

Sun Microsystems: Integrating its Own Enterprise

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August, 1999

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Executive Summary

Sun was originally a niche company making engineering workstations. In the late 1980s, Sun began to enter the multiuser server market, offering its products as departmental and network servers. By the mid-1990's, it was also trying to sell high-end servers for enterprise applications and the emerging web server market.

As the company grew, the senior management decided that Sun needed to develop corporate IT systems to be able to manage itself as one whole company. It also lacked knowledge of the enterprise market into which it was trying to sell its high-end servers. So Sun decided to develop its own enterprise systems running on Sun servers to improve its internal information systems and to gain the experience needed to sell and support hardware in the enterprise market.

The effort to run Sun on Sun was hobbled by management problems: creating some kind of centralized management structure to pull together the decentralized business units and requiring them to cooperate in developing the enterprise IT systems. In 1996, Ed Zander took over as Sun's first COO, restructured Sun to have more central management control, and started SunPeak, a project aimed at creating a complete enterprise information system running on Sun hardware. This effort was expensive and difficult, requiring the company to distribute its Oracle ERP systems across multiple servers and do a lot of custom work to make it operational. However, Sun sees the cost as justified by the experience and understanding gained.

In 1997, Sun developed the Enterprise 10000 server with mainframe-like capabilities using technology purchased from Cray. This system is much more robust than other Solaris servers, and Sun is shifting its own enterprise systems over to it. Sun is also positioning the E-10000 as an alternative to mainframes and high end servers from HP, IBM and Compaq in the enterprise and web server market.

Sun's motto of "the network is the computer" has guided the company for a decade, and underlies the new slogan "we put the dot on "dot.com." This slogan emphasizes Sun's strategy of providing core technologies (servers, Solaris, Java) and setting standards (Java and Jini) to run the Internet. Sun has repositioned itself away from the slow-growth workstation market and toward the high-growth Internet market, and its servers run high-profile web sites such as AOL, Amazon.com and e-bay.¹

Sun faces strong competition from HP and IBM in the high end of the market, and from the Intel camp in lower end servers and Internet standards but its strong corporate identity, technologies and alliances (AOL/Netscape, IBM) are competitive advantages, particularly in the Internet market.

Sun's willingness to be a testing ground for its own products causes a lot of headaches for the IT department (SunIT), but is important both for marketing purposes and for being able to provide service and support to its customers. Hence the very recent move of the Operations subunit of SunIT into the Services Division to create outsourcing capabilities for both Sun customers and for Sun itself.

¹ Arik Hesseldahl, "E-bay outages cast clouds on Sun," *Electronic News*, June 21, 1999.

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*In an industry synonymous with change, Sun has had one constant vision. It's at the heart of every technology, system, software, and service we offer today--and the focus of everything we invest in for tomorrow. It's the one thing that never changes: **The Network Is The Computer**TM Through open interfaces, industry standards, and platform-independent JavaTM technologies, we're working to provide seamless connectivity to anyone, anywhere, anytime, on virtually anything.* "Vision," Sun Microsystems, Inc., 1998 Annual Report.

INTRODUCTION²

Sun's vision appears everywhere—in talks by senior executives, inhouse publications, promotions to business partners and marketing to customers. Sun also lives the vision in the sense that it runs the company on its own networked hardware and software. As put by a Sun CIO, "We are like test pilots--we fly our own planes. Sometimes we crash so our customers don't have to."

Sun was founded in 1982 by a small group of classmates at Stanford and UC Berkeley who named it Sun, for Stanford University Network. Scott McNealy, the current Chairman and CEO of Sun, was an MBA graduate and one of the original founders.³ By the end of 1998, Sun had grown to nearly 26,300 employees and \$9.8 billion in revenues with operations in 190 countries.⁴

Sun's first product was a high-end computer workstation put together from standard parts and using a standard version of Unix for its operating system. The Sun workstation was a desktop machine that was considerably more powerful than a PC and therefore provided a desktop alternative to existing minicomputer systems for computationally intensive commercial and technical tasks. Similar workstations based on proprietary "closed" technologies were being marketed by IBM, DEC and HP at the time, but Sun's goal was to provide a proprietary "open" alternative.⁵

In the late 1980s Sun began to manufacture large multi-user servers which were also based on open standards and the Unix operating system. By the early 1990s server

² This case study has drawn material from several earlier case studies: Richard L. Nolan and Kelley A. Porter, 1999, "Sun Microsystems and the N-tier Architecture," Cambridge, MA: Harvard Business School, March 4; David Farlow, Glen Schmidt, Andy Tsay and Charles A. Holloway, 1996, "Supplier Management at Sun Microsystems (A) and (B)". Palo Alto, CA: Stanford University Graduate School of Business, OIT-16-A and OIT-16-B, March; Mark Cotteleer and Robert D. Austin, 1998, "Sun Microsystems: Realizing the Potential of Web Technologies," Cambridge, MA: Harvard Business School, December 22; Robert D. Austin, 1998, "Network Computing at Sun Microsystems: A Strategic Deployment," Cambridge, MA: Harvard Business School, March 13.

³ Two founders left to form or manage other companies; Bill Joy, the UNIX expert from UC Berkeley is still with Sun. See Brent Schlender, The Edison of the Internet, *Fortune*, 139(3): February 15, 1998.

⁴ Hoovers Company Profiles, 1999.

⁵ See footnote 14 for a discussion of the meaning of proprietary open.

sales for corporate networks had grown so dramatically that Sun declared itself an enterprise server company and developed ever more powerful servers seizing on the slogan "the network *is* the computer." By 1997, Sun was shipping about 100 servers and 2,500 workstations a day from just one (Milpitas, CA) of its three factories. Sun's servers ranged in price from \$14,000 to over \$1million with estimated average gross margin of 65%, while its workstations were priced at an average of \$15,000 with estimated average margin of 38%.⁶

Although the leader of Unix workstation and server markets, these are seen as declining markets as the position of Windows NT continues to grow in Sun's entry-level markets. Consequently, Sun is moving into new computing paradigms such as pervasive computing and the information utility which are expected to generate additional demand for higher-level servers (mainframes) while also continuing to exploit its technical and experiential edge in corporate networks and Internet computing. For Sun, networked computing sells computers in the sense that the greater the spread of computing networks of all kinds, the greater the prospect for sales of Sun's full range of computers. And, Sun's own use of IT internally and with its customers and suppliers is aimed at demonstrating the superior scalability, reliability and price/performance of its technology for networked computing.

Although Sun is a multifaceted company with its own microelectronics, software and service divisions, this case study focuses on the computer division which we refer to as Sun or Sun Microsystems. However, because the software and services divisions are so critical to Sun's business strategy, we elaborate on them where appropriate.

II. COMPETITIVE ENVIRONMENT

Sun operates in three product markets: Unix workstations, Unix servers, and the total server market (Unix/NT/Other). Sun is the leading firm in the traditional workstation market with 18.9% of the industry revenues in 1997 (Table 1).

Sun is also the leading firm in the Unix market for servers (from entry level to large scale) with 26% of units shipped and 24% of the revenues (Table 2). Sun's 1998 revenue growth was the highest of all its competitors in all categories of Unix servers except the midrange where it came in second to HP. Finally, Sun is ranked fourth in the total server market⁷ including Unix/NT/Other servers (Table 2).

Its primary competitors in these markets have been IBM and HP but new competition is developing from Compaq (DEC/Tandem) and Dell in the midrange server market (Table 1). Competitors like IBM, HP and NCR are reportedly leaving the Unix market and providing a temporary growth opportunity for Sun in what is considered a declining market overall.

⁶ Brent Schlender, "Javaman: The Adventures of Scott McNealy," *Fortune*, 138 (17) October 13, 1997.

⁷ Sun achieved a 75% year over year increase in total server shipments from 1997-1998. See Andrew Shikiar, 1998, "Sun Surges Ahead in Server Market, Commands First Place for Total Unix Server Shipments, Sun Press Release, July 27.

Table 1. Worldwide workstation and server market shares, 1992 and 1997 (percent)

Firm	Workstations		Midrange Servers \$5,000-\$500,000		Large Scale Servers >\$500,000	
	1997 \$19 billion	1992 \$10 billion	1997 \$39 billion	1992 \$24 billion	1997 \$16 billion	1992 \$26 billion
Sun	18.9%	22.8%	8.5%	n.a.	<1.0%	n.a.
IBM	13.4	10.9	16.8	24.2	33.1	34.6
HP	16.3	12.2	12.3	8.1		
DEC	2.6	9.5	6.5	10.6		
SGI	7.9	5.8				
Intergraph	2.1	4.0				
Compaq			15.8	n.a.		
NCR/AT&T			4.6	6.1		
Dell Computer			2.6	n.a.		
Fujitsu					26.9	19.9
Hitachi					13.1	11.4
NEC					8.8	9.5
Amdahl					n.a.	6.4
Groupe Bull					3.9	3.0
Siemens/Nixdorf					3.8	2.4
Unisys					3.2	3.7
Others	45.4*	28.2*	20.5**	17.5**	7.2***	9.1***

*Workstations are defined by McKinsey (1998) as high-performance, single user computers with high-resolution graphics, built-in networking, and highly functional systems software. Others: Fujitsu, NEC, Toshiba, Trigem, Mentor Graphics, Siemens/Nixdorf, ComputerVision.

