dataquest expects the worldwide supply of 16Mb DRAM to reach nearly 2.3 billion units (quite similar to the prior forecast of 2.26 billion units).

The 16Mb forecast for one supplier—Micron Technology—has been dramatically increased for 1997 and 1998. This forecast predicts that Micron will become the world's leading supplier of 16Mb DRAM (based on unit shipments) during third quarter 1997.

Dataquest has reverted to the original expectation that the production peak of 16Mb will be late 1998. (On the basis of the 16Mb production reductions that occurred earlier this year, last quarter's forecast showed the peak as being the first half 1998.)

Expectations for 16Mb DRAM demand have been increased slightly for 1997, while the 1998 demand forecast remains consistent with prior expectations. For the full year 1997, the worldwide demand forecast of 16Mb devices calls for 1.84 billion units (versus 1.78 billion units in the prior

forecast). The third quarter 1997 demand outlook remains consistent with prior expectations. For fourth quarter 1997, however, demand has been increased by more than 25 million units. For 1998, Dataquest expects worldwide demand for 16Mb DRAM to reach 2.21 billion units (while the prior forecast called for 2.24 billion units).

Average selling prices for 16Mb DRAM now show a faster rate of decline than in the prior forecast because of changed market conditions. Higher-priced synchronous DRAM (SDRAM) represents a higher proportion of the 16Mb market, but even these parts face pricing pressure.

Dataquest has revised the tables for this chapter. Table 3-1 is now a summary for 16Mb DRAM (formerly Table 3-8). Table 3-2 contains by vendor data for total 4Mb (the former Table 3-1). Dataquest has also included detail by vendor for common DRAM architectures—segmented into fast page mode, extended data out, synchronous, next-generation (including Rambus), and display architectures. This report no longer contains the "wide-bit ratio" tables.

High and Low Ranges of the 16Mb DRAM Supply Forecast

The High Side

On the high side, 1997 supply of 16Mb DRAM might be about 8 percent higher than the current forecast. This means a high-side 1997 forecast of 2.1 billion units. For 1998, supply might be 17 percent above the current forecast—meaning a 1998 high-side estimate of 2.7 billion units.

The Low Side

For 1997, 16Mb DRAM supply could be about 7 percent lower than forecast—which translates to just over 1.8 billion units. This would occur if key suppliers adhered to an aggressive 1997 program of 16Mb supply reduction, which is not likely. For 1998, assuming continuation of such an unlikely trend, 16Mb supply might be 25 percent lower than the current forecast—meaning a low-side estimate of just over 1.7 billion units.

Table 3-1
16Mb DRAM Supply/Demand Summary, Q1/97-1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Total Revenue (U.S.$M)	3,881.8	4,173.9	4,087.9	4,305.5	16,449.2	4,424.5	4,515.4	4,459.3	4,448.0	17,847.1	14,493.2
Total Units Shipped	444.1	477.9	499.1	532.7	1,953.9	556.4	576.8	573.7	578.9	2,285.8	1,875.1
Total Units Demanded	404.4	435.4	478.5	522.9	1,841.2	523.9	536.7	556.8	590.9	2,208.3	1,914.1
Sufficiency (%)	109.84	109.77	104.31	101.87	106.12	106.20	107.47	103.04	97.97	103.51	97.97
All Configurations	444.1	477.9	499.1	532.7	1,953.9	556.4	576.8	573.7	578.9	2,285.8	1,875.1
x1	8.3	6.4	5.3	5.9	25.9	5.4	5.6	5.3	5.5	21.7	9.5
x4	234.9	265.7	283.2	302.8	1,086.6	317.0	325.4	321.8	323.9	1,288.1	965.7
x8/9	59.4	74.1	87.4	90.3	311.2	94.0	98.1	101.5	104.9	398.5	308.6
x16/18	140.7	130.8	122.2	133.8	527.5	138.6	146.5	143.6	143.4	572.1	587.0
x32/36	0.8	0.9	1.1	-	2.7	1.3	1.3	1.6	1.3	5.4	4.4
All Interfaces	444.1	477.9	499.1	532.7	1,953.9	556.4	576.8	573.7	578.9	2,285.8	1,875.1
Fast Page Mode	50.6	42.4	35.2	40.0	168.2	33.9	33.0	31.4	28.4	126.7	182.8
Extended Data Out	306.2	333.1	323.4	337.0	1,299.6	300.0	277.1	227.5	205.7	1,010.2	524.8
Synchronous	80.6	92.8	130.0	145.3	448.7	214.8	258.8	305.1	335.0	1,113.7	1,132.8
Next-Generation	6.8	9.6	10.5	10.4	37.4	7.5	7.6	9.3	9.3	33.6	32.9
Display	-	-	-	-	-	0.2	0.3	0.5	0.6	1.5	1.9

Source: Dataquest (August 1997)

Table 3-2
Quarterly Shipments of All Configurations of 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	0.1	0.2	0.7	1.4	2.3	2.1	2.9	3.7	4.3	13.0	21.0
Fujitsu	21.0	24.0	25.5	27.0	97.5	27.0	24.0	24.0	21.0	96.0	72.0
Hitachi	40.0	35.0	35.0	35.0	145.0	33.0	33.0	30.0	30.0	126.0	102.0
Hyundai	41.0	48.0	45.5	44.4	178.9	41.7	40.0	37.3	35.0	154.0	125.0
IBM Microelectronics	17.5	20.2	21.7	23.7	83.1	24.8	25.1	24.5	23.9	98.3	58.0
LG Semicon	36.9	38.5	37.0	35.2	147.6	34.5	32.5	31.0	29.0	127.0	95.0
Matsushita	5.5	6.0	6.4	7.1	25.0	7.3	8.0	8.6	9.7	33.6	27.0
Micron Technology	50.5	56.0	73.1	92.0	271.6	106.3	112.6	114.6	112.4	445.9	227.3
Mitsubishi	30.0	27.0	24.0	18.0	99.0	18.0	18.0	16.0	16.0	68.0	65.2
Mosel Vitelic	0.1	0.3	0.9	2.0	3.3	2.5	3.0	4.0	5.5	15.0	18.0
Motorola	6.0	8.0	4.8	4.0	22.8	0.5	-	-	-	0.5	-
Nan Ya Technology	2.2	4.8	10.0	14.0	31.0	16.1	18.4	22.0	24.5	81.0	95.7
NEC	43.0	46.0	49.0	48.7	186.7	45.0	45.0	42.0	42.0	174.0	150.0
Nippon Steel	1.7	2.5	5.3	9.3	18.8	13.8	16.5	18.5	20.5	69.3	45.4
Oki	7.5	7.7	8.0	8.8	32.0	8.9	9.0	9.0	9.0	35.9	29.0
Samsung	58.0	66.0	55.0	51.0	230.0	50.0	50.0	42.0	42.0	184.0	145.0
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	15.9	18.9	21.8	29.0	85.6	37.1	44.5	49.7	53.5	184.8	215.5
Texas Instruments	35.5	38.2	40.9	46.0	160.6	51.4	55.7	59.6	62.8	229.5	275.1
Toshiba	25.3	21.6	21.6	21.6	90.1	21.0	21.0	18.0	15.0	75.0	49.0
Vanguard	6.5	9.0	13.0	14.5	43.0	15.4	17.6	19.2	22.8	75.0	60.0
All Companies	**444.1**	**477.9**	**499.1**	**532.7**	**1,953.9**	**556.4**	**576.8**	**573.7**	**578.9**	**2,285.8**	**1,875.1**
Average Selling Price (U.S.$)	8.74	8.73	8.19	8.08	8.42	7.95	7.83	7.77	7.68	7.81	7.73
Total Revenue (U.S.$M)	3,881.8	4,173.9	4,087.9	4,305.5	16,449.2	4,424.5	4,515.4	4,459.3	4,448.0	17,847.1	14,493.2
Total Demand	404.4	435.4	478.5	522.9	1,841.2	523.9	536.7	556.8	590.9	2,208.3	1,914.1
Sufficiency (%)	109.84	109.77	104.31	101.87	106.12	106.20	107.47	103.04	97.97	103.51	97.97

Source: Dataquest (August 1997)

Table 3-3
Quarterly Shipments of x1 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	1.6	1.4	1.4	1.4	5.8	1.0	1.0	0.6	0.6	3.2	2.0
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	0.5	0.5	0.5	0.6	2.1	0.4	0.5	0.4	0.5	1.8	0.8
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	1.2	1.1	0.7	0.5	3.5	0.5	0.5	0.5	0.5	2.0	1.3
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	0.9	0.9	0.5	0.5	2.8	0.5	0.5	0.4	0.4	1.7	1.5
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	0.4	0.4	0.3	0.4	1.4	0.2	0.2	0.2	0.2	0.7	0.6
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	3.5	1.9	1.6	2.3	9.4	2.6	2.8	3.0	3.1	11.5	2.8
Toshiba	0.3	0.2	0.2	0.2	0.9	0.2	0.2	0.2	0.2	0.8	0.5
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**8.3**	**6.4**	**5.3**	**5.9**	**25.9**	**5.4**	**5.6**	**5.3**	**5.5**	**21.7**	**9.5**
Average Selling Price (U.S.$)	8.66	8.63	8.07	7.97	8.37	7.88	7.77	7.72	7.63	7.75	7.68
Total Revenue (U.S.$M)	72.1	55.1	42.7	46.7	216.6	42.4	43.8	40.7	41.6	168.5	72.8

Source: Dataquest (August 1997)

Table 3-4
Quarterly Shipments of x4 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	10.5	12.0	10.2	10.8	43.5	11.3	10.1	10.1	8.8	40.3	28.8
Hitachi	23.2	20.3	19.3	19.3	82.0	13.9	12.9	11.7	11.7	50.1	35.7
Hyundai	22.6	31.2	31.9	31.1	116.7	29.2	28.0	26.1	24.5	107.8	87.5
IBM Microelectronics	9.1	9.8	9.1	9.5	37.5	9.9	10.0	9.8	9.6	39.3	17.4
LG Semicon	15.5	21.9	24.8	23.6	85.8	23.3	22.1	21.2	20.0	86.6	65.6
Matsushita	1.2	1.3	1.4	1.6	5.5	1.5	1.7	1.8	2.0	7.1	4.9
Micron Technology	40.4	44.8	58.5	73.6	217.3	85.0	90.1	91.7	89.9	356.7	181.8
Mitsubishi	15.0	13.5	12.0	9.0	49.5	8.5	8.5	7.5	7.5	32.0	29.3
Mosel Vitelic	-	-	0.4	0.8	1.2	1.2	1.7	2.5	3.9	9.2	12.6
Motorola	5.8	7.7	4.4	3.7	21.5	0.5	-	-	-	0.5	-
Nan Ya Technology	2.2	4.8	10.0	14.0	31.0	14.7	15.2	16.2	15.9	62.0	95.7
NEC	16.3	14.7	13.2	13.1	57.4	13.1	13.1	11.3	11.3	48.8	40.5
Nippon Steel	-	-	0.1	0.2	0.3	8.5	9.9	11.1	12.3	41.8	27.2
Oki	5.7	5.9	6.4	7.0	25.1	7.7	7.9	8.1	8.1	31.8	26.1
Samsung	32.5	43.6	38.5	35.7	150.2	35.6	36.3	31.0	31.5	134.4	108.8
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	8.0	9.7	11.1	14.5	43.2	18.6	22.3	24.9	26.8	92.4	107.8
Texas Instruments	13.1	11.5	12.3	13.8	50.6	15.4	16.7	17.9	18.8	68.9	55.0
Toshiba	13.9	13.0	13.0	14.0	53.9	10.5	8.4	6.3	5.3	30.5	17.2
Vanguard	-	-	6.8	7.5	14.3	8.7	10.7	12.6	16.0	48.0	24.0
All Companies	**234.9**	**265.7**	**283.2**	**302.8**	**1,086.6**	**317.0**	**325.4**	**321.8**	**323.9**	**1,288.1**	**965.7**
Average Selling Price (U.S.$)	8.66	8.63	8.07	7.97	8.30	7.88	7.77	7.72	7.63	7.75	7.68
Total Revenue (U.S.$M)	2,034.3	2,291.6	2,283.8	2,411.6	9,021.4	2,498.3	2,528.0	2,484.1	2,471.2	9,981.7	7,416.9

Source: Dataquest (August 1997)

Table 3-5
Quarterly Shipments of x8/9 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	7.4	8.4	12.8	13.5	42.0	13.5	12.0	12.0	10.5	48.0	32.4
Hitachi	5.6	4.9	5.3	5.3	21.0	5.9	6.6	6.9	6.9	26.3	28.6
Hyundai	1.2	2.4	4.6	4.4	12.6	4.7	5.0	5.1	5.3	20.1	18.8
IBM Microelectronics	5.7	7.1	8.9	9.5	31.3	9.9	10.0	9.8	9.6	39.3	26.1
LG Semicon	1.5	3.1	3.7	3.5	11.8	3.5	3.3	3.1	2.9	12.7	9.5
Matsushita	1.4	1.6	1.7	1.9	6.6	2.0	2.3	2.5	2.8	9.7	8.1
Micron Technology	1.0	1.1	1.5	1.8	5.4	2.1	2.3	2.3	2.2	8.9	4.5
Mitsubishi	4.2	3.8	3.1	2.3	13.4	2.3	2.3	2.1	2.1	8.8	7.8
Mosel Vitelic	-	-	-	-	-	-	0.1	0.2	0.3	0.5	0.9
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	1.4	3.2	5.8	8.6	19.0	-
NEC	14.6	19.3	25.5	25.3	84.7	22.5	22.5	22.7	22.7	90.4	81.0
Nippon Steel	-	-	0.2	0.3	0.4	2.1	2.5	2.8	3.1	10.4	6.8
Oki	0.3	0.3	0.3	0.4	1.3	0.2	0.1	0.1	0.1	0.4	0.3
Samsung	5.8	11.2	8.3	7.7	32.9	7.5	7.5	6.3	6.3	27.6	21.8
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	1.0	1.2	1.7	2.9	6.8	3.7	4.5	5.0	5.4	18.5	21.6
Texas Instruments	6.4	6.9	7.8	9.2	30.3	10.3	11.1	11.9	12.6	45.9	27.5
Toshiba	2.0	1.1	0.9	0.9	4.8	0.6	0.6	0.4	0.3	1.9	1.0
Vanguard	1.3	1.8	1.3	1.5	5.9	1.7	2.2	2.6	3.4	10.0	12.0
All Companies	**59.4**	**74.1**	**87.4**	**90.3**	**311.2**	**94.0**	**98.1**	**101.5**	**104.9**	**398.5**	**308.6**
Average Selling Price (U.S.$)	9.00	8.86	8.11	8.01	8.43	7.92	7.80	7.75	7.67	7.78	7.75
Total Revenue (U.S.$M)	534.6	656.8	708.8	723.4	2,623.5	744.9	765.0	786.3	804.4	3,100.6	2,391.4

Source: Dataquest (August 1997)

Table 3-6
Quarterly Shipments of x16/18 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	0.1	0.2	0.7	1.4	2.3	2.1	2.9	3.7	4.3	13.0	21.0
Fujitsu	3.2	3.6	2.6	2.7	12.0	2.2	1.9	1.4	1.3	6.8	9.4
Hitachi	9.6	8.4	9.1	9.1	36.2	12.2	12.5	10.8	10.8	46.4	35.7
Hyundai	17.2	14.4	9.1	8.9	49.6	7.8	7.0	6.1	5.3	26.1	18.8
IBM Microelectronics	2.7	3.3	3.7	4.7	14.4	5.0	5.0	4.9	4.8	19.7	14.5
LG Semicon	19.9	13.5	8.5	8.1	50.0	7.8	7.2	6.7	6.1	27.7	20.0
Matsushita	2.4	2.6	2.8	3.1	10.9	3.3	3.5	3.9	4.4	15.0	13.2
Micron Technology	9.1	10.1	13.2	16.6	48.9	19.1	20.3	20.6	20.2	80.3	40.9
Mitsubishi	9.6	8.6	8.2	6.1	32.5	6.7	6.7	5.9	5.9	25.2	26.7
Mosel Vitelic	0.1	0.3	0.5	1.2	2.1	1.3	1.3	1.4	1.4	5.3	4.5
Motorola	0.2	0.3	0.4	0.3	1.3	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	11.2	11.0	9.8	9.7	41.8	9.0	9.0	7.6	7.6	33.1	27.0
Nippon Steel	1.7	2.5	5.0	8.9	18.1	3.2	4.1	4.6	5.1	17.0	11.3
Oki	1.1	1.1	1.0	1.1	4.2	0.9	0.8	0.6	0.6	3.0	2.0
Samsung	19.7	11.2	8.3	7.7	46.8	6.9	6.3	4.7	4.2	22.1	14.5
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	7.0	8.0	8.9	11.6	35.5	14.8	17.8	19.9	21.4	73.9	86.2
Texas Instruments	12.4	18.0	19.2	20.7	70.3	23.1	25.1	26.8	28.3	103.3	189.8
Toshiba	8.3	6.5	6.5	6.5	27.8	8.4	10.5	10.1	8.4	37.4	27.4
Vanguard	5.2	7.2	4.9	5.5	22.9	5.0	4.7	4.0	3.4	17.0	24.0
All Companies	**140.7**	**130.8**	**122.2**	**133.8**	**527.5**	**138.6**	**146.5**	**143.6**	**143.4**	**572.1**	**587.0**
Average Selling Price (U.S.$)	8.77	8.89	8.54	8.40	8.65	8.14	7.98	7.91	7.82	7.96	7.80
Total Revenue (U.S.$M)	1,234.2	1,163.0	1,043.9	1,123.8	4,564.9	1,129.0	1,168.8	1,136.2	1,120.7	4,554.6	4,578.4

Source: Dataquest (August 1997)

Table 3-7
Quarterly Shipments of x32/36 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	0.5	0.4	0.9	1.4
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	0.8	0.9	1.1	-	2.7	1.3	1.3	1.1	0.9	4.5	2.9
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**0.8**	**0.9**	**1.1**	**-**	**2.7**	**1.3**	**1.3**	**1.6**	**1.3**	**5.4**	**4.4**
Average Selling Price (U.S.$)	8.66	8.63	8.07	-	8.41	7.88	7.77	7.72	7.63	7.75	7.68
Total Revenue (U.S.$M)	6.6	7.5	8.7	-	22.7	9.9	9.8	12.0	10.1	41.8	33.6

Source: Dataquest (August 1997)

Table 3-8
Quarterly Shipments of Fast Page Mode 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	2.1	2.4	2.6	2.7	9.8	2.7	2.4	2.4	2.1	9.6	7.2
Hitachi	4.0	2.5	1.8	1.8	10.0	1.0	1.0	0.6	0.6	3.2	2.0
Hyundai	4.1	4.8	4.6	4.4	17.9	3.6	3.0	2.3	1.8	10.7	6.3
IBM Microelectronics	2.6	2.0	1.1	1.2	6.9	1.2	1.3	1.2	1.2	4.9	1.7
LG Semicon	1.8	1.9	1.9	1.8	7.4	1.7	1.6	1.6	1.5	6.4	4.8
Matsushita	2.8	1.6	1.0	1.1	6.4	0.5	0.4	0.4	0.5	1.8	0.8
Micron Technology	6.6	5.6	5.1	5.5	22.8	5.3	5.6	5.7	3.4	20.0	2.3
Mitsubishi	4.5	2.7	1.2	0.9	9.3	0.9	1.4	1.1	1.1	4.6	3.9
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	1.8	1.2	0.5	4.0	7.5	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	95.7
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	0.7	0.8	1.6	2.8	5.8	2.8	1.6	1.7	1.8	7.9	-
Oki	3.8	2.3	0.8	0.9	7.7	0.4	0.5	0.5	0.5	1.8	0.9
Samsung	5.8	6.6	5.5	5.1	23.0	4.4	3.8	2.6	2.1	12.9	7.3
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	4.0	3.8	3.3	2.9	13.9	3.7	4.5	5.0	5.4	18.5	21.6
Texas Instruments	5.3	3.8	4.1	4.6	17.8	5.1	5.6	6.0	6.3	23.0	27.5
Toshiba	0.8	0.4	0.4	0.4	2.1	0.4	0.4	0.4	0.3	1.5	1.0
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**50.6**	**42.4**	**35.2**	**40.0**	**168.2**	**33.9**	**33.0**	**31.4**	**28.4**	**126.7**	**182.8**

Source: Dataquest (August 1997)

Table 3-9
Quarterly Shipments of Extended Data Out 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	0.1	0.2	0.7	1.4	2.3	2.1	2.9	3.7	4.3	13.0	21.0
Fujitsu	8.4	9.6	5.1	5.4	28.5	5.4	4.8	4.8	4.2	19.2	14.4
Hitachi	28.8	23.8	22.8	22.8	98.1	15.5	12.2	6.9	6.9	41.5	13.3
Hyundai	34.0	38.4	31.9	31.1	135.4	23.5	17.0	10.7	5.3	56.4	18.8
IBM Microelectronics	12.3	14.7	16.3	16.6	59.9	16.1	15.1	13.5	10.8	55.4	21.5
LG Semicon	31.0	32.3	27.0	25.7	116.0	20.2	14.3	9.1	4.4	48.0	14.3
Matsushita	2.8	4.2	5.1	5.7	17.8	5.1	5.6	5.6	6.3	22.6	14.0
Micron Technology	40.4	44.8	56.3	66.2	207.7	65.9	65.3	55.0	50.6	236.8	93.2
Mitsubishi	18.0	16.2	14.4	10.8	59.4	9.0	6.7	4.8	4.8	25.3	12.4
Mosel Vitelic	0.1	0.3	0.7	1.6	2.7	1.8	2.0	2.3	2.8	8.8	4.5
Motorola	3.6	5.6	3.4	-	12.6	0.5	-	-	-	0.5	-
Nan Ya Technology	2.2	4.8	10.0	14.0	31.0	14.7	15.2	16.2	15.9	62.0	-
NEC	15.1	18.4	17.2	17.0	67.6	6.8	6.8	4.2	4.2	21.9	15.0
Nippon Steel	1.0	1.8	3.7	6.5	13.0	10.9	12.0	6.3	7.0	36.2	9.1
Oki	3.5	4.9	6.3	7.0	21.6	6.1	5.9	5.7	5.7	23.4	13.6
Samsung	40.6	46.2	36.9	34.2	157.8	26.9	20.3	11.4	5.9	64.5	20.3
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	11.1	13.2	14.2	17.4	55.9	18.6	20.0	19.9	18.7	77.2	86.2
Texas Instruments	24.9	26.7	22.5	23.0	97.1	25.7	27.9	29.8	31.4	114.8	137.6
Toshiba	22.0	17.9	16.8	16.8	73.6	12.2	10.1	5.0	4.2	31.5	9.8
Vanguard	6.5	9.0	12.4	13.8	41.6	13.1	13.2	12.5	12.5	51.3	6.0
All Companies	306.2	333.1	323.4	337.0	1,299.6	300.0	277.1	227.5	205.7	1,010.2	524.8

Source: Dataquest (August 1997)

Table 3-10
Quarterly Shipments of Synchronous 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	10.5	12.0	17.9	18.9	59.3	18.9	16.8	16.8	14.7	67.2	50.4
Hitachi	7.2	8.8	10.5	10.5	37.0	16.5	19.8	22.5	22.5	81.3	86.7
Hyundai	2.9	4.8	9.1	8.9	25.7	14.6	20.0	24.2	28.0	86.8	100.0
IBM Microelectronics	2.6	3.4	4.3	5.9	16.3	7.4	8.8	9.8	12.0	38.0	34.8
LG Semicon	3.7	3.9	7.4	7.0	22.0	11.6	15.4	19.0	21.8	67.8	71.3
Matsushita	-	0.2	0.3	0.4	0.9	1.7	2.0	2.6	2.9	9.2	12.2
Micron Technology	3.5	5.6	11.7	20.2	41.1	35.1	41.7	53.9	58.4	189.1	131.8
Mitsubishi	7.5	8.1	8.4	6.3	30.3	8.1	9.9	10.1	10.1	38.2	48.9
Mosel Vitelic	-	-	0.2	0.4	0.6	0.7	1.1	1.7	2.8	6.2	13.5
Motorola	0.6	1.2	1.0	-	2.8	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	1.4	3.2	5.8	8.6	19.0	-
NEC	21.5	18.4	22.1	21.9	83.9	31.5	31.5	29.4	29.4	121.8	105.0
Nippon Steel	-	-	-	-	-	0.1	2.8	10.5	11.7	25.2	36.3
Oki	0.3	0.5	0.9	1.0	2.7	2.3	2.6	2.9	2.9	10.7	14.5
Samsung	11.6	13.2	12.7	11.7	49.2	18.8	26.0	27.9	34.0	106.7	117.5
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	0.8	1.9	4.4	8.7	15.7	14.8	20.0	24.9	29.4	89.1	107.8
Texas Instruments	5.3	7.6	14.3	18.4	45.7	20.6	22.3	23.8	25.1	91.8	110.0
Toshiba	2.5	3.2	4.3	4.3	14.4	8.4	10.5	12.6	10.5	42.0	38.2
Vanguard	-	-	0.7	0.7	1.4	2.3	4.4	6.7	10.3	23.7	54.0
All Companies	**80.6**	**92.8**	**130.0**	**145.3**	**448.7**	**214.8**	**258.8**	**305.1**	**335.0**	**1,113.7**	**1,132.8**

Source: Dataquest (August 1997)

Table 3-11
Quarterly Shipments of Next-Generation 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	0.4	0.4	0.7	0.7	2.2	0.8	0.8	0.9	0.9	3.3	2.9
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	6.5	9.2	9.8	9.7	35.2	6.8	6.8	8.4	8.4	30.3	30.0
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	6.8	9.6	10.5	10.4	37.4	7.5	7.6	9.3	9.3	33.6	32.9

Source: Dataquest (August 1997)

Table 3-12
Quarterly Shipments of Display DRAM 16Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	0.2	0.3	0.5	0.6	1.5	1.9
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	-	0.2	0.3	0.5	0.6	1.5	1.9

Source: Dataquest (August 1997)

Chapter 4
Production Statistics of 64Mb DRAM

This chapter provides estimates of 64Mb DRAM quarterly unit shipments by supplier. Tables show a summary for 64Mb (see Table 4-1) and total 64Mb shipments (see Table 4-2). Subsequent tables show shipments by organization (x4, x8/9, x64/18, and 32/36, in Tables 4-3 through 4-6) and by technology (fast page mode, extended data out, synchronous, and next generation, in Tables 4-7 through 4-10). Dataquest collects data through quarterly supplier surveys. These tables represent 64Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 64Mb DRAM. Average selling prices for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5.

What Has Changed since the Previous Report

Dataquest's outlook calls for 64Mb oversupply through third quarter (versus the last quarter's expectation of a fragile supply/demand balance). For 1997, the key applications will be workstations and notebook PCs, while, in 1998, desktop PCs should emerge as a mainstream application.

The 1997 and 1998 forecast for 64Mb DRAM supply remains consistent with prior expectations. For the full year 1997, the worldwide supply forecast of 64Mb parts calls for 0.092 billion units. For 1998, Dataquest expects worldwide supply of 64Mb DRAM to total 0.36 billion units (while the prior forecast called for 0.35 billion units).

The expectation for 64Mb DRAM demand, however, has been decreased for 1997. This stems from the near-term inability of 64Mb suppliers to supply the wider-configuration DRAM (for example, x16, x32) that meets PC "granularity" requirements. The 1998 demand forecast remains consistent with last quarter's expectation.

For 1997, the worldwide demand forecast of 64Mb devices now calls for 0.086 billion units (versus 0.09 billion units in the prior forecast). The third quarter 1997 demand outlook for 64Mb parts remains consistent with prior expectations of just over 25 million units. For fourth quarter 1997, 64Mb DRAM demand has been decreased to 39 million units (versus the prior expectation of 44 million units). For 1998, Dataquest expects worldwide demand for 64Mb DRAM to total 0.35 billion units (while the prior forecast called for 0.34 billion units).

Under current market conditions, the 64Mb market will not move into supply/demand balance till the end of 1998. The supply/demand equation should tighten during 100-MHz SDRAM production migration to the 0.25-micron process. The production rate of 100-MHz SDRAM will accelerate at that time, but so will demand, causing the supply/demand balance to tighten by the end of 1998.

Dataquest has revised the tables for this chapter. Table 4-1 is now a summary of 16Mb DRAM (formerly Table 4-7). Table 4-2 contains data by vendor for total 4Mb (the former Table 4-1). Dataquest has also included detail by vendor for common DRAM architectures—segmented into fast page mode, extended data out, synchronous, next-generation (including Rambus), and display architectures. This report no longer contains the "wide-bit ratio" tables.

High and Low Ranges of the 64Mb DRAM Supply Forecast

The High Side Estimate

For 1997, 64Mb supply could be about 7 percent higher than Dataquest's current forecast, which means a 1997 high-side forecast of fewer than 100 million units. The 64Mb upside potential this year is somewhat constrained because suppliers face a challenge to rapidly improve 64Mb yields, which are far lower than 16Mb yields.

By contrast, the 64Mb DRAM upside potential for 1998 is higher, should suppliers significantly improve 64Mb yields by early 1998. For 1998, 64Mb supply might be 20 percent higher than the current forecast, which means a 1998 high-side forecast of nearly 430 million units.

The Low Side Estimate

The 1997 downside potential to 64Mb DRAM supply is somewhat steeper than the upside potential because 64Mb yields might prove quite low this year. For 1997, 64Mb supply might be more than 15 percent lower than the current forecast, which means a 1997 low-side forecast of less than 80 million units.

The 64Mb yields should improve considerably during 1998. Concerns remain, however, about the 64Mb transition. On the low side, the 1998 supply of 64Mb DRAM might be about 15 percent lower than the current forecast, which means a low-side estimate of 300 million units.

Table 4-1
64Mb DRAM Supply/Demand Summary, Q1/97-1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Total Revenue (U.S.$M)	697.5	918.5	1,271.4	1,736.1	4,623.5	2,046.3	2,849.6	3,523.1	4,059.9	12,478.9	28,518.7
Total Units Shipped	9.3	16.2	26.2	39.8	91.4	53.1	75.1	100.9	128.6	357.7	940.4
Total Units Demanded	8.1	14.7	24.7	38.9	86.4	49.7	69.5	97.0	130.7	346.8	958.2
Sufficiency (%)	114.64	110.20	105.77	102.21	105.75	106.76	108.14	104.03	98.43	103.13	98.14
All Configurations	9.3	16.2	26.2	39.8	91.4	53.1	75.1	100.9	128.6	357.7	940.4
x1	-	-	-	-	-	-	-	-	-	-	-
x4	4.8	8.3	13.8	20.8	47.8	24.6	32.7	40.6	50.0	147.9	331.1
x8/9	2.9	5.2	8.3	12.4	28.8	16.4	22.6	30.2	38.8	108.0	291.6
x16/18	1.6	2.6	4.0	6.5	14.6	11.6	18.4	27.6	36.0	93.5	280.2
x32/36	-	-	-	-	0.1	0.6	1.4	2.5	3.9	8.3	37.6
All Interfaces	9.3	16.2	26.2	39.8	91.4	53.1	75.1	100.9	128.6	357.7	940.4
Fast Page Mode	-	-	-	0.1	0.2	0.1	0.2	0.2	0.2	0.8	5.7
Extended Data Out	7.7	12.8	19.3	29.4	69.3	33.3	38.8	41.3	43.8	157.2	187.9
Synchronous	1.5	3.3	6.7	10.1	21.7	19.4	35.5	58.1	82.5	195.4	728.2
Next-Generation	-	-	0.1	0.1	0.2	0.3	0.6	1.3	2.1	4.3	18.6
Display	-	-	-	-	-	-	-	-	-	-	-

Source: Dataquest (August 1997)

Table 4-2
Quarterly Shipments of All Configurations of 64Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	1.0
Fujitsu	0.3	0.5	0.7	0.9	2.4	1.5	2.7	4.3	6.1	14.6	52.0
Hitachi	0.3	0.4	0.6	1.0	2.2	1.5	4.0	6.0	7.9	19.4	61.3
Hyundai	0.3	0.6	1.0	3.0	4.9	5.4	8.2	11.7	15.5	40.8	105.1
IBM Microelectronics	0.3	0.3	0.4	0.7	1.7	1.8	3.0	4.7	6.5	16.0	50.1
LG Semicon	0.6	0.9	1.4	2.3	5.2	3.3	4.5	6.0	8.1	21.8	64.4
Matsushita	-	-	-	-	-	-	0.1	0.3	0.6	1.0	8.4
Micron Technology	0.2	0.5	0.9	1.2	2.8	1.6	2.4	3.3	4.5	11.8	37.6
Mitsubishi	1.6	1.8	2.5	3.2	9.1	5.2	7.5	10.5	13.1	36.3	97.3
Mosel Vitelic	-	-	-	0.2	0.2	0.6	1.0	1.9	2.8	6.3	22.4
Motorola	-	-	-	0.1	0.1	0.3	0.6	0.6	0.2	1.7	-
Nan Ya Technology	-	-	-	-	-	-	0.1	0.3	0.5	0.8	4.5
NEC	1.9	3.2	5.6	9.0	19.7	9.9	13.6	17.5	21.1	62.0	128.5
Nippon Steel	-	-	-	-	-	-	-	0.1	0.8	0.9	13.3
Oki	-	-	-	-	-	0.1	0.3	0.5	0.7	1.5	6.3
Samsung	3.2	6.8	11.2	14.4	35.6	15.4	18.5	21.3	23.9	79.0	143.5
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	0.2	0.4	0.6	0.7	1.0	1.5	2.5	5.7	26.0
Texas Instruments	0.4	0.5	0.7	1.4	3.0	2.3	3.2	4.0	5.1	14.6	40.3
Toshiba	0.3	0.7	1.0	2.0	4.0	3.5	4.5	6.5	8.8	23.3	70.5
Vanguard	-	-	-	-	-	-	-	-	0.2	0.2	7.9
All Companies	**9.3**	**16.2**	**26.2**	**39.8**	**91.4**	**53.1**	**75.1**	**100.9**	**128.6**	**357.7**	**940.4**
Average Selling Price (U.S.$)	75.00	56.88	48.62	43.68	50.61	38.54	37.94	34.93	31.56	34.89	30.33
Total Revenue (U.S.$M)	697.5	918.5	1,271.4	1,736.1	4,623.5	2,046.3	2,849.6	3,523.1	4,059.9	12,478.9	28,518.7
Total Demand	8.1	14.7	24.7	38.9	86.4	49.7	69.5	97.0	130.7	346.8	958.2
Sufficiency (%)	114.64	110.20	105.77	102.21	105.75	106.76	108.14	104.03	98.43	103.13	98.14

Source: Dataquest (August 1997)

Table 4-3
Quarterly Shipments of x4 64Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.1	0.1	0.1	0.1	0.3	0.1	0.1	0.2	0.3	0.7	1.6
Hitachi	0.2	0.2	0.4	0.6	1.5	0.6	1.4	2.1	2.8	6.9	15.3
Hyundai	0.2	0.4	0.7	2.1	3.4	3.7	5.5	7.7	9.9	26.8	67.3
IBM Microelectronics	0.1	0.1	0.2	0.3	0.7	0.7	1.2	1.9	2.6	6.4	22.5
LG Semicon	0.5	0.6	1.0	1.6	3.7	2.2	2.8	3.6	4.5	13.1	36.1
Matsushita	-	-	-	-	-	-	0.1	0.2	0.3	0.6	4.2
Micron Technology	0.2	0.5	0.9	1.0	2.5	1.2	1.7	2.1	2.9	8.0	22.6
Mitsubishi	1.2	1.3	1.6	2.1	6.1	2.9	3.8	4.7	5.9	17.2	29.2
Mosel Vitelic	-	-	-	0.2	0.2	0.3	0.4	0.6	0.6	1.8	4.5
Motorola	-	-	-	0.1	0.1	0.2	0.3	0.3	0.1	0.9	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	4.5
NEC	0.8	1.4	2.2	3.6	8.0	2.3	2.7	2.6	3.2	10.8	12.9
Nippon Steel	-	-	-	-	-	-	-	-	0.2	0.3	4.7
Oki	-	-	-	-	-	0.1	0.2	0.3	0.4	1.0	3.7
Samsung	1.3	3.4	6.2	7.9	18.8	8.3	9.7	10.9	11.9	40.8	71.8
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	0.1	0.2	0.3	0.4	0.5	0.7	1.0	2.6	7.8
Texas Instruments	0.1	0.1	0.2	0.5	0.9	0.9	1.3	1.4	1.5	5.1	12.1
Toshiba	0.2	0.2	0.3	0.6	1.3	0.9	1.1	1.3	1.8	5.1	10.6
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	**4.8**	**8.3**	**13.8**	**20.8**	**47.8**	**24.6**	**32.7**	**40.6**	**50.0**	**147.9**	**331.1**
Average Selling Price (U.S.$)	75.00	56.88	48.62	43.68	50.55	38.31	37.65	33.55	29.00	33.71	26.90
Total Revenue (U.S.$M)	359.3	474.1	672.3	910.1	2,415.8	941.3	1,232.0	1,361.4	1,449.5	4,984.2	8,905.6

Source: Dataquest (August 1997)

Table 4-4
Quarterly Shipments of x8/9 64Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.1	0.1	0.1	0.1	0.4	0.3	0.5	0.9	1.2	2.9	13.0
Hitachi	0.1	0.1	0.2	0.3	0.6	0.6	1.6	2.4	3.2	7.8	27.6
Hyundai	0.1	0.2	0.3	0.8	1.2	1.4	2.2	3.3	4.5	11.4	30.5
IBM Microelectronics	0.1	0.1	0.1	0.2	0.6	0.5	0.8	1.2	1.6	4.1	12.5
LG Semicon	0.1	0.2	0.3	0.5	1.0	0.8	1.2	1.9	2.9	6.9	23.2
Matsushita	-	-	-	-	-	-	-	0.1	0.2	0.3	3.4
Micron Technology	-	-	-	0.2	0.2	0.2	0.4	0.5	0.7	1.8	3.8
Mitsubishi	0.4	0.5	0.8	1.0	2.6	1.5	2.0	2.6	3.3	9.4	24.3
Mosel Vitelic	-	-	-	-	-	0.2	0.4	0.8	1.1	2.5	6.7
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	0.4	0.8	1.4	2.3	4.9	2.5	3.4	4.4	5.3	15.5	38.6
Nippon Steel	-	-	-	-	-	-	-	-	0.2	0.3	4.0
Oki	-	-	-	-	-	-	0.1	0.1	0.1	0.3	1.8
Samsung	1.3	2.7	4.5	5.8	14.2	6.2	7.4	8.5	9.5	31.6	57.4
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	0.1	0.2	0.2	0.3	0.5	0.8	1.7	7.8
Texas Instruments	0.3	0.3	0.4	0.6	1.6	0.8	1.0	1.2	1.5	4.5	10.1
Toshiba	0.1	0.3	0.3	0.6	1.3	1.1	1.4	2.0	2.6	7.0	24.7
Vanguard	-	-	-	-	-	-	-	-	-	-	2.4
All Companies	**2.9**	**5.2**	**8.3**	**12.4**	**28.8**	**16.4**	**22.6**	**30.2**	**38.8**	**108.0**	**291.6**
Average Selling Price (U.S.$)	75.00	56.88	48.62	43.68	50.65	38.31	37.65	33.55	29.00	33.49	26.90
Total Revenue (U.S.$M)	217.5	296.9	404.5	540.5	1,459.4	626.4	852.5	1,013.7	1,125.0	3,617.5	7,843.0

Source: Dataquest (August 1997)

Table 4-5
Quarterly Shipments of x16/18 64Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	1.0
Fujitsu	0.2	0.4	0.5	0.6	1.7	0.8	1.5	2.4	3.4	8.0	27.0
Hitachi	-	-	-	-	0.1	0.3	1.0	1.5	2.0	4.8	18.4
Hyundai	-	-	0.1	0.2	0.2	0.3	0.4	0.6	0.8	2.0	5.3
IBM Microelectronics	0.1	0.1	0.1	0.2	0.4	0.5	1.1	1.6	2.3	5.5	15.0
LG Semicon	-	0.1	0.1	0.2	0.5	0.3	0.3	0.4	0.4	1.4	3.2
Matsushita	-	-	-	-	-	-	-	-	-	-	0.8
Micron Technology	-	-	-	0.1	0.1	0.2	0.4	0.7	0.9	2.1	11.3
Mitsubishi	-	0.1	0.1	0.2	0.4	0.8	1.5	2.6	3.3	8.2	34.1
Mosel Vitelic	-	-	-	-	-	0.1	0.2	0.6	1.1	2.0	9.0
Motorola	-	-	-	0.1	0.1	0.2	0.3	0.3	0.1	0.9	-
Nan Ya Technology	-	-	-	-	-	-	0.1	0.3	0.5	0.8	-
NEC	0.7	1.0	2.0	3.2	6.8	5.1	7.5	10.5	12.6	35.7	77.1
Nippon Steel	-	-	-	-	-	-	-	-	0.3	0.3	4.7
Oki	-	-	-	-	-	-	-	0.1	0.1	0.2	0.9
Samsung	0.6	0.7	0.6	0.7	2.6	0.8	0.9	1.1	1.2	4.0	7.2
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	0.1	0.2	0.4	0.8	1.4	10.4
Texas Instruments	-	0.1	0.1	0.3	0.5	0.6	1.0	1.4	1.8	4.7	14.1
Toshiba	-	0.2	0.4	0.8	1.4	1.6	2.0	3.3	4.4	11.3	35.3
Vanguard	-	-	-	-	-	-	-	-	0.2	0.2	5.5
All Companies	**1.6**	**2.6**	**4.0**	**6.5**	**14.6**	**11.6**	**18.4**	**27.6**	**36.0**	**93.5**	**280.2**
Average Selling Price (U.S.$)	75.00	56.88	48.62	43.68	50.77	39.40	38.85	38.60	38.15	38.58	38.40
Total Revenue (U.S.$M)	120.6	146.1	192.9	283.6	743.2	455.8	713.4	1,064.5	1,372.9	3,606.5	10,758.4

Source: Dataquest (August 1997)

Table 4-6
Quarterly Shipments of x32/36 64Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	0.1	0.3	0.5	0.9	1.2	2.9	10.4
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	0.1	0.2	0.3	0.6	2.1
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	0.1	0.1	0.2	0.5	1.9
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	0.1	0.2	0.5	0.7	1.5	9.7
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	2.2
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	0.2	0.5	0.8	1.2	2.6	7.2
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	0.3	0.3	4.0
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	-	**0.1**	**0.6**	**1.4**	**2.5**	**3.9**	**8.3**	**37.6**
Average Selling Price (U.S.$)	-	56.88	48.62	43.68	48.47	38.31	37.65	33.55	29.00	32.45	26.90
Total Revenue (U.S.$M)	-	1.4	1.7	2.0	5.1	22.8	51.8	83.6	112.4	270.6	1,011.7

Source: Dataquest (August 1997)

Table 4-7
Quarterly Shipments of Fast Page Mode 64Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	0.1	0.1	0.1	-	0.1	0.3	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	0.1	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	4.5
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	0.1	0.1	0.1	0.1	0.2	0.4	1.2
Toshiba	-	-	-	-	-	-	-	-	-	-	-
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	-	0.1	0.2	0.1	0.2	0.2	0.2	0.8	5.7

Source: Dataquest (August 1997)

Table 4-8
Quarterly Shipments of Extended Data Out 64Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	0.3	0.4	0.6	0.9	2.1	1.4	2.8	3.3	4.3	11.8	12.3
Hyundai	0.3	0.5	0.9	2.6	4.2	3.7	4.3	4.2	3.1	15.4	21.0
IBM Microelectronics	0.3	0.2	0.3	0.5	1.3	1.2	1.9	2.8	3.2	9.0	10.0
LG Semicon	0.5	0.7	1.0	1.7	4.0	1.9	1.9	1.5	0.8	6.1	6.2
Matsushita	-	-	-	-	-	-	0.1	0.2	0.4	0.8	4.2
Micron Technology	0.2	0.5	0.9	1.1	2.7	1.4	1.9	2.5	2.7	8.5	11.3
Mitsubishi	1.6	1.8	2.5	3.2	9.1	4.9	6.8	7.4	9.2	28.2	34.1
Mosel Vitelic	-	-	-	0.2	0.2	0.5	0.8	1.2	1.4	3.9	4.5
Motorola	-	-	-	0.1	0.1	0.2	0.5	0.5	0.2	1.4	-
Nan Ya Technology	-	-	-	-	-	-	-	0.1	0.2	0.3	-
NEC	1.3	1.8	3.1	5.0	11.1	3.0	2.7	3.5	4.2	13.4	12.9
Nippon Steel	-	-	-	-	-	-	-	-	0.2	0.2	2.7
Oki	-	-	-	-	-	0.1	0.2	0.4	0.5	1.2	3.8
Samsung	2.7	5.8	8.4	10.8	27.7	9.4	8.8	7.2	4.8	30.2	28.7
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	0.2	0.4	0.5	0.6	0.8	1.1	1.8	4.3	13.0
Texas Instruments	0.3	0.4	0.6	1.1	2.3	1.7	2.3	2.8	3.4	10.2	12.1
Toshiba	0.3	0.7	1.0	1.9	3.9	3.2	3.2	2.6	3.5	12.4	10.6
Vanguard	-	-	-	-	-	-	-	-	-	-	0.8
All Companies	7.7	12.8	19.3	29.4	69.3	33.3	38.8	41.3	43.8	157.2	187.9

Source: Dataquest (August 1997)

Table 4-9
Quarterly Shipments of Synchronous 64Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	1.0
Fujitsu	0.3	0.5	0.7	0.9	2.4	1.5	2.7	4.3	6.1	14.6	52.0
Hitachi	-	-	-	-	0.1	0.2	1.2	2.7	3.6	7.6	49.0
Hyundai	-	0.1	0.2	0.5	0.7	1.7	3.9	7.5	12.4	25.4	84.1
IBM Microelectronics	-	-	0.1	0.2	0.3	0.5	1.1	1.9	3.3	6.7	40.1
LG Semicon	0.1	0.1	0.3	0.5	0.9	1.1	2.0	3.5	5.7	12.2	45.2
Matsushita	-	-	-	-	-	-	-	0.1	0.1	0.2	4.2
Micron Technology	-	-	-	0.1	0.1	0.2	0.5	0.8	1.8	3.3	26.3
Mitsubishi	-	-	-	-	-	0.3	0.8	3.2	3.9	8.1	63.2
Mosel Vitelic	-	-	-	-	-	0.1	0.3	0.7	1.4	2.4	17.9
Motorola	-	-	-	-	-	-	0.1	0.1	-	0.3	-
Nan Ya Technology	-	-	-	-	-	-	0.1	0.1	0.3	0.5	-
NEC	0.6	1.4	2.5	4.1	8.6	6.9	10.9	14.0	16.8	48.6	115.7
Nippon Steel	-	-	-	-	-	-	-	0.1	0.6	0.7	10.6
Oki	-	-	-	-	-	-	-	0.1	0.2	0.3	2.5
Samsung	0.5	1.0	2.8	3.6	7.9	6.0	9.7	14.1	19.1	48.8	114.8
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	0.1	0.2	0.4	0.8	1.4	13.0
Texas Instruments	-	0.1	0.1	0.3	0.5	0.5	0.8	1.1	1.5	3.9	25.0
Toshiba	-	-	-	0.1	0.1	0.4	1.4	3.6	4.8	10.1	56.4
Vanguard	-	-	-	-	-	-	-	-	0.2	0.2	7.1
All Companies	**1.5**	**3.3**	**6.7**	**10.1**	**21.7**	**19.4**	**35.5**	**58.1**	**82.5**	**195.4**	**728.2**

Source: Dataquest (August 1997)

Table 4-10
Quarterly Shipments of Next-Generation 64Mb DRAM to the World, Q1/97-1999 (Millions of Units Shipped)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Alliance Semiconductor	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-
Hitachi	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	0.1	0.1	0.2	0.3	0.6	1.0	1.6	3.5	13.0
Matsushita	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	2.0
Toshiba	-	-	-	-	-	-	-	0.3	0.4	0.8	3.5
Vanguard	-	-	-	-	-	-	-	-	-	-	-
All Companies	-	-	0.1	0.1	0.2	0.3	0.6	1.3	2.1	4.3	18.6

Source: Dataquest (August 1997)

Chapter 5
Consumption of DRAMs by Application

This chapter provides details of Dataquest's DRAM demand analysis. Quarterly DRAM demand figures are derived from Dataquest's electronic equipment forecast generated by the Semiconductor Application Markets Worldwide program, as well as forecasts from Dataquest's Computer Systems and Peripherals group and Telecommunications group.

Table 5-1 shows the quarterly electronic equipment production forecast (the system forecast). Table 5-2 provides Dataquest's estimate of DRAM megabyte consumption for each type of system. Dataquest calls this "megabytes per system." Table 5-3 shows the number of bits of memory required by the entire market (the system forecasts times DRAM usage) and the memory module market. Table 5-4 provides DRAM demand for each application by DRAM density, as well as total supply and demand by density and sufficiency in millions of 16Mb equivalent units.

What Has Changed since the Previous Report

Dataquest has revised the systems forecasts contained in Table 5-1. The key PC forecast shows undramatic changes for 1997 and 1998 (versus the forecast in last quarter's report).

Dataquest has increased somewhat the estimated number of DRAM megabytes contained in PCs as shipped from the PC factory and as upgraded following shipment from the PC factory.

Dataquest has updated the application segments by which it used to analyze DRAM demand. Replacing Chapter 6 (the PC forecast by microprocessor) is a matrix within the PC portion of Chapter 5. The new PC section divides PCs into servers, mobile PCs, and desk PCs. Each division also contains detail by microprocessor category (486 and below, 586, 686 and future, and others). Dataquest believes this new segmentation provides a better analysis of PC DRAM demand.

Dataquest has also eliminated the detail subsections of video games. Only one subsegment (32-bit and up/RISC games) possessed appreciable DRAM content.

Dataquest has eliminated the figures associated with Chapter 5 because they presented data identical to that presented in Chapters 2 through 5.

Table 5-1
High-Volume Electronic Equipment Unit Production Forecast, Q1/97-1999 (Thousands of Systems)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers	0.6	0.6	0.6	0.6	2.3	0.6	0.6	0.6	0.7	2.5	2.6
Mainframes	2.0	2.0	2.0	2.0	8.0	1.9	1.9	1.9	1.8	7.5	7.0
Midrange	203.2	211.8	220.5	229.1	864.5	229.9	239.7	249.5	259.3	978.3	1,097.1
Workstations	182.1	189.7	189.7	197.3	758.8	181.1	188.6	188.6	196.2	754.5	750.9
Personal Computers	18,746.4	19,351.2	21,072.7	25,108.0	84,278.3	21,824.4	22,323.8	24,463.9	29,764.4	98,376.6	113,596.1
Server PCs	337.3	366.9	384.7	517.5	1,606.4	427.9	446.9	479.3	641.4	1,995.5	2,483.1
486 and Below Server PCs	0.5	0.1	-	-	0.6	-	-	-	-	-	-
586 Server PCs	260.3	253.4	230.2	256.5	1,000.4	164.2	150.0	151.1	148.4	613.8	252.1
686 and Future Server PCs	69.8	105.3	145.5	249.9	570.5	252.7	287.5	317.9	480.8	1,338.9	2,184.9
Other Server PCs	6.7	8.0	9.1	11.2	35.0	10.9	9.4	10.3	12.1	42.8	46.1
Mobile PCs	3,177.7	3,328.6	3,718.6	4,166.5	14,391.4	3,763.9	3,886.5	4,473.0	5,059.5	17,182.9	20,364.2
486 and Below Mobile PCs	48.3	27.0	11.3	5.0	91.7	3.1	-	-	-	3.1	-
586 Mobile PCs	3,011.3	3,169.2	3,507.2	3,840.1	13,527.8	3,227.4	3,232.7	3,366.9	3,613.7	13,440.7	6,849.3
686 and Future Mobile PCs	0.4	2.9	41.5	140.8	185.6	307.6	469.9	855.2	1,154.5	2,787.1	12,402.4
Other Mobile PCs	117.7	129.4	158.6	180.6	586.3	225.8	183.9	250.9	291.3	952.0	1,112.5
Desk PCs	15,231.3	15,655.8	16,969.4	20,424.1	68,280.6	17,632.7	17,990.4	19,511.7	24,063.4	79,198.2	90,748.8
486 and Below Desk PCs	84.8	54.0	4.3	-	143.1	-	-	-	-	-	-
586 Desk PCs	12,902.1	12,529.6	12,033.2	12,091.5	49,556.4	8,846.2	7,606.2	6,541.7	6,550.4	29,544.6	10,974.5
686 and Future Desk PCs	1,402.0	2,125.5	3,850.8	7,192.8	14,571.1	7,778.8	9,249.8	11,763.5	16,247.8	45,039.8	74,920.9
Other Desk PCs	842.4	946.7	1,081.1	1,139.7	4,010.0	1,007.7	1,134.4	1,206.5	1,265.2	4,613.8	4,853.4
Additional Motherboards	2,954.4	2,745.7	2,662.8	2,581.2	10,944.1	2,678.4	2,792.4	2,906.4	3,020.4	11,397.6	13,171.8
Data Storage Devices	46,580.7	48,562.8	50,545.0	52,527.2	198,215.7	54,038.4	56,337.9	58,637.4	60,936.9	229,950.6	260,401.5
Printers	11,388.1	11,872.7	12,357.3	12,841.9	48,460.0	12,929.3	13,479.5	14,029.7	14,579.9	55,018.3	58,739.0
Facsimiles	2,633.7	2,613.9	2,666.0	2,659.4	10,572.9	2,663.4	2,681.9	2,691.9	2,739.8	10,777.0	11,321.0
Telephone Answering Machines	7,040.1	7,060.1	7,110.1	7,090.1	28,300.2	7,306.4	7,236.0	7,296.3	7,427.5	29,266.3	29,463.6
Routers/Internetworking	274.6	292.7	313.8	334.9	1,216.0	374.5	399.9	423.1	448.5	1,646.0	2,132.0
Industrial Applications	901.8	921.6	930.9	957.7	3,712.0	993.0	1,017.1	1,030.8	1,039.0	4,080.0	4,386.6
DVD Players	176.1	353.3	477.9	712.7	1,720.0	782.2	990.6	1,161.9	1,534.3	4,469.0	10,322.1
Set-Top Boxes	4,882.4	5,090.1	5,297.9	5,505.6	20,776.0	5,836.2	6,084.6	6,332.9	6,581.3	24,835.0	26,412.0
Video Games	4,414.8	4,602.6	4,790.5	4,978.4	18,786.2	5,410.7	5,664.5	5,687.2	5,207.7	21,970.0	18,573.6
All Applications	122,790.8	127,220.8	132,770.1	140,784.2	523,565.8	141,234.4	146,348.7	152,937.5	162,498.6	603,019.1	675,167.0

Source: Dataquest (August 1997)

Table 5-2
High-Volume Electronic Equipment Unit Production Forecast, Q1/97-1999 (Megabytes per System)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers	3,379.2	4,300.8	4,321.3	4,403.2	4,104.7	4,567.0	4,976.6	5,529.6	5,898.2	5,256.8	6,467.6
Mainframes	2,539.5	3,010.6	3,215.4	3,317.8	3,016.6	3,604.5	3,850.2	4,034.6	4,177.9	3,912.3	4,744.3
Midrange	184.0	204.8	233.6	256.0	220.8	310.4	348.8	386.1	423.0	369.0	509.3
Workstations	84.2	94.4	103.0	110.4	98.3	118.4	126.4	136.6	143.7	131.5	175.2
Personal Computers	27.5	28.1	29.8	31.0	29.2	33.7	36.1	38.8	40.5	37.6	49.7
Server PCs	61.5	68.7	76.1	82.4	73.4	88.7	93.1	96.5	102.6	96.0	120.4
486 and Below Server PCs	42.0	47.0	-	-	42.8	-	-	-	-	-	-
586 Server PCs	58.8	65.4	72.0	77.0	68.2	82.7	88.2	92.8	95.8	89.7	102.2
686 and Future Server PCs	72.0	77.0	82.7	88.2	82.7	92.8	95.8	98.4	104.8	99.1	122.9
Other Server PCs	58.8	65.4	72.0	77.0	69.5	82.7	88.2	92.8	95.8	90.1	102.7
Mobile PCs	15.1	16.3	17.9	20.9	17.8	22.4	24.2	26.6	29.8	26.1	37.7
486 and Below Mobile PCs	13.1	13.1	14.2	15.5	13.4	17.0	-	-	-	17.0	-
586 Mobile PCs	15.1	16.3	17.8	20.8	17.7	22.1	23.5	25.5	28.6	25.1	33.3
686 and Future Mobile PCs	17.0	20.0	21.8	23.0	22.7	25.5	28.6	30.5	33.0	30.7	40.2
Other Mobile PCs	15.5	17.0	20.0	21.8	19.0	23.0	25.5	28.6	30.5	27.3	36.3
Desk PCs	29.3	29.6	31.4	31.7	30.6	34.7	37.2	40.2	41.1	38.6	50.4
486 and Below Desk PCs	21.6	25.0	26.4	-	23.0	-	-	-	-	-	-
586 Desk PCs	29.6	29.8	31.3	31.4	30.5	33.5	35.4	38.0	38.7	36.2	42.0
686 and Future Desk PCs	27.7	28.6	31.7	32.1	31.0	36.1	38.6	41.6	42.2	40.2	52.2
Other Desk PCs	28.2	28.9	31.0	33.4	30.6	35.2	37.0	38.3	39.3	37.6	42.1
Additional Motherboards	25.0	28.2	28.9	30.2	28.0	33.5	37.4	38.8	39.5	37.4	49.0
Memory Modules	12.0	12.9	14.4	14.5	13.5	16.9	18.3	20.0	20.2	18.9	28.3
Data Storage Devices	0.2	0.2	0.3	0.3	0.2	0.4	0.4	0.5	0.7	0.5	0.8
Printers	3.7	3.8	3.9	4.0	3.9	4.2	4.4	4.6	4.8	4.5	5.4
Facsimiles	2.0	2.1	2.3	2.4	2.2	2.6	2.6	2.9	3.1	2.8	4.0
Telephone Answering Machines	2.0	2.1	2.2	2.3	2.2	2.4	2.5	2.6	2.7	2.6	3.0
Routers/Internetworking	5.5	5.7	5.9	6.0	5.8	6.3	6.5	6.7	7.0	6.7	8.2
Industrial Applications	9.3	9.9	10.5	11.2	10.3	12.9	14.0	14.6	15.5	14.3	15.5
DVD Players	2.1	3.5	3.9	4.2	3.8	4.6	5.2	5.3	5.4	5.2	6.5

Table 5-2 (Continued)
High-Volume Electronic Equipment Unit Production Forecast, Q1/97-1999 (Megabytes per System)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Set-Top Boxes	2.0	2.2	2.2	2.3	2.2	2.5	2.7	2.8	3.0	2.8	3.8
Video Games	4.4	4.9	5.0	5.2	4.9	5.4	5.6	5.8	6.0	5.7	6.8
Other Applications	-	-	-	-	-	-	-	-	-	-	-
All Applications	8.3	8.8	9.5	10.3	9.3	10.8	11.6	12.7	14.0	12.3	17.2
PCs + Aftermarket Module Megabytes per System	39.5	41.7	44.3	44.0	42.5	51.6	55.8	59.2	58.1	56.4	77.5

Source: Dataquest (August 1997)

Table 5-3
High-Volume Electronic Equipment Unit Production Forecast, Q1/97-1999 (Thousands of Megabytes)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers	1,926.1	2,451.5	2,506.3	2,597.9	9,481.8	2,785.9	3,035.8	3,538.9	3,833.9	13,194.4	16,880.4
Mainframes	5,180.6	6,081.3	6,398.6	6,502.8	24,163.3	6,920.6	7,354.0	7,463.9	7,603.8	29,342.3	33,209.8
Midrange	37,381.4	43,376.6	51,497.1	58,647.0	190,902.2	71,361.0	83,600.4	96,325.4	109,662.8	360,949.5	558,734.0
Workstations	15,326.5	17,907.6	19,546.6	21,780.5	74,561.1	21,439.3	23,841.6	25,773.0	28,184.8	99,238.7	131,535.4
Personal Computers	515,074.6	542,803.7	627,846.6	777,799.0	2,463,524.0	734,959.6	804,785.3	949,613.4	1,204,641.3	3,693,999.6	5,640,810.2
Server PCs	20,744.7	25,198.2	29,261.5	42,625.8	117,830.2	37,940.3	41,605.4	46,261.9	65,783.2	191,590.8	299,026.9
486 and Below Server PCs	20.6	4.5	-	-	25.1	-	-	-	-	-	-
586 Server PCs	15,306.5	16,564.8	16,572.0	19,737.5	68,180.7	13,582.4	13,225.3	14,025.5	14,226.8	55,060.0	25,758.4
686 and Future Server PCs	5,022.6	8,104.7	12,036.3	22,029.8	47,193.3	23,454.9	27,549.3	31,280.7	50,393.0	132,677.9	268,534.6
Other Server PCs	395.0	524.3	653.3	858.5	2,431.2	903.0	830.7	955.7	1,163.5	3,852.9	4,733.9
Mobile PCs	47,998.3	54,329.6	66,523.7	87,124.7	255,976.3	84,366.3	94,184.7	119,174.1	150,521.1	448,246.2	767,212.8
486 and Below Mobile PCs	634.2	354.4	161.4	77.6	1,227.7	53.4	-	-	-	53.4	-
586 Mobile PCs	45,530.9	51,721.5	62,287.9	79,874.0	239,414.3	71,260.7	76,033.2	85,923.4	103,495.6	336,712.8	227,821.0
686 and Future Mobile PCs	6.2	58.8	902.5	3,243.8	4,211.3	7,849.1	13,457.1	26,065.4	38,146.1	85,517.7	498,986.7
Other Mobile PCs	1,827.0	2,195.0	3,171.8	3,929.3	11,123.1	5,203.2	4,694.4	7,185.3	8,879.5	25,962.4	40,405.0
Desk PCs	446,331.6	463,275.9	532,061.4	648,048.5	2,089,717.4	612,653.0	668,995.2	784,177.4	988,337.0	3,054,162.6	4,574,570.5
486 and Below Desk PCs	1,832.4	1,346.9	114.1	-	3,293.4	-	-	-	-	-	-
586 Desk PCs	381,901.4	373,884.0	376,397.9	379,190.3	1,511,373.7	296,525.1	269,564.6	248,584.6	253,633.2	1,068,307.5	461,015.2
686 and Future Desk PCs	38,807.6	60,703.5	121,992.3	230,745.1	452,248.5	280,657.9	357,412.0	489,360.0	685,006.9	1,812,436.8	3,909,269.8
Other Desk PCs	23,790.2	27,341.4	33,557.1	38,113.2	122,801.9	35,470.0	42,018.6	46,232.8	49,696.9	173,418.3	204,285.5
Additional Motherboards	73,742.6	77,537.2	76,902.2	77,848.7	306,030.7	89,781.0	104,324.4	112,767.5	119,364.6	426,237.6	645,209.4
Memory Modules	268,920.0	301,682.0	347,507.7	362,842.6	1,280,952.3	439,647.6	491,907.7	556,706.4	579,822.4	2,068,084.0	3,534,392.0
Data Storage Devices	7,045.3	9,712.6	13,331.2	16,414.7	46,503.9	19,318.7	23,943.6	28,439.1	43,569.9	115,271.3	207,142.9
Printers	41,566.6	45,353.8	48,193.5	51,881.3	186,995.2	54,303.1	59,174.9	63,975.3	69,837.5	247,290.8	317,088.7
Facsimiles	5,148.8	5,554.5	6,065.2	6,449.0	23,217.5	6,858.2	7,066.9	7,860.3	8,411.3	30,196.7	45,096.1
Telephone Answering Machines	14,080.1	14,967.3	15,642.1	16,165.3	60,854.9	17,535.4	18,234.8	18,970.5	19,905.8	74,646.4	86,936.2
Routers/Internetworking	1,504.7	1,662.5	1,838.9	2,023.0	7,029.0	2,359.2	2,599.2	2,843.5	3,148.5	10,950.4	17,454.8
Industrial Applications	8,350.9	9,160.8	9,811.4	10,764.5	38,087.7	12,849.7	14,219.6	15,070.6	16,084.2	58,224.1	67,903.9
DVD Players	369.7	1,236.6	1,863.9	2,993.3	6,463.5	3,598.2	5,151.1	6,181.3	8,285.2	23,215.8	66,614.7
Set-Top Boxes	9,862.4	10,994.7	11,549.4	12,773.1	45,179.5	14,824.0	16,671.7	17,985.5	19,612.2	69,093.5	99,826.3
Video Games	19,424.9	22,644.9	23,952.5	26,086.6	92,108.8	29,217.7	31,607.8	32,985.6	31,454.3	125,265.4	126,144.1
Other Applications	-	-	-	-	-	-	-	-	-	-	-
All Applications	1,024,905.4	1,113,127.5	1,264,453.2	1,453,569.4	4,856,055.4	1,527,759.1	1,697,518.6	1,946,500.4	2,273,422.4	7,445,200.4	11,594,979.0

Source: Dataquest (August 1997)

Table 5-4
Consumption by Density and Application, Q1/97-1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Supercomputers											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-
64Mb	240.8	306.4	313.3	324.7	1,185.2	348.2	379.5	442.4	479.2	1,649.3	2,110.1
Mainframes											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	129.5	-	-	-	129.5	-	-	-	-	-	-
64Mb	615.2	760.2	799.8	812.9	2,988.0	865.1	919.2	933.0	950.5	3,667.8	4,151.2
Midrange											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	7,476.3	-	-	-	7,476.3	-	-	-	-	-	-
64Mb	2,803.6	5,422.1	6,437.1	7,330.9	21,993.7	8,920.1	10,450.0	12,040.7	13,707.8	45,118.7	69,841.8
Workstations											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	3,831.6	-	-	-	3,831.6	-	-	-	-	-	-
64Mb	957.9	2,238.4	2,443.3	2,722.6	8,362.2	2,679.9	2,980.2	3,221.6	3,523.1	12,404.8	16,441.9
Personal Computers											
1Mb	161.3	-	-	-	161.3	-	-	-	-	-	-
4Mb	52,550.7	45,582.6	40,878.6	9,091.9	148,103.8	7,183.6	5,521.2	3,626.4	1,505.2	17,836.4	7,672.1
16Mb	237,132.0	246,852.8	269,396.2	314,457.1	1,067,838.0	262,456.2	263,609.4	250,847.0	274,919.3	1,051,831.9	650,925.9
64Mb	1,814.4	3,288.4	8,576.9	18,042.3	31,722.0	25,806.9	34,350.8	55,763.3	81,756.3	197,677.2	541,890.3
Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	622.3	-	-	-	622.3	-	-	-	-	-	-
16Mb	7,779.3	8,008.9	8,436.1	11,099.7	35,323.9	7,863.8	7,997.8	7,655.4	8,502.1	32,019.2	13,393.3
64Mb	609.4	1,147.5	1,548.7	2,553.3	5,858.9	2,776.6	3,201.2	3,868.9	6,097.4	15,944.1	34,030.1

Table 5-4 (Continued)
Consumption by Density and Application, Q1/97-1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
486 and Below Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	0.6	-	-	-	0.6	-	-	-	-	-	-
16Mb	7.7	1.6	-	-	9.3	-	-	-	-	-	-
64Mb	0.6	0.2	-	-	0.8	-	-	-	-	-	-
586 Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	459.2	-	-	-	459.2	-	-	-	-	-	-
16Mb	5,739.9	5,797.7	5,800.2	6,414.7	23,752.5	4,074.7	3,637.0	3,506.4	3,201.0	14,419.1	4,182.5
64Mb	449.6	621.2	621.4	863.5	2,555.8	679.1	743.9	876.6	978.1	3,277.7	2,174.2
686 and Future Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	150.7	-	-	-	150.7	-	-	-	-	-	-
16Mb	1,883.5	2,026.2	2,407.3	4,406.0	10,722.8	3,518.2	4,132.4	3,910.1	5,039.3	16,600.0	8,465.8
64Mb	147.5	506.5	902.7	1,652.2	3,209.0	2,052.3	2,410.6	2,932.6	5,039.3	12,434.7	31,450.4
Other Server PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	11.9	-	-	-	11.9	-	-	-	-	-	-
16Mb	148.1	183.5	228.7	279.0	839.3	270.9	228.5	238.9	261.8	1,000.1	744.9
64Mb	11.6	19.7	24.5	37.6	93.3	45.1	46.7	59.7	80.0	231.6	405.5
Mobile PCs											
1Mb	14.7	-	-	-	14.7	-	-	-	-	-	-
4Mb	6,771.1	5,433.0	3,991.4	5,300.0	21,495.5	4,218.3	2,825.5	2,383.5	1,505.2	10,932.6	7,672.1
16Mb	22,305.5	25,534.9	31,531.0	38,932.8	118,304.2	35,227.6	36,559.0	41,288.4	46,716.3	159,791.3	117,106.8
64Mb	-	67.9	183.2	826.1	1,077.3	1,475.3	2,456.7	4,425.7	7,042.0	15,399.7	66,145.4
486 and Below Mobile PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	88.8	35.4	9.7	5.4	139.4	2.7	-	-	-	2.7	-
16Mb	294.9	166.6	76.7	34.3	572.5	22.3	-	-	-	22.3	-
64Mb	-	0.4	0.4	0.8	1.6	0.9	-	-	-	0.9	-

Table 5-4 (Continued)
Consumption by Density and Application, Q1/97-1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
586 Mobile PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	6,374.3	5,172.1	3,737.3	4,792.4	20,076.2	3,563.0	2,281.0	1,718.5	1,035.0	8,597.5	2,278.2
16Mb	21,171.9	24,309.1	29,586.8	35,943.3	111,011.0	30,285.8	30,413.3	32,221.3	36,223.4	129,143.8	53,478.5
64Mb	-	64.7	155.7	698.9	919.3	1,113.4	1,758.3	2,577.7	3,816.4	9,265.8	14,965.6
686 and Future Mobile PCs											
1Mb	0.1	-	-	-	0.1	-	-	-	-	-	-
4Mb	1.0	5.9	54.2	227.1	288.1	392.5	403.7	521.3	381.5	1,698.9	4,989.9
16Mb	2.9	27.6	361.0	1,216.4	1,607.9	2,747.2	4,373.6	6,516.4	7,629.2	21,266.3	50,597.7
64Mb	-	0.1	19.2	87.2	106.4	269.8	563.5	1,596.5	2,837.1	5,266.9	49,412.1
Other Mobile PCs											
1Mb	14.6	-	-	-	14.6	-	-	-	-	-	-
4Mb	306.9	219.5	190.3	275.1	991.8	260.2	140.8	143.7	88.8	633.5	404.1
16Mb	835.8	1,031.6	1,506.6	1,738.7	5,112.8	2,172.3	1,772.1	2,550.8	2,863.6	9,358.9	13,030.6
64Mb	-	2.7	7.9	39.3	50.0	91.1	135.0	251.5	388.5	866.0	1,767.7
Desk PCs											
1Mb	146.6	-	-	-	146.6	-	-	-	-	-	-
4Mb	45,157.3	40,149.7	36,887.2	3,791.9	125,986.0	2,965.3	2,695.6	1,242.9	-	6,903.8	-
16Mb	207,047.2	213,308.9	229,429.0	264,424.7	914,209.9	219,364.8	219,052.6	201,903.2	219,700.9	860,021.4	520,425.8
64Mb	1,205.0	2,072.9	6,845.0	14,662.9	24,785.8	21,555.1	28,692.8	47,468.7	68,616.9	166,333.5	441,714.9
486 and Below Desk PCs											
1Mb	146.6	-	-	-	146.6	-	-	-	-	-	-
4Mb	1,282.7	942.9	63.9	-	2,289.4	-	-	-	-	-	-
16Mb	586.4	437.8	41.1	-	1,065.2	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-
586 Desk PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	30,552.1	29,910.7	30,111.8	3,791.9	94,366.6	2,965.3	2,695.6	1,242.9	-	6,903.8	-
16Mb	181,403.2	175,725.5	169,379.1	163,051.8	689,559.6	120,092.6	95,021.5	86,693.9	82,430.8	384,238.9	122,092.5
64Mb	477.4	934.7	2,823.0	6,398.8	10,633.9	6,857.1	9,771.7	9,321.9	11,096.5	37,047.2	27,103.8

Table 5-4 (Continued)
Consumption by Density and Application, Q1/97-1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
686 and Future Desk PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	16,493.2	25,799.0	45,747.1	84,221.9	172,261.3	84,197.4	107,223.6	97,872.0	119,876.2	409,169.2	353,716.2
64Mb	727.6	1,138.2	3,812.3	7,787.6	13,465.7	14,032.9	17,870.6	36,702.0	55,656.8	124,262.3	400,229.7
Other Desk PCs											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	13,322.5	9,296.1	6,711.4	-	29,330.0	-	-	-	-	-	-
16Mb	8,564.5	11,346.7	14,261.8	17,150.9	51,323.9	15,074.8	16,807.4	17,337.3	17,393.9	66,613.4	44,617.1
64Mb	-	-	209.7	476.4	686.1	665.1	1,050.5	1,444.8	1,863.6	5,023.9	14,381.4
Additional Motherboards											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	41,295.8	26,362.6	15,380.4	-	83,038.9	-	-	-	-	-	-
16Mb	26,547.3	32,177.9	32,683.5	35,031.9	126,440.6	38,156.9	41,729.8	42,287.8	41,777.6	163,952.1	140,556.7
64Mb	-	-	480.6	973.1	1,453.7	1,683.4	2,608.1	3,524.0	4,476.2	12,291.7	45,512.0
Memory Modules											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	123,703.2	90,504.6	69,501.5	87,082.2	370,791.6	57,154.2	31,974.0	11,134.1	-	100,262.3	-
16Mb	96,811.2	117,656.0	133,790.5	125,180.7	473,438.3	168,165.2	167,248.6	192,063.7	188,442.3	715,919.8	674,278.9
64Mb	1,680.8	2,639.7	5,647.0	8,617.5	18,585.0	9,342.5	17,677.9	20,876.5	25,367.2	73,264.2	273,229.3
Data Storage Devices											
1Mb	47,908.2	45,843.3	43,726.5	41,365.1	178,843.2	38,637.4	35,436.5	34,127.0	33,113.1	141,314.1	111,611.0
4Mb	2,113.6	7,964.3	15,730.9	22,488.2	48,297.0	28,978.1	39,028.1	45,502.6	44,441.3	157,950.1	93,870.7
16Mb	-	-	-	-	-	-	-	711.0	8,605.1	9,316.0	73,128.1
64Mb	-	-	-	-	-	-	-	-	-	-	-
Printers											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	16,626.6	14,513.2	15,421.9	15,564.4	62,126.2	15,204.9	11,835.0	12,795.1	9,777.2	49,612.1	19,025.3
16Mb	16,626.6	19,048.6	20,241.3	22,049.6	77,966.1	23,350.3	26,628.7	28,788.9	32,474.4	111,242.3	153,788.0
64Mb	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
Consumption by Density and Application, Q1/97-1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Facsimiles											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	6,693.4	6,665.4	6,671.7	6,449.0	26,479.5	6,172.3	5,653.5	5,502.2	5,046.8	22,374.9	11,725.0
16Mb	901.0	1,110.9	1,364.7	1,612.3	4,988.9	1,886.0	2,120.1	2,554.6	2,944.0	9,504.6	19,616.8
64Mb	-	-	-	-	-	-	-	-	-	-	-
Telephone Answering Machines											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	26,752.2	25,444.5	23,463.2	22,631.5	98,291.4	21,042.5	16,411.3	13,279.3	9,952.9	60,686.0	10,369.3
16Mb	352.0	1,122.6	1,955.3	2,424.8	5,854.6	3,507.1	5,014.6	6,165.4	7,464.7	22,151.7	40,875.8
64Mb	-	-	-	-	-	-	-	-	-	-	-
Routers/Internetworking											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	120.4	116.4	128.7	40.5	405.9	-	-	-	-	-	-
16Mb	722.3	802.1	887.3	1,001.4	3,413.0	1,179.6	1,299.6	1,421.8	1,574.2	5,475.2	8,727.4
64Mb	-	-	-	-	-	-	-	-	-	-	-
Industrial Applications											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	8,601.5	9,527.2	9,418.9	7,104.6	34,652.2	7,709.8	5,687.8	5,124.0	4,825.3	23,346.9	11,796.9
16Mb	2,025.1	2,198.6	2,452.8	3,337.0	10,013.6	4,176.1	5,332.4	5,651.5	5,870.7	21,030.7	21,180.0
64Mb	-	-	24.5	67.3	91.8	80.3	88.9	150.7	241.3	561.2	2,455.7
DVD Players											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	295.8	865.6	1,118.3	1,496.6	3,776.4	719.6	1,030.2	618.1	497.1	2,865.1	3,996.9
16Mb	110.9	401.9	652.4	1,122.5	2,287.7	1,619.2	2,318.0	2,936.1	4,018.3	10,891.6	32,308.1
64Mb	-	-	-	-	-	-	-	-	-	-	-
Set-Top Boxes											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	10,256.9	9,455.4	8,777.5	8,762.3	37,252.1	8,153.2	8,335.9	7,194.2	7,844.9	31,528.2	15,680.4
16Mb	2,367.0	3,133.5	3,580.3	4,196.0	13,276.7	5,373.7	6,251.9	7,194.2	7,844.9	26,664.7	45,993.0
64Mb	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
Consumption by Density and Application, Q1/97-1999 (Millions of Units)

	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998	1999
Video Games											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	1,554.0	1,811.6	1,916.2	2,086.9	7,368.7	2,337.4	2,528.6	1,319.4	-	6,185.5	-
16Mb	9,324.0	10,869.5	11,497.2	12,521.5	44,212.2	14,024.5	15,171.7	16,162.9	14,940.8	60,300.0	52,714.6
64Mb	-	-	-	-	-	-	-	-	196.6	196.6	2,589.4
Other Applications											
1Mb	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-
All Applications											
1Mb	48,069.5	45,843.3	43,726.5	41,365.1	179,004.4	38,637.4	35,436.5	34,127.0	33,113.1	141,314.1	111,611.0
4Mb	290,564.2	238,813.4	208,407.9	182,798.2	920,583.7	154,655.6	128,005.6	106,095.5	83,890.7	472,647.4	174,136.6
16Mb	404,356.8	435,374.3	478,501.2	522,934.7	1,841,167.1	523,894.9	536,724.7	556,784.9	590,876.2	2,208,280.7	1,914,093.3
64Mb	8,112.6	14,655.2	24,722.6	38,891.3	86,381.7	49,726.5	69,454.6	96,952.1	130,698.2	346,831.4	958,221.6
All Companies											
1Mb	49,350.0	45,860.0	43,660.0	41,510.0	180,380.0	38,320.0	35,690.0	34,050.0	32,900.0	140,960.0	112,400.0
4Mb	291,165.0	237,800.0	209,470.0	182,340.0	920,775.0	154,685.0	128,350.0	106,165.0	83,863.3	473,063.3	173,572.0
16Mb	444,129.0	477,893.0	499,140.0	532,735.0	1,953,897.0	556,370.0	576,798.0	573,698.0	578,898.0	2,285,764.0	1,875,146.0
64Mb	9,300.0	16,150.0	26,150.0	39,750.0	91,350.0	53,090.0	75,110.0	100,860.0	128,640.0	357,700.0	940,400.0
16Mb Equivalent Demand	512,452.6	556,563.7	632,226.5	726,784.8	2,428,027.6	763,879.6	848,759.3	973,250.1	1,136,711.2	3,722,600.3	5,797,489.5
16Mb Equivalent Supply	557,204.6	604,809.3	658,836.3	739,914.4	2,560,764.5	809,796.3	911,556.1	1,005,807.4	1,116,480.1	3,843,639.8	5,687,164.0
Sufficiency	105.70	105.86	103.05	101.32	103.94	104.64	106.02	102.62	98.30	102.79	98.21

Source: Dataquest (August 1997)

Chapter 6
Worldwide DRAM Wafer Fabrication Plant Production Capacity

Chapter 6 provides analysis of DRAM fab capacity. Dataquest uses the data in this chapter to test the information provided in the supplier surveys.

Table 6-1 provides the silicon capacity for each production facility in square millimeters of silicon per month.

Please note that Dataquest does not gather all the displayed production information from the manufacturers themselves. Dataquest performs an extensive fab survey in the third and fourth quarters of each year and updates this periodically through the year with articles from the general and trade press. Analyzing fab production could cause some confusion when accounting for contract production. Contract production (foundry) is production by one company under license from a second company for that second company to sell under its brand name. Table 6-1 credits capacity used for contract production under foundry, while the shipment information in the tables in Chapters 2 through 4 credit shipments by the purchaser of that foundry production. Nearly every semiconductor manufacturer performs some contract manufacturing. Thus, these analyses should not be used to determine any particular company's inventory or utilization.

What Has Changed since the Previous Report

Dataquest has made relatively minor changes to the fab section contained in the report.

