Competition in the Software Industry

— Microsoft Corporation, January 1998

The basic goal of the antitrust laws is to promote competition, thereby insuring that consumers benefit from the widespread availability of goods and services at fair prices that such competition generates. Sometimes competition can be very vigorous, but the fact that certain companies perform better than others is no reason to doubt that consumers benefit greatly from intense competition. As many courts have recognized, all companies should strive to do as much business as they can, even if that means taking business away from rivals, because it is that quest that results in the creation of new and better products offered to consumers at attractive prices.

The software industry is one of the great success stories of our free market system. New innovative software products are being introduced at a rapid pace, and prices are declining steadily. Competition is particularly intense in the personal computer segment of the software industry, where thousands of software companies have sprung up to take advantage of benefits provided to software developers by the Microsoft Windows platform.

Software publishers are driven by the constant need to innovate in order to keep pace with improvements in technology and upwardly spiraling consumer expectations. A software company's prospects for success are only as good as its latest products, and any company that fails to keep up with the advance of progress is literally doomed. That is why Microsoft will spend $2.6 billion this year alone on research and development. This technological treadmill is what keeps any company—no matter how large its current share of sales—from exercising market power in the sense of restricting output or increasing prices.

Software exhibits none of the barriers to entry that characterize traditional industries like mining or manufacturing. In software, companies cannot exert control over productive assets like factories and equipment. Instead, the premium is on ingenuity and the ability to react quickly to competitive developments. The principal assets required to create excellent software products are human intelligence, creativity, and a willingness to assume entrepreneurial risk, all of which are in abundant supply in this country.

Another necessary asset to promote innovative products and ideas is venture capital. According to the 1997 Price Waterhouse National Venture Capital Survey, $2.25 billion was invested in 460 new high technology companies through the first three-quarters of 1997. These 460 high technology companies represent 68 percent of all companies receiving capital investment. Entrepreneurs and the U.S. financial community have recognized the explosive potential of new, innovative ideas in the software industry. Innovation and investment is why the United States leads the world in the software industry, and why this field is critical to the global economy.

As a leading developer of many kinds of software, Microsoft has been central to the meteoric rise of personal computing. By helping to make computers ever more functional and easier to use, Microsoft is working to make computers a universal component of modern life, akin to televisions and telephones. Of course, thousands of other companies are also involved in this process, many of them building upon technologies pioneered by Microsoft. To the extent Microsoft is successful in increasing the popularity of personal computing, that success will benefit of the entire industry, including Microsoft.

This paper provides a brief overview of the computer industry and Microsoft's role in fostering competition and

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innovation within that industry. Thousands of companies participate in the computer industry, generating hundreds of billions of dollars annually in revenue. (*See* Section A.) The personal computer software segment of the computer industry, in particular, is one of the most competitive, dynamic and innovative sectors of the U.S. economy. Prices are falling, output is rising, and innovative technologies are being introduced constantly. (*See* Section B.) Unless its progress is hindered by unnecessary regulation, the software industry will remain intensely competitive because it is remarkably open to new competitors and new ideas—ideas that can render existing products obsolete virtually overnight. Few other industries face such intense competitive pressure. (*See* Section C.) Microsoft has performed well in the intensely competitive environment of the software industry, and has contributed to the preservation of that environment in a very substantial way with its open platform for innovation, Microsoft Windows. (*See* Section D.) Thanks in part to the broad acceptance of Microsoft Windows, the software industry is thriving, growing at seven times the rate of the U.S. economy as a whole. (*See* Section E.) Ironically, many recent articles in the media have expressed concern that technology is progressing *too* quickly, hardly a symptom of an industry without competition.

A. The Vast Competitive Landscape

It is common ground that the "Information Age" holds great promise for the United States and world economies. Today, *the technology infrastructure* necessary to make that promise a reality is being built by a wide range of companies. The technology requirements—and resulting business opportunities—are enormous. Demand is driving (i) upgrades to telecommunications networks (such as telephone, cable, satellite, and other wireless systems), (ii) the introduction of new types of devices to work with such networks (from small "handheld personal computers" to sophisticated network routers and switches), and (iii) the creation of innovative new software technology to make both the networks and devices useful.

New technologies and new ideas are being introduced at a dizzying pace—led largely by innovative and highly competitive American companies. These companies are competing to deliver complete solutions to businesses and individuals to enable them to obtain the benefits of digital communications and information. These solutions will increasingly depend upon various combinations of networks, devices and software that cross traditional product categories and may render many of today's products obsolete.

Microsoft is a leader in the information technology industry. Nevertheless, Microsoft accounts for less than 1% of industry revenues—which were approximately $1 trillion in 1996.[1] Microsoft's small share of total revenues in the information technology industry reflects the breadth of competition in that industry. Competition will intensify even further as the upcoming "digital convergence" causes companies in such diverse industries as publishing, broadcasting, entertainment and consumer electronics to compete with traditional computer hardware and software vendors.