**Midrange servers are defined as processors and embedded peripherals for medium scale computer systems, including minicomputers, superminis, dedicated graphics processors, workstation servers, and PC servers. Others: Fujitsu, NEC, Toshiba, Siemens/Nixdorf, Groupe Bull, Sequent, Stratus, Unisys, Olivetti, Data General, Nihon Unisys, Wang.

***Large-scale servers are defined as processor and embedded peripherals for large-scale computer systems commonly called mainframes and supercomputers. Others: Compaq, Nihon Unisys, Silicon Graphics, Cray Research, Control Data Systems.

Source: McKinsey, 1998.

Table 2. Worldwide Unix market shares, 1998 (percent)

Firm	Total Unix Servers		Total Servers (Unix/NT/ Other)		Entry Servers (<\$100,000)			Midrange Servers (\$100,000 - \$1 million)			Large Scale Servers (>\$1 million)		
	Units	Rev.	Rev. share	Rev. Gr.	Units	Rev.	Rev. Gr.	Units	Rev.	Rev. Gr.	Units	Rev.	Rev. Gr.
Sun	26	24	10	29	25	27	14	28	19	22	42	32	51
HP	16	22	13	15	14	14	-39	32	30	31	26	12	5
IBM	19	15	25	1	16	23	- 5	10	16	-2	8	23	10
Compaq*	4	15	13	- 1	16	9	3	7	5	15	n.a.	n.a.	n.a.

Source: Reported in Computergram International, Sun Says Server Growth Remains Strong, ComputerWire, April 1, 1999. Cites IDC, 1998 report on server market as source.

* Compaq figures include DEC and Tandem too.

Sun does very well with high tech companies and those that can employ, sophisticated and experienced technical staffs to build and maintain complex corporate and inter-corporate networks. Its major customers tend to be large manufacturing,

finance, government, education and telecommunications (telephone, cable, ISPs) enterprises (Table 3). These five top industries provide 70% of Sun's business revenues, each providing a billion or more in revenue annually.⁸

Table 3. Illustrative large Sun customers by industry segment

Manufacturing	Telecommunications	Finance	Government	Education	All Other
Amoco, PGS, Ford Motor, Dow Corning, Howmedica (Pfizer),	Bell Atlantic, AT&T, Southwest Bell, Bay Networks, AOL, e-bay, Amazon.com	Bank of America, Fidelity, NY Life, Aetna, Toronto stock exchange, Chase	US Patent Office, US Postal Service,	Northern Arizona University	Simon & Shuster, New York Times, Sears Canada, The Gap, American Airlines, CSX

Sources: Various news media reports.

Sun has 41 offices world-wide providing sales, marketing, service and technical support. Sun's 1998 revenue was split 52% in the U.S. and 48% internationally. Sun is organized to provide sales and service for 11 geographical regions: Asia-Pacific (Asia, South Korea/Taiwan, China), EMEA (Benelux, Northeastern Europe, SEAME⁹, France, Germany, UK) and The Americas (US/Canada, Southern Hemisphere).

Although Sun's is a leader in the workstation/server industry and its growth has been strong, this generally has not been reflected in its stock price which trades at a price/earnings ratio more typical of a mature company (Figure 7, Section VI). Sun believes it should trade at a much higher multiple due to its future growth prospects, but Wall Street analysts believe that its "workstation growth will be threatened by the technological advance of personal computers, and particularly Windows NT."¹⁰ Consequently, there is significant pressure for Sun to maintain earnings growth through both increasing revenue and lowering costs. On the cost side, Sun has been working to streamline business processes and achieve annual cost and headcount reductions, but SG&A has been rising faster than revenues (Table 4).

On the revenue side, Sun has been trying to affect future software standards and turn the industry in its favor for the Internet and e-commerce. Sun has developed the Java software language, which makes it possible to run PC-like applications on any hardware platform and any software operating system. Java applications can run on network computers that are less complex than PCs and have no local disk storage because processing and data storage are provided on central servers. Such systems are projected by Sun and others (Gartner Group) to cost less to buy and support than PCs thereby affecting the total cost of ownership--an issue which has become important to top management in all user organizations. However, Sun's JavaStation has not been a success within the firm or in the market.

⁸ Confidential Industry Report (Ib).

⁹ Southern Europe, Africa, Middle East.

¹⁰ Forlow, et.al., 1996, p. 1.

Table 4. Sun's SG&A as percent of revenue, 1993-1998

	1993	1994	1995	1996	1997	1998	CAGR (%)
Revenue (\$ millions)	4,309	4,690	5,902	7,095	8,598	9,791	18.9
SG&A (% of revenue)	26	25	26	25.2	27.6	28.4	21.4
R&D (% of net revenues)				9.2	9.6	10.4	

The Java language is viewed as a threat to Microsoft and Intel, and a battle is underway between the Wintel alliance and Sun and its partners (Oracle, Netscape, IBM). What is at stake is the direction of distributed and networked computing in the years to come. If Sun's vision prevails, Microsoft and Intel might lose their proprietary lock on operating system and microprocessor designs, and associated applications. The jury is still out on this battle but its outcome will have serious implications for Sun's future growth.

So will the prospect for Internet utilities which Sun believes in and promotes vigorously. Instead of user organizations being required to buy, install and operate their own hardware and software products, Internet utilities would allow the user to contract for applications from various network service providers. Industry analyst David Mochella says that if user organizations migrate away from hardware and software products and towards competing network services, Sun will benefit in two big ways:

“First, service providers will want to share and leverage their systems and therefore will tend to require much larger configurations than those designed for an individual company. That plays directly to Sun's strength in high-end systems which is perhaps Windows NT's single biggest weakness. Second, if service providers replace end users as Sun's core customer base, the sales process itself is likely to become more sophisticated and technical. ...Sun already does much better with savvy Internet service providers and big Web sites.... So a shift toward a network-centric industry would surely help Sun....”¹¹

III. BUSINESS STRATEGY

Market Vision

Sun sees itself as one of the world's top providers of network computing solutions--not only to the networked enterprise, but to networked consumers and to networked customers, suppliers and partners (Figure 1, p. 30). For example, McNealy says in Sun's 1998 Annual Report (p.4):

"The network now stretches from the data center all the way to smart cards, palmtop computers, Web phones--and probably some devices that don't have names yet. Imagine a world where all your devices...speak to each other over a network that goes wherever you do. Imagine being able to access your personal desktop from any computer--just by swiping a smart card at an airport, computing kiosk, a hotel set-top box, or a client's workstation--anywhere you happen to be.

¹¹ David Moschella, 1999, "Internet Utilities will Rock IT World," *Computerworld*, May 17, p. 31.

So we won't have to carry our computers with us--the network will be everywhere we go."

Strategic Positioning

In its core workstation business, Sun competes on product features while meeting market standards on price/performance. The chief product feature that differentiates Sun from its competitors is scalable, reliable hardware solutions for the Unix operating system.¹² Sun is the only computer company that refuses to have anything to do with Microsoft. Along with Apple, it is the only vendor not to ship Windows NT on its servers or Windows on its smaller machines. It also eschews Intel's processors, concentrating on its own SPARC RISC architecture.¹³ IBM, Compaq and Hewlett-Packard have their own proprietary operating systems and chip architectures too, but they cover their bases by also selling machines based on the Wintel standard, which each year comprise a greater and greater proportion of their shipments. Compaq and Dell and most small vendors are almost entirely in the Wintel camp. McNealy reportedly disparages this strategy, arguing that if they all end up selling the same machine, they will not be able to differentiate themselves from each other.

More than any of its competitors, Sun is betting the company on the growth and evolution of network computing, especially the thin client model rather than the fat PC. "The model is changing," says McNealy. "Everything will be on the network. It's absurd that we keep all our data on PCs and laptops, where it can be too easily lost. You trust the bank with your money - why would you not trust the network with your data? You should download your data when you need it, just as you withdraw money when you need it."

Sun believes that its strength in core industries, coupled with its strong platform technology is expanding its opportunities in new markets related to the Internet such as e-commerce, digital media management, internet service providers and application service providers. The Internet represents a growing opportunity for Sun, which is quickly becoming a recognized leader in providing Internet-based system solutions due to high profile Internet customers like e-bay, Amazon.com and AOL.

Business Model

Sun has been described by a board member as "the last standing, fully integrated computing company."¹⁴ It is a vertically integrated computer company (Dedrick and Kraemer, 1998) that does everything from manufacture of microprocessors to operating systems, to computer systems to applications to distribution to customer service and support (Figure 1, p. 30). But it also partners with others.

Sun's strategy is to focus on the platform and enabling technology and partner with a few suppliers for manufacturing and with independent software vendors (ISVs),

¹² Sun has made availability a big issue, especially as it has moved into large-scale servers. Doug Chandler, "Sun continues its high-availability push with SunUP Program, IDC Flash, February, 1999.

¹³ However, Sun is now working with Intel on porting Solaris to run on the Merced processor. See: "Sun & Systems Partners Reach Key Milestone for Solaris Software on Merced Processor," M2 Presswire, January 12, 1999.

