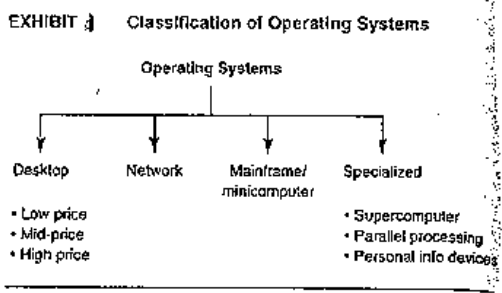


The Operating System Software Industry in 1994

Types of Operating Systems

OSs can broadly be classified into four main classes (see Exhibit 1): desktop OSs, network OSs, mainframe and minicomputer systems, and specialized niche OSs.

Desktop OSs. Desktop OSs run stand-alone desktop PCs and workstations. This segment can be fur-



ther divided into three subsegments based on price, performance and volume of systems:

1. The *low price segment* consists of products with suggested retail prices less than \$200 per copy. It is dominated by MS-DOS and Windows and constitutes about 75 percent of all desktop machines sold. The other competitors in this segment include IBM's OS/2, Apple Computer's System 7 and System 8, and Novell's DR-DOS products. The majority of these systems were installed on low-priced personal computers used for general productivity applications such as spreadsheets and word processors. The low-price segment was by far the largest segment of the OS market with nearly 24 million units shipped in 1993—14 million DOS units, of which 12 million had Windows, 3 million had OS/2 units, and 7 million had Apple System 7 units. This translated into a market of approximately \$1.2 billion to \$2.4 billion.

2. The *high price segment* of the desktop market is dominated by variants of the UNIX OS which typically retail for more than \$800 per copy. The major competitors in this segment are proprietary versions of Unix—IBM's AIX, Hewlett-Packard's HP-UX, the Santa Cruz Operation's SCO Open Desktop, and Sun Microsystems' Solaris. Steve Jobs's NeXT had also introduced a Unix derivative OS—NeXTStep. These higher-priced systems are primarily used for robust, mission critical, horizontal or vertical corporate applications run typically on a workstation or a high-end PC. This segment was significantly smaller—only 10 percent of the size of the low-priced segment. Of the nearly 2.5 million units shipped in this segment during 1993, Sun had 36 percent of the market, HP 24 percent, and IBM 20 percent.

3. During 1993, a *mid-price segment* had begun to emerge between the high-price and low-price segments. These products were typically priced between \$300 and \$500 retail. The major entrants in this segment were Microsoft's new Windows NT OS, and Novell's Unix product, Unixware. OS vendors viewed this segment as a way to differentiate their new products and segment their customer base. Vendors in the low-price segment, such as Microsoft, saw it as an opportunity to extract value for the added functionality incorporated in their new

products while gradually migrating customers from their existing systems. Competitors in the high-price segment, particularly the Unix vendors, faced with the growing threat from Windows NT and OS/2, saw it as an opportunity to deliver cheaper versions of their systems to run on higher-volume platforms without cannibalizing their higher-end products. This segment had shown much slower growth primarily because the OSs were newly released, not very robust, and lacked many third-party applications. During 1993, fewer than 300,000 units were shipped in this segment.

Network OSs. As desktop computers became increasingly connected as client-server networks, this segment began to show rapid growth. The segment was dominated by Novell's Netware products; other competitors included Microsoft's NT Advanced Server and Lan Manager products, and IBM's Lan Server (a derivative of Lan Manager). Some networks also used versions of Unix.

Mainframe and minicomputer OSs. While this segment had begun to show steady declines during the late 1980s and early 1990s, it was still extremely popular. The two main segments within this class were mainframe OSs, such as IBM's CICS and CMS systems, and minicomputer systems such as DEC's VMS system. As competition to mainframes and minis stiffened from workstations and PCs clustered in client-server networks, the total number of mainframes and minicomputers sold had declined sharply, falling by more than 40% between 1990 and 1993 alone. Fewer than 10,000 units were sold during 1993.

Market niches. Gray dominated the supercomputer market with its proprietary hardware and software. Parallel processing companies such as n-Cube and Thinking Machines delivered their own proprietary OSs which were customized to exploit the power of their hardware. Fewer than 5,000 parallel processing machines were sold each year. Small companies, such as Geoworks and General Magic, offered software to operate the emerging class of personal information devices.

Economics of OS Business

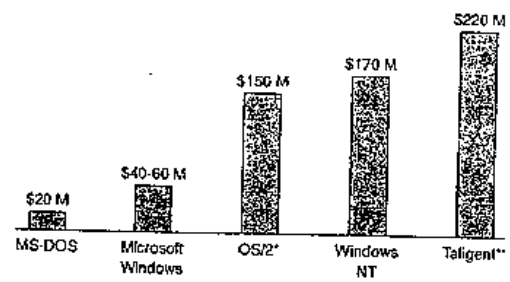
Driven both by technological advances and by constantly changing customer needs, the economics of the OS business continued to shift. Five fundamental characteristics underpin the economics of the business.