Microsoft is contributing to the technology infrastructure of the Information Age primarily by developing and marketing innovative software technology for various types of computers. Microsoft also contributes important new ideas by promulgating technology guidelines for others to use in manufacturing hardware devices (such as handheld personal computers or cable set-top boxes). And Microsoft works broadly to increase the use of computers at work, at home and at school. While Microsoft is one of the leading companies in these efforts, the company's revenues account for less than 2% of the revenues of the $747 billion computer industry.[2] Tens of thousands of companies compete in the computer industry, many of which, such as IBM ($75

billion), Hitachi ($69 billion) and Hewlett Packard ($38 billion), have revenues that dwarf those of Microsoft ($11 billion).

Microsoft is sometimes referred to as a "software giant," but even within the software segment of the computer industry, Microsoft faces fierce competition. *Tellingly, Microsoft accounts for less than 5% of total software industry revenues of $253 billion.*[3] Microsoft is not even the largest software publisher—IBM, with $13 billion in software revenues in 1996 holds that honor. More than a dozen companies, including such leading computer industry players as Hitachi, Computer Associates, Oracle, Digital Equipment, Novell, Sybase and Sun Microsystems, have more than $1 billion in annual software revenues.[4] And revenues for many of these companies have soared in recent years. (For example, total revenues at Oracle shot up from $1.2 billion in 1993 to $4.2 billion in 1996; over the same time Sun revenues rose from $4.3 billion to $7.1 billion.)

As is suggested by Microsoft's relatively small share, the software industry is highly fragmented. There are more than 10,000 software companies in the United States alone, and thousands more overseas.[5] The top twenty independent software publishers (a group that includes Microsoft) account for just 42% of total revenues from packaged software.[6] By the standards of antitrust analysis, the software industry is thus unconcentrated. The industry is also largely based in the United States: nine of the top ten software companies in the world are American.[7]

Microsoft is perhaps best known for developing and marketing computer operating systems, such as its Windows family of products. Here again, however, the company faces intense competition from many competitors. Dozens of operating systems are available for a variety of computers, ranging from new generations of so-called "information appliances" (such as handheld personal computers or "smartphones") to powerful mainframe computers. IBM alone offers a range of operating systems that include PC-DOS and OS/2 (for personal computers), AIX (for servers, mainframes, workstations and personal computers), OS/400 (for minicomputers), and OS/390 and other mainframe operating systems. Other major operating system vendors include Apple (Macintosh), Novell (IntranetWare), Sun Microsystems (Solaris and JavaOS), Hewlett Packard (HP/UX), Digital Equipment (VMS and Digital UNIX), Lucent (Inferno), Santa Cruz Operation (OpenServer and UnixWare) and a great many others. Overall, Microsoft accounts for just 13% of all operating system-level software revenues.[8]

Another way to assess the relative competitive significance of various operating systems is to look at the availability of software applications and other products for such operating systems. As of 1996, products designed for use on Microsoft Windows accounted for less than 33% of industry-wide packaged software revenues.[9]

Microsoft faces formidable competitors with leading market positions in many important segments of the software industry. For example:

- **Databases.** Database software is important because information, once digitized, must be stored in a database to be accessed and manipulated in useful ways. Oracle is the leading database publisher, with about 30% of 1996 database revenues. Microsoft trails at 6%.[10]
- **Email.** Email software is important because computers are increasingly used as communications devices. The email software business is highly fragmented among IBM (with Lotus Notes and other products), Novell, Netscape, Banyan, Qualcomm and many others. About 14% of all email software in use today is from Microsoft based on 1996 revenues.[11]

- **Online services.** Online services are important because they provide a convenient way for people to communicate with one another, conduct transactions and access information both on the online service and the Internet. Here, America Online is the clear leader. About 60% of all online service subscribers are customers of AOL, and that figure will grow to more than 75% when AOL completes its pending acquisition of rival Compuserve. Microsoft's online service offering, MSN, trails at about 9.8%.[12]

Antitrust lawyers and economists are accustomed to thinking about high "market shares" as a factor relevant to assessing competitive conditions. In the software industry, however, the significance of a high market share in any particular segment is quite limited because that figure represents only a snapshot of current software shipments. Market share numbers do not reflect the highly dynamic nature of the software industry, where entire business segments can disappear virtually overnight as new technologies are developed. Given the rapid pace of technological change—which is the central fact of life in the software industry—any software publisher that wishes to survive must remain innovative, and provide technologically advanced products at attractive prices. (*See* Section C.) Competition of this sort is far more intense than that which occurs in many traditional industries where products and markets are relatively stable over time.