¹⁴ Brent Schlender, 1997.

systems integrators and consultants for complementary products, distribution and service/support. Sun focuses its internal activity on R&D, marketing, design, and service. It maintains design and development responsibility for those components and systems where it is important to be first-to-market, maintain technical leadership and achieve systems integration. Its R&D spending is around 9-10% of net revenues (Table 4), which is high than other computer companies because Sun develops its own proprietary technologies. Sun has licensed technologies to other companies (in Japan, Taiwan) in a effort to gain additional revenues to offset the R&D, but the arrangement has not been as profitable as hoped. However, it has been a way to get into Japan and Taiwan markets without a big investment by Sun.¹⁵

As to platform, Sun reportedly strives to differentiate its products on two or three key dimensions on which it is leading edge and to compete on cost and quality on all others. Although these vary over time, Sun pursues three product differentiators:¹⁶

- *Open systems.* In open systems, every hardware and software component works with every other component via a set of shared computing standards. Sun has worked with partners like Oracle, Netscape and Netscape to promote proprietary open systems in competition with proprietary closed systems from IBM, DEC and H-P. Sun's products have been designed to support sophisticated interactions across networks and the open networking protocol, TCP/IP has also been in place at Sun from the beginning. These factors and Sun's continued focus on network computing have positioned it as a leader in deployment of internet and web technologies.
- *Scalability.* Sun's control over its technologies has enabled it to achieve commonality in its product lines from desktops to large systems that enable it to provide network computing that scales and runs reliably. This in turn has allowed Sun to meet the needs of large corporations converting to Unix-based servers to run enterprise systems such as SAP, PeopleSoft, Baan and Oracle. So far, Sun has been able to integrate 64 of its SPARC microprocessors thereby providing the capacity to handle such large applications.¹⁷ This has given it a strong image as a provider of industrial strength technology.
- *Proprietary Sun technologies.* Sun has designed its own microprocessor called SPARC, its own Unix-based operating system called Solaris, its own languages for web-based applications on the Internet called Java, and its own language for information appliances called Jini. On the surface, this seems contradictory with the notion of open systems, but these technologies are "open" in the sense that the standards and protocols are published and Sun licenses their use to other

¹⁵ Sun interviews, July 1999.

¹⁶ Farlow, et.al., p. 2.

¹⁷ In 1997, Sun introduced the Enterprise 10000, or Starfire server, which had capacity up to 64 400MHz UltraSparc processors and 64Gb of memory running under Solaris 7.0 which incorporated software technology licensed from Cray that allowed partitioning and other robust features that allowed applications to run independently, to operate interactively and to handle a large number of users simultaneously (up to 92,000 users). In the "Letter from the Chairman" in its 1998 Annual Report (p.10), Sun says that its third-generation UltraSPARC microprocessor should make it possible to build systems with more than a thousand processors while maintaining complete compatibility with its entire product family.

manufacturers.¹⁸ By making its technologies open in this manner, Sun has hoped to increase the size of its business ecology--the number of companies that have a stake in Sun's success because they write end user applications and other software¹⁹, manufacture hardware, distribute Sun products, integrate and install hardware and software in user companies, provide maintenance and support, train experts and end users, or consult on how businesses can use Sun technology for their operational effectiveness and strategic positioning to gain competitive advantage. Sun is clearly differentiated in the market place for its technologies, especially among other high technology companies.

Sun outsources manufacturing to a few key suppliers in order to minimize costs. In doing so, it uses a mix of make and buy strategies aimed at providing the greatest possible leverage over the technology (with product innovation provided by suppliers as well as in-house) on the one hand, and cost advantages of high volume production on the other.

Sun partners with other firms for distribution/fulfillment through business partnerships with master resellers and consulting companies. For example, in 1998, Sun provided systems integration and support for less than 10% of its products worldwide. The remainder is provided by leading independent software vendors such as SAP and Peoplesoft, and service providers who are business partners such as Andersen Consulting and EDS. These business partnerships allow Sun to concentrate its own efforts on its largest and most profitable customers.

IV. ORGANIZATION OF BUSINESS ACTIVITIES

Sun consists of five major divisions: Sun Microsystems Computer Company, SunService, SunSoft, Inc., Sun Microelectronics and JavaSoft. The bulk of Sun's revenues come from the Sun Microsystems Computer Company, which accounted for 73 percent of total revenues in fiscal 1997 (Figure 2). SunService, which provides system support, education, consulting, system integration and network management, accounted for an additional 13 percent and is integral to the success of Sun Microsystems because it provides service and support for the more than 700,000 Sun systems deployed in 190

¹⁸ Ferguson and Morris (1993, p. 88) refer to Sun technologies as "proprietary open" as differentiated from purely proprietary closed. Open systems refers to the fact that there are published standards and interface protocols that allow hardware and software from many vendors to work together in a network. "The standards define how programs and commands will work and how data will move around the system--communication protocols and formats that hardware components must adhere to, the rules for exchanging signals between applications software and the operating system, the processor's command structure, the allowable font descriptions for a printer and so forth." Thus, open versus closed systems refers to the degree to which architectural standards and protocols are published and available for others to use. In contrast to IBM which opened its PC architecture too broadly and Apple which kept it closed, Sun opened its Sparc RISC architecture very early both to software developers and processor/system cloners. Open systems help to create a broad base of third party hardware vendors that can produce commodity components and of third party software developers that helps the customer base and maintain customer loyalty to the platform. See Charles R. Morris and Charles H. Ferguson, 1993, "How Architecture Wins Technology Wars", *Harvard Business Review*, March-April, pp. 86-95.

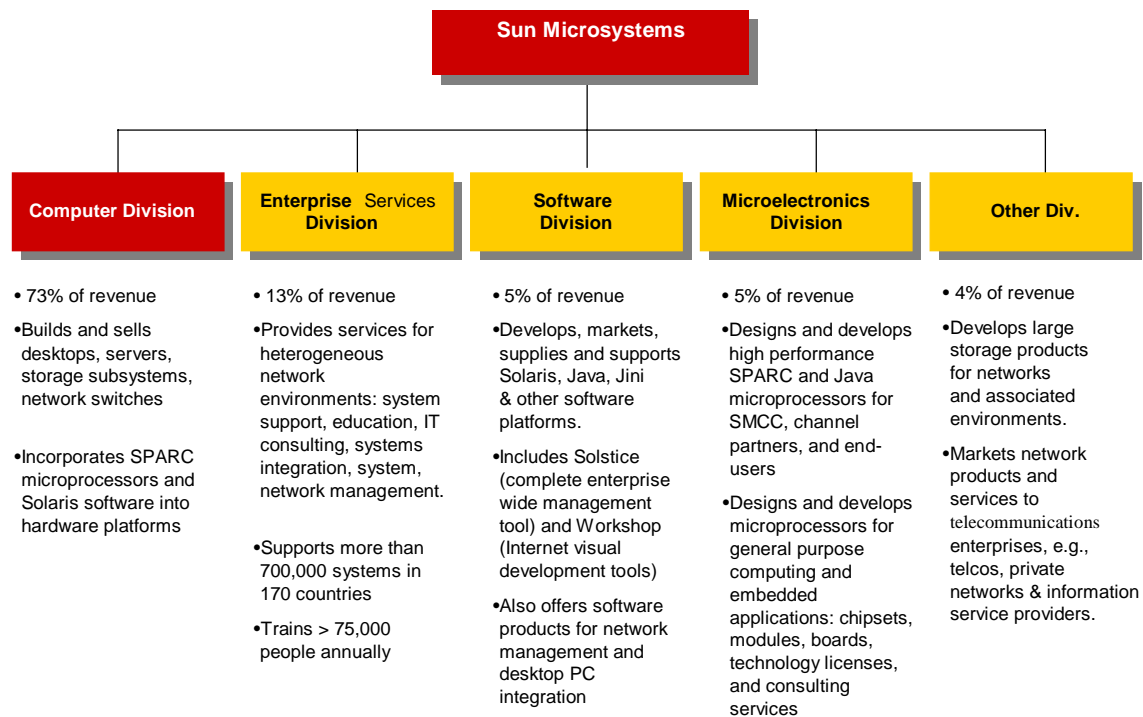
¹⁹ One outside report says that Sun is losing 10% of its application developer base every year. Confidential industry report, 1999 (Ib).

different countries around the world and trains about 75,000 people annually in the use of Sun systems and software.²⁰ In contrast, Sun Microelectronics, SunSoft and JavaSoft each contribute about 5% of Sun's revenues. They are strategic divisions which are essential to Sun's proprietary technologies and its strategic positioning aimed at product differentiation.

Production/Supply

Sun uses third parties to manufacture most of its products, and to improve on their design. It outsources the bulk of its manufacturing to a few contract manufacturers and suppliers in order to get economies of scale in production. For example, in 1994 Sun had fewer than 1,000 line employees involved in internal manufacturing out of 13,000 employees worldwide.²¹ The Sparc microprocessor is manufactured totally outside of Sun by Texas Instruments and Fujitsu who produce in volume and sell the chips to other licensed vendors as well, thereby reducing Sun's material costs. Sun also contracts out their board manufacturing to Solectron, their storage and disk subcomponents to Seagate Technology and Quantum (ATL Products), their power supplies to Zytec Corporation and their monitors to Sony.