Table 6-1
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Dominion Semiconductor	Module 1	Manassas VA	U.S.	64Mb DRAM	1997	28,000	200	0.25	-	-	-	-	879.6	879.6
Dominion Semiconductor Total						28,000			-	-	-	-	879.6	879.6
Fujitsu	Phase 1	Newton-Aycliffe	U.K.	4Mb 16Mb DRAM	1991	5,600	150	0.5	-	-	99.0	-	-	99.0
Fujitsu	Phase 2	Newton Aycliffe	U.K.	4Mb DRAM	1995	14,000	150	0.5	-	-	247.4	-	-	247.4
Fujitsu	No. 1	Gresham OR	U.S.	4Mb DRAM	1982	17,000	150	0.65	-	300.4	-	-	-	300.4
Fujitsu	No. 3	Isawa-Gun	Japan	4Mb DRAM SRAM ROM MPU	1987	50,000	150	0.8	-	-	-	-	-	-
Fujitsu	No. 4-1	Isawa-Gun	Japan	16Mb DRAM SGRAM	1990	20,000	150	0.42	-	-	-	353.4	-	353.4
Fujitsu	No. 4-2	Isawa-Gun	Japan	16Mb DRAM	1996	25,000	200	0.18	-	-	-	-	785.4	785.4
Fujitsu	No. 2	Kuwana-Gun	Japan	Log Arrays 4Mb DRAM	1987	10,000	150	0.8	-	-	-	-	-	-
Fujitsu	No. 3 Phase 1	Kuwana-Gun	Japan	4Mb 16Mb DRAM SRAM MPU	1992	15,000	150	0.5	-	-	265.1	-	-	265.1
Fujitsu	No. 3 Phase 2	Kuwana-Gun	Japan	16Mb 64Mb DRAM	1994	500	200	0.25	-	-	-	-	15.7	15.7
Fujitsu	No. 2	Gresham OR	U.S.	64Mb DRAM	1998	10,000	200	0.25	-	-	-	-	314.2	314.2
Fujitsu	Fab 2	Newton-Aycliffe	U.K.	16Mb 64Mb DRAM	1999	15,000	200	0.25	-	-	-	-	471.2	471.2
Fujitsu Total						182,100			-	300.4	611.4	353.4	1,586.5	2,851.8
Hitachi	E2	Landshut	Germany	16Mb DRAM	1993	16,000	200	0.35	-	-	-	502.7	-	502.7
Hitachi	U2	Irving TX	U.S.	1Mb 4Mb DRAM 256Kb SRAM MPU	1990	16,500	150	0.8	-	-	-	-	-	-
Hitachi	D1	Mobara-Shi	Japan	1Mb 4Mb DRAM LCD Driver	1982	25,000	125	1.3	306.8	-	-	-	-	306.8
Hitachi	D3	Mobara-Shi	Japan	4Mb DRAM	1990	15,000	150	0.8	-	-	-	-	-	-

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Hitachi	Chitose 1-1F	Chitose-Shi	Japan	4M DRAM MCU	1988	15,000	150	0.8	-	-	-	-	-	-
Hitachi	Chitose 1-2F	Chitose-Shi	Japan	4M DRAM MCU	1990	15,000	150	0.8	-	-	-	-	-	-
Hitachi	N2-1	Hitachinaka-Shi	Japan	16Mb DRAM	1994	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	R&D 2	Kodaira-Shi	Japan	MPU SRAM DRAM Arrays CBIC	1985	3,000	150	0.5	-	-	53.0	-	-	53.0
Hitachi	K2-1F	Nakakoma-Gun	Japan	4Mb DRAM SRAM MCU	1990	25,000	150	2	441.8	-	-	-	-	441.8
Hitachi	K4-3F	Nakakoma-Gun	Japan	4Mb DRAM 1Mb SRAM EPROM	1989	10,000	150	0.8	-	-	-	-	-	-
Hitachi	N1-1	Hitachinaka-Shi	Japan	1Mb 4Mb DRAM	1983	15,000	150	0.8	-	-	-	-	-	-
Hitachi	N2-2	Hitachinaka-Shi	Japan	16Mb 64Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	K2-2F	Nakakoma-Gun	Japan	16Mb DRAM	1995	10,000	200	0.5	-	-	314.2	-	-	314.2
Hitachi	Chitose 2	Chitose-Shi	Japan	64Mb DRAM	1998	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	N3/2F	Hitachinaka-Shi	Japan	64Mb DRAM	1998	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	N2/3F	Hitachinaka-Shi	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.35	-	-	-	471.2	-	471.2
Hitachi Total						220,500			748.6	-	367.2	2,230.5	-	3,346.3
Hitachi/Nippon Steel Semiconductor	Tampines	Singapore	Singapore	64Mb DRAM	1998	20,000	200	0.3	-	-	-	-	628.3	628.3
Hitachi/Nippon Steel Total						20,000			-	-	-	-	628.3	628.3
Hyundai	MOS Fab 1-A	Ichon	Korea	256K DRAM SRAM	1985	15,000	125	1	184.1	-	-	-	-	184.1
Hyundai	MOS Fab 2-A	Ichon	Korea	1Mb 4Mb DRAM	1986	15,000	150	0.65	-	265.1	-	-	-	265.1

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Hyundai	MOS Fab 3	Ichon	Korea	4Mb DRAM Telecom ICs ASIC	1989	20,000	150	0.5	-	-	353.4	-	-	353.4
Hyundai	MOS Fab 2-B	Ichon	Korea	4Mb DRAM	1992	20,000	150	0.5	-	-	353.4	-	-	353.4
Hyundai	MOS R&D	Ichon	Korea	DRAM	1989	3,000	150	0.25	-	-	-	-	53.0	53.0
Hyundai	Fab 4	Ichon	Korea	4Mb DRAM Telecom ICs ASIC	1993	10,000	200	0.35	-	-	-	314.2	-	314.2
Hyundai	Fab 5	Ichon	Korea	16Mb 64Mb DRAM	1994	25,000	200	0.35	-	-	-	785.4	-	785.4
Hyundai	Fab 6	Ichon	Korea	64Mb DRAM	1996	30,000	200	0.35	-	-	-	942.5	-	942.5
Hyundai	Oregon Fab	Eugene OR	U.S.	16Mb 64Mb DRAM	1998	30,000	200	0.25	-	-	-	-	942.5	942.5
Hyundai	Fab 7	Ichon	Korea	16Mb 64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
Hyundai	Phase 1	Dumfermline	U.K.	64Mb DRAM	1998	30,000	200	0.18	-	-	-	-	942.5	942.5
Hyundai	Phase 2	Dumfermline	U.K.	64Mb 256Mb DRAM			12	0.18	-	-	-	-	-	-
Hyundai Total						228,000			184.1	265.1	706.9	2,984.5	1,938.0	6,078.5
IBM Microelectronics		Corbeil-Essonnes	France	DRAM SRAM		25,000	125	1	306.8	-	-	-	-	306.8
IBM Microelectronics		Sindelfingen	Germany	DRAM SRAM DSP MPU Custom		25,000	125	1.5	306.8	-	-	-	-	306.8
IBM Microelectronics		Corbeil-Essonnes	France	1Mb DRAM	1989	7,000	200	0.8	-	-	-	-	-	-
IBM Microelectronics	Bldg. 963	Essex Junction VT	U.S.	4Mb DRAM MPU	1989	16,000	125	0.5	-	-	196.3	-	-	196.3
IBM Microelectronics	Bldg. 970	Essex Junction VT	U.S.	64Mb DRAM MPU Multimedia ICs	1988	24,000	200	0.35	-	-	-	754.0	-	754.0
IBM Microelectronics	Bldg. 973	Essex Junction VT	U.S.	16Mb DRAM	1989	20,000	200	0.5	-	-	628.3	-	-	628.3
IBM Microelectronics		Yasu-Gun	Japan	64Mb DRAM pDSP	1990	15,000	200	0.35	-	-	-	471.2	-	471.2

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
IBM Microelectronics	AMI'	Corbeil-Essonnes	France	64Mb DRAM	1997	15,000	200	0.2	-	-	-	-	471.2	471.2
IBM Microelectronics Total						147,000			613.6	-	824.7	1,225.2	471.2	3,134.7
IBM/Philips		Boeblingen	Germany	4Mb DRAM	1989	20,000	200	0.8	-	-	-	-	-	-
IBM/Philips Total						20,000			-	-	-	-	-	-
IBM/Siemens	ACL	Corbeil-Essonnes	France	16Mb 64Mb DRAM	1991	30,000	200	0.35	-	-	-	942.5	-	942.5
IBM/Siemens Total						30,000			-	-	-	942.5	-	942.5
Jinan	No. 2	Jinan	China	1Kb SRAM 4Kb DRAM	1989	8,000	75	5	35.3	-	-	-	-	35.3
Jinan Total						8,000			35.3	-	-	-	-	35.3
KTI Semiconductor	Fab 1	Nishiwaki-Shi	Japan	16Mb DRAM ASIC	1992	25,000	150	0.5	-	-	441.8	-	-	441.8
KTI Semiconductor	Fab 2	Nishiwaki-Shi	Japan	16Mb 64Mb DRAM ASIC	1996	5,500	200	0.35	-	-	-	172.8	-	172.8
KTI Semiconductor Total						30,500			-	-	441.8	172.8	-	614.6
LG Semicon	C1 Phase 1	Chongju-City	Korea	1Mb 4Mb DRAM	1990	30,000	150	0.5	-	-	530.1	-	-	530.1
LG Semicon	C1 Phase 2	Chongju-City	Korea	4Mb DRAM	1991	30,000	150	0.5	-	-	530.1	-	-	530.1
LG Semicon	C2 Phase 1	Chongju-City	Korea	16Mb DRAM	1993	15,000	200	0.35	-	-	-	471.2	-	471.2
LG Semicon	C1 Phase 3	Chongju-City	Korea	16Mb 64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
LG Semicon	C2 Phase 2	Chongju-City	Korea	16Mb DRAM	1995	25,000	200	0.35	-	-	-	785.4	-	785.4
LG Semicon	G2	Gumi-City	Korea	64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
LG Semicon	Phase 1	Newport	U.K.	64Mb DRAM 256Mb DRAM	1999	30,000	200		-	-	-	-	942.5	942.5
LG Semicon Total						190,000			-	-	1,060.3	3,141.6	942.5	5,144.4

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Matsushita	Fab C	Puyallup WA	U.S.	1Mb 4Mb DRAM 4-bit 8-bit MCU	1992	21,000	150	0.6	-	-	371.1	-	-	371.1
Matsushita	Kyoto R&D	Kyoto-Shi	Japan	DRAM	1991	500	200	0.25	-	-	-	-	15.7	15.7
Matsushita	S/C R6	Kadoma-Shi	Japan	16Mb 64Mb DRAM 64-bit MPU	1991	500	150	0.35	-	-	-	8.8	-	8.8
Matsushita	Fab B	Tonami-Shi	Japan	16Mb DRAM 16-bit MCU	1996	20,000	150	0.35	-	-	-	353.4	-	353.4
Matsushita	Fab C	Tonami-Shi	Japan	16Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Matsushita	Fab D	Tonami-Shi	Japan	16Mb 64Mb DRAM	1997	10,000	200	0.35	-	-	-	314.2	-	314.2
Matsushita	Fab D	Puyallup WA	U.S.	32-bit MRCO DSP 64Mb DRAM	1998	10,000	200	0.25	-	-	-	-	314.2	314.2
Matsushita Total						72,000			-	-	371.1	990.6	329.9	1,691.6
Micron Technology	Fab 3	Boise ID	U.S.	1Mb 4Mb 16Mb DRAM	1991	25,000	200	0.35	-	-	-	785.4	-	785.4
Micron Technology	Fab 1	Boise ID	U.S.	4Mb 16Mb DRAM VRAM SRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
Micron Technology	Fab 2	Boise ID	U.S.	16Mb 64Mb DRAM	1996	20,000	200	0.25	-	-	-	-	628.3	628.3
Micron Technology	Lehi Fab	Lehi UT	U.S.	64Mb DRAM	1999		200	0.25	-	-	-	-	-	-
Micron Technology Total						65,000			-	-	-	1,413.7	628.3	2,042.0
Mitsubishi		North Durham NC	U.S.	1Mb 4Mb DRAM	1990	9,000	150	0.5	-	-	159.0	-	-	159.0
Mitsubishi		Alsdorf	Germany	4MB 16MB DRAM	1997	7,000	200	0.35	-	-	-	219.9	-	219.9
Mitsubishi	B	Saijo-Shi	Japan	DRAM MCU	1984	39,000	125	0.9	478.6	-	-	-	-	478.6

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Mitsubishi	Sa2B	Saijo-Shi	Japan	64Mb DRAM EDRAM	1993	16,000	200	0.4	-	-	-	502.7	-	502.7
Mitsubishi	ULSI	Itami-Shi	Japan	16Mb 64Mb 256Mb DRAM ASIC Flash	1993	10,000	200	0.2	-	-	-	-	314.2	314.2
Mitsubishi	TA1	Kami-Gun	Japan	4Mb DRAM 1Mb SRAM ASSP	1990	30,000	150	0.7	-	530.1	-	-	-	530.1
Mitsubishi	D-1F	Kikuchi-Gun	Japan	16Mb 64Mb DRAM	1994	10,000	200	0.35	-	-	-	314.2	-	314.2
Mitsubishi	D-1F-2	Kikuchi-Gun	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.35	-	-	-	471.2	-	471.2
Mitsubishi	SA1F	Saijo-Shi	Japan	64Mb DRAM EDRAM EFlash	1997	15,000	200	0.3	-	-	-	-	471.2	471.2
Mitsubishi		Science Park	Taiwan	16Mb DRAM	1996	12,000	200	0.35	-	-	-	377.0	-	377.0
Mitsubishi Total						163,000			478.6	530.1	159.0	1,885.0	785.4	3,838.1
Mosel Vitelic	Fab 1A	Science Park	Taiwan	DRAM VRAM	1995	15,000	150	0.45	-	-	-	265.1	-	265.1
Mosel Vitelic	Fab 1B	Science Park	Taiwan	DRAM VRAM	1995	15,000	150	0.34	-	-	-	-	265.1	265.1
Mosel Vitelic Total						30,000			-	-	-	265.1	265.1	530.1
Nan Ya Technology	Fab 1	Tao Yuan	Taiwan	16Mb 64Mb DRAM	1996	30,000	200	0.45	-	-	-	942.5	-	942.5
Nan Ya Technology Total						30,000			-	-	-	942.5	-	942.5
NEC	Phase 1	Livingston	U.K.	DRAM SRAM MPU	1987	25,000	150	0.5	-	-	441.8	-	-	441.8
NEC	K-Line	Roseville CA	U.S.	DRAM ASIC MCU	1984	25,000	125	1	306.8	-	-	-	-	306.8
NEC	M-Line	Roseville CA	U.S.	16Mb DRAM	1991	35,000	150	0.5	-	-	618.5	-	-	618.5
NEC	Dif-1	Higashi Hiroshima-Shi	Japan	4Mb DRAM SRAM MPU 4Mb ROM	1990	30,000	150	0.6	-	-	530.1	-	-	530.1

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
NEC	G-1	Sagamihara-Shi	Japan	16Mb DRAM ASIC MPU 4Mb ROM	1988	10,000	150	0.8	-	-	-	-	-	-
NEC	Dif-5	Kumamoto-Shi	Japan	Logic DRAM MCU	1978	20,000	125	1.2	245.4	-	-	-	-	245.4
NEC	Dif-6	Kumamoto-Shi	Japan	1Mb DRAM MPU MCU Arrays	1987	30,000	150	1	530.1	-	-	-	-	530.1
NEC	Dif-7	Kumamoto-Shi	Japan	MCU 4Mb DRAM ASIC	1988	30,000	150	0.8	-	-	-	-	-	-
NEC	Dif-8 -1	Kumamoto-Shi	Japan	16Mb DRAM 4Mb SRAM RISC ASIC	1994	60,000	200	0.35	-	-	-	1,885.0	-	1,885.0
NEC	Dif-3	Otsu-Shi	Japan	SRAM 4Mb DRAM Micro ASIC	1983	17,000	150	1	300.4	-	-	-	-	300.4
NEC	Dif-1	Asa-Gun	Japan	4Mb DRAM 1Mb SRAM MPU FLASH	1988	45,000	150	0.8	-	-	-	-	-	-
NEC	Dif-2 (Bldg.C)	Asa-Gun	Japan	4Mb 16Mb DRAM ASIC	1993	45,000	150	0.5	-	-	795.2	-	-	795.2
NEC	Phase 2	Livingston	U.K.	16Mb 64Mb DRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
NEC	Dif-2	Higashi Hiroshima-Shi	Japan	16Mb 64Mb DRAM ASIC RISC	1996	33,000	200	0.25	-	-	-	-	1,036.7	1,036.7
NEC		Beijing	China	MCU Logic 4Mb 16Mb DRAM ASIC	2000	5,000	150	0.4	-	-	-	88.4	-	88.4
NEC Total						430,000			1,382.8	-	2,385.6	2,601.6	1,036.7	7,406.8
Nippon Silicon				16Mb DRAM	1990			0.6	-	-	-	-	-	-
Nippon Silicon Total						-			-	-	-	-	-	-

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Nippon Steel Corporation	Electronics Lab	Sagamihara-Shi	Japan	**ASIC 16Mb 64Mb DRAM**	**1991**	**500**	**150**	**0.35**	-	-	-	**8.8**	-	**8.8**
Nippon Steel Corporation Total						500			-	-	-	8.8	-	8.8
Nippon Steel Semiconductor	M2	Tateyama-Shi	Japan	1Mb 4Mb DRAM Flash Logic	1988	12,000	150	0.6	-	-	212.1	-	-	212.1
Nippon Steel **Semiconductor**	M3	Tateyama-Shi	Japan	4Mb 16Mb DRAM	1990	20,000	150	0.5	-	-	353.4	-	-	353.4
Nippon Steel Semiconductor	N1	Tateyama-Shi	Japan	16Mb 64Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Nippon Steel Total						42,000			-	-	565.5	314.2	-	879.6
Oki	S2	Kurokawa-Gun	Japan	16Mb 64Mb DRAM	1996	15,000	**200**	0.3	-	-	-	-	471.2	471.2
Oki	S1	Kurokawa-Gun	Japan	4Mb DRAM 1Mb SRAM 16Mb ROM	1981	30,000	**150**	**0.5**	-	-	530.1	-	-	530.1
Oki	M2	Miyazaki-Gun	Japan	1Mb DRAM 256K SRAM 4Mb ROM	1991	60,000	125	0.8	-	-	-	-	-	-
Oki	M3	Miyazaki-Gun	Japan	4Mb 16Mb DRAM	1967	30,000	150	0.4	-	-	-	530.1	-	530.1
Oki	V3	Hachioji-Shi	Japan	16Mb 64Mb DRAM Micro Gate Array	1989	2,000	150	0.5	-	-	35.3	-	-	35.3
Oki	U1	Hachioji-Shi	Japan	64Mb 256Mb DRAM Micro Logic	1992	1,000	**150**	**0.3**	-	-	-	-	17.7	17.7
Oki Total						138,000			-	-	565.5	530.1	488.9	1,584.5
Powerchip (Elitegroup)	Fab 1	Science Park	Taiwan	16Mb DRAM	1996	25,000	200	0.4	-	-	-	785.4	-	785.4

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Powerchip (Elitegroup) Total						25,000			-	-	-	785.4	-	785.4
ProMOS Technologies	Fab 2	Science Park	Taiwan	16Mb 64Mb 256Mb DRAM SRAM	1998	20,000	200	0.25	-	-	-	-	628.3	628.3
ProMOS Technologies Total						20,000			-	-	-	-	628.3	628.3
Samsung	Fab 4	Kiheung-Up	Korea	Alpha 4Mb DRAM SRAM EDRAM	1990	35,000	150	0.5	-	-	618.5	-	-	618.5
Samsung	Fab 5	Kiheung-Up	Korea	Alpha 4Mb DRAM SRAM EDRAM	1993	25,000	200	0.5	-	-	785.4	-	-	785.4
Samsung	Fab 6	Kiheung-Up	Korea	16Mb 64Mb DRAM	1995	30,000	200	0.35	-	-	-	942.5	-	942.5
Samsung	Fab 7	Kiheung-Up	Korea	16Mb 64Mb DRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
Samsung	Fab 8	Kiheung-Up	Korea	64Mb DRAM	1997	25,000	200	0.3	-	-	-	-	785.4	785.4
Samsung		Austin TX	U.S.	64Mb DRAM	1998	25,000	200	0.3	-	-	-	-	785.4	785.4
Samsung Total						160,000			-	-	1,403.9	1,570.8	1,570.8	4,545.5
Sanyo	A 1	Ojiya-Shi	Japan	1Mb 4Mb DRAM 4-bit 8-bit MCU DSP	1985	35,000	125	0.8	-	-	-	-	-	-
Sanyo	C 2	Ojiya-Shi	Japan	DRAM	1994	25,000	150	0.85	441.8	-	-	-	-	441.8
Sanyo Total						60,000			441.8	-	-	-	-	441.8
Sharp	Factory 2	Fukuyama-Shi	Japan	16Mb MROM DRAM SRAM	1989	40,000	150	0.6	-	-	706.9	-	-	706.9
Sharp	Factory 4	Fukuyama-Shi	Japan	Flash 64Mb DRAM	1998	16,000	200	0.25	-	-	-	-	502.7	502.7
Sharp Total						56,000			-	-	706.9	-	502.7	1,209.5

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Siemens	H15, H16, H17	Regensburg	Germany	1Mb 4Mb DRAM EDRAM ASIC ASSP	1986	46,600	150	0.35	-	-	-	823.5	-	823.5
Siemens	SIMEC (Lines 1 & 2)	Dresden	Germany	16Mb 64Mb DRAM	1996	30,000	200	0.25	-	-	-	-	942.5	942.5
Siemens		North Tyneside	U.K.	DRAM ASIC	1997	25,000	200	0.25	-	-	-	-	785.4	785.4
Siemens Total						101,600			-	-	-	823.5	1,727.9	2,551.4
Sony	3G	Isahaya-Shi	Japan	1Mb SRAM 4Mb VRAM CCD Logic	1991	25,000	150	0.5	-	-	441.8	-	-	441.8
Sony Total						25,000			-	-	441.8	-	-	441.8
Sumitomo Metal Industries		Amagasaki-Shi	Japan	4Mb DRAM Arrays	1991	300	150	0.8	-	-	-	-	-	-
Sumitomo Metal Industries Total						300			-	-	-	-	-	-
TSMC	Fab 3	Science Park	Taiwan	DRAM SRAM ROM Log Custom	1995	30,000	200	0.35	-	-	-	942.5	-	942.5
TSMC Total						30,000			-	-	-	942.5	-	942.5
Tech Semiconductor	Fab 1	Singapore	Singapore	16Mb DRAM	1993	12,000	200	0.5	-	-	377.0	-	-	377.0
Tech Semiconductor	Fab 2	Singapore	Singapore	16Mb DRAM	1996	25,000	200	0.35	-	-	-	785.4	-	785.4
Tech Semiconductor Total						37,000			-	-	377.0	785.4	-	1,162.4
Texas Instruments	AMOS-1	Avezzano	Italy	4Mb 16Mb DRAM 4Mb Flash	1990	22,000	200	0.25	-	-	-	-	691.2	691.2
Texas Instruments	AMOS-2	Avezzano	Italy	16Mb DRAM	1996	20,000	200	0.25	-	-	-	-	628.3	628.3

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm) >0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Texas Instruments	DMOS 5 Phase 1	Dallas TX	U.S.	16Mb DRAM	1995	16,000	200	0.5	-	-	502.7	-	-	502.7
Texas Instruments	DMOS 5 Phase 2	Dallas TX	U.S.	64Mb 256Mb DRAM	1997	16,000	200	0.35	-	-	-	502.7	-	502.7
Texas Instruments	Miho 6	Inashiki-Gun	Japan	1Mb 4Mb DRAM ASSP MPU		15,000	150	0.8	-	-	-	-	-	-
Texas-Instruments	AMOS-3	Avezzano	Italy	Flash 64Mb 256Mb DRAM EDRAM	1999	6,600	12	0.18	-	-	-	-	0.7	0.7
Texas Instruments Total						95,600			-	-	502.7	502.7	1,320.2	2,325.5
Texas Instruments/Acer	Fab 1A	Science Park	Taiwan	4Mb DRAM	1991	22,000	150	0.5	-	-	388.8	-	-	388.8
Texas-Instruments/Acer	Fab 1B	Science Park	Taiwan	4Mb 16Mb DRAM	1995	25,000	200	0.35	-	-	-	785.4	-	785.4
Texas Instruments/Acer	Fab 2	Science Park	Taiwan	16Mb 64Mb DRAM	1999	50,000	200	0.25	-	-	-	-	1,570.8	1,570.8
Texas Instruments/Acer Total						97,000			-	-	388.8	785.4	1,570.8	2,745.0
Texas Instruments/Anam Electronics		Pupyong	Korea	DRAM DSPs	2002	25,000	200	0.25	-	-	-	-	785.4	785.4
Texas Instruments/Anam Total						25,000			-	-	-	-	785.4	785.4
Tohoku Semiconductor	Step 1	Sendai-Shi	Japan	1Mb DRAM MCU MPU	1988	7,500	150	1	132.5	-	-	-	-	132.5
Tohoku Semiconductor	Step 2	Sendai-Shi	Japan	4Mb DRAM MPU MCU	1991	10,000	150	0.8	-	-	-	-	-	-
Tohoku Semiconductor	Step 3	Sendai-Shi	Japan	16Mb DRAM	1995	15,000	200	0.35	-	-	-	471.2	-	471.2

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
									>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Tohoku Semiconductor Total						32,500			132.5	-	-	471.2	-	603.8
Toshiba	Bldg.108 D-2	Kawasaki-Shi	Japan	16Mb 64Mb DRAM Flash	1990	1,300	200	0.35	-	-	-	40.8	-	40.8
Toshiba	Y-Cubed, No. 1-Mod 1	Yokkaichi-Shi	Japan	4Mb 16Mb DRAM	1993	10,000	200	0.5	-	-	314.2	-	-	314.2
Toshiba	Y-Cubed, No. 1-Mod 2	Yokkaichi-Shi	Japan	4Mb 16Mb DRAM	1994	25,000	200	0.35	-	-	-	785.4	-	785.4
Toshiba	C-Cubed 3	Oita-Shi	Japan	MCU ASIC DRAM SRAM	1989	32,000	125	1	392.7	-	-	-	-	392.7
Toshiba	C-Cubed 4	Oita-Shi	Japan	4Mb 16Mb DRAM	1991	40,000	150	0.5	-	-	706.9	-	-	706.9
Toshiba	Y-Cubed, No. 2	Yokkaichi-Shi	Japan	16Mb 64Mb 256Mb DRAM	1996	28,000	200	0.35	-	-	-	879.6	-	879.6
Toshiba	Step 5	Kitakami-Shi	Japan	16Mb 64Mb DRAM Logic	1998	30,000	200	0.35	-	-	-	942.5	-	942.5
Toshiba	C-Cubed 5	Oita-Shi	Japan	256Mb DRAM	2000		200	0.18	-	-	-	-	-	-
Toshiba Total						166,300			392.7	-	1,021.0	2,648.4	-	4,062.1
TwinStar Semiconductor	TwinStar	Richardson TX	U.S.	16Mb 64Mb DRAM	1996	15,000	200	0.3	-	-	-	-	471.2	471.2
Twinstar Semiconductor Total						15,000			-	-	-	-	471.2	471.2
Vanguard International	Fab 1	Science Park	Taiwan	4Mb DRAM	1991	4,000	150	0.5	-	-	70.7	-	-	70.7
Vanguard International	Fab 1A	Science Park	Taiwan	4Mb 16Mb DRAM	1995	16,000	200	0.35	-	-	-	502.7	-	502.7
Vanguard International	Fab 1B	Science Park	Taiwan	16Mb DRAM	1999	16,000	200	0.35	-	-	-	502.7	-	502.7

Table 6-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

									Maximum Silicon Area Capacity (Millions of Sq. mm)					
Company	Fab Name	City	Country	Products	Start of Production	Maximum Starts	Maximum Diameter (mm)	Minimum Line Width (Micron)	>0.8µ	0.8-0.65µ	0.64-0.5µ	0.49-0.35µ	<0.35µ	Total
Vanguard International	Fab 2	Science Park	Taiwan	4Mb 16Mb DRAM 1Mb SRAM	1999	40,000	200	0.18	-	-	-	-	1,256.6	1,256.6
Vanguard International Total						76,000			-	-	70.7	1,005.3	1,256.6	2,332.6
White Oak Semiconductor	MOS 18	Richmond VA	U.S.	64Mb 256Mb DRAM	1998	25,000	200	0.18	-	-	-	-	785.4	785.4
White Oak Semiconductor Total						25,000			-	-	-	-	785.4	785.4
Winbond	Fab II	Science Park	Taiwan	DRAM	1992	35,000	150	0.5	-	-	618.5	-	-	618.5
Winbond	Fab IV	Science Park	Taiwan	16Mb 64Mb 256Mb DRAM	1999	15,000	200	0.35	-	-	-	471.2	-	471.2
Winbond Total						50,000			-	-	618.5	471.2	-	1,089.7
Total						**3,171,900**			**4,410.0**	**1,095.6**	**13,590.1**	**30,793.9**	**20,599.8**	**70,489.4**

Source: Dataquest (July 1997)

Appendix A
Definitions

Additional motherboards: PC motherboards that do not ship into brand-name PCs and thus are not counted by Dataquest's Computer Systems and Peripherals group. These numbers are based in part on Dataquest MPU shipments and analyst estimates of upgrade activity.

Demand: The number of shipments of a product that Dataquest estimates to be sustainable in a market at the price forecast by Dataquest for that time. If the price were lower, demand would increase. If the price were higher, demand would decrease. Demand is used to determine whether the market is undersupplied or oversupplied.

Desk PC: PCs designed to remain beside or underneath a user's desk surface and not designed to be moved readily from place to place.

Facsimile: A machine that scans and encodes a document into electrical signals, transmits these electrical signals over a telephone/data line, then reconstructs the signals to print an exact duplicate of the original document on paper at the receiving end (colloquially called a fax).

Industrial applications: All controller boards and equipment used in embedded industrial control and medical applications. These boards are not officially counted by Dataquest, and the numbers used in this survey are estimates based on processor shipment numbers, secondary sources, and primary inputs from industrial board producers.

Mobile PC: PCs that are completely self-contained and can be carried as a single unit, which includes a keyboard, a display, mass storage, and main system unit.

Mainframe computer: A general-purpose information system with a starting price range of $100,000 or more. CPU bit width ranges from 32 to 64 bits. The physical environment can be either with or without special environmental controls and requires full-time support by professional computer systems support staff. The number of concurrent users is 100 or more. Dataquest views a mainframe system shipment as the CPU, the basic storage configuration (not including direct-access storage devices), the native operating system (the system must be bootable), and the operator's console. Dataquest does not routinely count upgrades unless the system footprint changes. Mainframes can use either DRAM or SRAM for cache storage.

Midrange computer: Includes all systems that fall between workstations and mainframes. These are multiuser systems that may or may not run proprietary operating systems. Midrange products have a wide price range, from as low as $10,000 to more than $1 million. Dataquest has included microcomputers, minicomputers, and superminicomputers in this product segment in the past. With the evolution of client/server computing and the systems that define this paradigm, traditional midrange product categories are becoming obsolete. Hewlett-Packard's HP 9000 and HP 3000, Digital Equipment Corporation's VAX systems, and

the IBM AS/400 line are joined by the dedicated server products from suppliers such as Auspex Systems Inc., NetFRAME Systems Inc., and Tricord Systems Inc. to make up the midrange product category. Office systems, which are proprietary turnkey computing solutions common in Japan, are also included in the midrange category, as are systems designed as servers from workstation suppliers.

Oversupply: An indication of an oversupplied market is low prices and growing inventories.

Routers/internetworking: A shared media hub is a LAN device that connects multiple PCs through a single node on a network, allowing central control for optional functions such as wide area network (WAN) connectivity, multiple media support, multiple technology support, and network management. A router is a class of network controller that determines the best routing for data transmission between a transmitter (sender) and a receiver. Routers operate at layer 3 of the ISO-OSI model.

Set-top box: Cable converter boxes that sit on top of TVs and act as converter devices for cable television signals, telephone, or wireless networks to television sets. These boxes contain a general-purpose microprocessor or a high-powered digital signal processor capable of digital transmission, reception, and decompression. Set-top boxes can be analog or digital, but only digital set-top boxes contain appreciable DRAM content.

Storage: A collective term for computer hard disk drives and CD-ROMs, where DRAM is often used as a cache memory. Since static RAM (SRAM) is sometimes used in place of DRAM, the DRAM consumption for this category appears unusually low to account for limited DRAM penetration into this equipment segment.

Supercomputer: A high-performance computer designed for numerically intensive applications. It is a system priced at more than $2 million, mainly used for batch applications, scientific, engineering, and other computation-oriented problems, or other very numerically intensive applications. Supercomputers require special environmental controls and cooling techniques. Performance speeds range upward from 50 mflops. Supercomputers can use either DRAM or SRAM.

Telephone answering machine: Machines for individual telephone lines using either cassette tape or MOS memory technology for incoming and outgoing message storage. Only tapeless (digital) phone answering machines use MOS memory for storage. Tapeless answering machines can use either DRAM or flash memory.

Undersupply: An indication of an undersupplied market is long lead times, high prices, and product allocation.

Video game: Video game and CD-ROM players are microprocessor-based devices that are handheld or console-based and play video games housed on cartridges or CD-ROMs.

Workstation: Dataquest classifies workstations by a composite of features, including their hardware and software. Workstations are typically based on reduced-instruction-set computing (RISC) processor architecture with a high-performance bus structure, graphics, and operating system. In general, a workstation must come standard with integrated floating-point processing, integrated networking, and a 32-bit multitasking operating system, as well as offer a configuration that has high-resolution graphics capabilities (typically 1-megapixel display). Dataquest does not determine a workstation architecture by its usage (that is, single-user, server, or multiuser). Instead, computers are classified by the primary market for which they are designed.

For More Information...

James Seay, Market Research Analyst ..... (408) 468-8259
Internet address ..... james.seay@dataquest.com
Via fax ..... (408) 954-1780
Dataquest Interactive ..... http://www.dataquest.com

Dataquest
A Gartner Group Company

DATAQUEST WORLDWIDE OFFICES

NORTH AMERICA

Worldwide Headquarters
251 River Oaks Parkway
San Jose, California 95134-1913
United States
Phone: 1-408-468-8000
Facsimile: 1-408-954-1780

East Coast Research Center
Nine Technology Drive
P.O. Box 5093
Westborough, Massachusetts 01581-5093
United States
Phone: 1-508-871-5555
Facsimile: 1-508-871-6262

Dataquest Global Events
3990 Westerly Place, Suite 100
Newport Beach, California 92660
United States
Phone: 1-714-476-9117
Facsimile: 1-714-476-9969

EUROPE

European Headquarters
Tamesis, The Glanty
Egham, Surrey TW20 9AW
United Kingdom
Phone: +44 1784 431 611
Facsimile: +44 1784 488 980

Dataquest France
Immeuble Défense Bergères
345, avenue Georges Clémenceau
TSA 40002
92882 - Nanterre CTC Cedex 9
France
Phone: +33 1 41 35 13 00
Facsimile: +33 1 41 35 13 13

Dataquest Germany
Martin-Kollar-Strasse 15
D-81829 München
Germany
Phone: +49 89 42 70 4-0
Facsimile: +49 89 42 70 4-270

JAPAN

Japan Headquarters
Aobadai Hills 4-7-7
Aobadai
Meguro-ku, Tokyo 153
Japan
Phone: 81-3-3481-3670
Facsimile: 81-3-3481-3644

ASIA/PACIFIC

Asia/Pacific Headquarters
Suite 5904-7, Central Plaza
18 Harbour Road, Wanchai
Hong Kong
Phone: 852-2824-6168
Facsimile: 852-2824-6138

Dataquest Korea
Suite 2407, Trade Tower
159 Samsung-dong, Kangnam-gu
Seoul 135-729
Korea
Phone: 822-551-1331
Facsimile: 822-551-1330

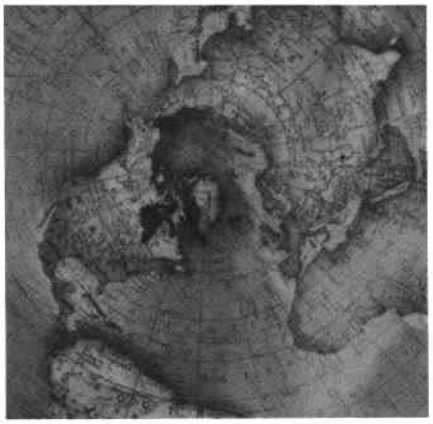
Dataquest Taiwan
11F-2, No. 188, Section 5
Nan King East Road
Taipei
Taiwan, R.O.C.
Phone: 8862-756-0389
Facsimile: 8862-756-2663

Dataquest Singapore
105 Cecil Street
#06-01/02 The Octagon
Singapore 069534
Phone: 65-227-1213
Facsimile: 65-227-4607

Dataquest Thailand
12/F, Vanissa Building
29 Soi Chidlom
Ploenchit Road
Patumwan, Bangkok 10330
Thailand
Phone: 662-655-0577
Facsimile: 662-655-0576

Dataquest Australia
80 Alfred Street
Milsons Point NSW 2061
Australia
Phone: 61-2-9941-4860
Facsimile: 61-2-9941-4868

Dataquest
A Gartner Group Company



Dataquest

DRAM Supply/Demand Quarterly Statistics: Second Quarter 1997 Outlook

Market Statistics

Program: DRAM Supply and Demand Quarterly Statistics Worldwide
Product Code: DSDR-WW-MS-97Q1
Publication Date: April 28, 1997
Filing: Market Statistics

DRAM Supply/Demand Quarterly Statistics: Second Quarter 1997 Outlook

Market Statistics

Program: DRAM Supply and Demand Quarterly Statistics Worldwide
Product Code: DSDR-WW-MS-97Q1
Publication Date: April 28, 1997
Filing: Market Statistics

Table of Contents

List of Figures

List of Tables

Chapter 1
Executive Summary

This report provides a second quarter 1997 outlook of the worldwide DRAM market based on the results of first quarter 1997 supplier surveys and related information. The report includes quarterly information through fourth quarter 1998.

Changed Market Conditions

Our DRAM supply-demand outlook has changed versus prior expectations largely because of a recent, abrupt change in 16Mb shipment projections. Led most visibly by Korean-based suppliers, some DRAM companies revised downward their supply of 16Mb DRAM starting in February 1997. These suppliers managed to control 16Mb DRAM shipments more skillfully than expected. The result? The worldwide DRAM market has moved, at least for the short term, closer to supply-demand balance than originally forecast. For example, Dataquest had expected DRAM bit shipments to exceed demand by more than 5 percent during the second and third quarters of 1997. By contrast, we now expect relatively close balance between DRAM supply and demand during these quarters.

The DRAM market remains as volatile as ever, so we view today's supply-demand balance as a "fragile balance." The impact of reduced 16Mb shipments varies across world regions, with sharper impact in Asia/Pacific, Japan, and Europe. To date, one hears the word "shortage" more frequently in those regions than in the Americas region.

Also, the recent dramatic market change has centered mostly on the so-called spot market. The large oversupply of 16Mb abruptly disappeared from the spot market by the end of February 1997—with concomitant strong upward pressure on spot pricing.

A sudden balance has also struck the 4Mb market. For example, 4Mb DRAM also recently disappeared from the spot market. Some companies are issuing "end of life" notices on 4Mb devices. Taiwan-based suppliers, however, remain a 4Mb "wild card." If Taiwanese suppliers increase 4Mb production and lower price aggressively, the 4Mb market could lose balance.

Alternatives to 16Mb DRAM

The process by which DRAM supply and demand recently tightened contributes to the fragile nature of the market balance. A large amount of 16Mb DRAM capacity exists today, but some suppliers strive not to use all of it. The range of tactics used by suppliers during first quarter 1997 to lower 16Mb DRAM supply likely included the following:

- Shifting wafer starts away from 16Mb DRAM to other products, such as ASICs
- Accelerating installation of 0.35-micron-capable equipment to DRAM fabs—but choosing to make 64Mb DRAM, not 16Mb devices
- Increasing 16Mb DRAM inventory versus selling into the spot market

These actions mean an increase in the 1997 and 1998 forecast of 64Mb supply, along with a lowered forecast of 16Mb shipments. Nevertheless, it is a challenge to "quantify" the near-term impact on DRAM supply of these actions. Because ample DRAM capacity exists, the focus of near-term attention centers on a metric that is difficult to gauge—inventory levels.

DRAM Inventory

A semiconductor supplier will typically not reveal an increase in its inventory because of the negative implications. The same supplier might comment more willingly, however, about increases in total market inventory. By contrast, suppliers are somewhat less consistent when discussing inventory decreases. Some suppliers cautiously report inventory decreases. Other suppliers, however, "publicly highlight" inventory decreases.

A stream of hard-to-verify DRAM inventory "reports" has issued since early March 1997. These reports often lack detail. The following summarizes DRAM inventory highlights as of early second quarter 1997:

- The DRAM inventory levels of Korea-based suppliers increased during February and March 1997 because narrow product portfolios hindered their ability to shift 16Mb DRAM capacity to non-DRAMproducts. As of now, their DRAM inventories are apparently declining to manageable levels.
- Japanese suppliers reduced their 16Mb DRAM inventory levels to the lowest possible level as the fiscal year ended on March 31, 1997. Their inventory levels were already lower than those of Korea-based suppliers because Japan-based suppliers had shifted some DRAM capacity to other products like gate arrays, microcontrollers, and other memory ICs. The 16Mb inventory decrease by Japan-based companies during March 1997 helped Korean suppliers because it reduced the market inventory.

If DRAM suppliers do successfully manage 16Mb DRAM inventory levels, the market should remain relatively balanced during midyear 1997. The current forecast operates on this assumption. If 16Mb DRAM inventories do not decrease during second quarter 1997, however, a large supply of 16Mb devices might flow into the market during the late second quarter or early third quarter. (The latter scenario would mean supply and demand will be more consistent with our prior expectations).

Meanwhile, an adequate supply of 16Mb DRAM devices remains available for first-tier contract buyers. Suppliers will negotiate vigorously for higher 16Mb pricing from major buyers, but a ready supply should remain available for key customers during 1997. Many suppliers now optimistically target a 16Mb contract price of $10 or more; this converts to a price of more than ¥1,200 at today's exchange rate.

64Mb Yields

The Korean and Japanese DRAM suppliers that are restraining 16Mb shipments will increase the production of 64Mb. Dataquest believes 64Mb DRAM yields are still quite low using standard wafers. The 64Mb yield problem stems from so-called latch-up, which is difficult to fix with

protection circuits in a conventional silicon chip. To increase 64Mb output this year, suppliers that focus on 64Mb devices must solve the low yield problem. To improve yields rapidly, they might have to switch to hydrogen-annealed wafers or epitaxial wafers. This wafer technology appears quite useful for solving the latch-up problem.

Dataquest expects the production of 64Mb to accelerate during second half 1997. In the initial stage of mass production, Japan-based and Americas-based suppliers likely will use epitaxial wafers. Korea-based suppliers have not yet indicated firm plans to use epitaxial wafers this year for 64Mb devices.

A Brighter 1997 Outlook?

In last quarter's report, we indicated there would be "some good news for DRAM suppliers following the challenge of 1996. For example, 16Mb DRAM yield efficiencies, among other factors, augur a somewhat brighter 1997 profit outlook for suppliers despite extremely competitive pricing." If current market conditions hold—and suppliers succeed on their goals of $10 to $12 contract prices—the 1997 DRAM profit outlook becomes quite bright. Otherwise, 1997 will be a good, but not great, year of DRAM market recovery.

Contributors: Masahiro Suzuki, Principal Analyst (Japan), Ronald Bohn, Principal Analyst (Worldwide and Americas), Jim Handy, Director and Principal Analyst (Worldwide and Americas), Yoshihiro Shimada, Principal Analyst (Japan), James Seay, Research Analyst (Worldwide and Americas), In-Hyung Baik, Research Analyst (Asia/Pacific and Korea), Sabrina Chiou, Research Analyst (Taiwan), Joe D'Elia, Director (Europe), Richard Gordon, Senior Industry Analyst (Europe), Chang Soo Kim, Senior Industry Analyst (Korea), and Jerry Yeh, Senior Industry Analyst (Taiwan)

Chapter 2
Production Statistics of 4Mb DRAM

This chapter provides estimates of 4Mb DRAM quarterly unit shipments by supplier. Tables show total 4Mb shipments (see Table 2-1) and shipments by organization (x1, x4, x8/9, and x16/18, located in Tables 2-2 through 2-5, respectively). Dataquest collects data through quarterly supplier surveys. These tables represent 4Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 4Mb DRAM. Average selling prices (ASPs) for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5. Following the configuration tables is an analysis of each vendor's shipments of x8/9, and x16/18, devices (see Table 2-6). Dataquest calls this the "wide-bit ratio."

What Has Changed since the Previous Report

This report now shows a 4Mb DRAM supply-and-demand balance for 1997 and 1998 (as opposed to the oversupply expectation of prior reports). The reason for the change is that Japan-based and Korea-based companies now produce 4Mb devices only on contract. Also, demand has migrated away from 4Mb devices to 16Mb parts. Micron Technology has issued an end-of-life notice on 4Mb DRAM, although shipments continue.

This report shows a slower rate of 4Mb DRAM price decrease than prior reports, in part because higher-priced video RAM now accounts for a higher percentage of the 4Mb market.

Undramatic changes have been made for 1997 and 1998 regarding 4Mb unit shipments.

Also, the former Tables 2-7 and 2-8 have been combined into a single table (which is now Table 2-7).

Table 2-1
4Mb DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	2.5	7.0	6.5	16.0	4.8	4.0	3.7	2.5	15.0	1.8	1.4	1.0	0.8	5.0
Fujitsu	20.5	17.0	10.5	12.0	60.0	6.0	5.4	4.5	4.5	20.4	3.6	3.6	3.0	3.0	13.2
Hitachi	30.5	28.0	27.0	23.0	108.5	23.0	22.0	20.0	12.0	77.0	12.0	11.0	10.0	10.0	43.0
Hyundai	38.8	32.2	24.0	22.0	117.0	18.3	15.2	11.5	12.0	57.0	10.0	8.3	6.9	5.8	31.0
IBM Microelectronics	19.5	15.8	13.8	11.5	60.6	5.8	3.7	2.3	1.1	12.9	0.4	0.2	0.1	0.1	0.6
LG Semicon	21.3	19.7	17.5	15.5	74.0	14.6	13.6	12.8	12.0	53.1	7.6	6.7	6.4	5.9	26.7
Matsushita	8.7	8.7	10.5	9.5	37.4	7.5	6.0	5.0	4.5	23.0	4.2	3.6	3.3	3.0	14.1
Micron Technology	61.5	62.5	41.0	25.0	190.0	15.0	8.0	4.2	2.8	30.0	1.3	0.9	0.5	0.5	3.2
Mitsubishi	19.2	18.6	14.5	11.2	63.5	10.5	10.5	10.5	9.0	40.5	9.0	7.5	7.5	6.0	30.0
Mosel Vitelic	3.2	9.4	26.0	26.0	64.6	20.0	18.0	3.5	6.5	48.0	6.5	4.5	4.5	5.5	21.0
Motorola	6.8	6.0	5.3	4.9	23.0	3.7	2.9	2.3	1.9	10.8	1.2	0.9	0.7	0.5	3.2
Nan Ya Technology	-	-	-	-	-	-	-	10.0	15.0	25.0	5.0	3.0	3.0	4.0	15.0
NEC	29.5	23.0	19.0	20.0	91.5	14.0	13.1	11.5	10.1	48.7	8.7	6.6	6.0	5.7	27.0
Nippon Steel Semiconductor	10.0	10.0	10.0	9.8	39.8	11.1	9.0	10.8	11.7	42.6	10.8	9.8	10.0	10.1	40.6
Oki	13.3	6.5	9.5	7.0	36.3	4.0	3.9	3.7	3.6	15.2	2.7	2.3	2.2	2.0	9.2
Samsung	27.1	21.4	25.0	26.0	99.5	21.4	13.6	12.6	9.0	56.6	8.5	8.0	7.0	7.0	30.5
Sharp	1.5	1.4	1.3	1.1	5.3	1.0	0.9	0.9	0.8	3.6	0.8	0.7	0.7	0.7	2.9
Siemens	10.0	10.0	13.0	12.0	45.0	13.0	13.5	15.0	16.5	58.0	16.5	15.5	13.0	10.0	55.0
Texas Instruments	33.0	29.9	25.1	18.5	106.5	14.1	12.4	10.2	9.1	45.8	6.0	3.1	1.5	1.0	11.6
Toshiba	22.0	16.0	14.0	9.0	61.0	8.1	6.9	6.4	5.8	27.1	5.5	5.5	5.5	5.5	22.0
Vanguard International	9.0	15.0	20.0	8.0	52.0	4.5	4.0	4.0	4.5	17.0	3.3	2.3	2.3	2.3	10.0
Worldwide Shipments	385.4	353.6	334.0	278.5	1,351.5	220.4	186.6	165.4	154.9	727.3	125.3	105.2	95.0	89.2	414.8
ASP ($)	8.57	5.14	3.47	3.16	5.30	3.07	3.06	3.13	3.10	3.09	3.10	3.10	3.11	3.14	3.11
Revenue ($M)	3,302.6	1,815.6	1,160.1	879.9	7,158.3	677.1	570.4	517.3	480.3	2,245.1	388.6	326.5	295.0	280.4	1,290.6
Demand	373.0	345.4	327.2	277.5	1,323.1	220.0	186.3	165.5	151.8	723.6	123.9	103.9	93.9	88.9	410.6
Sufficiency (%)	103.3	102.4	102.1	100.4	102.1	100.2	100.2	100.0	102.1	100.5	101.1	101.3	101.1	100.4	101.0

Source: Dataquest (April 1997)

Table 2-2
4Mbx1 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	1.0	0.9	0.5	0.5	2.9	0.3	0.3	0.4	0.4	1.3	0.4	0.4	0.3	0.3	1.3
Hitachi	2.5	2.3	2.0	1.7	8.4	1.5	1.5	1.2	0.6	4.8	0.6	0.6	0.5	0.5	2.2
Hyundai	4.7	4.2	2.9	2.6	14.4	0.7	0.5	0.3	0.4	1.9	0.4	0.3	0.3	0.2	1.2
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	2.1	2.0	1.6	1.1	6.8	1.0	1.0	0.9	0.8	3.7	0.5	0.5	0.4	0.4	1.9
Matsushita	0.7	0.7	0.8	0.7	2.9	0.5	0.4	0.3	0.2	1.4	0.2	0.2	0.2	0.2	0.7
Micron Technology	8.6	6.3	4.1	2.5	21.5	1.5	0.8	0.4	0.3	3.0	0.1	0.1	0.1	0.1	0.3
Mitsubishi	1.0	0.9	0.9	1.1	3.9	1.1	1.1	1.1	0.9	4.1	0.9	0.8	0.8	0.6	3.0
Mosel Vitelic	-	-	-	-	-	2.0	2.7	0.7	1.3	6.7	1.0	0.7	0.2	0.3	2.2
Motorola	1.8	1.4	1.2	1.0	5.5	0.7	0.5	0.4	0.3	1.9	0.2	0.1	0.1	0.1	0.5
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	3.5	2.8	2.1	2.0	10.4	1.3	1.2	0.9	0.6	4.0	0.4	0.3	0.3	0.3	1.3
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	0.6	0.6	0.6	0.6	0.6	0.6	2.4
Oki	1.3	0.7	1.0	0.7	3.6	0.3	0.3	0.3	0.3	1.2	0.2	0.1	0.1	0.1	0.6
Samsung	2.4	1.9	2.3	2.3	8.9	2.1	1.4	1.3	0.9	5.7	0.9	0.8	0.7	0.7	3.1
Sharp	-	-	-	-	-	0.1	0.1	0.1	0	0.2	0	0	0	0	0.1
Siemens	1.5	1.5	2.0	2.4	7.4	2.3	2.2	2.3	1.9	8.6	1.9	1.7	1.0	0.7	5.3
Texas Instruments	5.8	5.1	4.2	3.0	18.1	2.0	1.7	1.4	1.3	6.4	0.7	0.4	0.2	0.1	1.4
Toshiba	1.5	1.1	0.8	0.5	4.0	0.2	0.2	0.2	0.2	0.8	-	-	-	-	-
Vanguard International	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worldwide Shipments	38.4	31.6	26.2	22.2	118.5	17.7	15.6	12.0	10.9	56.3	9.1	7.5	5.7	5.1	27.4
ASP ($)	9.49	5.35	3.75	2.97	5.89	2.60	2.60	2.50	2.50	2.56	2.45	2.45	2.30	2.30	2.39
Revenue ($M)	364.7	169.3	98.2	66.0	698.3	46.0	40.6	30.0	27.3	144.0	22.2	18.3	13.2	11.8	65.6

Source: Dataquest (April 1997)

Table 2-3
1Mbx4 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	2.5	7.0	6.5	16.0	4.8	3.6	2.6	1.0	12.0	0.4	0.1	0.1	-	0.6
Fujitsu	12.3	9.7	5.1	6.6	33.7	3.0	1.9	1.4	1.4	7.6	0.7	0.7	0.6	0.6	2.6
Hitachi	14.0	12.9	12.2	10.4	49.4	9.9	8.8	7.0	3.8	29.5	3.6	3.1	2.5	2.5	11.7
Hyundai	22.1	18.0	12.5	11.2	63.8	7.7	6.1	4.3	4.3	22.3	3.4	2.8	2.4	2.0	10.5
IBM Microelectronics	17.7	14.0	12.0	9.0	52.7	3.8	2.2	1.1	0.5	7.5	0.1	0.1	0	0	0.2
LG Semicon	12.8	12.0	10.7	9.1	44.6	8.6	8.0	7.6	7.1	31.3	4.8	4.2	4.0	3.7	16.8
Matsushita	4.4	4.4	5.3	4.8	18.8	3.2	2.1	1.7	1.3	8.2	1.1	0.9	0.8	0.8	3.6
Micron Technology	46.1	46.6	30.8	17.5	140.9	10.5	5.6	2.9	2.0	21.0	0.9	0.6	0.4	0.4	2.2
Mitsubishi	9.2	8.9	7.0	4.5	29.6	3.7	3.7	3.7	3.2	14.2	3.2	2.6	2.6	2.1	10.5
Mosel Vitelic	0.2	4.4	16.0	12.0	32.6	8.0	6.3	1.2	2.3	17.8	1.0	0.5	0.5	0.3	2.2
Motorola	5.0	4.6	4.1	3.9	17.5	3.0	2.4	1.9	1.6	8.9	1.0	0.7	0.6	0.4	2.7
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	9.7	6.9	3.2	2.8	22.7	1.7	1.6	1.3	1.0	5.5	0.9	0.7	0.6	0.6	2.7
Nippon Steel Semiconductor	8.0	8.0	8.0	7.0	31.0	5.1	4.3	5.1	4.4	19.0	3.5	2.6	2.7	2.7	11.5
Oki	9.8	4.2	5.2	2.3	21.6	1.0	0.7	0.6	0.5	2.8	0.3	0.2	0.1	0.1	0.8
Samsung	9.5	7.6	8.8	8.3	34.2	7.3	4.6	4.8	3.4	20.1	3.1	3.0	2.6	2.6	11.3
Sharp	1.5	1.4	1.3	1.1	5.3	0.4	0.3	0.3	0.2	1.3	0.2	0.2	0.2	0.2	0.7
Siemens	6.0	6.0	7.8	6.6	26.4	7.3	7.6	8.1	8.8	31.8	8.6	7.8	6.5	4.8	27.6
Texas Instruments	22.4	20.4	16.9	11.8	71.5	8.6	7.2	5.7	5.1	26.6	3.1	1.5	0.7	0.4	5.7
Toshiba	12.1	8.0	5.6	3.2	28.9	3.2	1.9	0.8	0.4	6.3	-	-	-	-	-
Vanguard International	9.0	14.1	18.8	6.8	48.7	2.3	0.8	0.2	-	3.3	-	-	-	-	-
Worldwide Shipments	232.0	214.6	198.2	145.3	790.0	103.0	79.6	62.1	52.3	297.0	39.8	32.3	27.8	24.1	124.0
ASP ($)	8.28	4.77	3.13	2.84	5.03	2.40	2.35	2.31	2.26	2.34	2.22	2.22	2.18	2.18	2.20
Revenue ($M)	1,921.6	1,022.5	620.3	412.5	3,977.0	247.1	187.0	143.5	118.2	695.8	88.4	71.7	60.5	52.5	273.2

Source: Dataquest (April 1997)

Table 2-4
512Kx8/9 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	1.0	1.4	0.8	0.5	3.7	0.3	0.4	0.4	0.4	1.5	0.4	0.4	0.3	0.3	1.3
Hitachi	3.1	2.8	2.7	2.3	10.9	2.5	2.4	2.2	1.3	8.5	1.3	1.2	1.1	1.1	4.7
Hyundai	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	1.1	1.0	0.7	0.6	3.4	0.4	0.4	0.4	0.4	1.6	0.2	0.2	0.2	0.2	0.8
Matsushita	1.8	1.8	2.2	1.8	7.6	1.5	1.1	0.9	0.7	4.1	0.6	0.5	0.5	0.5	2.1
Micron Technology	0.6	0.3	-	-	0.9	-	-	-	-	-	-	-	-	-	-
Mitsubishi	1.0	0.9	0.9	1.1	3.9	1.1	1.1	1.1	0.9	4.1	0.9	0.8	0.8	0.6	3.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	7.1	5.5	4.8	4.6	22.0	3.4	3.1	2.8	2.4	11.7	2.2	1.6	1.5	1.4	6.7
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	0.3	0.3	0.2	0.2	1.0	0.1	0.1	0.1	0.1	0.5	0.1	0	0	0	0.2
Samsung	2.4	1.9	2.3	2.3	8.9	1.3	0.8	0.3	0.2	2.5	0.3	0.2	0.2	0.2	0.9
Sharp	-	-	-	-	-	0.2	0.2	0.2	0.1	0.6	0.1	0.1	0.1	0.1	0.4
Siemens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	3.0	2.6	2.4	2.2	10.2	2.1	2.0	1.6	1.5	7.2	1.0	0.5	0.2	0.1	1.8
Toshiba	0.4	0.5	0.6	0.5	2.0	0.6	0.5	0.4	0.4	1.9	0.4	0.4	0.4	0.4	1.5
Vanguard International	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worldwide Shipments	21.7	19.0	17.5	16.3	74.5	13.4	12.1	10.2	8.3	44.1	7.4	5.9	5.3	4.9	23.5
ASP ($)	9.10	5.50	4.13	3.29	5.74	2.82	2.71	2.62	2.56	2.69	2.49	2.45	2.41	2.40	2.44
Revenue ($M)	197.7	104.5	72.0	53.5	427.8	37.8	32.9	26.7	21.3	118.7	18.5	14.6	12.7	11.7	57.5

Source: Dataquest (April 1997)

Table 2-5
256Kx16/18 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	0.4	1.1	1.5	3.0	1.4	1.3	1.0	0.8	4.5
Fujitsu	6.2	5.1	4.0	4.4	19.7	2.4	2.8	2.4	2.4	10.1	2.2	2.2	1.8	1.8	7.9
Hitachi	11.0	10.1	10.2	8.7	39.9	9.0	9.3	9.6	6.2	34.2	6.5	6.2	5.9	5.9	24.4
Hyundai	12.0	10.0	8.6	8.1	38.8	9.9	8.7	6.9	7.3	32.8	6.2	5.2	4.3	3.6	19.2
IBM Microelectronics	1.8	1.8	1.8	2.5	7.9	2.0	1.5	1.2	0.7	5.4	0.3	0.1	0.1	0	0.4
LG Semicon	5.3	4.7	4.6	4.7	19.3	4.5	4.2	4.0	3.7	16.5	2.1	1.8	1.7	1.6	7.2
Matsushita	1.8	1.8	2.2	2.2	8.0	2.3	2.4	2.2	2.3	9.2	2.2	2.0	1.8	1.7	7.7
Micron Technology	6.2	9.4	6.2	5.0	26.7	3.0	1.6	0.8	0.6	6.0	0.3	0.2	0.1	0.1	0.6
Mitsubishi	8.1	7.8	5.8	4.5	26.2	4.7	4.7	4.7	4.1	18.2	4.1	3.4	3.4	2.7	13.5
Mosel Vitelic	3.0	5.0	10.0	14.0	32.0	10.0	9.0	1.6	2.9	23.5	4.6	3.4	3.8	5.0	16.7
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	10.0	15.0	25.0	5.0	3.0	3.0	4.0	15.0
NEC	9.1	7.8	8.9	10.6	36.5	7.7	7.2	6.6	6.1	27.5	5.2	3.9	3.6	3.4	16.2
Nippon Steel Semiconductor	2.0	2.0	2.0	2.8	8.8	6.0	4.7	5.7	6.6	23.1	6.7	6.6	6.7	6.7	26.7
Oki	1.9	1.3	3.1	3.8	10.1	2.6	2.8	2.7	2.7	10.8	2.2	1.9	1.9	1.7	7.7
Samsung	12.7	9.9	11.8	13.0	47.4	10.7	6.8	6.3	4.5	28.3	4.3	4.0	3.5	3.5	15.3
Sharp	-	-	-	-	-	0.3	0.4	0.4	0.4	1.5	0.4	0.4	0.4	0.4	1.6
Siemens	2.5	2.5	3.3	3.0	11.3	3.4	3.8	4.7	5.8	17.6	6.0	6.0	5.5	4.5	22.1
Texas Instruments	1.8	1.8	1.6	1.5	6.6	1.4	1.5	1.4	1.3	5.6	1.2	0.8	0.5	0.4	2.7
Toshiba	7.9	6.4	7.0	4.8	26.1	4.0	4.3	5.0	4.8	18.2	5.1	5.1	5.1	5.1	20.5
Vanguard International	-	0.9	1.2	1.2	3.3	2.3	3.2	3.8	4.5	13.8	3.3	2.3	2.3	2.3	10.0
Worldwide Shipments	93.2	88.3	92.2	94.8	368.5	86.3	79.2	81.1	83.4	330.1	69.0	59.5	56.2	55.1	239.8
ASP ($)	8.78	5.88	4.01	3.67	5.58	4.01	3.91	3.91	3.76	3.90	3.76	3.73	3.71	3.71	3.73
Revenue ($M)	818.5	519.3	369.5	347.9	2,055.2	346.2	309.9	317.0	313.6	1,286.6	259.5	221.9	208.6	204.4	894.3

Source: Dataquest (April 1997)

Table 2-6
4Mb Wide-Bit Ratio, 1996 to 1998 (Percentage of Total Company Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	10.0	29.7	60.0	20.0	80.0	90.0	95.0	100.0	89.0
Fujitsu	35.0	38.0	46.0	41.0	39.0	45.0	60.0	62.0	62.0	56.5	70.0	70.0	70.0	70.0	70.0
Hitachi	46.0	46.0	47.6	47.8	46.8	50.3	53.3	59.1	63.0	55.4	65.0	67.0	70.0	70.0	67.8
Hyundai	31.0	31.0	36.0	37.0	33.2	54.0	57.0	60.0	61.0	57.5	62.0	62.0	62.0	62.0	62.0
IBM	9.2	11.4	13.0	21.7	13.0	35.1	40.5	50.5	60.0	41.6	71.4	66.7	66.7	80.0	70.4
LG Semicon	30.0	29.0	30.0	34.0	30.6	34.0	34.0	34.0	34.0	34.0	30.0	30.0	30.0	30.0	30.0
Matsushita	41.4	41.4	42.2	42.8	42.0	50.6	58.7	61.1	66.0	58.0	68.0	70.0	70.0	70.0	69.4
Micron	11.0	15.5	15.0	20.0	14.5	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Mitsubishi	47.0	47.0	46.0	50.0	47.3	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
Mosel Vitelic	93.8	53.2	38.5	53.8	49.5	50.0	50.0	45.0	45.0	49.0	70.0	75.0	85.0	90.0	79.5
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NEC	55.0	58.0	72.0	76.0	63.9	79.0	79.0	81.0	84.0	80.5	85.0	85.0	85.0	85.0	85.0
Nippon Steel Semiconductor	20.0	20.0	20.0	29.0	22.2	54.0	52.0	53.0	57.0	54.1	62.0	67.0	67.0	67.0	65.7
Oki	16.0	25.0	35.0	57.0	30.5	68.0	74.0	76.0	78.0	73.9	83.0	84.0	88.0	88.0	85.5
Samsung	56.0	55.4	56.0	59.0	56.7	56.0	56.0	52.0	52.0	54.5	53.0	53.0	53.0	53.0	53.0
Sharp	-	-	-	-	-	50.6	58.7	61.1	66.0	58.7	68.0	70.0	70.0	70.0	69.4
Siemens	25.0	25.0	25.0	25.0	25.0	26.0	28.0	31.0	35.0	30.3	36.5	39.0	42.3	45.0	40.1
Texas Instruments	14.5	14.6	15.9	19.9	15.8	25.0	28.0	30.0	30.0	27.9	36.3	39.4	42.6	45.7	38.8
Toshiba	38.0	43.0	54.0	59.0	46.1	57.0	70.0	85.0	90.0	73.9	100.0	100.0	100.0	100.0	100.0
Vanguard	-	6.0	6.0	15.0	6.3	50.0	80.0	95.0	100.0	80.9	100.0	100.0	100.0	100.0	100.0
Total	29.8	30.4	32.8	39.9	32.8	45.3	49.0	55.2	59.2	51.4	61.0	62.2	64.7	67.2	63.5

Source: Dataquest (April 1997)

Table 2-7
4Mb Normalized Ratios, 1996 to 1998 (Percentage of Total Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
4Mbx1	10.0	9.0	7.8	8.0	8.8	8.0	8.4	7.3	7.0	7.7	7.2	7.1	6.1	5.8	6.6
1Mbx4	60.2	60.7	59.3	52.1	58.5	46.7	42.6	37.6	33.8	40.8	31.8	30.7	29.2	27.0	29.9
512Mbx8/9	5.6	5.4	5.2	5.8	5.5	6.1	6.5	6.2	5.4	6.1	5.9	5.6	5.5	5.5	5.7
256Mbx16/18	24.2	25.0	27.6	34.0	27.3	39.2	42.5	49.0	53.8	45.4	55.1	56.5	59.2	61.7	57.8
FPM DRAM	68.3	54.6	44.9	36.8	52.4	32.9	31.3	26.4	21.8	28.7	20.9	20.4	20.0	19.7	20.3
EDO DRAM	29.2	43.0	52.4	59.4	44.8	63.0	64.3	68.7	73.0	66.8	69.7	69.4	67.7	65.7	68.3
Synchronous DRAM	-	0.2	0.4	1.1	0.4	1.2	1.8	2.3	2.9	2.0	7.6	8.6	10.6	13.0	9.7
Next-Generation DRAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Display and Other DRAM	2.5	2.2	2.2	2.8	2.4	2.8	2.6	2.6	2.3	2.6	1.8	1.6	1.6	1.6	1.7
Americas Companies	31.3	33.0	27.6	23.8	29.3	19.7	16.6	13.7	11.2	15.7	8.5	6.1	3.9	3.2	5.7
Japan Companies	40.3	36.5	34.8	36.8	37.2	38.7	41.6	44.3	40.0	41.0	45.7	48.0	50.7	51.5	48.7
Europe Companies	2.6	2.8	3.9	4.3	3.3	5.9	7.2	9.1	10.7	8.0	13.2	14.7	13.7	11.2	13.3
Asia/Pacific Companies	25.8	27.6	33.7	35.0	30.1	35.8	34.5	32.9	38.1	35.3	32.6	31.1	31.7	34.1	32.3

Source: Dataquest (April 1997)

Chapter 3
Production Statistics of 16Mb DRAM

This chapter provides estimates of 16Mb DRAM quarterly unit shipments by supplier. Tables show total 16Mb shipments (see Table 3-1) and shipments by organization (x1, x4, x8/9, x16/18, and x32/36, located in Tables 3-2 through 3-6, respectively). Dataquest collects data through quarterly supplier surveys. These tables represent 16Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 16Mb DRAM. ASPs for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5. Following the configuration tables is an analysis of each vendor's shipments of x8/9, x16/18, and x32/36 devices (see Table 3-7). Dataquest calls this the "wide-bit ratio."

What Has Changed since the Previous Report

As noted, our outlook now calls for a relative balance of supply and demand in the 16Mb DRAM from second quarter 1997 through the end of 1998 (against the prior expectation of oversupply for most of the period).

For the quarters after first quarter 1997, 16Mb shipments by most Korean and Japanese suppliers have been reduced; by contrast, the 16Mb forecast for suppliers based in the Americas, Europe, or Taiwan are consistent with prior expectations or somewhat higher.

The forecast for 16Mb DRAM supply has been decreased for 1997 and 1998. For full-year 1997, the worldwide supply forecast of 16Mb devices now calls for 1.80 billion units (versus 1.85 billion in the prior forecast). For second quarter 1997, 16Mb supply has been decreased by 4 million units and for the third quarter by just over 30 million units. For fourth quarter 1997, supply has been decreased by 40 million units. For 1998, Dataquest now expects the worldwide supply of 16Mb DRAM to reach 2.25 billion units (while the prior forecast called for 2.5 billion units).

Dataquest now believes the production peak of 16Mb will be in the first quarter of 1998. (The prior forecast showed increased 16Mb shipments throughout each quarter of 1998.)

Expectations for 16Mb DRAM have been increased somewhat for 1997 but lowered for 1998. For full-year 1997, the worldwide demand forecast of 16Mb devices now calls for 1.78 billion units (versus 1.76 billion units in the prior forecast). For second quarter 1997, 16Mb demand has been increased by over 25 million units. The third quarter of 1997 demand outlook remains consistent with prior expectations. For fourth quarter 1997, however, demand has been decreased by over 40 million units.

For 1998, Dataquest now expects worldwide demand of 16Mb DRAM to reach 2.24 billion units (while the prior forecast called for 2.4 billion units).

Average selling prices for 16Mb DRAM now show a slower rate of decline than in the prior forecast because higher-priced synchronous DRAM (SDRAM) now represents a higher proportion of the 16Mb market.

Dataquest has combined normalized configuration and interface ratios, along with a regional contribution ratio (formerly provided in a figure), into one table (Table 3-8).

High and Low Range of the 16Mb DRAM Supply Forecast

In the prior report, Dataquest provided high and low estimates of 16Mb DRAM supply for 1997 and 1998.

Prior 16Mb High/Low Scenario

On the low side, we estimated 16Mb supply at just under 1.8 billion units for 1997. For 1998, the low estimate was about 2 billion units. On the high side, we estimated that the 1997 supply of 16Mb DRAM could exceed 2 billion units, while supply for 1998 could approach 3 billion units.

The result of changed market conditions is that our forecast now meshes with last quarter's *low end* estimate. As noted, our current forecast estimates 16Mb supply for 1997 at 1.80 billion units and for 1998 at 2.25 billion units. Note that Dataquest has increased its 64Mb DRAM supply forecast for 1997 and 1998 in part because of the transfer of some 16Mb capacity to 64Mb parts.

Current 16Mb High/Low Scenario

Current DRAM market trends, especially in the 16Mb market, reflect a high degree of market volatility. For this reason, the high/low range shows a wider spread than before.

The Low Side

A highly visible market issue has become the question of how low 16Mb supply can go. For 1997, 16Mb DRAM supply could be about 10 percent lower than our forecast—which translates to just over 1.6 billion units. This would occur if key suppliers successfully adhered to an aggressive 1997 program of 16Mb supply reduction. For 1998, assuming continuation of such a trend, 16Mb supply might be nearly 30 percent lower than the current forecast—meaning a low side estimate of just under 1.6 billion units.

The High Side

The high side potential should not be ignored, however, because the current 16Mb supply reduction efforts might not succeed. We should note that while Korea-based and Japan-based suppliers have lowered their 16Mb plans for 1997 and 1998, Americas-based and Taiwan-based suppliers have not and plan to increase 16Mb supply.

On the high side, 1997 supply of 16Mb DRAM might be about 10 percent higher than the current forecast. This means a high side 1997 forecast of nearly 2 billion units. For 1998, supply might be 15 percent above the current forecast—meaning a 1998 high side estimate of just under 2.6 billion units.

Table 3-1
16Mb DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	0.1	2.5	2.6	2.8	2.8	2.9	3.6	12.0	4.0	5.0	7.0	9.0	25.0
Fujitsu	10.0	10.5	12.5	13.1	46.1	21.0	24.0	25.5	27.0	97.5	27.0	24.0	24.0	21.0	96.0
Hitachi	20.7	24.6	31.2	45.0	121.5	45.0	46.0	47.0	42.0	180.0	42.0	39.0	39.0	39.0	159.0
Hyundai	20.5	25.0	27.9	29.9	103.4	33.0	33.0	33.0	35.0	134.0	34.0	39.0	45.0	51.0	169.0
IBM Microelectronics	4.7	6.4	9.1	14.0	34.1	14.5	14.7	14.6	17.2	60.9	19.9	20.2	21.5	23.4	85.0
LG Semicon	19.6	20.4	24.4	30.6	95.0	27.5	28.6	29.9	31.1	117.2	33.0	37.0	42.0	49.0	161.0
Matsushita	1.1	1.6	3.0	4.8	10.4	5.5	6.0	6.4	7.1	25.0	7.3	8.0	8.6	9.7	33.6
Micron Technology	1.0	1.5	10.5	20.0	33.0	30.0	37.0	41.0	49.0	157.0	49.8	51.3	53.0	55.5	209.5
Mitsubishi	11.7	15.3	20.2	24.7	71.9	30.0	27.0	24.0	18.0	99.0	18.0	18.0	18.0	18.0	72.0
Mosel Vitelic	0.3	0.2	0.2	0	0.7	0.3	0.5	0.8	1.4	3.0	4.0	6.5	9.0	10.5	30.0
Motorola	2.2	2.4	2.8	3.5	10.9	4.0	4.8	6.0	8.0	22.8	10.0	13.0	17.5	25.0	65.5
Nan Ya Technology	-	-	0.1	0.5	0.6	4.0	6.0	10.0	15.0	35.0	16.2	18.4	22.0	24.5	81.0
NEC	25.5	26.0	31.0	37.5	120.0	39.0	41.0	46.0	50.0	176.0	53.0	53.0	52.0	50.0	208.0
Nippon Steel Semiconductor	0.1	0.1	0.1	0.2	0.5	2.2	3.4	5.8	9.9	21.3	13.5	15.0	16.0	17.0	61.5
Oki	1.9	1.8	4.5	8.7	16.9	7.5	7.7	8.0	8.8	32.0	8.9	9.0	9.0	9.0	35.9
Samsung	39.0	43.0	45.0	59.7	186.7	53.0	53.0	54.0	55.0	215.0	56.0	57.0	58.0	61.0	232.0
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	4.0	5.0	6.0	10.0	25.0	12.0	17.5	27.5	43.0	100.0	43.0	44.5	45.5	47.0	180.0
Texas Instruments	16.5	19.8	27.9	37.6	101.8	38.6	40.0	43.5	49.0	171.1	44.9	46.7	49.3	51.6	192.5
Toshiba	14.3	15.3	19.0	23.0	71.6	25.3	25.0	25.0	25.0	100.3	21.0	21.0	21.0	21.0	84.0
Vanguard International	-	0.7	1.0	4.5	6.2	6.5	9.0	13.0	14.5	43.0	15.4	17.6	19.2	22.8	75.0
Worldwide Shipments	192.9	219.6	276.5	370.0	1,058.9	401.6	427.0	463.9	509.7	1,802.1	520.8	543.2	576.6	615.0	2,255.5
ASP ($)	36.39	18.29	11.92	9.67	16.91	8.53	8.09	7.85	7.73	8.02	7.67	7.58	7.57	7.52	7.58
Revenue ($M)	7,020.3	4,016.7	3,296.0	3,578.1	17,911.1	3,426.1	3,452.1	3,641.0	3,940.1	14,459.4	3,995.0	4,115.4	4,365.1	4,623.7	17,099.2
Demand	177.8	203.3	258.0	346.6	985.6	382.8	431.4	464.0	498.1	1,776.2	517.7	534.3	567.9	620.8	2,240.7
Sufficiency (%)	108.5	108.0	107.2	106.7	107.4	104.9	99.0	100.0	102.3	101.5	100.6	101.7	101.5	99.1	100.7

Source: Dataquest (April 1997)

Table 3-2
16Mbx1 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.1	0.1	0.1	-	0.3	-	-	-	-	-	-	-	-	-	-
Hitachi	1.4	1.5	1.6	1.8	6.3	1.8	1.8	1.9	1.7	7.2	1.3	1.2	0.8	0.8	4.0
Hyundai	0.4	0.3	-	-	0.7	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	0.2	0.2	-	-	0.4	-	-	-	-	-	-	-	-	-	-
Matsushita	0.5	0.5	0.5	0.5	2.0	0.5	0.5	0.5	0.5	2.0	0.4	0.5	0.4	0.5	1.8
Micron Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	0.7	0.8	0.8	1.0	3.3	1.2	1.1	0.7	0.5	3.5	0.5	0.5	0.5	0.5	2.2
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	1.0	0.8	0.6	0.8	3.2	0.8	0.8	0.5	0.5	2.6	0.5	0.5	0.5	0.5	2.1
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	0.2	0.1	0.3	0.5	1.1	0.4	0.4	0.3	0.3	1.3	0.2	0.2	0.2	0.2	0.7
Samsung	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	2.5	3.0	4.2	5.7	15.5	3.9	2.0	1.7	1.5	9.1	0.8	0.5	0.2	0.2	1.8
Toshiba	0.4	0.3	0.2	0.2	1.2	0.3	0.3	0.3	0.3	1.0	0.2	0.2	0.2	0.2	0.8
Vanguard International	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worldwide Shipments	7.5	7.6	8.4	10.5	33.9	8.8	6.9	5.9	5.2	26.7	4.0	3.6	2.9	2.9	13.4
ASP ($)	35.94	18.57	12.31	10.94	18.49	10.60	9.60	9.35	9.13	9.78	8.03	8.03	8.03	8.03	8.03
Revenue ($M)	268.3	140.6	103.0	114.5	626.5	92.7	65.8	55.0	47.5	261.0	31.9	29.1	23.3	23.5	107.8

Source: Dataquest (April 1997)

Table 3-3
4Mbx4 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	4.7	4.9	5.6	5.6	20.9	10.5	12.0	10.2	10.8	43.5	11.3	10.1	10.1	8.8	40.3
Hitachi	10.6	12.5	17.2	26.1	66.4	26.1	26.7	25.9	23.1	101.7	17.6	15.2	15.2	14.8	62.9
Hyundai	7.6	9.3	10.7	11.5	39.0	14.9	15.8	16.5	17.5	64.7	15.3	17.6	20.3	23.0	76.1
IBM Microelectronics	3.7	3.9	4.5	7.5	19.6	7.5	7.2	6.1	6.7	27.5	7.9	8.1	8.6	9.7	34.3
LG Semicon	6.5	6.5	7.8	9.8	30.6	11.6	13.5	15.0	17.1	57.1	14.5	16.3	18.5	21.6	70.8
Matsushita	0.3	0.5	0.8	1.1	2.7	1.2	1.3	1.4	1.5	5.4	1.5	1.7	1.8	1.9	6.9
Micron Technology	0.7	1.0	7.0	16.0	24.7	24.0	29.6	32.8	39.2	125.6	39.8	41.0	42.4	44.4	167.6
Mitsubishi	5.9	7.5	9.9	12.1	35.3	15.0	13.5	12.0	9.0	49.5	8.7	8.5	8.5	8.5	34.1
Mosel Vitelic	-	-	-	-	-	0	0.2	0.3	0.7	1.2	2.0	4.2	6.8	7.9	20.9
Motorola	2.2	2.3	2.7	3.4	10.6	3.9	4.6	5.5	7.0	21.0	8.3	10.4	13.4	18.4	50.5
Nan Ya Technology	-	-	0.1	0.5	0.6	4.0	6.0	6.3	10.0	26.3	6.8	5.2	6.8	8.2	26.9
NEC	6.4	6.5	11.2	13.9	37.9	14.4	14.8	16.1	17.5	62.8	17.0	15.9	15.6	15.0	63.5
Nippon Steel Semiconductor	-	-	-	-	-	-	-	0.2	4.0	4.2	8.1	9.0	9.6	10.2	36.9
Oki	1.3	1.4	3.5	5.0	11.2	5.7	5.9	6.4	7.4	25.4	7.7	7.9	8.1	8.2	31.9
Samsung	17.6	18.5	19.8	25.2	81.0	24.4	24.4	24.8	25.9	99.5	25.2	25.7	26.1	27.5	104.4
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	3.2	3.3	3.0	6.0	15.5	6.0	9.0	14.0	21.0	50.0	15.5	12.5	9.1	8.0	45.0
Texas Instruments	5.9	7.1	9.9	13.3	36.1	14.2	12.0	13.1	14.7	54.0	13.1	13.5	14.0	14.8	55.5
Toshiba	2.4	2.6	7.6	9.2	21.8	13.9	13.8	12.5	12.5	52.7	8.4	8.0	7.6	7.1	31.1
Vanguard International	-	-	-	-	-	-	-	6.7	9.1	15.8	10.0	12.3	13.4	17.0	52.7
Worldwide Shipments	78.8	87.7	121.3	166.1	453.9	197.3	210.1	225.7	254.7	887.7	238.7	242.8	255.8	274.8	1,012.1
ASP ($)	37.89	18.00	12.50	10.20	17.13	8.66	8.00	7.74	7.60	7.97	7.50	7.37	7.45	7.39	7.43
Revenue ($M)	2,985.7	1,579.3	1,515.7	1,694.7	7,775.3	1,708.4	1,680.8	1,746.8	1,935.6	7,071.5	1,790.3	1,789.6	1,906.0	2,030.6	7,516.4

Source: Dataquest (April 1997)

Table 3-4
2Mbx8/9 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	2.8	2.9	4.8	4.8	15.3	7.4	8.4	12.8	13.5	42.0	13.5	12.0	12.0	10.5	48.0
Hitachi	2.5	3.0	3.7	5.4	14.6	6.3	6.4	7.1	6.3	26.1	7.6	7.8	9.0	9.8	34.1
Hyundai	-	-	-	-	-	1.0	1.7	5.0	7.0	14.6	8.5	9.8	11.3	12.8	42.3
IBM Microelectronics	0.9	1.6	3.2	4.5	10.1	4.8	5.2	6.0	7.7	23.6	9.0	9.0	9.7	10.3	38.0
LG Semicon	-	-	-	-	-	1.1	2.3	4.5	6.2	14.1	9.2	10.4	11.8	13.7	45.1
Matsushita	0.1	0.2	0.5	1.2	2.0	1.4	1.6	1.7	2.0	6.7	2.0	2.3	2.5	2.9	9.8
Micron Technology	0	0.1	0.3	0.4	0.8	0.6	0.7	0.8	1.0	3.1	1.0	1.0	1.1	1.1	4.2
Mitsubishi	2.8	3.2	3.4	3.7	13.2	4.2	3.8	3.1	2.3	13.4	2.3	2.3	2.3	2.3	9.4
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	0.8	1.3	1.8	2.1	6.0
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	3.8	5.0	8.8	7.4	7.2	7.1	6.8	28.5
NEC	7.7	6.8	7.8	9.4	31.5	10.9	12.7	15.6	18.0	57.3	19.1	19.6	19.2	18.5	76.4
Nippon Steel Semiconductor	-	-	-	-	-	-	-	0.2	0.5	0.7	2.0	2.3	2.4	2.6	9.2
Oki	-	-	0.3	1.7	2.1	0.3	0.3	0.3	0.3	1.2	0.2	0.1	0.1	0.1	0.4
Samsung	5.9	6.5	6.8	8.7	27.8	5.3	9.0	9.2	8.8	32.3	14.0	14.3	14.5	15.3	58.0
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	0.4	0.5	0.4	0.6	1.9	0.7	1.1	2.2	6.0	10.0	12.9	17.8	23.2	27.1	81.0
Texas Instruments	2.5	3.0	4.2	5.7	15.4	7.0	7.2	8.3	9.3	31.8	8.6	8.9	9.4	9.7	36.7
Toshiba	0.9	0.9	1.1	1.4	4.3	2.0	1.3	1.0	1.0	5.3	0.6	0.6	0.4	0.4	2.1
Vanguard International	-	-	-	0.2	0.2	1.3	1.8	1.3	2.2	6.6	2.3	2.6	2.9	3.4	11.2
Worldwide Shipments	26.3	28.6	36.4	47.7	139.1	54.2	63.4	82.7	97.2	297.5	121.1	129.3	140.6	149.3	540.4
ASP ($)	32.56	20.63	11.65	9.56	16.74	9.00	8.65	8.28	8.18	8.46	8.11	8.06	8.00	7.96	8.03
Revenue ($M)	856.9	590.2	424.4	456.3	2,327.7	488.0	548.2	685.1	794.7	2,515.9	982.3	1,042.1	1,125.0	1,188.8	4,338.1

Source: Dataquest (April 1997)

Table 3-5
1Mbx16/18 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	0.1	2.5	2.6	2.8	2.8	2.9	3.6	12.0	4.0	5.0	7.0	9.0	25.0
Fujitsu	2.4	2.5	2.0	2.6	9.5	3.2	3.6	2.6	2.7	12.0	2.2	1.9	1.4	1.3	6.8
Hitachi	6.2	7.6	8.7	11.7	34.3	10.8	11.0	12.2	10.9	45.0	15.5	14.8	14.0	13.7	58.1
Hyundai	12.5	15.5	17.3	18.5	63.7	17.2	15.5	11.6	10.5	54.7	10.2	11.7	13.5	15.3	50.7
IBM Microelectronics	0.1	1.0	1.4	2.0	4.5	2.3	2.4	2.5	2.8	9.9	3.0	3.1	3.3	3.4	12.8
LG Semicon	12.9	13.7	16.6	20.8	64.0	14.9	12.9	10.5	7.8	46.0	9.2	10.4	11.8	13.7	45.1
Matsushita	0.2	0.3	1.1	2.1	3.8	2.4	2.6	2.8	3.1	10.9	3.3	3.5	3.9	4.4	15.1
Micron Technology	0.3	0.5	3.2	3.6	7.5	5.4	6.7	7.4	8.8	28.3	9.0	9.2	9.5	10.0	37.7
Mitsubishi	2.3	3.8	6.1	7.9	20.1	9.6	8.6	8.2	6.1	32.5	6.4	6.7	6.7	6.7	26.4
Mosel Vitelic	0.3	0.2	0.2	0	0.7	0.3	0.4	0.5	0.7	1.8	1.2	1.0	0.5	0.5	3.2
Motorola	0	0.1	0.1	0.1	0.3	0.1	0.2	0.5	1.0	1.8	1.7	2.6	4.1	6.6	15.0
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	2.0	6.0	8.0	9.5	25.5
NEC	10.5	12.0	11.5	13.5	47.4	12.9	12.7	13.8	14.0	53.4	16.4	17.0	16.6	16.0	66.0
Nippon Steel Semiconductor	0.1	0.1	0.1	0.2	0.5	2.2	3.4	5.5	5.5	16.5	3.4	3.8	4.0	4.3	15.4
Oki	0.4	0.3	0.4	1.4	2.5	1.1	1.1	1.0	0.9	4.0	0.9	0.8	0.6	0.5	2.9
Samsung	15.6	18.1	18.5	25.8	77.9	23.3	19.6	20.0	20.4	83.3	16.8	17.1	17.4	18.3	69.6
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	0.4	1.3	2.6	3.4	7.7	5.3	7.4	11.3	16.0	40.0	14.6	14.2	13.2	11.9	53.9
Texas Instruments	5.6	6.7	9.6	13.0	34.8	13.5	18.8	20.4	23.5	76.2	22.3	23.8	25.6	26.8	98.5
Toshiba	10.4	11.3	9.7	11.5	43.0	8.3	8.8	10.0	10.0	37.1	10.5	10.9	11.6	12.0	44.9
Vanguard International	-	0.7	1.0	4.3	6.0	5.2	7.2	5.0	3.1	20.5	3.1	2.6	2.9	2.5	11.1
Worldwide Shipments	80.2	95.5	110.0	144.9	430.7	140.6	145.6	148.3	151.4	585.9	155.7	166.2	175.4	186.3	683.6
ASP ($)	36.17	17.83	11.33	9.00	16.61	8.03	7.88	7.70	7.60	7.80	7.57	7.48	7.38	7.33	7.43
Revenue ($M)	2,901.7	1,702.7	1,246.8	1,304.3	7,155.5	1,129.1	1,147.6	1,142.1	1,150.5	4,569.3	1,178.6	1,242.9	1,294.8	1,365.4	5,081.7

Source: Dataquest (April 1997)

Table 3-6
512Kx32 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.4	0.9
Hitachi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toshiba	0.1	0.2	0.4	0.7	1.4	0.8	1.0	1.3	1.3	4.3	1.3	1.3	1.3	1.3	5.0
Vanguard International	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worldwide Shipments	0.1	0.2	0.4	0.7	1.4	0.8	1.0	1.3	1.3	4.3	1.3	1.3	1.7	1.7	5.9
ASP ($)	54.26	25.86	15.86	12.15	19.13	10.44	9.85	9.63	9.50	9.79	9.46	9.35	9.23	9.16	9.28
Revenue ($M)	7.8	4.0	6.0	8.4	26.1	7.9	9.9	12.0	11.9	41.7	11.9	11.8	16.1	15.4	55.1

Source: Dataquest (April 1997)

Table 3-7
16Mb Wide-Bit Ratio, 1996 to 1998 (Percentage of Total Company Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fujitsu	52.0	52.0	54.0	57.0	54.0	50.0	50.0	60.0	60.0	55.4	58.0	58.0	58.0	58.0	58.0
Hitachi	42.0	43.0	40.0	38.0	40.2	38.0	38.0	41.0	41.0	39.5	55.0	58.0	59.0	60.0	57.9
Hyundai	61.0	62.0	61.8	61.7	61.7	55.0	52.0	50.0	50.0	51.7	55.0	55.0	55.0	55.0	55.0
IBM	21.0	39.8	50.3	46.4	42.7	48.3	51.3	58.1	61.0	54.9	60.3	59.9	60.1	58.7	59.7
LG Semicon	66.0	67.0	68.0	68.0	67.4	58.0	53.0	50.0	45.0	51.3	56.0	56.0	56.0	56.0	56.0
Matsushita	25.0	36.0	55.0	68.0	55.1	69.0	70.0	70.0	72.0	70.3	73.3	73.3	73.9	75.7	74.2
Micron	33.0	33.3	33.0	20.0	25.1	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Mitsubishi	44.0	46.0	47.0	47.0	46.3	46.0	46.0	47.0	47.0	46.4	48.5	50.0	50.0	50.0	49.6
Mosel Vitelic	100.0	100.0	100.0	100.0	100.0	90.0	70.0	60.0	50.0	60.0	50.0	35.0	25.0	25.0	30.5
Motorola	1.8	2.2	2.4	2.8	2.4	3.5	4.3	8.3	12.0	7.9	16.8	20.1	23.3	26.3	22.8
Nan Ya Technology	-	-	-	-	-	-	-	37.5	33.3	25.0	58.2	71.9	68.8	66.7	66.7
NEC	71.0	72.0	62.0	61.0	65.8	61.0	62.0	64.0	64.0	62.9	67.0	69.0	69.0	69.0	68.5
Nippon Steel Semiconductor	100.0	100.0	100.0	100.0	100.0	100.0	100.0	97.0	60.0	80.5	40.0	40.0	40.0	40.0	40.0
Oki	21.0	17.0	16.0	36.0	27.0	19.0	18.0	16.0	13.0	16.4	12.0	10.0	8.0	7.0	9.2
Samsung	55.0	57.0	56.0	57.8	56.6	54.0	54.0	54.0	53.0	53.7	55.0	55.0	55.0	55.0	55.0
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	20.0	35.0	50.0	40.0	38.2	50.0	48.7	49.0	51.3	50.0	64.0	72.0	80.0	83.0	75.0
Texas Instruments	48.9	48.8	49.4	49.6	49.3	53.1	65.0	66.0	67.0	63.1	69.0	70.1	71.0	70.9	70.3
Toshiba	80.0	81.0	59.0	59.0	67.9	44.0	44.0	49.0	49.0	46.5	59.0	61.0	63.0	65.0	62.0
Vanguard	-	100.0	100.0	100.0	100.0	100.0	100.0	48.5	36.9	63.1	35.0	30.0	30.0	25.5	29.7
Total	55.3	56.6	53.1	52.3	53.9	48.7	49.2	50.1	49.0	49.3	53.4	54.6	55.1	54.8	54.5

Source: Dataquest (April 1997)

Table 3-8
16Mb Normalized Ratios, 1996 to 1998 (Percentage of Total Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
16Mbx1	3.9	3.4	3.0	2.8	3.2	2.2	1.6	1.3	1.0	1.5	0.8	0.7	0.5	0.5	0.6
4Mbx4	40.8	40.0	43.9	44.9	42.9	49.1	49.2	48.7	50.0	49.3	45.8	44.7	44.4	44.7	44.9
2Mbx8/9	13.6	13.0	13.2	12.9	13.1	13.5	14.8	17.8	19.1	16.5	23.3	23.8	24.4	24.3	24.0
1Mbx16/18	41.6	43.5	39.8	39.2	40.7	35.0	34.1	32.0	29.7	32.5	29.9	30.6	30.4	30.3	30.3
512Kx32/36	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3
FPM DRAM	60.9	35.8	25.2	18.3	31.5	11.2	8.6	6.8	5.7	7.9	4.1	3.8	3.3	3.0	3.5
EDO DRAM	36.5	60.3	68.0	69.1	61.0	65.8	63.0	51.5	47.3	56.2	39.1	35.1	29.4	26.5	32.2
Synchronous DRAM	2.2	2.7	5.5	11.1	6.3	22.0	27.4	40.5	45.8	34.8	54.9	59.2	65.5	68.5	62.4
Next-Generation DRAM	0.4	1.2	1.3	1.5	1.2	1.0	1.0	1.2	1.2	1.1	1.9	1.9	1.9	1.9	1.9
Display and Other DRAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Americas Companies	12.6	13.7	18.2	21.0	17.2	22.4	23.2	23.3	24.9	23.5	24.7	25.1	25.7	26.7	25.6
Japan Companies	44.2	43.3	44.0	42.4	43.3	43.7	42.2	40.5	36.9	40.6	36.6	34.4	32.5	30.0	33.3
Europe Companies	2.1	2.3	2.2	2.7	2.4	3.0	4.1	5.9	8.4	5.5	8.3	8.2	7.9	7.6	8.0
Asia/Pacific Companies	41.1	40.7	35.7	33.9	37.1	31.0	30.5	30.3	29.8	30.4	30.4	32.3	33.8	35.6	33.2

Source: Dataquest (April 1997)

Chapter 4
Production Statistics of 64Mb DRAM

This chapter provides estimates of 64Mb DRAM quarterly unit shipments by supplier. Tables show total 64Mb shipments (see Table 4-1) and shipments by organization (x4, x8/9, x16/18, and x32/36, located in Tables 4-2 through 4-5, respectively). Dataquest collects data through quarterly supplier surveys. These tables represent 64Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of total 64Mb DRAM. ASPs for the 64Mb family of DRAM come from Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5. Following the configuration tables is an analysis of each vendor's shipments of x8/9, x16/18, and x32/36 devices (see Table 4-6). Dataquest calls this the "wide-bit ratio."