B. The Stellar Performance of the Software Industry

From time to time Microsoft's competitors seek to portray the company as a "monopoly." To do so, these competitors seek to chop the computer industry into narrow segments, focusing solely upon personal computer software, where Microsoft has developed leading products in operating systems, business productivity applications, and certain other areas. *Yet personal computer software is far and away the most competitive and innovative segment of the computer industry.* New and innovative software products for personal computers are being introduced at a blistering pace. Prices continue to fall steadily. Output is soaring. As a result, demand for personal computers (hardware and software) is growing faster than for any other segment of the computer industry. Rapid growth attracts new competitors (witness the economic boom in Silicon Valley), which further fuels competition. As discussed below in section D, the intensely competitive nature of the personal computer industry (across both software *and* hardware) is attributable in substantial part to Microsoft's Windows family of operating system products, which provide an open development platform for literally thousands of other companies.

Antitrust policy seeks to promote low prices, high output, and rapid innovation. On all three measures, the personal computer software industry generally—and Microsoft in particular—is a model of competitiveness.

Prices. Prices for personal computer hardware and software are constantly falling, thanks in part to Microsoft's development of a standard operating system that will run software products from a wide variety of vendors. In addition, Microsoft directly spurs intense price competition through the pricing of its own products. In the late 1980s, for example, business productivity applications (such as word processors or spreadsheets) were typically distributed individually. Leading products from Lotus, WordPerfect or Microsoft typically cost several hundred dollars *each*. In 1990, however, Microsoft introduced Microsoft Office, a suite of business productivity applications, for one low price—and Microsoft has been rapidly improving the product ever since. Where a single Microsoft application such as Word (word processing software) cost $399

in 1990, today consumers can acquire all of Microsoft Office (which includes word processing, spreadsheet, presentations, calendaring and other functionality) for just $499 at retail. That low price drops to just $249 for anyone upgrading from any other business productivity application from any software publisher. Other software publishers such as IBM (Lotus) and Corel have created similarly priced product suites in response to Microsoft's product offering.

To take another example, multimedia software products on CD-ROMs directed at home users typically carried retail prices in the range of $80-$200 in the early 1990s. But in 1994, Microsoft lowered the prices of its CD-ROM offerings so that nearly all were available at retail for $29-$49. Microsoft's pricing helped to spur price reductions by its competitors. Today it is relatively rare to see CD-ROM offerings for home users priced above $49.

Software, of course, is just one component of a computer system. Prices for personal computers fall every year even as personal computers offer more features and functionality to users. As recently as 1990, for example, a typical personal computer with an Intel 386 chip, 2 Mb of RAM and a 60 Mb hard drive cost $3,000. Today, $1,500 will buy a multimedia personal computer with an Intel Pentium chip, 16 Mb of RAM, a 3 *gigabyte* hard drive, a 12X CD-ROM—and, of course, a vastly improved operating system. In fact, multimedia personal computers with Pentium chips are available for less than $999 today, and prices continue to fall. The amazing price/performance gains of personal computers are a function of many factors, including rapidly increasing power of microprocessors, declines in memory prices, and Microsoft's licensing of its Windows operating system software at attractive prices to personal computer manufacturers.

Output. The growth of the personal computer industry has been nothing short of spectacular. Microsoft's vision is "*a computer on every desktop, and in every home.*" That vision is fast becoming a reality. Most office workers in the United States use a personal computer regularly. (Europe lags behind, and its economy suffers as a consequence.) About 40% of U.S. homes have a personal computer—a figure that hopefully will rise as personal computers continue to become more powerful, less expensive and easier to use.

Growth in the personal computer industry has been remarkable. In 1990, manufacturers shipped about 25 million new personal computers. This year, manufacturers are expected to ship 80 million new personal computers, loaded with more software than ever before.[13] And sales of new personal computers are expected top 100 million annually by the year 2000.

Innovation. No segment of the world economy is more innovative and dynamic than the U.S.-based personal computer software industry. Product lifecycles are short—just twelve to eighteen months typically—as software publishers race to introduce new features and functionality at an ever faster pace. Microsoft and other vendors are now offering innovative products in categories that did not even exist two or three years ago. (Indeed, software publishers are releasing new products at such a furious pace that some large corporate customers, feeling overwhelmed by the pace of change, urge software publishers to release new products more slowly.) Today's personal computers are easier to use, more powerful and far more versatile than personal computers of even a few years ago. And the rate of innovation continues to accelerate as microprocessors become more powerful and new software products are developed to take advantage of that enhanced processing power. Before long, Microsoft Windows will enable personal computers to recognize users when they enter a room, respond (accurately) to spoken and handwritten

commands, and generally serve as highly efficient communications, productivity and entertainment devices.