Figure 2. Sun Microsystems' organization



Source: Confidential Industry Report (Ox), 1998; data is for 1997²²

²⁰ Confidential industry report (Ox).

²¹ Ibid.

²² Sun's Professional Services group within the SunService Division employed 856 IT professionals in 28 locations as of February 1998, and experienced 45% annual growth in revenues.

Sun generally does not buy fully finished systems; rather it uses two major approaches to outsourcing for its own production:²³

1. Buy components, assemble inhouse. This approach was adopted early in Sun's life as it partnered with suppliers who make integrated circuits, networks or other components needed to keep Sun's products leading edge. Sun believes that not having to bear the investment cost of supporting capital infrastructure makes it faster on its feet. In return, Sun helps its partners by sharing information about its intended technical directions and by being the largest purchaser of new technology.
2. Make and buy components, assemble in house. Sun has adopted this approach for key components such as CPU boards. Sun's purpose in using this dual model is not just to provide extra capacity, but to ensure it understands the technology and can effectively perform design for manufacture and testability. This approach also allows Sun to maintain higher utilization of its manufacturing capacity, outsourcing only that portion of demand which exceeds internal capacity. It also helps Sun to control costs internally and externally through cost comparison and cost reduction requirements and to develop new technologies in secret.

Standardization is widely used to lower costs and obtain economies of scale in production. Sun uses industry standards, standard components and standard suppliers everywhere but in its proprietary technologies. For example, the same power supplies and system boards are used in low end and midrange servers and at the low end Sun uses their offering as both workstations and servers thereby spreading the cost across two families of products.

Distribution/Fulfillment

Sun's sales efforts are about equally divided between the direct and indirect channels, with each channel dealing with demand generation, presales, closing, deployment and support activities. Direct sales are made through sales representatives (43 percent of revenue), telesales (5 percent), and the Internet (negligible as Sun only started selling in January 1998). Sun maintains 80 sales offices in the U.S. and an additional 88 offices worldwide to serve 1,500 large accounts,²⁴ including businesses, governments, education institutions, and software vendors. The direct sales rep's primary role is to service Sun's large accounts and to assist Sun's business partners in fulfillment. Sales managers and reps compensation is channel neutral to reduce potential channel conflict with distribution partners. About 52 percent of revenue is from the indirect channel, mainly three master resellers (Ingram-Micro, Merisel and Access Graphics) who sell to about 4,800 small and medium enterprises, and systems integrators, VARs, OEMs and independent distributors who service remote locations and smaller customers.²⁵ Sun makes limited use of the retail channel. Sun maintains 27 Solution Centers worldwide for presales and post-sales support of its sales staff, business partners and end user organizations. The Solution Centers, which are staffed with systems engineers, professional services consultants and trainers, are often opened jointly with business

²³ Farlow, et.al., 1996, pp. 2-3.

²⁴ Confidential industry report (Ib).

²⁵ Confidential industry report (Ib), (Ox, p. 290)

partners. For example, in late 1997 Sun opened a new center with CSC that focuses on supply chain management using the Internet and provides education, demonstration, and pilot project services.²⁶

Integration Services and Support

Sun relies heavily on third parties for integration services and support. Ten major independent software companies are strategic software partners with the SunService Division. These include: Baan, BEA, Computer Associates, Informix, J.D. Edwards, Lotus, Netscape, Oracle, PeopleSoft, SAP, SAS Institute, Sybase, Tivoli and IBM.

Sun also has strong relationships with the leading consulting companies including KPMG, Price Waterhouse, Andersen Consulting, EDS, MCI and Cambridge Technology Partners, Perot Systems, Ernst and Young, CSC, Cap Gemini and Deloitte ICS.²⁷ Sun recently used Andersen Consulting to assist with re-engineering of its own key business processes and implementation of a new IT infrastructure through the SunPeak project (see Section V below). The foregoing system of relationships between Sun and the major players in its extended value chain are shown in Figure 3.

The Sun/AOL/Netscape Alliance

The recent alliance with AOL/Netscape is not a major departure with significant implications for the future; rather it is simply part of Sun's continuing efforts to develop strategic alliances and partnerships. The purpose of the alliance is to develop unified, next-generation software infrastructure and products for e-commerce ranging from basic Web servers and messaging products to e-commerce applications. To do so, a 2000 member company of Sun and former Netscape (now AOL/Netscape) employees has been created to develop the unified products and to sell these through a dedicated 500 member sales force by first quarter 2000.

In the meantime, each company will market and sell one another's existing products. In addition, over the next three years, AOL will pay \$500 million for Sun hardware and services and \$5 million a quarter to license the Java software. In turn, Sun will pay AOL \$1.2 billion for licensing rights and \$10 million in cooperative marketing fees. The alliance has symbolic value as well as practical value for Sun. It identifies Sun more solidly with leading Internet and e-commerce companies and it gets AOL to buy servers which they had been buying from Sun's competitors previously. It also provides a major, high-profile company for Sun's new outsourcing business within the Enterprise Services Division.²⁸ Finally, it allies AOL/Netscape against Microsoft.

In order to boost their efforts, the alliance recently announced a preferred integrators initiative with Andersen Consulting, Cap Gemini, Computer Sciences

²⁶ Confidential industry report (Ox).

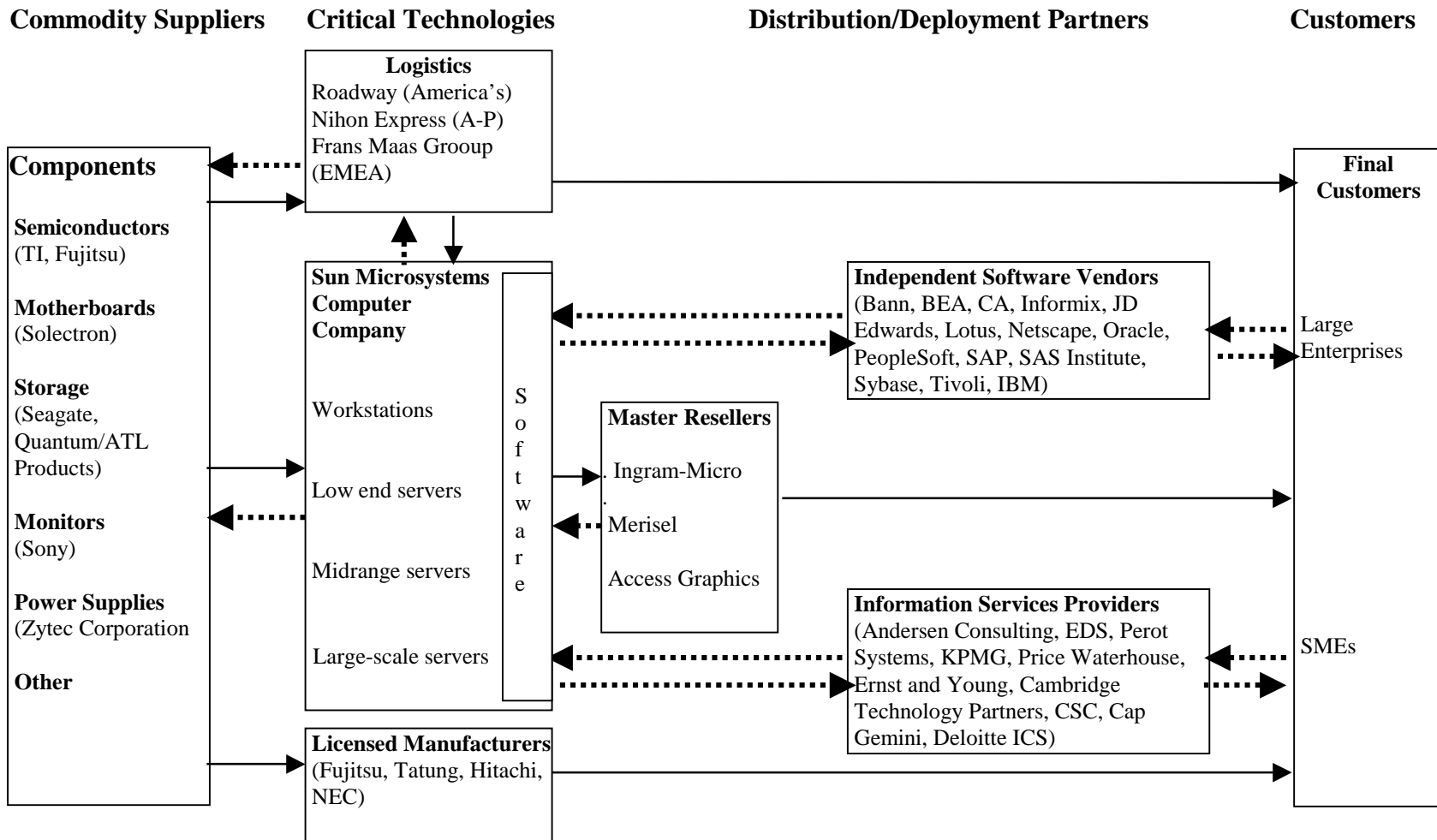
²⁷ Others include NTT Data, MCI, Logics, Software AG, CMA, Raytheon, and Imonics.