Dataquest has combined normalized configuration and interface ratios along with a regional contribution ratio (formerly provided in a graph) into one table (Table 4-7).

What Has Changed since the Previous Report

Our outlook now calls for relative balance of supply and demand for 64Mb DRAM from second quarter 1997 through the end of 1998 (against the prior expectation of oversupply through first quarter 1998).

The forecast for 64Mb DRAM supply has been increased for 1997 and 1998. This results from the shift of some 16Mb capacity to production of 64Mb devices. For full-year 1997, the worldwide supply forecast of 64Mb parts calls for 0.09 billion units (versus 0.07 billion in the prior forecast). For third quarter 1997, supply has been increased by over 5 million units and for the fourth quarter of this year by 15 million units. For 1998, Dataquest now expects worldwide supply of 64Mb DRAM to total 0.35 billion units (while the prior forecast called for 0.27 billion units).

Expectations for 64Mb DRAM demand have been increased for 1997 and 1998. For full-year 1997, the worldwide demand forecast of 64Mb devices now calls for 0.09 billion units (versus 0.07 billion units in the prior forecast). The third quarter 1997 demand outlook for 64Mb parts has been increased to just over 25 million units (versus the prior expectation of less than 20 million units). For fourth quarter 1997, 64Mb DRAM demand has been increased to 44 million units (versus the prior expectation of 30 million units). For 1998, Dataquest expects worldwide demand for 64Mb DRAM to total 0.34 billion units (while the prior forecast called for 0.27 billion units).

High/Low Range of 64Mb DRAM Supply Forecast

As noted, Dataquest has increased its 64Mb DRAM supply forecast for 1997 and 1998.

The High Side Estimate

Under current market conditions, another highly visible market issue is the question of how high the 64Mb DRAM supply can go, especially in 1998. For 1997, 64Mb supply could be about 10 percent higher than our current forecast, which means a 1997 high side forecast just under 100 million units. The 64Mb up side potential this year is somewhat constrained because suppliers face a challenge to rapidly improve 64Mb yields, which are far lower than 16Mb yields.

By contrast, the 64Mb DRAM up side potential for 1998 is higher, should suppliers significantly improve 64Mb yields by early 1998. For 1998, 64Mb supply might be 25 percent higher than the current forecast, which means a 1998 high side forecast of nearly 420 million units.

The Low Side Estimate

The 1997 down side potential to 64Mb DRAM supply is relatively steep. Even assuming a sharp shift of capacity to 64Mb DRAM production, 64Mb yields might prove quite low this year. For 1997, 64Mb supply might be more than 20 percent lower than the current forecast, which means a 1997 low side forecast of 70 million units.

The 64Mb yields should improve considerably during 1998. On the low side, the 1998 supply of 64Mb DRAM might be about 10 percent lower than the current forecast, which means a low side estimate of just under 300 million units.

Table 4-1
64Mb DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	0.1	0.1	0.3	0.9	1.5	3.0	5.7	6.0	7.5	9.0	12.0	34.5
Hitachi	-	-	-	0.3	0.3	0.3	0.4	0.4	0.7	1.8	1.0	2.0	3.5	3.8	10.3
Hyundai	-	-	0.1	0.3	0.4	0.5	1.0	1.9	3.3	6.7	3.7	6.1	7.7	8.8	26.3
IBM Microelectronics	0	0.1	0.2	0.2	0.4	0.2	0.3	0.4	0.8	1.7	1.3	2.3	5.0	10.0	18.6
LG Semicon	-	-	0.1	0.3	0.4	0.6	1.0	1.9	3.1	6.5	3.5	4.5	6.0	8.5	22.4
Matsushita	-	-	-	-	-	-	-	0	0.1	0.1	0.3	0.9	1.2	1.8	4.2
Micron Technology	-	-	-	-	-	0	0	0	0	0.1	0.1	0.1	0.5	0.7	1.4
Mitsubishi	-	-	0	0.1	0.1	0.2	0.9	3.0	5.4	9.5	6.0	7.5	10.5	10.5	34.5
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1	0.1
Motorola	-	-	-	-	-	-	0	0	0.1	0.1	0.2	0.3	0.6	0.9	2.0
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	0.1	0.3	0.5	0.8	1.6
NEC	0	0.2	0.5	1.2	1.9	1.9	2.9	4.9	9.0	18.7	11.2	14.0	16.8	19.8	61.8
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	0.1	1.4	1.5
Oki	-	-	-	-	-	-	0.1	0.4	1.1	1.6	1.3	1.6	2.0	2.1	7.0
Samsung	0.1	0.3	0.6	1.5	2.5	3.0	5.0	7.0	12.0	27.0	13.1	15.0	17.3	20.6	66.0
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	0	0	0.1	0.1	0.1	0.2	0.5	0.8	1.5	1.0	1.5	2.5	5.0	10.0
Texas Instruments	-	0	0.1	0.2	0.3	0.5	1.0	1.7	2.5	5.7	2.9	3.5	4.3	5.5	16.1
Toshiba	-	-	0	0.1	0.1	0.3	1.0	2.0	3.0	6.3	4.0	5.0	6.0	7.0	22.0
Vanguard International	-	-	-	-	-	-	-	-	0	0	0.2	0.7	1.6	2.5	5.0
Worldwide Shipments	0.2	0.5	1.6	4.2	6.5	7.8	14.5	25.7	44.9	92.9	55.8	72.7	95.0	121.7	345.2
ASP ($)	139.10	121.60	106.80	95.00	101.19	75.00	65.17	59.77	54.76	59.65	43.77	39.78	34.27	36.50	37.75
Revenue ($M)	21.4	65.1	168.5	402.7	658.2	586.1	945.8	1,538.6	2,456.9	5,543.3	2,442.4	2,891.1	3,257.0	4,443.1	13,031.9
Demand	0.1	0.5	1.5	3.9	6.1	7.1	14.2	25.5	44.4	91.2	54.6	71.0	91.7	121.0	338.3
Sufficiency (%)	107.9	105.9	104.9	108.4	107.3	110.3	102.0	100.8	101.1	101.9	102.2	102.4	103.6	100.6	102.1

Source: Dataquest (April 1997)

Table 4-2
16Mbx4 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	0	0	0.1	0.1	0.2	0.3	0.6	0.3	0.4	0.5	0.6	1.7
Hitachi	-	-	-	0.2	0.2	0.2	0.2	0.3	0.4	1.2	0.6	1.0	1.6	1.5	4.6
Hyundai	-	-	0.1	0.2	0.3	0.4	0.7	1.3	2.1	4.6	1.7	2.7	3.5	3.8	11.6
IBM Microelectronics	0	0	0.1	0.1	0.2	0.1	0.1	0.2	0.3	0.7	0.5	0.9	2.0	4.3	7.8
LG Semicon	-	-	0.1	0.2	0.3	0.4	0.7	1.3	2.0	4.5	1.9	2.0	3.0	3.5	10.4
Matsushita	-	-	-	-	-	-	-	0	0.1	0.1	0.2	0.6	0.7	1.0	2.5
Micron Technology	-	-	-	-	-	0	0	0	0	0	0	0	0.1	0.2	0.4
Mitsubishi	-	-	0	0	0	0.1	0.6	2.0	3.2	6.0	3.3	3.8	4.7	4.2	16.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	0	0	0	0.1	0.1	0.1	0.2	0.3	0.7
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	0	0.1	0.4	0.5	1.0	0.6	0.7	1.2	2.3	4.8	2.2	2.8	3.4	4.0	12.4
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	0	0.5	0.5
Oki	-	-	-	-	-	-	0.1	0.2	0.6	0.9	0.7	1.0	1.3	1.4	4.4
Samsung	0.1	0.2	0.4	1.0	1.7	1.8	3.0	3.9	6.0	14.7	5.3	6.0	6.9	8.3	26.4
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	0	0	0	0.1	0.1	0.1	0.3	0.4	0.9	0.5	0.7	1.0	1.8	3.9
Texas Instruments	-	0	0	0	0.1	0.1	0.2	0.2	0.2	0.6	0.1	0	0	0	0.2
Toshiba	-	-	0	0.1	0.1	0.2	0.7	1.3	1.8	4.0	2.2	2.5	2.7	2.8	10.2
Vanguard International	-	-	-	-	-	-	-	-	-	-	0	0.1	0.2	0.3	0.5
Worldwide Shipments	0.1	0.4	1.1	2.6	4.2	4.2	7.3	12.3	19.8	43.6	19.6	24.6	31.8	38.3	114.3
ASP ($)	139.10	121.60	106.80	95.00	101.93	75.00	65.00	59.50	54.50	59.64	43.50	39.50	34.00	36.50	37.65
Revenue ($M)	16.9	48.5	120.1	244.6	430.0	312.3	477.6	734.7	1,076.9	2,601.5	851.3	972.4	1,080.4	1,398.8	4,302.9

Source: Dataquest (April 1997)

Table 4-3
8Mbx8/9 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	0.1	0.1	0.2	0.5	0.9	1.2	1.5	1.8	2.4	6.9
Hitachi	-	-	-	0.1	0.1	0.1	0.1	0.1	0.2	0.5	0.3	0.6	1.1	1.1	3.1
Hyundai	-	-	-	0.1	0.1	0.1	0.2	0.5	0.9	1.7	0.7	1.2	1.5	1.8	5.3
IBM Microelectronics	0	0	0	0.1	0.1	0.1	0.1	0.1	0.3	0.6	0.5	0.9	2.2	4.2	7.9
LG Semicon	-	-	-	0.1	0.1	0.1	0.2	0.5	0.9	1.7	0.9	1.1	1.2	1.8	4.9
Matsushita	-	-	-	-	-	-	-	0	0	0	0.1	0.3	0.4	0.6	1.5
Micron Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	0	0	0	0.1	0.2	0.9	1.6	2.8	1.7	2.0	2.6	2.1	8.5
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	0	0	0.1	0.5	0.7	1.0	1.5	2.0	2.7	7.1	3.1	3.2	3.0	3.0	12.4
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	0	0.4	0.5
Oki	-	-	-	-	-	-	-	0.1	0.4	0.5	0.4	0.4	0.4	0.4	1.6
Samsung	0	0.1	0.1	0.3	0.4	1.1	1.8	2.8	5.4	11.0	4.2	4.5	4.3	4.1	17.1
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	0	0	0	0	0	0	0.2	0.3	0.5	0.4	0.6	1.1	2.4	4.5
Texas Instruments	-	0	0	0.1	0.2	0.4	0.8	1.4	2.0	4.6	1.9	1.9	1.7	1.4	6.9
Toshiba	-	-	0	0	0	0.1	0.3	0.6	0.9	1.9	1.2	1.5	1.8	2.1	6.6
Vanguard International	-	-	-	-	-	-	-	-	-	-	0	0.2	0.8	1.8	2.8
Worldwide Shipments	0	0.1	0.3	1.2	1.6	2.9	5.3	9.4	16.1	33.7	16.8	20.0	24.1	29.5	90.4
ASP ($)	139.10	121.60	106.80	95.00	99.81	75.00	65.00	59.50	54.50	59.31	43.50	39.50	34.00	36.50	37.80
Revenue ($M)	4.1	13.7	32.0	112.9	162.7	217.3	344.2	559.6	877.6	1,998.8	729.0	790.9	818.7	1,077.4	3,416.1

Source: Dataquest (April 1997)

Table 4-4
4Mbx16/18 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	0	0	0.2	0.6	1.1	2.1	4.0	3.3	4.1	5.0	6.6	19.0
Hitachi	-	-	-	-	-	-	-	0	0.1	0.1	0.2	0.4	0.9	1.1	2.6
Hyundai	-	-	-	-	-	-	0	0.1	0.2	0.4	0.9	1.5	1.9	2.3	6.6
IBM Microelectronics	0	0	0	0.1	0.1	0.1	0.1	0.1	0.2	0.4	0.3	0.5	0.8	1.5	2.9
LG Semicon	-	-	-	-	-	-	0	0.1	0.2	0.3	0.7	1.1	1.5	2.5	5.8
Matsushita	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.2	0.2
Micron Technology	-	-	-	-	-	-	-	-	0	0	0	0.1	0.4	0.5	1.0
Mitsubishi	-	-	-	-	-	0	0	0.2	0.5	0.7	0.9	1.5	2.6	3.2	8.2
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.1	0.1
Motorola	-	-	-	-	-	-	0	0	0	0.1	0.1	0.2	0.4	0.6	1.2
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	0.1	0.3	0.5	0.8	1.6
NEC	-	-	0.1	0.1	0.2	0.3	0.6	1.2	3.2	5.3	4.5	6.3	8.4	9.9	29.1
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	0	0.5	0.5
Oki	-	-	-	-	-	-	-	0.1	0.2	0.2	0.2	0.2	0.3	0.3	1.0
Samsung	-	0	0.1	0.3	0.3	0.2	0.3	0.4	0.6	1.4	3.3	3.8	4.3	5.2	16.5
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	0	0	0.1	0.1	0.1	0.2	0.4	0.9	1.5
Texas Instruments	-	-	-	-	-	0	0	0.1	0.3	0.4	0.7	1.3	2.1	3.5	7.6
Toshiba	-	-	-	-	-	-	-	0.1	0.3	0.4	0.6	1.0	1.5	2.1	5.2
Vanguard International	-	-	-	-	-	-	-	-	0	0	0.2	0.4	0.6	0.5	1.7
Worldwide Shipments	0	0	0.2	0.5	0.7	0.8	1.7	3.4	7.9	13.8	16.0	22.8	31.6	42.0	112.4
ASP ($)	139.10	121.60	106.80	95.00	99.81	75.00	65.00	59.50	54.50	59.31	43.50	39.50	34.00	36.50	37.80
Revenue ($M)	0.3	2.9	16.5	45.2	65.5	56.5	109.2	202.7	431.2	815.6	693.9	900.6	1,075.9	1,533.0	4,248.1

Source: Dataquest (April 1997)

Table 4-5
2Mbx32 DRAM Quarterly Shipments by Vendor, 1996 to 1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	0	0.1	0.2	0.3	1.2	1.5	1.8	2.4	6.9
Hitachi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	0.4	0.6	0.8	1.0	2.8
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-	0.2	0.3	0.8	1.3
Matsushita	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	0.1	0.2	0.5	1.1	1.9
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	0.1	0.5	0.9	1.5	1.3	1.7	2.0	3.0	8.0
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	0.4	0.8	1.7	3.1	6.0
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	0	0	0.1	0.1	0.2	0.4	0.6	1.4
Toshiba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanguard International	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worldwide Shipments	-	-	-	-	-	-	0.2	0.6	1.1	1.9	3.5	5.2	7.5	11.9	28.2
ASP ($)	-	-	-	-	-	-	78.00	71.40	65.40	68.57	47.85	43.45	37.40	36.50	37.80
Revenue ($M)	-	-	-	-	-	-	14.8	41.6	71.1	127.5	168.1	227.2	282.0	434.0	1,064.8

Source: Dataquest (April 1997)

Table 4-6
64Mb Wide-Bit Ratio, 1996 to 1998 (Percentage of Total Company Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	45.0	45.0	80.0	90.0	90.0	90.0	89.5	95.0	95.0	95.0	95.0	95.0
Hitachi	-	-	-	20.0	20.0	20.0	30.0	35.0	40.0	33.5	45.0	50.0	55.0	60.0	54.9
Hyundai	-	-	-	20.0	15.0	20.0	23.0	32.0	35.0	31.3	55.0	55.0	55.0	57.1	55.7
IBM	26.2	34.2	45.0	59.7	48.7	60.0	60.0	61.0	61.2	60.8	60.1	60.1	59.8	56.8	58.2
LG Semicon	-	-	-	20.0	15.0	20.0	25.0	30.0	35.0	30.8	45.0	55.0	50.0	58.8	53.6
Matsushita	-	-	-	-	-	-	-	20.0	20.0	20.0	30.0	35.0	40.0	45.0	40.4
Micron	-	-	-	-	-	-	-	-	20.0	9.4	50.0	65.0	72.0	75.7	72.6
Mitsubishi	-	-	20.0	25.0	23.8	26.0	30.0	35.0	40.0	37.2	45.0	50.0	55.0	60.0	53.7
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	100.0	100.0	100.0
Motorola	-	-	-	-	-	-	42.0	45.5	46.2	45.6	52.1	57.8	63.4	65.6	62.6
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	100.0	100.0	100.0	100.0	100.0
NEC	20.0	20.0	30.0	55.0	45.0	68.0	75.0	75.0	75.0	74.3	80.0	80.0	80.0	80.0	80.0
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	65.0	65.0	65.0
Oki	-	-	-	-	-	-	-	43.0	50.0	45.1	46.0	38.0	35.0	33.0	37.1
Samsung	20.0	25.0	31.3	33.3	31.3	40.0	40.0	45.0	50.0	45.7	60.0	60.0	60.0	60.0	60.0
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	20.0	20.0	20.0	20.0	25.0	30.0	36.0	45.0	39.2	50.0	55.0	60.0	65.0	60.8
Texas Instruments	-	58.0	64.0	75.0	71.8	80.0	83.0	89.0	93.0	89.0	96.0	99.0	99.5	99.9	98.9
Toshiba	-	-	20.0	20.0	20.0	20.0	30.0	35.0	40.0	36.0	45.0	50.0	55.0	60.0	53.6
Vanguard	-	-	-	-	-	-	-	-	100.0	100.0	92.5	90.0	90.0	88.6	89.4
Total	20.8	25.5	28.8	39.3	35.1	46.7	49.4	52.0	56.0	53.1	64.9	66.1	66.6	68.5	66.9

Source: Dataquest (April 1997)

Table 4-7
64Mb Normalized Ratios, 1996 to 1998 (Percentage of Total Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
16Mbx4	79.2	74.5	71.2	60.7	64.9	53.3	50.6	48.0	44.0	46.9	35.1	33.9	33.4	31.5	33.1
8Mbx8/9	19.4	21.1	19.0	28.0	25.1	37.1	36.5	36.5	35.9	36.3	30.0	27.6	25.3	24.2	26.2
4Mbx16/18	1.4	4.4	9.8	11.2	10.1	9.6	11.6	13.2	17.6	14.8	28.6	31.4	33.3	34.5	32.6
2Mbx32/36	-	-	-	-	-	-	1.3	2.3	2.4	2.0	6.3	7.2	7.9	9.8	8.2
FPM DRAM	14.6	12.3	5.3	3.0	4.6	0.7	0.3	0.1	0.1	0.2	0	0	0.1	0.3	0.1
EDO DRAM	82.2	82.1	86.0	78.1	80.4	71.7	65.8	62.2	56.4	60.7	47.7	43.6	39.4	31.2	38.7
Synchronous DRAM	3.3	5.6	8.7	18.9	15.0	27.7	33.7	37.2	42.9	38.6	50.7	54.8	58.8	66.5	59.5
Next-Generation DRAM	-	-	-	-	-	-	0.2	0.5	0.6	0.5	1.5	1.6	1.7	2.0	1.7
Display and Other DRAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Americas Companies	13.4	14.0	12.9	8.7	10.3	8.9	9.0	8.3	7.6	8.1	7.9	8.5	10.8	14.1	11.0
Japan Companies	21.5	28.0	34.5	40.6	37.6	38.0	42.4	47.6	49.7	47.0	53.4	53.0	51.7	48.0	50.9
Europe Companies	-	1.9	1.9	1.2	1.4	1.3	1.0	1.9	1.7	1.6	1.8	2.1	2.6	4.1	2.9
Asia/Pacific Companies	65.1	56.1	50.7	49.5	50.7	51.8	47.6	42.1	41.0	43.3	36.9	36.5	34.8	33.8	35.2

Source: Dataquest (April 1997)

Chapter 5
Consumption of DRAMs by Application

This chapter provides details of Dataquest's DRAM demand analysis. Quarterly DRAM demand figures are derived from Dataquest's electronic equipment forecast generated by the Semiconductor Application Markets Worldwide program, as well as forecasts from Dataquest's Computer Systems and Peripherals group and Telecommunications group.

Table 5-1 shows the quarterly electronic equipment production forecast (the system forecast). Table 5-2 provides Dataquest's estimate of DRAM megabyte consumption for each type of system. Dataquest calls this "megabytes per system." Table 5-3 shows the number of bits of memory required by the entire market (the system forecasts times DRAM usage) and the memory module market. Table 5-4 provides DRAM demand for each application by DRAM density as well as total supply and demand by density and sufficiency in millions of 4Mb equivalent units.

What Has Changed since the Previous Report

Dataquest revised the systems forecasts contained in Table 5-1, except for the PC forecast. Dataquest plans to issue its new worldwide PC forecast subsequent to publication of this report. We expect undramatic changes in the worldwide PC forecast for 1997 and 1998. (The next DRAM Supply/Demand Quarterly Statistics Report will contain that forecast).

The content of the figures presented in Chapter 5 has changed considerably. Figures 5-1 though 5-4 now show supply and sufficiency for each DRAM density as well as for total bit supply and sufficiency.

Table 5-1
High-Volume Electronic Equipment Unit Production, 1996 to 1998 (Thousands of Systems)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Mainframes	2.4	2.4	2.5	2.7	10.1	2.4	2.4	2.5	2.7	10.1	2.2	2.2	2.3	2.5	9.3
Supercomputers	0.7	0.7	0.7	0.8	2.9	0.8	0.8	0.8	0.9	3.4	0.9	0.9	0.9	1.0	3.6
Midranges	181.4	181.4	189.0	204.1	755.9	203.7	203.7	212.1	229.1	848.6	229.2	229.2	238.7	257.8	955.0
Workstations	199.0	199.0	207.3	223.8	829.0	205.3	205.3	213.8	230.9	855.2	221.5	221.5	230.7	249.2	922.8
Personal Computers	16,354.0	16,300.0	17,239.7	22,126.8	72,020.5	19,251.5	19,166.2	20,486.0	25,889.3	84,792.9	22,554.4	22,222.8	23,689.8	29,993.2	98,460.3
Server Marketed	257.5	283.2	299.8	398.2	1,238.7	338.6	362.3	377.0	493.0	1,571.0	432.7	431.6	460.8	599.3	1,924.3
Transportables	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ultraportable and Notepads	186.7	205.2	260.9	311.3	964.1	333.8	333.7	384.9	454.2	1,506.5	498.2	429.1	496.8	658.5	2,082.6
Notebooks	2,422.1	2,417.2	2,726.4	3,352.4	10,918.0	2,902.2	2,890.0	3,198.2	3,939.9	12,930.3	3,474.0	3,353.9	3,660.8	4,448.7	14,937.3
Laptops	18.8	12.3	19.3	25.3	75.7	7.2	6.1	8.3	10.7	32.3	9.2	5.3	8.3	10.3	33.0
Desktops	9,926.9	9,464.5	10,117.0	13,110.6	42,619.0	11,395.6	11,258.0	12,018.5	15,346.3	50,018.3	13,215.6	13,035.8	13,791.6	17,554.6	57,597.6
Desksides	3,541.9	3,917.7	3,816.2	4,929.0	16,204.9	4,274.2	4,316.0	4,499.1	5,645.3	18,734.6	4,924.8	4,967.2	5,271.7	6,721.7	21,885.4
PC Upgrades	2,436.4	2,540.4	2,644.4	2,786.7	10,407.9	2,589.9	2,669.4	2,785.1	2,899.7	10,944.1	2,678.4	2,792.4	2,906.4	3,020.4	11,397.6
Memory Modules	19,079.5	19,271.3	19,424.7	22,387.7	80,163.1	22,842.2	23,024.1	24,132.5	25,058.2	95,057.0	25,983.9	26,909.6	27,835.3	28,761.0	109,489.8
Data Storage Devices	37,290.1	38,876.9	40,463.7	42,050.5	158,681.1	46,580.7	48,562.8	50,545.0	52,527.1	198,215.7	54,038.4	56,337.9	58,637.4	60,936.9	229,950.6
Printers	10,171.1	10,603.9	11,036.8	11,469.6	43,281.4	11,601.4	11,982.6	12,324.7	12,551.3	48,460.0	13,173.2	13,401.4	13,948.4	14,495.4	55,018.3
Facsimile	2,446.1	2,550.2	2,654.3	2,648.1	10,298.6	2,666.3	2,558.1	2,662.5	2,686.1	10,572.9	2,639.9	2,698.1	2,667.2	2,771.8	10,777.0
LAN Hubs/Internetworking	182.5	200.7	217.9	240.8	842.0	274.6	292.7	313.8	334.9	1,216.0	374.5	399.9	423.1	448.5	1,646.0
Telephones/Answering Machines	2,130.0	2,415.5	2,854.7	3,284.8	10,685.0	3,268.7	3,553.4	3,869.8	4,302.1	14,994.0	4,163.6	4,503.7	4,812.9	5,467.8	18,948.0
Industrial Applications	820.1	837.8	846.2	873.9	3,378.0	901.8	921.6	930.9	957.7	3,712.0	993.0	1,017.1	1,030.8	1,039.0	4,080.0
Digital Video Disc	2.7	2.8	2.9	56.6	65.0	297.7	310.3	500.8	611.2	1,720.0	910.4	949.2	1,170.3	1,439.1	4,469.0
Cable/Satellite Set-Top Boxes	1,230.6	1,409.2	1,703.9	1,732.3	6,076.0	2,095.3	2,317.5	2,545.7	2,702.4	9,661.0	3,072.5	3,332.5	3,648.0	3,891.9	13,945.0
Games (Systems and Cartridges)	4,431.7	4,620.3	4,808.8	4,540.1	18,400.9	4,414.8	4,602.6	4,790.5	4,978.3	18,786.2	5,636.8	5,371.6	5,590.0	5,371.6	21,970.0
8-Bit Video Games	32.4	21.4	10.8	13.7	78.3	14.0	13.6	12.8	13.2	53.5	12.1	10.2	9.3	8.3	39.8
16-Bit Video Games	1,031.8	730.9	530.8	372.3	2,665.8	338.3	235.4	194.4	146.3	914.4	115.3	84.5	66.4	51.9	318.0
CD-ROM Games	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RISC and Future Video Games	3,367.4	3,868.0	4,267.3	4,154.1	15,656.7	4,062.4	4,353.7	4,583.3	4,818.9	17,818.3	5,509.5	5,276.9	5,514.3	5,311.4	21,612.1
Other Games	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Applications	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Dataquest (April 1997)

Table 5-2
DRAM Consumption by Application, 1996 to 1998 (Megabytes per System)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Mainframes	1,380.0	1,630.0	1,850.0	2,138.0	1,762.2	2,520.0	2,990.0	3,190.0	3,260.0	3,000.1	3,540.0	3,790.0	4,000.0	4,150.0	3,879.7
Supercomputers	2,434.4	2,638.7	2,830.0	3,104.2	2,763.2	3,360.0	4,300.0	4,390.0	4,400.0	4,123.9	4,770.0	5,200.0	5,620.0	6,000.0	5,417.8
Midranges	71.0	94.0	122.0	157.2	112.5	184.3	208.0	230.0	254.0	220.2	315.0	348.0	384.0	419.0	368.3
Workstations	59.0	62.5	69.5	77.3	67.4	83.1	107.0	108.0	109.0	102.1	119.1	127.3	136.2	145.0	132.3
Personal Computers	18.2	19.3	20.6	21.1	19.9	24.3	25.9	27.6	28.8	26.8	33.1	35.0	36.4	36.5	35.4
Server Marketed	41.8	44.5	49.4	52.2	47.6	58.8	65.4	72.0	81.0	70.4	89.1	97.1	105.6	114.1	102.6
Transportables	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ultraportable and Notepads	10.4	11.3	12.6	13.8	12.3	15.3	16.2	17.5	19.1	17.2	21.0	22.9	24.3	25.8	23.7
Notebooks	10.7	11.7	13.0	14.2	12.6	15.8	16.7	18.0	19.7	17.7	21.7	23.6	25.0	26.6	24.4
Laptops	10.3	11.2	12.5	13.6	12.1	15.2	16.0	17.3	18.9	17.1	20.8	22.7	24.0	25.6	23.4
Desktops	19.0	19.9	21.4	21.6	20.6	25.0	26.5	28.2	29.1	27.4	33.9	35.4	36.7	36.2	35.6
Desksides	19.9	20.9	22.4	22.7	21.6	26.2	27.9	29.7	30.5	28.7	35.6	37.2	38.6	38.1	37.4
PC Upgrades	18.8	19.7	21.1	21.4	20.3	24.7	26.3	28.0	28.8	27.0	33.5	35.1	36.4	35.9	35.3
Memory Modules	6.1	6.4	7.7	8.0	7.1	10.4	12.0	13.6	14.7	12.7	15.6	16.3	17.0	20.6	17.4
Data Storage Devices	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.3	0.3	0.2	0.3	0.4	0.5	0.5	0.4
Printers	3.1	3.1	3.4	3.4	3.3	3.6	3.8	3.9	3.9	3.8	4.2	4.3	4.4	4.5	4.3
Facsimile	1.5	1.5	1.7	1.7	1.6	1.9	2.1	2.2	2.3	2.1	2.4	2.6	2.7	2.9	2.6
LAN Hubs/Internetworking	4.8	4.9	5.1	5.3	5.0	5.6	5.8	5.9	6.1	5.9	6.3	6.5	6.7	7.0	6.7
Telephones/Answering Machines	1.6	1.7	1.8	1.9	1.8	1.9	2.0	2.0	2.1	2.0	2.2	2.4	2.5	2.6	2.4
Industrial Applications	6.5	6.6	6.6	6.7	6.6	6.8	7.0	7.2	7.5	7.1	7.8	8.1	8.5	9.0	8.4
Digital Video Disc	1.3	1.3	1.4	1.5	1.5	2.1	3.6	3.9	4.0	3.6	4.8	5.2	5.3	5.4	5.2
Cable/Satellite Set-Top Boxes	1.3	1.5	1.7	1.7	1.6	1.9	2.1	2.1	2.2	2.1	2.2	2.3	2.3	2.3	2.3
Games (Systems and Cartridges)	3.0	3.4	4.0	4.0	3.6	4.4	5.0	5.1	5.2	4.9	5.5	5.7	5.9	6.1	5.8
8-Bit Video Games	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
16-Bit Video Games	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0.1	0	0	0	0	0
CD-ROM Games	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RISC and Future Video Games	3.9	4.0	4.5	4.4	4.2	4.8	5.3	5.3	5.3	5.2	5.6	5.8	6.0	6.2	5.9
Other Games	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PC + Module Megabytes per System	25.3	26.9	29.3	29.2	27.8	36.6	40.3	43.6	43.0	41.1	51.1	54.8	56.3	56.3	54.8

Source: Dataquest (April 1997)

Table 5-3
DRAM Consumption by Application, 1996 to 1998 (Billions of Bits Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Mainframes	28,083.1	33,170.6	39,216.3	48,947.1	149,417.2	51,348.2	60,925.0	67,708.6	74,729.9	254,711.8	66,287.9	70,969.2	78,022.4	87,424.1	302,703.7
Supercomputers	14,223.2	15,416.4	17,223.2	20,403.5	67,266.3	22,668.1	29,009.8	30,851.0	33,394.9	115,923.8	34,475.8	37,583.6	42,311.7	48,786.5	163,157.6
Midranges	108,049.8	143,051.8	193,398.9	269,135.2	713,635.7	314,884.5	355,338.6	409,294.3	488,163.5	1,567,681.0	605,636.9	669,064.6	769,062.7	906,292.4	2,950,076.6
Workstations	98,474.1	104,269.0	120,791.9	145,144.9	468,679.9	143,142.4	184,235.3	193,705.4	211,138.9	732,221.9	221,271.1	236,505.6	263,583.9	303,063.4	1,024,424.0
Personal Computers	2,496,028.9	2,632,496.4	2,982,347.1	3,925,401.0	12,036,273.3	3,921,174.4	4,163,436.4	4,735,614.9	6,249,198.2	19,069,424.0	6,270,343.5	6,524,970.6	7,233,243.9	9,194,897.7	29,223,455.7
Server Marketed	90,386.3	105,654.9	124,139.8	174,507.4	494,688.5	167,030.3	198,659.2	227,713.7	334,792.4	928,195.5	323,461.0	351,610.5	408,165.3	573,533.7	1,656,770.5
Transportables	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ultraportable and Notepads	16,258.8	19,535.3	27,644.0	35,913.3	99,351.5	42,908.7	45,291.3	56,498.5	72,727.8	217,426.3	87,882.9	82,395.9	101,217.7	142,750.2	414,246.8
Notebooks	217,402.3	237,235.3	297,779.1	398,765.1	1,151,181.9	384,656.9	404,381.4	483,980.2	650,424.0	1,923,442.5	631,801.1	663,974.4	768,944.9	994,157.0	3,058,877.5
Laptops	1,618.1	1,158.4	2,027.3	2,892.2	7,695.9	911.5	821.0	1,206.8	1,691.2	4,630.5	1,600.8	1,003.3	1,664.6	2,211.4	6,480.1
Desktops	1,578,856.8	1,581,522.2	1,812,769.0	2,375,566.6	7,348,714.7	2,386,997.0	2,505,646.4	2,847,122.1	3,743,585.0	11,482,350.5	3,755,953.6	3,875,448.5	4,248,217.6	5,336,662.9	17,216,282.6
Deskssides	591,506.6	687,390.3	717,987.8	937,756.3	2,934,640.9	939,670.0	1,008,637.1	1,119,093.7	1,445,977.8	4,513,378.6	1,469,644.1	1,550,537.9	1,705,033.7	2,145,582.5	6,870,798.2
PC Upgrades	383,623.6	420,258.8	469,094.4	499,878.8	1,772,855.7	536,843.4	588,173.2	653,184.3	700,285.9	2,478,486.8	753,614.3	821,859.6	886,299.9	909,016.8	3,370,790.7
Memory Modules	980,909.4	1,039,871.7	1,247,921.0	1,500,532.7	4,769,234.8	1,986,276.6	2,323,740.4	2,751,615.4	3,081,580.3	10,143,212.6	3,398,726.0	3,688,496.5	3,964,530.4	4,970,172.9	16,021,925.9
Data Storage Devices	25,188.6	30,664.0	36,585.2	43,038.2	135,476.0	61,828.7	96,140.4	116,176.6	137,035.8	411,181.5	158,184.3	191,600.8	226,392.5	256,728.9	832,906.5
Printers	263,857.1	280,155.3	311,326.0	324,841.6	1,180,180.1	351,859.6	378,384.8	403,286.4	411,677.1	1,545,207.9	459,092.7	483,625.8	517,435.7	546,360.6	2,006,514.8
Facsimile	29,815.9	32,590.2	36,961.1	38,833.5	138,200.6	42,496.8	43,990.0	48,963.3	51,648.6	187,098.7	53,620.0	58,168.1	60,633.9	66,964.4	239,386.4
LAN Hubs/ Internetworking	7,343.0	8,224.7	9,304.0	10,606.7	35,478.4	12,783.6	14,117.5	15,610.1	17,222.7	59,733.9	19,822.2	21,836.9	23,888.8	26,351.8	91,899.6
Telephones/Answering Machines	29,431.7	35,348.6	43,627.8	51,162.3	159,570.5	53,203.6	58,727.1	65,573.0	74,757.2	252,260.9	77,450.5	89,916.1	100,126.2	119,483.6	386,976.5
Industrial Applications	45,001.8	46,373.2	47,132.5	49,191.7	187,699.3	51,594.0	53,962.3	56,300.6	60,012.0	221,868.9	64,890.9	68,941.6	73,500.7	78,618.1	285,951.3
Digital Video Disc	29.2	31.1	34.7	704.5	799.6	5,223.7	9,371.7	16,383.0	20,722.4	51,700.8	36,345.9	41,380.0	52,473.9	65,193.4	195,393.1
Cable/Satellite Set-Top Boxes	13,662.6	17,217.1	24,127.4	24,863.8	79,870.9	32,618.4	41,214.8	45,700.0	48,875.0	168,408.3	57,850.6	63,290.6	69,665.4	74,599.7	265,406.3
Games (Systems and Cartridges)	111,330.3	130,275.1	162,577.4	153,497.5	557,680.2	164,092.4	191,855.1	203,477.9	215,284.1	774,709.6	259,100.0	256,072.5	276,924.8	274,840.9	1,066,938.2
8-Bit Video Games	17.1	11.5	5.8	7.4	41.7	7.5	7.3	6.9	7.1	28.7	6.5	5.5	5.0	4.4	21.4
16-Bit Video Games	525.0	395.5	291.9	198.9	1,411.3	169.6	110.3	84.7	60.7	425.3	46.0	32.4	25.0	19.1	122.5
CD-ROM Games	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RISC and Future Video Games	110,788.3	129,868.1	162,279.7	153,291.2	556,227.2	163,915.3	191,737.6	203,386.4	215,216.3	774,255.5	259,047.5	256,034.7	276,894.8	274,817.4	1,066,794.3
Other Games	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Applications	438.1	3,058.6	137,045.5	204,982.8	345,524.9	119,492.0	425,179.5	416,478.3	128,516.4	1,089,666.2	365,260.6	868,551.7	1,468,331.0	1,010,838.0	3,712,981.4
Total Demand	4,635,490.6	4,972,472.8	5,878,714.5	7,311,165.6	22,797,843.4	7,871,530.4	9,017,802.0	10,229,923.1	12,004,243.1	39,123,498.7	12,901,973.1	14,192,853.8	16,106,428.0	18,939,633.3	62,140,888.3
Personal Computer Share of Total	53.8	52.9	50.7	53.7	52.8	49.8	46.2	46.3	52.1	48.7	48.6	46.0	44.9	48.5	47.0

Source: Dataquest (April 1997)

Table 5-4
DRAM Consumption by Application and Density, 1996 to 1998 (Millions of Units)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Mainframes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	0.3	0.2	-	-	0.6	-	-	-	-	-	-	-	-	-	-
16Mb	1.5	1.5	1.5	1.2	5.6	0.9	0.2	0.1	-	1.2	-	-	-	-	-
64Mb	0	0.1	0.2	0.4	0.8	0.5	0.9	1.0	1.1	3.5	1.0	1.1	1.2	1.3	4.5
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Supercomputers															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16Mb	0.7	0.5	0.4	0.2	1.8	0.1	0.1	-	-	0.2	-	-	-	-	-
64Mb	0	0.1	0.2	0.2	0.6	0.3	0.4	0.5	0.5	1.7	0.5	0.6	0.6	0.7	2.4
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Midrange															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16Mb	6.2	7.7	8.6	8.0	30.5	7.5	4.2	-	-	11.7	-	-	-	-	-
64Mb	0.1	0.2	0.7	2.0	3.0	2.8	4.2	6.1	7.3	20.4	9.0	10.0	11.5	13.5	44.0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Workstations															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	0.6	0.2	0.3	-	1.1	-	-	-	-	-	-	-	-	-	-
16Mb	5.7	6.0	6.1	6.3	24.1	6.0	1.1	1.2	1.3	9.5	0.7	0.4	0.3	-	1.4
64Mb	-	0	0.3	0.6	0.9	0.6	2.5	2.6	2.8	8.5	3.1	3.4	3.8	4.5	14.9
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Personal Computers															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	12.1	12.6	0.6	0.6	25.9	0.4	-	-	-	0.4	-	-	-	-	-
4Mb	235.0	204.1	183.8	147.5	770.3	89.9	74.4	50.4	28.9	243.7	23.0	2.7	2.1	1.4	29.1
16Mb	89.3	105.0	131.3	195.5	521.1	202.8	215.5	243.0	276.2	937.5	273.4	262.1	287.2	336.2	1,158.9

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996 to 1998 (Millions of Units)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
64Mb	-	0	0.1	0.4	0.5	2.1	3.5	6.7	22.3	34.6	23.7	31.5	35.8	52.9	143.9
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Server-Marketed PCs															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	3.7	3.8	3.3	2.9	13.6	2.0	2.4	1.6	-	6.0	-	-	-	-	-
16Mb	4.5	5.2	6.1	8.1	24.0	8.0	4.7	3.7	6.0	22.4	3.9	2.1	1.7	1.7	9.4
64Mb	-	0	0.1	0.4	0.5	0.4	1.6	2.4	3.5	7.9	3.9	4.7	5.7	8.1	22.3
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transportables															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ultraportables and Notepads															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	0	0.1	0.1	0.1	0.2	0	-	-	-	0	-	-	-	-	-
4Mb	1.0	0.9	1.0	0.8	3.7	0.9	0.5	0.4	0.6	2.4	0.5	0.3	0.2	0.2	1.2
16Mb	0.7	0.9	1.4	1.9	5.0	2.3	2.5	3.2	3.8	11.9	4.4	3.7	4.5	6.3	18.9
64Mb	-	-	-	-	-	-	0	0	0.1	0.1	0.2	0.3	0.4	0.5	1.4
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Notebooks															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	0.6	0.7	0.6	0.6	2.4	0.4	-	-	-	0.4	-	-	-	-	-
4Mb	13.0	11.3	10.5	9.4	44.1	7.7	4.8	3.5	5.4	21.4	3.8	2.4	1.8	1.2	9.2
16Mb	9.7	11.3	15.1	21.4	57.4	21.0	22.7	27.4	34.3	105.4	31.4	29.9	32.5	38.2	132.1
64Mb	-	-	-	-	-	-	0.1	0.1	0.8	1.0	1.3	2.3	3.2	5.2	12.0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996 to 1998 (Millions of Units)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Laptops															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	0	0	0	0	0	0	-	-	-	0	-	-	-	-	-
4Mb	0.1	0.1	0.1	0.1	0.3	0	0	0	0	0.1	0	0	0	0	0
16Mb	0.1	0.1	0.1	0.2	0.4	0	0	0.1	0.1	0.3	0.1	0	0.1	0.1	0.3
64Mb	-	-	-	-	-	-	0	0	0	0	0	0	0	0	0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Desktops															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	8.3	8.3	-	-	16.6	-	-	-	-	-	-	-	-	-	-
4Mb	158.1	131.0	121.0	96.3	506.4	56.9	47.6	32.2	16.5	153.2	13.4	-	-	-	13.4
16Mb	54.1	61.0	77.8	117.5	310.4	123.0	132.3	149.8	167.4	572.4	167.9	161.7	177.2	206.8	713.6
64Mb	-	-	-	-	-	1.2	1.3	3.0	12.9	18.4	13.2	17.3	19.0	27.8	77.3
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Desksides															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	3.1	3.6	-	-	6.7	-	-	-	-	-	-	-	-	-	-
4Mb	59.2	57.0	47.9	38.0	202.1	22.4	19.1	12.7	6.4	60.6	5.3	-	-	-	5.3
16Mb	20.3	26.5	30.8	46.4	124.0	48.4	53.2	58.9	64.6	225.2	65.7	64.7	71.1	83.1	284.7
64Mb	-	-	-	-	-	0.5	0.5	1.2	5.0	7.2	5.1	6.9	7.6	11.2	30.9
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PC Upgrades															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	2.0	2.2	-	-	4.2	-	-	-	-	-	-	-	-	-	-
4Mb	38.4	34.8	31.3	20.3	124.8	12.8	11.2	7.4	3.1	34.4	2.7	-	-	-	2.7
16Mb	13.1	16.2	20.1	24.7	74.2	27.7	31.0	34.4	31.3	124.4	33.7	34.3	37.0	35.2	140.2
64Mb	-	-	-	-	-	0.3	0.3	0.7	2.4	3.7	2.6	3.7	4.0	4.7	15.0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Memory Modules															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	14.0	8.9	7.1	7.2	37.3	-	-	-	-	-	-	-	-	-	-
4Mb	58.5	62.2	63.7	66.2	250.6	66.3	42.9	39.4	47.8	196.4	20.3	8.8	-	-	29.1
16Mb	43.0	45.9	58.0	72.4	219.3	101.8	126.7	142.7	140.5	511.7	159.0	162.7	137.1	162.9	621.7

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996 to 1998 (Millions of Units)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
64Mb	-	-	-	-	-	-	0.3	2.9	7.8	10.9	9.6	13.7	24.8	33.3	81.5
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Data Storage Devices															
256K	2.2	2.3	2.1	1.8	8.4	0.9	0.5	0.2	0.2	1.8	0.3	0.3	0.3	0.3	1.2
1Mb	17.5	17.6	20.8	24.2	79.9	23.3	22.9	16.6	14.4	77.2	15.8	15.0	13.4	11.9	56.0
4Mb	1.5	2.8	3.4	4.1	11.8	5.9	13.0	16.5	20.6	56.1	20.7	25.5	29.7	33.7	109.6
16Mb	-	-	-	-	-	0.7	1.0	1.7	2.1	5.6	3.3	4.1	5.2	6.1	18.7
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Printers															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	18.9	20.0	18.6	15.5	73.0	16.8	14.4	15.4	14.7	61.3	16.4	17.3	18.5	18.2	70.5
16Mb	11.0	11.7	13.9	15.5	52.1	16.8	18.9	20.2	20.9	76.8	23.3	24.5	26.2	28.0	102.0
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Facsimile															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	0.6	0.5	0.5	0.4	1.9	0.3	0.3	0.2	0.2	1.0	0.2	0.2	0.2	0.2	0.7
4Mb	6.0	6.4	7.0	6.2	25.7	6.5	6.2	6.9	7.2	26.8	7.4	7.9	7.8	8.6	31.6
16Mb	0.2	0.3	0.4	0.7	1.7	0.9	1.0	1.2	1.3	4.4	1.3	1.5	1.7	1.8	6.3
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAN Hubs/ Internetworking															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	0.8	0.8	0.6	0.4	2.7	0.5	0.5	0.5	0.6	2.1	0.7	0.7	0.8	0.9	3.1
4Mb	0.8	0.9	0.8	0.8	3.2	0.8	0.8	0.9	1.0	3.5	1.1	1.1	0.7	0.7	3.6
16Mb	0.2	0.2	0.3	0.4	1.1	0.5	0.6	0.7	0.7	2.6	0.9	1.0	1.2	1.3	4.4
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996 to 1998 (Millions of Units)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Telephones/Answering Machines															
256K	0.7	0.6	0.7	0.8	2.8	0.5	0.3	0.3	-	1.1	-	-	-	-	-
1Mb	12.7	15.0	16.1	17.6	61.4	15.0	14.4	13.1	12.6	55.2	10.6	10.1	9.6	10.3	40.6
4Mb	3.8	4.6	6.3	7.8	22.5	8.9	10.4	11.8	13.5	44.6	13.3	14.6	15.7	18.0	61.6
16Mb	-	-	-	-	-	0	0	0.1	0.3	0.4	0.6	1.1	1.4	2.0	5.1
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Industrial Applications															
256K	1.7	1.8	1.3	1.1	6.0	1.0	0.9	0.8	0.5	3.2	0.4	0.2	0.1	-	0.7
1Mb	9.4	9.7	9.4	8.0	36.6	5.9	3.1	3.8	4.3	17.0	4.0	3.8	3.9	4.0	15.7
4Mb	5.4	5.1	4.9	4.8	20.1	4.8	5.9	6.0	4.3	21.0	4.5	3.5	3.4	3.6	14.9
16Mb	0.7	0.9	1.0	1.2	3.8	1.5	1.5	1.6	2.2	6.9	2.5	3.0	3.3	3.5	12.3
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Digital Video Disc															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	0	0	0	0.1	0.1	0.5	0.3	0.7	0.6	2.1	-	-	-	-	-
4Mb	0	0	0	0	0	0.2	0.4	0.6	0.6	1.8	0.9	1.0	0.6	0.2	2.6
16Mb	0	0	0	0	0	0.2	0.4	0.8	1.0	2.5	1.9	2.2	3.0	3.8	10.9
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cable/Satellite Set-Top Boxes															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	4.4	4.6	5.1	3.6	17.6	1.9	-	-	-	1.9	-	-	-	-	-
4Mb	1.9	2.4	2.9	3.0	10.2	3.6	4.2	4.1	4.0	15.9	4.2	4.1	4.2	3.6	16.1
16Mb	0.1	0.1	0.4	0.5	1.1	0.9	1.4	1.7	1.9	5.9	2.4	2.7	3.1	3.6	11.8
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Games (Systems and Cartridges)															
256K	0.4	0.3	0.2	0.1	0.9	0.1	0.1	0	0	0.2	0	0	0	0	0.1
1Mb	0.4	0.3	0.2	0.2	1.1	0.1	0.1	0.1	0.1	0.4	0	0	0	0	0.1

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996 to 1998 (Millions of Units)

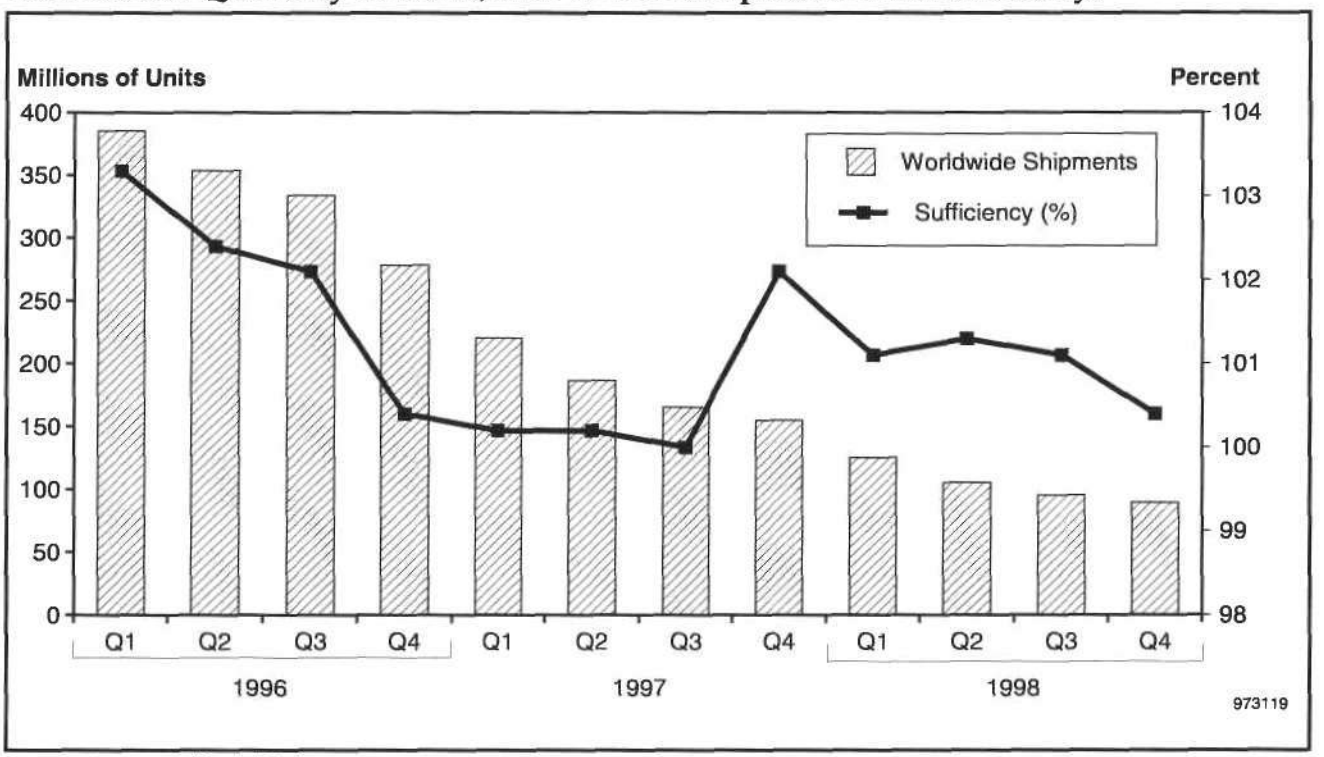
	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
4Mb	1.8	1.5	3.3	1.5	8.2	1.6	1.8	1.9	2.1	7.4	2.5	2.4	1.3	-	6.2
16Mb	6.1	7.4	8.8	8.8	31.1	9.4	11.0	11.6	12.3	44.3	14.8	14.7	16.2	16.2	61.9
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Bit Video Games															
256K	0	0	0	0	0	0	0	-	-	0	-	-	-	-	-
1Mb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16-Bit Video Games															
256K	0.4	0.3	0.2	0.1	0.9	0.1	0.1	0	0	0.2	0	0	0	0	0.1
1Mb	0.4	0.3	0.2	0.2	1.1	0.1	0.1	0.1	0	0.3	0	0	0	0	0.1
4Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CD-ROM Video Games															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RISC and Future Video Games															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	1.8	1.5	3.3	1.5	8.2	1.6	1.8	1.9	2.1	7.4	2.5	2.4	1.3	-	6.2
16Mb	6.1	7.4	8.8	8.8	31.1	9.4	11.0	11.6	12.3	44.3	14.8	14.7	16.2	16.2	61.9
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	0	0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996 to 1998 (Millions of Units)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Other Applications															
256K	0.1	0.1	0.2	0	0.5	0.2	0.2	0.1	0.1	0.7	0.1	0.1	0	0	0.2
1Mb	0.3	2.7	11.4	3.5	18.0	0.3	0	0	0.2	0.5	0.3	0.3	0.3	0	0.9
4Mb	0	0	1.0	0	1.0	2.0	0.6	4.1	4.0	10.6	7.0	15.0	10.0	1.0	33.0
16Mb	0	0	7.0	11.0	18.0	5.0	16.6	3.1	6.0	30.6	0	20.0	45.0	20.0	85.0
64Mb	0	0	0.1	0.3	0.3	0.4	2.2	5.2	0.2	7.9	5.0	7.0	10.0	10.0	32.0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
All Applications															
256K	5.1	5.0	4.6	3.9	18.6	2.8	2.0	1.4	0.9	7.0	0.9	0.6	0.4	0.3	2.2
1Mb	74.3	75.0	71.9	65.5	286.8	48.2	41.5	34.9	33.0	157.7	31.5	30.1	28.2	27.3	117.1
4Mb	373.0	345.4	327.2	277.5	1,323.1	220.0	186.3	165.5	151.8	723.6	123.9	103.9	93.9	88.9	410.6
16Mb	177.8	203.3	258.0	346.6	985.6	382.8	431.4	464.0	498.1	1,776.2	517.7	534.3	567.9	620.8	2,240.7
64Mb	0.1	0.5	1.5	3.9	6.1	7.1	14.2	25.5	44.4	91.2	54.6	71.0	91.7	121.0	338.3
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bits (Trillions)	4,635.5	4,972.5	5,878.7	7,311.2	22,797.8	7,871.5	9,017.8	10,229.9	12,004.2	39,123.5	12,902.0	14,192.9	16,106.4	18,939.6	62,140.9
Annual Bit Growth (%)	-	-	-	-	-	-	-	-	-	71.6	-	-	-	-	58.8
Worldwide Supply															
256K	5.2	5.1	4.7	3.9	18.8	2.8	2.0	1.4	0.9	7.1	0.9	0.6	0.5	0.3	2.3
1Mb	78.0	77.6	75.2	67.4	298.1	48.5	41.9	35.0	33.6	159.0	32.3	31.1	29.0	28.0	120.4
4Mb	385.4	353.6	334.0	278.5	1,351.5	220.4	186.6	165.4	154.9	727.3	125.3	105.2	95.0	89.2	414.8
16Mb	192.9	219.6	276.5	370.0	1,058.9	401.6	427.0	463.9	509.7	1,802.1	520.8	543.2	576.6	615.0	2,255.5
64Mb	0.2	0.5	1.6	4.2	6.5	7.8	14.5	25.7	44.9	92.9	55.8	72.7	95.0	121.7	345.2
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bits (Trillions)	4,946.7	5,285.2	6,225.4	7,731.3	24,188.5	8,238.3	8,964.2	10,241.0	12,246.8	39,690.3	13,040.9	14,463.4	16,479.9	18,890.8	62,875.0
Annual Bit Growth (%)	-	-	-	-	-	-	-	-	-	64.1	-	-	-	-	58.4
4Mb Equivalents															
Demand	1,105.2	1,185.5	1,401.6	1,743.1	5,435.4	1,876.7	2,150.0	2,439.0	2,862.0	9,327.8	3,076.1	3,383.8	3,840.1	4,515.6	14,815.5
Supply	1,179.4	1,260.1	1,484.2	1,843.3	5,767.0	1,964.2	2,137.2	2,441.6	2,919.9	9,462.9	3,109.2	3,448.3	3,929.1	4,503.9	14,990.6
Sufficiency (%)	106.7	106.3	105.9	105.7	106.1	104.7	99.4	100.1	102.0	101.4	101.1	101.9	102.3	99.7	101.2

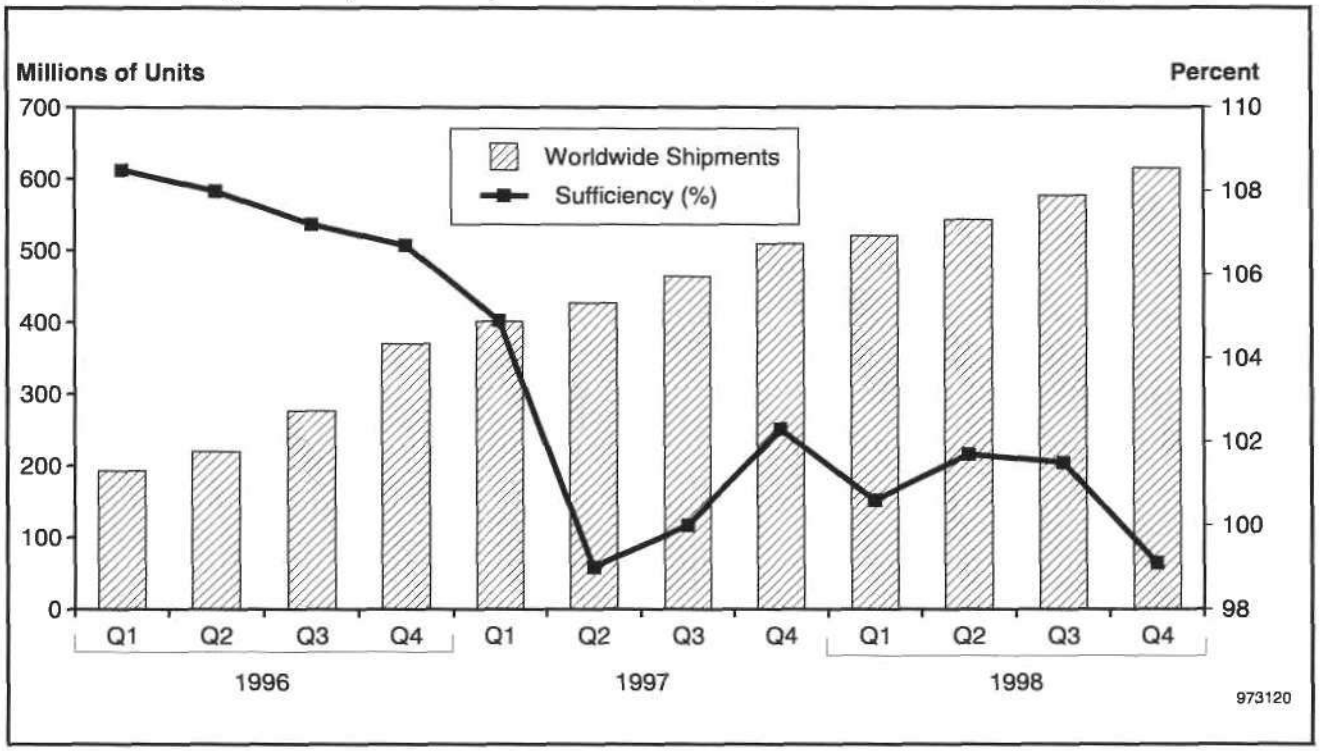
Source: Dataquest (April 1997)

Figure 5-1
4Mb DRAM Quarterly Outlook, 1996 to 1998 (Shipments and Sufficiency)



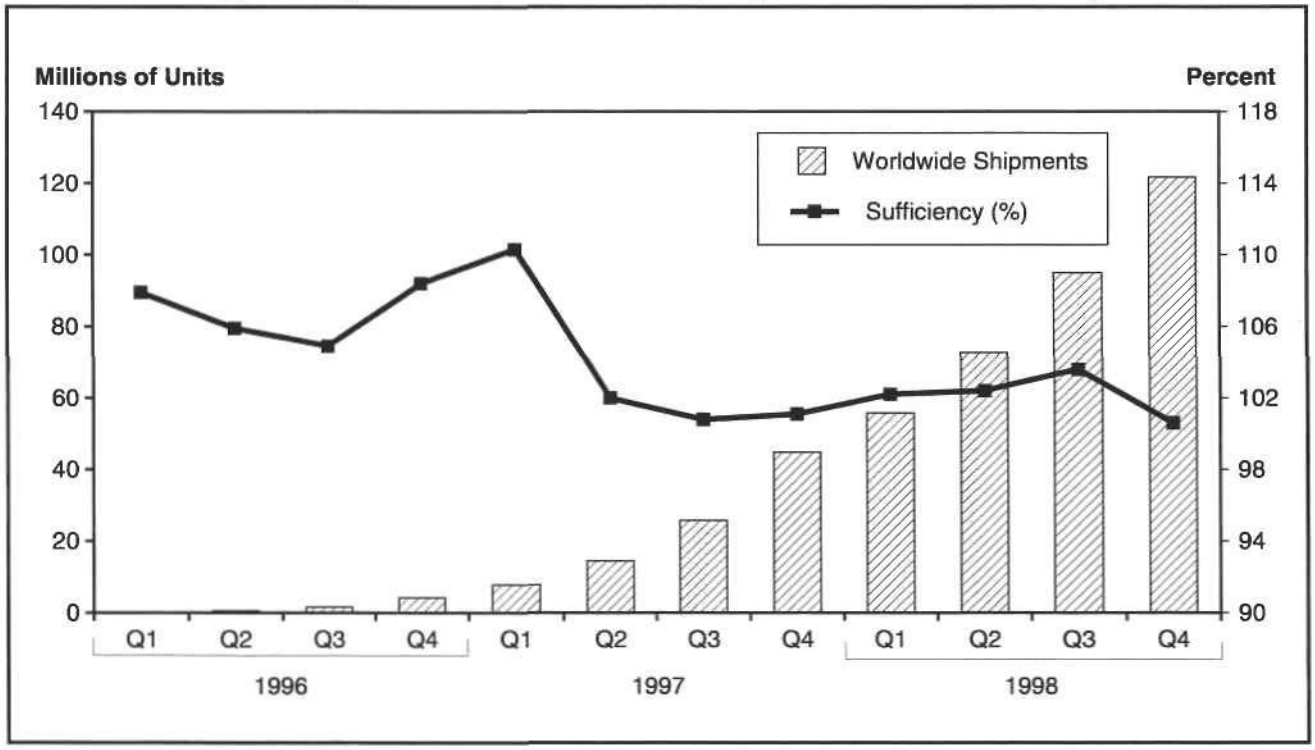
Source: Dataquest (April 1997)

Figure 5-2
16Mb DRAM Quarterly Outlook, 1996 to 1998 (Shipments and Sufficiency)



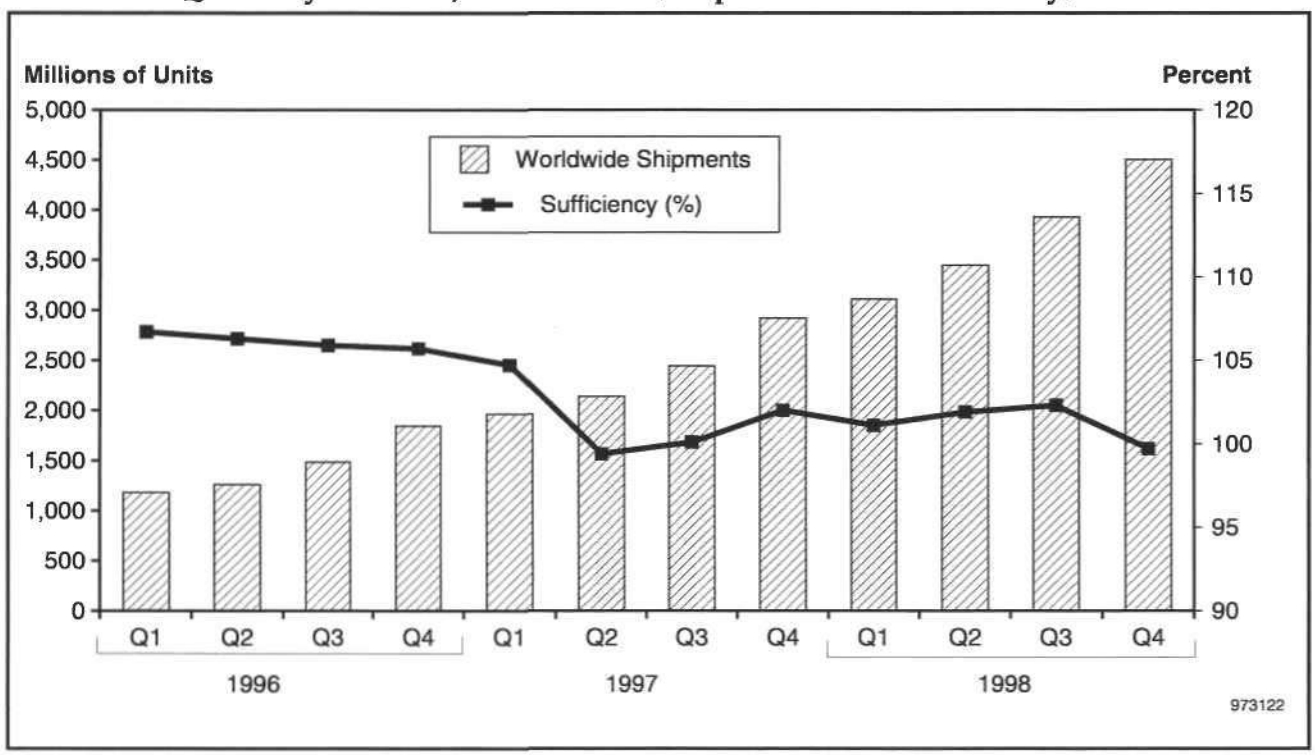
Source: Dataquest (April 1997)

Figure 5-3
64Mb DRAM Quarterly Outlook, 1996 to 1998 (Shipments and Sufficiency)



Source: Dataquest (April 1997)

Figure 5-4
Bit DRAM Quarterly Outlook, 1996 to 1998 (Shipments and Sufficiency)



Source: Dataquest (April 1997)

Chapter 6
PC DRAM Consumption by Processor Type

The data in this chapter provides a form of checks and balances on the demand-side statistics. Table 6-1 shows Dataquest's annual forecast of microprocessor unit shipments in personal computers. This data does not include shipments of either replacement motherboards or industrial controllers. Table 6-2 presents an estimate of DRAM consumption in megabytes per system in PCs at the point of sale. This is the sum of factory configuration of memory as the system leaves the original equipment manufacturer (OEM) plus memory added to the unit at or before the point of sale. Table 6-3 multiplies the numbers in Tables 6-1 and 6-2 to produce overall PC DRAM demand.

What Has Changed since the Previous Report

The number of megabytes of DRAM per specific microprocessor type (for example, the Pentium 150 MHz) has changed; the overall number of DRAM megabytes per PC system, however, remains consistent with the prior report.

As in the previous report, this chapter has been synchronized with the PC system and consumption forecasts in Tables 5-1 through 5-3. The "total" line in these tables corresponds to the "personal computers" line in Tables 5-1 through 5-3.

Table 6-1
Personal Computer Forecast by MPU, 1996 to 1998 (Thousands of Systems)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
386	5.2	1.5	0.1	-	6.7	-	-	-	-	-	-	-	-	-	-
486	2,901.2	1,851.8	754.7	429.1	5,936.9	120.4	48.5	24.8	5.3	198.9	3.1	-	-	-	3.1
Pentium 60-100 MHz and Unclassified	9,074.3	7,525.5	6,161.9	5,755.5	28,517.2	2,901.1	1,996.7	1,107.2	641.7	6,646.7	257.6	124.7	45.6	11.2	439.1
Pentium 120-133 MHz	2,734.9	4,308.5	5,711.2	6,025.0	18,779.5	4,574.6	3,169.3	2,612.5	2,212.6	12,569.0	1,016.7	446.8	203.6	70.8	1,737.9
Pentium 150-166 MHz	549.7	1,484.3	2,805.6	5,347.7	10,187.3	5,583.2	5,298.6	4,094.4	3,211.5	18,187.7	2,144.1	1,959.1	999.5	812.8	5,915.4
Pentium 180 MHz and Above	-	17.4	247.6	1,357.8	1,622.8	2,391.3	3,667.2	5,221.0	8,153.2	19,432.7	6,810.8	6,025.9	5,817.2	6,794.4	25,448.3
Pentium Pro 150-200 MHz	47.6	115.1	465.8	1,759.5	2,388.0	2,418.4	3,414.5	5,348.1	8,658.3	19,839.4	9,199.5	9,661.3	11,113.2	12,696.3	42,670.2
Pentium Pro over 200 MHz and Future x86	-	-	20.3	122.0	142.3	191.2	441.9	778.4	1,481.0	2,892.4	1,823.0	2,761.1	3,989.4	7,827.8	16,401.3
68xxx	103.0	33.9	16.9	12.3	166.1	4.1	2.0	2.0	4.0	12.2	-	-	-	-	-
Other CISC/RISC	938.1	962.1	1,055.5	1,318.0	4,273.6	1,067.0	1,127.5	1,297.6	1,521.9	5,013.9	1,299.5	1,244.0	1,521.4	1,779.9	5,844.8
All MPU Types	16,354.0	16,300.0	17,239.7	22,126.8	72,020.5	19,251.5	19,166.2	20,486.0	25,889.3	84,792.9	22,554.4	22,222.8	23,689.8	29,993.2	98,460.3

Source: Dataquest (April 1997)

Table 6-2
Personal Computer Forecast by MPU, 1996 to 1998 (Megabytes per System)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
386	12.8	13.0	13.2	-	12.8	-	-	-	-	-	-	-	-	-	-
486	14.0	14.2	14.5	14.1	14.2	15.4	15.8	16.2	16.3	15.6	18.3	-	-	-	18.3
Pentium 60-100 MHz and Unclassified	18.7	19.0	19.3	18.7	18.9	20.5	21.1	21.6	21.7	21.0	24.4	25.3	25.9	25.5	24.8
Pentium 120-133 MHz	20.5	20.9	21.2	20.6	20.8	22.6	23.2	23.7	23.9	23.2	26.8	27.8	28.5	28.1	27.3
Pentium 150-166 MHz	22.6	22.9	23.3	22.7	22.9	24.8	25.5	26.1	26.3	25.6	29.5	30.6	31.3	30.9	30.4
Pentium 180 MHz and Above	-	25.2	25.7	24.9	25.1	27.3	28.1	28.7	28.9	28.5	32.5	33.7	34.5	34.0	33.6
Pentium Pro 150-200 MHz	27.3	27.8	28.3	27.4	27.6	30.0	30.9	31.6	31.8	31.4	35.7	37.1	37.9	37.4	37.1
Pentium Pro over 200 MHz **and Future x86**	-	-	31.1	30.2	30.3	33.0	33.9	34.7	35.0	34.6	39.3	40.8	41.7	41.1	41.0
68xxx	15.4	15.7	15.9	15.5	15.5	17.0	17.4	17.8	18.0	17.5	-	-	-	-	-
Other CISC/RISC	17.0	17.2	17.5	17.0	17.2	18.7	19.2	19.6	19.8	19.4	22.2	23.0	23.5	23.2	23.0
All MPU Types	18.2	19.3	20.6	21.1	19.9	24.3	25.9	27.6	28.8	26.8	33.1	35.0	36.4	36.5	35.4

Source: Dataquest (April 1997)

Table 6-3
Personal Computer Forecast by MPU, 1996 to 1998 (Billions of Bits Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
386	557.2	157.9	9.3	-	724.3	-	-	-	-	-	-	-	-	-	-
486	341,349.5	221,337.9	91,790.1	50,690.8	705,168.3	15,570.5	6,439.8	3,370.3	719.4	26,099.9	484.0	-	-	-	484.0
Pentium 60-100 MHz and Unclassified	1,421,043.2	1,197,215.9	997,445.7	905,011.8	4,520,716.6	499,275.9	353,016.6	200,368.2	117,027.2	1,169,687.9	52,742.5	26,470.5	9,910.3	2,408.1	91,531.4
Pentium 120-133 MHz	471,113.7	753,972.6	1,016,935.3	1,042,119.3	3,284,140.9	866,013.5	616,364.5	520,053.4	443,865.6	2,446,297.1	228,996.6	104,361.3	48,643.1	16,679.5	398,680.5
Pentium 150-166 MHz	104,163.6	285,713.9	549,532.1	1,017,463.5	1,956,873.2	1,162,654.2	1,133,499.2	896,562.4	708,683.3	3,901,399.1	531,198.7	503,330.9	262,682.0	210,650.9	1,507,862.5
Pentium 180 MHz and Above	-	3,686.5	53,356.7	284,162.3	341,205.5	547,766.9	862,965.6	1,257,580.4	1,979,102.6	4,647,415.4	1,856,110.5	1,703,015.0	1,681,794.3	1,936,962.2	7,177,882.1
Pentium Pro 150-200 MHz	10,923.6	26,810.4	110,393.8	405,059.5	553,187.2	609,371.9	883,831.3	1,417,030.7	2,311,896.8	5,222,130.8	2,757,784.8	3,003,463.7	3,534,200.1	3,981,437.7	13,276,886.3
Pentium Pro over 200 MHz and Future x86	-	-	5,298.9	30,888.7	36,187.6	53,002.1	125,809.7	226,869.5	434,980.5	840,661.8	601,142.1	944,190.1	1,395,581.5	2,700,194.2	5,641,107.9
68xxx	13,326.8	4,463.5	2,263.0	1,600.1	21,653.4	583.7	298.2	303.0	602.9	1,787.8	-	-	-	-	-
Other CISC/RISC	133,551.3	139,137.9	155,322.1	188,405.0	616,416.3	166,935.8	181,211.5	213,476.9	252,320.0	813,944.2	241,884.3	240,139.0	300,432.7	346,565.1	1,129,021.1
All MPU Types	2,496,028.9	2,632,496.4	2,982,347.1	3,925,401.0	12,036,273.3	3,921,174.4	4,163,436.4	4,735,614.9	6,249,198.2	19,069,424.0	6,270,343.5	6,524,970.6	7,233,243.9	9,194,897.7	29,223,455.8

Source: Dataquest (April 1997)

Chapter 7
Worldwide DRAM Wafer Fabrication Plant Production Capacity

Chapter 7 provides analysis of DRAM fab capacity. Dataquest uses the data in this chapter to test the information provided in the supplier surveys. As with Chapter 6, this provides a form of checks and balances for market sizing.