C. Characteristics of the Software Industry that Ensure it will Remain Intensely Competitive

Antitrust policy and enforcement actions in the software industry should be guided by an understanding of certain characteristics of the industry that distinguish it from many industries concerned with the provision of goods and services. Software differs from many traditional industries in six fundamental respects that insure that the software industry will always be among the most competitive.

1. The Threat of Leapfrogging Innovation. In the software industry, extremely rapid and *unpredictable* changes constantly create new market opportunities—and threaten existing market leaders. *Market shares are never secure because it is impossible to know when the next new idea will come along that could render entire product categories obsolete overnight.* Few industries face this kind of intense competitive pressure, even in other parts of the high technology sector. In most parts of the economy, businesses can count on reasonably steady and predictable demand for their products. A gain or loss of a few percentage points of market share often measures success or failure. But the computer industry is full of examples of technologies and companies that enjoyed great success for a short time, only to be overtaken quickly by innovative new technology that better served users' needs. In short, Joseph Schumpeter's "gale of creative destruction" blows hard and fast through the software industry. *There is no greater spur to innovate rapidly and price competitively than the threat that an entire business could collapse practically overnight.*[14]

The astounding growth of the personal computer industry generally (and Microsoft in particular) is itself an example of this powerful phenomenon. In the 1960s and 1970s, IBM and a few other large vendors such as Sperry Rand, Honeywell, Burroughs, Control Data, and NCR led the computer industry. IBM in particular was thought by many—including many antitrust lawyers—to be invincible. (In fact, the Department of Justice filed a broad enforcement action against IBM in 1969, and pursued the case for thirteen years before dropping it.) Yet the computer industry was revolutionized in the space of a few years by hobbyists working in their garages who developed the concept of a "personal computer." The personal computer was derided by many manufacturers of "big iron" mainframe computers as a "toy" (which it was, at first). IBM and others were slow to appreciate fully the potential benefits of distributing computing power to *individuals*. Although IBM is still a leader in the computer industry, none of the traditional mainframe or minicomputer manufacturers fully embraced personal computers in a timely way, and many faltered as a result. Today, the computer industry is led largely by companies that did not even exist twenty five years ago, such as Compaq, Dell, Gateway 2000, Micron, Microsoft, Netscape, Novell, Oracle and Sun Microsystems.

Word processing provides another example of rapid and unpredictable technological change tripping up established market leaders. As cheap microprocessors became available in the 1970s, Wang, IBM and others developed computers that were dedicated to a single task: word processing. Demand for typewriters soon declined sharply, and sales of dedicated devices from Wang and IBM rose sharply. (At one time Wang was nearly synonymous with word processing.) In the 1980s, however, demand for these single-task-computing devices declined sharply, as personal computers became available that could perform a wide range of function in addition to

word processing. In the space of just a few years, Wang went from market leader in dedicated word processing devices to bankruptcy. In the early 1980s, a software product called WordStar was the leading personal computer word processor. By the mid-1980's, WordPerfect became the most widely used. Today Microsoft Word is the most widely used word processor. It too will fall by the wayside if Microsoft does not continually add new features and functionality to the product, and price it competitively.

Microsoft's understanding that today's success story could be tomorrow's has-been is reflected in the company's stark rallying cry: "Innovate or Die!" Nowhere is that attitude more evident than in Microsoft's response to the rise of the Internet as a powerful force in computing. Since 1995, a number of Microsoft's most formidable competitors have banded together to promote a range of new Internet-related technologies that they believe will greatly reduce the value of Microsoft Windows and other Microsoft products. (Indeed, some have suggested that the entire concept of a "personal computer" will soon be obsolete, replaced by a new breed of "network computers" or "information appliances" that do not run Microsoft software.) Microsoft has responded by focusing its creative energies on developing a range of new technologies that it hopes will best serve users' needs in the era of Internet computing. Within the past two years Microsoft has revamped all of its major products to reflect this intense focus on the Internet, and many more technology initiatives are underway. The rapid pace of Internet-related innovation, and Microsoft's response to it, is the very antithesis of an industry in which any company has monopoly power.

2. No Ownership of Productive Assets. In many traditional industries, a company that enjoys a large market share usually owns a large percentage of the *productive assets* used to create the product at issue. The great oil trusts of the turn of the century owned oil fields and pipelines, leading to passage of the antitrust laws. AT&T once owned the physical telephone network that connected virtually every home and business in this country. The leaders in any manufacturing industry will control a large proportion of manufacturing capacity in that industry.