²⁸ Robert D. Hof, Steve Hamm, and Ira Sager, "Sun Power: Is the Center of the Computing Universe Shifting?" *Business Week*, January 1, 1999; Catherine Yang, Peter Burrows and Michael Moeller, "The 800-Pound Gorilla of E-Commerce?" *Business Week*, April 5, 1999; "AOL-Sun Alliance is Virtually an Experiment," *San Jose Mercury News*, Business Question and Answer Column, April 12, 1999.

Corporation, EDS and PricewaterhouseCoopers and a plan to train 35,000 consultants to assist businesses with implementing e-commerce solutions.²⁹

²⁹ “Five Major Global Systems Integrators join new Sun-Netscape Alliance Preferred Intergrators Initiative for Implementing E-commerce Solutions,” PR Newswire, May 5, 1999.

Figure 3. Sun Microsystems' extended value chain



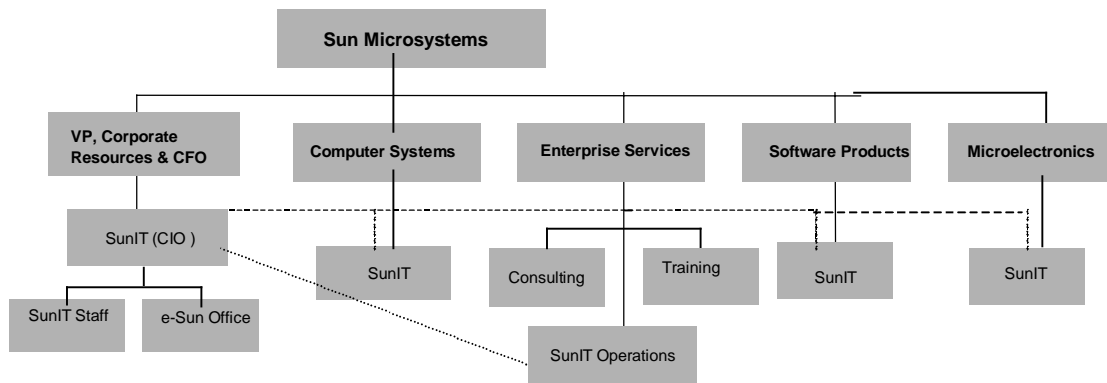
V. INFORMATION TECHNOLOGY

IT Organization

Sun's IT organization is highly decentralized with about 80% of the 2400 IT staff in the user divisions and 20% in a centralized CIO office called SunIT. The decentralized IT units report directly to the major divisions, and indirectly to the CIO (Figure 4). The two largest IT units are in Computer Systems and Enterprise Services, which each have about 800 IT staff. The CIO reports to Corporate Resources which includes the financial, human resources, legal, purchasing and IT functions. The CIO office, which has 400 people, encompasses four staff subunits--Enterprise Management and Architecture, Vendor Relations and Sourcing, Network Storage, and Corporate Resources--and the E-Sun program office. The E-Sun office is devoted to developing e-commerce applications and tools for Sun's own use and has 200 IT staff located in three different cities--Boston, Colorado Springs and San Jose.

A new CIO, H. William Howard, was appointed in September 1998³⁰ and reports directly to Mike Lehman, Vice President of Corporate Resources and Chief Financial Officer, who was acting CIO from April to September 1998.

Figure 4. Sun's IT organization



Source: Interviews with SunIT staff.

The current IT organization reflects a significant shift that occurred in the distribution of IT functions in 1999. The primary shift was the movement of IT Operations from the CIO's office to the Enterprise Services Division—a move which Sun officials refer to as equivalent to outsourcing their internal operations. This move is designed to enhance the

³⁰ "Sun Microsystems, Inc. Names H. William Howard New Chief Information Officer," PR Newswire, 09/24/1998.

capabilities of Sun's Services Division and to enable it to provide systems management, systems integration, and other information services to its customers beyond consulting and education/training. In other words, it is designed to support a corporate strategy aimed at growing the services side of Sun's computer business similar to that at IBM and Hewlett-Packard. Another change made in 1999 was the integration of IT units serving Sun Software Platforms. Previously, the SunSoft and SunJava divisions each had their own IT units, which were consolidated along with the software divisions themselves.

Sun Microsystems has a total IT budget of about \$500 million in 1999, and has been growing about \$100 million a year since 1995 (Table 5). IT spending has been about 4-5% of revenues, which is not unusual for a high-technology company, especially one in which IT is a major part of the production technology for hardware, software and services. Although Sun's IT investments exceed the mean of computer manufacturers and manufacturers in general, they are in line with the investments of leading technology companies such as IBM, Cisco, and Compaq.

Table 5. Sun's IT resources

Resource	Sun Microsystems	Computer, peripheral & network equipment manufacturers		All manufacturing	
		Average	Median	Average	Median
IT budget/% revenue	5%*	2.2	1.6	1.8	1.6
IT budget/employee (\$000s)	\$18,600*	\$6,118	\$7,567	\$5,479	\$3,543
Percent IT employees in user departments	80%*	7%	n.a.	8%	n.a.
Revenue/IT employee (\$million)	\$4.0*	\$7.1	\$9.6	\$14	\$9.6
Revenue/employee	\$372,000	\$285,100	370,400	\$384,900	\$218,800

Sources: Confidential industry report by Dataquest, 1999. *These estimates by the authors have been confirmed by SunIT staff.

IT Architecture

Sun's IT architecture has more or less reflected its organization structure, and changes therein. Historically, Sun was a workstation company and very decentralized with IT residing in the operating divisions and controlled by them. The leading IT unit was in the Computer Division, but IT units in the Microelectronics, Software and Services Divisions enjoyed similar autonomy. These decentralized structures led to the development of over 350 individual applications in response to the needs of the divisions, with different divisions and geographies having their own order entry, manufacturing, billing and other systems.

In the early 1990s, Sun's Executive Council decided that Sun needed to develop integrated systems in order to operate as a globally integrated company and that it should run the company on its own equipment—the "run Sun on Sun" mantra. Making the mantra a reality (or at least seem to be a reality) meant moving the mainframe based systems running on IBM computers off Sun premises and trying to develop a comprehensive system that ran on Sun servers. The major mainframe system was Cullinet's CAS (a packaged financial system) which Sun had customized extensively

over the years. Sun outsourced CAS to EDS's San Diego center, which still runs it today mainly for archive purposes.

Building integrated systems on Sun servers and making the Sun on Sun mantra a reality proved to be far more difficult than outsourcing the legacy systems. Beginning around 1994, the CIO (then Bill Raduchel) decided to create a comprehensive system based on Oracle's enterprise software. The efforts by the CIO's office ran into various difficulties. Sun made large servers, but these did not have the needed capacity to run a whole company. Therefore, building an enterprise system on Sun servers required designing an architecture to allow the applications to be spread over many machines and also over different geographies. While Sun servers were relatively inexpensive at internal transfer prices, building and maintaining a large network of servers and software was relatively difficult and expensive. In addition, the powerful operating divisions had their own systems which they did not want to give up. Thus, the difficulty of running large scale applications on Sun servers and the further difficulty of integrating them across the servers, the limited Sun experience in managing large-scale, corporate wide projects, and the lack of consistent strong executive support for integration stymied the internal integration effort.

The introduction of a COO into Sun's management structure in 1996 provided the basis for bringing about major change, as this first ever COO (Ed Zander) made the enterprise effort a priority. The vehicle of change was a program called SunPeak which was aimed at implementing certain core components of Oracle's enterprise system across all of Sun's divisions and on a global basis. The effort was centralized in the CIO's office and a team from Andersen Consulting was brought in to help manage the program, implement the Oracle systems, and create an enterprise infrastructure on which packaged applications could be implemented in the future.

SunPeak is described as enabling "the migration of Sun's computing infrastructure from a mainframe-based system to a flexible, scalable Sun-only platform optimized for the networked business world of the 21st. century--its own next-generation IT foundation powering Sun's own global enterprise."³¹ The project was a major re-engineering and re-architecture effort that:

- involved more than 60 business systems and 14 major processes,
- encompassed changes to more than 50% of Sun's computer systems business processes world wide,
- included the introduction of eight new systems, a new messaging architecture, and upgrades to 37 integrated systems,
- implemented a new enterprise application integration system,
- created one of the world's largest implementations of Oracle applications to date, and
- employed more than 500 Sun employees, consultants and contractors in some capacity over a two year period (1996-98).

The new system is described as following "a 'publish and subscribe' model, which is built around an 'Information Highway' that acts as the single interface mechanism. Each software application has exactly one interface--the Information Highway itself. This arrangement eliminates the chaos of multiple applications trying to

³¹ "Sun Unveils New Global IT Infrastructure," PR Newswire, 04/19/1999.

communicate across a variety of interfaces.” The so-called information highway is Sun-developed software similar to packaged middleware like TIBCO that provides for integration of data across applications.