Table 7-1 provides the silicon capacity for each production facility in square millimeters of silicon per month.

Please note that Dataquest does not gather all the displayed production information from the manufacturers themselves. Dataquest performs an extensive fab survey in the third and fourth quarters of each year and updates this periodically through the year with articles from the general and trade press. Analyzing fab production could cause some confusion when accounting for contract production. Contract production (foundry) is production under license from a different company for that different company to sell under its brand name. The table presented in Chapter 7 will credit capacity used for contract production under foundry, while the shipment information in Chapters 2 through 4 will credit shipments by the purchaser of that foundry production. Nearly every semiconductor manufacturer performs some contract manufacturing. Thus, these analyses should not be used to determine any particular company's inventory or utilization.

What Has Changed since the Previous Report

Dataquest has made its regular quarterly update to the fab section contained in the report.

Table 7-1
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
												> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
2240	Alphatec/TI Semiconductor	U.S./ Thailand	Phase 1	Bangkok	Chachaersao	Thailand	16Mb 64Mb DRAM	1997/Q3	20,000	200	0.35	-	-	-	628.3	-	628.3
	Alphatec/TI Semiconductor Total								**20,000**			-	-	-	**628.3**	-	**628.3**
2180	Dominion Semiconductor	U.S.	Module 1	Manassas	Virginia	U.S.	64Mb DRAM	1997/Q4	28,000	200	0.25	-	-	-	-	879.6	879.6
	Dominion Semiconductor Total								**28,000**			-	-	-	-	**879.6**	**879.6**
428	Fujitsu	Japan	Phase 1	Newton Aycliffe	England	U.K.	4Mb16Mb DRAM	1991	5,600	150	0.5	-	-	99.0	-	-	99.0
443	Fujitsu	Japan	Phase 2	Newton-Aycliffe	England	U.K.	4Mb DRAM	1995	14,000	150	0.5	-	-	247.4	-	-	247.4
1231	Fujitsu	Japan	No. 1	Gresham	Oregon	U.S.	4Mb DRAM	1982/Q1	17,000	150	0.65	-	300.4	-	-	-	300.4
1516	Fujitsu	Japan	No. 3	Isawa-Gun	Iwate	Japan	4Mb DRAM SRAM ROM MPU	1987	50,000	150	0.8	-	-	-	-	-	-
1517	Fujitsu	Japan	No. 4-1	Isawa-Gun	Iwate	Japan	16Mb DRAM SGRAM	1990/Q4	20,000	150	0.42	-	-	-	353.4	-	353.4
1518	Fujitsu	Japan	No. 4-2	Isawa-Gun	Iwate	Japan	16Mb DRAM	1996	25,000	200	0.18	-	-	-	-	785.4	785.4
1530	Fujitsu	Japan	No. 2	Kuwana-Gun	Mie	Japan	Logic Arrays 4Mb DRAM	1987	10,000	150	0.8	-	-	-	-	-	-
1531	Fujitsu	Japan	No. 3 Phase 1	Kuwana-Gun	Mie	Japan	4Mb 16Mb DRAM SRAM MPU	1992	15,000	150	0.5	-	-	265.1	-	-	265.1
1533	Fujitsu	Japan	No. 3 Phase 2	Kuwana-Gun	Mie	Japan	16Mb 64Mb DRAM	1994	500	200	0.25	-	-	-	-	15.7	15.7
2142	Fujitsu	Japan	No. 2	Gresham	Oregon	U.S.	64Mb DRAM	1998	10,000	200	0.25	-	-	-	-	314.2	314.2
2203	Fujitsu	Japan	Fab 2	Newton Aycliffe	England	U.K.	16Mb 64Mb DRAM	1999	15,000	200	0.25	-	-	-	-	471.2	471.2
	Fujitsu Total								**162,100**			-	**300.4**	**611.4**	**353.4**	**1,586.5**	**2,851.8**
447	Hitachi	Japan	E2	Landshut	Bavaria	Germany	16Mb DRAM	1993/Q1	16,000	200	0.35	-	-	-	502.7	-	502.7
800	Hitachi	Japan	U2	Irving	Texas	U.S.	1Mb 4Mb DRAM 256Kb SRAM MPU	1990	16,500	150	0.8	-	-	-	-	-	-
1554	Hitachi	Japan	D1	Mobara-Shi	Chiba	Japan	1Mb 4Mb DRAM LCD Driver	1982	25,000	125	1.3	306.8	-	-	-	-	306.8
1556	Hitachi	Japan	D3	Mobara-Shi	Chiba	Japan	4Mb DRAM	1990	15,000	150	0.8	-	-	-	-	-	-
1564	Hitachi	Japan	Chitose 1-1F	Chitose-Shi	Hokkaido	Japan	4M DRAM MCU	1988	15,000	150	0.8	-	-	-	-	-	-

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
												> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
1565	Hitachi	Japan	Chitose 1-2F	Chitose-Shi	Hokkaido	Japan	4M DRAM MCU	1990	15,000	150	0.8	-	-	-	-	-	-
1567	Hitachi	Japan	N2-1	Hitachinaka-Shi	Ibaraki	Japan	16Mb DRAM	1994/Q4	10,000	200	0.35	-	-	-	314.2	-	314.2
1589	Hitachi	Japan	R&D 2	Kodaira-Shi	Tokyo	Japan	MPU SRAM DRAM Arrays CBIC	1985	3,000	150	0.5	-	-	53.0	-	-	53.0
1595	Hitachi	Japan	K2-1F	Nakakoma-Gun	Yamanashi	Japan	4Mb DRAM SRAM MCU	1990	25,000	150	2	441.8	-	-	-	-	441.8
1604	Hitachi	Japan	K4-3F	Nakakoma-Gun	Yamanashi	Japan	4Mb DRAM 1Mb SRAM EPROM	1989	10,000	150	0.8	-	-	-	-	-	-
2101	Hitachi	Japan	N1-1	Hitachinaka-Shi	Ibaraki	Japan	1Mb 4Mb DRAM	1983	15,000	150	0.8	-	-	-	-	-	-
2172	Hitachi	Japan	N2-2	Hitachinaka-Shi	Ibaraki	Japan	16Mb 64Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
2205	Hitachi	Japan	K2-2F	Nakakoma-Gun	Yamanashi	Japan	16Mb DRAM	1995	10,000	200	0.5	-	-	314.2	-	-	314.2
2294	Hitachi	Japan	Chitose 2	Chitose-Shi	Hokkaido	Japan	64Mb DRAM	1998	10,000	200	0.35	-	-	-	314.2	-	314.2
2296	Hitachi	Japan	N3/2F	Hitachinaka-Shi	Ibaraki	Japan	64Mb DRAM	1998	10,000	200	0.35	-	-	-	314.2	-	314.2
2297	Hitachi	Japan	N2/3F	Hitachinaka-Shi	Ibaraki	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.35	-	-	-	471.2	-	471.2
Hitachi Total									**220,500**			**748.6**	-	**367.2**	**2,230.5**	-	**3,346.3**
2246	Hitachi/Nippon Steel Semiconductor	Japan	Tampins	Singapore	-	Singapore	64Mb DRAM	1998	20,000	200	0.3	-	-	-	-	628.3	628.3
Hitachi/Nippon Steel Semiconductor Total									**20,000**			-	-	-	-	**628.3**	**628.3**
19	Hyundai	Korea	MOS Fab 1-A	Ichon	Kyoungki-Do	Korea	256K DRAM SRAM	1985	15,000	125	1	184.1	-	-	-	-	184.1
20	Hyundai	Korea	MOS Fab 2-A	Ichon	Kyoungki-Do	Korea	1Mb 4Mb DRAM	1986	15,000	150	0.65	-	265.1	-	-	-	265.1
175	Hyundai	Korea	MOS Fab 3	Ichon	Kyoungki-Do	Korea	4Mb DRAM Telecom ICs ASIC	1989	20,000	150	0.5	-	-	353.4	-	-	353.4
176	Hyundai	Korea	MOS Fab 2-B	Ichon	Kyoungki-Do	Korea	4Mb DRAM	1992	20,000	150	0.5	-	-	353.4	-	-	353.4
202	Hyundai	Korea	MOS R&D	Ichon	Kyoungki-Do	Korea	DRAM	1989	3,000	150	0.25	-	-	-	-	53.0	53.0
2033	Hyundai	Korea	Fab 4	Ichon	Kyoungki-Do	Korea	4Mb DRAM Telecom ICs ASIC	1993	10,000	200	0.35	-	-	-	314.2	-	314.2

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm) > 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
2083	Hyundai	Korea	Fab 5	Ichon	Kyoungki-Do	Korea	16Mb 64Mb DRAM	1994	25,000	200	0.35	-	-	-	785.4	-	785.4
2120	Hyundai	Korea	Fab 6	Ichon	Kyoungki-Do	Korea	64Mb DRAM	1996	30,000	200	0.35	-	-	-	942.5	-	942.5
2168	Hyundai	Korea	Oregon Fab	Eugene	Oregon	U.S.	16Mb 64Mb DRAM	1998	30,000	200	0.25	-	-	-	-	942.5	942.5
2317	Hyundai	Korea	Fab 7	Ichon	Kyoungki-Do	Korea	16Mb 64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
2459	Hyundai	Korea	Phase 1	Dumfermline	Scotland	U.K.	64Mb DRAM	1998/Q4	30,000	200	0.18	-	-	-	-	942.5	942.5
2460	Hyundai	Korea	Phase 2	Dumfermline	Scotland	U.K.	64Mb 256Mb DRAM	-	-	12	0.18	-	-	-	-	-	-
	Hyundai Total								**228,000**			**184.1**	**265.1**	**706.9**	**2,984.5**	**1,938.0**	**6,078.5**
427	IBM Microelectronics	U.S.	-	Corbeil-Essonnes	-	France	DRAM SRAM	-	25,000	125	1	306.8	-	-	-	-	306.8
435	IBM Microelectronics	U.S.	-	Sindelfingen	-	Germany	DRAM SRAM DSP MPU Custom	-	25,000	125	1.5	306.8	-	-	-	-	306.8
463	IBM Microelectronics	U.S.	-	Corbeil-Essonnes	-	France	1Mb DRAM	1989	7,000	200	0.8	-	-	-	-	-	-
590	IBM Microelectronics	U.S.	Bldg 963	Essex Junction	Vermont	U.S.	4Mb DRAM MPU	1989/Q4	16,000	125	0.5	-	-	196.3	-	-	196.3
801	IBM Microelectronics	U.S.	Bldg 970	Essex Junction	Vermont	U.S.	64Mb DRAM MPU Mul-timedia ICs	1988	24,000	200	0.35	-	-	-	754.0	-	754.0
802	IBM Microelectronics	U.S.	Bldg. 973	Essex Junction	Vermont	U.S.	16Mb DRAM	1989/Q4	20,000	200	0.5	-	-	628.3	-	-	628.3
1607	IBM Microelectronics	U.S.	-	Yasu-Gun	Shiga	Japan	64Mb DRAM pDSP	1990	15,000	200	0.35	-	-	-	471.2	-	471.2
2221	IBM Microelectronics	U.S.	AMF	Corbeil-Essonnes	-	France	64Mb DRAM	1997	15,000	200	0.2	-	-	-	-	471.2	471.2
	IBM Microelectronics Total								**147,000**			**613.6**	-	**824.7**	**1,225.2**	**471.2**	**3,134.7**
429	IBM/Philips	U.S.	-	Boeblingen	-	Germany	4Mb DRAM	1989/Q1	20,000	200	0.8	-	-	-	-	-	-
	IBM/Philips Total								**20,000**								
1370	IBM/Siemens	U.S.	ACL	Corbeil-Essonnes		France	16Mb 64Mb DRAM	1991	30,000	200	0.35	-	-	-	942.5	-	942.5
	IBM/Siemens Total								**30,000**			-	-	-	**942.5**	-	**942.5**
152	Jinan	China	No. 2	Jinan	-	China	1KbSRAM 4KbDRAM	1989	8,000	75	5	35.3	-	-	-	-	35.3

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
												> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
	Jinan Total								**8,000**			**35.3**	-	-	-	-	**35.3**
1627	KTI Semiconductor	U.S./Japan	Fab 1	Nishiwaki-Shi	Hyogo	Japan	16Mb DRAM ASIC	1992/Q2	25,000	150	0.5	-	-	441.8	-	-	441.8
2149	KTI Semiconductor	U.S./Japan	Fab 2	Nishiwaki-Shi	Hyogo	Japan	16Mb 64Mb DRAM ASIC	1996/Q4	5,500	200	0.35	-	-	-	172.8	-	172.8
	KTI Semiconductor Total								**30,500**			-	-	441.8	172.8	-	614.6
172	LG Semicon	Korea	C1 Phase 1	Chongju-City	Chungcheongbuk-do	Korea	1Mb 4Mb DRAM	1990	30,000	150	0.5	-	-	530.1	-	-	530.1
173	LG Semicon	Korea	C1 Phase 2	Chongju-City	Chungcheongbuk-do	Korea	4Mb DRAM	1991	30,000	150	0.5	-	-	530.1	-	-	530.1
174	LG Semicon	Korea	C2 Phase 1	Chongju-City	Chungcheongbuk-do	Korea	16Mb DRAM	1993	15,000	200	0.35	-	-	-	471.2	-	471.2
2081	LG Semicon	Korea	C1 Phase 3	Chongju-City	Chungcheongbuk-do	Korea	16Mb 64Mb DRAM	1997/Q1	30,000	200	0.35	-	-	-	942.5	-	942.5
2095	LG Semicon	Korea	C2 Phase 2	Chongju-City	Chungcheongbuk-do	Korea	16Mb DRAM	1995	25,000	200	0.35	-	-	-	785.4	-	785.4
2316	LG Semicon	Korea	G2	Gumi-City	Kyeongsansbuk-do	Korea	64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
2464	LG Semicon	Korea	Phase 1	Newport	Wales	U.K.	64Mb DRAM 256Mb DRAM	1999	30,000	200	-	-	-	-	-	**942.5**	942.5
	LG Semicon Total								**190,000**			-	-	**1,060.3**	**3,141.6**	**942.5**	**5,144.4**
1224	Matsushita	Japan	Fab C	Puyallup	Washington	U.S.	1Mb 4Mb DRAM 4-Bit 8-Bit MCU	1992/Q1	21,000	150	0.6	-	-	371.1	-	-	371.1
1636	Matsushita	Japan	Kyoto R&D	Kyoto-Shi	Niigata	Japan	DRAM	1991	500	200	0.25	-	-	-	-	15.7	15.7
1654	Matsushita	Japan	S/C R6	Kadoma-Shi	Osaka	Japan	16Mb DRAM 64-Bit MPU 64Mb DRAM	1991/Q1	500	150	0.35	-	-	-	8.8	-	8.8
2143	Matsushita	Japan	Fab B	Tonami-Shi	Toyama	Japan	16Mb DRAM 16-Bit MCU	1996/Q1	20,000	150	0.35	-	-	-	353.4	-	353.4
2404	Matsushita	Japan	Fab C	Tonami-Shi	Toyama	Japan	16Mb DRAM	1996/Q4	10,000	200	0.35	-	-	-	314.2	-	314.2
2405	Matsushita	Japan	Fab D	Tonami-Shi	Toyama	Japan	16Mb 64Mb DRAM	1997	10,000	200	0.35	-	-	-	314.2	-	314.2
2443	Matsushita	Japan	Fab D	Puyallup	Washington	U.S.	32-Bit MRCO DSP 64Mb DRAM	1998/Q2	10,000	200	0.25	-	-	-	-	314.2	314.2

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Headquarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
												> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
	Matsushita Total								72,000			-	-	371.1	990.6	329.9	1,691.6
1270	Micron Technology	U.S.	Fab 3	Boise	Idaho	U.S.	1Mb 4Mb 16Mb DRAM	1991/Q1	20,000	200	0.35	-	-	-	628.3	-	628.3
2361	Micron Technology	U.S.	Fab 1	Boise	Idaho	U.S.	4Mb 16Mb DRAM VRAM SRAM	1996/Q4	18,000	200	0.35	-	-	-	565.5	-	565.5
2362	Micron Technology	U.S.	Fab 2	Boise	Idaho	U.S.	16Mb 64Mb DRAM	1996/Q4	10,000	200	0.25	-	-	-	-	314.2	314.2
2372	Micron Technology	U.S.	Lehi Fab	Lehi	Utah	U.S.	64Mb DRAM	1999	-	200	0.25	-	-	-	-	-	-
	Micron Technology Total								48,000			-	-	-	1,193.8	314.2	1,508.0
1246	Mitsubishi	Japan	-	North Durham	North Carolina	U.S.	1Mb 4Mb DRAM	1990/Q4	9,000	150	0.5	-	-	159.0	-	-	159.0
1419	Mitsubishi	Japan	-	Alsdorf		Germany	4MB 16MB DRAM	1997/Q2	7,000	200	0.35	-	-	-	219.9	-	219.9
1672	Mitsubishi	Japan	B	Saijo-Shi	Ehime	Japan	DRAM MCU	1984	39,000	125	0.9	478.6	-	-	-	-	478.6
1678	Mitsubishi	Japan	Sa2B	Saijo-Shi	Ehime	Japan	64Mb DRAM EDRAM	1993	16,000	200	0.4	-	-	-	502.7	-	502.7
1690	Mitsubishi	Japan	ULSI	Itami-Shi	Hyogo	Japan	16Mb 64Mb 256Mb DRAM ASIC Flash	1993	10,000	200	0.2	-	-	-	-	314.2	314.2
1693	Mitsubishi	Japan	TA1	Kami-Gun	Kochi	Japan	4Mb DRAM 1Mb SRAM ASSP	1990	30,000	150	0.7	-	530.1	-	-	-	530.1
1699	Mitsubishi	Japan	D-1F	Kikuchi-Gun	Kumamoto	Japan	16Mb 64Mb DRAM	1994	10,000	200	0.35	-	-	-	314.2	-	314.2
2174	Mitsubishi	Japan	D-1F-2	Kikuchi-Gun	Kumamoto	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.35	-	-	-	471.2	-	471.2
2211	Mitsubishi	Japan	SA1F	Saijo-Shi	Ehime	Japan	64Mb DRAM EDRAM EFlash	1997	15,000	200	0.3	-	-	-	-	471.2	471.2
2408	Mitsubishi	Japan	-	Hsin Chu	-	Taiwan	16Mb DRAM	1996	12,000	200	0.35	-	-	-	377.0	-	377.0
	Mitsubishi Total								163,000			478.6	530.1	159.0	1,885.0	785.4	3,838.1
195	Mosel Vitelic	Taiwan	Fab 1A	Science Park	Hsin Chu	Taiwan	DRAM VRAM	1995/Q1	15,000	150	0.45	-	-	-	265.1	-	265.1
2442	Mosel Vitelic	Taiwan	Fab 1B	Science Park	Hsin Chu	Taiwan	DRAM VRAM	1995/Q4	15,000	150	0.34	-	-	-	-	265.1	265.1

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm) > 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
	Mosel Vitelic Total								**30,000**			-	-	-	**265.1**	**265.1**	**530.1**
2086	Nan Ya Technology	Taiwan	Fab 1	Tao Yuan	-	Taiwan	16Mb 64Mb DRAM	1996/Q2	30,000	200	0.45	-	-	-	942.5	-	942.5
	Nan Ya Technology Total								**30,000**			-	-	-	**942.5**	-	**942.5**
469	NEC	Japan	1 Phase	Livingston	Scotland	U.K.	DRAM SRAM MPU	1987	25,000	150	0.5	-	-	441.8	-	-	441.8
646	NEC	Japan	K-Line	Roseville	California	U.S.	DRAM ASIC MCU	1984	25,000	125	1	306.8	-	-	-	-	306.8
1286	NEC	Japan	M-Line	Roseville	California	U.S.	16Mb DRAM	1991	35,000	150	0.5	-	-	618.5	-	-	618.5
1727	NEC	Japan	Dif-1	Higashi Hiroshima-Shi	Hiroshima	Japan	4Mb DRAM SRAM MPU 4Mb ROM	1990/Q4	30,000	150	0.6	-	-	530.1	-	-	530.1
1737	NEC	Japan	G-1	Sagamihara-Shi	Kanagawa	Japan	16Mb DRAM ASIC MPU 4Mb ROM	1988	10,000	150	0.8	-	-	-	-	-	-
1746	NEC	Japan	Dif-5	Kumamoto-Shi	Kumamoto	Japan	Logic DRAM MCU	1978	20,000	125	1.2	245.4	-	-	-	-	245.4
1747	NEC	Japan	Dif-6	Kumamoto-Shi	Kumamoto	Japan	1Mb DRAM MPU MCU Arrays	1987	30,000	150	1	530.1	-	-	-	-	530.1
1748	NEC	Japan	Dif-7	Kumamoto-Shi	Kumamoto	Japan	MCU 4Mb DRAM ASIC	1988	30,000	150	0.8	-	-	-	-	-	-
1749	NEC	Japan	Dif-8-1	Kumamoto-Shi	Kumamoto	Japan	16Mb DRAM 4Mb SRAM RISC ASIC	1994	60,000	200	0.35	-	-	-	1,885.0	-	1,885.0
1763	NEC	Japan	Dif-3	Otsu-Shi	Shiga	Japan	SRAM 4Mb DRAM Micro ASIC	1983	17,000	150	1	300.4	-	-	-	-	300.4
1775	NEC	Japan	Dif-1	Asa-Gun	Yamaguchi	Japan	4Mb DRAM 1Mb SRAM MPU Flash	1988	45,000	150	0.8	-	-	-	-	-	-
1776	NEC	Japan	Dif-2 (Bldg C)	Asa-Gun	Yamaguchi	Japan	4Mb 16Mb DRAM ASIC	1993	45,000	150	0.5	-	-	795.2	-	-	795.2
2121	NEC	Japan	2 Phase	Livingston	Scotland	U.K.	16Mb 64Mb DRAM	1996/Q4	20,000	200	0.35	-	-	-	628.3	-	628.3

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
												> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
2175	NEC	Japan	Dif-2	Higashi Hiroshima-Shi	Hiroshima	Japan	16Mb 64Mb DRAM ASIC RISC	1996	33,000	200	0.25	-	-	-	-	1,036.7	1,036.7
2445	NEC	Japan	-	Beijing	-	China	MCU Logic 4Mb 16Mb DRAM ASIC	2000	5,000	150	0.4	-	-	-	88.4	-	88.4
NEC Total									**430,000**			**1,382.8**	-	**2,385.6**	**2,601.6**	**1,036.7**	**7,406.8**
1788	**Nippon Silicon**	**Japan**	-	-	-	-	16Mb DRAM	1990	-	-	0.6	-	-	-	-	-	-
Nippon Silicon Total									-	-	-	-	-	-	-	-	-
1789	Nippon Steel Corporation	Japan	Electronics Lab	Sagamihara-Shi	Kanagawa	Japan	ASIC 16Mb 64Mb DRAM	1991/Q4	500	150	0.35	-	-	-	8.8	-	8.8
Nippon Steel Corporation Total									**500**			-	-	-	**8.8**	-	**8.8**
1803	**Nippon Steel Semiconductor**	**Japan**	M2	Tateyama-Shi	Chiba	Japan	1Mb 4Mb DRAM Flash Logic	1988	12,000	150	**0.6**	-	-	212.1	-	-	212.1
1804	Nippon Steel Semiconductor	Japan	M3	Tateyama-Shi	Chiba	Japan	4Mb 16Mb DRAM	1990	20,000	150	0.5	-	-	353.4	-	-	353.4
2409	Nippon Steel Semiconductor	**Japan**	N1	Tateyama-Shi	Chiba	Japan	16Mb 64Mb DRAM	1996/Q3	10,000	200	0.35	-	-	-	314.2	-	314.2
Nippon Steel Semiconductor Total									**42,000**			-	-	**565.5**	**314.2**	-	**879.6**
1809	**Oki**	**Japan**	S2	Kurokawa-Gun	Miyagi	Japan	16Mb 64Mb DRAM	1996/Q1	15,000	200	0.3	-	-	-	-	471.2	471.2
1810	**Oki**	**Japan**	S1	Kurokawa-Gun	Miyagi	Japan	4Mb DRAM VRAM 1Mb SRAM 16M MROM	1981	**30,000**	150	0.5	-	-	530.1	-	-	530.1
1812	Oki	Japan	M2	Miyazaki-Gun	Miyazaki	Japan	1Mb DRAM 256Kb SRAM 4M MROM	1991	**60,000**	**125**	**0.8**	-	-	-	-	-	-
1813	Oki	Japan	**M3**	Miyazaki-Gun	Miyazaki	Japan	4Mb 16Mb DRAM	1967	30,000	**150**	**0.4**	-	-	-	530.1	-	530.1
1821	Oki	Japan	V3	Hachioji-Shi	Tokyo	Japan	16Mb 64Mb DRAM Micro Gate Array	1989	2,000	150	**0.5**	-	-	35.3	-	-	35.3

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm) > 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
2104	Oki	Japan	U1	Hachioji-Shi	Tokyo	Japan	64Mb 256Mb DRAM Micro Logic	1992	1,000	150	0.3	-	-	-	-	17.7	17.7
Oki Total									138,000	-	-	-	-	565.5	530.1	488.9	1,584.5
2127	Powerchip (Elitegroup)	Japan/ Taiwan	Fab 1	Science Park	Hsin Chu	Taiwan	16Mb DRAM	1996/Q2	25,000	200	0.4	-	-	-	785.4	-	785.4
Powerchip (Elitegroup) Total									**25,000**			-	-	-	**785.4**	-	**785.4**
2182	ProMOS Technologies	Taiwan	Fab 2	Science Park	Hsin Chu	Taiwan	16Mb 64Mb 256Mb DRAM SRAM	1998	20,000	200	0.25	-	-	-	-	628.3	628.3
ProMOS Technologies Total									**20,000**			-	-	-	-	**628.3**	**628.3**
169	Samsung	Korea	Fab 4	Kiheung-Up	Kyungki-Do	Korea	Alpha MPU 4Mb DRAM SRAM Embed. DRAM	1990	35,000	150	0.5	-	-	618.5	-	-	618.5
180	Samsung	Korea	Fab 5	Kiheung-Up	Kyungki-Do	Korea	Alpha MPU 4Mb DRAM SRAM Embed. DRAM	1993	25,000	200	0.5	-	-	785.4	-	-	785.4
228	Samsung	Korea	Fab 6	Kiheung-Up	Kyungki-Do	Korea	16Mb 64Mb DRAM	1995/Q1	30,000	200	0.35	-	-	-	942.5	-	942.5
2096	Samsung	Korea	Fab 7	Kiheung-Up	Kyungki-Do	Korea	16Mb 64Mb DRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
2200	Samsung	Korea	Fab 8	Kiheung-Up	Kyungki-Do	Korea	64Mb DRAM	1997	25,000	200	0.3	-	-	-	-	785.4	785.4
2222	Samsung	Korea	-	Austin	Texas	U.S.	64Mb DRAM	1998/Q1	25,000	200	0.3	-	-	-	-	785.4	785.4
Samsung Total									**160,000**			-	-	**1,403.9**	**1,570.8**	**1,570.8**	**4,545.5**
1861	Sanyo	Japan	A 1	Ojiya-Shi	Niigata	Japan	1Mb 4Mb DRAM 4-Bit 8-Bit MCU DSP	1985	35,000	125	0.8	-	-	-	-	-	-
1866	Sanyo	Japan	C 2	Ojiya-Shi	Niigata	Japan	DRAM	1994	25,000	150	0.85	441.8	-	-	-	-	441.8
Sanyo Total									**60,000**			**441.8**	-	-	-	-	**441.8**
1885	Sharp	Japan	Factory 2	Fukuyama-Shi	Hiroshima	Japan	16Mb MROM DRAM SRAM	1989	40,000	150	0.6	-	-	706.9	-	-	706.9
2295	Sharp	Japan	Factory 4	Fukuyama-Shi	Hiroshima	Japan	Flash 64Mb DRAM	1998/Q1	16,000	200	0.25	-	-	-	-	502.7	502.7

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
												> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
	Sharp Total								**56,000**			-	-	706.9	-	502.7	1,209.5
319	Siemens	Germany	H15, H16, H17	Regensburg	Bavaria	Germany	4Mb DRAM ASIC ASSP 1Mb DRAM H182ASIC	1986/Q3	46,600	150	0.35	-	-	-	823.5	-	823.5
2070	Siemens	Germany	SIMEC (Lines 1 and 2)	Dresden	Saxonia	Germany	16Mb 64Mb DRAM	1996/Q2	30,000	200	0.25	-	-	-	-	942.5	942.5
2216	Siemens	Germany		North Tyneside	England	U.K.	DRAM ASIC	1997/Q3	25,000	200	0.25	-	-	-	-	785.4	785.4
	Siemens Total								**101,600**			-	-	-	823.5	1,727.9	2,551.4
1918	Sony	Japan	3G	Isahaya-Shi	Nagasaki	Japan	1Mb SRAM 4Mb VRAM CCD Logic	1991/Q1	25,000	150	0.5	-	-	441.8	-	-	441.8
	Sony Total								**25,000**			-	-	441.8	-	-	441.8
1930	Sumitomo Metal Industries	Japan		Amagasaki-Shi	Hyogo	Japan	4Mb DRAM Arrays	1991	300	150	0.8	-	-	-	-	-	-
	Sumitomo Metal Industries Total								**300**			-	-	-	-	-	-
241	Taiwan Semiconductor Mfg. Co.	Taiwan/ Netherlands	Fab 3	Science Park	Hsin Chu	Taiwan	DRAM SRAM ROM Logic Custom	1995	30,000	200	0.35	-	-	-	942.5	-	942.5
	Taiwan Semiconductor Mfg. Co. Total								**30,000**			-	-	-	**942.5**	-	**942.5**
2028	Tech Semiconductor	Singapore/ U.S.	Fab 1	Singapore	-	Singapore	16Mb DRAM	1993/Q2	12,000	200	0.5	-	-	377.0	-	-	377.0
2029	Tech Semiconductor	Singapore/ U.S.	Fab 2	Singapore	–	Singapore	16Mb DRAM	1996/Q3	25,000	200	0.35	-	-	-	785.4	-	785.4
	Tech Semiconductor Total								**37,000**			-	-	**377.0**	**785.4**	-	**1,162.4**
438	Texas Instruments	U.S.	AMOS-1	Avezzano	AQ	Italy	4Mb 16Mb DRAM 4Mb Flash	1990	22,000	200	0.25	-	-	-	-	691.2	691.2
441	Texas Instruments	U.S.	AMOS-2	Avezzano	AQ	Italy	16Mb DRAM	1996	20,000	200	0.25	-	-	-	-	628.3	628.3
1189	Texas Instruments	U.S.	DMOS 5 Phase 1	Dallas	Texas	U.S.	16Mb DRAM	1995	16,000	200	0.5	-	-	502.7	-	-	502.7
1252	Texas Instruments	U.S.	DMOS 5 Phase 2	Dallas	Texas	U.S.	64Mb 256Mb DRAM	1997	16,000	200	0.35	-	-	–	502.7	-	502.7
1938	Texas Instruments	U.S.	Miho 6	Inashiki-Gun	Ibaragi	Japan	1Mb 4Mb DRAM ASSP MPU		15,000	150	0.8	-	-	-	-	-	-

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
												> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
2449	Texas Instruments	U.S.	AMOS-3	Avezzano	AQ	Italy	Flash 64Mb 256Mb Embed-ded DRAM	1999/Q1	6,600	12	0.18	-	-	-	-	0.7	0.7
	Texas Instruments Total								95,600			-	-	502.7	502.7	1,320.2	2,325.5
109	Texas Instru-ments/Acer	U.S.	Fab 1A	Science Park	Hsin Chu	Taiwan	4Mb DRAM	1991/Q4	22,000	150	0.5	-	-	388.8	-	-	388.8
189	Texas Instru-ments/Acer	U.S.	Fab 1B	Science Park	Hsin Chu	Taiwan	4Mb 16Mb DRAM	1995/Q3	25,000	200	0.35	-	-	-	785.4	-	785.4
2261	Texas Instru-ments/Acer	U.S.	Fab 2	Science Park	Hsin Chu	Taiwan	16Mb 64Mb DRAM	1999	50,000	200	0.25	-	-	-	-	1,570.8	1,570.8
	Texas Instruments/Acer Total								97,000			-	-	388.8	785.4	1,570.8	2,745.0
2461	Texas Instru-ments/Anam Electronics	U.S./Korea	-	Pupyong	Seoul	Korea	DRAM DSPs	2002	25,000	200	0.25	-	-	-	-	785.4	785.4
	Texas Instruments/Anam Electronics Total								25,000			-	-	-	-	785.4	785.4
1946	Tohoku Semiconductor	Japan/U.S.	Step 1	Sendai-Shi	Miyagi	Japan	1Mb DRAM MCU MPU	1988	7,500	150	1	132.5	-	-	-	-	132.5
1947	Tohoku Semiconductor	Japan/U.S.	Step 2	Sendai-Shi	Miyagi	Japan	4Mb DRAM MPU MCU	1991	10,000	150	0.8	-	-	-	-	-	-
1948	Tohoku Semiconductor	Japan/U.S.	Step 3	Sendai-Shi	Miyagi	Japan	16Mb DRAM	1995/Q2	15,000	200	0.35	-	-	-	471.2	-	471.2
	Tohoku Semiconductor Total								32,500			132.5	-	-	471.2	-	603.8
1977	Toshiba	Japan	Bldg. 108 D-2	Kawasaki-Shi	Kanagawa	Japan	16Mb 64Mb DRAM Flash	1990	1,300	200	0.35	-	-	-	40.8	-	40.8
1980	Toshiba	Japan	Y-Cubed, No. 1-Mod 1	Yokkaichi-Shi	Mie	Japan	4Mb 16Mb DRAM	1993	10,000	200	0.5	-	-	314.2	-	-	314.2
1981	Toshiba	Japan	Y-Cubed, No. 1-Mod 2	Yokkaichi-Shi	Mie	Japan	4Mb 16Mb DRAM	1994	25,000	200	0.35	-	-	-	785.4	-	785.4
1991	Toshiba	Japan	C-Cubed 3	Oita-Shi	Oita	Japan	MCU ASIC DRAM SRAM	1989	32,000	125	1	392.7	-	-	-	-	392.7
1993	Toshiba	Japan	C-Cubed 4	Oita-Shi	Oita	Japan	4Mb 16Mb DRAM	1991	40,000	150	0.5	-	-	706.9	-	-	706.9
2150	Toshiba	Japan	Y-Cubed, No. 2	Yokkaichi-Shi	Mie	Japan	16Mb DRAM 64Mb DRAM 256Mb DRAM	1996/Q3	28,000	200	0.35	-	-	-	879.6	-	879.6

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Fab ID	Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm) > 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
2264	Toshiba	Japan	Step 5	Kitakami-Shi	Iwate	Japan	16Mb 64Mb DRAM Logic	1998	30,000	200	0.35	-	-	-	942.5	-	942.5
2458	Toshiba	Japan	C-Cubed 5	Oita-Shi	Oita	Japan	256Mb DRAM	2000		200	0.18	-	-	-	-	-	-
Toshiba Total									**166,300**			**392.7**	-	**1,021.0**	**2,648.4**	-	**4,062.1**
2079	Twinstar Semiconductor	Japan/U.S.	Twinstar	Richardson	Texas	U.S.	16Mb 64Mb DRAM	1996/Q2	15,000	200	0.3	-	-	-	-	471.2	471.2
Twinstar Semiconductor Total									**15,000**			-	-	-	-	**471.2**	**471.2**
248	Vanguard International	Taiwan	Fab 1	Science Park	Hsin Chu	Taiwan	4Mb DRAM	1991	4,000	150	0.5	-	-	70.7	-	-	70.7
2093	Vanguard International	Taiwan	Fab 1A	Science Park	Hsin Chu	Taiwan	4Mb 16Mb DRAM	1995/Q2	16,000	200	0.35	-	-	-	502.7	-	502.7
2154	Vanguard International	Taiwan	Fab 1B	Science Park	Hsin Chu	Taiwan	16Mb DRAM	1999	16,000	200	0.35	-	-	-	502.7	-	502.7
2238	Vanguard International	Taiwan	Fab 2	Science Park	Hsin Chu	Taiwan	4Mb DRAM 16Mb DRAM 1Mb Sync SRAM	1999	40,000	200	0.18	-	-	-	-	1,256.6	1,256.6
Vanguard International Total									**76,000**			-	-	**70.7**	**1,005.3**	**1,256.6**	**2,332.6**
2249	White Oak Semiconductor	U.S./ Germany	MOS 18	Richmond	Virginia	U.S.	64Mb 256Mb DRAM	1998/Q3	25,000	200	0.18	-	-	-	-	785.4	785.4
White Oak Semiconductor Total									**25,000**			-	-	-	-	**785.4**	**785.4**
200	Winbond	Taiwan	Fab II	Science Park	Hsin Chu	Taiwan	DRAM	1992/Q4	35,000	150	0.5	-	-	618.5	-	-	618.5
2350	Winbond	Taiwan	Fab IV	Science Park	Hsin Chu	Taiwan	16Mb 64Mb 256Mb DRAM	1999	15,000	200	0.35	-	-	-	471.2	-	471.2
Winbond Total									**50,000**			-	-	**618.5**	**471.2**	-	**1,089.7**
Total									**3,174,900**			**4,410.0**	**1,095.6**	**13,590.1**	**31,202.3**	**20,285.6**	**70,583.7**

Source: Dataquest (April 1997)

Chapter 8
Definitions

Demand: The number of shipments of a product that Dataquest estimates to be sustainable in a market at the price forecast by Dataquest for that time. If the price were lower, demand would increase. If the price were higher, demand would decrease. Demand is used to determine whether the market is undersupplied or oversupplied.

Deskside PC: PCs designed to stand vertically beside or underneath a user's desk. The primary design distinguishes a deskside from a desktop unit in that the deskside unit keeps a sideways orientation and that drive bays usually remain horizontal when the central processor (CPU) is placed on the floor.

Desktop PC: All systems not otherwise classified into categories of deskside computers or portable computers. They are PCs intended for use on a user's desktop or work surface and are not designed to be moved readily from place to place. Models switchable between desktop and deskside are included in the desktop category.

Digital phone answering machine: Telephone answering machines for individual telephone lines using MOS memory technology for outgoing message storage, incoming message storage, or both.

Facsimile: A machine that scans and encodes a document into electrical signals, transmits these electrical signals over a telephone/data line, then reconstructs the signals to print an exact duplicate of the original document on paper at the receiving end (generically called a fax).

Game: Video game and CD-ROM players are microprocessor-based devices that are handheld or console-based and play video games housed on cartridges or CD-ROMs.

Industrial board: A controller board, usually based on an x86 processor, that is used in embedded industrial control and medical applications. These boards are not officially counted by Dataquest, and the numbers used in this survey are estimates based on processor shipment numbers, secondary sources, and primary inputs from industrial board producers.

Laptop PC: Systems that meet all criteria for a transportable personal computer but are smaller and lighter. The system is completely self-contained and can be carried as a single unit, which includes a keyboard, a display, mass storage, and main system unit. It is also distinguished from a transportable by its case design, which is typically a clamshell. System weight is usually less than 15 pounds. Its power source is either AC or DC. This category is now included under "transportable PC."

Mainframe computer: A general-purpose information system with a starting price range of $100,000 or more. CPU bit width ranges from 32 to 64 bits. Physical environment can be either with or without special environmental controls and requires full-time support by professional computer systems support staff. Number of concurrent users is upward of 100.

Dataquest views a mainframe system shipment as the CPU, the basic storage configuration (not including direct-access storage devices), the native operating system (the system must be bootable), and the operator's console. Dataquest does not routinely count upgrades unless the system footprint changes.

Midrange computer: The midrange product category includes all systems that fall between workstations and mainframes. These are multiuser systems that may or may not run proprietary operating systems. Midrange products have a wide price range, from as low as $10,000 to more than $1 million. Dataquest has included microcomputers, minicomputers, and superminicomputers in this product segment in the past. With the evolution of client/server computing and the systems that define this paradigm, traditional midrange product categories are becoming obsolete. Hewlett-Packard's HP 9000 and HP 3000, Digital Equipment Corporation's VAX systems, and the IBM AS/400 line are joined by the dedicated server products from suppliers such as Auspex Systems Inc., NetFRAME Systems Inc., and Tricord Systems Inc. to make up the midrange product category. Office systems, proprietary turnkey computing solutions common in Japan, are also included in the midrange category. Systems designed as servers from workstation suppliers are also included here.

Network hub/router: A shared media hub is a LAN device that connects multiple PCs through one single node on a network, allowing central control for different optional functionalities such as wide area network (WAN) connectivity, multiple media support, multiple technology support, and network management. A router is a class of network controller that determines the best routing for data transmission between a transmitter (sender) and a receiver. Routers operate at Layer 3 of the ISO-OSI model.

Notebook PC: Systems that meet all criteria for a laptop DC personal computer but are smaller and lighter. The case style typically measures 8.5 x 11 inches or A4 size. Weight typically is less than 8 pounds with the battery.

Notepad: A subcategory of the subnotebook product type, this is distinguished by a pen-based operating system and a pen rather than a keyboard as a primary input device.

Oversupply: An indication of an oversupplied market is low prices and growing inventories.

Page printer: A page printer prints one page at a time.

Set-top box: Digital cable converter boxes that sit on top of TVs and act as converter devices for digital information over cable television (CATV), telephone, or wireless networks to television sets. These boxes contain a general-purpose microprocessor or a high-powered digital signal processor capable of digital transmission, reception, and decompression.

Storage: A collective term for computer hard disk drives and CD-ROMs, where DRAM is often used as a cache memory. Since static random-access memory (SRAM) is sometimes used in place of DRAM, the DRAM consumption for this category appears unusually low to account for limited DRAM penetration into this equipment segment.

Subnotebook PC: Systems that meet all the criteria for a notebook PC but are lighter and do not have an internal floppy disk drive. They typically weigh 4 pounds or less. This segment corresponds to the "ultraportable" category in the newly resegmented PC forecast produced by Dataquest's Computer Systems and Peripherals group.

Supercomputer: A high-performance computer designed for numerically intensive applications. The current price ranges from about $100,000 to $20 million. It is a system priced at more than $2 million, mainly used for batch applications, scientific, engineering, and other computation-oriented problems, or other very heavy, numerically intensive applications. Supercomputers require special environmental controls and cooling techniques. Performance speeds range upward from 50 mflops.

Tablet PC: A subcategory of the notebook product type, the tablet is distinguished by a pen-based operating system that uses a pen, rather than a keyboard, as a primary input device.

Transportable PC: Systems that meet all other personal computer criteria but are designed to be easily moved from place to place. The case style may be identified as a lunch box, and the system is completely self-contained and can be carried as a single unit, which includes a keyboard, a display, mass storage, and the main system unit. Its primary source of power is AC power. Its typical weight is 18 to 20 pounds. This segment corresponds to the "other mobile" category in the newly resegmented PC forecast produced by Dataquest's Computer Systems and Peripherals group.

Undersupply: An indication of an undersupplied market is long lead times, high prices, and product allocation.

Upgrade motherboard: An entire PC motherboard that can be retrofitted into an existing PC chassis in the installed base of PCs. Dataquest does not count these boards as PCs in PC statistics. These numbers are based in part on Dataquest MPU shipments and analyst estimates of upgrade activity.

Workstation: Dataquest classifies workstations by a composite of features, including their hardware and software. Workstations are typically based on reduced-instruction-set computing (RISC) processor architecture with a high-performance bus structure, graphics, and operating system. In general, a workstation must come standard with integrated floating-point processing, integrated networking, and a 32-bit multitasking operating system, as well as offer a configuration that has high-resolution graphics capabilities (typically 1-megapixel display). We do not determine a workstation architecture by its usage (that is, single-user, server, or multiuser). Instead, computers are classified by the primary market for which they are designed.

Appendix A
Worldwide DRAM Fabs

Tables A-1 through A-4 are the tables presented in the previous report (DSDR-MS-96Q4).

Table A-1
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	Siemens	-	Balan-strasse	-	NA	2	24,000	4							
Europe	Siemens	-	Mega 1	1987	1M/4M DRAM	0.6	28,000	6		50	30	85	70	1,856,400	635,040
Europe	Siemens	-	Regens-burg	1994	16M DRAM	0.5	5,000	8	28,000						
Europe	Siemens	Dresden		1995	64M DRAM	0.35	8,000	8							
	Siemens Total						**65,000**		**28,000**					**1,856,400**	**635,040**
Japan	Fujitsu	Tokyo	NA	1995	256M DRAM	0.35	3,000	8							
Japan	Fujitsu	Iwate	No. 3	1987	1M/4M/16M DRAM SRAM ROM	0.8	25,000	6		45		85		1,912,500	
Japan	Fujitsu	Iwate	No. 4	1990	4M/16M DRAM, Flash, SRAM, ASIC	0.5	30,000	6	25,000	45	20	85	65	1,912,500	455,000
Japan	Fujitsu	Iwate	No. 4-2	1995/Q4	16M DRAM	0.35	20,000	8	25,000						
Japan	Fujitsu	Mie	No. 2	1987	Logic, Gate Arrays, 4M DRAM	0.8	10,000	6		30		85		39,780	
Japan	Fujitsu	Mie	No. 3 Phase 2	1994	4M/16M DRAM, SRAM, MPU	0.25	500	8	1,000	50	20	80	65	90,000	16,250
Japan	Fujitsu	Mie	No. 3 Phase 1	1992	16M DRAM	0.5	15,000	6	500	20	40	85	70	318,240	470,400
Europe	Fujitsu	Newton Aycliffe	Phase 1	1991	4M/16M DRAM, ASIC	0.8	5,600	6	12,000	100	0	85	65	1,700,000	
Europe	Fujitsu	Newton Aycliffe	Phase 2	1994	16M DRAM	0.5	14,000	6	10,000	50	40	85	65	935,000	364,000
U.S.A.	Fujitsu	Gresham	No. 1	1990	1M, 4M DRAM	0.8	13,000	6	10,000	30		80		624,000	
U.S.A.	Fujitsu	Gresham	No. 2-2	1997	16M/64M DRAM	0.32	10,000	8	13,000						
	Fujitsu Total						**146,100**		**96,500**					**7,532,020**	**1,305,650**
Japan	Hitachi	Chiba	D3	1990	4M/16M DRAM	0.8	25,000	6		20		85		795,600	
Japan	Hitachi	Gunma	No.2	1991	256K SRAM, 4M DRAM, MCU	0.8	20,000	6	30,000	25		85		663,000	
Japan	Hitachi	Hokkaido	Chitose 2	1990	4M DRAM, 1M SRAM, EEPROM, ROM	0.8	15,000	6	20,000	15		85		298,350	

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Hitachi	Hokkaido	Chitose 1	1988	1M SRAM, 4M DRAM, MPU	0.8	15,000	6	15,000	20		85		397,800	
Japan	Hitachi	Hokkaido	Chitose 2	1998	64M DRAM	0.35	10,000	8	15,000						
Japan	Hitachi	Tokyo	D4/D5	1994	64M DRAM	0.35	3,000	8							
Japan	Hitachi	Ibaraki	N-2 Phase 1	1994/Q4	16M DRAM	0.5	10,000	8		25	40	80	65	720,000	624,000
Japan	Hitachi	Ibaraki	N2-2	1996	16M/64M DRAM	0.35	20,000	8	8,000						
Japan	Hitachi	Ibaraki	N1-1	1983	1M/4M DRAM	0.8	15,000	6		40		85		795,600	
Japan	Hitachi	Ibaraki	N1-2	1988	4M/16M DRAM	0.8	20,000	6	15,000	40		85		1,360,000	
Japan	Hitachi	Tokyo	R&D 2	1990	4M/16M DRAM	0.5	4,000	6	20,000	50	35	85	60	265,200	109,200
Japan	Hitachi	Yamanashi	Imasuwa	1990	4M DRAM, 4M SRAM, 16M Proto-DRAM	0.6	25,000	6	4,000	50	10	85	60	2,125,000	195,000
Japan	Hitachi	Yamanashi	K-2	1990	4M/16M DRAM	0.5	4,000	8	25,000	0	50	80	65		243,750
Japan	Hitachi	Yamanashi	No. K4-3	1989	4M DRAM, 1M SRAM EPROM	0.8	10,000	6	3,000	50		85		663,000	
Japan	Hitachi/Tobu Semicon-ductor		NA	1990		0.6	17,000	6	10,000	35		80		742,560	
Europe	Hitachi	Landshut	E2	1992	4M, 16M DRAM 1M SRAM	0.5	16,000	8	17,000	40	40	80	60	1,152,000	480,000
U.S.A.	Hitachi	Irving	U 1	1989	MPU MCU 256K SRAM 1/4M DRAM	0.5	16,000	8	8,000	60		85		1,632,000	
U.S.A.	Hitachi	Irving	Phase 2	1993	CBIC 16M DRAM 4M SRAM	0.6	5,000	8	16,000		50		65		406,250
U.S.A.	Hitachi/TI	Dallas	NA	1996	16M/64M DRAM	0.35		8	5,000						
	Hitachi Total						**250,000**		**211,000**					**11,610,110**	**2,058,200**
Japan	IBM	Shiga	NA	1990	4M/16M DRAM	0.6	6,000	8		60	0	85	60	1,193,400	
Europe	IBM	Sindelfingen	NA	1989	4M/16M DRAM	0.8	20,000	8	5,200	50	0	80	60	2,700,000	

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	IBM	Corbeil-Essonnes	NA	1989	1M DRAM		7,000	8	15,000						
U.S.A.	IBM	East Fishkill	NA		NA	0.8	20,000	8							
U.S.A.	IBM	Essex Junction	Bldg. 970	1988	16M DRAM		24,000	8		50		80		4,320,000	
U.S.A.	IBM	Essex Junction	Bldg. 973	1989	16M DRAM	0.5	20,000	8	24,000		60		60		1,080,000
U.S.A.	IBM	Manassas	VHSIC	1989	Memory, MPU, ASIC, MIL	0.8	1,600	5	12,000						
U.S.A.	IBM	Essex Junction	Bldg. 963	1989	1M DRAM	1	16,000	8							
Europe	IBM/Siemens	Corbeil-Essonnes	ACL	1992	16M DRAM	0.4	16,100	8			60		60		720,000
	IBM Total						**130,700**		**56,200**					**8,213,400**	**1,800,000**
Japan	Matsushita	Kyoto	LAB	1994	16M/64M DRAM	0.35	1,000	8			50		60		75,000
Japan	Matsushita	Toyama	Fab 1	1994	4M/16M DRAM, MCU, ASIC	0.5	20,000	6	1,000	45	40	80	60	720,000	259,200
Japan	Matsushita	Toyama	Fab C-2	1990	4M/16M/64M DRAM, SRAM	0.5	24,000	6	10,000	45	50	80	60	864,000	388,800
Japan	Matsushita	Tonami	Fab 2	1996	16M DRAM, ASIC	0.35	20,000	8	12,000						
U.S.A.	Matsushita	Puyallup	NA	1991	1M/4M DRAM, MCU, Gate Arrays	0.8	15,000	6		0		80			
	Matsushita Total						**80,000**		**23,000**					**1,584,000**	**723,000**
Japan	Mitsubishi	Ehime	D-1F	1996	64M DRAM	0.35	20,000	8							
Japan	Mitsubishi	Ehime	SA2A	1991	4M/16M DRAM	0.5	20,000	6		25	50	85	70	850,000	756,000
Japan	Mitsubishi	Ehime	SA2B	1994	4M/16M DRAM	0.5	16,000	8	20,000	25	60	80	60	1,040,000	1,170,000
Japan	Mitsubishi	Osaka	ULSI	1993	16M/64M DRAM	0.35	10,000	8	13,000		70		60		525,000
Japan	Mitsubishi	Kumamoto		1996/Q2	16M/64M DRAM	0.35	15,000	8	5,000						
Japan	Mitsubishi	Kochi	TA1	1990	4M DRAM, 1M SRAM	0.7	30,000	6		60		85		3,060,000	
U.S.A.	Mitsubishi		NA	1990	1M/4M DRAM	0.9	7,800	5	30,000	0		85			
U.S.A.	Mitsubishi	Alsodorf	NA	1997	16M DRAM	0.35	7,000	8	7,800						

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Mitsubishi Total						125,800		75,800					4,950,000	2,451,000
Japan	NEC	Hiroshima	Dif-1	1990	4M DRAM, SRAM, MPU, 4M ROM	0.6	30,000	6		50	10	85	70	2,550,000	294,000
Japan	NEC	Hiroshima	Dif-2	1995	16M DRAM, ASIC, RISC	0.35	10,000	8	30,000	0	70	80	65		568,750
Japan	NEC	Kanagawa	G-1	1988	4M DRAM, ASIC, MPU, 4M ROM	0.8	10,000	6	5,000	30		85		397,800	
Japan	NEC	Kumamoto	Dif-7	1988	MCU, 4M DRAM, ASIC	0.8	30,000	6	10,000	20	0	85	70	795,600	
Japan	NEC	Kumamoto	Dif-8	1994/Q4	16M DRAM, 4M SRAM, RISC MPU	0.35	15,000	8	30,000	40	45	85	65	1,632,000	877,500
Japan	NEC	Kumamoto	Dif-8-2	1998	64M/256M DRAM	0.25	30,000	8	12,000						
Japan	NEC	Yamaguchi	Dif-1	1988	4M/16M DRAM	0.8	45,000	6		40		85		2,040,000	
Japan	NEC	Yamaguchi	Dif 2	1993	16M/4M DRAM	0.5	45,000	6	30,000	40	45	85	65	678,912	524,160
Europe	NEC	Livingston, West Lothian	Phase 1	1987	4M/16M DRAM	0.7	25,000	5	12,800	0					
Europe	NEC	Livingston, West Lothian	Phase 2	1991	4M DRAM, 256K SRAM, MPR, MPU	0.35	10,000	6		80		85		2,121,600	
Europe	NEC	Livingston, West Lothian	Phase 3	1997/Q1	16M/64M DRAM	0.35	10,000	8	20,000						
U.S.A.	NEC	Roseville	M-Line	1991	4M/16M DRAM	0.5	13,000	6		20	75	85	55	583,440	1,089,000
U.S.A.	NEC	Roseville	M-Line 2	1994	4M/16M DRAM	0.5	17,000	6	22,000						
	NEC Total						290,000		171,800					10,799,352	3,353,410
Japan	Nittetsu Semi-conductor	Chiba	M1	1985	1M DRAM, 8-bit MPU, ASIC, Linear	1	20,000	5							
Japan	Nittetsu Semi-conductor	Chiba	M2	1988	1M DRAM, 2M/4M/8M Flash	0.8	15,000	6	20,000						

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Nittetsu Semiconductor	Chiba	M3	1990	4M DRAM	0.5	15,000	6	15,000	80	10	85	60	1,591,200	97,200
	Nittetsu Semiconductor Total						**50,000**		**35,000**					**1,591,200**	**97,200**
Japan	Oki	Miyagi	NA	1989	Gate Arrays, 1M DRAM, VRAM, Logic	0.8	20,000	6							
Japan	Oki	Miyagi	S1	1990	4M DRAM, VRAM, 1M SRAM	0.45	30,000	6	1,000	55		85		2,103,750	
Japan	Oki	Miyagi	S2	1995	16M/64M DRAM	0.35	15,000	8	25,000						
Japan	Oki	Miyazaki	M1	1988	DRAM, SRAM, Gate Arrays, MPU	1.5	30,000	4							
Japan	Oki	Miyazaki	M2	1984	DRAM, EEPROM, ASIC, SRAM	0.8	20,000	5		0		85			
Japan	Oki	Miyazaki	M3	1991	4M/16M DRAM, 90K Gate Arrays	0.45	30,000	6	28,000	75	20	85	60	3,098,250	453,600
Japan	Oki	Tokyo	V-1	1979	All (Trial)		50,000	3	27,000						
U.S.A.	Oki	Tualatin	NA	1994	ASIC, DRAM		15,000	6							
	Oki Total						**210,000**		**81,000**					**5,202,000**	**453,600**
Japan	Tohoku Semiconductor	Miyagi	Step 1	1988	1M DRAM, MCU, MPU, SRAM	1	7,500	6							
Japan	Tohoku Semiconductor	Miyagi	Step 2	1991	4M DRAM	0.8	20,000	6							
Japan	Tohoku Semiconductor	Miyagi	Step 3	1995	16M/64M DRAM	0.35	15,000	8		100		85		2,652,000	
Europe	Motorola	East Kilbride	MOS 9	1990	SRAM, 1M DRAM, MPU	0.8	22,000	6	20,000		80		50		72,000
	Motorola Total*						**64,500**		**20,000**					**2,652,000**	**72,000**
Japan	Toshiba	Kanagawa	Fab B	1990	4M/16M DRAM	0.5	1,300	8		40	50	80	55	124,800	71,500
Japan	Toshiba	Kanagawa	ULSI LAB	1993	64M DRAM	0.35	3,000	8	1,300						
Japan	Toshiba	Mie	Y-Cubed, No. 1	1993	4M/16M DRAM	0.5	9,000	8		35	55	85	60	803,250	594,000
Japan	Toshiba	Mie	Y-Cubed, No. 2	1996/Q4	64M DRAM	0.35	25,000	8	9,000						
Japan	Toshiba	Mie	NA	1996/Q4	64M DRAM	0.35	40,000	8							

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Toshiba	Oita	C-Cubed, No. 1	1986	MCU, ROM, RAM	0.8	33,000	5							
Japan	Toshiba	Oita	C-Cubed, No. 2	1987	MCU, ROM, RAM	0.8	32,000	5							
Japan	Toshiba	Oita	C-Cubed, No. 3	1987	RAM	0.7	60,000	6		60	30	85	65	3,978,000	1,267,500
Japan	Toshiba	Oita	C-Cubed, No. 4	1991	RAM	0.5	40,000	6	50,000	60	30	85	65	2,943,720	937,950
Japan	Toshiba	Oita	C-Cubed, No. 5	1996 Planned		0.35	20,000	8	37,000						
	Toshiba Total						**263,300**		**97,300**					**7,849,770**	**2,870,950**
U.S.A.	TI	Dallas	DMOS 4.1	1985	256K SRAM, 16M DRAM, Logic, ASSP	0.6	29,200	6		60	40	80	65	1,123,200	696,214
U.S.A.	TI	Dallas	DMOS 5 Phase 1	1995/Q3	16M DRAM	0.5	16,000	8	15,000		80		60		
U.S.A.	TI	Dallas	DMOS 5 Phase 2	1997	64M, 256M DRAM	0.35	16,000	8							
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1-A	1991	4M DRAM	0.6	17,000	6		90		85		1,432,080	
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 2	1994	16M DRAM	0.8	9,000	8	12,000						
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1 Module B	1995/Q3	16/64M DRAM	0.5	9,000	8			80		55		185,147
Europe	TI	Avezzano	AMOS	1991	4M DRAM, ASSP, CBIC	0.5	13,500	6	8,000	80	15	85	60	1,652,400	216,897
Europe	TI	Avezzano	Phase 2	1996	16M DRAM	0.5	20,000	8	13,500						-
Japan	KTI Semiconductor	Hyogo	Fab 1	1992	4M/16M DRAM, ASIC	0.5	11,000	8		58	30	85	60	1,972,000	459,042
	TI Total						**140,700**		**48,500**					**6,179,680**	**1,557,300**
U.S.A.	Micron	Idaho	Fab 1	1981	256K/1M DRAM, 256K SRAM	1.2	32,000	6							
U.S.A.	Micron	Idaho	Fab 2		4M/16M DRAM	0.5	14,400	6	32,000	70	30	85	65	3,427,200	365,040
U.S.A.	Micron	Idaho	Fab 3	1991	1M/4M DRAM	0.8	20,000	6	14,400	95		85		6,460,000	
	Micron Total						**66,400**		**46,400**					**9,887,200**	**365,040**
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab I-A	1984	256K DRAM, 64K SRAM, ASIC	1.2	15,000	5							

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab II	1985	1M/4M DRAM	0.8	25,000	6		70		80		2,800,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab III	1991	4M DRAM	0.6	20,000	6	25,000	90		85		3,060,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E2 (Fab 5)	1995	16M/64M DRAM	0.35	30,000	8	20,000		80		50		640,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E1 (Fab 4)	1994	4M/16M DRAM	0.5	20,000	8	8,000	20	65	80	60	960,000	1,560,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E3	1998	16M/64M DRAM	0.35	20,000	8	20,000						
	Hyundai Total						**130,000**		**73,000**					**6,820,000**	**2,200,000**
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 4	1990	4M DRAM, SRAM	0.6	35,000	6		80		85		5,712,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 3	1988	1M DRAM, SRAM, VRAM, ROM	0.8	35,000	6	30,000	50		85		4,165,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 5	1993	4M/16M DRAM	0.5	25,000	8	35,000	10	75	80	65	960,000	3,046,875
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 6	1995/Q1	16M/64M DRAM	0.35	30,000	8	25,000	0	90	80	65		1,462,500
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 7	1996	16M/64M DRAM	0.35	25,000	8	10,000						
	Samsung Total						**150,000**		**100,000**					**10,837,000**	**4,509,375**
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 1	1990	4M/16M DRAM	0.8	30,000	6		40		80		1,920,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 2	1991	4M DRAM	0.7	30,000	6	30,000	75		85		3,825,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 3	1997	16/64M DRAM	0.35	30,000	8	30,000						
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C2, Phase 1	1993	4M/16M DRAM	0.5	20,000	8		20	50	75	65	1,350,000	1,950,000
Asia/ Pacific	LG Semicon	Gumi	C2, Phase 2	1996	16M DRAM	0.5	20,000	8	30,000						
	LG Semicon Total						**130,000**		**90,000**					**7,095,000**	**1,950,000**
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 1-A	1995	4M DRAM	0.5	15,000	6		100		80		624,000	
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 1-B	1994/Q4	4M/16M DRAM	0.5	15,000	8	5,000						
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 2	1996/Q1	16M/64M DRAM	0.5	15,000	8							
	Mosel Vitelic Total						**45,000**		**5,000**					**624,000**	

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Tech Semiconductor	Woodlands	Fab 1	1993	4Mb/16Mb DRAM	0.5	12,000	8	10,500	50	40	85	55	1,338,750	462,000
Asia/ Pacific	Tech Semiconductor	Woodlands	Fab 2	1996	16Mb/64Mb DRAM	0.35	10,000	8							
	Tech Semiconductor Total						**22,000**		**10,500**					**1,338,750**	**462,000**
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1A	1995/Q1	4M/16M DRAM	0.5	15,000	8			80		55		352,000
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1B	1996/Q2	4M/16M DRAM	0.35	15,000	8	4,000						
Asia/ Pacific	Vanguard	Hsin Chu	Fab 2	1997/Q2	16M/64M DRAM	0.35	15,000	8							
	Vanguard Total						**45,000**		**4,000**						**352,000**
	Americas Companies						402,300		171,100					26,932,280	3,794,340
	European Companies						65,000		28,000					1,856,400	635,040
	Japanese Companies						1,415,200		791,400					51,118,452	13,313,010
	Asia/Pacific Companies						522,000		282,500					26,714,750	9,473,375
	Korean Companies						410,000		263,000					24,752,000	8,659,375
	Taiwan Companies						90,000		9,000					624,000	352,000
	Rest of Asia/Pacific Companies						22,000		10,500					1,338,750	462,000
	Worldwide Companies						2,404,500		1,273,000					106,621,882	27,215,765

*Tohoku Semiconductor production is split 50-50 between Toshiba and Motorola.
NA = Not available
Source: Dataquest (October 1996)

Table A-2
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	Siemens		Mega 1	1987	1M/4M DRAM	0.6	28,000	6	28,000	40	40	85	75	1,485,120	907,200
Europe	Siemens		Regens-burg	1994	16M DRAM	0.5	5,000	8							
Europe	Siemens	Dresden		1995	64M DRAM	0.35	8,000	8							
	Siemens Total						**41,000**		**28,000**					**1,485,120**	**907,200**
Japan	Fujitsu	Akiru	Akiru R&D Center	1996	256M DRAM	0.35	3,000	8							
Japan	Fujitsu	Iwate	No. 3	1987	1M/4M/16M DRAM SRAM ROM	0.8	25,000	6	30,000	40		85		1,700,000	
Japan	Fujitsu	Iwate	No. 4	1990	4M/16M DRAM, Flash, SRAM, ASIC	0.5	30,000	6	5,000	40	20	85	75	2,040,000	630,000
Japan	Fujitsu	Iwate	No. 4-2	1995/Q4	16M DRAM	0.35	20,000	8	1,000		70		70		857,500
Japan	Fujitsu	Mie	No. 2	1987	Logic, Gate Arrays, 4M DRAM	0.8	10,000	6	10,000	30		85		397,800	
Japan	Fujitsu	Mie	No. 3 Phase 2	1994	4M/16M DRAM, SRAM, MPU	0.25	500	8			0				
Japan	Fujitsu	Mie	No. 3 Phase 1	1992	16M DRAM	0.5	15,000	6	10,000	20	50	85	75	510,000	787,500
Europe	Fujitsu	Newton Aycliffe	Phase 1	1991	4M/16M DRAM, ASIC	0.8	10,000	6	10,000	60	0	85	70	1,020,000	
Europe	Fujitsu	Newton Aycliffe	Phase 2	1994	16M DRAM	0.5	15,000	6	13,000	40	40	85	70	1,122,000	588,000
U.S.A.	Fujitsu	Gresham	No. 1	1990	1M, 4M DRAM	0.8	13,000	6		45		80		936,000	
U.S.A.	Fujitsu	Gresham	No. 2-2	1997	16M/64M DRAM	0.32	10,000	8							

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Fujitsu Total						**151,500**		**79,000**					**7,725,800**	**2,863,000**
Japan	Hitachi	Chiba	D3	1990	4M/16M DRAM	0.8	15,000	6	15,000	50		85		994,500	
Japan	Hitachi	Gunma	NA	1995	16Mb DRAM	0.8	20,000	6	20,000	10		85		265,200	
Japan	Hitachi	Hokkaido	Chitose 2	1990	4M DRAM, 1M SRAM, EEPROM, ROM	0.8	15,000	6	15,000	10		85		198,900	
Japan	Hitachi	Hokkaido	Chitose 1	1988	1M SRAM, 4M DRAM, MPU	0.8	15,000	6	15,000	20		85		397,800	
Japan	Hitachi	Hokkaido	CHI-TOSE 3	1998	64M DRAM	0.35	10,000	8							
Japan	Hitachi	Tokyo	D4/D5	1994	64M DRAM	0.35	3,000	8							
Japan	Hitachi	Ibaraki	N-2 Phase 1	1994/Q4	16M DRAM	0.5	20,000	8	15,000	25	40	80	70	1,350,000	1,260,000
Japan	Hitachi	Ibaraki	N1-1	1983	1M/4M DRAM	0.8	15,000	6	15,000	40		85		1,020,000	
Japan	Hitachi	Tokyo	R&D 2	1990	4M/16M DRAM	0.5	4,000	6	4,000	50	40	85	65	340,000	135,200
Japan	Hitachi	Yamanashi	Imasuwa	1990	4M DRAM, 4M SRAM, 16M Proto-DRAM	0.6	25,000	6	25,000	20	10	85	65	850,000	211,250
Japan	Hitachi	Yamanashi	K-2-2F	1990	4M/16M DRAM	0.5	4,000	8	10,000		50		70		1,050,000
Japan	Hitachi/ Tobu Semicon-ductor		NA	1990		0.6	17,000	6	17,000	20		80		544,000	
Europe	Hitachi	Landshut	E2	1992	16Mb DRAM	0.5	16,000	8	12,000	30	50	80	65	1,296,000	1,170,000
U.S.A.	Hitachi	Irving	Phase 2	1993	CBIC 16M DRAM 4M SRAM	0.6	5,000	8	10,000		50		70		1,050,000
U.S.A.	Twinstar	Dallas	Twinstar	1996	16M/64M DRAM	0.35	15,000	8	15,000						

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Hitachi Total						**199,000**		**188,000**					**7,256,400**	**4,876,450**
Japan	IBM	Shiga	NA	1990	4M/16M DRAM	0.6	6,000	8	200	30	40	85	65		
Europe	IBM	Sindelfingen	NA	1989	4M/16M DRAM	0.8	20,000	8	15,000	30	20	80	65	1,620,000	487,500
Europe	IBM	Corbeil-Essonnes	NA	1989	1M DRAM		7,000	8							
U.S.A.	IBM	East Fishkill	NA		NA	0.8	20,000	8							
U.S.A.	IBM	Essex Junction	Bldg. 970	1988	16M DRAM		24,000	8	24,000	50		80		4,320,000	
U.S.A.	IBM	Essex Junction	Bldg. 973	1989	16M DRAM	0.5	20,000	8	12,000		60		65		1,170,000
U.S.A.	IBM	Manassas	VHSIC	1989	Memory, MPU, ASIC, MIL	0.8	1,600	5							
U.S.A.	IBM	Essex Junction	Bldg. 963	1989	1M DRAM	1	16,000	8							
Europe	IBM/ Siemens	Corbeil-Essonnes	ACL	1992	16M DRAM	0.4	16,100	8	8,000		60		65		780,000
	IBM Total						**130,700**		**59,200**					**5,940,000**	**2,437,500**
Japan	Matsushita	Kyoto	LAB	1992	16M/64M DRAM	0.35	1,000	8			50		65		81,250
Japan	Matsushita	Toyama	Fab 1	1994	4M/16M DRAM, MCU, ASIC	0.5	20,000	6	10,000	30	50	80	65	480,000	351,000
Japan	Matsushita	Toyama	Fab C-2	1990	4M/16M/ 64M DRAM, SRAM	0.5	24,000	6	15,000	45	60	80	65	1,080,000	631,800
Japan	Matsushita	Tonami	Fab 2	1996	16M DRAM, ASIC	0.35	20,000	8	15,000						
U.S.A.	Matsushita	Puyallup	NA	1991	1M/4M DRAM, MCU, Gate Arrays	0.8	15,000	6		0		80			

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Matsushita Total						80,000		40,000					1,560,000	1,064,050
Japan	Mitsubishi	Ehime	KD-1	1995	16Mb/ 64Mb DRAM	0.40	20,000	8	10,000	30	50	65	55	510,000	297,000
Japan	Mitsubishi	Ehime	SA2A	1991	4M/16M DRAM	0.40	15,000	6	15,000	20	60	85	75	748,000	972,000
Japan	Mitsubishi	Ehime	SA2B	1994	4M/16M DRAM	0.40	17,000	8	15,000	15	75	80	65	768,000	1,950,000
Japan	Mitsubishi	Osaka	U	1993	16M/64M DRAM	0.35	3,000	8	1,000		70		65		796,250
Japan	Mitsubishi	Kumamoto	KD-1-2	1996	16M/64M DRAM	0.35	15,000	8	7,000						
Japan	Mitsubishi	Kochi	TA1	1990	4M DRAM, 1M SRAM	0.60	33,000	6	30,000	60		85		3,366,000	
U.S.A.	Mitsubishi		NA	1990	1M/4M DRAM	0.60	7,800	6	7,800	0		85			
U.S.A.	Mitsubishi	Alsodorf	NA	1998	64Mb DRAM	0.35	7,000	8							
	Mitsubishi Total						117,800		85,800					5,392,000	4,015,250
Japan	NEC	Hiroshima	Dif-1	1990	4M DRAM, SRAM, MPU, 4M ROM	0.6	30,000	6	30,000	40	10	85	75	1,530,000	
Japan	NEC	Hiroshima	Dif-2	1996	16M DRAM, ASIC, RISC	0.35	10,000	8	8,000		80		70		2,677,500
Japan	NEC	Kumamoto	Dif-7	1988	MCU, 4M DRAM, ASIC	0.8	30,000	6	30,000	20		85		795,600	
Japan	NEC	Kumamoto	Dif-8	1994	16M DRAM, 4M SRAM, RISC MPU	0.35	15,000	8	15,000		70		70		2,520,000
Japan	NEC	Kumamoto	Dif-8-2	1998	64M/256M DRAM	0.25	30,000	8							
Japan	NEC	Yamaguchi	Dif-1	1988	4Mb DRAM 1Mb SRAM MPU	0.50	30,000	6	30,000		04			1,530,000	

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	NEC	Yamaguchi	Dif-2	1993	16Mb DRAM 4Mb DRAM	0.50	45,000	6	12,800					455,200	873,600
Europe	NEC	Living-ston, West Lothian	Phase 2	1991	4M DRAM, 256K SRAM, MPR, MPU	0.5	25,000	6	10,000	80		85		1,360,000	
Europe	NEC	Living-ston, West Lothian	Phase 3	1997/Q1	16M/64M DRAM	0.35	10,000	8							
U.S.A.	NEC	Roseville	M-Line	1991	4M/16M DRAM	0.5	35,000	6	15,000	20	75	85	65	612,000	823,200
	NEC Total						**260,000**		**150,800**					**6,262,800**	**6,894,300**
Japan	Nittetsu Semicon-ductor	Chiba	M3	1990	4M DRAM	0.5	15,000	6	15,000	70	20	85	60	1,392,300	234,000
	Nittetsu Semiconductor Total						**15,000**		**15,000**					**1,392,300**	**234,000**
Japan	Oki	Miyagi	S1	1990	4M DRAM, VRAM, 1MSRAM	0.50	30,000	6	25,000	50		85		1,912,500	
Japan	Oki	Miyagi	S2	1996	16Mb DRAM	0.30	15,000	8	5,000		100		60		750,000
Japan	Oki	Miyazaki	M1	1981	DRAM, SRAM, Gate Arrays, MPU	1.50	50,000	4							
Japan	Oki	Miyazaki	M2	1984	DRAM, EEPROM, ASIC, SRAM	0.8	60,000	5	28,000	0		85			
Japan	Oki	Miyazaki	M3	1991	4M/16M DRAM, 90K Gate Arrays	0.4	30,000	6	27,000	65	30	85	65	2,685,150	737,100

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Oki Total						**185,000**		**85,000**					**4,597,650**	**1,487,100**
Japan	Tohoku Semiconductor	Miyagi	Step 1	1988	1M DRAM, MCU, MPU, SRAM	1	7,500	6							
Japan	Tohoku Semiconductor	Miyagi	Step 2	1991	4M DRAM	0.8	20,000	6	20,000	100		85		2,652,000	
Japan	Tohoku Semiconductor	Miyagi	Step 3	1995	16M/64M DRAM	0.35	15,000	8	5,000		90		60		600,000
Europe	Motorola	East Kilbride	MOS 9	1990	SRAM, 1M DRAM, MPU	0.8	22,000	6							
	Motorola Total*						**64,500**		**25,000**					**2,652,000**	**600,000**
Japan	Toshiba	Kanagawa	Bldg 108 D-2	1990	16Mb DRAM	0.5	1,300	8	1,300	25	65	80	60	78,000	126,750
Japan	Toshiba	Mie	Y-Cubed, No. 1, Module 2	1993	4M/16M DRAM	0.5	20,000	8	9,000	10	80	85	65	229,500	1,170,000
Japan	Toshiba	Mie	Y-Cubed, No. 1, Module 2	1994	64M DRAM	0.35	20,000	8							
Japan	Toshiba	Mie	Y-Cubed, No. 2	1996/Q4	64M DRAM	0.35	40,000	8							
Japan	Toshiba	Oita	C-Cubed, No. 3	1987	DRAM	0.7	20,000	6	50,000	55	35	85	70	4,675,000	1,715,000
Japan	Toshiba	Oita	C-Cubed, No. 4	1991	4Mb, 16Mb DRAM	0.5	25,000	6	37,000	55	35	85	70	3,459,500	1,269,100
	Toshiba Total						**126,300**		**97,300**					**8,442,000**	**4,280,850**
U.S.A.	TI	Dallas	DMOS 4.1	1985	4M, 16M	0.6	29,200	6	15,000	0.75	0.25	80	65	2,700,000	357,941
U.S.A.	TI	Dallas	DMOS 5 Phase 1	1995/Q3	16M DRAM	0.5	16,000	8	12,000	40	60	80	60	1,152,000	906,259
U.S.A.	TI	Dallas	DMOS 5 Phase 2	1997	64M, 256M DRAM	0.35	16,000	8			80		55		
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1-A	1991	4M DRAM	0.45	20,000	6	20,000	90		85		4,590,000	
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1-B	1995/3Q	16/64Mb DRAM	0.45	15,000	8	10,000	55	45	85	55	1,320,000	571,132

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 2	1997	16M DRAM	0.35	20,000	8							
Asia/ Pacific	TI/Acer	Hsin Chu	FAB 2B	1998	16/64M DRAM	0.3	20,000	8							
Europe	TI	Avezzano	AMOS	1991	4M DRAM, ASSP, CBIC	0.5	13,500	6	13,500	0.75	0.25	85	70	2,151,563	346,927
Europe	TI	Avezzano	Phase 2	1996	16M DRAM	0.5	20,000	8	10,000	0.4	0.6	85	70	850,000	616,760
Japan	KTI Semicon ductor	Hyogo	Fab 1	1992	4M/16M DRAM, ASIC	0.5	11,000	8	9,000		85		70		1,404,230
Japan	KTI Semicon ductor	Hyogo	Fab 2	1997	16Mb DRAM	0.35	15,000	8							
	TI Total						**195,700**		**89,500**					**12,763,563**	**4,203,249**
U.S.A.	Micron	Idaho	Fab 2		4M DRAM, 256K SRAM, VRAM	0.5	14,400	6	32,000	95		90		5,294,160	
U.S.A.	Micron	Idaho	Fab 3	1991	4M/16M DRAM	0.5	40,000	6	30,000	80	20	90	65	9,288,000	546,000
	Micron Total						**54,400**		**62,000**					**14,582,160**	**546,000**
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab I-A	1984	256K DRAM, 64K SRAM, ASIC	1.2	15,000	5							
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab II	1985	1M/4M DRAM	0.8	25,000	6	25,000	70		80		2,800,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab III	1991	4M DRAM	0.6	20,000	6	20,000	90		85		3,060,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E2 (Fab 5)	1995	16M/64M DRAM	0.35	25,000	8	15,000		80		55		1,650,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E1 (Fab 4)	1994	4M/16M DRAM	0.5	10,000	8	20,000	10	80	80	65	480,000	2,600,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E3	1998	16M/64M DRAM	0.35	20,000	8							

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Hyundai Total						**115,000**		**80,000**					**6,340,000**	**4,250,000**
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 4	1990	4M DRAM, SRAM	0.6	35,000	6	30,000	80		88		5,880,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 3	1988	1M DRAM, SRAM, VRAM, ROM	0.8	35,000	6	35,000	60		88		5,145,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 5	1993	4M/16M DRAM	0.5	25,000	8	25,000	10	90	85	80	1,020,000	4,500,000
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 6	1995/Q1	16M/64M DRAM	0.35	30,000	8	25,000		95		80		4,571,875
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 7	1996	16M/64M DRAM	0.35	20,000	8	10,000		95		72		1,828,750
	Samsung Total						**145,000**		**125,000**					**12,045,000**	**10,900,625**
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 1	1990	4M/16M DRAM	0.8	30,000	6	30,000	40		80		1,920,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 2	1991	4M DRAM	0.7	30,000	6	30,000	75		85		3,825,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 3	1997	16/64M DRAM	0.35	30,000	8							
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C2, Phase 1	1993	4M/16M DRAM	0.5	20,000	8	30,000	20	85	75	65	1,350,000	2,681,250
Asia/ Pacific	LG Semicon	Gumi	C2, Phase 2	1996	16M DRAM	0.5	20,000	8	10,000		80		65		1,300,000
	LG Semicon Total						**130,000**		**100,000**					**7,095,000**	**3,981,250**
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 1	1995	4M DRAM	0.5	30,000	6	15,000	100		80		1,872,000	

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 2	1996/Q4	16M/64M DRAM	0.4	25,000	8							
	Mosel Vitelic Total						**55,000**		**15,000**					**1,872,000**	
Asia/ Pacific	Tech Semi-conduc-tor	Woodlands	Fab 1	1993	4M/16M DRAM	0.5	12,000	8	12,000	45	45	85	60	1,377,000	648,000
Asia/ Pacific	Tech Semi-conduc-tor	Woodlands	Fab 2	1996	16M/64M DRAM	0.35	10,000	8							
	Tech Semiconductor Total						**22,000**		**12,000**					**1,377,000**	**648,000**
Asia/ Pacific	Nan Ya Technol-ogy	Hsin Chu	Fab 1	1996	16M/64M DRAM	0.45	20,000	8	10,000						
	Nan Ya Technology Total						**20,000**		**10,000**						
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1A	1994	4M/16M DRAM	0.5	14,000	8	10,000	70	20	80	65	1,680,000	260,000
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1B	1996/Q2	4M/16M DRAM	0.35	18,000	8							
Asia/ Pacific	Vanguard	Hsin Chu	Fab 2	1997/Q2	16M/64M DRAM	0.35	15,000	8							
	Vanguard Total						**47,000**		**10,000**					**1,680,000**	**260,000**
	Americas Companies						445,300		235,700					35,937,723	7,786,749
	European Companies						41,000		28,000					1,485,120	907,200
	Japanese Companies						1,134,600		740,900					42,628,950	25,715,000
	Asia/Pacific Companies						534,000		352,000					30,409,000	20,039,875
	Korean Companies						390,000		305,000					25,480,000	19,131,875
	Taiwan Companies						122,000		35,000					3,552,000	260,000
	Rest of Asia/Pacific Companies						22,000		12,000					1,377,000	648,000
	Worldwide Companies						2,154,900		1,356,600					110,460,793	54,448,824

*Tohoku Semiconductor production is split 50-50 between Toshiba and Motorola.
NA = Not available
Source: Dataquest (October 1996)