Economies of scale in product development. The fundamental factor driving the OS business is the enormous economies of scale associated with the product. Each OS requires a very large up front investment in product development, resulting in heavy fixed costs (see Exhibit 2). These development expenses can be borne only by a limited number of players in the market and serve as a barrier to smaller entrants.

Having developed the product, however, additional costs were small. Variable costs included manufacturing costs for documentation and products, the cost of training users and developers on the use of the system, and the cost of supporting customers. With the availability of CD-ROMs, costs for producing documentation and "manufacturing" the product were nearly \$5 to \$15 per copy. These represented less than 4 percent of the retail price

(\$150-\$500) for the Windows OS. Training costs represent only a very small fraction of total costs—Microsoft reports between 1 and 2 percent of total revenues are spent on training. Most major systems vendors, including Microsoft, provided only limited training free of cost. Support costs tend to have a fixed component and a variable component. In setting up a telephone response center to provide customer support for a new product, vendors do incur significant capital expenditures. (Microsoft is reported to have spent upwards of \$20 million

EXHIBIT 2. Operating System Development Costs



* IBM has spent over \$4 billion on the OS/2 project to date. \$150 million represents the development cost alone for the first release of OS/2.
 ** Taligent's costs represent expenditures through December 1993; product was not expected to ship until 2Q 1994.

developing a corporate response center for its Windows NT OS.) Variable support costs come mainly from the additional support operators required as customers are added.

Two factors mitigate these costs. Fully loaded costs for a customer support engineer are significantly lower than the costs of a software developer—Apple Computer, for example, estimates the fully loaded cost of a support engineer to be \$125,000 per year as compared to nearly \$200,000 for a software developer. Most vendors treat support as an important profit center and charge customers for additional services over a fairly limited basic service package.

Development costs for new operating systems have increased sharply over the years. The operating system purchase decision is a highly risk averse choice and customers are very reluctant to switch from their existing systems to try a new system. As a result, OS vendors find it necessary to incorporate significant incremental functionality compared to existing systems in order to encourage customer trial. This has raised the cost of developing new systems. Moreover, the added functionality has dramatically increased the complexity of the new systems. As a result, very few companies have the internal expertise to develop and deliver a bug-free operating system. Both these trends are expected to accelerate in the future, further limiting the number of vendors who can develop and market new OSs.

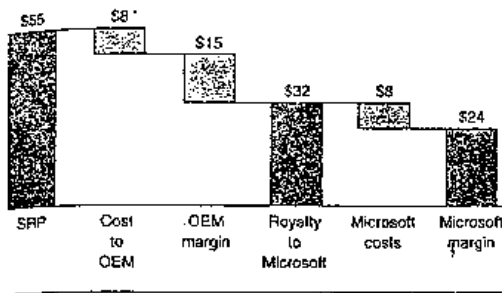
Long product life cycle. Since an OS takes typically between four and five years to develop, it has a fairly long product life cycle. The prolonged product life cycle complicates the development process in two ways: first, it makes it difficult to develop products to a specific set of customer needs which have been identified in detail before the development process is started. This requires fairly significant shifts in product development priorities as customer needs change, and the applications software market changes, typically raising total development costs. Second, due to the extended development process, it is difficult to line up third-

party support from hardware vendors, resellers, and ISVs at the start of the development process. Third parties typically take a wait-and-see approach to different OS platforms, preferring to get a market response to the product before making a commitment to it as a strategic platform. Therefore, developing an OS is a very risky venture requiring substantial resource commitments while betting on customer and third-party support.

Long payback period. The economics of the business are further complicated by the long payback period for the products. Three factors lengthen the payback period. First, the long product development cycle extends the time for initial product release. Second, the customers purchasing OSs are highly risk averse, and are unwilling to cut over to a new system until they are certain that it enables a substantial number of new applications. Enabling many new types of applications requires building significant commitment to the platform among ISVs, a slow process. Third, customers are also unwilling to make a commitment to a new system until they are convinced that the platform is stable, and most of the software bugs have been worked out of the system. The vast majority of customers typically delay purchasing the product until at least the third release, further extending the payback period. These three factors together lengthen the payback period, making it difficult for many competitors to afford the significant resource expenditures required to develop a competitive OS product.