Business Applications

Sun's business applications are the IT workhorses supporting day-to-day operations and providing information to aid decision making about the strategic positioning of products and services (Figure 5). The core business applications are the manufacturing components (material planning, order administration, manufacture planning, inventory management, purchasing) and finance components (accounts receivable, cost accounting, internal controls, financial/management reporting) of Oracle's enterprise system which were installed between 1996-1998 through the SunPeak program and previous activities (Oracle's general ledger and accounts payable). Another key part of the SunPeak effort included shipments planning and management on the outbound logistics side.

Sales and marketing

Sun provides its Sales and Marketing staff with an on-line, AI-based configuration application to assist them in configuring enterprise networks and additions thereto for customers. Sun sales personnel submit sales orders by email (most common), fax or express courier. Customer Service then enters the order into the Oracle order entry module and determines whether to fulfill the order through the factory or through a master reseller. Order entry is a centralized function based in Palo Alto for the Americas and regional headquarters in Europe and the Far East. The system is highly integrated such that all worldwide sales can be tracked as they are entered into the system. The sales force also can track orders and receive account information from the Oracle database, which is linked to the Sun intranet (SWAN). Resellers and end users also have access to order tracking info through SWAN (see section on IT Infrastructure below).

Production/Distribution

Order entry/management has automatic forwarding that transfers an order to the appropriate factory or business partner. Sales and Marketing work with them to schedule delivery based on product availability and the priority status of the customer. SunExpress telereps schedule deliveries for after-market products but this application is being integrated into e-commerce applications through E-Sun.

Oracle's Manufacturing Application Systems provide linked applications for material planning, order administration, manufacture planning, inventory management and purchasing with additional linkages to Oracle Finance Applications. Industrial Computer Corporation's Shop Floor Data Manager (SFDM) tracks data on assembly operations. SFDM brings together in a single platform such diverse functions as quality control, document management, plant-floor dispatching and integration of machines and devices used on plant floors. It includes detailed product routing and tracking, labor reporting, resource and rework management, production measurement, and data collection. By capturing "live" information about set-ups, run times, throughput, and yields, managers are able to measure constraints, identify bottlenecks, and get a better understanding of capacity.³²

³² Kevin Parker, 1977, "A concept matures," *Manufacturing Systems*, July, p.140.

Products are delivered primarily by third party distributors such as Roadway Logistics Systems (The Americas), Nippon Express (Asia-Pacific) and royal Frans Maas Group (EMEA). They use Sun's email system to communicate with Sun sales and marketing people. Once the products are installed, Sun sales reps or business partners update the existing customer file created at order entry indicating any changes that may have occurred from order to delivery. Electronic Software Distribution (ESD) is used to distribute software upgrades and applications that had previously been placed on CD-ROM and shipped to customers. ESD is reported to reduce cycle times to customers, allow distributors to focus on higher end products, lower costs and lower barriers to product entry into new markets.

Business support functions

Billing is centralized in Palo Alto or the countries and is automatic in the sense that when an order is logged into the order entry system, a bill for the order is generated automatically. The customer generally receives only one invoice per order so an invoice can be easily linked with the proper purchase order and the bill generally accompanies product shipment. Accounts receivable is also a centralized, automated process that runs on an Oracle database globally. This database is the line for order processing, installation recording, billing and invoicing and collecting. Sun's business partners and customers can access account information, status and history through SWAN.

IT infrastructure

The heart of Sun's IT infrastructure--the Sun Wide Area Network (SWAN)--is a centralized TCP/IP based intranet that spans 180 countries and has 38,000 nodes or connections.³³ It is powered by four data centers located in Singapore, Holland, Massachusetts and California (being replaced by a Colorado data center to move it out of its current earthquake-prone area). SWAN supports about 400 Oracle and Sybase relational databases, 45,000 clients (3,000 JavaStations, 4,500 laptops, and 37,500 SPARC stations), 10,000 servers, and more than 4,500 subnets. It supports more than 2 million internal web pages, processes 4 million email messages a day and has 10,000 remote access accounts. The system is reported to have low latency and is 99.9 percent reliable.³⁴

Web-based applications

Sun started experimenting with web-based applications in early 1994 and released its first external Web site containing product and contact information in April 1994. In creating the external web site, the Sun web team developed processes, procedures and templates for creating and launching web sites and made these available to others within Sun via a de facto intranet home page for the company. The site included a button that

³³ Cotteleer, et. al., p. 3

³⁴ Nolan and Porter, 1999, p. 6.

said "Push this button to make your own machine a web site," which led to an overnight explosion of internal web sites and creation of web traffic that overwhelmed Sun's computing network.

*In early March 1994, web traffic overwhelmed the network link between Sun's corporate data center in California and a primary manufacturing plant in Scotland. Production was lost because new orders could not be transmitted to the plant.*³⁵

An organization-wide request for cutback in traffic allowed the network people to add capacity and solve the problem temporarily. But no one realized that internal web sites and traffic would grow exponentially. By the end of 1995, Sun had 2000 active servers, nearly 99 percent of which resided on personal desktops and contained three million documents. This proliferation of web servers created problems of uncontrolled development, duplicate content and growing costs for ever more computer and network resources.

The proliferation led to a move in early 1996 to migrate the thousands of individual desktop servers to a centralized resource and to professionally manage Sun's internal web sites. Users would be relieved of the need to back up and maintain their server space, and would have access to the latest standards and tools. Benefits to Sun were expected to include reductions in the cost of maintaining desktops, increased security due to the centralized location of corporate information, and an increased ability to track application utilization.³⁶ Needless to say, some employees resisted such a move to centralized web management as being against the tradition of creativity and individualism that marked the company's culture. Table 6 is a list of the major web-based applications running at Sun. All applications, including legacy systems, database applications and functional systems have web interfaces.

Value added of IT innovations

There is no systematic assessment of the value of the IT innovations at Sun, but there are anecdotes from cases studies and claims of value added in material on Sun's web site, some of which are believable in principle. Similarly, SunSolve is reported in Cotteleer and Austin (1998) to have saved millions.

"The SunSolve server distributes patches via the web rather than by telephone and hard media (i.e., mailing a disk). By implementing the service, we were able to off-load thousands of phone calls per week. In short, we let the customers get their own patches. They do the work, they are in control, and they are happier for it."³⁷

As with Cisco, Microsoft and others, the single greatest demonstrable value of IT comes from the use of the Internet to download software and software patches to ISVs, business partners and customers.

³⁵ Cotteleer, et.al., p. 5

³⁶ Cotteleer, et. al., pp. 9-10.

³⁷ Cotteleer and Austin, p. 9.

Table 6. Description of web-based applications by value chain segment

Segment	Program	Description
Sales and Marketing	SunConfigurator	Provides artificial intelligence configuration application that ensures system configurations are valid and efficient and automatically forwards sales reps configuration to systems engineers for independent check.
Production/supply	Oracle ERP Order Administration Application (replaced SunOASIS)	Provides record of all orders received by email, fax or express mail; automatically transfers orders to the appropriate factory or business partner; automatically invoices customer; permits business partners and customers to access order status, information and history; permits sales rep or partner to update order record upon completion of delivery or install.
Distribution	SunVIP (Vendor Integration Program)	Provides support for joint Sun and independent Software Vendor customers; designed to eliminate finger-pointing by customers at either ISV or Sun by giving the customer a discernible avenue to place the blame for technical problems.
	Electronic Software Distribution (ESD)	Uses the Internet to distribute software upgrades and applications that had previously been placed on CD-ROM and shipped to customers.
Business Support	Accounts Receivable	A centralized, automated process that runs on an Oracle database globally. This database is the line for order processing, installation recording, billing and invoicing and collecting. Sun's business partners and customers can access account information, status and history through SWAN.
Service & support	SunTutor	Provides multimedia training products
	SunSolve	Search and retrieval system that tracks support solutions, including bugs and patch descriptions, technical articles and reports. Available on CD-ROM, through the Internet and certain company intranets.
	Sun NetRequest Service	Email tool that speeds submission of user requests for service, helps standardize call logging, and automatically allocates requests to the appropriate level of technical support based upon a customer defined priority.
	SunSolve EarlyNotifier	Provides online notification and alert of bugs, workarounds, and solutions from Sun Solution Centers.
	SunSolve Bulletin Board	Allows Sun customers using the Internet to discuss and resolve technical issues and exchange information with each other and Sun personnel.
	Sun HelpDesk Tools	Allow customers to establish their own inhouse help desks.
	Human Resources-	WSUN
	SunWeb intranet	Provides employees with a comprehensive means of learning about the company through access to 5 million online documents including Postscript and PDF files about everything from health care (including forms) to network statistical reports. ³⁸ First created in 1994.

Sources: Confidential industry reports (Ib), (Ox). Many of these applications are being incorporated into the new E-Sun (e-commerce) effort or replaced by it.

³⁸ "Sun Microsystems Wins CIO Web Business 50/50 Award," Business Wire, 07/06/1998. See www.cio.com for more information.

VI. FIRM PERFORMANCE

Business Perspective

Sun's profit model is to sell high margin servers for current hot workloads such as enterprise systems, technical computing and the Internet while simultaneously working to cut its operating costs. It uses strong ISV endorsements and its scalable server platforms to win market share. It makes its profits on midrange to large-scale servers, large storage, and high-end workstations. The low end workstations and servers are priced to hold onto market share, combat the Wintel platform, and drive the need for large servers.