Table A-3
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	Siemens		Balan-strasse		NA	2	24,000	4							
Europe	Siemens		Mega 1	1987	1M/4M DRAM	0.6	28,000	6	28,000	30	50	85	75	1,113,840	1,134,000
Europe	Siemens		Regens-burg	1994	16M DRAM	0.5	5,000	8							
Europe	Siemens	Dresden		1995	64M DRAM	0.35	8,000	8							
	Siemens Total						**65,000**		**28,000**					**1,113,840**	**1,134,000**
Japan	Fujitsu	Akiru	Akiru R&D Center	1996	256M DRAM	0.35	3,000	8							
Japan	Fujitsu	Iwate	No. 3	1987	1M/4M/ 16M DRAM, SRAM, ROM	0.8	25,000	6	25,000	30		85		1,700,000	
Japan	Fujitsu	Iwate	No. 4	1990	4M/16M DRAM, Flash, SRAM, ASIC	0.5	30,000	6	30,000	30	40	85	75	1,530,000	1,260,000
Japan	Fujitsu	Iwate	No. 4-2	1995/Q4	16M DRAM	0.35	20,000	8	10,000						1,788,500
Japan	Fujitsu	Mie	No. 2	1987	Logic, Gate Arrays, 4M DRAM	0.8	10,000	6	10,000	80		85		397,800	
Japan	Fujitsu	Mie	No. 3 Phase 2	1994	4M/16M DRAM, SRAM, MPU	0.25	500	8	500	20	20	80	70		
Japan	Fujitsu	Mie	No. 3 Phase 1	1992	16M DRAM	0.5	15,000	6	15,000	0	80	85	75		1,260,000
Europe	Fujitsu	Newton Aycliffe	Phase 1	1991	4M, 16M DRAM, ASIC	0.8	5,600	6	10,000	40	0	85	70	680,000	
Europe	Fujitsu	Newton Aycliffe	Phase 2	1994	16M DRAM	0.5	10,000	6	10,000	40	40	85	70	1,122,000	588,000
U.S.A.	Fujitsu	Gresham	No. 1	1990	1M, 4M DRAM	0.8	13,000	6	13,000	30		80		936,000	
U.S.A.	Fujitsu	Gresham	No. 2-2	1997	16M/64M DRAM	0.32	10,000	8							

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Fujitsu Total						**142,100**		**123,500**					**6,365,800**	**4,896,500**
Japan	Hitachi	Chiba	D3	1990	4M/16M DRAM	0.8	15,000	6	15,000	0		85		994,500	
Japan	Hitachi	Gunma	NA	1995	16Mb DRAM	0.8	20,000	6	20,000	0		85			
Japan	Hitachi	Hokkaido	Chitose 2	1990	4M DRAM, 1M SRAM, EEPROM, ROM	0.8	15,000	6	15,000	0		85			
Japan	Hitachi	Hokkaido	Chitose 1	1988	1M SRAM, 4M DRAM, MPU	0.8	15,000	6	15,000	20		85		397,800	
Japan	Hitachi	Hokkaido	CHI-TOSE 3	1998	64M DRAM	0.35	10,000	8							
Japan	Hitachi	Tokyo	D4/D5	1994	64M DRAM	0.35	3,000	8							
Japan	Hitachi	Ibaraki	N-2 Phase 1	1994/Q4	16M DRAM	0.5	20,000	8	20,000	20	50	80	75	960,000	2,625,000
Japan	Hitachi	Ibaraki	N2-2	1996	16M/64M DRAM	0.35	20,000	8							
Japan	Hitachi	Ibaraki	N1-1	1983	1M/4M DRAM	0.8	15,000	6	15,000	30		85		765,000	
Japan	Hitachi	Ibaraki	N1-2	1988	4M/16M DRAM	0.50	20,000	6	4,000	40		85		136,000	156,000
Japan	Hitachi	Tokyo	R&D 2	1990	4M/16M DRAM	0.5	4,000	6	4,000	20	40	85	75	136,000	156,000
Japan	Hitachi	Yamanashi	Imasuwa	1990	4M DRAM, 4M SRAM, 16M Proto-DRAM	0.6	25,000	6	25,000	20	10	85	75	850,000	243,750
Japan	Hitachi	Yamanashi	K-2-2F	1990	4M/16M DRAM	0.5	4,000	8	3,000	0	50	80	70		367,500
Japan	Hitachi/ Tobu Semi-conductor		NA	1990		0.6	17,000	6		0		80			
Europe	Hitachi	Landshut	E2	1992	4M/16M DRAM, 1M SRAM	0.5	16,000	8	16,000	15	65	80	70	576,000	2,548,000

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
U.S.A.	Hitachi	Irving	Phase 2	1993	CBIC, 16M DRAM, 4MSRAM	0.6	5,000	8	5,000		60		70		735,000
U.S.A.	Twinstar	Dallas	Twinstar	1996	16M/64M DRAM	0.35	15,000	8	15,000						1,050,000
	Hitachi Total						**239,000**		**172,000**					**4,815,300**	**7,881,250**
Japan	IBM	Shiga	NA	1990	4M/16M DRAM	0.6	6,000	8	5,200	20	50	85	65	397,800	507,000
Europe	IBM	Sindelfin-gen	NA	1989	4M/16M DRAM	0.8	20,000	8	15,000	30	40	80	65	1,620,000	780,000
Europe	IBM	Corbeil-Essonnes	NA	1989	1M DRAM		7,000	8							
U.S.A.	IBM	East Fishkill	NA		NA	0.8	20,000	8							
U.S.A.	IBM	Essex Junction	Bldg. 970	1988	16M DRAM		24,000	8	24,000	40		80		3,456,000	
U.S.A.	IBM	Essex Junction	Bldg. 973	1989	16M DRAM	0.5	20,000	8	15,000		80		70		2,520,000
U.S.A.	IBM	Manassas	VHSIC	1989	Memory, MPU, ASIC, MIL	0.8	1,600	5							
U.S.A.	IBM	Essex Junction	Bldg. 963	1989	1M DRAM	1	16,000	8							
Europe	IBM/Siemens	Corbeil-Essonnes	ACL	1992	16M DRAM	0.4	16,100	8	10,000		80		70		1,680,000
	IBM Total						**130,700**		**69,200**					**5,473,800**	**5,487,000**
Japan	Matsushita	Kyoto	LAB	1992	16M/64M DRAM	0.35	1,000	8	1,000		20		65		39,000
Japan	Matsushita	Toyama	Fab 1	1994	4M/16M DRAM, MCU, ASIC	0.5	20,000	6	20,000	20	60	80	70	704,000	1,092,000
Japan	Matsushita	Toyama	Fab C-2	1990	4M/16M/64M DRAM, SRAM	0.5	24,000	6	20,000	40	70	80	70	1,408,000	1,274,000
Japan	Matsushita	Tonami	Fab 2	1996	16M DRAM, ASIC	0.35	20,000	8							

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
U.S.A.	Matsushita	Puyallup	NA	1991	1M/4M DRAM, MCU, Gate Arrays	0.8	15,000	6	15,000	0		80			
	Matsushita Total						**80,000**		**56,000**					**2,112,000**	**2,405,000**
Japan	Mitsubishi	Ehime	KD-1	1995	16Mb/ 64Mb DRAM	0.40	20,000	8	10,000		70		60		526,500
Japan	Mitsubishi	Ehime	SA2A	1991	4M/16M DRAM	0.40	15,000	6	20,000	20	30	85	75		585,000
Japan	Mitsubishi	Ehime	SA2B	1994	4M/16M DRAM	0.40	17,000	8	16,000	0	80	80	70		2,688,000
Japan	Mitsubishi	Osaka	ULSI	1993	16M/64M DRAM	0.35	3,000	8	7,000		70		65		955,500
Japan	Mitsubishi	Kumamoto		1996	16M/64M DRAM	0.35	15,000	8	7,000						780,000
Japan	Mitsubishi	Kochi	TA1	1990	4M DRAM, 1M SRAM	0.60	33,000	6	30,000	50		85		2,805,000	
U.S.A.	Mitsubishi		NA	1990	1M/4M DRAM	0.60	7,800	6	7,800	0		85			
U.S.A.	Mitsubishi	Alsodorf	NA	1998	64Mb DRAM	0.35	7,000	8							
	Mitsubishi Total						**117,800**		**97,800**					**2,805,000**	**5,535,000**
Japan	NEC	Hiroshima	Dif-1	1990	4M DRAM, SRAM, MPU, 4M ROM	0.6	30,000	6	30,000	30		85		1,530,000	
Japan	NEC	Hiroshima	Dif-2	1996	16M DRAM, ASIC, RISC	0.35	10,000	8	15,000		85		70		2,677,500
Japan	NEC	Kumamoto	Dif-7	1988	MCU, 4M DRAM, ASIC	0.8	30,000	6	30,000	20		85		795,600	
Japan	NEC	Kumamoto	Dif-8	1994	16M DRAM, 4M SRAM, RISC MPU	0.35	15,000	8	15,000		80		70		2,520,000
Japan	NEC	Kumamoto	Dif-8-2	1998	64M/256M DRAM	0.25	30,000	8							

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	NEC	Yamaguchi	Dif-1	1988	4Mb DRAM 1Mb SRAM MPU	0.50	30,000	6	30,000					1,530,000	
Japan	NEC	Yamaguchi	Dif-2	1993	16Mb DRAM 4Mb DRAM	0.50	45,000	6	12,800	20	65	85	75	435,200	873,600
Europe	NEC	Living-ston, West Lothian	Phase 2	1991	4M DRAM, 256K SRAM, MPR, MPU	0.35	10,000	6	10,000	80		85		1,360,000	
U.S.A.	NEC	Roseville	M-Line	1991	4M/16M DRAM	0.5	35,000	6	23,000	15	75	85	70	986,000	1,685,600
	NEC Total						**235,000**		**165,800**					**6,636,800**	**7,756,700**
Japan	Nittetsu Semicon-ductor	Chiba	M3	1990	4M DRAM	0.5	15,000	6	15,000	20	20	85	60	1,392,300	234,000
	Nittetsu Semiconductor Total						**15,000**		**15,000**					**1,392,300**	**234,000**
Japan	Oki	Miyagi	S1	1990	4M DRAM, VRAM, 1MSRAM	0.50	30,000	6	25,000	45		85		1,721,250	
Japan	Oki	Miyagi	S2	1996	16M/64M DRAM	0.30	15,000	8	8,000		60		70		1,176,000
Japan	Oki	Miyazaki	M1	1981	DRAM, SRAM, Gate Arrays, MPU	1.50	50,000	4							
Japan	Oki	Miyazaki	M2	1984	DRAM, EEPROM, ASIC, SRAM	0.8	60,000	5	28,000	0		85			
Japan	Oki	Miyazaki	M3	1991	4M/16M DRAM, 90K Gate Arrays	0.45	30,000	6	27,000	60	40	85	70	2,065,500	982,800
	Oki Total						**185,000**		**88,000**					**3,786,750**	**2,158,800**
Japan	Tohoku Semi-conductor	Miyagi	Step 2	1991	4M DRAM	0.8	20,000	6						2,652,000	

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Tohoku Semiconductor	Miyagi	Step 3	1995	16M/64M DRAM	0.35	15,000	8	20,000	100		85			1,785,000
	Motorola Total*						**35,000**		**20,000**					**2,652,000**	**1,785,000**
Japan	Toshiba	Kanagawa	Bldg 108 D-2	1990	4M/16M DRAM	0.5	1,300	8	1,300	10	70	80	70		222,950
Japan	Toshiba	Mie	Y-Cubed, No. 1	1993	4M/16M DRAM	0.5	20,000	8	9,000	20	70	85	70	459,000	1,543,500
Japan	Toshiba	Mie	Y-Cubed, No. 2	1994	64M DRAM	0.35	20,000	8							
Japan	Toshiba	Mie	NA	1996/Q4	64M DRAM	0.35	40,000	8							
Japan	Toshiba	Oita	C-Cubed, No. 3	1987	RAM	0.7	20,000	6	50,000	40	30	85	70	3,400,000	1,365,000
Japan	Toshiba	Oita	C-Cubed, No. 4	1991	RAM	0.5	25,000	6	37,000	40	30	85	70	2,516,000	1,010,100
	Toshiba Total						**126,300**		**97,300**					**6,375,000**	**4,141,550**
U.S.A.	TI	Dallas	DMOS4.1	1985	256K SRAM, 16M DRAM, Logic, ASSP	0.6	29,200	6	15,000	60	40	85	65	2,295,000	536,571
U.S.A.	TI	Dallas	DMOS 5 Phase 1	1995/Q3	16M DRAM	0.5	16,000	8	12,000	35	65	85	60	1,071,000	996,490
U.S.A.	TI	Dallas	DMOS 5 Phase 2		64M, 256M DRAM	0.35	16,000	8			80		55		
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1-A	1991	4M DRAM	0.45	20,000	6	20,000	90		85		4,590,000	
Asia/ Pacific	TI/Acer	Hsin Chu	FAB 1B	1995/3Q	16/64Mb DRAM	0.45	15,000	8	12,000	45	55	85	55	1,377,000	1,159,378
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 2	1997	16M DRAM	0.35	20,000	8							
Europe	TI	Avezzano	AMOS	1991	4M DRAM, ASSP, CBIC	0.5	13,500	6	13,500	80	15	85	70	1,147,500	719,341
Europe	TI	Avezzano	Phase 2	1996	16M DRAM	0.5	20,000	8	12,000	35	65	85	60	892,500	996,490
Japan	KTI Semiconductor	Hyogo	Fab 1	1992	4M/16M DRAM, ASIC	0.5	11,000	8	9,000		85		70		1,588,156
Japan	KTI Semiconductor	Hyogo	Fab 2	1997	16Mb DRAM	0.35	15,000	8							

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	TI Total						**175,700**		**93,500**					**11,373,000**	**5,996,426**
U.S.A.	Micron	Idaho	Fab 1	1981	256K/1M DRAM, 256K SRAM	1.2	32,000	6	32,000						
U.S.A.	Micron	Idaho	Fab 2		4M DRAM, 256K SRAM, VRAM	0.5	14,400	6	14,400	90		88		5,474,304	
U.S.A.	Micron	Idaho	Fab 3	1991	4M/16M DRAM	0.5	NA	8	24,000	80	20	90	65	11,750,400	936,000
U.S.A.	Micron	Idaho	Fab D	1997	16M/64MDRAM	0.3		8							
	Micron Total						**46,400**		**70,400**					**17,224,704**	**936,000**
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab I-A	1984	256K DRAM, 64K SRAM, ASIC	1.2	15,000	5							
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab II	1985	1M/4M DRAM	0.8	25,000	6	25,000	70		80		2,800,000	
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab III	1991	4M DRAM	0.6	20,000	6	20,000	90		85		3,060,000	
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS E2 (Fab 5)	1995	16M/64M DRAM	0.35	30,000	8	25,000		70		60		3,150,000
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS E1 (Fab 4)	1994	4M/16M DRAM	0.5	20,000	8	20,000	0	80	80	65		3,120,000
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS E3	1998	16M/64M DRAM	0.35	20,000	8							
	Hyundai Total						**130,000**		**90,000**					**5,860,000**	**6,270,000**
Asia/Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 4	1990	4M DRAM, SRAM	0.6	35,000	6	22,000	70		85		3,665,200	

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 3	1988	1M DRAM, SRAM, VRAM, ROM	0.8	35,000	6	25,000	40		85		2,380,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 5	1993	4M/16M DRAM	0.5	25,000	8	25,000	10	70	80	70		5,670,000
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 6	1995/Q1	16M/64M DRAM	0.35	30,000	8	30,000		80		65		6,840,000
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 7	1996	16M/64M DRAM	0.35	20,000	8	10,000		70		60		2,280,000
	Samsung Total						**145,000**		**112,000**					**6,045,200**	**14,790,000**
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 1	1990	4M/16M DRAM	0.8	30,000	6	30,000	40		80		1,920,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 2	1991	4M DRAM	0.7	30,000	6	30,000	75		85		3,825,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 3	1997	16/64M DRAM	0.35	30,000	8							
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C2, Phase 1	1993	4M/16M DRAM	0.5	20,000	8	30,000	10	70	75	65	675,000	4,777,500
Asia/ Pacific	LG Semicon	Gumi	C2, Phase 2	1996	16M DRAM	0.5	20,000	8	10,000		80		65		1,820,000
	LG Semicon Total						**130,000**		**100,000**					**6,420,000**	**6,597,500**
Asia/ Pacific	Mosel Vitelic	Hsin Chu	FAB 1-A	1995/Q1	4M DRAM	0.5	15,000	6	15,000	30		79		554,580	
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 1-B	1995/Q4	4M/16M DRAM	0.5	15,000	6	15,000	80		78		1,460,160	
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 2	1997	16M/64M DRAM	0.4	20,000	8		10	80				

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Mosel Vitelic Total						**50,000**		**30,000**					**2,014,740**	
Asia/ Pacific	Tech Semicon-ductor	Woodlands	Fab 1	1993	16M DRAM	0.5	12,000	8	11,000	35	55	85	65	1,071,000	858,000
Asia/ Pacific	Tech Semicon-ductor	Woodlands	Fab 2	1996	16M/64M DRAM	0.35	10,000	8	2,000						
	Tech Semiconductor Total						**22,000**		**13,000**					**1,071,000**	**858,000**
Asia/ Pacific	Nan Ya Technology	Tao-Yuan	Fab 1	1996/Q3	16M/64M DRAM	0.45	25,000	8	5,000		100		65		341,250
	Nan Ya Technology Total						25,000		5,000						341,250
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1A	1995/Q1	4M/16M DRAM	0.5	15,000	8	12,000		80		65		2,184,000
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1B	1996/Q2	4M/16M DRAM	0.35	15,000	8	5,000	35	55	85	65	446,250	357,500
Asia/ Pacific	Vanguard	Hsin Chu	Fab 2	1997/Q2	16M/64M DRAM	0.35	15,000	8							
	Vanguard Total						**45,000**		**17,000**					**446,250**	**2,541,500**
	Americas Companies						387,800		253,100					36,723,504	14,204,426
	European Companies						65,000		28,000					1,113,840	1,134,000
	Japanese Companies						1,140,200		815,400					34,288,950	35,008,800
	Asia/Pacific Companies						547,000		367,000					21,857,190	31,398,250
	Korean Companies						405,000		302,000					18,325,200	27,657,500
	Taiwan Companies						120,000		52,000					2,460,990	2,882,750
	Rest of Asia/Pacific Companies						22,000		13,000					1,071,000	858,000
	Worldwide Companies						2,140,000		1,463,500					93,983,484	81,745,476

*Tohoku Semiconductor production is split 50-50 between Toshiba and Motorola.
NA = Not available
Source: Dataquest (October 1996)

Table A-4
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	Siemens		Mega 1	1987	1M/4M DRAM	0.6	28,000	6	28,000	20	65	85	75	742,560	1,474,200
Europe	Siemens		Regens-burg	1994	16M DRAM	0.5	5,000	8							
Europe	Siemens	Dresden		1995	64M DRAM	0.35	8,000	8							
	Siemens Total						**41,000**		**28,000**					**742,560**	**1,474,200**
Japan	Fujitsu	Akiru	Akiru R&D Center	1995	256M DRAM	0.35	3,000	8							
Japan	Fujitsu	Iwate	No. 3	1987	1M/4M/ 16M DRAM, SRAM, ROM	0.8	25,000	6	25,000	20		85		850,000	
Japan	Fujitsu	Iwate	No. 4	1990	4M/16M DRAM, Flash, SRAM, ASIC	0.5	30,000	6	30,000	20	50	85	78	1,020,000	2,293,200
Japan	Fujitsu	Iwate	No. 4-2	1996	16M DRAM	0.35	20,000	8	10,000		70		77		1,886,500
Japan	Fujitsu	Mie	No. 2	1987	Logic, Gate Arrays, 4M DRAM	0.8	10,000	6	10,000	30		85		397,800	
Japan	Fujitsu	Mie	No. 3 Phase 2	1994	4M/16M DRAM, SRAM, MPU	0.25	500	8	500	0	20	80	70		
Japan	Fujitsu	Mie	No. 3 Phase 1	1992	16M DRAM	0.5	15,000	6	15,000		80		75		1,764,000
Europe	Fujitsu	Newton Aycliffe	Phase 1	1991	4M, 16M DRAM, ASIC	0.8	5,600	6	10,000	30		85		510,000	
Europe	Fujitsu	Newton Aycliffe	Phase 2	1994	16M DRAM	0.5	15,000	6	15,000	20	50	85	70	561,000	1,029,000
Europe	Fujitsu	Newton Aycliffe	Fab 2	1997	16Mb 64Mb DRAM	0.32	30,000	8							
U.S.A.	Fujitsu	Gresham	No. 1	1990	1M, 4M DRAM	0.8	13,000	6	13,000	45		80		936,000	
U.S.A.	Fujitsu	Gresham	No. 2-2	1997	16M/64M DRAM	0.32	10,000	8							

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Fujitsu Total						**177,100**		**128,500**					**4,274,800**	**6,972,700**
Japan	Hitachi	Chiba	D3	1990	4M/16M DRAM	0.8	15,000	6	15,000	50	50	85	75	994,500	731,250
Japan	Hitachi	Gunma	NA	1995	16Mb DRAM	0.8	20,000	6	10,000	0	50	85	75		487,500
Japan	Hitachi	Hokkaido	Chitose 2	1990	4M DRAM, 1M SRAM, EEPROM, ROM	0.8	15,000	6	15,000	60		85		1,193,400	
Japan	Hitachi	Hokkaido	Chitose 1	1988	1M SRAM, 4M DRAM, MPU	0.8	15,000	6	15,000	20		85		397,800	
Japan	Hitachi	Hokkaido	Chitose 2	1998	64M DRAM	0.35	10,000	8							
Japan	Hitachi	Tokyo	D4/D5	1994	64M DRAM	0.35	3,000	8							
Japan	Hitachi	Ibaraki	N-2 Phase 1	1994/Q4	16M DRAM	0.5	20,000	8	20,000	10	70	80	75	480,000	3,885,000
Japan	Hitachi	Ibaraki	N2-2	1996	16M/64M DRAM	0.35	20,000	8							
Japan	Hitachi	Ibaraki	N1-1	1983	1M/4M DRAM	0.8	15,000	6	15,000	60		85		1,530,000	
Asia/ Pacific	Hitachi/LG Semicon	Kedah		1998	16Mb/64Mb DRAM	0.3	30,000	8							
Asia/ Pacific	Hitachi/ Nippon Steel Semi-conductor/ EDB			1998	16Mb/64Mb DRAM	0.3	30,000	8							
Japan	Hitachi	Tokyo	R&D 2	1990	4M/16M DRAM	0.5	4,000	6	4,000	60	40	85	75	408,000	156,000
Japan	Hitachi	Yamanashi	Imasuwa	1990	4MDRAM, 4MSRAM, 16M Proto-DRAM	0.6	25,000	6	25,000	40	20	85	75	1,700,000	487,500
Japan	Hitachi	Yamanashi	K-2-2F	1990	4M/16M DRAM	0.5	4,000	8	3,000	50	50	85	75	382,500	416,250
Japan	Hitachi/ Tobu Semi-conductor		NA	1990		0.6	17,000	6	17,000	50		85		1,445,000	
Europe	Hitachi	Landshut	E2	1992	4M/16M DRAM, 1M SRAM	0.5	16,000	8	16,000		85		75		3,774,000
U.S.A.	Hitachi	Irving	Phase 2	1993	CBIC, 16M DRAM, 4M SRAM	0.6	5,000	8	5,000		70		75		971,250

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
U.S.A.	Twinstar	Dallas	Twinstar	1996	16M/64M DRAM	0.35	15,000	8	5,000		80		75		1,050,000
	Hitachi Total						**279,000**		**165,000**					**8,531,200**	**11,958,750**
Japan	IBM	Shiga	NA	1990	4M/16M DRAM	0.6	6,000	8	5,200	20	70	85	65	397,800	709,800
Europe	IBM	Sindelfin-gen	NA	1989	4M/16M DRAM	0.8	20,000	8	15,000		50		65		975,000
Europe	IBM	Corbeil-Essonnes	NA	1989	1M DRAM	-	7,000	8							
U.S.A.	IBM	East Fishkill	NA	-	NA	0.8	20,000	8							
U.S.A.	IBM	Essex Junction	Bldg. 970	1988	16M DRAM	-	24,000	8	24,000	40		80		3,456,000	
U.S.A.	IBM	Essex Junction	Bldg. 973	1989	16M DRAM	0.5	20,000	8	15,000		100		70		3,150,000
U.S.A.	IBM	Manassas	VHSIC	1989	Memory, MPU, ASIC, MIL	0.8	1,600	5							
Americas	IBM/Toshiba	VA		1997	16Mb/64Mb DRAM DSP	0.35	28,000	8							
Europe	IBM/ Siemens	Corbeil-Essonnes	ACL	1992	16M DRAM	0.4	16,100	8	12,000		100		70		2,520,000
	IBM Total						**142,700**		**71,200**					**3,853,800**	**7,354,800**
Japan	Matsushita	Kyoto	LAB	1994	16M/64M DRAM	0.35	1,000	8	1,000		20		65		39,000
Japan	Matsushita	Toyama	Fab 1	1994	4M/16M DRAM, MCU, ASIC	0.5	20,000	6	20,000	10	65	60	70	352,000	1,183,000
Japan	Matsushita	Toyama	Fab C-2	1990	4M/16M/ 64M DRAM, SRAM	0.5	24,000	6	20,000	30	70	80	70	1,056,000	1,274,000
Japan	Matsushita	Tonami	Fab 2	1996	16M DRAM, ASIC	0.35	20,000	8							
U.S.A.	Matsushita	Puyallup	NA	1991	1M/4M DRAM, MCU, Gate Arrays	0.8	15,000	6	15,000					-	
	Matsushita Total						**80,000**		**56,000**					**1,408,000**	**2,496,000**
Japan	Mitsubishi	Ehime	KD-1	1995	16Mb/64Mb DRAM	0.40	20,000	8	10,000		75		70		567,000
Japan	Mitsubishi	Ehime	SA2A	1991	4M/16M DRAM	0.40	20,000	6	20,000	10	30	85	75	374,000	486,000

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Mitsubishi	Ehime	SA2B	1994	4M/16M DRAM	0.40	16,000	8	16,000		80		70		3,136,000
Japan	Mitsubishi	Ehime	Sa2F	1997	16Mb 64Mb DRAM	0.35	20,000	8							
Japan	Mitsubishi	Osaka	ULSI	1993	16M/64M DRAM	0.35	10,000	8	10,000		80		65		1,820,000
Japan	Mitsubishi	Kumamoto	D-1F	1994	16Mb DRAM	0.35	10,000	8							
Japan	Mitsubishi	Kumamoto		1996	16M/64M DRAM	0.35	10,000	8	5,000		80		65		910,000
Japan	Mitsubishi	Kochi	TA1	1990	4M DRAM, 1M SRAM	0.7	30,000	6	30,000	40		85		2,244,000	
U.S.A.	Mitsubishi		NA	1990	1M/4M DRAM	0.9	7,800	5	7,800						
Asia/ Pacific	Powerchip Semicon-ductor (Elite-group)	Hsinchu		1996	16M DRAM	0.4	25,000	8							
U.S.A.	Mitsubishi	Alsdorf	NA	1997	16M DRAM	0.35	7,000	8							
	Mitsubishi Total						**175,800**		**98,800**					**2,618,000**	**6,919,000**
Japan	NEC	Hiroshima	Dif-1	1990	4M DRAM, SRAM, MPU, 4M ROM	0.6	30,000	6	30,000	20		85		1,020,000	
Japan	NEC	Hiroshima	Dif-2	1995	16M DRAM, ASIC, RISC	0.35	10,000	8	20,000	0	90	80	75	-	4,725,000
Japan	NEC	Kumamoto	Dif-7	1988	MCU, 4M DRAM, ASIC	0.8	30,000	6	30,000	20		85		795,600	
Japan	NEC	Kumamoto	Dif-8	1994/Q4	16M DRAM, 4M SRAM, RISC MPU	0.35	15,000	8	15,000		80		75		3,150,000
Japan	NEC	Kumamoto	Dif-8-2	1997	64M/256M DRAM	0.25	30,000	8	3,000						
Japan	NEC	Yamaguchi	Dif-1	1988	4M/16M DRAM	0.8	45,000	6	30,000	10		85		510,000	
Japan	NEC	Yamaguchi	Dif 2	1993	4M/16M DRAM	0.5	45,000	6	12,800		65		75		998,400
Europe	NEC	Livingston, West Lothian	Phase 2	1991	4M DRAM, 256K SRAM, MPR, MPU	0.35	10,000	6	10,000	80		85		1,360,000	

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	NEC	Livingston, West Lothian	Phase 3	1996	16M/64M DRAM	0.35	10,000	8	10,000						
U.S.A.	NEC	Roseville	M-Line	1991	4M/16M DRAM	0.5	35,000	6	12,000	25	75	85	70	510,000	945,000
Japan	NEC	Roseville		1997	16Mb/64Mb DRAM	0.25	20,000	8	2,000						
	NEC Total						**280,000**		**174,000**					**4,195,600**	**9,818,400**
Japan	Nittetsu Semicon-ductor	Chiba	M3	1990	4M DRAM	0.5	15,000	6	15,000	60	30	85	60	1,193,400	351,000
	Nittetsu Semiconductor Total						**15,000**		**15,000**					**1,193,400**	**351,000**
Japan	Oki	Miyagi	NA	1989	Gate Arrays, 1M DRAM, VRAM, Logic	0.8	20,000	6	1,000						
Japan	Oki	Miyagi	S1	1990	4M DRAM, VRAM, 1M SRAM	0.50	30,000	6	25,000	45		85		1,721,250	
Japan	Oki	Miyagi	S2	1995	16M/64M DRAM	0.30	15,000	8	12,000		60		70		1,764,000
Japan	Oki	Miyazaki	M1	1988	DRAM, SRAM, Gate Arrays, MPU	1.50	50,000	4							
Japan	Oki	Miyazaki	M2	1984	DRAM, EEPROM, ASIC, SRAM	0.8	60,000	5	28,000						
Japan	Oki	Miyazaki	M3	1991	4M/16M DRAM, 90K Gate Arrays	0.4	30,000	6	27,000	40	50	85	70	1,652,400	1,323,000
	Oki Total						**205,000**		**93,000**					**3,373,650**	**3,087,000**
Japan	Tohoku Semicon-ductor	Miyagi	Step 2	1991	4M DRAM	0.8	20,000	6	20,000	80		85		2,121,600	
Japan	Tohoku Semicon-ductor	Miyagi	Step 3	1995	16M/64M DRAM	0.35	15,000	8	15,000		85		70		3,123,750

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Motorola Total*						**35,000**		35,000					**2,121,600**	**3,123,750**
Japan	Toshiba	Kanagawa	Bldg 108 D-2	1990	16Mb/64Mb DRAM Flash	0.35	1,300	8	1,300		80		75		273,000
Japan	Toshiba	Mie	Y-Cubed, No. 1	1993	4M/16M DRAM	0.5	20,000	8	9,000	0	80	80	75	-	1,890,000
Japan	Toshiba	Mie	Y-Cubed, No. 2	1996	16Mb/64Mb DRAM	0.35	40,000	8	9,000		70		75		1,653,750
Japan	Toshiba	Mie	NA	1996/Q4	64M DRAM	0.35	40,000	8							
Japan	Toshiba	Oita	C-Cubed, No. 3	1987	DRAM	0.7	20,000	6	15,000	30	40	85	75	765,000	585,000
Japan	Toshiba	Oita	C-Cubed, No. 4	1991	DRAM	0.5	25,000	6	20,000	30	40	85	75	1,020,000	780,000
	Toshiba Total						**146,300**		**54,300**					**1,785,000**	**5,181,750**
U.S.A.	TI	Dallas	DMOS 4.1	1985	256K SRAM, 16M DRAM, Logic, ASSP	0.6	29,200	6	15,000	50	50	85	65	1,800,300	638,185
U.S.A.	TI	Dallas	DMOS 5 Phase 1	1995	16M DRAM	0.5	16,000	8	16,000	30	70	85	70	1,224,000	1,648,727
U.S.A.	TI	Dallas	DMOS 5 Phase 2	1996	64M, 256M DRAM	0.35	16,000	8	1,000		80		55		161,929
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1-A	1991	4M DRAM	0.45	20,000	6	20,000	90		85		4,590,000	-
Asia/ Pacific	TI/Acer	Hsin Chu	FAB 1B	1995/3Q	16/64Mb DRAM	0.45	15,000	8	15,000	35	65	85	60	1,338,750	1,845,354
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 2	1994	16M DRAM	0.8	9,000	8							-
Asia/ Pacific	TI/Acer		Fab 2A	1997	16Mb 64Mb DRAM	0.3	20,000	8							-
Asia/ Pacific	TI/Acer	Hsin Chu	FAB 2B	1998	16Mb 64Mb DRAM	0.30	20,000	8							-
Europe	TI	Avezzano	AMOS	1991	4M DRAM, ASSP, CBIC	0.5	13,500	6	13,500	35	60	85	65	1,004,063	775,049
Europe	TI	Avezzano	Phase 2	1996	16M DRAM	0.5	20,000	8	12,000		70		65		1,148,220
Japan	KTI Semiconductor	Hyogo	Fab 1	1992	4M/16M DRAM, ASIC	0.5	11,000	8	9,000		90		70		1,788,574
Japan	KTI Semiconductor	Hyogo	Fab 2	1997	16Mb DRAM	0.35	15,000	8							-

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Alphatec/TI	Chachaer-sao	Phase 1	1997	16Mb/64Mb DRAM	0.3	15,000	8							-
	TI Total						219,700		101,500					9,957,113	8,006,038
U.S.A.	Micron	Idaho	Fab 1	1981	256K/1M DRAM, 256K SRAM	1.2	32,000	6							
U.S.A.	Micron	Idaho	Fab 2	-	4M DRAM, 256K SRAM, VRAM	0.5	NA	8	12,000	90		90		4,179,600	
U.S.A.	Micron	Idaho	Fab 3	1991	4M/16M DRAM	0.50	NA	8	36,000	60	40	90	70	8,359,200	3,024,000
U.S.A.	Micron	Idaho	Fab D	1998	16M/64M DRAM	0.3		8							
	Micron Total						32,000		48,000					12,538,800	3,024,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab I-A	1984	256K DRAM, 64K SRAM, ASIC	1.2	15,000	5							
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab II	1985	1M/4M DRAM	0.8	25,000	6	25,000	70		80		2,800,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab III	1991	4M DRAM	0.6	20,000	6	20,000	90		85		3,060,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E2 (Fab 5)	1994	16M/64M DRAM	0.35	25,000	8	30,000		70		60		4,410,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E1 (Fab 4)	1994	4M/16M DRAM	0.5	10,000	8	20,000	0	80		65		3,640,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E3	1998	16M/64M DRAM	0.35	20,000	8							
Americas	Hyundai	Oregon	Oregon Fab	1997	16Mb 64Mb DRAM	0.35	30,000	8							

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Hyundai Total						**145,000**		**95,000**					**5,860,000**	**8,050,000**
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 4	1990	4M DRAM, SRAM	0.6	35,000	6	30,000	20		85		1,428,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 3	1988	4M DRAM, SRAM, VRAM, ROM	0.8	35,000	6	35,000	25		85		2,082,500	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 5	1994	16Mb/64Mb DRAM	0.5	25,000	8	25,000		95		85		6,762,813
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 6	1994	16M/64M DRAM	0.35	30,000	8	30,000		95		85		8,115,375
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 7	1996	16M/64M DRAM	0.35	20,000	8	20,000		95		85		5,410,250
	Samsung Total						**145,000**		**140,000**					**3,510,500**	**20,288,438**
Asia/ Pacific	LG Semicon	Chongju-City, Choong-buk	C1, Phase 1	1990	4M/16M DRAM	0.7	30,000	6	30,000	40		80		1,920,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choong-buk	C1, Phase 2	1991	4M DRAM	0.7	30,000	6	30,000	75		85		3,825,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choong-buk	C1, Phase 3	1997	16/64M DRAM	0.35	30,000	8							
Asia/ Pacific	LG Semicon	Chongju-City, Choong-buk	C2, Phase 1	1993	4M/16M DRAM	0.5	20,000	8	30,000		90		65		5,460,000
Asia/ Pacific	LG Semicon	Gumi	C2, Phase 2	1996	16M DRAM	0.5	20,000	8	10,000		90		65		1,820,000

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	LG Semicon Total						**130,000**		**100,000**					**5,745,000**	**7,280,000**
Asia/ Pacific	Mosel Vitelic	Hsin Chu	FAB 1-A	1995/Q1	4M DRAM	0.5	15,000	6	15,000	30		80		561,600	
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 1-B	1995/Q4	4M/16M DRAM	0.5	15,000	6	15,000	80	5	80	60	1,497,600	157,500
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 2	1997	16M/64M DRAM	0.40	20,000	8	-	10	80			-	-
	Mosel Vitelic Total						**50,000**		**30,000**					**2,059,200**	**157,500**
Asia/ Pacific	**Tech Semi-conductor**	**Woodlands**	Fab 1	1993	16M DRAM	0.5	12,000	**8**	12,000		95		70		1,321,500
Asia/ Pacific	**Tech Semi-conductor**	**Woodlands**	Fab 2	1996	16M/64M DRAM	0.35	10,000	**8**	10,000		95		65		2,100,000
	Tech Semiconductor Total						**22,000**		**22,000**					-	**3,421,500**
Asia/ Pacific	Nan Ya Technology	Tao-Yuan	Fab 1	1996/Q3	16M/64M DRAM	0.45	25,000	8	5,000		100		65	-	1,137,500
	Nan Ya Technology Total						**25,000**		**5,000**					-	**1,137,500**
Asia/ Pacific	**Vanguard**	**Hsin Chu**	Fab 1A	1995	4M/16M DRAM	0.35	18,000	**8**	14,000		80		65		2,548,000
Asia/ Pacific	**Vanguard**	**Hsin Chu**	Fab 1B	1996	4M/16M DRAM	0.35	18,000	**8**	10,000	30	65	85	65	765,000	929,500
Asia/ Pacific	Vanguard	Hsin Chu	Fab 2	1997	16M/64M DRAM	0.35	15,000	8							
	Vanguard Total						**51,000**		**24,000**					**765,000**	**3,477,500**
Asia/ Pacific	UMC	Hsin Chu	Fab 3-A	1995/Q3	SRAM, Mask ROM, 4M/ 16M DRAM	0.5	15,000	**8**	11,000	60		50		990,000	
Asia/ Pacific	**UMC**	**Hsin Chu**	Fab 3-B	1997/Q1	64M DRAM	0.35	15,000	**8**							
	UMC Total						**30,000**		**11,000**					**990,000**	-
	Americas Companies						429,400		255,700					28,471,313	21,508,588
	European Companies						41,000		28,000					742,560	1,474,200
	Japanese Companies						1,358,200		785,400					27,379,650	46,784,600
	Asia/Pacific Companies						598,000		427,000					18,929,700	43,812,438
	Korean Companies						420,000		335,000					15,115,500	35,618,438
	Taiwan Companies						156,000		70,000					3,814,200	4,772,500
	Rest of Asia/Pacific Companies						22,000		22,000					-	3,421,500
	Worldwide Companies						2,426,600		1,496,100					75,523,223	113,579,826

*Tohoku Semiconductor production is split 50-50 between Toshiba and Motorola.
NA = Not available
Source: Dataquest (October 1996)

For More Information...

James Seay, Market Research Analyst..... (408) 468-8265
Internet address .....james.seay@dataquest.com
Via fax ..... (408) 954-1780
Dataquest Interactive..... http://www.dataquest.com

Dataquest
A Gartner Group Company

DATAQUEST WORLDWIDE OFFICES

NORTH AMERICA

Worldwide Headquarters
251 River Oaks Parkway
San Jose, California 95134-1913
United States
Phone: 1-408-468-8000
Facsimile: 1-408-954-1780

East Coast Headquarters
Nine Technology Drive
P.O. Box 5093
Westborough, Massachusetts 01581-5093
United States
Phone: 1-508-871-5555
Facsimile: 1-508-871-6262

Dataquest Global Events
3990 Westerly Place, Suite 100
Newport Beach, California 92660
United States
Phone: 1-714-476-9117
Facsimile: 1-714-476-9969

Sales Offices:
Washington, DC (Federal)
New York, NY (Financial)
Dallas, TX

LATIN AMERICA

Research Affiliates and Sales Offices:
Buenos Aires, Argentina
Sao Paulo, Brazil
Santiago, Chile
Mexico City, Mexico

EUROPE

European Headquarters
Tamesis, The Glanty
Egham, Surrey TW20 9AW
United Kingdom
Phone: +44 1784 431 611
Facsimile: +44 1784 488 980

Dataquest France
Immeuble Défense Bergères
345, avenue Georges Clémenceau
TSA 40002
92882 - Nanterre CTC Cedex 9
France
Phone: +33 1 41 35 13 00
Facsimile: +33 1 41 35 13 13

Dataquest Germany
Kronstadter Strasse 9
81677 München
Germany
Phone: +49 89 93 09 09 0
Facsimile: +49 89 93 03 27 7

Sales Offices:
Brussels, Belgium
Kfar Saba, Israel
Milan, Italy
Randburg, South Africa
Madrid, Spain

JAPAN

Japan Headquarters
Aobadai Hills 4-7-7
Aobadai
Meguro-ku, Tokyo 153
Japan
Phone: 81-3-3481-3670
Facsimile: 81-3-3481-3644

ASIA/PACIFIC

Asia/Pacific Headquarters
Suite 5904-7, Central Plaza
18 Harbour Road, Wanchai
Hong Kong
Phone: 852-2824-6168
Facsimile: 852-2824-6138

Dataquest Korea
Suite 2407, Trade Tower
159 Samsung-dong, Kangnam-gu
Seoul 135-729
Korea
Phone: 822-551-1331
Facsimile: 822-551-1330

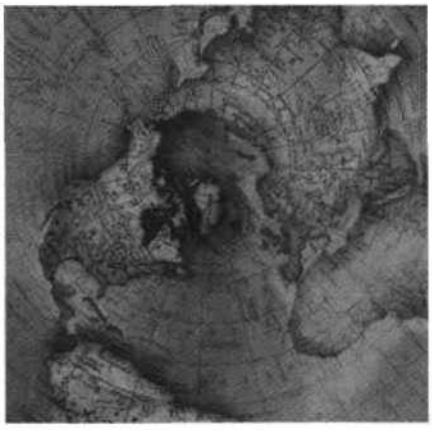
Dataquest Taiwan
11F-2, No. 188, Section 5
Nan King East Road
Taipei
Taiwan, R.O.C.
Phone: 8862-756-0389
Facsimile: 8862-756-2663

Dataquest Singapore
105 Cecil Street
#06-01/02 The Octagon
Singapore 069534
Phone: 65-227-1213
Facsimile: 65-227-4607

Dataquest Thailand
12/F, Vanissa Building
29 Soi Chidlom
Ploenchit Road
Patumwan, Bangkok 10330
Thailand
Phone: 662-655-0577
Facsimile: 662-655-0576

Research Affiliates and Sales Offices:
Melbourne, Australia
Beijing, China

Dataquest
A Gartner Group Company



Dataquest

DRAM Supply/Demand Quarterly Statistics: First Quarter 1997 Outlook

Market Statistics

Program: DRAM Supply and Demand Quarterly Statistics
Product Code: DSDR-WW-MS-96Q4
Publication Date: January 27, 1997
Filing: Market Statistics

DRAM Supply/Demand Quarterly Statistics: First Quarter 1997 Outlook

Market Statistics

Program: DRAM Supply and Demand Quarterly Statistics
Product Code: DSDR-WW-MS-96Q4
Publication Date: January 27, 1997
Filing: Market Statistics

Table of Contents

List of Figures

List of Tables

Chapter 1
Executive Summary

This report provides a first quarter 1997 outlook for the worldwide DRAM market based on the results of fourth quarter 1996 supplier surveys and related information. The report includes quarterly information through fourth quarter 1998.

Dataquest's 1997 DRAM supply-demand outlook remains consistent with prior expectations. The DRAM oversupply will persist throughout 1997 and well into 1998; however, a dramatic increase in the number of DRAM megabytes per PC means parity or undersupply in the second half of 1998. We have raised our DRAM bit shipment expectations—and our expectations of PC demand for DRAM—so the near-term supply and demand outlook has changed little.

Although no near-term market shortage is anticipated, there is some good news for DRAM suppliers following the challenge of 1996. For example, 16Mb DRAM yield efficiencies, among other factors, augur a somewhat brighter 1997 profit outlook for suppliers, despite extremely competitive pricing.

As indicated, high 16Mb yields and considerable new capacity mean a large supply of 16Mb DRAMs over the next several quarters. Meanwhile, the holiday 1996 season whetted the appetite of both the business PC market and home PC market for systems with more than 16MB of DRAM. For example, although many PCs sold with 16MB of DRAM during fourth quarter 1996, many year-end 1996 and early 1997 advertisements have touted systems with 24MB or 32MB of DRAM. As shown in this report, this sets the stage for a market move to the 32MB PC as the standard during late 1997 to 1998. The long-term business market move to Windows NT should add to the momentum toward much larger amounts of DRAM in PCs.

Several DRAM market moves are just starting or will start during 1997. Synchronous DRAM (SDRAM) will gain a lot of market attention during the first half of 1997, with considerable market impact over the second half of the year. The reality remains, however, that extended data out (EDO) DRAM, also known as hyperpage, will show market staying power.

The emergence of 64Mb DRAM meshes with the long-term trend toward synchronous architectures like SDRAM and RAMBUS. Suppliers turning to 64Mb production will find yield difficulties as well as a scarcity of applications willing to absorb the cost per megabyte increase to migrate to a 64Mb granularity. Dataquest expects most 64Mb-capable fabs to produce 16Mb throughout 1997 and 1998.

Japanese suppliers are moving their wafer starts away from DRAM to other products while accelerating installation of 0.35-micron-capable equipment to some fabs. This accelerated installation is primarily to compensate for lowered 16Mb prices. Japanese suppliers will also use the new equipment to bring 64Mb chips to market during 1997 and 1998. They

must do this in balanced fashion, however, or they risk diminishing the extra profitability usually enjoyed at early stages in the DRAM life cycle.

Suppliers in other regions seem content to work through the bit and unit transitions to the 16Mb. Dataquest expects these vendors to time their entrances into the 64Mb market when they can better profit from improving production yields.

The 4Mb now moves to the decline stage of the life cycle. The 256Mb DRAM will be mostly a post-1998 phenomenon.

Note: The title of this report has been changed to *First Quarter 1997 Outlook*. This report takes a more forward-looking approach. (The prior report was titled *Third Quarter 1996*, so this version would otherwise have been called *Fourth Quarter 1996*.)

Contributors: Masahiro Suzuki, Senior Analyst (Japan), Ronald Bohn, Principal Analyst (Worldwide and Americas), Jim Handy, Director/Principal Analyst (Worldwide and Americas), Yoshihiro Shimada, Principal Analyst (Japan), James Seay, Research Analyst (Worldwide and Americas), In-Hyung Baik, Research Analyst (Asia/Pacific and Korea), Sabrina Chiou, Research Analyst (Taiwan), Joe D'Elia, Director (Europe), Richard Gordon, Senior Analyst (Europe), Chang Soo Kim, Senior Analyst (Korea), and Jerry Yeh, Senior Analyst (Taiwan)

Chapter 2
Production Statistics of 4Mb DRAM

This chapter provides estimates of 4Mb DRAM quarterly unit shipments by supplier. Tables show total 4Mb shipments (see Table 2-1) and shipments by organization (x1, x4, x8/9, and x16/18, shown in Tables 2-2 through 2-5, respectively). Dataquest collects data through quarterly supplier surveys and compares the surveys with production capabilities estimated using Dataquest's DRAM fab database, presented in Chapter 7. These tables represent 4Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of each configuration. Average selling prices (ASPs) for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5. Following the configuration tables is an analysis of each vendor's shipments of x8/9 and x16/18 devices (see Table 2-6). Dataquest calls this the "wide-bit ratio."

Table 2-1
4Mb Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	2.5	7.0	6.5	16.0	4.8	4.0	3.7	2.5	15.0	1.8	1.4	1.0	0.8	5.0
Fujitsu	20.5	17.0	10.5	9.0	57.0	6.0	5.4	4.5	4.5	20.4	3.6	3.6	3.0	3.0	13.2
Hitachi	30.5	28.0	27.0	23.0	108.5	21.0	20.0	18.0	17.0	76.0	15.0	13.5	12.0	11.0	51.5
Hyundai	-	32.2	24.0	22.1	117.2	18.3	14.2	13.8	12.1	58.4	10.0	8.3	6.9	5.8	31.0
IBM Microelectronics	19.4	16.0	9.0	4.8	49.2	1.8	0.7	0.3	0.1	2.9	0.1	0	0	0	0.1
LG Semicon	21.3	19.7	17.5	15.5	74.0	14.6	13.6	12.8	12.0	53.1	7.6	7.0	6.4	5.9	26.9
Matsushita	8.7	8.7	10.5	9.5	37.4	7.5	6.0	5.0	4.5	23.0	4.2	3.6	3.3	3.0	14.1
Micron Technology	51.0	54.5	40.3	19.7	165.6	13.6	9.8	8.0	5.2	36.6	4.7	2.7	2.3	1.2	10.9
Mitsubishi	19.2	18.6	14.5	11.2	63.5	10.5	10.5	10.5	9.0	40.5	9.0	7.5	7.5	6.0	30.0
Mosel Vitelic	2.0	5.2	12.0	15.0	34.2	18.0	15.0	11.0	6.0	50.0	6.0	5.0	5.0	5.0	21.0
Motorola	6.8	6.0	5.3	4.9	23.0	3.7	2.9	2.3	1.9	10.8	1.2	0.9	0.7	0.5	3.2
Nan Ya Technology	-	-	-	-	-	-	-	10.0	15.0	25.0	14.0	11.0	9.0	5.0	39.0
NEC	28.8	22.0	17.0	14.0	81.8	13.1	11.5	10.1	8.7	43.4	6.6	6.0	5.7	5.6	23.9
Nippon Steel Semiconductor	10.0	10.0	10.0	9.8	39.8	9.5	9.3	9.0	8.8	36.6	8.5	8.3	8.0	7.8	32.6
Oki	13.3	6.5	9.5	7.0	36.3	4.0	3.9	3.7	3.6	15.2	2.7	2.3	2.2	2.0	9.2
Samsung	27.1	21.2	25.0	24.0	97.2	21.4	13.6	12.6	9.0	56.6	7.5	7.6	7.6	7.7	30.4
Sharp	1.5	1.4	1.3	1.1	5.3	1.1	1.0	1.0	1.0	4.1	0.8	0.8	0.8	0.8	3.2
Siemens	10.0	10.0	13.0	12.0	45.0	13.0	13.5	15.0	16.5	58.0	16.5	15.5	13.0	10.0	55.0
Texas Instruments	33.0	29.9	25.1	18.5	106.5	14.1	12.4	10.2	9.1	45.8	6.0	3.1	1.5	1.0	11.6
Toshiba	22.0	16.0	14.0	9.0	61.0	8.2	7.0	6.5	6.0	27.7	5.5	5.5	5.5	5.5	22.0
Vanguard International	9.0	13.0	20.0	8.0	50.0	4.5	4.5	4.0	4.0	17.0	3.3	2.3	2.3	2.3	10.0
Worldwide Shipments	372.9	338.3	312.6	244.7	1,268.4	208.7	178.8	172.1	156.5	716.1	134.5	115.8	103.6	89.9	443.8
ASP ($)	8.57	5.13	3.46	3.14	5.35	2.82	2.88	2.90	2.86	2.86	2.83	2.73	2.69	2.66	2.74
Revenue ($M)	3,195.5	1,735.0	1,082.5	769.2	6,782.2	587.9	515.1	498.6	446.7	2,048.3	380.6	315.9	278.6	238.9	1,213.9
Demand	320.1	280.7	270.3	229.9	1,101.0	191.9	166.8	160.8	150.7	670.2	127.7	110.4	98.9	89.2	426.1
Sufficiency (%)	116.5	120.5	115.6	106.4	115.2	108.8	107.2	107.0	103.8	106.8	105.3	104.9	104.8	100.8	104.2

Source: Dataquest (December 1996)

Table 2-2
4Mbx1 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	1.0	0.9	0.5	0.5	2.9	0.3	0.3	0.4	0.4	1.3	0.4	0.4	0.3	0.3	1.3
Hitachi	2.5	2.3	2.0	1.7	8.4	1.4	1.3	1.1	0.9	4.7	0.8	0.7	0.6	0.6	2.6
Hyundai	-	4.2	2.8	2.7	14.3	0.7	0.4	0.4	0.4	1.9	0.4	0.3	0.3	0.3	1.3
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	2.2	2.0	1.5	1.0	6.7	1.0	0.9	0.9	0.9	3.7	0.6	0.5	0.4	0.4	1.9
Matsushita	0.7	0.7	0.8	0.7	2.9	0.5	0.4	0.3	0.2	1.4	0.2	0.2	0.2	0.2	0.7
Micron Technology	7.1	6.3	4.9	1.7	20.0	1.8	1.4	1.1	0.7	5.1	0.6	0.4	0.3	0.2	1.5
Mitsubishi	1.0	0.9	0.9	1.1	3.9	1.1	1.1	1.1	0.9	4.1	0.9	0.8	0.8	0.6	3.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	1.8	1.4	1.2	1.0	5.5	0.7	0.5	0.4	0.3	1.9	0.2	0.1	0.1	0.1	0.5
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	3.5	2.6	1.9	1.4	9.4	1.2	1.0	0.8	0.5	3.5	0.3	0.3	0.3	0.3	1.2
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	1.3	0.7	1.0	0.7	3.6	0.3	0.3	0.3	0.3	1.2	0.2	0.1	0.1	0.1	0.6
Samsung	2.4	2.1	2.3	2.5	9.2	2.0	1.2	1.2	1.0	5.4	0.7	0.7	0.6	0.6	2.6
Sharp	-	-	-	-	-	0.1	0.1	0.1	0.1	0.2	0	0	0	0	0.2
Siemens	1.5	1.5	2.0	2.4	7.4	2.3	2.2	2.3	1.9	8.6	1.9	1.7	1.0	0.7	5.3
Texas Instruments	5.8	5.1	4.2	3.0	18.1	2.0	1.8	1.4	1.2	6.5	0.7	0.4	0.2	0.1	1.4
Toshiba	1.5	1.1	0.8	0.5	4.0	0.2	0.2	0.2	0.2	0.8	-	-	-	-	-
Vanguard International	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worldwide Shipments	36.8	31.8	26.7	20.9	116.2	15.7	13.1	11.8	9.7	50.4	7.9	6.5	5.2	4.3	23.9
ASP ($)	9.49	5.35	3.75	2.97	5.86	2.72	2.67	2.64	2.62	2.67	2.58	2.39	2.38	2.30	2.43
Revenue ($M)	349.1	170.2	100.1	62.2	681.5	42.6	35.1	31.1	25.5	134.4	20.3	15.6	12.4	10.0	58.3
Demand	31.6	26.4	23.1	19.7	100.7	14.4	12.3	11.0	9.4	47.1	7.5	6.2	5.0	4.3	23.0
Sufficiency (%)	116.5	120.5	115.6	106.4	115.4	108.8	107.2	107.0	103.8	107.0	105.3	104.9	104.8	100.8	104.3

Source: Dataquest (December 1996)

Table 2-3
1Mbx4 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	2.5	7.0	6.5	16.0	4.8	4.0	3.7	2.5	15.0	1.8	1.4	1.0	0.8	5.0
Fujitsu	12.3	9.7	5.1	3.6	30.7	1.8	1.6	1.4	1.4	6.1	0.7	0.7	0.6	0.6	2.6
Hitachi	14.0	12.9	12.2	10.4	49.4	9.0	8.0	6.3	5.4	28.8	4.5	3.8	3.0	2.8	14.0
Hyundai	-	17.9	12.6	11.4	64.1	7.7	5.7	5.2	4.3	22.9	3.5	2.8	2.3	1.9	10.5
IBM Microelectronics	19.4	16.0	9.0	4.8	49.2	1.8	0.7	0.3	0.1	2.9	0.1	0	0	0	0.1
LG Semicon	12.8	12.2	10.6	9.2	44.8	8.6	8.1	7.6	7.1	31.5	4.6	4.4	4.1	3.9	17.0
Matsushita	4.4	4.4	5.3	4.8	18.8	3.2	2.1	1.7	1.3	8.2	1.1	0.9	0.8	0.8	3.6
Micron Technology	37.9	41.0	33.2	13.4	125.5	11.7	8.4	6.9	4.5	31.5	4.1	2.3	2.0	1.1	9.4
Mitsubishi	9.2	8.9	7.0	4.5	29.6	3.7	3.7	3.7	3.2	14.2	3.2	2.6	2.6	2.1	10.5
Mosel Vitelic	-	1.3	7.2	9.0	17.5	7.2	3.0	1.1	-	11.3	-	-	-	-	-
Motorola	5.0	4.6	4.1	3.9	17.5	3.0	2.4	1.9	1.6	8.9	1.0	0.7	0.6	0.4	2.7
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	9.5	6.6	2.9	2.0	21.0	1.6	1.4	1.1	0.9	4.9	0.7	0.6	0.6	0.6	2.4
Nippon Steel Semiconductor	8.0	8.0	8.0	7.0	31.0	6.0	5.6	5.3	5.0	21.9	4.5	4.3	4.0	3.8	16.6
Oki	9.8	4.2	5.2	2.3	21.6	1.0	0.7	0.6	0.5	2.8	0.3	0.2	0.1	0.1	0.8
Samsung	9.6	7.5	8.8	7.3	33.2	6.7	3.6	3.1	2.1	15.5	1.8	1.9	2.0	2.1	7.9
Sharp	1.5	1.4	1.3	1.1	5.3	0.5	0.3	0.3	0.3	1.4	0.2	0.2	0.2	0.2	0.8
Siemens	6.0	6.0	7.8	6.6	26.4	7.3	7.6	8.1	8.8	31.8	8.6	7.8	6.5	4.8	27.6
Texas Instruments	22.4	20.4	16.9	11.8	71.5	8.6	7.4	5.6	4.8	26.4	3.1	1.5	0.7	0.4	5.7
Toshiba	12.1	8.0	5.6	3.2	28.9	3.4	1.9	0.8	0.4	6.5	-	-	-	-	-
Vanguard International	9.0	12.2	18.8	6.8	46.8	2.3	0.9	0.2	-	3.4	-	-	-	-	-
Worldwide Shipments	225.3	205.7	188.6	129.3	748.9	99.8	76.9	64.8	54.3	295.8	43.7	36.3	31.1	26.3	137.4
ASP ($)	8.28	4.77	3.13	2.84	5.08	2.42	2.45	2.44	2.40	2.43	2.38	2.18	2.20	2.20	2.25
Revenue ($M)	1,866.3	979.9	590.3	367.3	3,803.8	241.6	188.5	158.1	130.3	718.4	104.1	79.0	68.4	57.9	309.4
Demand	193.4	170.7	163.1	121.5	648.7	91.8	71.8	60.5	52.3	276.4	41.5	34.5	29.7	26.1	131.9
Sufficiency (%)	116.5	120.5	115.6	106.4	115.4	108.8	107.2	107.0	103.8	107.0	105.3	104.9	104.8	100.8	104.2

Source: Dataquest (December 1996)

Table 2-4
512Kx8/9 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	1.0	1.4	0.8	0.5	3.7	0.3	0.4	0.4	0.4	1.5	0.4	0.4	0.3	0.3	1.3
Hitachi	3.1	2.8	2.7	2.3	10.9	2.3	2.2	2.0	1.9	8.4	1.7	1.5	1.3	1.2	5.7
Hyundai	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	0.9	0.9	0.7	0.7	3.2	0.5	0.4	0.4	0.4	1.7	0.2	0.2	0.2	0.2	0.8
Matsushita	1.8	1.8	2.2	1.8	7.6	1.5	1.1	0.9	0.7	4.1	0.6	0.5	0.5	0.5	2.1
Micron Technology	1.6	2.1	2.2	1.5	7.4	-	-	-	-	-	-	-	-	-	-
Mitsubishi	1.0	0.9	0.9	1.1	3.9	1.1	1.1	1.1	0.9	4.1	0.9	0.8	0.8	0.6	3.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	6.9	5.3	4.3	3.2	19.7	3.1	2.8	2.4	2.1	10.4	1.6	1.5	1.4	1.4	6.0
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	0.3	0.3	0.2	0.2	1.0	0.1	0.1	0.1	0.1	0.5	0.1	0	0	0	0.2
Samsung	2.6	1.9	2.1	2.3	9.0	1.3	0.7	0.3	0.3	2.6	0.3	0.3	0.4	0.4	1.3
Sharp	-	-	-	-	-	0.2	0.2	0.2	0.2	0.7	0.1	0.1	0.1	0.1	0.5
Siemens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	3.0	2.6	2.4	2.2	10.2	2.1	1.9	1.7	1.6	7.2	1.0	0.5	0.2	0.1	1.8
Toshiba	0.4	0.5	0.6	0.5	2.0	0.4	0.5	0.5	0.4	1.8	0.4	0.4	0.4	0.4	1.5
Vanguard International	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worldwide Shipments	22.6	20.5	19.1	16.4	78.6	12.9	11.3	9.8	8.8	42.8	7.3	6.2	5.6	5.2	24.2
ASP ($)	9.10	5.50	4.13	3.29	5.74	2.69	2.56	2.43	2.33	2.52	2.33	2.33	2.31	2.31	2.32
Revenue ($M)	205.5	112.6	78.7	54.1	450.8	34.7	28.9	23.9	20.6	108.0	16.9	14.4	12.9	12.0	56.2
Demand	19.4	17.0	16.5	15.4	68.3	11.9	10.5	9.2	8.5	40.1	6.9	5.9	5.3	5.2	23.2
Sufficiency (%)	116.5	120.5	115.6	106.4	115.0	108.8	107.2	107.0	103.8	106.9	105.3	104.9	104.8	100.8	104.1

Source: Dataquest (December 1996)

Table 2-5
256Kx16/18 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	6.2	5.1	4.0	4.5	19.7	3.6	3.1	2.4	2.4	11.5	2.2	2.2	1.8	1.8	7.9
Hitachi	11.0	10.1	10.2	8.7	39.9	8.3	8.5	8.7	8.8	34.2	8.1	7.6	7.1	6.5	29.2
Hyundai	-	10.0	8.6	8.1	38.7	9.9	8.1	8.3	7.4	33.6	6.1	5.1	4.3	3.6	19.2
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	5.4	4.7	4.6	4.6	19.2	4.5	4.2	3.9	3.6	16.2	2.2	1.9	1.7	1.5	7.3
Matsushita	1.8	1.8	2.2	2.2	8.0	2.3	2.4	2.2	2.3	9.2	2.2	2.0	1.8	1.7	7.7
Micron Technology	4.4	5.2	-	3.0	12.6	-	-	-	-	-	-	-	-	-	-
Mitsubishi	8.1	7.8	5.8	4.5	26.2	4.7	4.7	4.7	4.1	18.2	4.1	3.4	3.4	2.7	13.5
Mosel Vitelic	2.0	3.9	4.8	6.0	16.7	10.8	12.0	9.9	6.0	38.7	6.0	5.0	5.0	5.0	21.0
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	10.0	15.0	25.0	14.0	11.0	9.0	5.0	39.0
NEC	8.9	7.5	8.0	7.4	31.8	7.2	6.3	5.8	5.2	24.5	3.9	3.6	3.4	3.4	14.3
Nippon Steel Semiconductor	2.0	2.0	2.0	2.8	8.8	3.5	3.7	3.7	3.8	14.7	4.0	4.0	4.0	4.0	16.0
Oki	1.9	1.3	3.1	3.8	10.1	2.6	2.8	2.7	2.7	10.8	2.2	1.9	1.9	1.7	7.7
Samsung	12.4	9.6	11.9	11.9	45.8	11.4	8.1	8.0	5.6	33.1	4.7	4.6	4.6	4.6	18.5
Sharp	-	-	-	-	-	0.3	0.4	0.4	0.5	1.7	0.4	0.4	0.4	0.4	1.7
Siemens	2.5	2.5	3.3	3.0	11.3	3.4	3.8	4.7	5.8	17.6	6.0	6.0	5.5	4.5	22.1
Texas Instruments	1.8	1.8	1.6	1.4	6.6	1.4	1.3	1.5	1.5	5.7	1.2	0.8	0.5	0.4	2.7
Toshiba	7.9	6.4	7.0	4.8	26.1	4.1	4.4	5.1	5.0	18.6	5.1	5.1	5.1	5.1	20.5
Vanguard International	-	0.8	1.2	1.2	3.2	2.3	3.6	3.8	4.0	13.7	3.3	2.3	2.3	2.3	10.0
Worldwide Shipments	88.2	80.4	78.2	78.0	324.8	80.3	77.4	85.7	83.6	327.0	75.6	66.9	61.8	54.0	258.3
ASP ($)	8.78	5.88	4.01	3.67	5.69	3.36	3.40	3.34	3.24	3.33	3.17	3.10	3.00	2.95	3.07
Revenue ($M)	765.2	467.3	308.6	280.6	1,821.6	264.4	258.6	281.6	267.6	1,072.1	236.9	204.6	182.6	156.8	780.9
Demand	75.7	66.7	67.6	73.3	283.3	73.8	72.2	80.1	80.6	306.7	71.8	63.7	58.9	53.6	248.1
Sufficiency (%)	116.5	120.5	115.6	106.4	114.6	108.8	107.2	107.0	103.8	106.6	105.3	104.9	104.8	100.8	104.1

Source: Dataquest (December 1996)

Table 2-6
4Mb Wide-Bit Ratio, 1996-1998 (Percentage of Total Company Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	35.0	38.0	46.0	55.0	41.1	65.0	65.0	62.0	62.0	63.7	70.0	70.0	70.0	70.0	70.0
Hitachi	46.0	46.0	47.6	47.8	46.8	50.3	53.3	59.1	63.0	56.0	65.0	67.0	70.0	70.0	67.8
Hyundai	-	31.2	35.6	36.7	33.1	54.1	57.0	59.9	61.0	57.6	61.4	61.9	62.2	62.6	61.9
IBM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	29.4	28.2	30.4	34.1	30.3	34.2	33.7	33.5	33.3	33.7	31.9	30.6	29.3	28.0	30.1
Matsushita	41.4	41.4	42.2	42.8	42.0	50.6	58.7	61.1	66.0	58.0	68.0	70.0	70.0	70.0	69.4
Micron	11.8	13.3	5.6	23.0	12.1	-	-	-	-	-	-	-	-	-	-
Mitsubishi	47.0	47.0	46.0	50.0	47.3	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
Mosel Vitelic	100.0	75.0	40.0	40.0	48.8	60.0	80.0	90.0	100.0	77.4	100.0	100.0	100.0	100.0	100.0
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
NEC	55.0	58.0	72.0	76.0	62.9	79.0	79.0	81.0	84.0	80.5	85.0	85.0	85.0	85.0	85.0
Nippon Steel Semiconductor	20.0	20.0	20.0	29.0	22.2	37.0	40.0	41.0	43.0	40.2	47.0	48.0	50.0	51.0	48.9
Oki	16.0	25.0	35.0	57.0	30.5	68.0	74.0	76.0	78.0	73.9	83.0	84.0	88.0	88.0	85.5
Samsung	51.8	50.0	51.0	52.9	51.5	51.7	54.5	54.8	53.8	53.4	53.7	53.7	53.6	53.5	53.6
Sharp	-	-	-	-	-	50.6	58.7	61.1	66.0	58.9	68.0	70.0	70.0	70.0	69.5
Siemens	25.0	25.0	25.0	25.0	25.0	26.0	28.0	31.0	35.0	30.3	36.5	39.0	42.3	45.0	40.1
Texas Instruments	14.5	14.6	15.9	19.8	15.8	24.7	25.8	31.2	34.0	28.3	36.3	39.4	42.6	45.7	38.8
Toshiba	38.0	43.0	54.0	59.0	46.1	55.0	70.0	85.0	90.0	73.4	100.0	100.0	100.0	100.0	100.0
Vanguard	-	6.0	6.0	15.0	6.4	50.0	80.0	95.0	100.0	80.3	100.0	100.0	100.0	100.0	100.0
Total	29.7	29.8	31.1	38.6	31.8	44.7	49.6	55.5	59.1	51.7	61.6	63.1	65.0	65.9	63.6

Source: Dataquest (December 1996)

What Has Changed since the Previous Report

This report provides Dataquest's first look on a quarterly basis at 4Mb DRAM supply and demand during 1998. Prior forecasts included information for full year 1998 but no quarterly presentation for the year.

4Mb unit shipments have not been changed for 1996. Undramatic increases have been made for the 1997-to-1998 period.

The 128Kx32/36 estimates have been eliminated.

The prices included in this report are now based on North American contract pricing from survey results provided by Dataquest's Semiconductor Supply and Pricing Worldwide program (SPSG).

Tables 2-7 and 2-8 show the 4Mb normalized interface and configuration ratios.

Table 2-7
4Mb Normalized Interface Ratios, 1996-1998 (Percentage of Total Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Fast Page DRAM	73.8	58.9	47.1	40.0	56.9	32.1	28.9	24.3	21.7	27.1	18.7	18.7	18.3	19.0	18.7
EDO DRAM	24.0	39.1	50.8	57.2	40.9	65.0	67.8	72.0	72.3	69.0	73.4	72.0	70.5	69.0	71.5
Synchronous DRAM	0	0.2	0.4	1.3	0.4	1.5	2.1	2.5	4.8	2.6	6.8	8.1	10.0	10.7	8.7
Next-Generation DRAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Display and Other DRAM	2.1	1.8	1.6	1.5	1.8	1.4	1.3	1.2	1.2	1.3	1.1	1.1	1.2	1.3	1.2

Source: Dataquest (December 1996)

Table 2-8
4Mb Normalized Configuration Ratios, 1996-1998 (Percentage of Total Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
4Mbx1	9.9	9.4	8.5	8.6	9.2	7.5	7.4	6.9	6.2	7.0	5.9	5.6	5.0	4.8	5.4
1Mbx4	60.4	60.8	60.3	52.9	59.0	47.8	43.0	37.7	34.7	41.3	32.5	31.3	30.0	29.3	31.0
512Kx8/9	6.1	6.0	6.1	6.7	6.2	6.2	6.3	5.7	5.6	6.0	5.4	5.3	5.4	5.8	5.5
256Kx16/18	23.7	23.8	25.0	31.9	25.6	38.5	43.3	49.8	53.5	45.7	56.2	57.7	59.6	60.1	58.2

Source: Dataquest (December 1996)

Chapter 3
Production Statistics of 16Mb DRAM

This chapter provides estimates of 16Mb DRAM quarterly unit shipments by supplier. Tables show total 16Mb shipments (see Table 3-1) and shipments by organization (x1, x4, x8/9, x16/18, and x32/36, located in Tables 3-2 through 3-6, respectively). Dataquest collects data through quarterly supplier surveys and compares the surveys with theoretical maximum production capabilities estimated using Dataquest's DRAM fab database, presented in Chapter 7. These tables represent 16Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of each configuration. ASPs for each device come from Dataquest's Semiconductor Supply and Pricing Worldwide program, as well as Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5. Following the configuration tables is an analysis of each vendor's shipments of x8/9, x16/18, and x32/36 devices (see Table 3-7). Dataquest calls this the "wide-bit ratio."

Table 3-1
16Mb Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	0.1	2.5	2.6	2.8	2.8	2.9	3.6	12.0	4.0	5.0	7.0	9.0	25.0
Fujitsu	10.0	10.5	13.5	16.5	50.5	21.0	24.0	25.5	27.0	97.5	27.0	24.0	24.0	21.0	96.0
Hitachi	20.7	24.6	25.0	32.0	102.3	34.3	35.4	38.0	41.0	148.7	41.0	40.0	39.0	38.0	158.0
Hyundai	-	25.0	28.0	30.0	103.5	36.3	45.1	49.7	54.2	185.3	60.1	60.1	60.1	60.1	240.5
IBM Microelectronics	5.2	6.4	9.1	14.1	34.8	16.3	16.8	18.0	19.1	70.1	19.8	20.3	21.5	23.5	85.0
LG Semicon	19.6	20.4	24.4	30.7	95.0	30.5	34.9	38.1	42.6	146.0	50.2	49.8	49.4	49.0	198.3
Matsushita	1.1	1.6	3.0	4.8	10.4	5.5	6.0	6.4	7.1	25.0	7.3	8.0	8.6	9.7	33.6
Micron Technology	2.5	4.2	9.5	18.5	34.7	25.1	28.9	30.4	31.9	116.2	33.5	35.1	37.8	40.6	146.9
Mitsubishi	11.7	15.3	20.2	24.7	71.9	25.0	25.0	26.0	27.5	103.5	27.5	28.0	29.0	30.0	114.5
Mosel Vitelic	-	-	-	-	-	-	-	0.2	1.0	1.2	4.0	7.0	10.0	11.0	32.0
Motorola	2.2	2.4	2.8	3.5	10.9	4.0	4.8	6.0	8.0	22.8	10.0	13.0	17.5	25.0	65.5
Nan Ya Technology	-	-	0	1.2	1.2	3.0	5.1	14.2	16.7	39.0	16.7	15.8	13.4	10.2	56.0
NEC	25.5	26.0	32.0	36.0	119.5	38.0	43.0	48.0	51.0	180.0	55.0	54.0	52.0	50.0	211.0
Nippon Steel Semiconductor	0.1	0.1	0.1	0.6	0.9	2.1	2.8	5.5	9.2	19.6	11.2	12.6	13.6	14.6	52.0
Oki	1.9	1.8	4.5	8.7	16.9	7.5	7.7	8.0	8.8	32.0	8.9	9.0	9.0	9.1	36.0
Samsung	39.0	43.0	45.0	51.0	178.0	54.8	59.8	68.1	68.1	250.8	75.0	75.4	75.7	76.0	302.1
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	4.0	5.0	6.0	10.0	25.0	12.0	17.5	27.5	43.0	100.0	43.0	44.5	45.5	47.0	180.0
Texas Instruments	13.9	17.0	20.8	25.0	76.7	28.4	33.5	39.9	41.5	143.3	44.3	47.8	50.5	59.9	202.4
Toshiba	14.3	15.3	19.0	23.0	71.6	25.3	27.0	29.0	31.0	112.3	35.0	39.0	39.0	39.5	152.5
Vanguard International	-	0.7	1.0	4.5	6.2	6.5	11.0	13.5	17.0	48.0	18.4	20.6	23.2	27.2	89.4
Worldwide Shipments	192.2	219.2	263.9	337.2	1,012.5	378.4	431.0	494.7	549.2	1,853.3	591.8	608.8	625.7	650.4	2,476.7

Table 3-1 (Continued)
16Mb Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
ASP ($)	36.40	18.30	11.93	9.66	17.20	9.02	8.72	8.38	8.11	8.51	7.82	7.66	7.56	7.46	7.62
Revenue ($M)	6,995.3	4,010.8	3,148.1	3,257.1	17,411.4	3,412.1	3,757.0	4,145.9	4,455.3	15,770.3	4,624.9	4,660.8	4,731.8	4,853.3	18,870.9
Demand	175.4	198.0	242.7	323.6	939.6	355.2	404.4	464.7	539.2	1,763.5	565.5	582.9	602.9	645.3	2,396.6
Sufficiency (%)	109.6	110.7	108.7	104.2	107.8	106.5	106.6	106.5	101.9	105.1	104.6	104.4	103.8	100.8	103.3

Source: Dataquest (December 1996)

Table 3-2
16Mbx1 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	0.1	0.1	0.1	-	0.3	-	-	-	-	-	-	-	-	-	-
Hitachi	1.4	1.5	1.3	1.6	5.8	1.7	1.8	1.5	1.6	6.6	1.2	1.2	0.8	0.8	4.0
Hyundai	-	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.4	0.1	0.1	0.1	0.1	0.4
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	0.2	0.2	0.1	0.1	0.6	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.3
Matsushita	0.5	0.5	0.5	0.5	2.0	0.5	0.5	0.5	0.5	2.0	0.4	0.5	0.4	0.5	1.8
Micron Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	0.7	0.8	0.8	1.0	3.3	1.0	1.0	0.8	0.8	3.6	0.8	0.8	0.9	0.9	3.4
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	1.0	0.8	0.6	0.7	3.2	0.8	0.9	0.5	0.5	2.6	0.6	0.5	0.5	0.5	2.1
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	0.2	0.1	0.3	0.5	1.1	0.4	0.4	0.3	0.3	1.3	0.2	0.2	0.2	0.2	0.7
Samsung	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	1.8	1.9	2.1	2.3	8.1	2.3	2.1	2.1	2.2	8.7	1.8	1.4	0.9	0.3	4.4
Toshiba	0.4	0.3	0.2	0.2	1.2	0.3	0.3	0.3	0.3	1.1	0.4	0.4	0.4	0.4	1.5
Vanguard International	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worldwide Shipments	6.4	6.2	6.1	7.0	25.7	7.0	7.0	6.1	6.3	26.6	5.5	5.2	4.3	3.7	18.7
ASP ($)	35.94	18.57	12.31	10.94	19.36	10.60	9.60	9.35	9.13	9.69	8.03	8.03	8.03	8.03	8.03
Revenue ($M)	231.4	115.0	74.7	76.5	497.7	74.5	67.6	57.5	57.9	257.5	44.3	41.9	34.2	29.7	150.1
Demand	5.9	5.6	5.6	6.7	23.8	6.6	6.6	5.8	6.2	25.2	5.3	5.0	4.1	3.7	18.0
Sufficiency (%)	109.59	110.73	108.73	104.23	108.1	106.53	106.57	106.46	101.85	105.4	104.64	104.45	103.78	100.79	103.6

Source: Dataquest (December 1996)

Table 3-3
4Mbx4 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	4.9	5.1	6.6	7.4	24.1	11.6	12.0	10.2	10.8	44.6	11.3	10.1	10.1	8.8	40.3
Hitachi	10.6	12.5	12.0	15.4	50.5	16.1	16.6	17.1	18.0	67.9	17.2	15.6	15.2	14.4	62.5
Hyundai	-	8.2	10.7	11.5	38.2	14.3	17.3	19.9	21.7	73.1	23.4	22.7	22.0	21.3	89.4
IBM Microelectronics	4.4	5.3	7.5	11.5	28.7	13.2	13.6	14.6	15.3	56.6	15.6	15.6	16.6	17.9	65.6
LG Semicon	6.6	6.6	7.8	9.9	30.8	11.7	12.9	13.7	14.8	53.2	18.0	18.4	18.9	19.3	74.7
Matsushita	0.3	0.5	0.8	1.1	2.7	1.2	1.3	1.4	1.5	5.4	1.5	1.7	1.8	1.9	6.9
Micron Technology	1.7	2.8	6.4	12.3	23.2	16.7	19.0	20.0	20.6	76.3	21.2	21.8	23.0	24.4	90.5
Mitsubishi	5.9	7.5	9.9	12.1	35.3	12.3	12.3	12.7	13.5	50.7	12.9	13.2	13.6	14.1	53.8
Mosel Vitelic	-	-	-	-	-	-	-	0.2	1.0	1.2	2.0	3.0	5.0	5.5	15.5
Motorola	2.2	2.3	2.7	3.4	10.6	3.9	4.6	5.5	7.0	21.0	8.3	10.4	13.4	18.4	50.5
Nan Ya Technology	-	-	0	1.2	1.2	3.0	3.8	7.1	5.0	18.9	4.2	3.2	2.0	1.0	10.3
NEC	6.4	6.5	11.5	13.3	37.7	14.1	15.5	16.8	17.9	64.2	17.6	16.2	15.6	15.0	64.4
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	0.1	0.1	2.1	3.2	4.1	5.1	14.5
Oki	1.3	1.4	3.5	5.0	11.2	5.7	5.9	6.4	7.4	25.4	7.7	7.9	8.1	8.3	32.0
Samsung	17.5	18.4	19.6	20.4	75.9	21.4	22.1	25.8	25.8	95.0	28.2	28.1	28.0	27.9	112.1
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	3.2	3.3	3.0	6.0	15.5	6.0	9.0	14.0	21.0	50.0	15.5	12.5	9.1	8.0	45.0
Texas Instruments	6.4	7.8	9.7	11.8	35.6	12.0	13.3	15.5	12.3	53.2	13.3	14.3	14.8	17.1	59.4
Toshiba	2.4	2.6	7.6	9.2	21.8	7.6	9.5	11.6	14.0	42.6	14.0	14.8	14.0	13.4	56.3
Vanguard International	-	-	-	-	-	1.3	3.9	6.8	10.2	22.1	12.0	14.4	16.2	20.4	63.0
Worldwide Shipments	81.4	90.8	119.3	151.4	442.9	171.8	192.6	219.3	237.8	821.5	246.0	246.9	251.5	262.2	1,006.6

Table 3-3 (Continued)
4Mbx4 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
ASP ($)	37.89	18.00	12.50	10.20	17.51	9.00	8.67	8.38	8.17	8.52	7.96	7.84	7.79	7.73	7.83
Revenue ($M)	3,086.0	1,634.5	1,491.0	1,544.4	7,755.8	1,546.6	1,669.4	1,837.7	1,942.5	6,996.2	1,958.3	1,935.7	1,959.2	2,027.0	7,880.2
Demand	74.3	82.0	109.7	145.3	411.3	161.3	180.7	206.0	233.4	781.4	235.1	236.4	242.3	260.2	974.0
Sufficiency (%)	109.59	110.73	108.73	104.23	107.7	106.53	106.57	106.46	101.85	105.1	104.64	104.45	103.78	100.79	103.4

Source: Dataquest (December 1996)

Table 3-4
2Mbx8/9 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	2.5	2.6	4.6	5.0	14.7	7.4	9.6	12.8	13.5	43.2	13.5	12.0	12.0	10.5	48.0
Hitachi	2.5	3.0	3.3	4.2	12.8	4.8	5.0	5.7	6.2	21.6	7.4	8.0	9.0	9.5	33.9
Hyundai	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	0.2	0.3	0.5	0.6	1.5	0.8	0.8	0.9	0.8	3.3	0.8	0.8	0.9	0.9	3.4
LG Semicon	0.1	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-
Matsushita	0.1	0.2	0.5	1.2	2.0	1.4	1.6	1.7	2.0	6.7	2.0	2.3	2.5	2.9	9.8
Micron Technology	0.1	0.1	0.3	0.6	1.0	0.7	0.6	0.4	0.3	2.1	0.2	0.2	0.4	0.2	1.0
Mitsubishi	2.8	3.2	3.4	3.7	13.2	3.5	3.5	3.4	3.6	14.0	3.6	3.6	3.8	3.9	14.9
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	1.0	2.0	2.0	2.2	7.2
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	0.3	1.4	2.5	4.2	2.5	2.0	1.3	1.0	6.8
NEC	7.7	6.8	8.0	9.0	31.4	10.6	13.3	16.3	18.4	58.7	19.8	20.0	19.2	18.5	77.5
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	0.3	1.7	2.1	0.3	0.3	0.3	0.3	1.2	0.2	0.1	0.1	0.1	0.4
Samsung	6.0	6.6	6.9	8.7	28.3	7.4	7.2	7.8	7.8	30.3	8.4	8.2	8.0	7.8	32.4
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	0.4	0.5	0.4	0.6	1.9	0.7	1.1	2.2	6.0	10.0	12.9	17.8	23.2	27.1	81.0
Texas Instruments	3.9	4.7	5.8	7.1	21.5	7.4	7.2	7.2	7.7	29.5	8.3	9.1	9.7	11.4	38.5
Toshiba	0.9	0.9	1.1	1.4	4.3	1.5	1.4	1.2	1.2	5.3	1.1	1.2	0.8	0.8	3.8
Vanguard International	-	-	-	-	-	-	0.6	1.4	2.6	4.5	2.8	3.1	3.5	4.1	13.4
Worldwide Shipments	27.0	28.9	35.1	43.7	134.6	46.6	52.3	62.7	72.7	234.3	84.4	90.4	96.3	101.0	372.1
ASP ($)	32.56	20.63	11.65	9.56	17.09	9.06	8.65	8.04	7.96	8.35	7.53	7.36	7.27	7.18	7.33
Revenue ($M)	877.9	595.7	408.7	417.7	2,300.0	422.5	452.6	503.8	578.8	1,957.7	635.5	665.2	700.2	725.4	2,726.3
Demand	24.6	26.1	32.3	41.9	124.9	43.8	49.1	58.9	71.4	223.1	80.7	86.5	92.8	100.2	360.2
Sufficiency (%)	109.59	110.73	108.73	104.23	107.8	106.53	106.57	106.46	101.85	105.0	104.64	104.45	103.78	100.79	103.3

Source: Dataquest (December 1996)

Table 3-5
1Mbx16/18 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	0.1	2.5	2.6	2.8	2.8	2.9	3.6	12.0	4.0	5.0	7.0	9.0	25.0
Fujitsu	2.5	2.6	2.2	4.1	11.4	2.1	2.4	2.6	2.7	9.8	2.2	1.9	1.4	1.3	6.8
Hitachi	6.2	7.6	8.5	10.9	33.2	11.7	12.0	13.7	15.2	52.5	15.2	15.2	14.0	13.3	57.7
Hyundai	-	16.7	17.3	18.5	65.1	22.0	27.7	29.7	32.4	111.9	36.7	37.3	38.0	38.7	150.7
IBM Microelectronics	0.6	0.8	1.2	2.0	4.6	2.3	2.3	2.5	3.1	10.2	3.4	3.8	4.1	4.7	16.0
LG Semicon	12.7	13.7	16.4	20.7	63.5	18.8	21.9	24.3	27.7	92.6	32.1	31.2	30.4	29.6	123.3
Matsushita	0.2	0.3	1.1	2.1	3.8	2.4	2.6	2.8	3.1	10.9	3.3	3.5	3.9	4.4	15.1
Micron Technology	0.8	1.3	2.9	5.6	10.6	7.7	9.2	10.0	10.9	37.8	12.0	13.1	14.4	16.0	55.5
Mitsubishi	2.3	3.8	6.1	7.9	20.1	8.3	8.3	9.1	9.6	35.2	10.2	10.4	10.7	11.1	42.4
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	1.0	2.0	3.0	3.3	9.3
Motorola	0	0.1	0.1	0.1	0.3	0.1	0.2	0.5	1.0	1.8	1.7	2.6	4.1	6.6	15.0
Nan Ya Technology	-	-	-	-	-	-	1.0	5.7	9.2	15.9	10.0	10.7	10.1	8.1	38.8
NEC	10.5	12.0	11.8	13.0	47.2	12.5	13.3	14.4	14.3	54.6	17.1	17.3	16.6	16.0	67.0
Nippon Steel Semiconductor	0.1	0.1	0.1	0.6	0.9	2.1	2.8	5.5	9.1	19.5	9.1	9.5	9.5	9.5	37.5
Oki	0.4	0.3	0.4	1.4	2.5	1.1	1.1	1.0	0.9	4.0	0.9	0.8	0.6	0.5	2.9
Samsung	15.5	18.0	18.5	21.9	73.9	26.0	30.5	34.5	34.5	125.5	38.5	39.1	39.7	40.3	157.6
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	0.4	1.3	2.6	3.4	7.7	5.3	7.4	11.3	16.0	40.0	14.6	14.2	13.2	11.9	53.9
Texas Instruments	1.9	2.6	3.2	3.9	11.6	6.6	10.9	15.0	19.4	51.9	20.9	22.9	25.1	31.1	100.0
Toshiba	10.4	11.3	9.7	11.5	43.0	15.2	14.9	14.5	14.0	58.5	17.5	20.3	21.5	22.5	81.7
Vanguard International	-	0.7	1.0	4.5	6.2	5.2	6.6	5.4	4.3	21.5	3.7	3.1	3.5	2.7	13.0
Worldwide Shipments	77.2	93.2	103.1	134.5	407.9	152.1	178.0	205.2	230.8	766.1	253.7	264.0	270.8	280.6	1,069.2
ASP ($)	36.17	17.83	11.33	9.00	16.75	8.94	8.74	8.44	8.06	8.49	7.75	7.56	7.43	7.29	7.50
Revenue ($M)	2,792.2	1,661.7	1,167.7	1,210.1	6,831.7	1,359.7	1,555.5	1,731.7	1,860.4	6,507.4	1,966.4	1,995.9	2,012.1	2,045.9	8,020.3
Demand	70.4	84.2	94.8	129.0	378.4	142.8	167.0	192.7	226.6	729.1	242.5	252.8	260.9	278.4	1,034.6
Sufficiency (%)	109.6	110.7	108.7	104.2	107.8	106.5	106.6	106.5	101.9	105.1	104.6	104.4	103.8	100.8	103.3

Source: Dataquest (December 1996)

Table 3-6
512Kx32/36 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.4	0.9
Hitachi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Toshiba	0.1	0.2	0.4	0.7	1.4	0.8	1.1	1.5	1.6	4.8	2.1	2.3	2.3	2.4	9.2
Vanguard International	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worldwide Shipments	0.1	0.2	0.4	0.7	1.4	0.8	1.1	1.5	1.6	4.8	2.1	2.3	2.8	2.8	10.1
ASP ($)	54.26	25.86	15.86	12.15	19.13	11.62	10.93	10.55	10.08	10.65	9.69	9.45	9.29	9.11	9.36
Revenue ($M)	7.8	4.0	6.0	8.4	26.1	8.8	11.8	15.3	15.6	51.5	20.3	22.1	26.2	25.4	94.1
Demand	0.1	0.1	0.3	0.7	1.3	0.7	1.0	1.4	1.5	4.6	2.0	2.2	2.7	2.8	9.7
Sufficiency (%)	109.59	110.73	108.73	104.23	106.7	106.53	106.57	106.46	101.85	105.0	104.64	104.45	103.78	100.79	103.3

Source: Dataquest (December 1996)

Table 3-7
16Mb Wide-Bit Ratio, 1996-1998 (Percentage of Total Company Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Fujitsu	50.0	50.0	50.0	55.0	51.6	45.0	50.0	60.0	60.0	54.3	58.0	58.0	58.0	58.0	58.0
Hitachi	42.0	43.0	47.0	47.0	45.0	48.0	48.0	51.0	52.0	49.9	55.0	58.0	59.0	60.0	57.9
Hyundai	-	66.9	61.7	61.5	62.9	60.6	61.5	59.8	59.8	60.4	61.0	62.1	63.2	64.4	62.7
IBM	15.0	16.5	18.0	18.5	17.5	19.0	19.0	19.0	20.0	19.3	21.0	23.0	23.0	24.0	22.8
LG Semicon	65.5	67.0	67.4	67.5	67.0	61.5	62.7	63.7	65.1	63.4	63.9	62.8	61.6	60.4	62.2
Matsushita	25.0	36.0	55.0	68.0	55.1	69.0	70.0	70.0	72.0	70.3	73.3	73.3	73.9	75.7	74.2
Micron	33.8	33.4	33.0	33.3	33.3	33.6	34.1	34.3	35.3	34.4	36.5	37.8	39.1	39.9	38.4
Mitsubishi	44.0	46.0	47.0	47.0	46.3	47.0	47.0	48.0	48.0	47.5	50.0	50.0	50.0	50.0	50.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	50.0	57.1	50.0	50.0	51.6
Motorola	1.8	2.2	2.4	2.8	2.4	3.5	4.3	8.3	12.0	7.9	16.8	20.1	23.3	26.3	22.8
Nan Ya Technology	-	-	-	-	-	-	25.0	50.0	70.0	51.4	75.0	80.0	85.0	90.0	81.5
NEC	71.0	72.0	62.0	61.0	65.8	61.0	62.0	64.0	64.0	62.9	67.0	69.0	69.0	69.0	68.5
Nippon Steel Semiconductor	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	99.0	99.5	81.0	75.0	70.0	65.0	72.2
Oki	21.0	17.0	16.0	36.0	27.0	19.0	18.0	16.0	13.0	16.4	12.0	10.0	8.0	7.0	9.2
Samsung	55.1	57.3	56.4	60.0	57.4	61.0	63.1	62.2	62.2	62.1	62.4	62.7	63.0	63.3	62.9
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	20.0	35.0	50.0	40.0	38.2	50.0	48.7	49.0	51.3	50.0	64.0	72.0	80.0	83.0	75.0
Texas Instruments	41.2	42.9	43.5	43.8	43.1	49.6	53.9	55.8	65.2	56.8	65.9	67.2	68.9	71.0	68.5
Toshiba	80.0	81.0	59.0	59.0	67.9	69.0	64.0	59.0	54.0	61.1	59.0	61.0	63.0	65.0	62.1
Vanguard	-	100.0	100.0	100.0	100.0	80.0	65.0	50.0	40.0	54.0	35.0	30.0	30.0	25.0	29.5
Total	54.3	55.8	52.5	53.0	53.7	52.7	53.7	54.4	55.6	54.2	57.5	58.6	59.1	59.1	58.6

Source: Dataquest (December 1996)

What Has Changed since the Previous Report

Our forecast for 16Mb DRAM supply and also demand has been increased for the 1997-to-1998 period. For 1997, the worldwide supply forecast of 16Mb devices now calls for more than 1.8 billion units (versus less than 1.6 billion in the prior forecast). For 1998, Dataquest now expects worldwide supply of 16Mb DRAM to reach 2.5 billion units (while the prior forecast called for 2 billion units).