Distribution economics vary by channel. Distribution channel economics are a large part of the total cost to the customer. OS vendors primarily use two-tier, indirect distribution channels. The three most important channels are: (1) bundled with hardware and sold by computer makers (OEMs),

EXHIBIT 3 Economics of OEM Channel

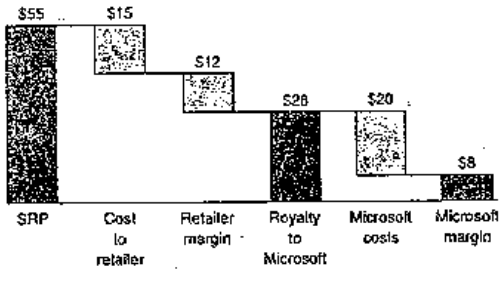


(2) bundled with applications and sold via resellers (VARs, SIs, ISVs), and (3) as standalone products through retail channels (Egghead, BusinessLand). The OEM channel offers far higher margins than the other channels due to the low costs involved at both tiers (see Exhibit 3). By preloading the OS on a PC or workstation, the OEM eliminates incremental distribution costs and keeps sales and marketing expenses to the minimum. In turn, the OS vendor bears very little incremental expense to support an OEM (limited selling and marketing cost; almost no distribution and manufacturing cost since the vendor ships the OEM a single master copy of the software for the OEM to duplicate). As a result, gross margins from the OEM channel to the OS vendor are very high compared with other channels (see Exhibit 4). Further, the OEM channel shows the least variability in unit shipments and

represents a stable source of royalties to the OS vendor. Therefore, OS vendors that control the OEM channel can derive sustainable competitive advantage relative to their rivals.

Upgrade economics. The OS business is fundamentally attractive due to the enormous and steady cashflows generated by the upgrade business. The development cost associated with the production of an OS upgrade is very small compared with the new OS. Also, an OS vendor has very low customer churn (loss of installed base of customers) due to high customer switching costs. Switching costs are high because it requires changing the complete application suite in addition to the OS, retraining users unfamiliar with a new system, and, frequently,

EXHIBIT 4 Economics of Retail Channel



purchasing new hardware since the system requirements (disk space, RAM, bus performance, etc.) of OSs differ considerably. Finally, having purchased an OS, customers tend to purchase most new upgrades. Over the last five years, estimates indicate that roughly 32 percent of Microsoft's customer base upgraded on interim releases (the "dot" releases) while nearly 75 percent upgraded on major releases. The numbers were even higher for Unix with nearly 70 percent purchasing both interim releases and major releases. Customers choose to upgrade either to be able to use the most current versions of the applications developed for the system, or to ensure that they continue to receive customer service and support from the systems vendor. The upgrade stream of cashflows makes it extremely attractive for vendors to widely proliferate a new OS by pricing it aggressively and then recovering their investments from the upgrade stream. Rick Sherlund, of Goldman Sachs, estimates the potential revenue stream of Microsoft's Chicago product (the next upgrade to Windows) to be between \$700 million and \$1.5 billion over the next three years.

Misperceptions of the nature of the business have frequently led even large systems vendors with

significant industry expertise to make strategic mistakes. The most prevalent misperception was that price could be used to encourage customers to switch from their existing OS. When an OS is released, the vendors have already spent a lot of money for product development. Vendors tend to consider their development expenses as sunk costs and frequently price their product to cover their variable costs. Additionally, vendors recognize the upgrade nature of the business and tend to pursue penetration pricing strategies. Beginning in 1993, prices began to plummet. IBM dropped the price of OS/2 from \$495 to \$99 and typically sells it after discounts for less than \$50 per copy. Microsoft responded, pricing Windows NT at \$295, considerably below the \$795 to \$895 prices for Unix, its primary competitor. While vendors aggressively compete on price, data collected from various industry surveys indicate that customers do not perceive price to be a very important factor in their purchase decision. Hence, while price should be lowered to the point where price is no longer a barrier to customer purchase, further price reductions have proved counterproductive and destroyed margins.

Wide gap between winners and losers. New OS products can either be priced at the low end of the market or at the high end. OS vendors therefore face a dilemma when bringing new products to market—how should they price their new products? With the continued commoditization of PC hardware and the associated decline in prices and margins, OEMs are reluctant to burden their machines with high-priced OSs. Therefore, pricing an OS too high can limit it to very high-end systems and preclude its establishing a broad horizontal standard.

The vendor can price the OS in the low-price band and bet on generating a large installed base and a substantial upgrade revenue stream. Should the vendor fail to achieve significant market penetration, it becomes trapped in a vicious "low-price, low-volume" cycle. It cannot afford to lower prices significantly since it is already cash thin, and still lower prices may not generate incremental volume. Additionally, it cannot raise prices easily—since the product is not competitive at a low price, raising price is likely to further worsen its competitive position. These factors therefore create a wide gap between winners and losers. Winners, such as Microsoft, generate enormous cash flows and enjoy very high market valuations. Losers could spend large amounts of capital and fail to gain any share. It is estimated that IBM spent nearly \$4 billion between 1985 and 1993 on the OS/2 product alone.

Answer the following problem sets in Chinese as much as possible.

1. (60 points) What is the structure of the operating system industry in 1994? What are the major customer segments in the industry? In 1994, how attractive is the OS industry? For Whom?
2. (40 points) What are the key factors governing the economics of the operating system business? Are they likely to change? Why/Why not?