Sun cuts costs by outsourcing manufacturing to a few key suppliers and outsourcing service and support to the leading systems integration and service firms while building up its in-house services division to handle its largest customers. Sun attempts to minimize cost by re-use of technology throughout its product line.

Sun hopes to drive future demand for servers through networked computing, e-commerce, and pervasive computing ranging from telephone handsets to palmtops to laptops to desktops to a myriad of home appliances. It is already established in the first two segments and hopes to gain a place in pervasive computing through (1) innovation in SmartCards, Java applications, new information appliance technologies and (2) leveraging its Java, Jini, and Jain standards for promoting its technologies and its image as a trend setter.

Financial perspective

Sun's financial performance has been solid and generally ahead of its industry on many indicators (Table 7).

Table 7. Sun's comparison with industry performance

Growth Rates	Sun	Industry	Market
36-month Revenue Growth	15.10%	4.80%	7.60%
36-month Net Income Growth	20.60%	14.50%	8.00%
36-month EPS Growth	19.60%	8.20%	-3.50%
Gross Profit Margin	57.13%	43.80%	46.64%
Pre-Tax Profit Margin	12.90%	10.58%	7.00%
Net Profit Margin	8.20%	7.48%	5.19%
Return on Equity	20.60%	25.70%	13.70%
Return on Assets	12.10%	8.50%	2.60%
Return on Invested Capital	20.60%	17.80%	7.10%

Source: Hoovers Company Profiles, 1999. Note: According to Hoovers, Sun is in the "Diversified Computer Systems" Industry. The "Market" is the approximately 8,000 publicly traded NYSE, AMEX and NASDAQ stocks. 36-month numbers are a CAGR using a least squares method.

However, during the period 1992-1994, its net profit margins fell significantly due to problems with new workstations based on the SuperSparc chip and a new version of its UNIX-based operating system called Solaris 2 (Figure 6). There were delays in getting out the new platform, and performance shortfalls once released. For example, the new workstations were reportedly less powerful than UNIX-based workstations from HP, IBM and DEC. In mid 1993, Sun was also facing competition from Intel Pentium-based

computers and the soon to be released Windows NT, and IBM and Apple were planning to introduce new PowerPC workstations.³⁹ All of these events created uncertainty and resulted in a general slowdown in growth of the overall market for workstations, which combined with Sun's problems, resulted in poor performance for Sun. The situation changed dramatically when a new generation of UltraSparc workstations were introduced in 1995 allowing Sun to once again take and maintain the lead in powerful workstations.⁴⁰

It is difficult to compare Sun with specific competitors because the comparable businesses cannot be broken out from the other parent companies (e.g., IBM and HP). Sun's revenues and net income have increased steadily from 1989 to 1998 with compound growth rates of 18.7% and 28.7% respectively (Table 8). However, growth has been especially strong between 1994-1998. While revenues averaged only 15.8% over the period, net income averaged 31.2% and net profit margins nearly doubled from 4.2% to 7.8% (Figure 6).

Between 1989 and 1998, Sun's earnings per share have increased at a compound annual growth rate around 25% as has its stock price. This steady growth and stellar performance in higher end servers has led to a large increase in Sun's market valuation from 1995 to 1998 (Figure 7).

Table 8. Sun's financial performance, 1989-1998

Year	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	CAGR	Year-over-Year Growth
Revenue	1,765	2,466	3,221	3,589	4,309	4,690	5,902	7,095	8,598	9,791	18.7%	13.9%
Net Income	61	111	190	173	157	196	356	476	762	763	28.7%	0.1%
Net Profit Margin	3.4%	4.5%	5.9%	4.8%	3.6%	4.2%	6.0%	6.7%	8.9%	7.8%		
EPS	0.1	0.16	0.24	0.22	0.19	0.26	0.46	0.61	0.98	0.97	25.5%	-1.0%
Employees	10,208	11,500	12,480	12,800	13,253	13,282	14,498	17,400	21,500	26,300	9.9%	22.3%
Revenue/Employee (\$000)	173	214	258	280	325	353	407	408	400	372		-6.9%

Source: Hoover's Company Profiles, 1999.

Operational perspective

Industry experts reportedly agree that Sun has one of the most efficient distribution networks in the IT industry. Order responsiveness in North Americas for 1997 was reported by industry analysts and business partners to be around 85% and on time delivery around 97%, although Sun claims it is higher. The figures are similar in EMEA, but lower in the Asia Pacific (80% and 87% respectively) and lower still in Latin America (75% and 70%). Order to ship and ship to delivery times were two days each for

³⁹ Marilyn Chase, 1993, "Sun Scurries to Overcome Delays and Fend Off Rivals," *The Asian Wall Street Journal*, May 12, p. 12; Robert D. Hof, 1993, "Sun vs. The Heavyweights: Does it have a Shot?--*Business Week*, May 31, p. 85.

⁴⁰ Peter ffoulkes, 1997, "UNIX Workstations: The Shape of Things to Come," Gartner Group, August 18.

lower end hardware, software and after market products. For about 45% of its products in North America, Sun guarantees same day shipping.

Sun sales personnel estimated that the number of accounts receivable days outstanding is 44 and inventory turns are 14.2. Sun's automated order entry minimizes the number of people involved in order processing and thus the potential for errors with invoice accuracy levels of 99.5%.

Figure 6. Sun's profitability

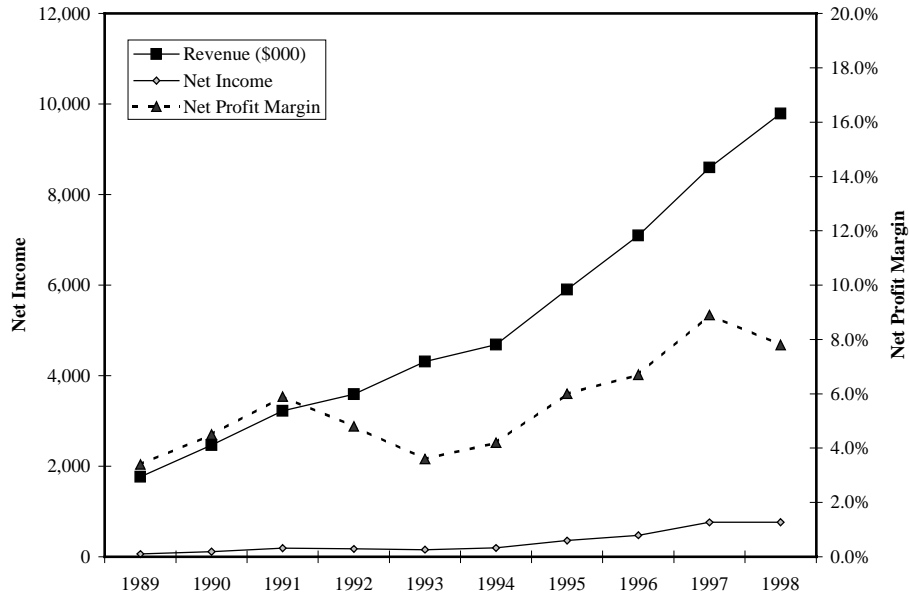
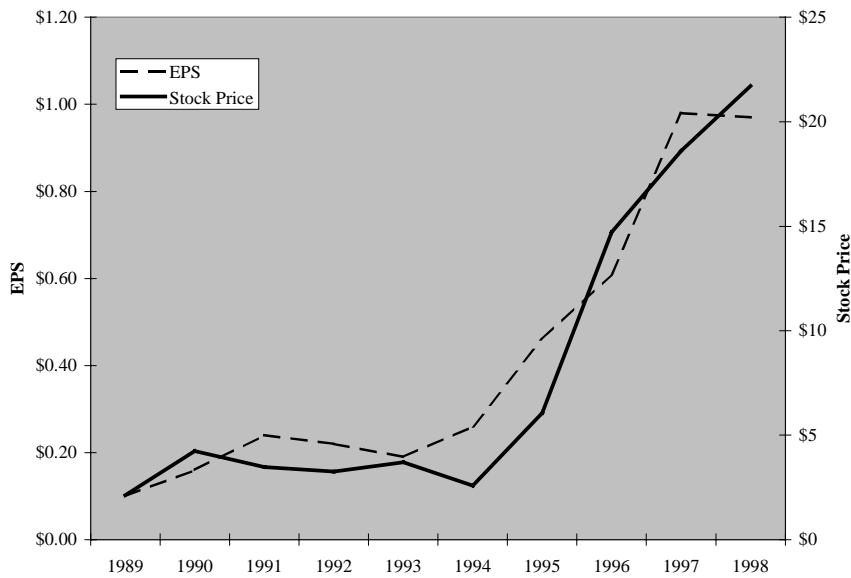


Figure 7. Sun's market valuation



Customer perspective

Bonus compensation is tied directly to quality and customer satisfaction, and Sun's intranet contains a customer satisfaction scorecard which is updated weekly. The scorecard measures customer quality and customer loyalty as two indicies forming an x-y axis that is used to directly calculate employee and manager bonuses. Less than 5% of Sun's customers are reportedly dissatisfied with Sun's quality or fulfillment performance.