Software is different. *The productive capacity of the software industry is infinite and not subject to ownership by anyone.* Creating new software products does not require large capital investment in equipment. New software products are based on *ideas* that software developers implement in lines of code that provide instructions to a computer. No one can monopolize new ideas or the ability to capitalize on new ideas by creating new software products. Development of a new software product requires three things, all readily available: (i) software programmers (there are millions in the United States); (ii) software development tools (available from Microsoft and many other vendors for less than $2,000); and (iii) personal computers (available from hundreds of manufacturers for a few thousand dollars).

3. Ability to Increase Output Quickly to Meet Demand. In many industries a company with a promising new product will require substantial capital investment and time to scale up production to meet demand, hampering the company's ability to compete with incumbent market leaders. This is not true in the software industry. Once software is created, the cost to copy it ten times, a hundred times or a thousand times is relatively small. And software publishers generally do not need to incur substantial distribution costs. Software can be distributed to computer users nearly instantaneously via the Internet and other networks—and software will increasingly be distributed in this way as electronic commerce matures and higher bandwidth networks are rolled out.

The great success of Netscape is an example of this phenomenon. In September 1994, four-month old Netscape posted an early version of its Navigator Web browser software to the Internet, free for anyone to download and use. Navigator was an instant hit, and within a few months most Web users had switched from the previous leader, the Mosaic browser. Netscape proceeded to distribute tens of million of free copies of Navigator to computer users, helping to fuel growing interest in the Internet and providing strong market position which Netscape is exploiting to sell other Internet-related software products. Netscape recently announced that it will distribute more than 125 million copies of the latest version of its Navigator software over the next year—which ought to be sufficient to satisfy demand since there are only about 50 million Internet users in the world today.

4. Software Is a High Growth Business. In many industries demand remains stable or grows modestly over time, making it relatively difficult for new companies or new products to find customers. Plainly that is not the case in the personal computer software industry: The industry grew at *seven times* the rate of the U.S. economy overall between 1987 and 1994 (and the rate of growth has, if anything, accelerated since then).[15] As recently as 1990, revenue from all types of packaged software sold in the U.S. totaled just $35 billion. That figure is likely to top $105 billion this year—and these revenue figures understate the rate of industry growth because prices have been falling steadily over this time period.

Prospects for high growth also attracts capital to fund software start-ups. Venture finance capital is widely available, as is stock market financing. Hundreds of software companies have gone public in recent years. With ready sources of financing, there is no obstacle to smart people with good ideas repeating the rags to riches stories of many of today's leading software companies.

5. Competition with Non-Software Products. New products offered by the personal computer industry often compete with tried-and-true ways of doing things. Personal finance software has been available for years that automates the process of balancing a checkbook, yet most people still use paper and pencil. Dozens of software products offer address book and calendar features, but here again, even many computer enthusiasts still prefer paper. And today we have tens of thousands of Web sites presenting information to Internet users, yet newspapers, books, television and radio present information conveniently and efficiently too. In many product categories, software publishers face very real competition from non-software solutions—competition that continually spurs software developers to make products more functional, easier to use, and less expensive.

6. Durability of Software. Unlike consumables and many other products, software never wears out. Once acquired, software can be used forever without additional cost to the end user—or revenue to the software publisher. Thus, in a very real sense, every software publisher competes with its own products. To generate revenue from its customer base, a software publisher must substantially improve the features and functionality of its products and offer new versions at attractive prices. That, and competition from other companies, explains why product cycles in the software industry are typically just twelve to eighteen months.

The upshot of these characteristics of the software industry is that the industry is *remarkably open to new ideas and new competition.* As noted above, the personal computer industry itself is an example of a new idea that presented great challenges to computer vendors that had built their

businesses on mainframes and minicomputers. More recently, the burst of creativity and innovation related to the Internet has spawned literally hundreds of software start-ups—some of which have already achieved great success.

The Netscape success story is a prime example. The company was formed in April 1994; it released its first product, the Navigator Web browser in September 1994; and it went public eleven months later, making an instant billionaire of one of its founders. On the day it went public—just fifteen months from the day the company was formed—it had a market capitalization of $2.2 billion. Such rapid success and value creation likely would not be possible in any industry other than software.

The rapid acceptance and deployment of the Java programming language from Sun Microsystems provides another example. Sun introduced the new language in May 1995. It was met with such interest that just seven months later Sun portrayed Java as "the de facto standard" for writing applications for the Internet. Microsoft recognized the importance of Java as a programming language and soon set about developing tools to assist Java programmers. Today, Microsoft's Visual J++ is one of the leading developer toolkits for creating Java programs, and Microsoft has built Java-related technology into its Windows products so that Windows will serve as a great platform for running Java programs.