As indicated, however, the DRAM expectations for 16Mb DRAM during the same period have also been adjusted upward.

16Mb DRAM average selling prices have been reduced from the prior forecast. These worldwide prices coordinate, with some modification, with our latest Americas contract price forecast from the Semiconductor Supply and Pricing Worldwide program's quarterly pricing survey.

As noted previously, this report provides Dataquest's first look on a quarterly basis at 16Mb DRAM supply and demand during 1998. Prior forecasts included information for full year 1998 but no quarterly presentation.

Tables 3-8 and 3-9 show the 16Mb normalized interface and configuration ratios.

High/Low Range of 16Mb DRAM Supply Forecast

The major issue in the DRAM market at this time is how high 16Mb supply can go. On the high side, we estimate that our 1997-to-1998 forecasts could be increased by about 15 percent under certain circumstances. The key factor is potential use of 64Mb-capable capacity for production of 16Mb DRAM (and not 64Mb parts). This means that 1997 supply of 16Mb DRAM could exceed the 2 billion unit threshold, while supply for 1998 could approach 3 billion units.

On the low side, there appears little that DRAM suppliers can do to lower 16Mb supply for 1997. Early 1997 is "relatively late" for doing much about the 1997 supply of 16Mb DRAM—without an unexpectedly strong and quick move by suppliers to 64Mb DRAM and away from 16Mb parts. The low side of 1997 is about 5 percent lower than our forecast—meaning just under 1.8 billion units. For 1998, the low end would be about 2.2 billion units (versus the current forecast of 2.5 billion units).

Table 3-8
16Mb Normalized Interface Ratios, 1996-1998 (Percentage of Total Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Fast Page DRAM	62.0	35.5	23.4	15.6	31.0	11.4	8.8	7.0	6.2	8.0	5.5	5.3	4.8	4.4	5.0
EDO DRAM	35.5	60.8	69.4	71.4	61.6	61.8	59.4	50.6	48.2	54.2	41.9	38.1	34.6	32.2	36.6
Synchronous DRAM	2.1	2.6	5.7	11.4	6.2	24.4	29.3	40.0	43.3	35.3	50.4	54.4	58.5	61.4	56.3
Next-Generation DRAM	-	1.2	1.5	1.7	1.3	2.5	2.5	2.4	2.4	2.4	2.2	2.2	2.1	2.0	2.1
Display and Other DRAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Dataquest (December 1996)

Table 3-9
16Mb Normalized Configuration Ratios, 1996-1998 (Percentage of Total Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
16Mbx1	3.4	2.8	2.3	2.1	2.5	1.9	1.6	1.2	1.2	1.4	0.9	0.9	0.7	0.6	0.8
4Mbx4	42.4	41.4	45.2	44.9	43.7	45.4	44.7	44.3	43.3	44.3	41.6	40.6	40.2	40.3	40.6
2Mbx8/9	14.0	13.2	13.3	13.0	13.3	12.3	12.1	12.7	13.2	12.6	14.3	14.8	15.4	15.5	15.0
1Mbx16/18	40.2	42.5	39.1	39.9	40.3	40.2	41.3	41.5	42.0	41.3	42.9	43.4	43.3	43.2	43.2
512Kx32	0.1	0.1	0.1	0.2	0.1	0.2	0.3	0.3	0.3	0.3	0.4	0.4	0.5	0.4	0.4

Source: Dataquest (December 1996)

Chapter 4
Production Statistics of 64Mb DRAM

This chapter provides estimates of 64Mb DRAM quarterly unit shipments by supplier. Tables show total 64Mb shipments (see Table 4-1) and shipments by organization (x4, x8/9, x16/18, and x32/36, shown in Tables 4-2 through 4-5, respectively). Dataquest collects data through quarterly supplier surveys and compares the surveys against theoretical maximum production capabilities estimated using Dataquest's DRAM fab database, presented in Chapter 7. These tables represent 64Mb DRAM unit shipments of each company's brand-name parts. For example, if one company produces DRAMs for another company under a foundry agreement, Dataquest counts the product as shipments from the company that purchased the product to ship under its brand name. This avoids the problem of double-counting shipments.

The tables also show prices, dollar markets, and estimated consumption of each configuration. ASPs for the 64Mb family of DRAM come from Dataquest's Memories Worldwide program. Multiplying total shipments by these ASPs yields an estimated dollar market for that device. Dataquest derives demand from a units-per-system analysis detailed in Chapter 5. Following the configuration tables is an analysis of each vendor's shipments of x8/9, x16/18, and x32/36 devices (see Table 4-6). Dataquest calls this the "wide-bit ratio."

Table 4-1
64Mb Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.5	0.8
Fujitsu	-	-	-	0.1	0.1	0.3	0.8	1.2	1.7	4.0	2.5	3.7	5.0	7.1	18.3
Hitachi	-	-	-	0.1	0.1	0.5	0.8	1.4	2.1	4.8	3.0	4.1	5.4	6.9	19.4
Hyundai	-	-	-	0.3	0.3	0.6	1.0	1.9	2.3	5.8	3.1	5.1	6.5	7.0	21.7
IBM Microelectronics	0	0.1	0.2	0.2	0.4	0.2	0.3	0.4	0.8	1.7	1.3	2.3	5.0	10.5	19.1
LG Semicon	-	-	-	0.3	0.3	0.6	1.1	1.7	2.7	6.1	3.5	4.5	6.0	10.1	24.0
Matsushita	-	-	-	-	-	-	-	0	0.1	0.1	0.3	0.9	1.2	1.8	4.2
Micron Technology	-	-	-	0	0	0	0	0.1	0.1	0.2	0.3	0.5	0.7	1.1	2.6
Mitsubishi	-	-	0	0.1	0.1	0.2	0.6	1.1	1.7	3.6	2.5	3.6	4.9	6.6	17.6
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.8	1.3
Motorola	-	-	-	0	0	0	0.1	0.2	0.3	0.6	0.6	0.9	1.5	2.5	5.5
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	0.1	0.3	0.5	0.8	1.6
NEC	0	0.2	0.5	1.0	1.6	1.9	2.9	4.9	7.3	17.0	8.4	9.5	10.8	12.6	41.3
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	0.1	0.2	0.4	0.7	0.8	1.2	1.3	1.5	4.8
Samsung	0.1	0.3	0.6	1.5	2.5	1.7	3.0	4.1	5.5	14.2	7.0	8.2	9.9	12.0	37.1
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	0	0	0.1	0.1	0.1	0.2	0.5	0.8	1.5	1.0	1.5	2.5	5.0	10.0
Texas Instruments	-	0	0.1	0.2	0.3	0.5	1.0	1.7	2.5	5.7	2.9	3.5	4.3	5.5	16.1
Toshiba	-	-	0	0.1	0.1	0.3	0.5	1.0	1.8	3.6	2.5	4.0	4.0	5.0	15.5
Vanguard International	-	-	-	-	-	-	-	-	0	0	0.6	1.0	1.3	1.5	4.4
Worldwide Shipments	0.2	0.5	1.4	3.8	5.9	6.8	12.3	20.3	30.0	69.5	40.3	54.6	71.5	98.7	265.0
ASP ($)	139.34	121.82	106.89	95.00	101.35	86.93	80.71	70.41	61.96	70.22	54.96	48.91	42.02	38.61	44.14
Revenue ($M)	21.4	65.2	147.3	365.1	599.0	595.3	996.1	1,429.4	1,857.7	4,878.4	2,215.5	2,669.8	3,004.6	3,809.2	11,699.2
Demand	0.1	0.5	1.3	3.4	5.3	6.2	11.3	18.8	29.0	65.3	39.2	54.5	73.3	101.1	268.1
Sufficiency (%)	107.8	108.1	110.2	112.3	111.3	110.5	109.1	108.1	103.5	106.5	102.8	100.2	97.6	97.6	98.9

Source: Dataquest (December 1996)

Table 4-2
16Mbx4 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.5	0.8
Fujitsu	-	-	-	0	0	0.1	0.1	0.1	0.2	0.4	0.3	0.6	0.7	0.8	2.4
Hitachi	-	-	-	0.1	0.1	0.4	0.6	0.9	1.3	3.1	1.7	2.0	2.4	2.8	8.9
Hyundai	-	-	-	0.2	0.2	0.5	0.7	1.3	1.5	4.0	1.4	2.3	2.9	3.2	9.8
IBM Microelectronics	0	0	0.1	0.1	0.2	0.1	0.1	0.2	0.3	0.7	0.5	0.7	1.0	1.4	3.5
LG Semicon	-	-	-	0.2	0.2	0.5	0.8	1.3	1.7	4.3	2.0	2.5	3.3	5.4	13.3
Matsushita	-	-	-	-	-	-	-	0	0.1	0.1	0.2	0.6	0.7	1.0	2.5
Micron Technology	-	-	-	0	0	0	0	0	0	0.1	0.1	0.1	0.2	0.2	0.6
Mitsubishi	-	-	0	0	0.1	0.2	0.4	0.7	1.0	2.3	1.4	1.8	2.2	2.6	8.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	0	0	0	0	0.1	0.1	0.3	0.2	0.3	0.5	0.7	1.7
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	0	0.1	0.4	0.3	0.8	0.6	0.7	1.2	1.8	4.4	1.9	2.1	2.4	2.5	8.9
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	0.1	0.1	0.2	0.4	0.4	0.7	0.8	1.0	3.0
Samsung	0.1	0.2	0.4	1.0	1.7	1.0	1.5	2.0	2.5	7.0	3.0	3.3	4.2	4.6	15.1
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	0	0	0	0.1	0.1	0.1	0.3	0.4	0.9	0.5	0.7	1.0	1.8	3.9
Texas Instruments	-	0	0	0	0.1	0.1	0.2	0.2	0.2	0.6	0.1	0	0	0	0.2
Toshiba	-	-	0	0.1	0.1	0.2	0.4	0.7	1.1	2.3	1.4	2.0	1.8	2.0	7.2
Vanguard International	-	-	-	-	-	-	-	-	-	-	0	0.1	0.1	0.2	0.5
Worldwide Shipments	0.1	0.4	0.9	2.2	3.7	3.7	5.7	9.1	12.3	30.8	15.1	19.9	24.5	30.7	90.1
ASP ($)	139.10	121.60	106.80	95.00	102.23	86.36	80.00	70.25	61.13	70.33	54.17	48.67	41.75	38.50	44.25
Revenue ($M)	16.3	47.8	98.4	212.0	374.6	318.1	458.0	638.2	754.3	2,168.6	817.2	966.1	1,022.6	1,180.2	3,986.1
Demand	0.1	0.4	0.8	2.0	3.3	3.3	5.2	8.4	11.9	28.9	14.7	19.8	25.1	31.4	91.0
Sufficiency (%)	107.8	108.1	110.2	112.3	111.1	110.5	109.1	108.1	103.5	106.7	102.8	100.2	97.6	97.6	99.0

Source: Dataquest (December 1996)

Table 4-3
8Mbx8/9 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	0	0	0.1	0.1	0.2	0.3	0.6	0.4	0.7	1.0	1.4	3.6
Hitachi	-	-	-	0	0	0.1	0.2	0.4	0.6	1.4	0.9	1.2	1.6	2.1	5.8
Hyundai	-	-	-	0.1	0.1	0.1	0.2	0.4	0.5	1.2	0.7	1.0	1.3	1.4	4.4
IBM Microelectronics	0	0	0	0	0	0	0	0	0.1	0.1	0.1	0.2	0.4	0.6	1.2
LG Semicon	-	-	-	0.1	0.1	0.1	0.1	0.2	0.2	0.6	0.3	0.4	0.5	0.7	1.7
Matsushita	-	-	-	-	-	-	-	0	0	0	0.1	0.3	0.4	0.6	1.5
Micron Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	0	0	0	0	0.2	0.3	0.5	1.0	0.7	1.0	1.2	1.3	4.2
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	0	0	0.1	0.5	0.6	1.0	1.5	2.0	2.2	6.6	2.4	2.4	2.4	2.7	9.9
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	0.1	0.1	0.2	0.2	0.3	0.3	0.3	1.1
Samsung	0	0.1	0.1	0.3	0.4	0.3	0.5	0.7	0.9	2.4	1.0	1.1	1.2	1.7	5.0
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	0	0	0	0	0	0	0.2	0.3	0.5	0.4	0.6	1.1	2.4	4.5
Texas Instruments	-	0	0	0.1	0.2	0.4	0.8	1.4	2.0	4.6	1.9	1.9	1.7	1.4	6.9
Toshiba	-	-	0	0	0	0.1	0.2	0.3	0.5	1.0	0.8	1.2	1.2	1.5	4.7
Vanguard International	-	-	-	-	-	-	-	-	-	-	0.1	0.3	0.7	1.1	2.1
Worldwide Shipments	0	0.1	0.3	1.1	1.5	2.1	3.7	6.1	8.3	20.2	9.9	12.5	15.0	19.1	56.5
ASP ($)	140.13	122.42	107.07	95.01	99.87	87.60	81.33	70.55	62.55	71.05	55.44	49.06	42.17	38.66	44.83
Revenue ($M)	3.8	12.6	28.5	104.0	148.9	183.7	304.6	430.5	516.1	1,434.9	547.9	614.7	631.4	738.0	2,532.0
Demand	0	0.1	0.2	1.0	1.3	1.9	3.4	5.6	8.0	18.9	9.6	12.5	15.3	19.6	57.0
Sufficiency (%)	107.8	108.1	110.2	112.3	111.5	110.5	109.1	108.1	103.5	106.6	102.8	100.2	97.6	97.6	99.0

Source: Dataquest (December 1996)

Table 4-4
4Mbx16/18 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	0	0	0.2	0.6	0.8	1.2	2.8	1.6	2.0	2.8	3.9	10.2
Hitachi	-	-	-	-	-	-	-	0.1	0.2	0.3	0.5	0.8	1.4	2.1	4.7
Hyundai	-	-	-	-	-	-	0.1	0.2	0.3	0.6	0.8	1.3	1.7	1.8	5.5
IBM Microelectronics	0	0	0.1	0.1	0.2	0.1	0.2	0.2	0.5	0.9	0.8	1.5	3.6	8.5	14.4
LG Semicon	-	-	-	-	-	-	0.2	0.3	0.7	1.2	1.2	1.6	2.2	4.0	9.0
Matsushita	-	-	-	-	-	-	-	-	-	-	-	-	0.1	0.2	0.2
Micron Technology	-	-	-	0	0	0	0	0	0.1	0.1	0.2	0.4	0.5	0.9	2.0
Mitsubishi	-	-	-	-	-	0	0	0.1	0.2	0.2	0.4	0.7	1.2	2.0	4.3
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	0.5	0.8	1.3
Motorola	-	-	-	0	0	0	0	0.1	0.2	0.3	0.4	0.6	1.0	1.8	3.8
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	0.1	0.3	0.5	0.8	1.6
NEC	-	-	0.1	0.1	0.2	0.3	0.6	1.2	2.6	4.7	3.2	3.9	4.7	5.6	17.3
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	0	0.1	0.1	0.1	0.2	0.2	0.2	0.7
Samsung	-	0	0.1	0.3	0.3	0.3	0.7	1.0	1.6	3.6	2.2	2.6	3.1	3.9	11.8
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	0	0	0.1	0.1	0.1	0.2	0.4	0.9	1.5
Texas Instruments	-	-	-	-	-	0	0	0.1	0.3	0.4	0.7	1.3	2.1	3.5	7.6
Toshiba	-	-	-	-	-	-	-	0.1	0.2	0.2	0.4	0.8	1.0	1.5	3.7
Vanguard International	-	-	-	-	-	-	-	-	0	0	0.5	0.6	0.5	0.3	1.9
Worldwide Shipments	0	0	0.2	0.5	0.8	1.0	2.4	4.2	8.0	15.6	12.9	18.7	27.4	42.4	101.3
ASP ($)	140.13	122.42	107.07	95.01	100.02	87.60	81.33	70.55	62.55	69.18	55.44	49.06	42.17	38.66	43.66
Revenue ($M)	1.3	4.8	20.3	49.1	75.5	86.9	194.0	296.0	499.5	1,076.5	713.1	915.8	1,156.9	1,638.3	4,424.1
Demand	0	0	0.2	0.5	0.7	0.9	2.2	3.9	7.7	14.7	12.5	18.6	28.1	43.4	102.7
Sufficiency (%)	107.8	108.1	110.2	112.3	111.5	110.5	109.1	108.1	103.5	106.0	102.8	100.2	97.6	97.6	98.7

Source: Dataquest (December 1996)

Table 4-5
2Mbx32/36 Quarterly Shipments by Vendor, 1996-1998 (Millions of Units Shipped)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	-	-	-	0	0.1	0.1	0.2	0.2	0.3	0.6	1.0	2.1
Hitachi	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hyundai	-	-	-	-	-	-	-	-	-	-	0.3	0.5	0.7	0.7	2.2
IBM Microelectronics	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LG Semicon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Matsushita	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Micron Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mitsubishi	-	-	-	-	-	-	-	-	-	-	0	0.1	0.2	0.7	1.0
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Motorola	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NEC	-	-	-	-	-	-	0.1	0.5	0.7	1.4	1.0	1.1	1.3	1.8	5.2
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Samsung	-	-	-	-	-	0.1	0.3	0.4	0.6	1.3	0.8	1.2	1.4	1.8	5.2
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Texas Instruments	-	-	-	-	-	-	-	0	0	0.1	0.1	0.2	0.4	0.6	1.4
Toshiba	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanguard International	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worldwide Shipments	-	-	-	-	-	0.1	0.5	0.9	1.4	2.9	2.5	3.5	4.6	6.5	17.1
ASP ($)	-	-	-	-	-	87.60	81.33	70.55	62.55	68.91	55.44	49.06	42.17	38.66	44.17
Revenue ($M)	-	-	-	-	-	6.6	39.4	64.7	87.7	198.4	137.4	173.1	193.7	252.8	757.0
Demand	-	-	-	-	-	0.1	0.4	0.8	1.4	2.7	2.4	3.5	4.7	6.7	17.3
Sufficiency (%)	-	-	-	-	-	110.5	109.1	108.1	103.5	106.0	102.8	100.2	97.6	97.6	98.8

Source: Dataquest (December 1996)

Table 4-6
64Mb Wide-Bit Ratio, 1996-1998 (Percentage of Total Company Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Alliance	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Fujitsu	-	-	-	70.0	70.0	80.0	90.0	90.0	90.0	89.3	87.0	84.2	87.0	88.6	87.1
Hitachi	-	-	-	20.0	20.0	20.0	30.0	35.0	40.0	34.8	45.0	50.0	55.0	60.0	54.2
Hyundai	-	-	-	20.0	20.0	20.0	30.0	31.6	33.3	30.8	54.8	54.9	55.4	55.0	55.1
IBM	46.3	44.2	46.7	48.2	46.9	54.5	60.3	62.5	62.5	61.1	65.4	71.7	80.0	86.7	81.7
LG Semicon	-	-	-	20.0	20.0	20.0	23.1	25.3	35.9	29.0	41.2	42.9	44.4	46.4	44.5
Matsushita	-	-	-	-	-	-	-	20.0	20.0	20.0	30.0	35.0	40.0	45.0	40.4
Micron	-	-	-	46.1	46.1	52.0	58.0	63.0	65.4	62.9	68.2	71.9	75.7	79.5	75.7
Mitsubishi	-	-	20.0	20.0	20.0	20.0	30.0	35.0	40.0	35.7	45.0	50.0	55.0	60.0	54.4
Mosel Vitelic	-	-	-	-	-	-	-	-	-	-	-	-	100.0	100.0	100.0
Motorola	-	-	-	42.0	42.0	45.5	46.2	52.1	57.8	54.1	63.4	65.6	68.3	72.0	69.0
Nan Ya Technology	-	-	-	-	-	-	-	-	-	-	100.0	100.0	100.0	100.0	100.0
NEC	20.0	20.0	30.0	65.0	49.3	68.0	75.0	75.0	75.0	74.2	77.6	77.9	78.1	80.0	78.5
Nippon Steel Semiconductor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oki	-	-	-	-	-	-	-	43.0	50.0	40.9	46.0	38.0	35.0	33.0	37.0
Samsung	20.0	25.0	31.3	33.3	31.3	39.4	50.0	50.6	55.5	51.1	57.1	60.1	57.6	61.7	59.4
Sharp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Siemens	-	20.0	20.0	20.0	20.0	25.0	30.0	36.0	45.0	39.2	50.0	55.0	60.0	65.0	60.8
Texas Instruments	-	58.0	64.0	75.0	71.8	80.0	83.0	89.0	93.0	89.0	96.0	99.0	99.5	99.9	98.9
Toshiba	-	-	20.0	20.0	20.0	20.0	30.0	35.0	40.0	35.8	45.0	50.0	55.0	60.0	53.7
Vanguard	-	-	-	-	-	-	-	-	100.0	100.0	92.5	90.0	90.0	87.5	89.5
Total	23.5	26.6	33.1	41.9	38.0	46.2	53.6	55.2	58.8	55.6	62.6	63.6	65.7	68.9	66.0

Source: Dataquest (December 1996)

What Has Changed since the Previous Report

This report shows little change in estimated shipments of 64Mb DRAM. For example, the 1996 and 1998 estimates remain the same as the prior supply forecast. The 1997 forecast has been lowered undramatically.

Also, this report provides Dataquest's first look on a quarterly basis at 16Mb DRAM supply and demand during 1998. Prior forecasts included information for full year 1998, but no quarterly presentation.

Tables 4-7 and 4-8 show the 64Mb normalized interface and configuration ratios.

Table 4-7
64Mb Normalized Interface Ratios, 1996-1998 (Percentage of Total Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Fast Page DRAM	14.4	11.2	5.5	3.4	4.9	0.9	0.4	0.2	0.1	0.3	0.1	0.1	0	0	0
EDO DRAM	82.4	83.1	89.9	81.1	83.4	78.0	70.3	67.0	62.6	66.8	54.6	46.7	40.4	34.6	41.7
Synchronous DRAM	3.3	5.6	4.5	15.5	11.7	21.1	29.0	32.3	36.3	32.3	43.4	51.3	57.4	62.8	56.0
Next-Generation DRAM	-	-	-	-	-	-	0.2	0.5	1.0	0.6	1.9	1.9	2.1	2.6	2.2
Display and Other DRAM	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Source: Dataquest (December 1996)

Table 4-8
64Mb Normalized Configuration Ratios, 1996-1998 (Percentage of Total Shipments)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
16Mbx4	76.5	73.4	66.9	58.1	62.0	53.8	46.4	44.8	41.2	44.4	37.4	36.4	34.3	31.1	34.0
8Mbx8/9	17.7	19.2	19.3	28.5	25.2	30.6	30.3	30.1	27.5	29.1	24.5	23.0	20.9	19.3	21.3
4Mbx16/18	5.9	7.4	13.8	13.4	12.8	14.5	19.3	20.7	26.6	22.4	31.9	34.2	38.4	43.0	38.2
2Mbx32/36	-	-	-	-	-	1.1	3.9	4.5	4.7	4.1	6.1	6.5	6.4	6.6	6.5

Source: Dataquest (December 1996)

Chapter 5
Consumption of DRAMs by Application

This chapter provides details of Dataquest's DRAM demand analysis. Quarterly DRAM demand figures are derived from Dataquest's electronic equipment forecast generated by the Semiconductor Application Markets Worldwide program, as well as forecasts from Dataquest's Computers and Peripherals group and Telecommunications group.

Table 5-1 shows the quarterly electronic equipment production forecast (the system forecast). Table 5-2 provides Dataquest's estimate of DRAM megabyte consumption for each type of system. Dataquest calls this "megabytes per system." Table 5-3 shows the number of bits of memory required by the entire market (the system forecasts times DRAM usage) and the memory module market. Table 5-4 provides DRAM demand for each application by DRAM density, as well as total supply and demand by density and sufficiency in 4Mb equivalents.

Figure 5-1 presents total 4Mb DRAM supply versus demand, and Figures 5-2 through 5-5 show supply versus demand for each 4Mb organization. Figure 5-6 presents total 16Mb DRAM supply versus demand, and Figures 5-7 through 5-11 show supply versus demand for each 16Mb organization. Figure 5-12 shows total 64Mb DRAM supply versus demand, and Figures 5-13 through 5-16 show supply versus demand for each 64Mb organization. These figures draw on data in Tables 2-1 through 2-5, 3-1 through 3-6, and 4-1 through 4-5.

What Has Changed since the Previous Report

Dataquest has raised the DRAM consumption forecast for PCs for the 1996-to-1998 period. Going forward, this report projects a much sharper growth (versus prior forecasts) of DRAM megabytes per PC. This stems in large part from much lower DRAM pricing expectations but also from other factors, such as the business market migration to Windows NT.

For example, Table 5-2 shows for first quarter 1997 more than 21MB of DRAM in PCs as shipped from the PC factory (versus less than 17MB in the prior forecast). For fourth quarter 1997, we expect nearly 26MB of DRAM in PCs (compared to 19MB in the prior forecast). By the end of 1998, the number of PC megabytes will reach 33MB or more.

Dataquest revised the systems forecasts contained in Table 5-1. The new forecasts reflect the results of Dataquest's fall/winter forecast cycle as well as the new PC quarterly forecast service. The segment names (for example, "ultraportable") now reflect the new segment names in Dataquest's PC forecast.

Dataquest changed the following application segments. "Data storage devices" now includes rigid disk drives, optical disk drives, CD-ROM drives, and writable optical drives. Dataquest replaced the segment "page printers" with the segment "printers." Printers includes both serial, "Desk Jet" printers and page printers, as both printer types consume DRAM.

Dataquest moved "compute market share" and "PC average DRAM content" from Table 5-5 into Table 5-3 and Table 5-2, respectively. This eliminated the redundant Table 5-5. Compute market share (now in Table 5-3) is now known as "compute + module share of total" and is the sum of bit demand in mainframes, supercomputers, midrange computers, workstations, personal computers, and modules, divided by total bits demanded. "PC average DRAM content" (now in Table 5-2) is now known as "personal computer + module megabytes per system" and is the sum of bit demand in personal computers and modules, divided by the PC system forecast. This latter metric is Dataquest's method for quantifying aftermarket consumption by PCs.

Dataquest moved "supply and demand by density" (Table 5-6 in the previous report) into "DRAM consumption by application and density" (Table 5-4 in both the previous and current reports). The supply and demand roll-ups appear as totals at the bottom of Table 5-4. Also included in Table 5-4 is the overall sufficiency, measured in 4Mb equivalents. These moves eliminated the information in Table 5-6 that was redundant to information in Table 5-4.

The above restructuring eliminated only repeated information and resulted in no net loss of data or analysis from previous reports.

As indicated in the third quarter 1996 report, this report provides the first quarterly 1998 forecast of demand by system application, including the PC forecast.

Table 5-1
Electronic Equipment Production Forecast, 1996-1998 (Thousands of Systems)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Mainframes	2.4	2.4	2.5	2.7	10.1	2.4	2.4	2.5	2.7	10.1	2.2	2.2	2.3	2.5	9.3
Supercomputers	0.7	0.7	0.7	0.8	2.9	0.8	0.8	0.8	0.9	3.4	0.9	0.9	0.9	1.0	3.6
Midranges	181.4	181.4	189.0	204.1	755.9	203.7	203.7	212.1	229.1	848.6	229.2	229.2	238.7	257.8	955.0
Workstations	199.0	199.0	207.3	223.8	829.0	205.3	205.3	213.8	230.9	855.2	221.5	221.5	230.7	249.2	922.8
Personal Computers	16,354.0	16,300.0	17,239.7	22,126.8	72,020.5	19,251.5	19,166.2	20,486.0	25,889.3	84,792.9	22,554.4	22,222.8	23,689.8	29,993.2	98,460.3
Server-Marketed	257.5	283.2	299.8	398.2	1,238.7	338.6	362.3	377.0	493.0	1,571.0	432.7	431.6	460.8	599.3	1,924.3
Transportables	17.6	11.9	19.0	24.9	73.4	7.2	6.1	8.3	10.7	32.3	9.2	5.3	8.3	10.3	33.0
Ultraportables and Notepads	186.7	205.2	260.9	311.3	964.1	333.8	333.7	384.9	454.2	1,506.5	498.2	429.1	496.8	658.5	2,082.6
Notebooks	2,422.1	2,417.2	2,726.4	3,352.4	10,918.0	2,902.2	2,890.0	3,198.2	3,939.9	12,930.3	3,474.0	3,353.9	3,660.8	4,448.7	14,937.3
Laptops	1.2	0.4	0.3	0.4	2.3	-	-	-	-	-	-	-	-	-	-
Desktops	9,926.9	9,464.5	10,117.0	13,110.6	42,619.0	11,395.6	11,258.0	12,018.5	15,346.3	50,018.3	13,215.6	13,035.8	13,791.6	17,554.6	57,597.6
Desksides	3,541.9	3,917.7	3,816.2	4,929.0	16,204.9	4,274.2	4,316.0	4,499.1	5,645.3	18,734.6	4,924.8	4,967.2	5,271.7	6,721.7	21,885.4
PC Upgrades	2,130.5	2,130.5	2,219.3	2,396.8	8,877.0	2,544.5	2,544.5	2,650.5	2,862.5	10,602.0	3,037.0	3,037.0	3,163.5	3,416.6	12,654.0
Data Storage Devices	38,188.9	40,026.5	41,853.4	43,961.1	164,029.8	45,834.7	47,952.1	49,979.3	51,959.7	195,725.8	53,041.6	54,325.6	55,510.9	56,498.6	219,376.7
Printers	8,224.9	7,329.1	8,804.5	11,964.2	36,322.7	9,435.7	8,541.9	10,209.6	13,873.6	42,060.8	10,659.1	9,649.5	11,533.5	15,672.6	47,514.6
Facsimiles	2,585.1	2,625.0	2,674.9	2,704.9	10,590.0	2,735.6	2,765.3	2,824.6	2,854.5	11,180.0	2,879.5	2,919.0	2,953.6	2,997.9	11,750.0
LAN Hubs/ Internetworking	182.5	200.7	217.9	240.8	842.0	274.6	292.7	313.8	334.9	1,216.0	374.5	399.9	423.1	448.5	1,646.0
Telephone Sets/Answering Machines	2,130.0	2,415.5	2,854.7	3,284.8	10,685.0	3,268.7	3,553.4	3,869.8	4,302.1	14,994.0	4,163.6	4,503.7	4,812.9	5,467.8	18,948.0
Industrial Applications	820.1	837.8	846.2	873.9	3,378.0	901.8	921.6	930.9	957.7	3,712.0	993.0	1,017.1	1,030.8	1,039.0	4,080.0
Digital Video Disc	0	60.9	112.4	192.0	365.3	338.9	523.2	702.1	875.8	2,440.0	1,001.2	1,276.2	1,706.9	2,482.7	6,467.0
Cable/Satellite Set-Top Boxes	1,335.6	1,606.8	1,903.3	2,170.3	7,016.0	2,376.1	2,650.5	2,920.6	3,207.7	11,155.0	3,542.4	3,864.5	4,186.5	4,508.6	16,102.0
Games (Systems and Cartridges)	2,869.4	3,239.3	3,572.5	3,647.8	13,329.0	3,153.2	3,225.1	3,373.6	3,590.0	13,342.0	3,620.2	3,958.8	4,354.0	4,864.0	16,797.0
8-Bit Video Games	21.0	15.0	8.0	11.0	55.0	10.0	9.5	9.0	9.5	38.0	7.8	7.5	7.3	7.5	30.0
16-Bit Video Games	668.1	512.4	394.3	299.2	1,874.0	241.7	164.9	136.9	105.5	649.0	74.0	62.3	51.7	47.0	235.0
CD-ROM Games	137.6	115.8	106.5	112.1	472.0	84.8	67.1	56.5	59.6	268.0	39.1	24.0	12.2	14.8	90.0
RISC and Future Video Games	2,042.7	2,596.0	3,063.7	3,225.6	10,928.0	2,816.8	2,983.6	3,171.2	3,415.5	12,387.0	3,499.4	3,865.0	4,282.8	4,794.8	16,442.0

Source: Dataquest (December 1996)

Table 5-2
Electronic Equipment Production Forecast, 1996-1998 (Megabytes per System)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Mainframes	1,720.0	1,812.5	2,251.5	2,330.0	2,039.8	2,590.0	2,908.0	3,310.0	3,557.6	3,107.6	3,860.0	4,050.0	4,224.0	4,344.0	4,127.3
Supercomputers	2,434.4	2,638.7	2,997.4	3,104.2	2,805.0	3,544.2	4,040.2	4,516.0	5,056.0	4,314.4	5,480.0	5,888.0	6,192.0	6,344.0	5,989.2
Midranges	143.2	146.6	157.3	196.9	162.0	184.3	309.2	359.0	401.6	316.6	443.4	486.4	525.0	543.0	501.0
Workstations	59.0	62.5	69.5	81.3	68.5	83.1	104.4	115.3	120.3	106.3	131.0	139.4	149.0	157.3	144.6
Personal Computers	18.2	19.3	20.6	21.2	19.9	24.3	25.7	27.5	28.8	26.8	33.1	35.0	36.4	36.4	35.3
Server-Marketed	35.6	37.2	40.5	45.3	40.2	48.7	54.4	60.6	64.9	58.0	70.2	74.5	78.2	79.2	75.9
Transportables	3.0	3.0	3.2	3.2	3.1	3.4	3.5	3.6	3.7	3.6	3.8	4.0	4.1	4.3	4.1
Ultraportables and Notepads	6.6	6.9	7.2	7.5	7.1	8.1	8.4	8.9	9.1	8.7	9.5	9.7	9.9	10.2	9.8
Notebooks	6.4	6.5	7.1	7.6	7.0	8.7	9.3	9.9	10.2	9.6	10.8	11.1	11.4	11.7	11.3
Laptops	3.7	3.8	3.8	3.8	3.8	-	-	-	-	-	-	-	-	-	-
Desktops	12.7	12.9	15.8	16.1	14.5	20.7	22.3	25.0	26.6	23.9	33.7	35.9	38.2	38.0	36.6
Desksides	41.2	42.0	42.3	42.8	42.1	43.7	44.6	45.7	46.1	45.1	46.6	47.3	47.9	47.4	47.3
PC Upgrades	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Memory Modules	6.1	6.4	7.7	8.0	7.1	10.4	12.0	13.6	14.7	12.7	15.6	16.3	17.0	20.6	17.4
Data Storage Devices	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.3	0.2	0.3	0.4	0.5	0.5	0.4
Printers	3.1	3.1	3.4	3.4	3.3	3.6	3.8	3.9	4.0	3.8	4.2	4.3	4.4	4.5	4.4
Facsimiles	1.5	1.5	1.7	1.7	1.6	1.9	2.1	2.2	2.3	2.1	2.4	2.6	2.8	3.0	2.7
LAN Hubs/Internetworking	4.8	4.9	5.3	5.5	5.2	6.2	6.4	6.5	6.6	6.4	6.8	6.9	7.0	7.0	6.9
Telephone Sets/Answering Machines	1.6	1.7	1.8	1.9	1.8	1.9	2.0	2.0	2.1	2.0	2.2	2.4	2.5	2.6	2.4
Industrial Applications	6.5	6.6	6.7	6.8	6.7	7.5	8.0	8.4	8.9	8.2	10.3	10.9	11.2	11.3	10.9
Digital Video Disc	1.3	1.3	1.4	1.5	1.4	2.1	2.6	3.3	4.0	3.3	4.8	5.2	5.3	5.4	5.2
Cable/Satellite Set-Top Boxes	1.3	1.5	1.7	1.7	1.6	1.9	1.9	2.1	2.2	2.0	2.2	2.3	2.3	2.3	2.3
Games (Systems and Cartridges)	2.9	3.3	3.8	3.9	3.5	4.3	4.7	4.9	5.1	4.8	5.4	5.7	5.9	6.1	5.8
8-Bit Video Games	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
16-Bit Video Games	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0	0.1	0	0	0	0	0
CD-ROM Games	0.9	1.0	1.1	1.1	1.0	1.2	1.2	1.2	1.3	1.2	1.3	1.4	1.4	1.5	1.4
RISC and Future Video Games	3.9	4.0	4.4	4.4	4.2	4.8	5.0	5.2	5.3	5.1	5.6	5.8	6.0	6.2	5.9
Other Games	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Personal Computer + Module Megabytes per System	25.4	26.9	29.3	29.3	27.9	36.6	40.2	43.6	43.0	41.1	51.2	54.8	56.4	56.2	54.8

Source: Dataquest (December 1996)

Table 5-3
DRAM Consumption by Application, 1996-1998 (Billions of Bits Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Mainframes	35.0	36.9	47.7	53.3	173.0	52.8	59.3	70.3	81.6	263.8	72.3	75.8	82.4	91.5	322.0
Supercomputers	14.2	15.4	18.2	20.4	68.3	23.9	27.3	31.7	38.4	121.3	39.6	42.6	46.6	51.6	180.4
Midranges	218.0	223.1	249.3	337.1	1,027.5	314.9	528.2	638.9	771.9	2,253.9	852.5	935.2	1,051.5	1,174.5	4,013.6
Workstations	98.5	104.3	120.8	152.6	476.1	143.1	179.8	206.8	233.0	762.8	243.4	259.0	288.4	328.7	1,119.5
Personal Computers	2,495.3	2,632.8	2,978.7	3,928.8	12,035.6	3,919.0	4,139.1	4,728.4	6,251.9	19,038.4	6,270.2	6,517.1	7,237.5	9,161.0	29,185.8
Server-Marketed	76.9	88.4	101.8	151.2	418.2	138.5	165.3	191.6	268.4	763.7	255.0	269.9	302.1	398.0	1,224.9
Transportables	0.4	0.3	0.5	0.7	1.9	0.2	0.2	0.3	0.3	1.0	0.3	0.2	0.3	0.4	1.1
Ultraportables and Notepads	10.3	11.9	15.9	19.7	57.7	22.7	23.6	28.7	34.7	109.7	39.6	34.8	41.4	56.1	172.0
Notebooks	130.9	132.7	161.8	212.4	637.8	212.6	226.2	265.4	338.4	1,042.5	313.8	313.6	350.6	437.6	1,415.6
Laptops	0	0	0	0	0.1	-	-	-	-	-	-	-	-	-	-
Desktops	1,054.1	1,020.6	1,343.9	1,775.6	5,194.2	1,979.2	2,107.4	2,517.4	3,426.9	10,030.8	3,737.3	3,928.0	4,423.9	5,598.5	17,687.6
Desksides	1,222.6	1,379.0	1,354.8	1,769.3	5,725.7	1,566.0	1,616.5	1,725.2	2,183.1	7,090.8	1,924.3	1,970.6	2,119.2	2,670.4	8,684.6
PC Upgrades	6.3	6.4	6.7	7.3	26.7	7.9	8.0	8.4	9.2	33.4	9.8	9.9	10.5	11.4	41.6
Memory Modules	980.9	1,039.9	1,247.9	1,500.5	4,769.2	1,986.3	2,323.7	2,751.6	3,081.6	10,143.2	3,398.7	3,688.5	3,964.5	4,970.2	16,021.9
Data Storage Devices	25.8	31.6	37.8	45.0	140.2	60.8	81.4	96.8	116.9	355.9	155.3	184.7	214.3	238.0	792.3
Printers	213.4	193.6	248.4	338.9	994.2	286.2	269.7	334.1	460.0	1,350.0	371.5	348.2	427.9	590.7	1,738.3
Facsimiles	31.5	33.5	38.8	39.7	143.5	44.4	48.3	51.9	54.9	199.5	58.5	64.0	69.5	75.4	267.5
LAN Hubs/Internetworking	7.3	8.2	9.7	11.2	36.5	14.2	15.6	17.1	18.5	65.4	21.3	23.3	24.9	26.4	95.8
Telephone Sets/Answering Machines	29.4	35.3	43.6	51.2	159.6	53.2	58.7	65.6	74.8	252.3	77.5	89.9	100.1	119.5	387.0
Industrial Applications	45.0	46.4	47.4	49.8	188.7	56.8	61.5	65.4	71.2	254.8	85.4	92.9	97.0	98.6	373.9
Digital Video Disc	0	0.7	1.3	2.4	4.4	5.9	11.4	19.6	29.7	66.6	40.0	55.6	76.5	112.5	284.6
Cable/Satellite Set-Top Boxes	14.8	19.6	27.0	31.1	92.6	37.0	42.5	50.6	58.0	188.2	66.7	73.4	79.9	86.4	306.5
Games (Systems and Cartridges)	68.6	88.4	113.2	120.2	390.5	114.6	126.5	139.7	153.2	534.1	165.0	187.8	215.2	248.3	816.4
8-Bit Video Games	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-Bit Video Games	0.3	0.3	0.2	0.2	1.0	0.1	0.1	0.1	0	0.3	0	0	0	0	0.1
CD-ROM Games	1.1	0.9	1.0	1.0	4.0	0.8	0.7	0.6	0.6	2.8	0.4	0.3	0.1	0.2	1.0
RISC and Future Video Games	67.2	87.2	112.0	119.0	385.4	113.7	125.8	139.0	152.5	531.0	164.5	187.5	215.1	248.1	815.2
Other Games	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Applications	92.4	94.3	129.3	3.7	319.6	110.0	307.2	491.0	152.7	1,060.9	761.4	1,282.1	1,491.9	629.8	4,165.1
Total Demand	4,376.4	4,610.4	5,366.0	6,693.1	21,046.0	7,231.0	8,288.2	9,767.8	11,657.4	36,944.4	12,688.9	13,930.0	15,478.7	18,014.5	60,112.2
Compute + Module Share of Total	55.4	55.4	55.2	55.9	55.5	57.2	57.9	57.6	58.0	57.7	56.9	55.9	55.3	57.6	56.5

Source: Dataquest (December 1996)

Table 5-4
DRAM Consumption by Application and Density, 1996-1998 (Millions of Units Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Mainframes	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	0.7	0.6	0.4	-	1.7	-	-	-	-	-	-	-	-	-	-
16Mb	1.8	1.9	1.9	1.5	7.1	1.0	0.5	0.2	0.1	1.8	0	0	-	-	0
64Mb	0	0	0.2	0.4	0.7	0.5	0.8	1.0	1.2	3.5	1.1	1.1	1.2	1.4	4.8
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Supercomputers															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16Mb	0.7	0.6	0.5	0.3	2.0	0.2	0.1	0.1	-	0.4	-	-	-	-	-
64Mb	0	0.1	0.1	0.2	0.5	0.3	0.4	0.5	0.6	1.7	0.6	0.6	0.7	0.8	2.7
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Midranges															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	3.2	3.0	2.4	0.9	9.5	0	-	-	-	0	-	-	-	-	-
16Mb	11.9	12.0	12.5	12.5	48.9	11.4	9.3	6.4	4.4	31.6	3.5	2.3	1.6	0.6	7.9
64Mb	0.1	0.1	0.4	1.8	2.5	1.8	5.5	7.9	10.4	25.7	11.8	13.4	15.3	17.4	57.8
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Workstations															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	0.6	0.4	0.2	0	1.2	0	-	-	-	0	-	-	-	-	-
16Mb	5.7	5.9	6.4	6.6	24.7	5.9	5.3	4.7	3.5	19.5	2.4	1.6	1.1	0.8	6.0
64Mb	-	0	0.2	0.6	0.8	0.7	1.4	1.9	2.6	6.5	3.0	3.5	4.0	4.7	15.2
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996-1998 (Millions of Units Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Personal Computers															
256K	0	0	0	-	0.1	-	-	-	-	-	-	-	-	-	-
1Mb	10.5	3.1	0.4	0.3	14.3	0.3	0.2	0.3	0.1	0.9	0	0	0	0	0
4Mb	159.3	123.4	105.5	89.7	478.0	68.7	53.1	39.4	28.2	189.3	18.4	15.0	14.1	7.7	55.3
16Mb	108.2	125.8	150.8	210.4	595.3	209.0	225.2	252.2	329.3	1,015.7	314.4	300.8	289.6	328.6	1,233.4
64Mb	-	0	0.1	0.3	0.4	1.9	2.1	4.9	9.1	17.9	13.7	21.0	34.6	53.9	123.1
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Server-Marketed PCs															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	0.1	0.1	0	-	0.2	-	-	-	-	-	-	-	-	-	-
4Mb	3.3	3.1	2.7	2.7	11.8	1.8	1.4	1.2	1.2	5.5	0.9	0.8	0.9	1.0	3.6
16Mb	3.8	4.4	5.0	7.0	20.2	6.3	7.0	7.3	9.3	29.9	7.9	7.5	7.5	8.8	31.6
64Mb	-	0	0.1	0.3	0.4	0.4	0.6	0.9	1.6	3.6	1.8	2.1	2.6	3.7	10.1
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Transportables															
256K	0	0	-	-	0	-	-	-	-	-	-	-	-	-	-
1Mb	0	0	0	0	0	0	0	-	-	0	-	-	-	-	-
4Mb	0.1	0.1	0.1	0.1	0.3	0	0	0	0	0.1	0	0	0	0	0
16Mb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.1
64Mb	-	-	-	-	-	-	-	-	-	-	-	0	0	0	0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ultraportables and Notepads															
256K	0	0	-	-	0	-	-	-	-	-	-	-	-	-	-
1Mb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4Mb	1.0	0.9	1.0	1.0	3.8	0.9	0.7	0.7	0.7	3.0	0.6	0.4	0.2	0.1	1.2
16Mb	0.4	0.5	0.7	0.9	2.5	1.1	1.2	1.5	1.9	5.8	2.2	1.9	2.2	2.9	9.2
64Mb	-	-	-	-	-	-	-	-	-	-	0	0	0	0.1	0.2
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996-1998 (Millions of Units Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Notebooks															
256K	0	0	0	-	0.1	-	-	-	-	-	-	-	-	-	-
1Mb	0.3	0.3	0.3	0.3	1.3	0.3	0.2	0.3	0.1	0.9	-	-	-	-	-
4Mb	8.2	6.7	6.0	5.5	26.4	4.3	3.5	3.2	3.0	14.0	1.9	1.3	0.7	0.4	4.3
16Mb	5.7	6.2	8.1	11.3	31.3	11.6	12.6	15.0	18.8	58.0	16.7	15.8	16.4	18.4	67.2
64Mb	-	-	-	-	-	-	-	-	0.1	0.1	0.4	0.7	1.1	1.9	4.0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Laptops															
256K	0	0	0	-	0	-	-	-	-	-	-	-	-	-	-
1Mb	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
4Mb	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
16Mb	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Desktops															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	10.1	2.7	-	-	12.7	-	-	-	-	-	-	-	-	-	-
4Mb	114.7	86.3	80.5	71.1	352.6	55.3	45.0	33.6	23.2	157.1	15.1	12.5	12.3	6.3	46.2
16Mb	33.5	39.1	60.0	88.1	220.6	98.2	111.8	134.2	186.4	530.6	195.5	192.9	192.1	225.9	806.4
64Mb	-	-	-	-	-	1.5	0.6	1.8	3.0	7.0	5.9	9.5	17.1	26.6	59.1
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Desksides															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	32.1	26.3	15.3	9.4	83.0	6.5	2.5	0.6	-	9.6	-	-	-	-	-
16Mb	64.9	75.6	76.9	103.1	320.5	91.7	92.6	94.1	112.9	391.3	92.1	82.7	71.4	72.6	318.8
64Mb	-	-	-	-	-	-	0.8	2.1	4.3	7.2	5.6	8.7	13.7	21.6	49.7
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996-1998 (Millions of Units Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
PC Upgrades															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	1.9	1.8	1.9	1.9	7.5	2.0	1.9	1.9	2.0	7.9	2.1	2.0	2.0	2.1	8.2
4Mb	1.0	1.1	1.1	1.3	4.5	1.4	1.4	1.5	1.7	6.0	1.8	1.9	2.0	2.2	7.9
16Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Memory Modules															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	12.8	12.7	12.0	9.0	46.5	1.1	0	0.1	-	1.3	-	-	-	-	-
4Mb	92.5	91.3	87.8	85.1	356.8	66.2	54.0	47.9	50.1	218.2	40.0	23.5	2.4	0	65.9
16Mb	34.5	38.3	51.7	67.6	192.2	101.8	124.1	144.4	158.1	528.4	174.5	187.4	196.7	226.1	784.7
64Mb	-	-	-	-	-	-	0.2	1.9	3.3	5.4	4.5	6.6	9.7	17.5	38.4
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Data Storage Devices															
256K	2.3	2.3	1.9	1.5	8.0	0.9	0.4	0.1	0.1	1.5	0.1	0.1	0.1	0.1	0.4
1Mb	15.7	16.2	16.6	17.1	65.6	14.7	14.4	9.5	8.8	47.4	9.0	8.9	6.1	4.2	28.2
4Mb	2.1	3.3	4.7	6.3	16.5	8.1	10.0	12.5	15.5	46.1	18.0	20.8	24.1	25.5	88.5
16Mb	-	-	-	-	-	0.7	1.4	2.0	2.5	6.7	4.2	5.2	6.4	7.5	23.3
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Printers															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	6.4	5.1	5.7	6.6	23.8	4.7	3.6	3.6	3.7	15.6	2.3	1.5	1.0	0.2	5.1
4Mb	18.5	15.6	15.5	19.0	68.5	13.5	11.3	13.0	16.2	54.0	12.5	11.2	13.0	15.4	52.1
16Mb	7.7	7.3	10.6	15.0	40.6	13.4	13.0	16.4	23.1	66.0	18.9	17.9	22.2	31.3	90.3
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996-1998 (Millions of Units Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Facsimiles															
256K	0	0	0	0	0.1	0	0	0	0	0.1	0	0	0	-	0.1
1Mb	0.6	0.6	0.5	0.4	2.1	0.3	0.3	0.2	0.2	1.0	0.2	0.2	0.2	0.2	0.7
4Mb	6.7	6.8	6.9	6.9	27.2	6.8	6.8	6.8	6.8	27.2	6.7	6.7	6.6	6.4	26.4
16Mb	0.2	0.3	0.6	0.6	1.6	0.9	1.2	1.4	1.6	5.0	1.8	2.1	2.5	2.9	9.3
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LAN Hubs/ Internetworking															
256K	0	0	0	-	0	-	-	-	-	-	-	-	-	-	-
1Mb	0.9	0.8	0.6	0.5	2.8	0.5	0.5	0.5	0.4	1.9	0.4	0.4	0.5	0.4	1.7
4Mb	0.9	0.9	0.8	0.8	3.4	0.8	0.7	0.7	0.7	2.9	0.8	0.8	0.8	0.8	3.2
16Mb	0.2	0.2	0.3	0.4	1.1	0.6	0.7	0.8	0.9	2.9	1.0	1.1	1.2	1.3	4.7
64Mb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Telephone Sets/ Answering Machines															
256K	0.7	0.7	0.7	0.7	2.9	0.6	0.4	0.3	-	1.3	-	-	-	-	-
1Mb	12.9	14.2	16.1	17.1	60.2	15.0	14.4	13.1	12.6	55.2	10.6	10.1	9.6	10.3	40.6
4Mb	3.7	4.8	6.3	7.9	22.8	8.9	10.4	11.8	13.5	44.6	13.3	14.6	15.7	18.0	61.6
16Mb	-	-	-	-	-	-	-	0.1	0.3	0.4	0.6	1.1	1.4	2.0	5.1
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Industrial Applications															
256K	1.6	1.5	1.4	1.2	5.7	1.1	1.0	0.9	0.6	3.8	0.5	0.3	0.1	-	0.9
1Mb	9.1	9.0	8.6	7.9	34.6	6.9	5.9	5.3	5.0	23.3	5.2	5.2	5.1	5.1	20.6
4Mb	5.9	6.2	6.2	6.2	24.5	6.2	6.0	5.5	5.1	22.7	4.9	4.7	4.5	4.4	18.6
16Mb	0.6	0.6	0.7	0.9	2.9	1.4	1.8	2.2	2.7	8.0	3.5	4.0	4.3	4.4	16.3
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996-1998 (Millions of Units Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
Digital Video Disc															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	0	0.2	0.3	0.4	1.0	0.5	0.3	0.1	0.1	1.0	-	-	-	-	-
4Mb	0	0.1	0.1	0.2	0.4	0.4	0.5	0.7	0.9	2.5	1.0	1.2	1.6	2.3	6.2
16Mb	0	0	0	0.1	0.1	0.2	0.5	1.0	1.5	3.3	2.1	3.0	4.2	6.1	15.4
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cable/Satellite Set-Top Boxes															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	4.4	5.2	5.6	4.3	19.6	2.2	0.2	-	-	2.3	-	-	-	-	-
4Mb	2.2	2.7	3.3	3.8	12.0	4.1	4.4	4.6	4.7	17.8	4.9	4.8	4.8	4.7	19.2
16Mb	0.1	0.2	0.4	0.6	1.3	1.1	1.4	1.9	2.3	6.6	2.8	3.2	3.6	4.0	13.5
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Games (Systems and Cartridges)															
256K	0.3	0.2	0.1	0.1	0.7	0.1	0	0	0	0.2	0	0	0	0	0.1
1Mb	0.5	0.4	0.3	0.2	1.4	0.2	0.1	0.1	0.1	0.4	0	0	0	0	0.1
4Mb	1.1	1.4	1.3	1.3	5.1	1.1	1.1	1.0	1.0	4.2	1.0	1.0	1.0	0.9	3.9
16Mb	3.8	4.9	6.4	6.8	21.9	6.6	7.3	8.1	8.9	30.8	9.6	10.9	12.6	14.6	47.7
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8-Bit Video Games															
256K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1Mb	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996-1998 (Millions of Units Demanded)

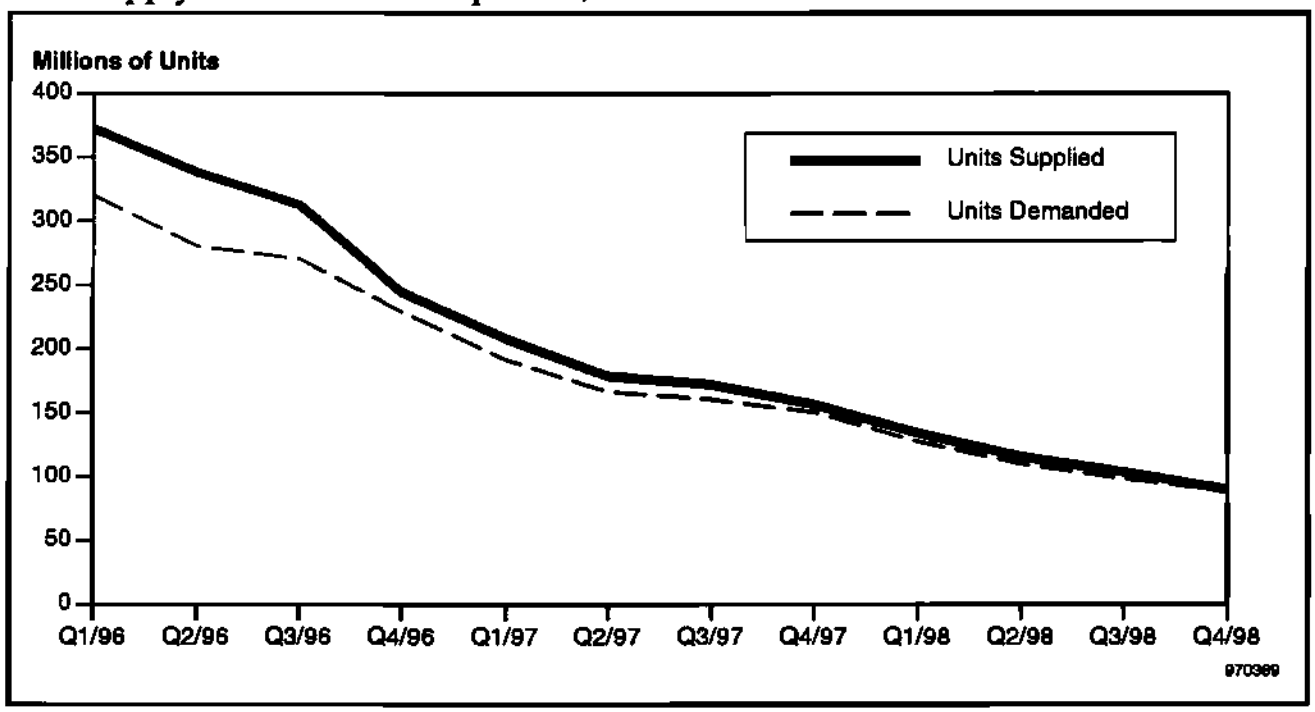
	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
16-Bit Video Games															
256K	0.2	0.2	0.1	0.1	0.7	0.1	0	0	0	0.2	0	0	0	0	0
1Mb	0.3	0.2	0.2	0.1	0.8	0.1	0.1	0	0	0.2	0	0	0	0	0.1
4Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CD-ROM Video Games															
256K	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1Mb	0.2	0.1	0.1	0.1	0.5	0.1	0	0	0	0.2	0	0	0	0	0
4Mb	0.2	0.2	0.2	0.2	0.7	0.1	0.1	0.1	0.1	0.3	0	0	0	0	0.1
16Mb	0	0	0	0	0	0	0	0	0	0.1	0	0	0	0	0
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
RISC and Future Video Games															
256K	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
4Mb	0.9	1.2	1.1	1.1	4.4	1.0	1.0	1.0	1.0	3.8	0.9	1.0	1.0	0.9	3.9
16Mb	3.8	4.9	6.4	6.8	21.9	6.5	7.3	8.0	8.9	30.7	9.6	10.9	12.6	14.6	47.6
64Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other Applications															
256K	-	0.1	0.2	0	0.3	0	0	0	0.1	0.1	0.3	0.2	0.2	0.2	0.9
1Mb	1.2	4.1	3.4	0.8	9.4	0	0	0.1	0.2	0.3	2.0	2.5	4.3	5.5	14.3
4Mb	21.6	19.0	27.5	0.5	68.7	5.8	7.1	15.4	6.3	34.6	4.5	4.1	8.2	0.6	17.3
16Mb	-	-	-	-	-	1.1	12.5	22.7	0	36.4	26.1	42.2	55.6	15.0	139.0
64Mb	0	0.2	0.2	0	0.3	1.0	1.0	0.7	1.9	4.6	4.5	8.3	7.8	5.5	26.0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 5-4 (Continued)
DRAM Consumption by Application and Density, 1996-1998 (Millions of Units Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
All Applications															
256K	5.0	4.9	4.4	3.6	17.9	2.8	1.9	1.4	0.9	7.0	0.9	0.6	0.5	0.3	2.3
1Mb	76.8	73.4	72.0	66.7	288.9	48.4	41.9	34.9	33.4	158.6	31.8	30.8	28.9	28.0	119.5
4Mb	320.1	280.7	270.3	229.9	1,101.0	191.9	166.8	160.8	150.7	670.2	127.7	110.4	98.9	89.2	426.1
16Mb	175.4	198.0	242.7	323.6	939.6	355.2	404.4	464.7	539.2	1,763.5	565.5	582.9	602.9	645.3	2,396.6
64Mb	0.1	0.5	1.3	3.4	5.3	6.2	11.3	18.8	29.0	65.3	39.2	54.5	73.3	101.1	268.1
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bits (Trillions)	4,376.4	4,610.4	5,366.0	6,693.1	21,046.0	7,231.0	8,288.2	9,767.8	11,657.4	36,944.4	12,688.9	13,930.0	15,478.7	18,014.5	60,112.2
Annual Bit Growth (%)										75.5					62.7
Worldwide Supply															
256K	5.2	5.1	4.7	3.9	18.8	2.8	2.0	1.4	0.9	7.1	0.9	0.6	0.5	0.3	2.3
1Mb	78.0	77.6	75.2	67.4	298.1	48.5	41.9	35.0	33.6	159.0	32.3	31.1	29.0	28.0	120.4
4Mb	372.9	338.3	312.6	244.7	1,268.4	208.7	178.8	172.1	156.5	716.1	134.5	115.8	103.6	89.9	443.8
16Mb	192.2	219.2	263.9	337.2	1,012.5	378.4	431.0	494.7	549.2	1,853.3	591.8	608.8	625.7	650.4	2,476.7
64Mb	0.2	0.5	1.4	3.8	5.9	6.8	12.3	20.3	30.0	69.5	40.3	54.6	71.5	98.7	265.0
256Mb	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bits (Trillions)	4,881.6	5,215.5	5,910.5	7,013.9	23,021.5	7,734.2	8,853.4	10,421.3	11,917.8	38,926.6	13,231.6	14,396.0	15,760.9	17,938.3	61,326.8
Annual Bit Growth (%)										69.1					57.5
4Mb Equivalents (Millions of Units)															
Demand	1,043.4	1,099.2	1,279.4	1,595.8	5,017.8	1,724.0	1,976.1	2,328.8	2,779.3	8,808.2	3,025.3	3,321.2	3,690.4	4,295.0	14,331.9
Supply	1,163.9	1,243.5	1,409.2	1,672.2	5,488.8	1,844.0	2,110.8	2,484.6	2,841.4	9,280.8	3,154.7	3,432.3	3,757.7	4,276.8	14,621.5
Sufficiency (%)	111.5	113.1	110.1	104.8	109.4	107.0	106.8	106.7	102.2	105.4	104.3	103.3	101.8	99.6	102.0

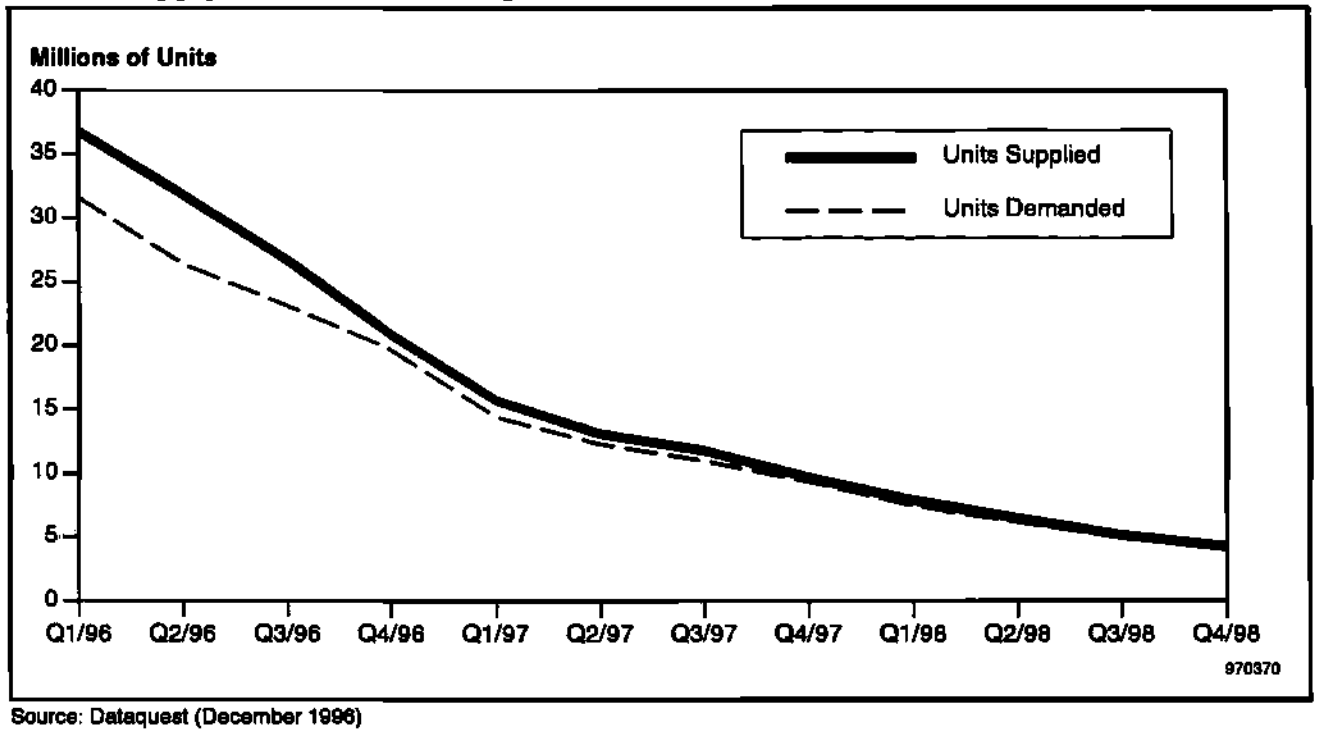
Source: Dataquest (December 1996)

Figure 5-1
4Mb Supply and Demand Comparison, 1996-1997



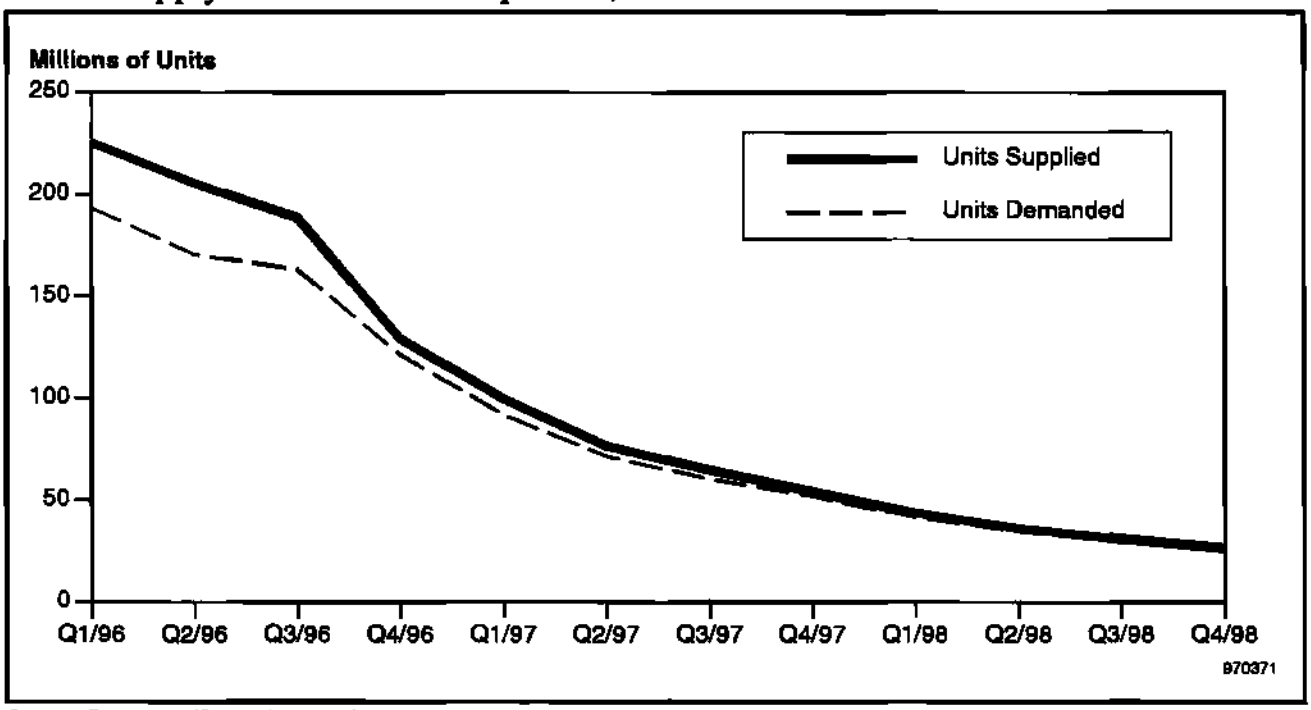
Source: Dataquest (December 1996)

Figure 5-2
4Mbx1 Supply and Demand Comparison, 1996-1997



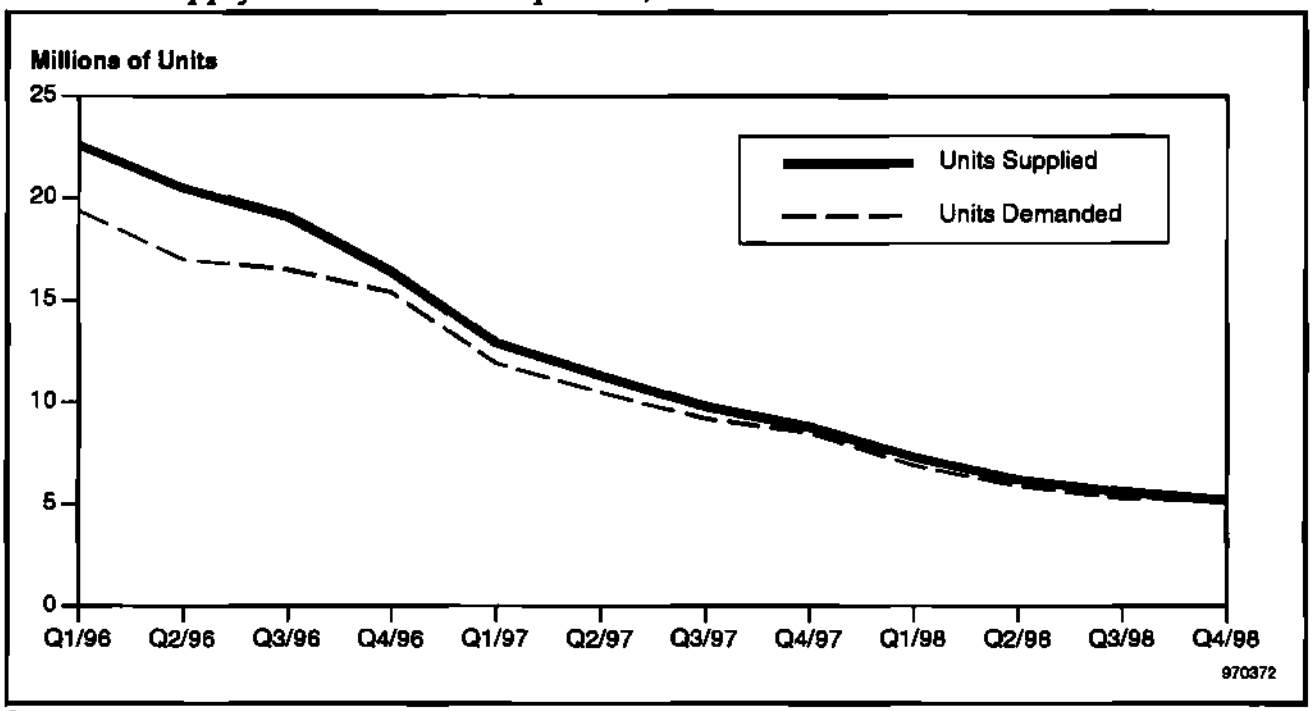
Source: Dataquest (December 1996)

Figure 5-3
1Mbx4 Supply and Demand Comparison, 1996-1997



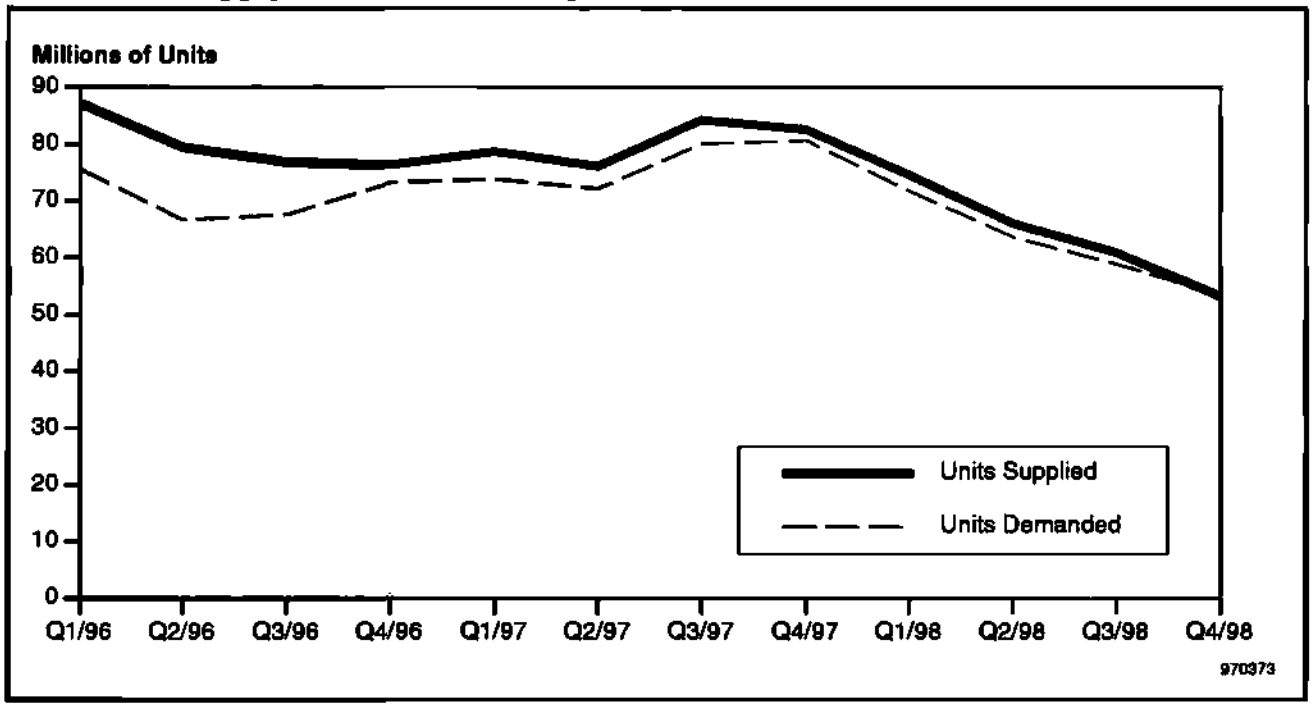
Source: Dataquest (December 1996)