VII. CONCLUSIONS

Sun Microsystems is highly differentiated from other competitors in its market by its hardware, software, brand image and controversial Chairman and CEO. Sun's great strength is its focus on the Unix market, scalability and reliability of its equipment and operating system, and its experience from being one of the first pioneers in network computing, the Internet and e-commerce. Sun wants to be recognized as the leader in providing servers for the Internet, and is one of the few vendors that understands the computing requirements for running complex networks, the security issues surrounding e-commerce, and has the depth, breadth, and scalability to satisfy users requirements. Sun is also the vendor of choice among high technology companies that have the sophistication and technical staffs needed to implement and support complex networks. But herein lies a critical weakness.

Sun's greatest weakness is its singular focus on the Unix marketplace and its lack of a strong industry alliance that helps it battle the Wintel alliance. The Unix market is declining in the face of Windows NT and Linux. Sun's Intel/NT strategy has been interoperability⁴¹ although it is reportedly working with Intel on a Merced implementation of Solaris. In the short term, Sun is betting on the slow growth of NT/Merced scalability and the further pick-up of Unix customers as other vendors leave this market. However, unlike the high tech companies who use Sun hardware and software, most user companies are not high technology companies and do not have leading edge technical staffs. For example, a recent study of CIOs indicated that while most had heard of Java, only 40 percent could describe it as a programming language or platform, and less than 20% of those surveyed associated Java with Sun. In contrast, Microsoft sits on nearly every desktop and its applications are used in 85% of all computing environments.

Although Sun's Solaris OS and E-10000 are highly proven in enterprise computing, the number of independent software vendors writing for Sun's Solaris OS is decreasing, with the company reported to be losing an average of 10 percent market share every year to NT for software development. Sun needs to attract applications to the Java platform. Although Java is proliferating with an 85% penetration on the client, the server

⁴¹ Windows interoperability is achieved through a Sun PC card, co-processor card to run windows applications, an S-bus card to run PCI systems, Insignia's Softwindows95, and Ntrigue's remote Windows NT server support in which Windows and NT applications are executed on a remote Intel server and all graphics are displayed at the client. Confidential industry source (Ib).

side has only around 40% penetration.⁴² Performance issues reportedly have impeded more companies from using Java for their mission critical applications. Sun's new N-tier architecture is designed to address these problems, but there is no external, objective evidence to date that it has done so.

Sun's use of IT is strategic in that (1) it employs the same technology that it provides to customers, i.e., it is its own beta test site, and (2) it thereby demonstrates to customers, suppliers and business partners the concept, the operating reality and the benefits of its approach. Sun uses its own technology to run its business. For example, a former CIO of Sun Microsystems said:

“Sun on Sun technology is a religious point.... We run our company on our own technology. This allows us to show we can run an \$8 billion company on our own technology. We walk the walk. We are like test pilots--we fly our own planes. Sometimes we crash so our customers don't have to.”⁴³

The SunPeak project, unveiled in 1999, is another attempt to run Sun on Sun but with a new integrated architecture and to gain PR advantage from it.

Sun develops partnerships with leading companies in selected industries in an effort to demonstrate its capabilities and create marketing advantage. For example, it has partnered with Cisco Systems, America OnLine, AT&T, Bank of America and American Airlines. Sun has actively sought out these leading companies in their industry to demonstrate the strength of its hardware and software and has generally benefited by bringing other companies in the same industry on board as a result. This was shown earlier in Table 3.

Sun's own use of IT illustrates several broad principles for IT innovation which are also present in other companies such as Cisco Systems and Dell Computer.

Share information with key constituencies. Sun's master resellers and business partners can place and track orders, download software, access technical support material, and interact with Sun staff through SWAN, the intranet and functional applications such as order management.

Provide end to end integration of IT infrastructure. Though an expensive process, Sun has integrated its own IT infrastructure out of its own need for globally integrated operations in a highly decentralized company, out of its need to demonstrate that Sun equipment can do, and in order to learn what it takes to deliver integrated networked computing for its services business.

Encourage self help. Sun provides self-help applications both for its own staff in the areas of travel, benefits, retirement, and web sites. It also does so for its customers, resellers and business partners in the areas of order tracking, downloading of software fixes, technical support manuals, technical support, problem solving and xxxx..

Make your own use of IT a showcase of your computing paradigm for your customers and business partners. As put by the PR Newswire in describing the SunPeak project, "...the power of Sun's own products and technologies are demonstrated in this implementation, giving Sun a powerful tool for marketing its

⁴² Nolan and Porter, 1999.

⁴³ Mike Moore, director of information resources for Sun Microelectronics, quoted in Cotteleer, et.al., 1998, p. 3.

scalability and reliability capabilities to other large enterprise customers. The new system also serves as the ultimate research and development tool for Sun, allowing the company to test and hone its future technologies in a "real world application."

Finally, Sun's shift to enterprise IT, particularly its effort to run Sun on Sun has been an expensive learning experience, but it also has helped it to bring about major change in the company. Until the early 90's, Sun had been an engineering workstation company selling to engineers. If it was to continue to grow, Sun had to shift from an engineering customer base to an enterprise customer base, from selling to engineers to selling to senior executives. And to convince senior executives, Sun had to show that it could run its own enterprise on its own equipment. Sun tried to do so with various internally-led efforts, but these were unsuccessful due to major technical and organizational problems. Sun finally turned to outsiders--Andersen Consulting--for help in making the change through a "two year and several hundred million dollar effort" called SunPeak and involving as many as 200 consultant staff and an equal number of Sun IT staff pulled together from the divisions and the CIO's office. SunPeak succeeded in showing that Sun could be run on Sun servers, but at very great complexity and expense.

Ironically, it was Sun's new E-10000 "mainframe-like" computer that turned out to be key in reducing the complexity and cost of running Sun's new enterprise system. Now applications that were implemented on servers during SunPeak are being evaluated for migration to the mainframe to further reduce complexity and maintenance. As put by one senior executive, "running Sun on Sun has been expensive for IT, but it would have been more costly [in terms of the future of the company] not to do it. The effort showed senior management that there is a gap between design and engineering of computers and operating an enterprise system. Engineers design equipment and the IT guys have to operate it as a system. Engineers believe the things they design work, but they often don't work as conceived, or they don't adequately consider the operating aspects. Sun's experience shows that a company succeeds or fails on how well it manages the gap between [design and] engineering and operations. It is essentially a management problem."⁴⁴

⁴⁴ Sun interview, July 22, 1999.

References

- Austin, Robert D., 1998, "Network Computing at Sun Microsystems: A Strategic Deployment," Cambridge, MA: Harvard Business School, March 13.
- Cotteleer, Mark, and Robert D. Austin, 1998, "Sun Microsystems: Realizing the Potential of Web Technologies," Cambridge, MA: Harvard Business School, December 22.
- Curry, J. and M. Kenney (1999). "Beating the clock: corporate responses to rapid change in the PC industry." Working paper. Davis, CA: Department of Human and Community Development, University of California, Davis.
- Dedrick, Jason, and Kenneth L. Kraemer, 1998, *Asia's Computer Challenge: Opportunity or Threat for the United States and the World*, New York: Oxford University Press.
- Kraemer, Kenneth L, Jason Dedrick and Sandra Yamashiro, forthcoming, "Refining and Extending the Business Model with Information Technology: Dell Computer Corporation," *The Information Society*.
- Farlow, David, Glen Schmidt, Andy Tsay and Charles A. Holloway, 1996, "Supplier Management at Sun Microsystems (A) and (B)". Palo Alto, CA: Stanford University Graduate School of Business, OIT-16-A and OIT-16-B, March.
- Hoovers Company Profiles Online, 1999.
- McKinsey & Co., *The 1998 Report on the Computer Industry*.
- Moschella, David, *Waves of power : dynamics of global technology leadership, 1964-2010*, New York : AMACOM, 1997.
- Morris, Charles R., and Charles H. Ferguson, 1993, "How Architecture Wins Technology Wars", *Harvard Business Review*, March-April, pp. 86-95.
- Nolan ,Richard L., and Kelley A. Porter, 1999, "Sun Microsystems and the N-tier Architecture," Cambridge, MA: Harvard Business School, March 4.
- Porter, Michael E., *Competitive Advantage: Creating and Sustaining Superior Performance*, New York: Free Press, 1985.
- Womack, James P., Daniel T. Jones and Daniel Roos, *The Machine That Changed the World*, New York : Rawson Associates, c1990.
- Brent Schlender, "Javaman: The Adventures of Scott McNealy," *Fortune Magazine*, 138 (17) October 13, 1997.
- Brent Schlender, The Edison of the Internet, *Fortune*, 139(3): February 15, 1998.
- Shikiar, Andrew, 1998, "Sun Surges Ahead in Server Market, Commands First Place for Total Unix Server Shipments, Sun Press Release, July 27.
- Wysocki, Bernard, Jr., "The Outlook," *Wall Street Journal*, May 10, 1999, p. A1.

Figure 1. Sun's vision for the future of networked computing