D. How Microsoft's Business Model Promotes Competition and Benefits Customers

The personal computer industry has enjoyed truly spectacular growth since its birth less than twenty years ago. Microsoft certainly benefited from the growth of the personal computer industry, but Microsoft has also played a fundamental role in promoting the growth of the personal computer industry. Microsoft's contribution to the growth of the personal computer industry is rooted in the basic elements of Microsoft's business model, particularly as exemplified by the company's development and marketing of its Windows family of operating system products. Microsoft Windows, coupled with the amazing performance gains of microprocessors from Intel and others, is the catalyst that has driven the development of the dynamic, intensely competitive and highly efficient personal computer industry.

1. Microsoft's Business Model

Microsoft's business model is based upon three fundamental strategies: (i) rapid development of innovative software that responds to consumer demands; (ii) broad distribution of that software at attractive prices; and (iii) close collaboration with other hardware and software companies to foster development of a wide range of compatible products, providing consumers with a wide range of choices. Such variety fuels increased demand, which prompts still more innovation and competition.

All of Microsoft's efforts are driven by recognition of the vast potential of a personal computing platform. Microsoft has been at the forefront in developing personal computers from the outset, when the concept of a computer for personal use (as opposed to a mainframe housed in an air-conditioned glass room) was radical. In fact, the first widely used software program for a personal computer-like device, a version of the BASIC programming language, was written by Bill Gates in the mid-1970s. Microsoft believed from the start that as the processing power of microprocessors grew exponentially, the benefits of providing individuals with "personal computers" would become obvious, providing vast business opportunities. That belief proved to be correct.

Thousands of companies currently contribute to the growth and vitality of the personal computer industry. But Microsoft is the only company that has invested broadly and consistently in the development and marketing of a full range of software products for personal computers—computer languages, operating systems and applications, and related technologies. Microsoft's investment benefits the industry and customers by providing an open, state-of-the-art and constantly evolving computer architecture that promotes innovation and competition.

Rapid Innovation. Product development at Microsoft is driven by the company's firmly held belief that it must constantly innovate or it will quickly face ruin. Simply stated, Microsoft is constantly working to render its own products obsolete. In 1990, for example, Microsoft released Windows 3.0 (a 16-bit operating system built upon MS-DOS), which was the first commercially successful version of Windows. In 1989, however, before Windows 3.0 was even released, Microsoft set out to make the product obsolete by undertaking an ambitious effort to develop an all-new, 32-bit operating system from the ground up that would be free of the engineering constraints of MS-DOS (and UNIX). That operating system, later named Windows NT (for "new technology"), was released in 1993 and today provides an alternative to various versions of UNIX and other network operating systems. Within the next few years, Windows NT will replace Windows 95 and its successors as Microsoft's basic operating system for personal computers.

The numbers tell the story of Microsoft's commitment to innovation. Microsoft's investment in research and development has skyrocketed from about $350 million annually in 1992 to more than $2 billion this year. Microsoft far outpaces other companies in the computer industry in R&D spending relative to its size. This year Microsoft will devote about 16% of revenues to R&D. Other leading companies such as Intel, Oracle and Sun Microsystems devote only about 8% of revenues to R&D. IBM devotes just 6%. Microsoft's R&D efforts include a commitment to long-term, basic R&D that the company hopes will result in development of breakthrough technologies in the 21st century.

Broad Distribution. Microsoft believes that the personal computer industry—in hardware and software—is driven by volume economics. While many vendors have attempted to exact a premium price for their products, thus limiting market demand for their technology, Microsoft has always believed that the company, the industry and customers benefit more from widespread licensing of new software products at attractive prices. In hardware, high volume provides substantial economies of scale and demand for a wide variety of product offerings, which fuels intense price and innovation competition. In software, high volume leads to widespread compatibility among computer programs and files, enabling users to share their work and communicate more readily, and provides software developers with a large base of prospective users for new products.

Close Collaboration. Customers value choice and variety, so compatibility among hardware and software products is important. Microsoft works closely with dozens of leading computer companies and hundreds of smaller companies to develop technical specifications that make all the parts of a personal computer system work well together. In particular, Microsoft focuses intently on the needs of other software developers, providing those developers with a wide range of software development tools and technologies. While the collaborative process tries to marry a

wide range of views and perspectives, the process works extraordinarily well for the industry and for customers.

Partnerships between Microsoft and original equipment manufacturers (OEMs) have resulted in high standards for personal computers. Microsoft has worked closely with companies such as Compaq, Dell, Hewlett Packard and Toshiba create a standard for personal computers which ensures a high level of technology for all consumers.

The basic elements of Microsoft's business model—rapid innovation, broad distribution and close collaboration—can be understood more fully in the context of Microsoft Windows family of operating systems products.

2. Microsoft Windows: An Engine for Growth

Microsoft has promoted an open systems approach to technology in the personal computer industry. Through its development and widespread licensing of its Windows family of operating system products, Microsoft has helped compartmentalize software and hardware innovation in the personal computer industry—allowing them to proceed on parallel tracks at a furious pace, spurred by hundreds of different players.