Figure 5-4
512Kx8/9 Supply and Demand Comparison, 1996-1997



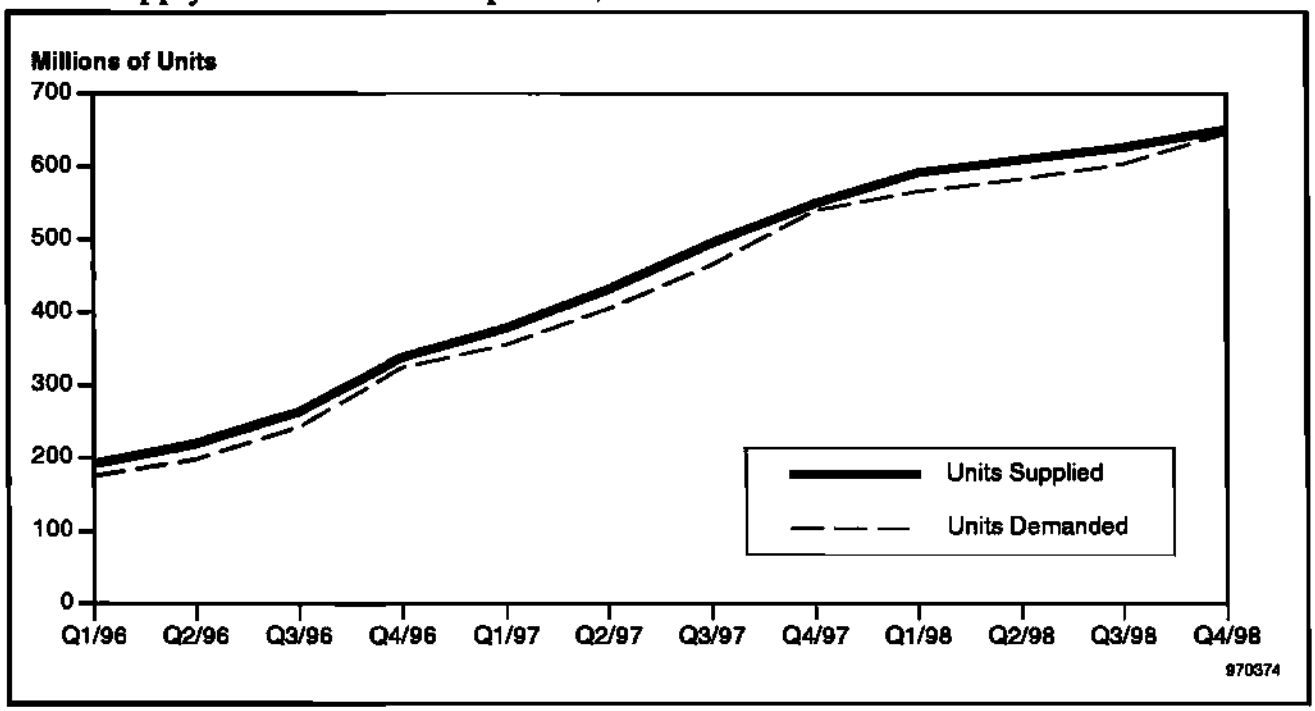
Source: Dataquest (December 1996)

Figure 5-5
256Kx16/18 Supply and Demand Comparison, 1996-1997



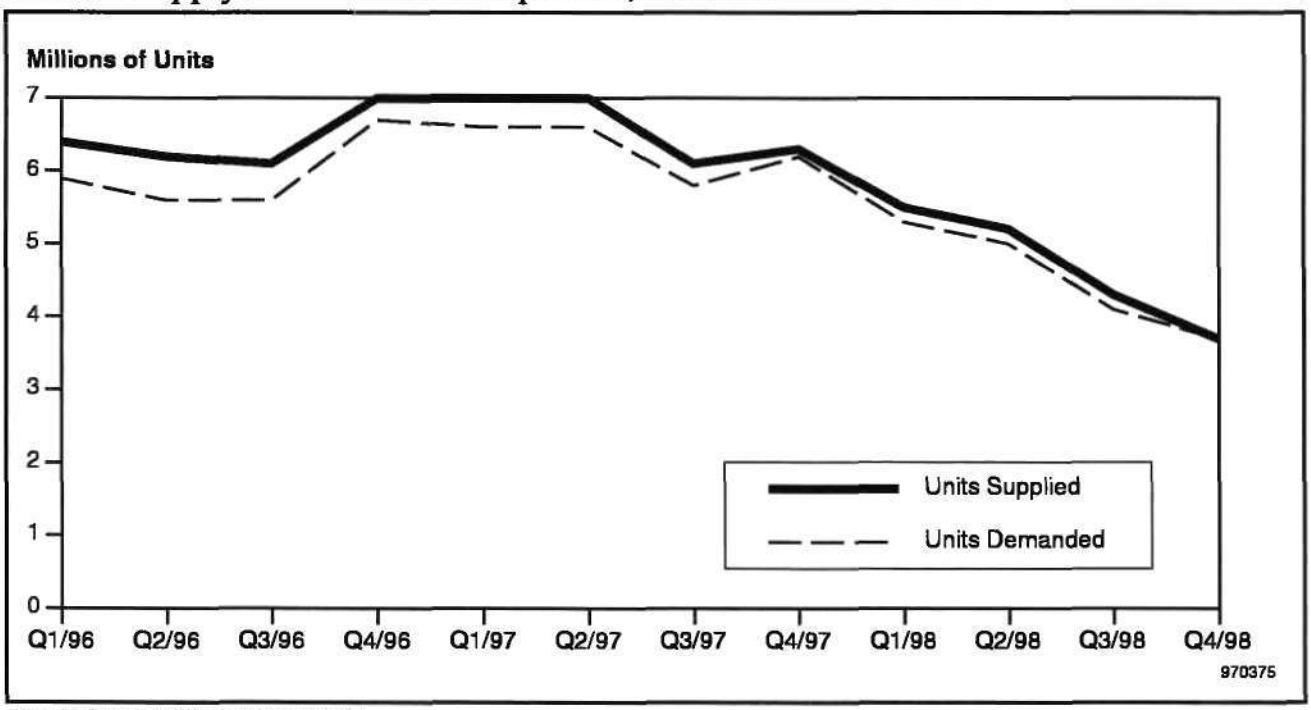
Source: Dataquest (December 1996)

Figure 5-6
16Mb Supply and Demand Comparison, 1996-1997



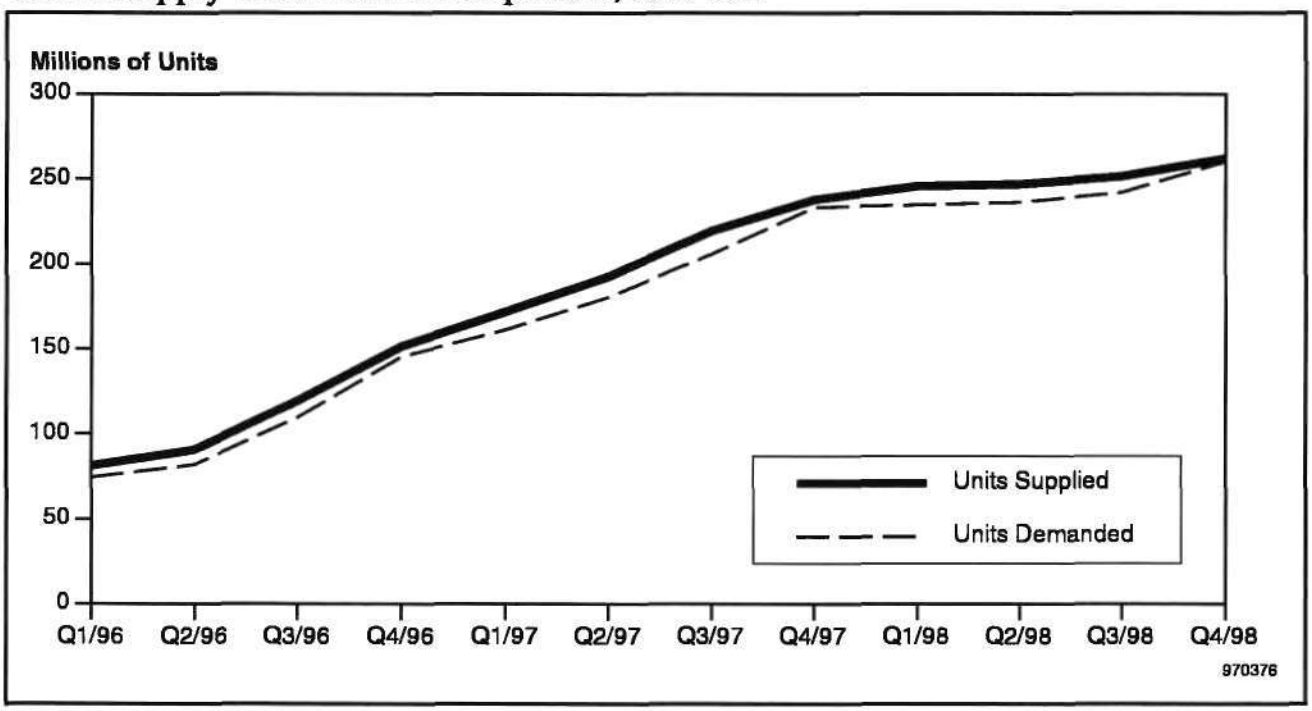
Source: Dataquest (December 1996)

Figure 5-7
16Mbx1 Supply and Demand Comparison, 1996-1997



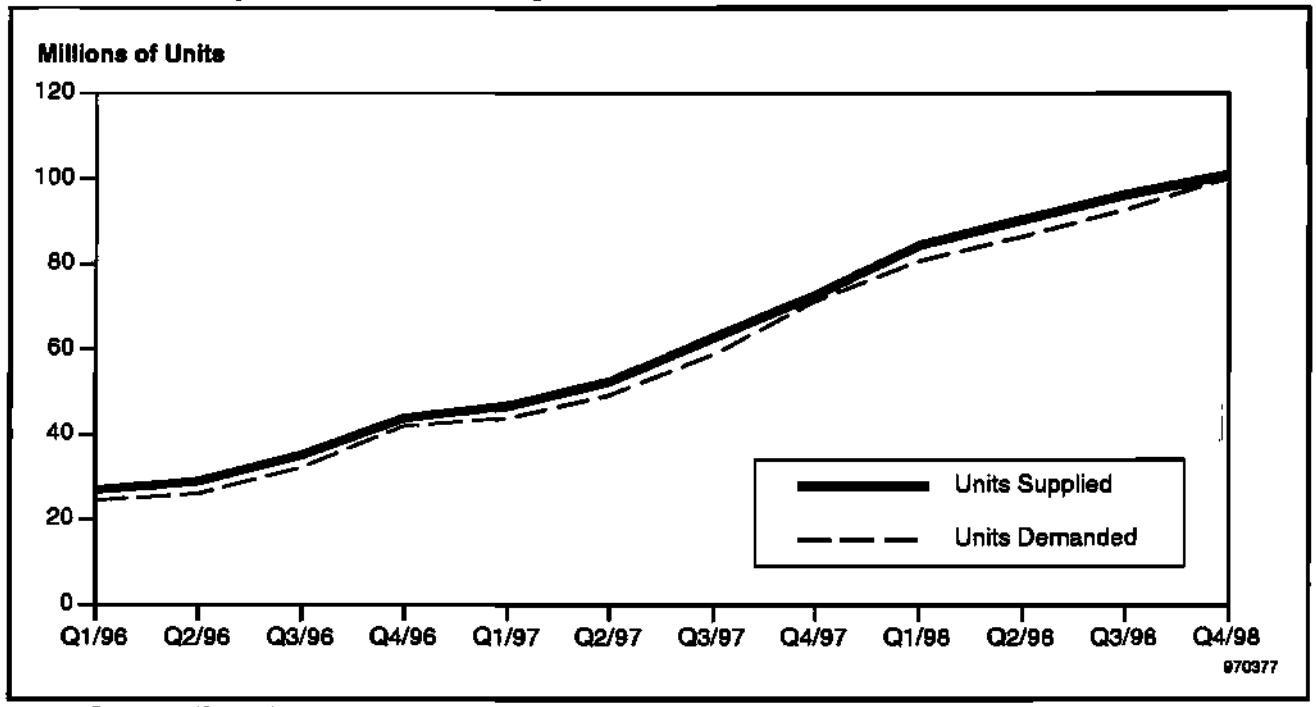
Source: Dataquest (December 1996)

Figure 5-8
4Mbx4 Supply and Demand Comparison, 1996-1997



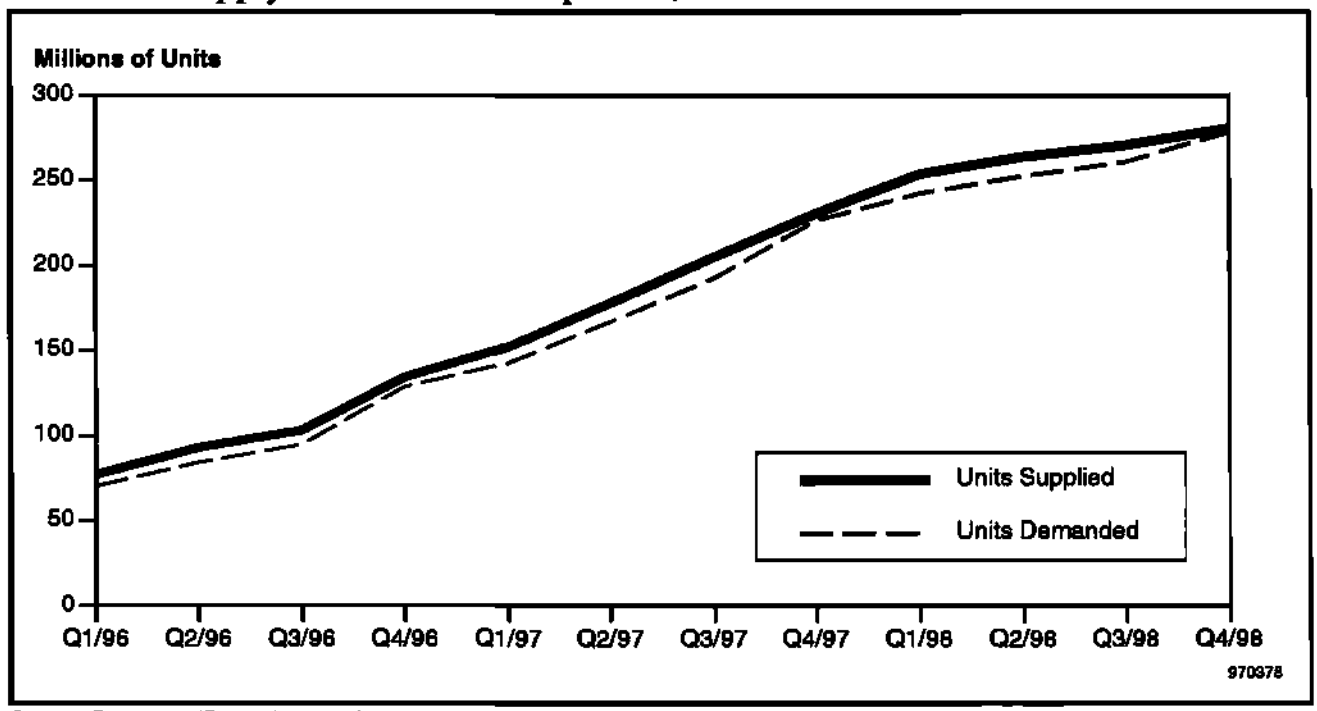
Source: Dataquest (December 1996)

Figure 5-9
2Mbx8/9 Supply and Demand Comparison, 1996-1997



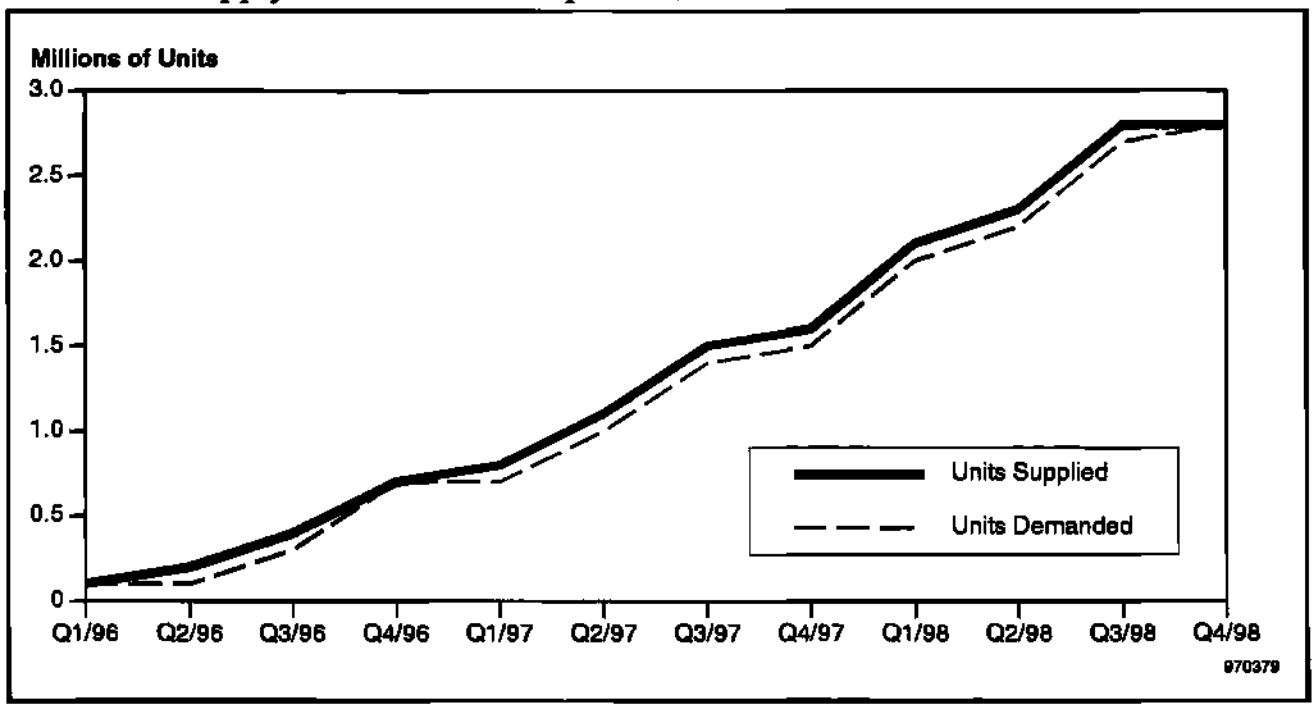
Source: Dataquest (December 1996)

Figure 5-10
1Mbx16/18 Supply and Demand Comparison, 1996-1997



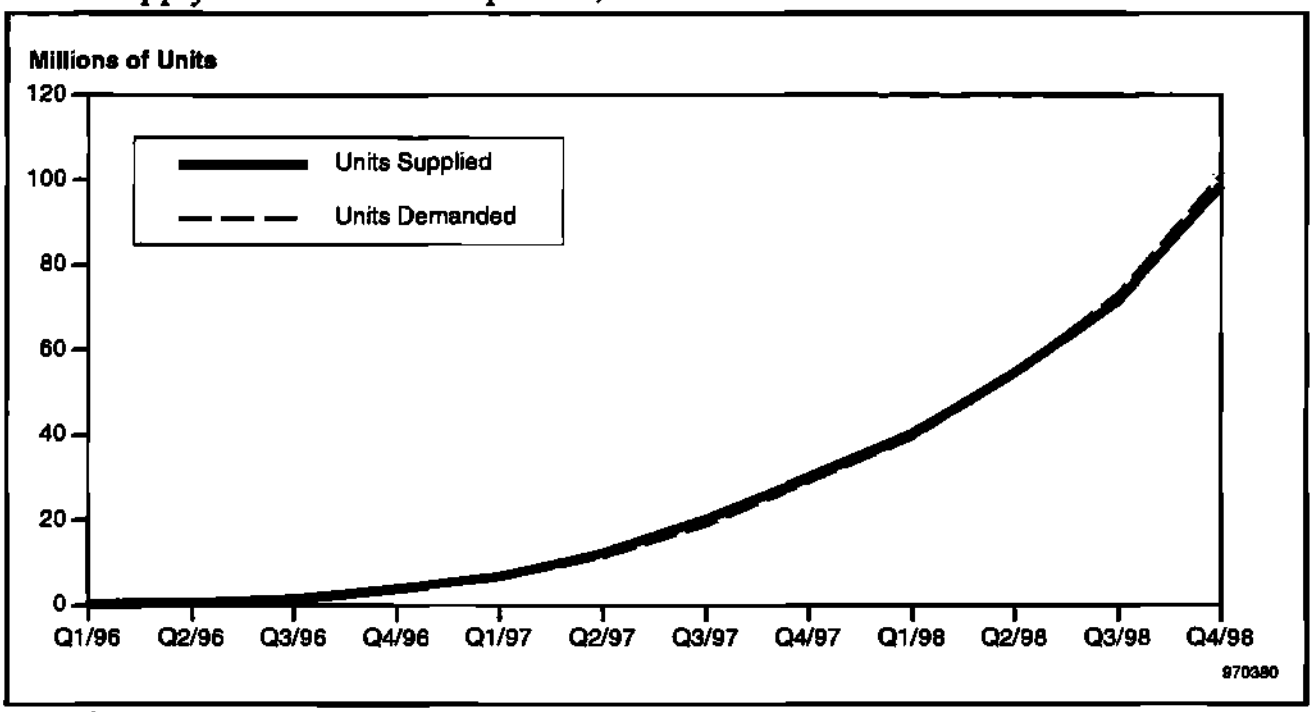
Source: Dataquest (December 1996)

Figure 5-11
512Kx32/36 Supply and Demand Comparison, 1996-1997



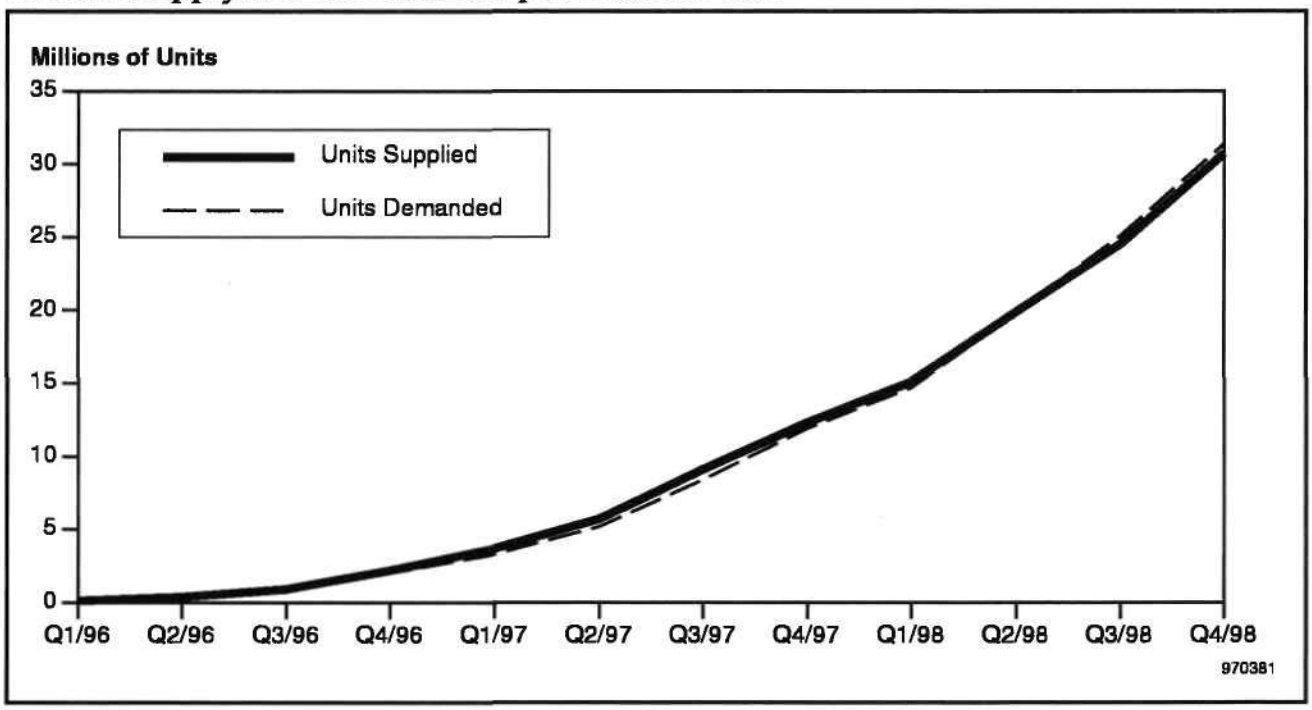
Source: Dataquest (December 1996)

Figure 5-12
64Mb Supply and Demand Comparison, 1996-1997



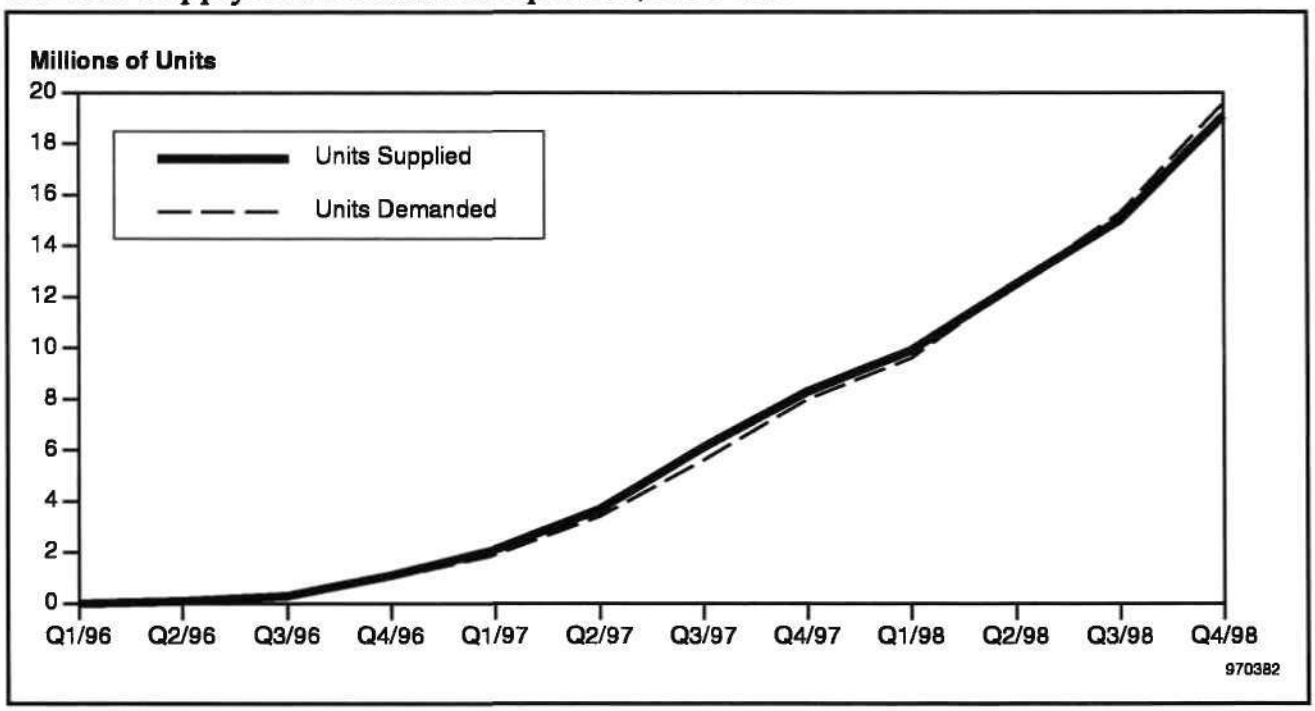
Source: Dataquest (December 1996)

Figure 5-13
16Mbx4 Supply and Demand Comparison, 1996-1997



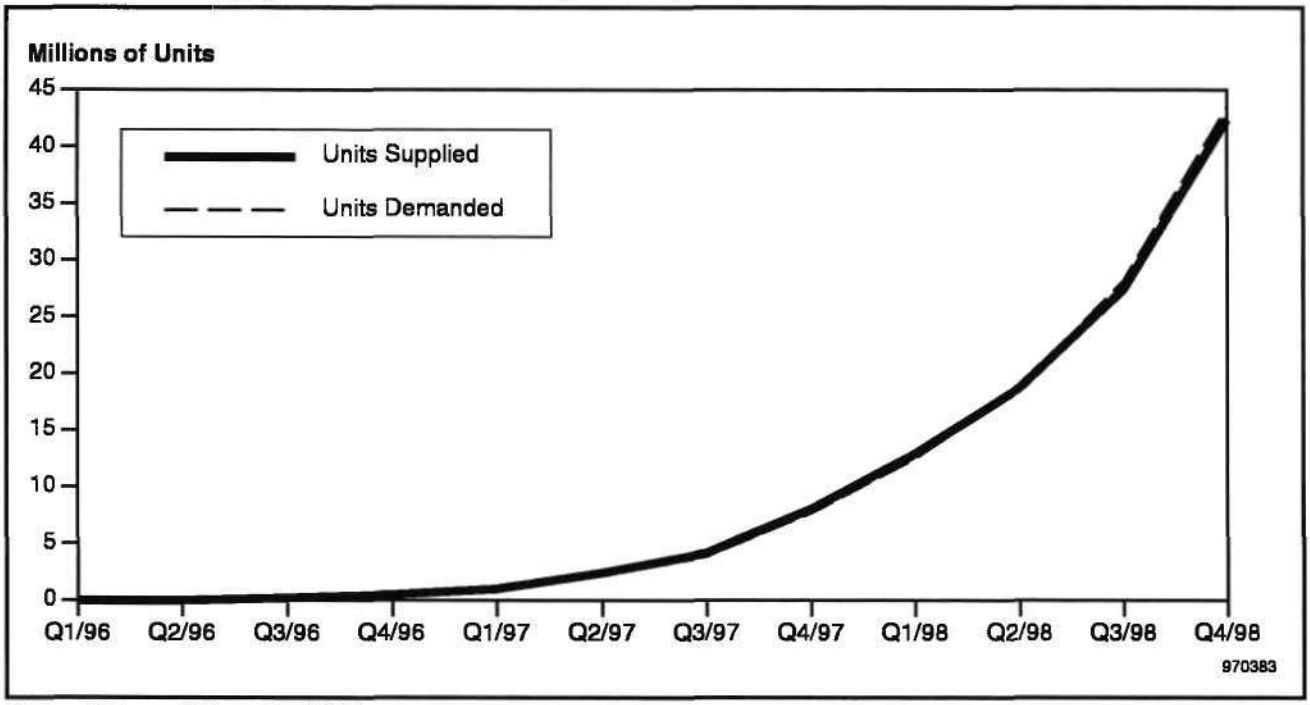
Source: Dataquest (December 1996)

Figure 5-14
8Mbx8/9 Supply and Demand Comparison, 1996-1997



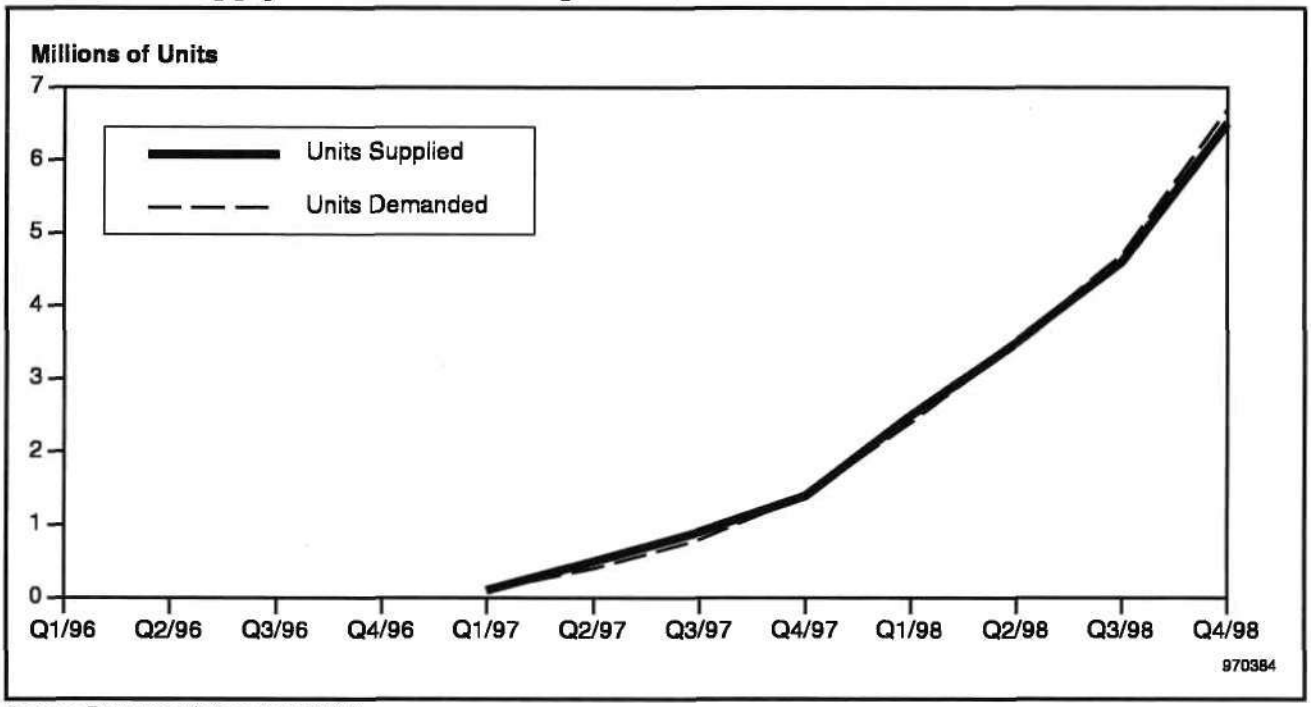
Source: Dataquest (December 1996)

Figure 5-15
4Mbx16/18 Supply and Demand Comparison, 1996-1997



Source: Dataquest (December 1996)

Figure 5-16
2Mbx32/36 Supply and Demand Comparison, 1996-1997



Source: Dataquest (December 1996)

Chapter 6
PC DRAM Consumption by Processor Type

The data in this chapter provides a form of checks and balances on the demand-side statistics. Table 6-1 shows Dataquest's annual forecast of microprocessor unit shipments in personal computers. This data does not include shipments of either replacement motherboards or industrial controllers. Table 6-2 presents an estimate of DRAM consumption in megabytes per system in PCs at the point of sale. This is the sum of factory configuration of memory as the system leaves the original equipment manufacturer (OEM) plus memory added to the unit at or before the point of sale. Table 6-3 multiplies the numbers in Tables 6-1 and 6-2 to produce overall PC DRAM demand.

What Has Changed since the Previous Report

As in the previous report, this chapter has been synchronized with the PC system and consumption forecasts in Tables 5-1 through 5-3. The "total" line in these tables corresponds to the "personal computers" line in Tables 5-1 through 5-3.

This analysis now makes use of the new quarterly PC forecast supplied by Dataquest's Computers and Peripherals program.

Table 6-1
PC Shipment Forecast by Microprocessor (Excluding Upgrades), 1996-1998 (Millions of Systems)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
386	5.2	1.5	0.1	-	6.7	-	-	-	-	-	-	-	-	-	-
486	2,901.2	1,851.8	754.7	429.1	5,936.9	120.4	48.5	24.8	5.3	198.9	3.1	-	-	-	3.1
Pentium 60-100 MHz and Unclassified	9,074.3	7,525.5	6,161.9	5,755.5	28,517.2	2,901.1	1,996.7	1,107.2	641.7	6,646.7	257.6	124.7	45.6	11.2	439.1
Pentium 120-133 MHz	2,734.9	4,308.5	5,711.2	6,025.0	18,779.5	4,574.6	3,169.3	2,612.5	2,212.6	12,569.0	1,016.7	446.8	203.6	70.8	1,737.9
Pentium 150-166 MHz	549.7	1,484.3	2,805.6	5,347.7	10,187.3	5,583.2	5,298.6	4,094.4	3,211.5	18,187.7	2,144.1	1,959.1	999.5	812.8	5,915.4
Pentium 180 MHz and Above	-	17.4	247.6	1,357.8	1,622.8	2,391.3	3,667.2	5,221.0	8,153.2	19,432.7	6,810.8	6,025.9	5,817.2	6,794.4	25,448.3
Pentium Pro 150-200 MHz	47.6	115.1	465.8	1,759.5	2,388.0	2,418.4	3,414.5	5,348.1	8,658.3	19,839.4	9,199.5	9,661.3	11,113.2	12,696.3	42,670.2
Pentium Pro >200 MHz and Future x86	-	-	20.3	122.0	142.3	191.2	441.9	778.4	1,481.0	2,892.4	1,823.0	2,761.1	3,989.4	7,827.8	16,401.3
68xxx	103.0	33.9	16.9	12.3	166.1	4.1	2.0	2.0	4.0	12.2	-	-	-	-	-
Other CISC/RISC	938.1	962.1	1,055.5	1,318.0	4,273.6	1,067.0	1,127.5	1,297.6	1,521.9	5,013.9	1,299.5	1,244.0	1,521.4	1,779.9	5,844.8
All MPU Types	16,354.0	16,300.0	17,239.7	22,126.8	72,020.5	19,251.5	19,166.2	20,486.0	25,889.3	84,792.9	22,554.4	22,222.8	23,689.8	29,993.2	98,460.3

Source: Dataquest (December 1996)

Table 6-2
PC DRAM Consumption Forecast by Microprocessor (Excluding Upgrades), 1996-1998 (Megabytes per System)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
386	13.8	16.1	7.1	-	14.2	-	-	-	-	-	-	-	-	-	-
486	13.2	13.8	14.3	14.0	13.6	18.9	17.9	18.4	10.0	18.4	10.4	-	-	-	10.4
Pentium 60-100 MHz and Unclassified	18.4	18.1	18.5	18.0	18.3	20.5	21.1	20.8	21.0	20.8	22.7	20.6	25.3	11.5	22.1
Pentium 120-133 MHz	21.7	20.8	20.7	19.6	20.5	20.8	22.2	22.7	23.3	22.0	24.5	22.9	18.6	14.4	23.0
Pentium 150-166 MHz	27.8	27.6	25.6	24.0	25.2	26.4	26.7	25.8	25.1	26.1	26.9	29.4	24.2	19.3	26.2
Pentium 180 MHz and Above	-	26.8	27.1	26.6	26.6	26.9	27.0	29.4	29.6	28.7	32.9	33.9	35.7	35.7	34.6
Pentium Pro 150-200 MHz	28.8	27.7	27.0	26.5	26.7	28.1	28.6	30.2	30.6	29.9	34.9	35.9	36.4	35.2	35.6
Pentium Pro >200 MHz and Future x86	-	-	36.8	37.5	37.4	33.5	31.0	32.6	34.4	33.3	39.2	40.3	41.5	41.1	40.9
68xxx	10.4	9.5	11.0	13.9	10.6	17.5	22.1	24.8	26.6	22.5	-	-	-	-	-
Other CISC/RISC	16.0	17.8	19.0	19.0	18.1	22.9	24.7	26.8	27.7	25.8	32.3	35.4	36.4	35.8	35.1
All MPU Types	18.2	19.3	20.6	21.2	19.9	24.3	25.7	27.5	28.8	26.8	33.1	35.0	36.4	36.4	35.3

Source: Dataquest (December 1996)

Table 6-3
PC DRAM Consumption Forecast by Microprocessor (Excluding Upgrades), 1996-1998 (Trillions of Bits Demanded)

	Q1/96	Q2/96	Q3/96	Q4/96	1996	Q1/97	Q2/97	Q3/97	Q4/97	1997	Q1/98	Q2/98	Q3/98	Q4/98	1998
386	0.6	0.2	0	-	0.8	-	-	-	-	-	-	-	-	-	-
486	321.1	215.1	90.6	50.5	677.2	19.1	7.3	3.8	0.4	30.6	0.3	-	-	-	0.3
Pentium 60-100 MHz and Unclassified	1,402.4	1,143.4	956.4	867.4	4,369.6	498.6	353.7	193.0	113.1	1,158.4	49.0	21.5	9.7	1.1	81.3
Pentium 120-133 MHz	496.8	753.2	991.2	990.0	3,231.3	796.5	590.6	497.9	432.8	2,317.8	209.1	85.7	31.8	8.6	335.1
Pentium 150-166 MHz	128.3	343.5	602.9	1,077.7	2,152.4	1,235.6	1,187.9	884.8	675.5	3,983.8	483.8	483.1	202.9	131.5	1,301.2
Pentium 180 MHz and Above	-	3.9	56.2	302.4	362.6	539.7	830.8	1,286.4	2,024.1	4,680.9	1,881.1	1,716.1	1,743.8	2,037.5	7,378.5
Pentium Pro 150-200 MHz	11.5	26.8	105.5	390.8	534.6	570.4	819.7	1,356.9	2,224.9	4,972.0	2,695.9	2,907.5	3,397.5	3,746.1	12,747.0
Pentium Pro >200 MHz and Future x86	-	-	6.3	38.4	44.6	53.7	115.1	212.9	426.7	808.4	598.8	933.8	1,387.3	2,701.7	5,621.6
68xxx	9.0	2.7	1.6	1.4	14.7	0.6	0.4	0.4	0.9	2.3	-	-	-	-	-
Other CISC/RISC	125.7	144.0	168.0	210.1	647.7	204.8	233.7	292.2	353.5	1,084.2	352.3	369.3	464.6	534.6	1,720.8
All MPU Types	2,495.3	2,632.8	2,978.7	3,928.8	12,035.6	3,919.0	4,139.1	4,728.4	6,251.9	19,038.4	6,270.2	6,517.1	7,237.5	9,161.0	29,185.8

Source: Dataquest (December 1996)

Chapter 7
Worldwide DRAM Wafer Fabrication Plant Production Capacity

Chapter 7 provides analysis of DRAM fab capacity. Dataquest uses the data in this chapter to test the information provided in the supplier surveys. As with Chapter 6, this provides a form of checks and balances for market sizing.

Table 7-1 provides the silicon capacity for each production facility in square millimeters of silicon per month.

Please note that Dataquest does not gather all the displayed production information from the manufacturers themselves. Dataquest performs an extensive fab survey in the third and fourth quarters of each year and updates this periodically through the year with articles from the general and trade press. Analyzing fab production could cause some confusion when accounting for contract production. Contract production (foundry) is production under license from a different company for that different company to sell under its brand name. The table presented in Chapter 7 will credit capacity used for contract production under the foundry, while the shipment information in Chapters 2 through 4 will credit shipments by the purchaser of that foundry production. Nearly every semiconductor manufacturer performs some contract manufacturing. Thus, one should not use these analyses to determine any particular company's inventory or utilization.

What Has Changed since the Previous Report

Dataquest has updated and revised the fab section contained in the third quarter 1996 report. This section is now synchronized with Dataquest's Semiconductor Equipment Manufacturing and Materials Worldwide program (SEMM) fab database. The database reflects the 1996 fab survey results.

Dataquest has also changed the analysis resulting from the fab database. Now listed is each fab line's silicon area capacity by it feature size capability. Subtotals include each company's (or incorporated joint venture's) capability, and totals include the entire industry's silicon processing capability. Also listed are prominent delays and cancellations.

As a courtesy, we have also included the tables from the previous report for your reference in Appendix A.

Table 7-1
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Headquarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm) > 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Asia Semiconductor Mfg. Co. (ASMC)	Taiwan	Fab 1	Science Park	Hsin Chu	Taiwan	Foundry DRAM	1998	30,000	200	0.35	Cancelled					-
Asia Semiconductor Mfg. Co. (ASMC) Total											-	-	-	-	-	-
Fujitsu	Japan	No. 1	Gresham	Oregon	U.S.	4Mb DRAM	1982	17,000	150	0.65	-	300.4	-	-	-	300.4
Fujitsu	Japan	No. 3	Isawa-Gun	Iwate	Japan	4Mb DRAM SRAM ROM MPU	1987	50,000	150	0.8	-	883.6	-	-	-	883.6
Fujitsu	Japan	No. 2	Kuwana-Gun	Mie	Japan	Logic Arrays 4Mb DRAM	1987	10,000	150	0.8	-	176.7	-	-	-	176.7
Fujitsu	Japan	No. 4-1	Isawa-Gun	Iwate	Japan	16Mb DRAM SGRAM	1990/Q4	20,000	150	0.42	-	-	-	353.4	-	353.4
Fujitsu	Japan	Phase 1	Newton Aycliffe	England	U.K.	4Mb 16Mb DRAM	1991	5,600	150	0.5	-	-	99.0	-	-	99.0
Fujitsu	Japan	No. 3 Phase 1	Kuwana-Gun	Mie	Japan	4Mb 16Mb DRAM SRAM MPU	1992	15,000	150	0.5	-	-	265.1	-	-	265.1
Fujitsu	Japan	No. 3 Phase 2	Kuwana-Gun	Mie	Japan	16Mb 64Mb DRAM	1994	500	200	0.25	-	-	-	-	15.7	15.7
Fujitsu	Japan	Phase 2	Newton Aycliffe	England	U.K.	4Mb DRAM	1995	14,000	150	0.5	-	-	247.4	-	-	247.4
Fujitsu	Japan	No. 4-2	Isawa-Gun	Iwate	Japan	16Mb DRAM	1996	25,000	200	0.3	-	-	-	-	785.4	785.4
Fujitsu	Japan	No. 2	Gresham	Oregon	U.S.	64Mb DRAM	1998	10,000	200	0.25	-	-	-	-	314.2	314.2
Fujitsu	Japan	Fab 2	Newton Aycliffe	England	U.K.	16Mb 64Mb DRAM	1999	15,000	200	0.25	On Hold					-
Fujitsu Total											-	1,360.7	611.4	353.4	1,115.3	3,440.8

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Hitachi	Japan	D1	Mobara-Shi	Chiba	Japan	1Mb 4Mb DRAM LCD Driver	1982	25,000	125	1.3	306.8	-	-	-	-	306.8
Hitachi	Japan	N1-1	Hitachi-naka-Shi	Ibaraki	Japan	1Mb 4Mb DRAM	1983	15,000	150	0.8	-	265.1	-	-	-	265.1
Hitachi	Japan	R&D 2	Kodaira-Shi	Tokyo	Japan	MPU SRAM DRAM Arrays CBIC	1985	3,000	150	0.5	-	-	53.0	-	-	53.0
Hitachi	Japan	Chitose 1-1F	Chitose-Shi	Hokkaido	Japan	4Mb DRAM MCU	1988	15,000	150	0.8	-	265.1	-	-	-	265.1
Hitachi	Japan	K4-3F	Naka-koma-Gun	Yamanashi	Japan	4Mb DRAM 1Mb SRAM EPROM	1989	10,000	150	0.8	-	176.7	-	-	-	176.7
Hitachi	Japan	Chitose 1-2F	Chitose-Shi	Hokkaido	Japan	4Mb DRAM MCU	1990	15,000	150	0.8	-	265.1	-	-	-	265.1
Hitachi	Japan	U2	Irving	Texas	U.S.	1Mb 4Mb DRAM 256Kb SRAM MPU	1990	16,500	150	0.8	-	291.6	-	-	-	291.6
Hitachi	Japan	D3	Mobara-Shi	Chiba	Japan	4Mb DRAM	1990	15,000	150	0.8	-	265.1	-	-	-	265.1
Hitachi	Japan	K2-1F	Naka-koma-Gun	Yamanashi	Japan	4Mb DRAM SRAM MCU	1990	25,000	150	2	441.8	-	-	-	-	441.8
Hitachi	Japan	E2	Landshut	Bavaria	Germany	16Mb DRAM	1993	16,000	200	0.35	-	-	-	502.7	-	502.7
Hitachi	Japan	D4/D5	Ome-Shi	Tokyo	Japan	64Mb DRAM 64Mb Flash ASIC	1994	5,000	200	0.35	-	-	-	157.1	-	157.1
Hitachi	Japan	N2-1	Hitachi-naka-Shi	Ibaraki	Japan	16Mb DRAM	1994/Q4	10,000	200	0.35	-	-	-	314.2	-	314.2

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Hitachi	Japan	K2-2F	Naka-koma-Gun	Yamanashi	Japan	16Mb DRAM	1995	10,000	200	0.5	-	-	314.2	-	-	314.2
Hitachi	Japan	T3	Takasaki-Shi	Gunma	Japan	16Mb DRAM	1995	10,000	200	0.5	-	-	314.2	-	-	314.2
Hitachi	Japan	N2/3F	Hitachi-naka-Shi	Ibaraki	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.35	-	-	-	471.2	-	471.2
Hitachi	Japan	N2-2	Hitachi-naka-Shi	Ibaraki	Japan	16Mb 64Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	Japan	Chitose 2	Chitose-Shi	Hokkaido	Japan	64Mb DRAM	1998	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi	Japan	N3/2F	Hitachi-naka-Shi	Ibaraki	Japan	64Mb DRAM	1998	10,000	200	0.35	-	-	-	314.2	-	314.2
Hitachi Total											**748.6**	**1,528.6**	**681.3**	**2,387.6**	-	**5,346.1**
Hitachi/LG	Japan		Kulim		Malaysia	64Mb 256Mb DRAM	1988	30,000	200	0.35	Still under Negotiation					-
Hitachi/LG Total											-	-	-	-	-	-
Hitachi/ Nippon Steel Semiconductor	Japan	Tampins	Singapore		Sin-gapore	64Mb DRAM	1998	20,000	200	0.3	-	-	-	-	628.3	628.3
Hitachi/Nippon Steel Semiconductor Total											-	-	-	-	**628.3**	**628.3**
Hyundai	Korea	MOS Fab 1-A	Ichon	Kyoungki-Do	Korea	256K DRAM SRAM	1985	15,000	125	1	184.1	-	-	-	-	184.1
Hyundai	Korea	MOS Fab 2-A	Ichon	Kyoungki-Do	Korea	1Mb 4Mb DRAM	1986	15,000	150	0.65	-	265.1	-	-	-	265.1
Hyundai	Korea	MOS Fab 3	Ichon	Kyoungki-Do	Korea	4Mb DRAM	1989	20,000	150	0.5	-	-	353.4	-	-	353.4
Hyundai	Korea	MOS R&D	Ichon	Kyoungki-Do	Korea	DRAM	1989	3,000	150	0.25	-	-	-	-	53.0	53.0
Hyundai	Korea	MOS Fab 2-B	Ichon	Kyoungki-Do	Korea	4Mb DRAM	1992	20,000	150	0.5	-	-	353.4	-	-	353.4
Hyundai	Korea	Fab 4	Ichon	Kyoungki-Do	Korea	4Mb 16Mb DRAM	1993	10,000	200	0.35	-	-	-	314.2	-	314.2

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Headquarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Hyundai	Korea	Fab 5	Ichon	Kyoungki-Do	Korea	16Mb 64Mb DRAM	1994	25,000	200	0.35	-	-	-	785.4	-	785.4
Hyundai	Korea	Fab 6	Ichon	Kyoungki-Do	Korea	64Mb DRAM	1996	30,000	200	0.35	-	-	-	942.5	-	942.5
Hyundai	Korea	Fab 7	Ichon	Kyoungki-Do	Korea	16Mb 64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
Hyundai	Korea	Oregon Fab	Eugene	Oregon	U.S.	16Mb 64Mb DRAM	1998	30,000	200	0.25	-	-	-	-	942.5	942.5
Hyundai Total											**184.1**	**265.1**	**706.9**	**2,984.5**	**995.5**	**5,136.0**
IBM Microelectronics	U.S.	Bldg. 970	Essex Junction	Vermont	U.S.	64Mb DRAM MPU Multimedia ICs	1988	24,000	200	0.35	-	-	-	754.0	-	754.0
IBM Microelectronics	U.S.		Corbeil-Essonnes		France	1Mb DRAM	1989	7,000	200	0.8	-	219.9	-	-	-	219.9
IBM Microelectronics	U.S.	Bldg. 963	Essex Junction	Vermont	U.S.	4Mb DRAM MPU	1989/Q4	16,000	125	0.5	-	-	196.3	-	-	196.3
IBM Microelectronics	U.S.	Bldg. 973	Essex Junction	Vermont	U.S.	16Mb DRAM	1989/Q4	20,000	200	0.5	-	-	628.3	-	-	628.3
IBM Microelectronics	U.S.		Yasu-Gun	Shiga	Japan	64Mb DRAM pDSP	1990	15,000	200	0.35	-	-	-	471.2	-	471.2
IBM Microelectronics	U.S.	AMF	Corbeil-Essonnes		France	64Mb DRAM	1997	15,000	200	0.2	-	-	-	-	471.2	471.2
IBM Microelectronics	U.S.		Corbeil-Essonnes		France	DRAM SRAM		25,000	125	1	306.8	-	-	-	-	306.8
IBM Microelectronics	U.S.		Sindelfingen		Germany	DRAM SRAM DSP MPU Custom		25,000	125	1.5	306.8	-	-	-	-	306.8
IBM Microelectronics Total											**613.6**	**219.9**	**824.7**	**1,225.2**	**471.2**	**3,354.6**
IBM/Philips	U.S.		Boeblingen		Germany	4Mb DRAM	1989	20,000	200	0.8	-	628.3	-	-	-	628.3
IBM/Philips Total											-	**628.3**	-	-	-	**628.3**

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Headquarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
IBM/Siemens	U.S.	ACL	Corbeil-Essonnes		France	16Mb 64Mb DRAM	1991	30,000	200	0.35	-	-	-	942.5	-	942.5
IBM/Siemens Total											-	-	-	**942.5**	-	**942.5**
IBM/Toshiba	U.S.		Manassas	Virginia	U.S.	64Mb DRAM	1997/Q4	28,000	200	0.25	-	-	-	-	879.6	879.6
IBM/Toshiba Total											-	-	-	-	**879.6**	**879.6**
KTI Semiconductor	U.S./ Japan	Fab 1	Nishiwaki-Shi	Hyogo	Japan	16Mb DRAM ASIC	1992/Q4	10,000	200	0.5	-	-	314.2	-	-	314.2
KTI Semiconductor	U.S./ Japan	Fab 2	Nishiwaki-Shi	Hyogo	Japan	16Mb 64Mb DRAM ASIC	1997	5,500	200	0.35	-	-	-	172.8	-	172.8
KTI Semiconductor Total											-	-	**314.2**	**172.8**	-	**486.9**
LG Semicon	Korea	C1 Phase 1	Chongju-City	Chung-cheong-buk-do	Korea	1Mb 4Mb DRAM	1990	30,000	150	0.5	-	-	530.1	-	-	530.1
LG Semicon	Korea	C1 Phase 2	Chongju-City	Chung-cheong-buk-do	Korea	4Mb DRAM	1991	30,000	150	0.5	-	-	530.1	-	-	530.1
LG Semicon	Korea	C2 Phase 1	Chongju-City	Chung-cheong-buk-do	Korea	16Mb DRAM	1993	15,000	200	0.35	-	-	-	471.2	-	471.2
LG Semicon	Korea	C2 Phase 2	Chongju-City	Chung-cheong-buk-do	Korea	16Mb DRAM	1995	25,000	200	0.35	-	-	-	785.4	-	785.4
LG Semicon	Korea	C1 Phase 3	Chongju-City	Chung-cheong-buk-do	Korea	16Mb 64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
LG Semicon	Korea	G2	Gumi-City	Kyeong-sansbuk-do	Korea	64Mb DRAM	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
LG Semicon Total											-	-	**1,060.3**	**3,141.6**	-	**4,201.9**
Matsushita	Japan	Kyoto R&D	Kyoto-Shi	Niigata	Japan	DRAM	1991	500	200	0.25	-	-	-	-	15.7	15.7
Matsushita	Japan	S/C R6	Kadoma-Shi	Osaka	Japan	16Mb DRAM 64-bit MPU 64Mb DRAM	1991	500	150	0.35	-	-	-	8.8	-	8.8

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
[redacted]	Japan	Fab C	Puyallup	Washing-ton	U.S.	1Mb 4Mb DRAM 4-bit 8-bit MCU	1992	21,000	150	0.6	-	-	371.1	-	-	371.1
Matsushita	Japan	Fab C	Tonami-Shi	Toyama	Japan	16Mb DRAM	1996	10,000	200	0.35	-	-	-	314.2	-	314.2
Matsushita	Japan	Fab B	Tonami-Shi	Toyama	Japan	16Mb DRAM 16-bit MCU	1996	20,000	150	0.35	-	-	-	353.4	-	353.4
Matsushita	Japan	Fab D	Tonami-Shi	Toyama	Japan	16Mb 64Mb DRAM	1997	10,000	200	0.35	-	-	-	314.2	-	314.2
Matsushita	Japan	Fab D	Puyallup	Washing-ton	U.S.	DRAM Logic	1998/Q3	20,000	200	0.25	-	-	-	-	628.3	628.3
Matsushita Total											-	-	371.1	990.6	644.0	2,005.7
Micron Technology	U.S.	Fab 3	Boise	Idaho	U.S.	1Mb 4Mb 16Mb DRAM	1991	20,000	200	0.35	-	-	-	628.3	-	628.3
Micron Technology	U.S.	Fab 1	Boise	Idaho	U.S.	4Mb 16Mb DRAM VRAM SRAM	1996/Q4	18,000	200	0.35	-	-	-	565.5	-	565.5
Micron Technology	U.S.	Fab 2	Boise	Idaho	U.S.	4Mb 16Mb DRAM VRAM SRAM	1996/Q4	10,000	200	0.35	-	-	-	314.2	-	314.2
Micron Technology Total											-	-	-	1,508.0	-	1,508.0
Mitsubishi	Japan	B	Saijo-Shi	Ehime	Japan	DRAM MCU	1984	39,000	125	0.9	478.6	-	-	-	-	478.6
Mitsubishi	Japan	TA1	Kami-Gun	Kochi	Japan	4Mb DRAM 1Mb SRAM ASSP	1990	30,000	150	0.7	-	530.1	-	-	-	530.1
Mitsubishi	Japan		North Durham	North Carolina	U.S.	1Mb 4Mb DRAM	1990/Q4	9,000	150	0.5	-	-	159.0	-	-	159.0

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Mitsubishi	Japan	ULSI	Itami-Shi	Hyogo	Japan	16Mb 64Mb 256Mb DRAM ASIC Flash	1993	10,000	200	0.2	-	-	-	-	314.2	314.2
Mitsubishi	Japan	Sa2B	Saijo-Shi	Ehime	Japan	64Mb DRAM EDRAM	1993	16,000	200	0.4	-	-	-	502.7	-	502.7
Mitsubishi	Japan	D-1F	Kikuchi-Gun	Kuma-moto	Japan	16Mb DRAM	1994	10,000	200	0.35	-	-	-	314.2	-	314.2
Mitsubishi	Japan	D-1F-2	Kikuchi-Gun	Kuma-moto	Japan	16Mb DRAM	1996	15,000	200	0.35	-	-	-	471.2	-	471.2
Mitsubishi	Japan		Science Park	Hsin Chu	Taiwan	16Mb DRAM	1996	12,000	200	0.35	-	-	-	377.0	-	377.0
Mitsubishi	Japan	SA1F	Saijo-Shi	Ehime	Japan	64Mb DRAM EDRAM	1997	15,000	200	0.3	-	-	-	-	471.2	471.2
Mitsubishi	Japan		Alsdorf		Germany	4Mb 16Mb DRAM	1997/Q3	7,000	200	0.35	-	-	-	219.9	-	219.9
Mitsubishi Total											**478.6**	**530.1**	**159.0**	**1,885.0**	**785.4**	**3,838.1**
Mosel Vitelic	Taiwan	Fab 1A	Science Park	Hsin Chu	Taiwan	DRAM VRAM	1995	15,000	150	0.45	-	-	-	265.1	-	265.1
Mosel Vitelic	Taiwan	Fab 1B	Science Park	Hsin Chu	Taiwan	DRAM VRAM	1995/Q4	15,000	150	0.34	-	-	-	-	265.1	265.1
Mosel Vitelic	Taiwan	Fab 2	Science Park	Hsin Chu	Taiwan	16Mb 64Mb DRAM SRAM	1997/Q3	20,000	200	0.35	-	-	-	628.3	-	628.3
Mosel Vitelic Total											**-**	**-**	**-**	**893.4**	**265.1**	**1,158.5**
Motorola/ Siemens	U.S.	MOS 18	Richmond	Virginia	U.S.	64Mb 256Mb DRAM	1998/Q3	25,000	200	0.18	-	-	-	-	785.4	785.4
Motorola/Siemens Total											**-**	**-**	**-**	**-**	**785.4**	**785.4**
Nan Ya Technology	Taiwan	Fab 1	Tao Yuan		Taiwan	16Mb 64Mb DRAM	1996/Q3	30,000	200	0.45	-	-	-	942.5	-	942.5
Nan Ya Technology Total											**-**	**-**	**-**	**942.5**	**-**	**942.5**

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
NEC	Japan	Dif-5	Kumamoto -Shi	Kuma-moto	Japan	Logic DRAM MCU	1978	20,000	125	1.2	245.4	-	-	-	-	245.4
NEC	Japan	Dif-3	Otsu-Shi	Shiga	Japan	SRAM 4Mb DRAM Micro ASIC	1983	17,000	150	1	300.4	-	-	-	-	300.4
NEC	Japan	K-Line	Roseville	California	U.S.	DRAM ASIC MCU	1984	25,000	125	1	306.8	-	-	-	-	306.8
NEC	Japan	Dif-6	Kumamoto -Shi	Kuma-moto	Japan	1Mb DRAM MPU MCU Arrays	1987	30,000	150	1	530.1	-	-	-	-	530.1
NEC	Japan	1 Phase	Livingston	Scotland	U.K.	DRAM SRAM MPU	1987	25,000	150	0.5	-	-	441.8	-	-	441.8
NEC	Japan	Dif-1	Asa-Gun	Yamagu-chi	Japan	4Mb DRAM 1Mb SRAM MPU FLASH	1988	45,000	150	0.8	-	795.2	-	-	-	795.2
NEC	Japan	Dif-7	Kumamoto -Shi	Kuma-moto	Japan	MCU 4Mb DRAM ASIC	1988	30,000	150	0.8	-	530.1	-	-	-	530.1
NEC	Japan	G-1	Sagami-hara-Shi	Kanagawa	Japan	16Mb DRAM ASIC MPU 4Mb ROM	1988	10,000	150	0.8	-	176.7	-	-	-	176.7
NEC	Japan	Dif-1	Higashi Hiroshi ma-Shi	Hiroshima	Japan	4Mb DRAM SRAM MPU 4Mb ROM	1990/Q4	30,000	150	0.6	-	-	530.1	-	-	530.1
NEC	Japan	M-Line	Roseville	California	U.S.	16Mb DRAM	1991	35,000	150	0.5	-	-	618.5	-	-	618.5

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Headquarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm) > 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
NEC	Japan	Dif-2 (Bldg. C)	Asa-Gun	Yamaguchi	Japan	4Mb 16Mb DRAM ASIC	1993	45,000	150	0.5	-	-	795.2	-	-	795.2
NEC	Japan	Dif-8-1	Kumamoto -Shi	Kumamoto	Japan	16Mb DRAM 4Mb SRAM RISC ASIC	1994	60,000	200	0.35	-	-	-	1,885.0	-	1,885.0
NEC	Japan	Dif-2	Higashi Hiroshima-Shi	Hiroshima	Japan	16Mb 64Mb DRAM ASIC RISC	1996	33,000	200	0.25	-	-	-	-	1,036.7	1,036.7
NEC	Japan	2 Phase	Livingston	Scotland	U.K.	16Mb 64Mb DRAM	1996/Q4	20,000	200	0.35	-	-	-	628.3	-	628.3
NEC	Japan	G-Line	Roseville	California	U.S.	64Mb 256Mb DRAM	1998	20,000	200	0.25	On Hold					-
NEC	Japan		Beijing		China	MCU Logic 4Mb DRAM ASIC	2000	5,000	150	0.7	-	88.4	-	-	-	88.4
NEC Total											**1,382.8**	**1,590.4**	**2,385.6**	**2,513.3**	**1,036.7**	**8,908.9**
Nippon Steel Semiconductor	Japan	M2	Tateyama-Shi	Chiba	Japan	1Mb 4Mb DRAM Flash Logic	1988	12,000	150	0.5	-	-	212.1	-	-	212.1
Nippon Steel Semiconductor	Japan	M3	Tateyama-Shi	Chiba	Japan	4Mb 16Mb DRAM	1990	20,000	150	0.5	-	-	353.4	-	-	353.4
Nippon Steel Semiconductor	Japan	Electronics Lab	Sagamihara-Shi	Kanagawa	Japan	ASIC 16Mb 64Mb DRAM	1991/Q4	500	150	0.35	-	-	-	8.8	-	8.8
Nippon Steel Semiconductor	Japan		Tateyama-Shi	Chiba	Japan	16Mb DRAM	1996/Q3	15,000	200		Status Unknown					-
Nippon Steel Semiconductor	Japan	N1	Tateyama-Shi	Chiba	Japan	16Mb DRAM	1997	10,000	200	0.35	-	-	-	314.2	-	314.2

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Headquarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Nippon Steel Semiconductor Total											-	-	565.5	323.0	-	888.5
Oki	Japan	M3	Miyazaki-Gun	Miyazaki	Japan	4Mb 16Mb DRAM	1967	30,000	150	0.4	-	-	-	530.1	-	530.1
Oki	Japan	S1	Kurokawa-Gun	Miyagi	Japan	4Mb DRAM VRAM 1Mb SRAM 16Mb MROM	1981	30,000	150	0.5	-	-	530.1	-	-	530.1
Oki	Japan	V3	Hachioji-Shi	Tokyo	Japan	16Mb 64Mb DRAM Micro Gate Array	1989	2,000	150	0.5	-	-	35.3	-	-	35.3
Oki	Japan	M2	Miyazaki-Gun	Miyazaki	Japan	1Mb DRAM 256Kb SRAM 4Mb MROM	1991	60,000	125	0.8	-	736.3	-	-	-	736.3
Oki	Japan	U1	Hachioji-Shi	Tokyo	Japan	64Mb 256Mb DRAM Micro Logic	1992	1,000	150	0.3	-	-	-	-	17.7	17.7
Oki	Japan	S2	Kurokawa-Gun	Miyagi	Japan	16Mb 64Mb DRAM	1996	15,000	200	0.3	-	-	-	-	471.2	471.2
Oki Total											-	736.3	565.5	530.1	488.9	2,320.9
Powerchip (Elitegroup)	Japan/ Taiwan	Fab 1	Science Park	Hsin Chu	Taiwan	16Mb DRAM	1996/Q3	25,000	200	0.4	-	-	-	785.4	-	785.4
Powerchip (Elitegroup) Total											-	-	-	785.4	-	785.4
Samsung	Korea	Fab 3	Kiheung-Up	Kyungki-Do	Korea	1Mb DRAM SRAM	1988/Q3	35,000	150	0.8	-	618.5	-	-	-	618.5
Samsung	Korea	Fab 4	Kiheung-Up	Kyungki-Do	Korea	4Mb DRAM SRAM	1990	35,000	150	0.5	-	-	618.5	-	-	618.5

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Samsung	Korea	Fab 5	Kiheung-Up	Kyungki-Do	Korea	16Mb DRAM	1993	25,000	200	0.5	-	-	785.4	-	-	785.4
Samsung	Korea	Fab 6	Kiheung-Up	Kyungki-Do	Korea	16Mb 64Mb DRAM	1995	30,000	200	0.35	-	-	-	942.5	-	942.5
Samsung	Korea	Fab 7	Kiheung-Up	Kyungki-Do	Korea	16Mb 64Mb DRAM	1996	20,000	200	0.35	-	-	-	628.3	-	628.3
Samsung	Korea	Fab 8	Kiheung-Up	Kyungki-Do	Korea	64Mb DRAM	1997	25,000	200	0.3	-	-	-	-	785.4	785.4
Samsung	Korea		Austin	Texas	U.S.	64Mb DRAM	1998	25,000	200	0.3	-	-	-	-	785.4	785.4
Samsung Total											**-**	**618.5**	**1,403.9**	**1,570.8**	**1,570.8**	**5,164.0**
Sanyo	Japan	A 1	Ojiya-Shi	Niigata	Japan	1Mb 4Mb DRAM 4-bit 8-bit MCU DSP	1985	35,000	125	0.8	-	429.5	-	-	-	429.5
Sanyo	Japan	C 2	Ojiya-Shi	Niigata	Japan	DRAM	1994	25,000	150	0.85	441.8	-	-	-	-	441.8
Sanyo Total											**441.8**	**429.5**	**-**	**-**	**-**	**871.3**
Sharp	Japan	Factory 2	Fukuyama -Shi	Hiroshima	Japan	16Mb MROM DRAM SRAM	1989	40,000	150	0.6	-	-	706.9	-	-	706.9
Sharp	Japan	Factory 4	Fukuyama -Shi	Hiroshima	Japan	Flash 64Mb DRAM	1998	16,000	200	0.25	-	-	-	-	502.7	502.7
Sharp Total											**-**	**-**	**706.9**	**-**	**502.7**	**1,209.5**
Siemens	Germany	H15, H16, H17	Regens-burg	Bavaria	Germany	4Mb DRAM ASIC ASSP 1Mb DRAM ASIC	1986/Q3	46,600	150	0.35	-	-	-	823.5	-	823.5
Siemens	Germany	SIMEC (Lines 1 and 2)	Dresden	Saxonia	Germany	16Mb 64Mb DRAM	1996/Q3	30,000	200	0.25	-	-	-	-	942.5	942.5
Siemens	Germany		Newcastle-upon-Tyne	England	U.K.	DRAM	1997/Q3	16,000	200	0.25	-	-	-	-	565.5	565.5

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Siemens Total											-	-	-	823.5	1,308.0	2,331.5
Taiwan Semi-conductor Mfg. Co. (TSMC)	Taiwan/ Neth-erlands	Fab 3	Science Park	Hsin Chu	Taiwan	DRAM SRAM ROM Logic Custom	1995	30,000	200	0.35	-	-	-	942.5	-	942.5
Taiwan Semi-conductor Mfg. Co. (TSMC)	Taiwan/ Neth-erlands	Fab 4	Science Park	Hsin Chu	Taiwan	Logic Custom MPU Mem-ory 64Mb DRAM	1996/Q4	25,000	200	0.35	-	-	-	785.4	-	785.4
Taiwan Semi-conductor Mfg. Co. (TSMC)	Taiwan/ Neth-erlands	Fab 6	Camas	Washing-ton	U.S.	DRAM SRAM Mixed Signal ASIC	1998	30,000	200	0.25	-	-	-	-	942.5	942.5
Taiwan Semiconductor Mfg. Co. (TSMC) Total											-	-	-	1,727.9	942.5	2,670.4
Tech Semicon-ductor	Sin-gapore /U.S.	Fab 1	Singapore		Sin-gapore	16Mb DRAM	1993/Q3	12,000	200	0.5	-	-	377.0	-	-	377.0
Tech Semicon-ductor	Sin-gapore /U.S.	Fab 2	Singapore		Sin-gapore	16Mb DRAM	1996/Q3	25,000	200	0.35	-	-	-	785.4	-	785.4
Tech Semiconductor Total											-	-	377.0	785.4	-	1,162.4
Texas Instruments	U.S.	AMOS Phase 1	Avezzano	AQ	Italy	4Mb 16Mb DRAM 4Mb Flash	1990	22,000	200	0.25	-	-	-	-	691.2	691.2
Texas Instruments	U.S.	DMOS 5 Phase 1	Dallas	Texas	U.S.	16Mb DRAM	1995	16,000	200	0.5	-	-	502.7	-	-	502.7
Texas Instruments	U.S.	AMOS Phase 2	Avezzano	AQ	Italy	16Mb DRAM	1996	20,000	200	0.25	-	-	-	-	628.3	628.3
Texas Instruments	U.S.	DMOS 5 Phase 2	Dallas	Texas	U.S.	64Mb 256Mb DRAM	1997	16,000	200	0.35	-	-	-	502.7	-	502.7
Texas Instruments	U.S.	Miho 6	Inashiki-Gun	Ibaragi	Japan	1Mb 4Mb DRAM ASSP MPU		15,000	150	0.8	-	265.1	-	-	-	265.1

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Headquarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Texas Instruments Total											-	265.1	502.7	502.7	1,319.5	2,589.9
Texas Instruments/ Acer	U.S.	Fab 1A	Science Park	Hsin Chu	Taiwan	4Mb DRAM	1991/Q4	22,000	150	0.5	-	-	388.8	-	-	388.8
Texas Instruments/ Acer	U.S.	Fab 1B	Science Park	Hsin Chu	Taiwan	4Mb 16Mb DRAM	1995/Q3	25,000	200	0.35	-	-	-	785.4	-	785.4
Texas Instruments/ Acer	U.S.	Fab 2	Science Park	Hsin Chu	Taiwan	16Mb 64Mb DRAM	1997/Q3	50,000	200	0.35	On Hold					-
Texas Instruments/Acer Total											-	-	388.8	785.4	-	1,174.2
Texas Instruments/ Alphatec	U.S./ Thailand	Phase 1	Bangkok	Chachaer-sao	Thailand	16Mb 64Mb DRAM	1997/Q3	20,000	200	0.35	-	-	-	628.3	-	628.3
Texas Instruments/Alphatec Total											-	-	-	628.3	-	628.3
Tohoku Semi-conductor	Japan/ U.S.	Step 1	Sendai-Shi	Miyagi	Japan	1Mb DRAM MCU MPU	1988	7,500	150	1	132.5	-	-	-	-	132.5
Tohoku Semi-conductor	Japan/ U.S.	Step 2	Sendai-Shi	Miyagi	Japan	4Mb DRAM MPU MCU	1991	10,000	150	0.8	-	176.7	-	-	-	176.7
Tohoku Semi-conductor	Japan/ U.S.	Step 3	Sendai-Shi	Miyagi	Japan	16Mb 64Mb DRAM	1995/Q3	15,000	200	0.35	-	-	-	471.2	-	471.2
Tohoku Semiconductor Total											132.5	176.7	-	471.2	-	780.5
Toshiba	Japan	C-Cubed 3	Oita-Shi	Oita	Japan	MCU ASIC DRAM SRAM	1989	32,000	125	1	392.7	-	-	-	-	392.7
Toshiba	Japan	Bldg.108 D-2	Kawasaki-Shi	Kanagawa	Japan	16Mb 64Mb DRAM Flash	1990	1,300	200	0.35	-	-	-	40.8	-	40.8
Toshiba	Japan	C-Cubed 4	Oita-Shi	Oita	Japan	4Mb 16MDRAM	1991	40,000	150	0.5	-	-	706.9	-	-	706.9
Toshiba	Japan	Y-Cubed, No. 1-Mod 1	Yokkaichi-Shi	Mie	Japan	4Mb 16Mb DRAM	1993	10,000	200	0.5	-	-	314.2	-	-	314.2

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Headquarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm) > 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Toshiba	Japan	Y-Cubed, No. 1-Mod 2	Yokkaichi-Shi	Mie	Japan	4Mb 16Mb DRAM	1994	25,000	200	0.35	-	-	-	785.4	-	785.4
Toshiba	Japan	Y-Cubed, No. 2	Yokkaichi-Shi	Mie	Japan	16Mb DRAM 64Mb DRAM 256Mb DRAM	1996/Q3	28,000	200	0.35	-	-	-	879.6	-	879.6
Toshiba	Japan	Adv. Micro-electronic Ctr.	Isogo	Yokohama	Japan	256Mb 1Gb DRAM Flash ASIC	1997	1,800	200	0.15	-	-	-	-	56.5	56.5
Toshiba	Japan	Step 5	Kitakami-Shi	Iwate	Japan	16Mb 64Mb DRAM Logic	1997	30,000	200	0.35	-	-	-	942.5	-	942.5
Toshiba Total											**392.7**	**-**	**1,021.0**	**2,648.4**	**56.5**	**4,118.6**
Twinstar Semiconductor	Japan/ U.S.	Twinstar	Richardson	Texas	U.S.	16Mb 64Mb DRAM	1996/Q3	15,000	200	0.3	-	-	-	-	471.2	471.2
Twinstar Semiconductor Total											**-**	**-**	**-**	**-**	**471.2**	**471.2**
Vanguard International	Taiwan	Fab 1	Science Park	Hsin Chu	Taiwan	4Mb DRAM	1991	4,000	150	0.5	-	-	70.7	-	-	70.7
Vanguard International	Taiwan	Fab 1A	Science Park	Hsin Chu	Taiwan	4Mb 16Mb DRAM	1995/Q3	16,000	200	0.35	-	-	-	502.7	-	502.7
Vanguard International	Taiwan	Fab 1B	Science Park	Hsin Chu	Taiwan	16Mb DRAM	1997	16,000	200	0.35	On Hold					-
Vanguard International	Taiwan	Fab 2	Science Park	Hsin Chu	Taiwan	4Mb DRAM 16Mb DRAM 1Mb Sync SRAM	1998	40,000	200	0.18	On Hold					-
Vanguard International Total											**-**	**-**	**70.7**	**502.7**	**-**	**573.3**

Table 7-1 (Continued)
DRAM Capacity by Feature Capability (Millions of Square Millimeters)

Company	Head-quarters Country	Fab Name	City	Prefecture	Country	Products	Initial Production Date	Maximum Monthly Starts	Maximum Diameter (mm)	Minimum Line Width (Microns)	Maximum Silicon Area Capacity (Millions of Sq. mm)					
											> 0.8m	0.8 - 0.65m	0.64 - 0.5m	0.49 - 0.35m	< 0.35m	Total
Winbond	Taiwan	Fab 2	Science Park	Hsin Chu	Taiwan	DRAM	1992/Q4	35,000	150	0.5	-	-	618.5	-	-	618.5
Winbond	Taiwan	Fab 4	Science Park	Hsin Chu	Taiwan	DRAM	1997/Q3	15,000	200	0.35	On Hold					-
Winbond Total											**-**	**-**	**618.5**	**-**	**-**	**618.5**
Total											**4,374.7**	**6,349.3**	**13,334.9**	**32,025.0**	**14,466.6**	**72,550.5**

Source: Dataquest (December 1996)

Chapter 8
Definitions

Demand: The number of shipments of a product that Dataquest estimates to be sustainable in a market at the price forecast by Dataquest for that time. If the price were lower, demand would increase. If the price were higher, demand would decrease. Demand is used to determine whether the market is undersupplied or oversupplied.

Deskside PC: PCs designed to stand vertically beside or underneath a user's desk. The primary design distinguishes a deskside from a desktop unit in that the deskside unit keeps a sideways orientation and that drive bays usually remain horizontal when the central processor (CPU) is placed on the floor.

Desktop PC: All systems not otherwise classified into categories of deskside computers or portable computers. They are PCs intended for use on a user's desktop or work surface and are not designed to be moved readily from place to place. Models switchable between desktop and deskside are included in the desktop category.

Digital phone answering machine: Telephone answering machines for individual telephone lines using MOS memory technology for outgoing message storage, incoming message storage, or both.

Facsimile: A machine that scans and encodes a document into electrical signals, transmits these electrical signals over a telephone/data line, then reconstructs the signals to print an exact duplicate of the original document on paper at the receiving end (generically called a fax).

Game: Video game and CD-ROM players are microprocessor-based devices that are handheld or console-based and play video games housed on cartridges or CD-ROMs.

Industrial board: A controller board, usually based on an x86 processor, that is used in embedded industrial control and medical applications. These boards are not officially counted by Dataquest, and the numbers used in this survey are estimates based on processor shipment numbers, secondary sources, and primary inputs from industrial board producers.

Laptop PC: Systems that meet all criteria for a transportable personal computer but are smaller and lighter. The system is completely self-contained and can be carried as a single unit, which includes a keyboard, a display, mass storage, and main system unit. It is also distinguished from a transportable by its case design, which is typically a clamshell. System weight is usually less than 15 pounds. Its power source is either AC or DC. This category is now included under "transportable PC."

Mainframe computer: A general-purpose information system with a starting price range of $100,000 or more. CPU bit width ranges from 32 to 64 bits. Physical environment can be either with or without special environmental controls and requires full-time support by professional computer systems support staff. Number of concurrent users is upward of 100.

Dataquest views a mainframe system shipment as the CPU, the basic storage configuration (not including direct-access storage devices), the native operating system (the system must be bootable), and the operator's console. Dataquest does not routinely count upgrades unless the system footprint changes.

Midrange computer: The midrange product category includes all systems that fall between workstations and mainframes. These are multiuser systems that may or may not run proprietary operating systems. Midrange products have a wide price range, from as low as $10,000 to more than $1 million. Dataquest has included microcomputers, minicomputers, and superminicomputers in this product segment in the past. With the evolution of client/server computing and the systems that define this paradigm, traditional midrange product categories are becoming obsolete. Hewlett-Packard's HP 9000 and HP 3000, Digital Equipment Corporation's VAX systems, and the IBM AS/400 line are joined by the dedicated server products from suppliers such as Auspex Systems Inc., NetFrame Systems Inc., and Tricord Systems Inc. to make up the midrange product category. Office systems, proprietary turnkey computing solutions common in Japan, are also included in the midrange category. Systems designed as servers from workstation suppliers are also included here.

Network hub/router: A shared media hub is a LAN device that connects multiple PCs through one single node on a network, allowing central control for different optional functionalities such as wide area network (WAN) connectivity, multiple media support, multiple technology support, and network management. A router is a class of network controller that determines the best routing for data transmission between a transmitter (sender) and a receiver. Routers operate at Layer 3 of the ISOSI model.

Notebook PC: Systems that meet all criteria for a laptop DC personal computer but are smaller and lighter. The case style typically measures 8.5 x 11 inches or A4 size. Weight typically is less than 8 pounds with the battery.

Notepad: A subcategory of the subnotebook product type distinguished by a pen-based operating system and a pen rather than a keyboard as a primary input device.

Oversupply: An indication of an oversupplied market is low prices and growing inventories.

Page printer: A printer that prints one page at a time.

Set-top box: Digital cable converter boxes that sit on top of TVs and act as converter devices for digital information over cable television (CATV), telephone, or wireless networks to television sets. These boxes contain a general-purpose microprocessor or a high-powered digital signal processor capable of digital transmission, reception, and decompression.

Storage: A collective term for computer hard disk drives and CD-ROMs, where DRAM is often used as a cache memory. Since static random access memory (SRAM) is sometimes used in place of DRAM, the DRAM consumption for this category appears unusually low to account for limited DRAM penetration into this equipment segment.

Subnotebook PC: Systems that meet all the criteria for a notebook PC but are lighter and do not have an internal floppy disk drive. They typically weigh 4 pounds or less. This segment corresponds to the "ultraportable" category in the newly resegmented PC forecast produced by Dataquest's Computer Systems and Peripherals group.