This "open system" is available and accessible to the thousands of hardware and software developers throughout the world. By openly licensing Windows to all personal computer manufacturers, Microsoft has set a standard by which consumers can share information and communicate effectively with any of a wide variety of personal computer from hundreds of manufacturers. This has meant greater competition within the industry and drastically lower prices for consumers.

Traditional computer industry vendors, such as IBM and Digital Equipment, and even Apple Computer and Sun Microsystems today, chose the opposite approach. These vendors develop and market complete computer systems ó microprocessor, hardware and software all included from one vendor. The Apple Macintosh, Sun Sparc workstations, and Digital VAX minicomputers are examples of such integrated product offerings. Vertical integration through hardware and software provides real benefits, most notably the ability to ensure that all components of a computer system are optimized to work together. But, in Microsoft's view, these benefits are outweighed by the inability of such integrated computer systems to work well—or at all—with computer systems from other vendors. Since computer systems from different vendors are generally not compatible with one another (or compatible only in a limited sense), the potential customer base for such products is inherently limited, leading to higher prices and less innovation.

As explained below, Microsoft Windows is a key element of the separation of hardware and software development that keeps the personal computer industry so fiercely competitive.

Software Competition and Innovation. From the very start, Microsoft has been supporting third party software developers: the company was founded to develop computer languages and tools for such software developers. As software developers themselves, Microsoft's early employees understood the difficulties of attempting to develop and support software products that ran on a multiplicity of incompatible operating systems. Therefore, Microsoft set out to develop a family of broadly popular operating systems, first MS-DOS and later Windows, that simplified the process software development and provided compatibility for software products from a wide range of vendors.

Today Microsoft's leading operating system products are Windows 95, Windows NT and Windows CE (a new operating system designed for small devices such as "handheld personal computers"). These open operating systems provide enormous benefits to software developers and consumers. Each provides a set of state-of-the-art building blocks that other software developers can freely call upon when developing their own software products. For example, Microsoft operating systems provide a rich set of system services (referred to as "DirectX") for use in developing highly interactive multimedia applications, such as action games. Similarly, the Microsoft operating systems provide a set of system services for presenting information to users in the form of menus, toolbars, dialog boxes, and the like. The many services made available by the operating system allow software developers to be more productive and efficient: they can focus their creative energies on their particular value-added component, knowing that they need not repeatedly "reinvent the wheel."

Microsoft makes this technology available to any software developer that wishes to use it—including Microsoft's direct competitors—entirely free of charge. Any software developer can invoke Microsoft technology by making a "call" to an "application programming interface" (API) in Windows. Windows will then perform the function requested by the software developer's product. These APIs are published by Microsoft, and available in any bookstore that carries books about computer programming.

Microsoft not only makes APIs available to software developers without charge; it actively encourages software developers to create products that use these APIs. Microsoft's promotion of Windows APIs is central to its business strategy: Microsoft knows that a key attribute of any operating system is the availability of a wide range of applications that run on the operating system. Simply put, customers are more likely to choose Windows if the applications they like run on Windows. And if more customers choose Windows, more software developers are likely to create Windows applications.

Microsoft seeks to promote the use of Windows APIs in four ways.

First, Microsoft runs an elaborate program—far and away the most extensive in the industry—to solicit input from the computer industry about the development of Windows APIs. (Traditionally, third party software developers played little role in the development of operating systems; their contribution essentially being limited to testing for bugs.) Microsoft solicits input and feedback from other software developers from the earliest stages of the development process. The Win32 APIs, which are the basis for Windows 95 and Windows NT, provide a good example. Windows NT, the first operating system to implement the Win32 APIs, was released in 1993. But Microsoft had provided initial specifications for the Win32 APIs to 25 third party software developers three years earlier, in November 1990, and obtained valuable feedback from them in a series of meetings that followed. During 1991 Microsoft provided updates to the Win32 APIs to more than 300 third party software developers. By January 1992, the Win32 APIs were posted on CompuServe, America Online and the Internet, and in March 1992 the Win32 APIs were published by Microsoft Press. By the time Windows NT was commercially released in 1993, the Win32 APIs were the most thoroughly reviewed set of APIs in history, ensuring quality and increasing the likelihood that the APIs would be widely used. Updates of the APIs continued through the release of Windows 95 and to date.

Second, Microsoft devotes very substantial resources—about $1 billion per year—to upgrading its Windows products to ensure that they will provide the functionality that software developers need to create their software products. Software developers know that Microsoft is intently focused on delivering new versions of Windows on a rapid schedule to meet changing

customer demands. For example, Microsoft responded quickly to rising customer interest in the Internet by enhancing its Windows products with a host of Internet-related technologies, including the basic "plumbing" that makes it easy to connect a personal computer to the Internet and software that enables computer users to browse Web sites right from their Windows desktop. These new technologies opened up extensive opportunities for software developers (and Web site developers), who have built a large number of products that take advantage of Windows' new capabilities.