Supercomputer: A high-performance computer designed for numerically intensive applications. The current price ranges from about $100,000 to $20 million. It is a system priced at more than $2 million, mainly used for batch applications, scientific, engineering, and other computation-oriented problems, or other very heavy, numerically intensive applications. Supercomputers require special environmental controls and cooling techniques. Performance speeds range upward from 50 mflops.

Tablet PC: A subcategory of the notebook product type, the tablet is distinguished by a pen-based operating system that uses a pen, rather than a keyboard, as a primary input device.

Transportable PC: Systems that meet all other personal computer criteria but are designed to be easily moved from place to place. The case style may be identified as a lunch box, and the system is completely self-contained and can be carried as a single unit, which includes a keyboard, a display, mass storage, and the main system unit. Its primary source of power is AC power. Its typical weight is 18 to 20 pounds. This segment corresponds to the "other mobile" category in the newly resegmented PC forecast produced by Dataquest's Computers and Peripherals group.

Undersupply: An indication of an undersupplied market is long lead-times, high prices, and product allocation.

Upgrade motherboard: An entire PC motherboard that can be retrofitted into an existing PC chassis in the installed base of PCs. Dataquest does not count these boards as PCs in PC statistics. These numbers are based in part on Dataquest MPU shipments and analyst estimates of upgrade activity.

Workstation: Dataquest classifies workstations by a composite of features, including their hardware and software. Workstations are typically based on reduced-instruction-set computing (RISC) processor architecture with a high-performance bus structure, graphics, and operating system. In general, a workstation must come standard with integrated floating-point processing, integrated networking, and a 32-bit multitasking operating system, as well as offer a configuration that has high-resolution graphics capabilities (typically 1-megapixel display). We do not determine a workstation architecture by its usage (that is, single-user, server, or multiuser). Instead, computers are classified by the primary market for which they are designed.

Appendix A
Worldwide DRAM Fabs

Tables A-1 through A-4 are the tables presented in the previous report (DSDR-MS-96Q3).

Table A-1
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	Siemens		Balan-strasse		NA	2	24,000	4							
Europe	Siemens		Mega 1	1987	1M/4M DRAM	0.6	28,000	6		50	30	85	70	1,856,400	635,040
Europe	Siemens		Regens-burg	1994	16M DRAM	0.5	5,000	8	28,000						
Europe	Siemens	Dresden		1995	64M DRAM	0.35	8,000	8							
	Siemens Total						**65,000**		**28,000**					**1,856,400**	**635,040**
Japan	Fujitsu	Tokyo	NA	1995	256M DRAM	0.35	3,000	8							
Japan	Fujitsu	Iwate	No. 3	1987	1M/4M/16M DRAM SRAM ROM	0.8	25,000	6		45		85		1,912,500	
Japan	Fujitsu	Iwate	No. 4	1990	4M/16M DRAM, Flash, SRAM, ASIC	0.5	30,000	6	25,000	45	20	85	65	1,912,500	455,000
Japan	Fujitsu	Iwate	No. 4-2	1995/Q4	16M DRAM	0.35	20,000	8	25,000						
Japan	Fujitsu	Mie	No. 2	1987	Logic, Gate Arrays, 4M DRAM	0.8	10,000	6		30		85		39,780	
Japan	Fujitsu	Mie	No. 3 Phase 2	1994	4M/16M DRAM, SRAM, MPU	0.25	500	8	1,000	50	20	80	65	90,000	16,250
Japan	Fujitsu	Mie	No. 3 Phase 1	1992	16M DRAM	0.5	15,000	6	500	20	40	85	70	318,240	470,400
Europe	Fujitsu	Newton Aycliffe	Phase 1	1991	4M/16M DRAM, ASIC	0.8	5,600	6	12,000	100	0	85	65	1,700,000	-
Europe	Fujitsu	Newton Aycliffe	Phase 2	1994	16M DRAM	0.5	14,000	6	10,000	50	40	85	65	935,000	364,000
U.S.A.	Fujitsu	Gresham	No. 1	1990	1M, 4M DRAM	0.8	13,000	6	10,000	30		80		624,000	
U.S.A.	Fujitsu	Gresham	No. 2-2	1997	16M/64M DRAM	0.32	10,000	8	13,000						
	Fujitsu Total						**146,100**		**96,500**					**7,532,020**	**1,305,650**
Japan	Hitachi	Chiba	D3	1990	4M/16M DRAM	0.8	25,000	6		20		85		795,600	
Japan	Hitachi	Gunma	No.2	1991	256K SRAM, 4M DRAM, MCU	0.8	20,000	6	30,000	25		85		663,000	
Japan	Hitachi	Hokkaido	Chitose 2	1990	4M DRAM, 1M SRAM, EEPROM, ROM	0.8	15,000	6	20,000	15		85		298,350	

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Hitachi	Hokkaido	Chitose 1	1988	1M SRAM, 4M DRAM, MPU	0.8	15,000	6	15,000	20		85		397,800	
Japan	Hitachi	Hokkaido	Chitose 2	1998	64M DRAM	0.35	10,000	8	15,000						
Japan	Hitachi	Tokyo	D4/D5	1994	64M DRAM	0.35	3,000	8							
Japan	Hitachi	Ibaraki	N-2 Phase 1	1994/Q4	16M DRAM	0.5	10,000	8		25	40	80	65	720,000	624,000
Japan	Hitachi	Ibaraki	N2-2	1996	16M/64M DRAM	0.35	20,000	8	8,000						
Japan	Hitachi	Ibaraki	N1-1	1983	1M/4M DRAM	0.8	15,000	6		40		85		795,600	
Japan	Hitachi	Ibaraki	N1-2	1988	4M/16M DRAM	0.8	20,000	6	15,000	40		85		1,360,000	
Japan	Hitachi	Tokyo	R&D 2	1990	4M/16M DRAM	0.5	4,000	6	20,000	50	35	85	60	265,200	109,200
Japan	Hitachi	Yamanashi	Imasuwa	1990	4M DRAM, 4M SRAM, 16M Proto-DRAM	0.6	25,000	6	4,000	50	10	85	60	2,125,000	195,000
Japan	Hitachi	Yamanashi	K-2	1990	4M/16M DRAM	0.5	4,000	8	25,000	0	50	80	65	-	243,750
Japan	Hitachi	Yamanashi	No. K4-3	1989	4M DRAM, 1M SRAM EPROM	0.8	10,000	6	3,000	50		85		663,000	
Japan	Hitachi/Tobu Semicon-ductor		NA	1990		0.6	17,000	6	10,000	35		80		742,560	
Europe	Hitachi	Landshut	E2	1992	4M, 16M DRAM 1M SRAM	0.5	16,000	8	17,000	40	40	80	60	1,152,000	480,000
U.S.A.	Hitachi	Irving	U 1	1989	MPU MCU 256K SRAM 1/4M DRAM	0.5	16,000	8	8,000	60		85		1,632,000	
U.S.A.	Hitachi	Irving	Phase 2	1993	CBIC 16M DRAM 4M SRAM	0.6	5,000	8	16,000		50		65		406,250
U.S.A.	Hitachi/TI	Dallas	NA	1996	16M/64M DRAM	0.35		8	5,000						
	Hitachi Total						**250,000**		**211,000**					**11,610,110**	**2,058,200**
Japan	IBM	Shiga	NA	1990	4M/16M DRAM	0.6	6,000	8		60	0	85	60	1,193,400	-
Europe	IBM	Sindelfingen	NA	1989	4M/16M DRAM	0.8	20,000	8	5,200	50	0	80	60	2,700,000	-

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	IBM	Corbeil-Essonnes	NA	1989	1M DRAM		7,000	8	15,000						
U.S.A.	IBM	East Fishkill	NA	-	NA	0.8	20,000	8							
U.S.A.	IBM	Essex Junction	Bldg. 970	1988	16M DRAM		24,000	8		50		80		4,320,000	
U.S.A.	IBM	Essex Junction	Bldg. 973	1989	16M DRAM	0.5	20,000	8	24,000		60		60		1,080,000
U.S.A.	IBM	Manassas	VHSIC	1989	Memory, MPU, ASIC, MIL	0.8	1,600	5	12,000						
U.S.A.	IBM	Essex Junction	Bldg. 963	1989	1M DRAM	1	16,000	8							
Europe	IBM/Siemens	Corbeil-Essonnes	ACL	1992	16M DRAM	0.4	16,100	8			60		60		720,000
	IBM Total						**130,700**		**56,200**					**8,213,400**	**1,800,000**
Japan	Matsushita	Kyoto	LAB	1994	16M/64M DRAM	0.35	1,000	8			50		60		75,000
Japan	Matsushita	Toyama	Fab 1	1994	4M/16M DRAM, MCU, ASIC	0.5	20,000	6	1,000	45	40	80	60	720,000	259,200
Japan	Matsushita	Toyama	Fab C-2	1990	4M/16M/64M DRAM, SRAM	0.5	24,000	6	10,000	45	50	80	60	864,000	388,800
Japan	Matsushita	Tonami	Fab 2	1996	16M DRAM, ASIC	0.35	20,000	8	12,000						
U.S.A.	Matsushita	Puyallup	NA	1991	1M/4M DRAM, MCU, Gate Arrays	0.8	15,000	6		0		80		-	
	Matsushita Total						**80,000**		**23,000**					**1,584,000**	**723,000**
Japan	Mitsubishi	Ehime	D-1F	1996	64M DRAM	0.35	20,000	8							
Japan	Mitsubishi	Ehime	SA2A	1991	4M/16M DRAM	0.5	20,000	6	-	25	50	85	70	850,000	756,000
Japan	Mitsubishi	Ehime	SA2B	1994	4M/16M DRAM	0.5	16,000	8	20,000	25	60	80	60	1,040,000	1,170,000
Japan	Mitsubishi	Osaka	ULSI	1993	16M/64M DRAM	0.35	10,000	8	13,000		70		60		525,000
Japan	Mitsubishi	Kumamoto		1996/Q2	16M/64M DRAM	0.35	15,000	8	5,000						
Japan	Mitsubishi	Kochi	TA1	1990	4M DRAM, 1M SRAM	0.7	30,000	6		60		85		3,060,000	
U.S.A.	Mitsubishi		NA	1990	1M/4M DRAM	0.9	7,800	5	30,000	0		85		-	
U.S.A.	Mitsubishi	Alsodorf	NA	1997	16M DRAM	0.35	7,000	8	7,800						
	Mitsubishi Total						125,800		75,800					4,950,000	2,451,000

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	NEC	Hiroshima	Dif-1	1990	4M DRAM, SRAM, MPU, 4M ROM	0.6	30,000	6		50	10	85	70	2,550,000	294,000
Japan	NEC	Hiroshima	Dif-2	1995	16M DRAM, ASIC, RISC	0.35	10,000	8	30,000	0	70	80	65	-	568,750
Japan	NEC	Kanagawa	G-1	1988	4M DRAM, ASIC, MPU, 4M ROM	0.8	10,000	6	5,000	30		85		397,800	
Japan	NEC	Kumamoto	Dif-7	1988	MCU, 4M DRAM, ASIC	0.8	30,000	6	10,000	20	0	85	70	795,600	-
Japan	NEC	Kumamoto	Dif-8	1994/Q4	16M DRAM, 4M SRAM, RISC MPU	0.35	15,000	8	30,000	40	45	85	65	1,632,000	877,500
Japan	NEC	Kumamoto	Dif-8-2	1998	64M/256M DRAM	0.25	30,000	8	12,000						
Japan	NEC	Yamaguchi	Dif-1	1988	4M/16M DRAM	0.8	45,000	6		40		85		2,040,000	
Japan	NEC	Yamaguchi	Dif 2	1993	16M/4M DRAM	0.5	45,000	6	30,000	40	45	85	65	678,912	524,160
Europe	NEC	Livingston, West Lothian	Phase 1	1987	4M/16M DRAM	0.7	25,000	5	12,800	0					
Europe	NEC	Livingston, West Lothian	Phase 2	1991	4M DRAM, 256K SRAM, MPR, MPU	0.35	10,000	6		80		85		2,121,600	
Europe	NEC	Livingston, West Lothian	Phase 3	1997/Q1	16M/64M DRAM	0.35	10,000	8	20,000						
U.S.A.	NEC	Roseville	M-Line	1991	4M/16M DRAM	0.5	13,000	6		20	75	85	55	583,440	1,089,000
U.S.A.	NEC	Roseville	M-Line 2	1994	4M/16M DRAM	0.5	17,000	6	22,000						
	NEC Total						**290,000**		**171,800**					**10,799,352**	**3,353,410**
Japan	Nittetsu Semiconductor	Chiba	M1	1985	1M DRAM, 8-bit MPU, ASIC, Linear	1	20,000	5							
Japan	Nittetsu Semiconductor	Chiba	M2	1988	1M DRAM, 2M/4M/8M Flash	0.8	15,000	6	20,000						
Japan	Nittetsu Semiconductor	Chiba	M3	1990	4M DRAM	0.5	15,000	6	15,000	80	10	85	60	1,591,200	97,200
	Nittetsu Semiconductor Total						**50,000**		**35,000**					**1,591,200**	**97,200**

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Oki	Miyagi	NA	1989	Gate Arrays, 1M DRAM, VRAM, Logic	0.8	20,000	6							
Japan	Oki	Miyagi	S1	1990	4M DRAM, VRAM, 1M SRAM	0.45	30,000	6	1,000	55		85		2,103,750	
Japan	Oki	Miyagi	S2	1995	16M/64M DRAM	0.35	15,000	8	25,000						
Japan	Oki	Miyazaki	M1	1988	DRAM, SRAM, Gate Arrays, MPU	1.5	30,000	4	-						
Japan	Oki	Miyazaki	M2	1984	DRAM, EEPROM, ASIC, SRAM	0.8	20,000	5		0		85		-	
Japan	Oki	Miyazaki	M3	1991	4M/16M DRAM, 90K Gate Arrays	0.45	30,000	6	28,000	75	20	85	60	3,098,250	453,600
Japan	Oki	Tokyo	V-1	1979	All (Trial)		50,000	3	27,000						
U.S.A.	Oki	Tualatin	NA	1994	ASIC, DRAM		15,000	6							
	Oki Total						**210,000**		**81,000**					**5,202,000**	**453,600**
Japan	Tohoku Semi-conductor	Miyagi	Step 1	1988	1M DRAM, MCU, MPU, SRAM	1	7,500	6							
Japan	Tohoku Semi-conductor	Miyagi	Step 2	1991	4M DRAM	0.8	20,000	6							
Japan	Tohoku Semi-conductor	Miyagi	Step 3	1995	16M/64M DRAM	0.35	15,000	8		100		85		2,652,000	
Europe	Motorola	East Kilbride	MOS 9	1990	SRAM, 1M DRAM, MPU	0.8	22,000	6	20,000		80		50		72,000
	Motorola Total[a]						**64,500**		**20,000**					**2,652,000**	**72,000**
Japan	Toshiba	Kanagawa	Fab B	1990	4M/16M DRAM	0.5	1,300	8		40	50	80	55	124,800	71,500
Japan	Toshiba	Kanagawa	ULSI LAB	1993	64M DRAM	0.35	3,000	8	1,300						
Japan	Toshiba	Mie	Y-Cubed, No. 1	1993	4M/16M DRAM	0.5	9,000	8		35	55	85	60	803,250	594,000
Japan	Toshiba	Mie	Y-Cubed, No. 2	1996/Q4	64M DRAM	0.35	25,000	8	9,000						
Japan	Toshiba	Mie	NA	1996/Q4	64M DRAM	0.35	40,000	8							
Japan	Toshiba	Oita	C-Cubed, No. 1	1986	MCU, ROM, RAM	0.8	33,000	5							
Japan	Toshiba	Oita	C-Cubed, No. 2	1987	MCU, ROM, RAM	0.8	32,000	5							

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Toshiba	Oita	C-Cubed, No. 3	1987	RAM	0.7	60,000	6		60	30	85	65	3,978,000	1,267,500
Japan	Toshiba	Oita	C-Cubed, No. 4	1991	RAM	0.5	40,000	6	50,000	60	30	85	65	2,943,720	937,950
Japan	Toshiba	Oita	C-Cubed, No. 5	1996 Planned		0.35	20,000	8	37,000						
	Toshiba Total						**263,300**		**97,300**					**7,849,770**	**2,870,950**
U.S.A.	TI	Dallas	DMOS 4.1	1985	256K SRAM, 16M DRAM, Logic, ASSP	0.6	29,200	6		60	40	80	65	1,123,200	696,214
U.S.A.	TI	Dallas	DMOS 5 Phase 1	1995/Q3	16M DRAM	0.5	16,000	8	15,000		80		60		-
U.S.A.	TI	Dallas	DMOS 5 Phase 2	1997	64M, 256M DRAM	0.35	16,000	8	-						-
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1-A	1991	4M DRAM	0.6	17,000	6	-	90		85		1,432,080	-
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 2	1994	16M DRAM	0.8	9,000	8	12,000						-
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1 Module B	1995/Q3	16/64M DRAM	0.5	9,000	8			80		55		185,147
Europe	TI	Avezzano	AMOS	1991	4M DRAM, ASSP, CBIC	0.5	13,500	6	6,000	80	15	85	60	1,652,400	216,897
Europe	TI	Avezzano	Phase 2	1996	16M DRAM	0.5	20,000	8	13,500						-
Japan	KTI Semiconductor	Hyogo	Fab 1	1992	4M/16M DRAM, ASIC	0.5	11,000	8		58	30	85	60	1,972,000	459,042
	TI Total						**140,700**		**48,500**					**6,179,680**	**1,557,300**
U.S.A.	Micron	Idaho	Fab 1	1981	256K/1M DRAM, 256K SRAM	1.2	32,000	6							
U.S.A.	Micron	Idaho	Fab 2	-	4M/16M DRAM	0.5	14,400	6	32,000	70	30	85	65	3,427,200	365,040
U.S.A.	Micron	Idaho	Fab 3	1991	1M/4M DRAM	0.8	20,000	6	14,400	95		85		6,460,000	
	Micron Total						**66,400**		**46,400**					**9,887,200**	**365,040**
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab I-A	1984	256K DRAM, 64K SRAM, ASIC	1.2	15,000	5							
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab II	1985	1M/4M DRAM	0.8	25,000	6		70		80		2,800,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab III	1991	4M DRAM	0.6	20,000	6	25,000	90		85		3,060,000	

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E2 (Fab 5)	1995	16M/64M DRAM	0.35	30,000	8	20,000		80		50		640,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E1 (Fab 4)	1994	4M/16M DRAM	0.5	20,000	8	8,000	20	65	80	60	960,000	1,560,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E3	1998	16M/64M DRAM	0.35	20,000	8	20,000						
	Hyundai Total						**130,000**		**73,000**					**6,820,000**	**2,200,000**
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 4	1990	4M DRAM, SRAM	0.6	35,000	6		80		85		5,712,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 3	1988	1M DRAM, SRAM, VRAM, ROM	0.8	35,000	6	30,000	50		85		4,165,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 5	1993	4M/16M DRAM	0.5	25,000	8	35,000	10	75	80	65	960,000	3,046,875
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 6	1995/Q1	16M/64M DRAM	0.35	30,000	8	25,000	0	90	80	65	-	1,462,500
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 7	1996	16M/64M DRAM	0.35	25,000	8	10,000						
	Samsung Total						**150,000**		**100,000**					**10,837,000**	**4,509,375**
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 1	1990	4M/16M DRAM	0.8	30,000	6		40		80		1,920,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 2	1991	4M DRAM	0.7	30,000	6	30,000	75		85		3,825,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 3	1997	16/64M DRAM	0.35	30,000	8	30,000						
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C2, Phase 1	1993	4M/16M DRAM	0.5	20,000	8		20	50	75	65	1,350,000	1,950,000
Asia/ Pacific	LG Semicon	Gumi	C2, Phase 2	1996	16M DRAM	0.5	20,000	8	30,000						
	LG Semicon Total						**130,000**		**90,000**					**7,095,000**	**1,950,000**
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 1-A	1995	4M DRAM	0.5	15,000	6		100		80		624,000	
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 1-B	1994/Q4	4M/16M DRAM	0.5	15,000	8	5,000						
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 2	1996/Q1	16M/64M DRAM	0.5	15,000	8							
	Mosel Vitelic Total						**45,000**		**5,000**					**624,000**	-
Asia/ Pacific	Tech Semiconductor	Woodlands	Fab 1	1993	4Mb/16Mb DRAM	0.5	12,000	8	10,500	50	40	85	55	1,338,750	462,000
Asia/ Pacific	Tech Semiconductor	Woodlands	Fab 2	1996	16Mb/64Mb DRAM	0.35	10,000	8							-
	Tech Semiconductor Total						**22,000**		**10,500**					**1,338,750**	**462,000**

Table A-1 (Continued)
Worldwide DRAM Fabs, Midyear 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1A	1995/Q1	4M/16M DRAM	0.5	15,000	8			80		55		352,000
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1B	1996/Q2	4M/16M DRAM	0.35	15,000	8	4,000						
Asia/ Pacific	Vanguard	Hsin Chu	Fab 2	1997/Q2	16M/64M DRAM	0.35	15,000	8							
	Vanguard Total						**45,000**		**4,000**					**-**	**352,000**
	Americas Companies						402,300		171,100					26,932,280	3,794,340
	European Companies						65,000		28,000					1,856,400	635,040
	Japanese Companies						1,415,200		791,400					51,118,452	13,313,010
	Asia/Pacific Companies						522,000		282,500					26,714,750	9,473,375
	Korean Companies						410,000		263,000					24,752,000	8,659,375
	Taiwan Companies						90,000		9,000					624,000	352,000
	Rest of Asia/Pacific Companies						22,000		10,500					1,338,750	462,000
	Worldwide Companies						2,404,500		1,273,000					106,621,882	27,215,765

*Tohoku Semiconductor production is split 50-50 between Toshiba and Motorola.
NA = Not available
Source: Dataquest (October 1996)

Table A-2
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	Siemens		Mega 1	1987	1M/4M DRAM	0.6	28,000	6	28,000	40	40	85	75	1,485,120	907,200
Europe	Siemens		Regens-burg	1994	16M DRAM	0.5	5,000	8							
Europe	Siemens	Dresden		1995	64M DRAM	0.35	8,000	8							
	Siemens Total						**41,000**		**28,000**					**1,485,120**	**907,200**
Japan	Fujitsu	Akiru	Akiru R&D Center	1996	256M DRAM	0.35	3,000	8							
Japan	Fujitsu	Iwate	No. 3	1987	1M/4M/ 16M DRAM SRAM ROM	0.8	25,000	6	30,000	40		85		1,700,000	
Japan	Fujitsu	Iwate	No. 4	1990	4M/16M DRAM, Flash, SRAM, ASIC	0.5	30,000	6	5,000	40	20	85	75	2,040,000	630,000
Japan	Fujitsu	Iwate	No. 4-2	1995/Q4	16M DRAM	0.35	20,000	8	1,000		70		70		857,500
Japan	Fujitsu	Mie	No. 2	1987	Logic, Gate Arrays, 4M DRAM	0.8	10,000	6	10,000	30		85		397,800	
Japan	Fujitsu	Mie	No. 3 Phase 2	1994	4M/16M DRAM, SRAM, MPU	0.25	500	8	-		0			-	-
Japan	Fujitsu	Mie	No. 3 Phase 1	1992	16M DRAM	0.5	15,000	6	10,000	20	50	85	75	510,000	787,500
Europe	Fujitsu	Newton Aycliffe	Phase 1	1991	4M/16M DRAM, ASIC	0.8	10,000	6	10,000	60	0	85	70	1,020,000	-
Europe	Fujitsu	Newton Aycliffe	Phase 2	1994	16M DRAM	0.5	15,000	6	13,000	40	40	85	70	1,122,000	588,000
U.S.A.	Fujitsu	Gresham	No. 1	1990	1M, 4M DRAM	0.8	13,000	6		45		80		936,000	
U.S.A.	Fujitsu	Gresham	No. 2-2	1997	16M/64M DRAM	0.32	10,000	8							
	Fujitsu Total						**151,500**		**79,000**					**7,725,800**	**2,863,000**

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Hitachi	Chiba	D3	1990	4M/16M DRAM	0.8	15,000	6	15,000	50		85		994,500	
Japan	Hitachi	Gunma	NA	1995	16Mb DRAM	0.8	20,000	6	20,000	10		85		265,200	
Japan	Hitachi	Hokkaido	Chitose 2	1990	4M DRAM, 1M SRAM, EEPROM, ROM	0.8	15,000	6	15,000	10		85		198,900	
Japan	Hitachi	Hokkaido	Chitose 1	1988	1M SRAM, 4M DRAM, MPU	0.8	15,000	6	15,000	20		85		397,800	
Japan	Hitachi	Hokkaido	CHI-TOSE 3	1998	64M DRAM	0.35	10,000	8							
Japan	Hitachi	Tokyo	D4/D5	1994	64M DRAM	0.35	3,000	8	-						
Japan	Hitachi	Ibaraki	N-2 Phase 1	1994/Q4	16M DRAM	0.5	20,000	8	15,000	25	40	80	70	1,350,000	1,260,000
Japan	Hitachi	Ibaraki	N1-1	1983	1M/4M DRAM	0.8	15,000	6	15,000	40		85		1,020,000	
Japan	Hitachi	Tokyo	R&D 2	1990	4M/16M DRAM	0.5	4,000	6	4,000	50	40	85	65	340,000	135,200
Japan	Hitachi	Yamanashi	Imasuwa	1990	4M DRAM, 4M SRAM, 16M Proto-DRAM	0.6	25,000	6	25,000	20	10	85	65	850,000	211,250
Japan	Hitachi	Yamanashi	K-2-2F	1990	4M/16M DRAM	0.5	4,000	8	10,000		50		70		1,050,000
Japan	Hitachi/ Tobu Semicon-ductor		NA	1990		0.6	17,000	6	17,000	20		80		544,000	
Europe	Hitachi	Landshut	E2	1992	16Mb DRAM	0.5	16,000	8	12,000	30	50	80	65	1,296,000	1,170,000
U.S.A.	Hitachi	Irving	Phase 2	1993	CBIC 16M DRAM 4M SRAM	0.6	5,000	8	10,000		50		70		1,050,000
U.S.A.	Twinstar	Dallas	Twinstar	1996	16M/64M DRAM	0.35	15,000	8	15,000						
Hitachi Total							**199,000**		**188,000**					**7,236,400**	**4,876,450**

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	IBM	Shiga	NA	1990	4M/16M DRAM	0.6	6,000	8	200	30	40	85	65	-	-
Europe	IBM	Sindelfin-gen	NA	1989	4M/16M DRAM	0.8	20,000	8	15,000	30	20	80	65	1,620,000	487,500
Europe	IBM	Corbeil-Essonnes	NA	1989	1M DRAM	-	7,000	8							
U.S.A.	IBM	East Fishkill	NA	-	NA	0.8	20,000	8							
U.S.A.	IBM	Essex Junction	Bldg. 970	1988	16M DRAM	-	24,000	8	24,000	50		80		4,320,000	
U.S.A.	IBM	Essex Junction	Bldg. 973	1989	16M DRAM	0.5	20,000	8	12,000		60		65		1,170,000
U.S.A.	IBM	Manassas	VHSIC	1989	Memory, MPU, ASIC, MIL	0.8	1,600	5							
U.S.A.	IBM	Essex Junction	Bldg. 963	1989	1M DRAM	1	16,000	8							
Europe	IBM/ Siemens	Corbeil-Essonnes	ACL	1992	16M DRAM	0.4	16,100	8	8,000		60		65		780,000
	IBM Total						**130,700**		**59,200**					**5,940,000**	**2,437,500**
Japan	Matsushita	Kyoto	LAB	1992	16M/64M DRAM	0.35	1,000	8			50		65		81,250
Japan	Matsushita	Toyama	Fab 1	1994	4M/16M DRAM, MCU, ASIC	0.5	20,000	6	10,000	30	50	80	65	480,000	351,000
Japan	Matsushita	Toyama	Fab C-2	1990	4M/16M/ 64M DRAM, SRAM	0.5	24,000	6	15,000	45	60	80	65	1,080,000	631,800
Japan	Matsushita	Tonami	Fab 2	1996	16M DRAM, ASIC	0.35	20,000	8	15,000						
U.S.A.	Matsushita	Puyallup	NA	1991	1M/4M DRAM, MCU, Gate Arrays	0.8	15,000	6		0		80		-	
	Matsushita Total						**80,000**		**40,000**					**1,560,000**	**1,064,050**

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Mitsubishi	Ehime	KD-1	1995	16Mb/ 64Mb DRAM	0.40	20,000	8	10,000	30	50	85	55	510,000	297,000
Japan	Mitsubishi	Ehime	SA2A	1991	4M/16M DRAM	0.40	15,000	6	15,000	20	60	85	75	748,000	972,000
Japan	Mitsubishi	Ehime	SA2B	1994	4M/16M DRAM	0.40	17,000	8	15,000	15	75	80	65	768,000	1,950,000
Japan	Mitsubishi	Osaka	U	1993	16M/64M DRAM	0.35	3,000	8	1,000		70		65		796,250
Japan	Mitsubishi	Kumamoto	KD-1-2	1996	16M/64M DRAM	0.35	15,000	8	7,000						
Japan	Mitsubishi	Kochi	TA1	1990	4M DRAM, 1M SRAM	0.60	33,000	6	30,000	60		85		3,366,000	
U.S.A.	Mitsubishi		NA	1990	1M/4M DRAM	0.60	7,800	6	7,800	0		85		-	
U.S.A.	Mitsubishi	Alsodorf	NA	1998	64Mb DRAM	0.35	7,000	8	-						
	Mitsubishi Total						**117,800**		**85,800**					**5,392,000**	**4,015,250**
Japan	NEC	Hiroshima	Dif-1	1990	4M DRAM, SRAM, MPU, 4M ROM	0.6	30,000	6	30,000	40	10	85	75	1,530,000	-
Japan	NEC	Hiroshima	Dif-2	1996	16M DRAM, ASIC, RISC	0.35	10,000	8	8,000		80		70		2,677,500
Japan	NEC	Kumamoto	Dif-7	1988	MCU, 4M DRAM, ASIC	0.8	30,000	6	30,000	20		85		795,600	
Japan	NEC	Kumamoto	Dif-8	1994	16M DRAM, 4M SRAM, RISC MPU	0.35	15,000	8	15,000		70		70		2,520,000
Japan	NEC	Kumamoto	Dif-8-2	1998	64M/256M DRAM	0.25	30,000	8							
Japan	NEC	Yamaguchi	Dif-1	1988	4Mb DRAM 1Mb SRAM MPU	0.50	30,000	6	30,000		0.4			1,530,000	

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	NEC	Yamaguchi	Dif-2	1993	16Mb DRAM 4Mb DRAM	0.50	45,000	6	12,800					435,200	873,600
Europe	NEC	Livingston, West Lothian	Phase 2	1991	4M DRAM, 256K SRAM, MPR, MPU	0.5	25,000	6	10,000	80		85		1,360,000	
Europe	NEC	Livingston, West Lothian	Phase 3	1997/Q1	16M/64M DRAM	0.35	10,000	8							
U.S.A.	NEC	Roseville	M-Line	1991	4M/16M DRAM	0.5	35,000	6	15,000	20	75	85	65	612,000	823,200
	NEC Total						**260,000**		**150,800**					**6,262,800**	**6,894,300**
Japan	Nittetsu Semiconductor	Chiba	M3	1990	4M DRAM	0.5	15,000	6	15,000	70	20	85	60	1,392,300	234,000
	Nittetsu Semiconductor Total						**15,000**		**15,000**					**1,392,300**	**234,000**
Japan	Oki	Miyagi	S1	1990	4M DRAM, VRAM, 1M SRAM	0.50	30,000	6	25,000	50		85		1,912,500	
Japan	Oki	Miyagi	S2	1996	16Mb DRAM	0.30	15,000	8	5,000		100		60		750,000
Japan	Oki	Miyazaki	M1	1981	DRAM, SRAM, Gate Arrays, MPU	1.50	50,000	4							
Japan	Oki	Miyazaki	M2	1984	DRAM, EEPROM, ASIC, SRAM	0.8	60,000	5	28,000	0		85		-	
Japan	Oki	Miyazaki	M3	1991	4M/16M DRAM, 90K Gate Arrays	0.4	30,000	6	27,000	65	30	85	65	2,685,150	737,100
	Oki Total						**185,000**		**85,000**					**4,597,650**	**1,487,100**

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Tohoku Semicon-ductor	Miyagi	Step 1	1988	1M DRAM, MCU, MPU, SRAM	1	7,500	6							
Japan	Tohoku Semicon-ductor	Miyagi	Step 2	1991	4M DRAM	0.8	20,000	6	20,000	100		85		2,652,000	
Japan	Tohoku Semicon-ductor	Miyagi	Step 3	1995	16M/64M DRAM	0.35	15,000	8	5,000		40		60		600,000
Europe	Motorola	East Kilbride	MOS 9	1990	SRAM, 1M DRAM, MPU	0.8	22,000	6	-						
	Motorola Total*						**64,500**		**25,000**					**2,652,000**	**600,000**
Japan	Toshiba	Kanagawa	Bldg 108 D-2	1990	16Mb DRAM	0.5	1,300	8	1,300	25	65	80	60	78,000	126,750
Japan	Toshiba	Mie	Y-Cubed, No. 1, Mod-ule 2	1993	4M/16M DRAM	0.5	20,000	8	9,000	10	80	85	65	229,500	1,170,000
Japan	Toshiba	Mie	Y-Cubed, No. 1, Mod-ule 2	1994	64M DRAM	0.35	20,000	8							
Japan	Toshiba	Mie	Y-Cubed, No. 2	1996/Q4	64M DRAM	0.35	40,000	8							
Japan	Toshiba	Oita	C-Cubed, No. 3	1987	DRAM	0.7	20,000	6	50,000	55	35	85	70	4,675,000	1,715,000
Japan	Toshiba	Oita	C-Cubed, No. 4	1991	4Mb, 16Mb DRAM	0.5	25,000	6	37,000	55	35	85	70	3,459,500	1,269,100
	Toshiba Total						**126,300**		**97,300**					**8,442,000**	**4,280,850**
U.S.A.	TI	Dallas	DMOS 4.1	1985	4M, 16M	0.6	29,200	6	15,000	0.75	0.25	80	65	2,700,000	357,941
U.S.A.	TI	Dallas	DMOS 5 Phase 1	1995/Q3	16M DRAM	0.5	16,000	8	12,000	40	60	80	60	1,152,000	906,259
U.S.A.	TI	Dallas	DMOS 5 Phase 2	1997	64M, 256M DRAM	0.35	16,000	8			80		55		-
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1-A	1991	4M DRAM	0.45	20,000	6	20,000	90		85		4,590,000	-
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1-B	1995/3Q	16/64Mb DRAM	0.45	15,000	8	10,000	55	45	85	55	1,320,000	571,132
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 2	1997	16M DRAM	0.35	20,000	8							-

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	TI/Acer	Hsin Chu	FAB 2B	1998	16/64M DRAM	0.3	20,000	8							-
Europe	TI	Avezzano	AMOS	1991	4M DRAM, ASSP, CBIC	0.5	13,500	6	13,500	0.75	0.25	85	70	2,151,563	346,927
Europe	TI	Avezzano	Phase 2	1996	16M DRAM	0.5	20,000	8	10,000	0.4	0.6	85	70	850,000	616,760
Japan	KTI Semicon ductor	Hyogo	Fab 1	1992	4M/16M DRAM, ASIC	0.5	11,000	8	9,000		85		70		1,404,230
Japan	KTI Semicon ductor	Hyogo	Fab 2	1997	16Mb DRAM	0.35	15,000	8							-
	TI Total						**195,700**		**89,500**					**12,763,563**	**4,203,249**
U.S.A.	Micron	Idaho	Fab 2	-	4M DRAM, 256K SRAM, VRAM	0.5	14,400	6	32,000	95		90		5,294,160	-
U.S.A.	Micron	Idaho	Fab 3	1991	4M/16M DRAM	0.5	40,000	6	30,000	80	20	90	65	9,288,000	546,000
	Micron Total						**54,400**		**62,000**					**14,582,160**	**546,000**
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab I-A	1984	256K DRAM, 64K SRAM, ASIC	1.2	15,000	5							
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab II	1985	1M/4M DRAM	0.8	25,000	6	25,000	70		80		2,800,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab III	1991	4M DRAM	0.6	20,000	6	20,000	90		85		3,060,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E2 (Fab 5)	1995	16M/64M DRAM	0.35	25,000	8	15,000		80		55		1,650,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E1 (Fab 4)	1994	4M/16M DRAM	0.5	10,000	8	20,000	10	80	80	65	480,000	2,600,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E3	1998	16M/64M DRAM	0.35	20,000	8							
	Hyundai Total						**115,000**		**80,000**					**6,340,000**	**4,250,000**

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 4	1990	4M DRAM, SRAM	0.6	35,000	6	30,000	80		88		5,880,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 3	1988	1M DRAM, SRAM, VRAM, ROM	0.8	35,000	6	35,000	60		88		5,145,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 5	1993	4M/16M DRAM	0.5	25,000	8	25,000	10	90	85	80	1,020,000	4,500,000
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 6	1995/Q1	16M/64M DRAM	0.35	30,000	8	25,000		95		80		4,571,875
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 7	1996	16M/64M DRAM	0.35	20,000	8	10,000		95		72		1,828,750
	Samsung Total						**145,000**		**125,000**					**12,045,000**	**10,900,625**
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 1	1990	4M/16M DRAM	0.8	30,000	6	30,000	40		80		1,920,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 2	1991	4M DRAM	0.7	30,000	6	30,000	75		85		3,825,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 3	1997	16/64M DRAM	0.35	30,000	8							
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C2, Phase 1	1993	4M/16M DRAM	0.5	20,000	8	30,000	20	55	75	65	1,350,000	2,681,250
Asia/ Pacific	LG Semicon	Gumi	C2, Phase 2	1996	16M DRAM	0.5	20,000	8	10,000		80		65		1,300,000
	LG Semicon Total						**130,000**		**100,000**					**7,095,000**	**3,981,250**
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 1	1995	4M DRAM	0.5	30,000	6	15,000	100		80		1,872,000	
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 2	1996/Q4	16M/64M DRAM	0.4	25,000	8							

Table A-2 (Continued)
Worldwide DRAM Fabs, Year-End 1995

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Mosel Vitelic Total						**55,000**		**15,000**					**1,872,000**	**-**
Asia/ Pacific	Tech Semi-conduc-tor	Woodlands	Fab 1	1993	4M/16M DRAM	0.5	12,000	8	12,000	45	45	85	60	1,377,000	648,000
Asia/ Pacific	Tech Semi-conduc-tor	Woodlands	Fab 2	1996	16M/64M DRAM	0.35	10,000	8	-						-
	Tech Semiconductor Total						**22,000**		**12,000**					**1,377,000**	**648,000**
Asia/ Pacific	Nan Ya Technol-ogy	Hsin Chu	Fab 1	1996	16M/64M DRAM	0.45	20,000	8	10,000						
	Nan Ya Technology Total						**20,000**		**10,000**					**-**	**-**
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1A	1994	4M/16M DRAM	0.5	14,000	8	10,000	70	20	80	65	1,680,000	260,000
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1B	1996/Q2	4M/16M DRAM	0.35	18,000	8							
Asia/ Pacific	Vanguard	Hsin Chu	Fab 2	1997/Q2	16M/64M DRAM	0.35	15,000	8							
	Vanguard Total						**47,000**		**10,000**					**1,680,000**	**260,000**
	Americas Companies						445,300		235,700					35,937,723	7,786,749
	European Companies						41,000		28,000					1,485,120	907,200
	Japanese Companies						1,134,600		740,900					42,628,950	25,715,000
	Asia/Pacific Companies						534,000		352,000					30,409,000	20,039,875
	Korean Companies						390,000		305,000					25,480,000	19,131,875
	Taiwan Companies						122,000		35,000					3,552,000	260,000
	Rest of Asia/Pacific Companies						22,000		12,000					1,377,000	648,000
	Worldwide Companies						2,154,900		1,356,600					110,460,793	54,448,824

*Tohoku Semiconductor production is split 50-50 between Toshiba and Motorola.
NA = Not available
Source: Dataquest (October 1996)

Table A-3
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	Siemens		Balan-strasse	-	NA	2	24,000	4							
Europe	Siemens		Mega 1	1987	1M/4M DRAM	0.6	28,000	6	28,000	30	50	85	75	1,113,840	1,134,000
Europe	Siemens		Regens-burg	1994	16M DRAM	0.5	5,000	8							
Europe	Siemens	Dresden		1995	64M DRAM	0.35	8,000	8							
	Siemens Total						**65,000**		**28,000**					**1,113,840**	**1,134,000**
Japan	Fujitsu	Akiru	Akiru R&D Center	1996	256M DRAM	0.35	3,000	8							
Japan	Fujitsu	Iwate	No. 3	1987	1M/4M/ 16M DRAM, SRAM, ROM	0.8	25,000	6	25,000	30		85		1,700,000	
Japan	Fujitsu	Iwate	No. 4	1990	4M/16M DRAM, Flash, SRAM, ASIC	0.5	30,000	6	30,000	30	40	85	75	1,530,000	1,260,000
Japan	Fujitsu	Iwate	No. 4-2	1995/Q4	16M DRAM	0.35	20,000	8	10,000						1,788,500
Japan	Fujitsu	Mie	No. 2	1987	Logic, Gate Arrays, 4M DRAM	0.8	10,000	6	10,000	30		85		397,800	
Japan	Fujitsu	Mie	No. 3 Phase 2	1994	4M/16M DRAM, SRAM, MPU	0.25	500	8	500	20	20	80	70		
Japan	Fujitsu	Mie	No. 3 Phase 1	1992	16M DRAM	0.5	15,000	6	15,000	0	80	85	75	-	1,260,000
Europe	Fujitsu	Newton Aycliffe	Phase 1	1991	4M, 16M DRAM, ASIC	0.8	5,600	6	10,000	40	0	85	70	680,000	-
Europe	Fujitsu	Newton Aycliffe	Phase 2	1994	16M DRAM	0.5	10,000	6	10,000	40	40	85	70	1,122,000	588,000
U.S.A.	Fujitsu	Gresham	No. 1	1990	1M, 4M DRAM	0.8	13,000	6	13,000	30		80		936,000	
U.S.A.	Fujitsu	Gresham	No. 2-2	1997	16M/64M DRAM	0.32	10,000	8							
	Fujitsu Total						**142,100**		**123,500**					**6,365,800**	**4,896,500**

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Hitachi	Chiba	D3	1990	4M/16M DRAM	0.8	15,000	6	15,000	0		85		994,500	
Japan	Hitachi	Gunma	NA	1995	16Mb DRAM	0.8	20,000	6	20,000	0		85		-	
Japan	Hitachi	Hokkaido	Chitose 2	1990	4M DRAM, 1M SRAM, EEPROM, ROM	0.8	15,000	6	15,000	0		85		-	
Japan	Hitachi	Hokkaido	Chitose 1	1988	1M SRAM, 4M DRAM, MPU	0.8	15,000	6	15,000	20		85		397,800	
Japan	Hitachi	Hokkaido	CHI-TOSE 3	1998	64M DRAM	0.35	10,000	8							
Japan	Hitachi	Tokyo	D4/D5	1994	64M DRAM	0.35	3,000	8							
Japan	Hitachi	Ibaraki	N-2 Phase 1	1994/Q4	16M DRAM	0.5	20,000	8	20,000	20	50	80	75	960,000	2,625,000
Japan	Hitachi	Ibaraki	N2-2	1996	16M/64M DRAM	0.35	20,000	8							
Japan	Hitachi	Ibaraki	N1-1	1983	1M/4M DRAM	0.8	15,000	6	15,000	30		85		765,000	
Japan	Hitachi	Ibaraki	N1-2	1988	4M/16M DRAM	0.50	20,000	6	4,000	40		85		136,000	156,000
Japan	Hitachi	Tokyo	R&D 2	1990	4M/16M DRAM	0.5	4,000	6	4,000	20	40	85	75	136,000	156,000
Japan	Hitachi	Yamanashi	Imasuwa	1990	4M DRAM, 4M SRAM, 16M Proto-DRAM	0.6	25,000	6	25,000	20	10	85	75	850,000	243,750
Japan	Hitachi	Yamanashi	K-2-2F	1990	4M/16M DRAM	0.5	4,000	8	3,000	0	50	80	70	-	367,500
Japan	Hitachi/ Tobu Semi-conductor		NA	1990		0.6	17,000	6		0		80		-	
Europe	Hitachi	Landshut	E2	1992	4M/16M DRAM, 1M SRAM	0.5	16,000	8	16,000	15	65	80	70	576,000	2,548,000
U.S.A.	Hitachi	Irving	Phase 2	1993	CBIC, 16M DRAM, 4M SRAM	0.6	5,000	8	5,000		60		70		735,000

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
U.S.A.	Twinstar	Dallas	Twinstar	1996	16M/64M DRAM	0.35	15,000	8	15,000						1,050,000
	Hitachi Total						**239,000**		**172,000**					**4,815,300**	**7,881,250**
Japan	IBM	Shiga	NA	1990	4M/16M DRAM	0.6	6,000	8	5,200	20	50	85	65	397,800	507,000
Europe	IBM	Sindelfin-gen	NA	1989	4M/16M DRAM	0.8	20,000	8	15,000	30	40	80	65	1,620,000	780,000
Europe	IBM	Corbeil-Essonnes	NA	1989	1M DRAM	-	7,000	8							
U.S.A.	IBM	East Fishkill	NA	-	NA	0.8	20,000	8							
U.S.A.	IBM	Essex Junction	Bldg. 970	1988	16M DRAM	-	24,000	8	24,000	40		80		3,456,000	
U.S.A.	IBM	Essex Junction	Bldg. 973	1989	16M DRAM	0.5	20,000	8	15,000		80		70		2,520,000
U.S.A.	IBM	Manassas	VHSIC	1989	Memory, MPU, ASIC, MIL	0.8	1,600	5							
U.S.A.	IBM	Essex Junction	Bldg. 963	1989	1M DRAM	1	16,000	8							
Europe	IBM/Siemens	Corbeil-Essonnes	ACL	1992	16M DRAM	0.4	16,100	8	10,000		80		70		1,680,000
	IBM Total						**130,700**		**69,200**					**5,473,800**	**5,487,000**
Japan	Matsushita	Kyoto	LAB	1992	16M/64M DRAM	0.35	1,000	8	1,000		20		65		39,000
Japan	Matsushita	Toyama	Fab 1	1994	4M/16M DRAM, MCU, ASIC	0.5	20,000	6	20,000	20	60	80	70	704,000	1,092,000
Japan	Matsushita	Toyama	Fab C-2	1990	4M/16M/ 64M DRAM, SRAM	0.5	24,000	6	20,000	40	70	80	70	1,408,000	1,274,000
Japan	Matsushita	Tonami	Fab 2	1996	16M DRAM, ASIC	0.35	20,000	8							
U.S.A.	Matsushita	Puyallup	NA	1991	1M/4M DRAM, MCU, Gate Arrays	0.8	15,000	6	15,000	0		80		-	

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
	Matsushita Total						**80,000**		**56,000**					**2,112,000**	**2,405,000**
Japan	Mitsubishi	Ehime	KD-1	1995	16Mb/ 64Mb DRAM	0.40	20,000	8	10,000		70		60		526,500
Japan	Mitsubishi	Ehime	SA2A	1991	4M/16M DRAM	0.40	15,000	6	20,000	20	30	85	75	-	585,000
Japan	Mitsubishi	Ehime	SA2B	1994	4M/16M DRAM	0.40	17,000	8	16,000	0	60	80	70	-	2,688,000
Japan	Mitsubishi	Osaka	ULSI	1993	16M/64M DRAM	0.35	3,000	8	7,000		70		65		955,500
Japan	Mitsubishi	Kumamoto		1996	16M/64M DRAM	0.35	15,000	8	7,000						780,000
Japan	Mitsubishi	Kochi	TA1	1990	4M DRAM, 1M SRAM	0.60	33,000	6	30,000	50		85		2,805,000	
U.S.A.	Mitsubishi		NA	1990	1M/4M DRAM	0.60	7,800	6	7,800	0		85		-	
U.S.A.	Mitsubishi	Alsodorf	NA	1998	64Mb DRAM	0.35	7,000	8							
	Mitsubishi Total						**117,800**		**97,800**					**2,805,000**	**5,535,000**
Japan	NEC	Hiroshima	Dif-1	1990	4M DRAM, SRAM, MPU, 4M ROM	0.6	30,000	6	30,000	30		85		1,530,000	-
Japan	NEC	Hiroshima	Dif-2	1996	16M DRAM, ASIC, RISC	0.35	10,000	8	15,000		85		70		2,677,500
Japan	NEC	Kumamoto	Dif-7	1988	MCU, 4M DRAM, ASIC	0.8	30,000	6	30,000	20		85		795,600	-
Japan	NEC	Kumamoto	Dif-8	1994	16M DRAM, 4M SRAM, RISC MPU	0.35	15,000	8	15,000		80		70		2,520,000
Japan	NEC	Kumamoto	Dif-8-2	1998	64M/256M DRAM	0.25	30,000	8							
Japan	NEC	Yamaguchi	Dif-1	1988	4Mb DRAM 1Mb SRAM MPU	0.50	30,000	6	30,000					1,530,000	

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	NEC	Yamaguchi	Dif-2	1993	16Mb DRAM 4Mb DRAM	0.50	45,000	6	12,800	20	65	85	75	435,200	873,600
Europe	NEC	Living-ston, West Lothian	Phase 2	1991	4M DRAM, 256K SRAM, MPR, MPU	0.35	10,000	6	10,000	80		85		1,360,000	
U.S.A.	NEC	Roseville	M-Line	1991	4M/16M DRAM	0.5	35,000	6	23,000	15	75	85	70	986,000	1,685,600
	NEC Total						**235,000**		**165,800**					**6,636,800**	**7,756,700**
Japan	Nittetsu Semicon-ductor	Chiba	M3	1990	4M DRAM	0.5	15,000	6	15,000	70	20	85	60	1,392,300	234,000
	Nittetsu Semiconductor Total						**15,000**		**15,000**					**1,392,300**	**234,000**
Japan	Oki	Miyagi	S1	1990	4M DRAM, VRAM, 1M SRAM	0.50	30,000	6	25,000	45		85		1,721,250	
Japan	Oki	Miyagi	S2	1996	16M/64M DRAM	0.30	15,000	8	8,000		60		70		1,176,000
Japan	Oki	Miyazaki	M1	1981	DRAM, SRAM, Gate Arrays, MPU	1.50	50,000	4							
Japan	Oki	Miyazaki	M2	1984	DRAM, EEPROM, ASIC, SRAM	0.8	60,000	5	28,000	0		85			
Japan	Oki	Miyazaki	M3	1991	4M/16M DRAM, 90K Gate Arrays	0.45	30,000	6	27,000	50	40	85	70	2,065,500	982,800
	Oki Total						**185,000**		**88,000**					**3,786,750**	**2,158,800**
Japan	Tohoku Semi-conductor	Miyagi	Step 2	1991	4M DRAM	0.8	20,000	6						2,652,000	
Japan	Tohoku Semi-conductor	Miyagi	Step 3	1995	16M/64M DRAM	0.35	15,000	8	20,000	100		85			1,785,000
	Motorola Total*						**35,000**		**20,000**					**2,652,000**	**1,785,000**

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Toshiba	Kanagawa	Bldg 108 D-2	1990	4M/16M DRAM	0.5	1,300	8	1,300	10	70	80	70		222,950
Japan	Toshiba	Mie	Y-Cubed, No. 1	1993	4M/16M DRAM	0.5	20,000	8	9,000	20	70	85	70	459,000	1,543,500
Japan	Toshiba	Mie	Y-Cubed, No. 2	1994	64M DRAM	0.35	20,000	8							-
Japan	Toshiba	Mie	NA	1996/Q4	64M DRAM	0.35	40,000	8							
Japan	Toshiba	Oita	C-Cubed, No. 3	1987	RAM	0.7	20,000	6	50,000	40	30	85	70	3,400,000	1,365,000
Japan	Toshiba	Oita	C-Cubed, No. 4	1991	RAM	0.5	25,000	6	37,000	40	30	85	70	2,516,000	1,010,100
	Toshiba Total						**126,300**		**97,300**					**6,375,000**	**4,141,550**
U.S.A.	TI	Dallas	DMOS4.1	1985	256K SRAM, 16M DRAM, Logic, ASSP	0.6	29,200	6	15,000	60	40	85	65	2,295,000	536,571
U.S.A.	TI	Dallas	DMOS 5 Phase 1	1995/Q3	16M DRAM	0.5	16,000	8	12,000	35	65	85	60	1,071,000	996,490
U.S.A.	TI	Dallas	DMOS 5 Phase 2		64M, 256M DRAM	0.35	16,000	8	-		80		55		-
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1-A	1991	4M DRAM	0.45	20,000	6	20,000	90		85		4,590,000	-
Asia/ Pacific	TI/Acer	Hsin Chu	FAB 1B	1995/3Q	16/64Mb DRAM	0.45	15,000	8	12,000	45	55	85	55	1,377,000	1,159,378
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 2	1997	16M DRAM	0.35	20,000	8							-
Europe	TI	Avezzano	AMOS	1991	4M DRAM, ASSP, CBIC	0.5	13,500	6	13,500	80	15	85	70	1,147,500	719,341
Europe	TI	Avezzano	Phase 2	1996	16M DRAM	0.5	20,000	8	12,000	35	65	85	60	892,500	996,490
Japan	KTI Semiconductor	Hyogo	Fab 1	1992	4M/16M DRAM, ASIC	0.5	11,000	8	9,000		85		70		1,588,156
Japan	KTI Semiconductor	Hyogo	Fab 2	1997	16Mb DRAM	0.35	15,000	8							-
	TI Total						**175,700**		**93,800**					**11,373,000**	**5,996,426**

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
U.S.A.	Micron	Idaho	Fab 1	1981	256K/1M DRAM, 256K SRAM	1.2	32,000	6	32,000						
U.S.A.	Micron	Idaho	Fab 2	-	4M DRAM, 256K SRAM, VRAM	0.5	14,400	6	14,400	90		68		5,474,304	
U.S.A.	Micron	Idaho	Fab 3	1991	4M/16M DRAM	0.5	NA	8	24,000	80	20	90	65	11,750,400	936,000
U.S.A.	Micron	Idaho	Fab D	1997	16M/64MDRAM	0.3		8							
	Micron Total						**46,400**		**70,400**					**17,224,704**	**936,000**
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab I-A	1984	256K DRAM, 64K SRAM, ASIC	1.2	15,000	5							
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab II	1985	1M/4M DRAM	0.8	25,000	6	25,000	70		80		2,800,000	
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab III	1991	4M DRAM	0.6	20,000	6	20,000	90		85		3,060,000	
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS E2 (Fab 5)	1995	16M/64M DRAM	0.35	30,000	8	25,000		70		60		3,150,000
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS E1 (Fab 4)	1994	4M/16M DRAM	0.5	20,000	8	20,000	0	80	80	65	-	3,120,000
Asia/Pacific	Hyundai	Ichun, Kyungki-Do	MOS E3	1998	16M/64M DRAM	0.35	20,000	8							
	Hyundai Total						**130,000**		**90,000**					**5,860,000**	**6,270,000**
Asia/Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 4	1990	4M DRAM, SRAM	0.6	35,000	6	22,000	70		85		3,665,200	
Asia/Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 3	1988	1M DRAM, SRAM, VRAM, ROM	0.8	35,000	6	25,000	40		85		2,380,000	

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 5	1993	4M/16M DRAM	0.5	25,000	8	25,000	10	70	80	70		5,670,000
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 6	1995/Q1	16M/64M DRAM	0.35	30,000	8	30,000		80		65		6,840,000
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 7	1996	16M/64M DRAM	0.35	20,000	8	10,000		70		60		2,280,000
	Samsung Total						**145,000**		**112,000**					**6,045,200**	**14,790,000**
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 1	1990	4M/16M DRAM	0.8	30,000	6	30,000	40		80		1,920,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 2	1991	4M DRAM	0.7	30,000	6	30,000	75		85		3,825,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 3	1997	16/64M DRAM	0.35	30,000	8							
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C2, Phase 1	1993	4M/16M DRAM	0.5	20,000	8	30,000	10	70	75	65	675,000	4,777,500
Asia/ Pacific	LG Semicon	Gumi	C2, Phase 2	1996	16M DRAM	0.5	20,000	8	10,000		80		65		1,820,000
	LG Semicon Total						**130,000**		**100,000**					**6,420,000**	**6,597,500**
Asia/ Pacific	Mosel Vitelic	Hsin Chu	FAB 1-A	1995/Q1	4M DRAM	0.5	15,000	6	15,000	30		79		554,580	
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 1-B	1995/Q4	4M/16M DRAM	0.5	15,000	6	15,000	80		78		1,460,160	
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 2	1997	16M/64M DRAM	0.4	20,000	8	-	10	80				
	Mosel Vitelic Total						**50,000**		**30,000**					**2,014,740**	-

Table A-3 (Continued)
Worldwide DRAM Fabs, Midyear 1996

Region	Company	Prefecture	Fab Name	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Tech Semicon-ductor	Woodlands	Fab 1	1993	16M DRAM	0.5	12,000	8	11,000	35	55	85	65	1,071,000	858,000
Asia/ Pacific	Tech Semicon-ductor	Woodlands	Fab 2	1996	16M/64M DRAM	0.35	10,000	8	2,000						-
	Tech Semiconductor Total						**22,000**		**13,000**					**1,071,000**	**858,000**
Asia/ Pacific	Nan Ya Technology	Tao-Yuan	Fab 1	1996/Q3	16M/64M DRAM	0.45	25,000	8	5,000		100		65		341,250
	Nan Ya Technology Total						25,000		5,000					-	341,250
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1A	1995/Q1	4M/16M DRAM	0.5	15,000	8	12,000		80		65		2,184,000
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1B	1996/Q2	4M/16M DRAM	0.35	15,000	8	5,000	35	55	85	65	446,250	357,500
Asia/ Pacific	Vanguard	Hsin Chu	Fab 2	1997/Q2	16M/64M DRAM	0.35	15,000	8							
	Vanguard Total						**45,000**		**17,000**					**446,250**	**2,541,500**
	Americas Companies						387,800		253,100					36,723,504	14,204,426
	European Companies						65,000		28,000					1,113,840	1,134,000
	Japanese Companies						1,140,200		815,400					34,288,950	35,008,800
	Asia/Pacific Companies						547,000		367,000					21,857,190	31,398,250
	Korean Companies						405,000		302,000					18,325,200	27,657,500
	Taiwan Companies						120,000		52,000					2,460,990	2,882,750
	Rest of Asia/Pacific Companies						22,000		13,000					1,071,000	858,000
	Worldwide Companies						2,140,000		1,463,500					93,983,484	81,745,476

*Tohoku Semiconductor production is split 50-50 between Toshiba and Motorola.
NA = Not available
Source: Dataquest (October 1996)

Table A-4
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	Siemens		Mega 1	1987	1M/4M DRAM	0.6	28,000	6	28,000	20	65	85	75	742,560	1,474,200
Europe	Siemens		Regens-burg	1994	16M DRAM	0.5	5,000	8							
Europe	Siemens	Dresden		1995	64M DRAM	0.35	8,000	8							
	Siemens Total						**41,000**		**28,000**					**742,560**	**1,474,200**
Japan	Fujitsu	Akiru	Akiru R&D Center	1995	256M DRAM	0.35	3,000	8							
Japan	Fujitsu	Iwate	No. 3	1987	1M/4M/ 16M DRAM, SRAM, ROM	0.8	25,000	6	25,000	20		85		850,000	
Japan	Fujitsu	Iwate	No. 4	1990	4M/16M DRAM, Flash, SRAM, ASIC	0.5	30,000	6	30,000	20	50	85	78	1,020,000	2,293,200
Japan	Fujitsu	Iwate	No. 4-2	1996	16M DRAM	0.35	20,000	8	10,000		70		77		1,886,500
Japan	Fujitsu	Mie	No. 2	1987	Logic, Gate Arrays, 4M DRAM	0.8	10,000	6	10,000	30		85		397,800	
Japan	Fujitsu	Mie	No. 3 Phase 2	1994	4M/16M DRAM, SRAM, MPU	0.25	500	8	500	0	20	80	70	-	-
Japan	Fujitsu	Mie	No. 3 Phase 1	1992	16M DRAM	0.5	15,000	6	15,000		80		75		1,764,000
Europe	Fujitsu	Newton Aycliffe	Phase 1	1991	4M, 16M DRAM, ASIC	0.8	5,600	6	10,000	30		85		510,000	
Europe	Fujitsu	Newton Aycliffe	Phase 2	1994	16M DRAM	0.5	15,000	6	15,000	20	90	85	70	561,000	1,029,000
Europe	Fujitsu	Newton Aycliffe	Fab 2	1997	16Mb 64Mb DRAM	0.32	30,000	8							
U.S.A.	Fujitsu	Gresham	No. 1	1990	1M, 4M DRAM	0.8	13,000	6	13,000	45		80		936,000	
U.S.A.	Fujitsu	Gresham	No. 2-2	1997	16M/64M DRAM	0.32	10,000	8							
	Fujitsu Total						**177,100**		**128,500**					**4,274,800**	**6,972,700**

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Hitachi	Chiba	D3	1990	4M/16M DRAM	0.8	15,000	6	15,000	50	50	85	75	994,500	731,250
Japan	Hitachi	Gunma	NA	1995	16Mb DRAM	0.8	20,000	6	10,000	0	50	85	75	-	487,500
Japan	Hitachi	Hokkaido	Chitose 2	1990	4M DRAM, 1M SRAM, EEPROM, ROM	0.8	15,000	6	15,000	60		85		1,193,400	
Japan	Hitachi	Hokkaido	Chitose 1	1988	1M SRAM, 4M DRAM, MPU	0.8	15,000	6	15,000	20		85		397,800	
Japan	Hitachi	Hokkaido	Chitose 2	1998	64M DRAM	0.35	10,000	8							
Japan	Hitachi	Tokyo	D4/D5	1994	64M DRAM	0.35	3,000	8							
Japan	Hitachi	Ibaraki	N-2 Phase 1	1994/Q4	16M DRAM	0.5	20,000	8	20,000	10	70	80	75	480,000	3,885,000
Japan	Hitachi	Ibaraki	N2-2	1996	16M/64M DRAM	0.35	20,000	8							
Japan	Hitachi	Ibaraki	N1-1	1983	1M/4M DRAM	0.8	15,000	6	15,000	60		85		1,530,000	
Asia/ Pacific	Hitachi/LG Semicon	Kedah		1998	16Mb/64Mb DRAM	0.3	30,000	8							
Asia/ Pacific	Hitachi/ Nippon Steel Semi-conductor/ EDB			1998	16Mb/64Mb DRAM	0.3	30,000	8							
Japan	Hitachi	Tokyo	R&D 2	1990	4M/16M DRAM	0.5	4,000	6	4,000	60	40	85	75	408,000	156,000
Japan	Hitachi	Yamanashi	Imasuwa	1990	4MDRAM, 4MSRAM, 16M Proto-DRAM	0.6	25,000	6	25,000	40	20	85	75	1,700,000	487,500
Japan	Hitachi	Yamanashi	K-2-2F	1990	4M/16M DRAM	0.5	4,000	8	3,000	50	50	85	75	382,500	416,250
Japan	Hitachi/ Tobu Semi-conductor		NA	1990		0.6	17,000	6	17,000	50		85		1,445,000	
Europe	Hitachi	Landshut	E2	1992	4M/16M DRAM, 1M SRAM	0.5	16,000	8	16,000		85		75		3,774,000
U.S.A.	Hitachi	Irving	Phase 2	1993	CBIC, 16M DRAM, 4M SRAM	0.6	5,000	8	5,000		70		75		971,250

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
U.S.A.	Twinstar	Dallas	Twinstar	1996	16M/64M DRAM	0.35	15,000	8	5,000		80		75		1,050,000
	Hitachi Total						**279,000**		**165,000**					**8,531,200**	**11,958,750**
Japan	IBM	Shiga	NA	1990	4M/16M DRAM	0.6	6,000	8	5,200	20	70	85	65	397,800	709,800
Europe	IBM	Sindelfin-gen	NA	1989	4M/16M DRAM	0.8	20,000	8	15,000		50		65		975,000
Europe	IBM	Corbeil-Essonnes	NA	1989	1M DRAM	-	7,000	8							
U.S.A.	IBM	East Fishkill	NA	-	NA	0.8	20,000	8							
U.S.A.	IBM	Essex Junction	Bldg. 970	1988	16M DRAM	-	24,000	8	24,000	40		80		3,456,000	
U.S.A.	IBM	Essex Junction	Bldg. 973	1989	16M DRAM	0.5	20,000	8	15,000		100		70		3,150,000
U.S.A.	IBM	Manassas	VHSIC	1989	Memory, MPU, ASIC, MIL	0.8	1,600	5							
Americas	IBM/Toshiba	VA		1997	16Mb/64Mb DRAM DSP	0.35	28,000	8							
Europe	IBM/ Siemens	Corbeil-Essonnes	ACL	1992	16M DRAM	0.4	16,100	8	12,000		100		70		2,520,000
	IBM Total						**142,700**		**71,200**					**3,853,800**	**7,354,800**
Japan	Matsushita	Kyoto	LAB	1994	16M/64M DRAM	0.35	1,000	8	1,000		20		65		39,000
Japan	Matsushita	Toyama	Fab 1	1994	4M/16M DRAM, MCU, ASIC	0.5	20,000	6	20,000	10	65	80	70	352,000	1,183,000
Japan	Matsushita	Toyama	Fab C-2	1990	4M/16M/ 64M DRAM, SRAM	0.5	24,000	6	20,000	30	70	80	70	1,056,000	1,274,000
Japan	Matsushita	Tonami	Fab 2	1996	16M DRAM, ASIC	0.35	20,000	8							
U.S.A.	Matsushita	Puyallup	NA	1991	1M/4M DRAM, MCU, Gate Arrays	0.8	15,000	6	15,000					-	
	Matsushita Total						**80,000**		**56,000**					**1,408,000**	**2,496,000**
Japan	Mitsubishi	Ehime	KD-1	1995	16Mb/64Mb DRAM	0.40	20,000	8	10,000		75		70		567,000
Japan	Mitsubishi	Ehime	SA2A	1991	4M/16M DRAM	0.40	20,000	6	20,000	10	30	85	75	374,000	486,000

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Mitsubishi	Ehime	SA2B	1994	4M/16M DRAM	0.40	16,000	8	16,000		80		70		3,136,000
Japan	Mitsubishi	Ehime	Sa2F	1997	16Mb 64Mb DRAM	0.35	20,000	8							
Japan	Mitsubishi	Osaka	ULSI	1993	16M/64M DRAM	0.35	10,000	8	10,000		80		65		1,820,000
Japan	Mitsubishi	Kumamoto	D-1F	1994	16Mb DRAM	0.35	10,000	8							
Japan	Mitsubishi	Kumamoto		1996	16M/64M DRAM	0.35	10,000	8	5,000		80		65		910,000
Japan	Mitsubishi	Kochi	TA1	1990	4M DRAM, 1M SRAM	0.7	30,000	6	30,000	80		85		2,244,000	
U.S.A.	Mitsubishi		NA	1990	1M/4M DRAM	0.9	7,800	5	7,800						
Asia/ Pacific	Powerchip Semicon-ductor (Elite-group)	Hsinchu		1996	16M DRAM	0.4	25,000	8							
U.S.A.	Mitsubishi	Alsdorf	NA	1997	16M DRAM	0.35	7,000	8							
	Mitsubishi Total						**175,800**		**98,800**					**2,616,000**	**6,919,000**
Japan	NEC	Hiroshima	Dif-1	1990	4M DRAM, SRAM, MPU, 4M ROM	0.6	30,000	6	30,000	20		85		1,020,000	
Japan	NEC	Hiroshima	Dif-2	1995	16M DRAM, ASIC, RISC	0.35	10,000	8	20,000	0	90	80	75	-	4,725,000
Japan	NEC	Kumamoto	Dif-7	1988	MCU, 4M DRAM, ASIC	0.8	30,000	6	30,000	20		85		795,600	
Japan	NEC	Kumamoto	Dif-8	1994/Q4	16M DRAM, 4M SRAM, RISC MPU	0.35	15,000	8	15,000		80		75		3,150,000
Japan	NEC	Kumamoto	Dif-8-2	1997	64M/256M DRAM	0.25	30,000	8	3,000						
Japan	NEC	Yamaguchi	Dif-1	1988	4M/16M DRAM	0.8	45,000	6	30,000	10		85		510,000	
Japan	NEC	Yamaguchi	Dif 2	1993	4M/16M DRAM	0.5	45,000	6	12,800		65		75		998,400
Europe	NEC	Livingston, West Lothian	Phase 2	1991	4M DRAM, 256K SRAM, MPR, MPU	0.35	10,000	6	10,000	80		85		1,360,000	

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Europe	NEC	Livingston, West Lothian	Phase 3	1996	16M/64M DRAM	0.35	10,000	8	10,000						
U.S.A.	NEC	Roseville	M-Line	1991	4M/16M DRAM	0.5	35,000	6	12,000	25	75	85	70	510,000	945,000
Japan	NEC	Roseville		1997	16Mb/64Mb DRAM	0.25	20,000	8	2,000						
	NEC Total						**280,000**		**174,800**					**4,195,600**	**9,818,400**
Japan	Nittetsu Semicon-ductor	Chiba	M3	1990	4M DRAM	0.5	15,000	6	15,000	60	30	85	60	1,193,400	351,000
	Nittetsu Semiconductor Total						**15,000**		**15,000**					**1,193,400**	**351,000**
Japan	Oki	Miyagi	NA	1989	Gate Arrays, 1M DRAM, VRAM, Logic	0.8	20,000	6	1,000						
Japan	Oki	Miyagi	S1	1990	4M DRAM, VRAM, 1M SRAM	0.50	30,000	6	25,000	45		85		1,721,250	
Japan	Oki	Miyagi	S2	1995	16M/64M DRAM	0.30	15,000	8	12,000		60		70		1,764,000
Japan	Oki	Miyazaki	M1	1988	DRAM, SRAM, Gate Arrays, MPU	1.50	50,000	4							
Japan	Oki	Miyazaki	M2	1984	DRAM, EEPROM, ASIC, SRAM	0.8	60,000	5	28,000						
Japan	Oki	Miyazaki	M3	1991	4M/16M DRAM, 90K Gate Arrays	0.4	30,000	6	27,000	40	50	85	70	1,652,400	1,323,000
	Oki Total						**205,000**		**93,000**					**3,373,650**	**3,087,000**
Japan	Tohoku Semicon-ductor	Miyagi	Step 2	1991	4M DRAM	0.8	20,000	6	20,000	80		85		2,121,600	
Japan	Tohoku Semicon-ductor	Miyagi	Step 3	1995	16M/64M DRAM	0.35	15,000	8	15,000		85		70		3,123,750
	Motorola Total*						**35,000**		**35,000**					**2,121,600**	**3,123,750**

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Japan	Toshiba	Kanagawa	Bldg 108 D-2	1990	16Mb/64Mb DRAM Flash	0.35	1,300	8	1,300		80		75		273,000
Japan	Toshiba	Mie	Y-Cubed, No. 1	1993	4M/16M DRAM	0.5	20,000	8	9,000	0	80	80	75	-	1,890,000
Japan	Toshiba	Mie	Y-Cubed, No. 2	1996	16Mb/64Mb DRAM	0.35	40,000	8	9,000		70		75		1,653,750
Japan	Toshiba	Mie	NA	1996/Q4	64M DRAM	0.35	40,000	8							
Japan	Toshiba	Oita	C-Cubed, No. 3	1987	DRAM	0.7	20,000	6	15,000	30	40	85	75	765,000	585,000
Japan	Toshiba	Oita	C-Cubed, No. 4	1991	DRAM	0.5	25,000	6	20,000	30	40	85	75	1,020,000	780,000
	Toshiba Total						**146,300**		**54,300**					**1,785,000**	**5,181,750**
U.S.A.	TI	Dallas	DMOS4.1	1985	256K SRAM, 16M DRAM, Logic, ASSP	0.6	29,200	6	15,000	50	50	85	65	1,800,300	638,185
U.S.A.	TI	Dallas	DMOS 5 Phase 1	1995	16M DRAM	0.5	16,000	8	16,000	30	70	85	70	1,224,000	1,648,727
U.S.A.	TI	Dallas	DMOS 5 Phase 2	1996	64M, 256M DRAM	0.35	16,000	8	1,000		80		55		161,929
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 1-A	1991	4M DRAM	0.45	20,000	6	20,000	90		85		4,590,000	-
Asia/ Pacific	TI/Acer	Hsin Chu	FAB 1B	1995/3Q	16/64Mb DRAM	0.45	15,000	8	15,000	35	65	85	60	1,338,750	1,845,354
Asia/ Pacific	TI/Acer	Hsin Chu	Fab 2	1994	16M DRAM	0.8	9,000	8							-
Asia/ Pacific	TI/Acer		Fab 2A	1997	16Mb 64Mb DRAM	0.3	20,000	8							-
Asia/ Pacific	TI/Acer	Hsin Chu	FAB 2B	1998	16Mb 64Mb DRAM	0.30	20,000	8							-
Europe	TI	Avezzano	AMOS	1991	4M DRAM, ASSP, CBIC	0.5	13,500	6	13,500	35	60	85	65	1,004,063	775,049
Europe	TI	Avezzano	Phase 2	1996	16M DRAM	0.5	20,000	8	12,000		70		65		1,148,220
Japan	KTI Semiconductor	Hyogo	Fab 1	1992	4M/16M DRAM, ASIC	0.5	11,000	8	9,000		90		70		1,788,574
Japan	KTI Semiconductor	Hyogo	Fab 2	1997	16Mb DRAM	0.35	15,000	8							-

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Alphatec/TI	Chachaer-sao	Phase 1	1997	16Mb/64Mb DRAM	0.3	15,000	8							-
	TI Total						**219,700**		**101,500**					**9,957,113**	**8,006,038**
U.S.A.	Micron	Idaho	Fab 1	1981	256K/1M DRAM, 256KSRAM	1.2	32,000	6							
U.S.A.	Micron	Idaho	Fab 2	-	4M DRAM, 256K SRAM, VRAM	0.5	NA	8	12,000	90		90		4,179,600	
U.S.A.	Micron	Idaho	Fab 3	1991	4M/16M DRAM	0.50	NA	8	36,000	60	40	90	70	8,359,200	3,024,000
U.S.A.	Micron	Idaho	Fab D	1998	16M/64M DRAM	0.3		8							
	Micron Total						**32,000**		**48,000**					**12,538,800**	**3,024,000**
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab I-A	1984	256K DRAM, 64K SRAM, ASIC	1.2	15,000	5							
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab II	1985	1M/4M DRAM	0.8	25,000	6	25,000	70		80		2,800,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS Fab III	1991	4M DRAM	0.6	20,000	6	20,000	90		85		3,060,000	
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E2 (Fab 5)	1994	16M/64M DRAM	0.35	25,000	8	30,000		70		60		4,410,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E1 (Fab 4)	1994	4M/16M DRAM	0.5	10,000	8	20,000	8	80		65		3,640,000
Asia/ Pacific	Hyundai	Ichun, Kyungki-Do	MOS E3	1998	16M/64M DRAM	0.35	20,000	8							
Americas	Hyundai	Oregon	Oregon Fab	1997	16Mb 64Mb DRAM	0.35	30,000	8							
	Hyundai Total						**145,000**		**95,000**					**5,860,000**	**8,050,000**

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 4	1990	4M DRAM, SRAM	0.6	35,000	6	30,000	20		85		1,428,000	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 3	1988	4M DRAM, SRAM, VRAM, ROM	0.8	35,000	6	35,000	25		85		2,082,500	
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 5	1994	16Mb/64Mb DRAM	0.5	25,000	8	25,000		95		85		6,762,813
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 6	1994	16M/64M DRAM	0.35	30,000	8	30,000		95		85		8,115,375
Asia/ Pacific	Samsung	Kiheung-Up, Kyungki-Do	Fab 7	1996	16M/64M DRAM	0.35	20,000	8	20,000		95		85		5,410,250
	Samsung Total						**145,000**		**140,000**					**3,510,500**	**20,288,438**
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 1	1990	4M/16M DRAM	0.7	30,000	6	30,000	40		80		1,920,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 2	1991	4M DRAM	0.7	30,000	6	30,000	75		85		3,825,000	
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C1, Phase 3	1997	16/64M DRAM	0.35	30,000	8							
Asia/ Pacific	LG Semicon	Chongju-City, Choongbuk	C2, Phase 1	1993	4M/16M DRAM	0.5	20,000	8	30,000		80		65		5,460,000
Asia/ Pacific	LG Semicon	Gumi	C2, Phase 2	1996	16M DRAM	0.5	20,000	8	10,000		80		65		1,820,000
	LG Semicon Total						**130,000**		**100,000**					**5,745,000**	**7,280,000**
Asia/ Pacific	Mosel Vitelic	Hsin Chu	FAB 1-A	1995/Q1	4M DRAM	0.5	15,000	6	15,000	30		80		561,600	
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 1-B	1995/Q4	4M/16M DRAM	0.5	15,000	6	15,000	80	5	80	60	1,497,600	157,500

Table A-4 (Continued)
Worldwide DRAM Fabs, Year-End 1996

Region	Company	Prefecture	Fab	Year of Initial Production	Products	Geometry (Microns)	Maximum Monthly Wafer Capacity	Wafer Size (Inches)	Current Wafer Starts	Ratio 4M (%)	Ratio 16M (%)	Yield 4M (%)	Yield 16M (%)	Production 4M (Units)	Production 16M (Units)
Asia/ Pacific	Mosel Vitelic	Hsin Chu	Fab 2	1997	16M/64M DRAM	0.40	20,000	8	-	10	80			-	-
	Mosel Vitelic Total						**30,000**		**30,000**					**2,059,200**	**157,500**
Asia/ Pacific	Tech Semi-conductor	Woodlands	Fab 1	1993	16M DRAM	0.5	12,000	8	12,000		95		70		1,321,500
Asia/ Pacific	Tech Semi-conductor	Woodlands	Fab 2	1996	16M/64M DRAM	0.35	10,000	8	10,000		95		65		2,100,000
	Tech Semiconductor Total						**22,000**		**22,000**					-	**3,421,500**
Asia/ Pacific	Nan Ya Technology	Tao-Yuan	Fab 1	1996/Q3	16M/64M DRAM	0.45	25,000	8	5,000		100		65	-	1,137,500
	Nan Ya Technology Total						**25,000**		**5,000**					-	**1,137,500**
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1A	1995	4M/16M DRAM	0.35	18,000	8	14,000		80		65		2,548,000
Asia/ Pacific	Vanguard	Hsin Chu	Fab 1B	1996	4M/16M DRAM	0.35	18,000	8	10,000	30	65	85	65	765,000	929,500
Asia/ Pacific	Vanguard	Hsin Chu	Fab 2	1997	16M/64M DRAM	0.35	15,000	8							
	Vanguard Total						**51,000**		**24,000**					**765,000**	**3,477,500**
Asia/ Pacific	UMC	Hsin Chu	Fab 3-A	1995/Q3	SRAM, Mask ROM, 4M/ 16M DRAM	0.5	15,000	8	11,000	60		50		990,000	
Asia/ Pacific	UMC	Hsin Chu	Fab 3-B	1997/Q1	64M DRAM	0.35	15,000	8							
	UMC Total						**30,000**		**11,000**					**990,000**	-
	Americas Companies						429,400		255,700					28,471,313	21,508,588
	European Companies						41,000		28,000					742,560	1,474,200
	Japanese Companies						1,358,200		785,400					27,379,650	46,784,600
	Asia/Pacific Companies						598,000		427,000					18,929,700	43,812,438
	Korean Companies						420,000		335,000					15,115,500	35,618,438
	Taiwan Companies						156,000		70,000					3,814,200	4,772,500
	Rest of Asia/Pacific Companies						22,000		22,000					-	3,421,500
	Worldwide Companies						2,426,600		1,496,100					75,523,223	113,579,826

*Tohoku Semiconductor production is split 50-50 between Toshiba and Motorola.
NA = Not available
Source: Dataquest (October 1996)

For More Information...

James Seay, Market Research Analyst..... (408) 468-8259
Internet address .....jseay@dataquest.com
Via fax ..... (408) 954-1780

Dataquest
A Gartner Group Company

DATAQUEST WORLDWIDE OFFICES

NORTH AMERICA

Worldwide Headquarters
251 River Oaks Parkway
San Jose, California 95134-1913
United States
Phone: 1-408-468-8000
Facsimile: 1-408-954-1780

East Coast Headquarters
Nine Technology Drive
P.O. Box 5093
Westborough, Massachusetts 01581-5093
United States
Phone: 1-508-871-5555
Facsimile: 1-508-871-6262

Dataquest Global Events
3990 Westerly Place, Suite 100
Newport Beach, California 92660
United States
Phone: 1-714-476-9117
Facsimile: 1-714-476-9969

Sales Offices:
Washington, DC (Federal)
New York, NY (Financial)
Dallas, TX

LATIN AMERICA
Research Affiliates and Sales Offices:
Buenos Aires, Argentina
Sao Paulo, Brazil
Santiago, Chile
Mexico City, Mexico

EUROPE

European Headquarters
Tamesis, The Glanty
Egham, Surrey TW20 9AW
United Kingdom
Phone: +44 1784 431 611
Facsimile: +44 1784 488 980

Dataquest France
Immeuble Défense Bergères
345, avenue Georges Clémenceau
TSA 40002
92882 - Nanterre CTC Cedex 9
France
Phone: +33 1 41 35 13 00
Facsimile: +33 1 41 35 13 13

Dataquest Germany
Kronstadter Strasse 9
81677 München
Germany
Phone: +49 89 93 09 09 0
Facsimile: +49 89 93 03 27 7

Sales Offices:
Brussels, Belgium
Kfar Saba, Israel
Milan, Italy
Randburg, South Africa
Madrid, Spain

JAPAN

Japan Headquarters
Aobadai Hills 4-7-7
Aobadai
Meguro-ku, Tokyo 153
Japan
Phone: 81-3-3481-3670
Facsimile: 81-3-3481-3644

ASIA/PACIFIC

Asia/Pacific Headquarters
Suite 5904-7, Central Plaza
18 Harbour Road, Wanchai
Hong Kong
Phone: 852-2824-6168
Facsimile: 852-2824-6138

Dataquest Korea
Suite 2407, Trade Tower
159 Samsung-dong, Kangnam-gu
Seoul 135-729
Korea
Phone: 822-551-1331
Facsimile: 822-551-1330

Dataquest Taiwan
11F-2, No. 188, Section 5
Nan King East Road
Taipei
Taiwan, R.O.C.
Phone: 8862-756-0389
Facsimile: 8862-756-2663

Dataquest Singapore
105 Cecil Street
#06-01/02 The Octagon
Singapore 069534
Phone: 65-227-1213
Facsimile: 65-227-4607

Dataquest Thailand
12/F, Vanissa Building
29 Soi Chidlom
Ploenchit Road
Patumwan, Bangkok 10330
Thailand
Phone: 662-655-0577
Facsimile: 662-655-0576

Research Affiliates and Sales Offices:
Melbourne, Australia
Beijing, China

Dataquest
A Gartner Group Company