Third, Microsoft does not simply disclose Windows APIs to third party software developers. Rather, it actively "evangelizes" the Windows APIs to software developers. In fact, Microsoft devotes about $100 million per year and 2,000 employees (nearly 10% of the Microsoft workforce) to developer support. No other computer company provides anything like this level of support to the developer community.

As part of this developer support, Microsoft offers a free, dedicated website where developers can access information, technical support and Software Development Kits. These tools and support all help developers create software that can run on the Windows platform. Microsoft takes the extra step to have dedicated staff designated to help developers quickly absorb and utilize new technologies, and other resources such as seminars, training sessions and speakers to communicate the information needed to develop the most innovative software. Consumers will reap the benefits of newer technology and more available software.

Fourth, as described below, Microsoft seeks to ensure the widest possible distribution of Windows software. Naturally, many software developers prefer to target the largest possible base of prospective customers when creating new products. Microsoft provides such a broad customer base with Windows.

Software developers and consumers have responded very positively to Microsoft's efforts to advance Windows as an open platform. No other computer platform in history has resulted in so many compatible products, from so many vendors, as the Windows platform. Today tens of thousands of Windows-based products are commercially available from thousands of software publishers (and thousands more are under development). Customers value choice, and Windows provides it. Such choice drives competition and innovation.

Hardware Competition and Innovation. Microsoft's strategy with respect to hardware is very simple: Microsoft is pleased to license its Windows operating system software at attractive prices to *any* viable computer manufacturer that wants to install Windows on its machines. By licensing Windows broadly, Microsoft enables consumers to benefit from broad compatibility across personal computers from literally thousands of computer manufacturers. That gives consumers a wide variety of choices in purchasing a personal computer. It also requires computer manufacturers to compete intensely on price, features and customer support since they all offer the same Windows operating system software.

Windows supports a huge number of hardware devices and components that can be used with a personal computer. Because computer manufacturers know that, they have many options in purchasing such devices from their suppliers. Thus, Microsoft's open licensing of Windows drives strong economies of scale across a wide variety of components, such as memory, various add-in cards, and peripherals of all types. These economies of scale lead to substantial cost savings for consumers.

While Windows is a key contributor to the popularity of personal computers, it accounts for less than 3% of the cost of a typical new machine.

As noted above, other leading operating systems are not licensed in an open manner like Windows—they often come bundled primarily or exclusively with hardware from a single manufacturer. These integrated computer systems, such as the Apple Macintosh or various offerings from Sun, tend to be substantially more expensive that a comparable Windows-based personal computer since these hardware manufacturers face less direct competition than manufacturers of Windows-based machines and benefit less from economies of scale.

Within the past year alone, computer manufacturers have introduced more than 1,500 new models of Windows-based machines. No other computing platform comes close to offering such a wide range of choice to customers.

The software industry is one of the most competitive sectors of the United States economy. Output is soaring, prices are falling, and consumers are benefiting greatly from a wide range of innovative new computer technologies. The future holds unlimited potential for software developers that focus on identifying technological trends and ever-changing customer needs, and delivering software that satisfies those needs at attractive prices.

Endnotes

1. Information Technology Industry Council (1997). Information technology includes computers, software services, business equipment, and telecommunications equipment and services.
2. *Ibid.*
3. *Ibid.*
4. Software Magazine (July 1997).
5. Bureau of Labor Statistics, June 1996, *Covered Employment and Wages, ES-202.*
6. *Worldwide Software Review and Forecast*, IDC (1997). The term "packaged software" refers to software products created for licensing to multiple customers, as opposed to custom software that is developed for to meet the particular needs of a single customer or small group of customers. Microsoft develops and markets software tools to assist software developers in creating custom software programs, but it generally does not develop such custom software programs itself.
7. Broadview Associates, 1995.
8. *Worldwide Software Review and Forecast*, IDC (1997). System-level software includes operating systems and various other system-related software programs that may or may not be included as part of various operating system products.
9. *Ibid.*
10. World Database Vendor Revenue Estimates for 1996, Dataquest (1997).
11. Worldwide Electronic Mail Software Market Review and Forecast, 1996-2001, IDC, 1997.
12. Consumer Online Services Industry Forecast, 1996-2001, IDC, 1997.
13. IDC PC Market Tracker 1997.
14. For a businessperson's perspective on the threat of leapfrogging innovation, see Andy Grove, *Only the Paranoid Survive* (1996) and Bill Gates, *The Road Ahead* (1995).
15. Business Software Alliance (1995).